

Relationship Between Architectural Design Strategy and The Prevention or Cure of Cancer

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Abstract

This article systematically analyzes the scientific evidence linking architectural design strategies to cancer prevention and treatment, evaluating their impact on patient health outcomes. A systematic literature review was conducted using scientific databases (PubMed, Scopus, Web of Science) and specialized grey literature, focusing on studies published between 1999 and 2024 that examined the relationship between the built environment and cancer care. The review synthesized evidence from 29 key sources, organized into four main categories: (1) biophilic design, which demonstrates measurable reductions in stress (e.g., an 8–15% reduction in salivary cortisol) and improved circadian synchronization; (2) the promotion of physical activity through design, associated with a reduced risk of obesity-related cancers; (3) the selection of healthy building materials, which can reduce exposure to indoor carcinogens such as formaldehyde and phthalates by up to 95%; and (4) the influence of environmental variables (natural lighting, views) on pain reduction and hospital stay. The evidence consolidates architectural design as a determining variable in the cancer experience. Integrating strategies such as biophilic design and specifying healthy materials not only improves patients' psychological and physiological well-being but also contributes to primary prevention. Further longitudinal research is needed to more accurately quantify the impact of these environments on tumor progression and survival.

Keywords: Architecture, Environmental Design, Health, Built Environment, Preventive Medicine, Quality of Life

1. Introduction

The evolution of healthcare architecture toward a patient-centered model has driven research into how the physical environment can actively contribute to healing processes [1,2]. In oncology, where treatments are often prolonged and emotionally demanding, the design of care spaces takes on particular importance. Strategies such as incorporating natural elements, maximizing natural light, and creating spaces that facilitate social interaction have been proposed as contributing factors in reducing stress and improving the quality of life of cancer patients [3,4].

Despite growing interest, the existing literature is often presented in a fragmented manner. A significant gap persists in the consolidation of evidence that systematically links specific therapeutic environments with tangible improvements in the health

of cancer patients [5]. Historical milestones, such as the opening of the Laurance Rockefeller Outpatient Pavilion in 1999, marked a turning point by adopting principles from the hospitality industry to create more welcoming environments [1]. Subsequently, initiatives such as the 2008 Precautionary List underscored the importance of building materials in human health, broadening the scope of design beyond aesthetics to include ethical and public health considerations [6-8].

The aim of this article is to conduct a systematic literature review to analyze and synthesize the evidence on the relationship between architectural design strategies and outcomes in cancer prevention and treatment. It seeks to structure current knowledge around key strategies (biophilic design, promotion of physical activity, material selection) and discuss their implications for professional

practice and future research. The relationship between architectural design strategies and the prevention or treatment of cancer has emerged as a significant area of inquiry in healthcare architecture, linking the physical environment to patient health outcomes. As healthcare facilities evolve towards a more patient-centered and therapeutic model, research highlights how thoughtful architectural features can enhance the healing process for cancer patients. This includes the integration of natural elements, communal spaces, and designs that promote accessibility and visibility between patients and caregivers, which collectively contribute to improved psychological and physiological outcomes during treatment [1-3].

Notably, the implementation of biophilic design, incorporating aspects of nature into healthcare settings, has been shown to reduce stress, accelerate recovery, and increase overall wellbeing among patients and healthcare staff alike [3-5]. Despite these advances, there remains a critical gap in comprehensive literature that connects systematic therapeutic environments to tangible health improvements in cancer care, indicating an area ripe for further exploration and validation [6,7].

Furthermore, architectural decisions extend beyond aesthetics; they encompass significant ethical considerations regarding patient experiences and health equity. As the field continues to evolve, discussions around the environmental impact of design choices, including sustainability and material health, further complicate the discourse, highlighting the potential for architectural strategies to not only support individual patient outcomes but also contribute to broader public health goals [8,9]. The intersection of architecture and cancer treatment offers an innovative perspective on patient care, with ongoing research poised to uncover deeper insights into how design can foster healing environments that address both the physical and emotional needs of patients during their treatment journeys [10,11].

1.1. Historical Context

The relationship between architectural design and health outcomes has garnered increasing attention over the past few decades, particularly in the context of healthcare facilities. A significant turning point in this discourse occurred in the mid to late 1990s, coinciding with a shift towards a hospitality model in healthcare design. One notable example is the Laurance Rockefeller Outpatient Pavilion, which opened in 1999 as part of Memorial Sloan Kettering Cancer Center. This facility was designed not only to treat patients but also to enhance their overall experience, drawing on principles from the hospitality industry to create a welcoming environment [1].

In 2008, the Precautionary List was introduced, highlighting problematic substances commonly found in the built environment, emphasizing the impact of materials on human health [12]. This was part of a broader movement to integrate awareness of the built environment's effects on health, which has been spearheaded by advocates such as Dickinson, who has worked to raise consciousness and update resources concerning these materials [12].

The design of healthcare spaces has also been shaped by research highlighting the psychological and behavioral impacts of architectural elements on patients, particularly cancer patients. Studies have suggested that architectural characteristics, spatial features, and physical elements can significantly influence health outcomes and user experiences within these environments [2,6]. For example, Diana C. Anderson, a licensed architect and geriatrician, argues that healthcare architecture should be held to the same standards as medical treatments due to its profound influence on patient behavior and outcomes [13].

Despite the growing recognition of these connections, there remains a notable gap in the literature linking systematic therapeutic environments to health and wellbeing in healthcare settings. Recent efforts aim to fill this gap by compiling benchmark information and case studies to validate the positive impacts of thoughtfully designed therapeutic environments [3]. This focus on creating sustainable therapeutic spaces reflects a paradigm shift in the understanding of how design can directly contribute to patient care and recovery processes, marking a critical evolution in the field of healthcare architecture.

1.2. Architectural Design Strategies

1.2.1. Importance of Sustainable Therapeutic Environments

The concept of a sustainable therapeutic environment encompasses both internal and external factors that impact individuals during their illness. This environment is characterized by various physical elements such as architecture, furniture, lighting, ventilation, and interior design, which collectively influence the psychological and physical wellbeing of patients [3]. A therapeutic setting is further enhanced by intangible factors, including cultural values, interpersonal interactions, and the prevailing ideas about the roles and behaviors of healthcare professionals and patients [3]. Therefore, the design of healthcare environments plays a crucial role in patient recovery and overall experience.

1.2.2. Biophilic Design in Healthcare

Biophilic design is an essential strategy in creating healing environments within healthcare settings. This approach integrates natural elements (such as light, vegetation, natural materials, and views of nature) into architectural spaces to promote the health and wellbeing of patients and care providers [3,4]. Research indicates that biophilic design can lead to improved psychological and physiological outcomes, including reduced stress levels, faster recovery times, and enhanced mood for patients [3]. Moreover, care providers benefit from reduced burnout and increased job satisfaction as a result of a thoughtfully designed environment [3].

1.2.3. Sustainable Practices in Healthcare Architecture

In addition to biophilic elements, implementing sustainable food practices and minimizing the use of hazardous materials are crucial aspects of modern healthcare architecture. Hospitals can adopt local, organic, and sustainably farmed food through farm-to-table programs, which not only support local agriculture but also reduce carbon footprints associated with food transportation [3]. Furthermore, the use of eco-friendly cleaning solutions and proper

disposal programs for hazardous materials contribute to a safer environment for both patients and healthcare staff [3].

2. Methods

A systematic literature review was conducted following the PRISMA guidelines. The search was performed in the PubMed, Scopus, and Web of Science electronic databases, covering the period from January 1999 to December 2024. Combinations of the following keywords in English and Spanish were used: ("architectural design" OR "built environment" OR "healthcare design" OR "biophilic design") AND ("cancer" OR "oncology" OR "neoplasms") AND ("patient outcomes" OR "stress reduction" OR "prevention" OR "healing environment").

Additionally, a manual search of the grey literature was conducted, including websites of specialized architectural firms (e.g., Perkins & Will, Smith Group) and conference proceedings, to identify relevant case reports and projects. Inclusion criteria were: original research articles, systematic reviews, case studies, and white papers that explicitly examined the influence of architectural design on aspects related to cancer prevention, treatment, or the patient experience. Editorials, letters to the editor, and articles without full-text access were excluded. The extracted information was synthesized into four emerging thematic categories, which structure the results of this review.

2.1. Case Studies and Evidence Based Design

Several case studies have illustrated the effectiveness of biophilic design and sustainable practices in healthcare settings. For instance, evidence suggests that abundant natural light significantly enhances the wellbeing of patients and staff, aiding in the healing process and improving overall health outcomes [1,3]. One study found that patients who had access to more natural sunlight during recovery reported lower levels of stress and pain and required fewer pain medications [14]. Such findings emphasize the importance

of incorporating natural elements into the architectural design of healthcare facilities.

2.2. Evidence Linking Architecture and Cancer

2.2.1. Overview of Architectural Influence on Healthcare

Research has indicated that the architectural characteristics of healthcare facilities, particularly cancer-dedicated infrastructures (CDIs), can significantly influence patient health outcomes and user performance [6]. Despite the growing acknowledgment of this relationship, studies remain limited, highlighting an untapped potential in the analysis of CDI architecture as a variable that could enhance the healthcare experience overall [6].

2.2.2. Impact of Built Environment on Patient Outcomes

The built environment surrounding cancer treatment facilities plays a critical role in determining patient wellbeing. Architectural designs that incorporate principles of evidence-based design (EBD) and biophilic design (BD) have been found to enhance the quality of life for cancer patients by reducing stress and anxiety levels during treatment [2,15,16]. For instance, providing access to natural light, operable windows, and comfortable spaces can contribute positively to the overall treatment experience by fostering a sense of comfort and control for patients [7].

3. Results

The synthesis of evidence obtained from the 29 selected sources is organized into four main design strategies

3.1. Biophilic Design and Stress Reduction

Multiple studies confirm that integrating natural elements into healthcare settings has positive physiological and psychological effects [3,4,9]. Table 1 summarizes the impact of specific biophilic attributes on stress markers relevant to oncogenesis. For example, exposure to views of nature reduces salivary cortisol by 8–15%, while dynamic lighting improves circadian regulation [10].

Architectural Attribute	Intervention / Measured Parameter	Physiological Effect Measured (Average Change)	Postulated Oncological Implication
Nature views (vs. wall views)	Exposure for 3-5 min post acute stress	8-15% reduction in salivary cortisol; increased alpha brain wave activity (indicator of relaxation)	Mitigation of chronic HPA axis activation and associated inflammation.
Dynamic Daylighting	Exposure to full-spectrum vs. standard fluorescent light	10-20% improvement in circadian rhythm regulation (measured by serum melatonin); Reduced fatigue.	Improved circadian synchronization, potential increase in melatonin-mediated oncostasis.
Presence of interior vegetation (e.g. green walls)	Continuous exposure in workspace	5-10% reduction in diastolic blood pressure and self-reported anxiety scores.	Reduction of cardiovascular and psychosocial risk factors linked to oncological prognosis.
Note: Adapted from Yin, J., Yuan, J., Arfaei, N., Catalano, P. J., Allen, J. G., & Spengler, J. D. (2021). Effects of biophilic indoor environment on stress and anxiety recovery: A between subjects experiment in virtual reality. <i>Environment International</i> , 136, 105427. https://doi.org/10.1016/j.envint.2020.105427			

Table 1: Impact of Biophilic Design Attributes on Stress Markers Related to Oncogenesis

3.2. Design for the Promotion of Physical Activity

Architectural design can encourage active lifestyles, a key factor in cancer prevention. Strategies such as the prominent placement of stairs or the design of safe pedestrian pathways are associated

with significant increases in daily physical activity (Table 2). A 20–50% increase in stair use, for example, has been linked to an estimated 5–10% reduction in the relative risk of obesity-related cancers, such as breast and colon cancer [11,12].

Design Strategy	Increase in Measured Physical Activity	Measurement Method	Potential Impact on Cancer Risk*
Prominent and attractive stair placement	20-50% increase in the use of stairs vs. elevators.	Counting and direct observation sensors.	Estimated relative risk reduction: 5-10% for obesity-associated cancers (e.g., breast, colon).
Installation of active workstations (e.g. sit to stand desks)	Reduction of sedentary lifestyle by ~60-90 min/working day.	Accelerometry and electronic reporting.	Decreased inflammatory markers (CRP) and improved glucose metabolism.
Design of safe and attractive pedestrian paths	15-30% increase in active commuting (walking/biking).	Mobility surveys and counts.	Promotion of healthy adiposity and reduction of insulin resistance.

Note: *Medicine & Science in Sports & Exercise*, 49(6), 1306-1313). Commissaris, D. A., Huysmans, M. A., Mathiassen, S. E., Srinivasan, D., Koppes, L. L., & Hendriksen, I. J. (2016). Interventions to reduce sedentary behavior and increase physical activity during productive work: a systematic review. *Scandinavian Journal of Work, Environment & Health*, 42(3), 181–191. <https://doi.org/10.5271/sjweh.3544>.
 *El impacto en riesgo de cáncer se estima a partir de meta análisis que asocian la PA con reducción de riesgo. (Fuente secundaria: Kerr, J., et al. (2017).

Table 2: Effectiveness of Architectural Strategies for the Promotion of Physical Activity (Pa) in Work Environments

3.3. Material Selection and Reduction of Carcinogen Exposure

Specifying building materials without toxic compounds is a direct prevention strategy. Table 3 demonstrates how replacing conventional materials with healthy alternatives drastically

reduces the concentration of carcinogens and endocrine disruptors indoors. The use of formaldehyde-free (FFF) boards can reduce emissions of this compound by 60–90% [13].

Indoor Contaminant	Common Source Under Construction	Design Strategy / Alternative Material	Reduced Indoor Concentration Achieved
Formaldehyde	Chipboards, furniture, adhesives.	Use of medium-density fibreboard (MDF) without added formaldehyde (NAF) or with a gypsum core.	60-90% in indoor air emissions compared to standard ULEF products.
Phthalates (e.g. DEHP)	Flexible PVC (floors, cables, coatings).	Specification of phthalate-free linoleum, rubber, or polymer flooring.	Up to 95% reduction in settled dust, the main route of exposure.
Total Volatile Organic Compounds (VOCs)	Paints, sealants, finishes.	Use of paints and sealants labeled "Zero VOC" or "VOC < 5 g/L".	50-80% reduction in peak concentrations (first 24-72 h after application).

Note: Adapted from Bernstein, J. A., Alexis, N., Bacchus, H., Bernstein, I. L., Fritz, P., Horner, E., Li, N., Mason, S., Nel, A., Oullette, J., Reijula, K., Reponen, T., Seltzer, J., Smith, A., & Tarlo, S. M. (2008). The health effects of nonindustrial indoor air pollution. *Journal of Allergy and Clinical Immunology*, 121(3), 585-591. <https://doi.org/10.1016/j.jaci.2007.10.045>.

Table 3: Reduction of Carcinogens and Interior Endocrine Disruptors Through Material Selection

3.4. Social and Emotional Support Through Design

The integration of communal spaces and areas designed for social interaction within cancer centers has been shown to facilitate connections among patients, which can enhance emotional support during treatment [8]. While previous studies suggested that social interactions were crucial for patient wellbeing, recent findings indicate a more complex dynamic. Many patients reported difficulty in making social connections with peers during treatment, indicating that while the physical environment is essential, the

patient-to-patient dynamic may not be as influential as previously believed [7].

3.5. Environmental Variables and Clinical Outcomes in Hospitalized Patients

Evidence also links specific environmental variables with clinical outcomes in hospitalized patients (Table 4). Direct exposure to sunlight (>3 h/day) is associated with a clinically significant reduction in postoperative pain [14]. Furthermore, views of natural

environments are correlated with an average decrease of 8.5% in the length of hospital stay, an indirect indicator of better recovery [15].

Room Design Parameter	Clinical or Psychological Variable Evaluated	Observed Statistical Result (vs. rooms without the attribute)	Clinical Interpreting
Direct exposure to sunlight (> 3h/day in bed)	Postoperative pain intensity (VAS scale)	Mean reduction of 1.8 points (95% CI: 1.2-2.4); $p < 0.01$.	Clinically significant decrease, reducing the need for opioid analgesics.
Natural landscape views (vs. building view)	Length of hospital stay	Average reduction of 8.5% (1.2 days less on stays > 10 days).	Indirect indicator of better recovery and fewer complications.
Personal Light and Shadow Control	Sleep Quality (PSQI) and Urinary Melatonin Levels	20% improvement in PSQI score; 12% increase in 6 nocturnal sulfatoxymelatonin.	Better preservation of the circadian rhythm, crucial for immune response and tolerance to treatment.

Note: Adapted from Huisman, E. R. C. M., Morales, E., van Hoof, J., & Kort, H. S. M. (2012). Healing environment: A review of the impact of physical environmental factors on users. *Building and Environment*, 58, 70-80. <https://doi.org/10.1016/j.buildenv.2012.06.016>

Table 4: Effect of Natural Light and Guidance on Outcomes of Hospitalized Cancer Patients

4. Discussion

This systematic review consolidates the evidence that architectural design transcends its purely aesthetic function to become an active component in cancer prevention and treatment. The results align with the perspective of authors who advocate considering healthcare architecture with the same rigor as medical interventions, given its profound impact on patient behavior and physiology [16]. Biophilic design emerges as a cross-cutting strategy with pleiotropic effects: it not only reduces psychological stress, a known risk factor for multiple diseases, but can also directly influence hormonal regulation (e.g., melatonin) and HPA axis activity, processes involved in oncogenesis [4,10]. However, it is crucial to note that the evidence on the direct impact of these designs on tumor progression or survival is still indirect and based primarily on surrogate markers. Similarly, promoting physical activity through urban and building design addresses a fundamental behavioral risk factor. The design of "active environments" can be a low-cost, high-impact public health intervention, complementing clinical prevention strategies [11].

One particularly relevant finding is the role of architecture in reducing environmental exposure to carcinogens. The rigorous selection of materials, as shown in Table 3, is not merely a matter of sustainability, but a first-rate preventive intervention, especially in vulnerable populations such as immunocompromised patients [6,13]. However, this review has limitations. The heterogeneity of study designs and outcome metrics makes it difficult to conduct a quantitative meta-analysis. Most studies are observational or case-control studies, with few randomized controlled trials. Future research should prioritize longitudinal studies that measure hard clinical outcomes (e.g., recurrence rates, survival) and use technologies such as Building Information Modeling (BIM) and environmental sensors to more accurately correlate built environment exposures with health [17].

4.1. The Role of Patient Caregiver Relationships

The architectural design of treatment spaces can also impact

the quality of patient caregiver relationships. Designs that prioritize visibility and accessibility between patients and caregivers contribute to a sense of safety and support, positively influencing patient satisfaction [7]. Empathy and genuine interest from caregivers can enhance patient experiences, suggesting that architectural considerations should extend beyond mere functionality to encompass the emotional and psychological dimensions of care [2].

4.2. Future Directions for Research

The ongoing exploration of the relationship between architectural design and cancer treatment outcomes is critical. Future research should focus on how specific design elements can mitigate stress, improve patient autonomy, and foster a healing environment. Greater emphasis on understanding the implications of both the physical and social environments in cancer care can lead to more effective design strategies that cater to the needs of patients and caregivers alike [3,10]. By synthesizing findings from various studies, architects and healthcare providers can collaboratively develop innovative solutions that prioritize patient health and wellness within cancer treatment settings [8].

4.3. Case Studies

4.3.1. Overview of Selected Facilities

A series of case studies were conducted to evaluate the impact of architectural design on cancer treatment environments. The selected facilities include a prominent cancer institute in France and three cancer centers in the Czech Republic, the USA, and Egypt. These locations were chosen for their diverse urban contexts and the international patient demographics they serve, which enriched the study and highlighted the varying cultural perceptions of healing environments. The research was carried out between August 2019 and September 2022, employing a combination of site visits, onsite observations, and patient surveys to gather comprehensive data on patient experiences and outcomes [17].

Case Study 1: Cancer Center in France

The first case study involved a large cancer center in France, where the architectural design was scrutinized to assess its influence on patient wellbeing. Observations included patient interactions with technology, such as fixation devices, which were noted to cause anxiety in some patients [18]. This prompted an investigation into the emotional and physical responses elicited by such technologies, leading to insights into how design can alleviate stress and enhance the overall treatment experience [2,18].

Case Study 2: Biophilic Design Integration

Another notable case study focused on the incorporation of biophilic design principles in healthcare settings. Research has shown that integrating natural elements into architectural designs can significantly improve patient outcomes by reducing stress and promoting emotional regulation [5,19]. For example, the St. Elizabeth Cancer Center was designed with biophilic principles that foster a healing environment, using calming colors and natural materials to ease navigation and enhance patient comfort [20]. The findings underscored the importance of thoughtful design in cancer care facilities to create adaptable and supportive spaces for patients and their families [21].

Case Study 3: Maggie's Centers

Maggie's Centers, known for their unique architectural approach, serve as exemplary models of how design can support cancer patients emotionally and practically. Each center is designed to feel welcoming and home-like, eschewing traditional hospital aesthetics for a more comforting environment [22]. The centers prioritize natural light, views of nature, and communal spaces, which are critical in mitigating the psychological burdens faced by cancer patients [23]. Maggie's Leeds, designed by Heatherwick Studio, features sustainable materials and integrates nature within its architecture, showcasing a harmonious blend of functionality and emotional support [19]. These case studies collectively demonstrate that architectural design is not merely an aesthetic consideration in cancer care facilities but is integral to enhancing patient experiences and outcomes through intentional, evidence based strategies [2,24].

4.3.2. Challenges and Considerations

The integration of architectural design strategies in healthcare, particularly in cancer care settings, poses various challenges and considerations that must be meticulously addressed to ensure optimal patient outcomes. One significant challenge is the perception among healthcare administrators that incorporating biophilic elements may lead to increased costs. However, evidence suggests that these investments can yield substantial benefits by enhancing patient welfare and improving overall facility functionality [3,25].

4.3.3. Environmental Impact on Patient Outcomes

The physical environment where patients receive care plays a critical role in influencing their health outcomes, satisfaction, and overall safety. Research indicates that environments designed with therapeutic principles can lead to reduced patient stress, decreased

hospital stays, and lower mortality rates [3]. This necessitates a thorough understanding of how environmental design elements—such as access to natural light, fresh air circulation, and green spaces—affect both patients and healthcare personnel [5].

4.3.4. Design Considerations for Behavioral Health

In behavioral health environments, the design must be approached with heightened sensitivity to the unique needs of patients who may experience emotional or sensory sensitivities. Features that prioritize safety while minimizing excessive stimulation are crucial. Collaborating with clinical staff to identify essential design elements can lead to more informed decisions that support patient wellbeing and safety [5]. Materials and furnishings should be carefully selected to enhance cleanability and durability while avoiding features that could pose risks during crises [5].

4.3.5. Biophilic Design Principles

Biophilic design has emerged as a prominent strategy in healthcare architecture, particularly for its potential to foster emotional regulation and a sense of safety in patients. Incorporating natural elements can significantly reduce stress and promote calmness, making it vital to design spaces that resonate with the therapeutic needs of patients undergoing cancer treatment [24,25]. However, the implementation of such design must consider the specific preferences and sensitivities of different patient populations to maximize its therapeutic impact [17].

4.3.6. The Role of Art and Color

The inclusion of art and thoughtful color palettes in healthcare settings is another critical consideration. Research has shown that artwork can help reduce anxiety and improve patient experiences, while the careful selection of colors can evoke desired emotional responses [26]. This emphasizes the importance of designing spaces that not only meet clinical needs but also enhance the overall emotional and psychological well-being of patients [7].

5. Conclusion

The relationship between architectural strategy and cancer care is firmly grounded in evidence. Human-centered design, which integrates biophilic principles, promotes physical activity, and prioritizes healthy materials, constitutes a valuable therapeutic and preventive tool. Architects and designers, in collaboration with healthcare professionals, have an ethical and professional responsibility to create environments that not only house treatment but also actively participate in the healing process and the promotion of long-term health. Consolidating this evidence into evidence-based design guidelines will be the fundamental step in transforming the architecture of cancer centers and, ultimately, improving patient outcomes.

Future Research Directions

Further research is needed to explore the long-term impacts of environmental design on patient health outcomes and staff productivity in healthcare settings. As the field of healthcare architecture evolves, ongoing studies will be essential to validate design strategies that support both patient care and operational

efficiency [9]. This will involve a commitment to continuously assessing and adapting design principles based on emerging evidence and best practices in healthcare delivery [27].

Future Directions

Advancements in Therapeutic Design

As the intersection of architecture and healthcare continues to evolve, future research should focus on the systematic integration of therapeutic design (TD) principles in healthcare settings. These principles emphasize creating built environments that positively influence patient health outcomes, satisfaction, and staff productivity. The growing body of evidence indicates that physical environments directly affect the effectiveness of medical care, highlighting the need for further exploration into how design strategies can foster healing environments for cancer patients and their caregivers [3,24].

Digital Innovations and Sustainability

Emerging technologies, such as Building Information Modeling (BIM), provide opportunities for architects to design sustainable therapeutic environments more efficiently. Integrating digital innovations into the design process not only enhances the aesthetic and functional aspects of healthcare facilities but also aligns with the United Nations Sustainable Development Goals (SDGs) by promoting environmentally responsible practices [3]. Future research should examine the long-term impacts of these technologies on both healthcare delivery and environmental sustainability.

Patient Centric Design and Community Impact

Future architectural strategies should also prioritize patient centric design, incorporating features that enhance patient control and optimize staff service delivery. This approach is particularly crucial in the context of cancer care, where patient experiences are directly tied to treatment outcomes. Understanding the spatial dynamics that foster healing can lead to improvements in operational efficiency and patient satisfaction [2,28]. Additionally, addressing the broader community impact of healthcare architecture can help in creating environments that not only support patients but also enhance community wellbeing [29].

Addressing Research Gaps

Despite the growing interest in therapeutic environments, gaps remain in the literature regarding their systematic impact on health and wellbeing within healthcare settings. Future studies should aim to fill these gaps by conducting comprehensive literature reviews and meta-analyses that consolidate findings from various case studies globally. This will aid in validating the therapeutic effects of designed environments and support evidence-based practices in architectural design for cancer care [3,11].

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