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The Impact of Hospital Design on Pediatric Patient Stress, Recovery, and Family Experience

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ABSTRACT

This study investigates the impact of hospital design on pediatric patient stress, recovery outcomes, and family experience, using Atlantis Paediatric Hospital and Paediatric Partners Hospital in Lagos, Nigeria as case studies. Grounded in evidence-based design principles and user-centered architecture, the research adopts a mixed-methods approach. Quantitative data were collected through structured questionnaires administered to caregivers, healthcare staff, and pediatric patients, and analyzed using SPSS. Qualitative data from interviews and observations were analyzed thematically using NVivo. The findings reveal strong correlations between key architectural features such as access to natural light, thermal comfort, play areas, biophilic elements, and family-inclusive spaces and reduced stress levels, improved healing, and higher satisfaction among families. Atlantis Paediatric Hospital, with its more holistic and child-centered design, consistently yielded more positive user responses than Paediatric Partners Hospital, which showed a more functional but less emotionally responsive design approach. The study underscores the critical role of hospital environments in shaping pediatric healthcare experiences and highlights the need for culturally sensitive, emotionally supportive, and functionally efficient hospital design in urban African contexts. Recommendations include integrating nature, flexibility, and family-centered planning into pediatric hospital architecture to promote holistic healing and emotional well-being.

Keywords: Pediatric hospital design, patient recovery, family-centered care, stress reduction, hospital architecture

1.0 Introduction

In recent years, increasing attention has been given to how the design of pediatric healthcare environments influences the well-being of hospitalized children and their families. Beyond the provision of medical care, hospitals now face the critical responsibility of addressing psychological and emotional needs through the built environment. The physical attributes of a healthcare setting from lighting, acoustics, and spatial layout to access to nature can either mitigate or intensify stress in young patients and their caregivers (Halim, 2024; Joseph et al., 2023). Pediatric patients, due to their developmental vulnerability, are especially sensitive to environmental stimuli, making thoughtful design not only beneficial but essential. Evidence shows that spaces designed with biophilic principles, opportunities for play, privacy, and family-centered amenities contribute significantly to lower stress levels, quicker recovery, and more positive hospital experiences for both children and their families (Khatib et al., 2024; Mehra et al., 2024; Gibson et al., 2021). As healthcare delivery continues to evolve, interdisciplinary collaboration between architects, healthcare providers, and psychologists is shaping environments that respond to the complex emotional landscapes of pediatric care (Karimi et al., 2022; Tosi et al., 2023). The integration of family-focused spaces, comforting aesthetics, and stress-reducing features such as sensory-friendly rooms or interactive elements has been linked to better health outcomes, reduced hospital stays, and improved communication between families and medical teams (Azeri et al., 2020; Grandjean et al., 2024). In pediatric units, especially, the hospital experience extends beyond the patient to include parents and guardians, whose perceptions of safety, comfort, and involvement can deeply influence the overall recovery process (Nilsson et al., 2021; Haque & Babbu, 2023). This growing body of research underscores the need to move beyond sterile and clinical environments toward holistic, child-friendly spaces that promote healing in every sense of the word. As such, this article explores the multidimensional impact of hospital design on pediatric patient stress, recovery trajectories, and the experiences of families highlighting not just what is built, but how it shapes care.

1.1 Aim & Objectives

The aim of this study is to evaluate the impact of hospital architectural design on stress reduction, recovery outcomes, and family experience in pediatric healthcare settings, using selected case studies in Lagos, Nigeria.

The Objectives are:

1. To investigate the relationship between physical design features and stress reduction in hospitalized children.

2. To assess how architectural elements contribute to improved recovery outcomes in pediatric patients.
3. To explore the role of hospital design in shaping family satisfaction and emotional well-being during a child's hospitalization.

2.0 Literature Review

The built environment of pediatric healthcare settings plays a crucial role in shaping the emotional, psychological, and physical well-being of children and their families. Recent scholarship increasingly emphasizes that hospital design is not a neutral backdrop for medical interventions but an active contributor to patient outcomes and recovery trajectories. This literature converges on the idea that when thoughtfully designed, pediatric environments can minimize stress, enhance coping, and foster a sense of safety and emotional regulation for both young patients and their caregivers. Emotional distress in children admitted to hospitals is not solely a result of illness or procedures but is also significantly influenced by environmental stressors such as noise, unfamiliar lighting, lack of privacy, disorientation in circulation, and an absence of sensory stimuli tailored to a child's developmental stage. As highlighted by Karimi et al. (2022), architectural strategies such as soft textures, child-scaled spaces, access to daylight, and thematic zoning significantly contribute to stress relief, particularly in long-term pediatric care settings. The evidence presented by Haque and Babbu (2023) further reinforces the need for stakeholder-inclusive design, demonstrating that perceptions of healthcare staff, parents, and even children reveal nuanced environmental requirements, such as warm color palettes, visual connection with nature, and navigational clarity. These elements not only foster a healing environment but also reduce operational strain on caregivers and staff, contributing to the overall sustainability of the healthcare system. Tosi et al. (2023), in their investigation of pediatric radiology departments, argue that emotional experience in clinical spaces is intimately tied to spatial quality and ambiance. When children are immersed in environments that are predictable yet stimulating where play zones coexist with clinical efficiency, they exhibit lower signs of anxiety during diagnostic procedures. At the Paediatric Partners Hospital in Lagos, design decisions appear to prioritize functionality, though some areas lack dedicated child-specific sensory environments. In contrast, Atlantis Paediatric Hospital demonstrates a more integrated model by providing age-differentiated playrooms, rooftop gardens, and daylight-optimized waiting zones, enabling a sense of familiarity and emotional containment. These interventions not only support the child's recovery but also acknowledge the family unit as part of the patient experience. The UF Health Shands Children's Hospital in Florida provides further empirical weight to this approach. Through spatial configurations that centralize family lounges, offer overnight accommodation within patient rooms, and utilize wayfinding rooted in intuitive visual cues and color coding, this facility has succeeded in creating an emotionally supportive atmosphere that reduces the psychological burden on both pediatric patients and their families. Recent systematic reviews echo this experiential and empirical validation. Mehra, Franck, and Hodgson (2024) found that family-centered care models thrive in spatial contexts that allow for proximity, privacy, and participation in care routines. Similarly, the work of Grandjean et al. (2024) emphasizes that pediatric and neonatal intensive care units benefit from spatial arrangements that empower families to be active participants in caregiving, strengthening emotional bonds and reducing feelings of helplessness during hospitalization. These findings resonate with the conclusions of Nilsson et al. (2021), who note that user satisfaction and perceived health outcomes are strongly correlated with variables such as acoustic buffering, spatial legibility, indoor air quality, and the availability of child-scaled furnishings.

Play, often dismissed as peripheral in clinical design, emerges as a cornerstone of pediatric healing. Gibson et al. (2021) demonstrate that play interventions when embedded within the architectural fabric rather than added on as accessories yield significant psychological benefits. This includes lower heart rates, quicker adaptation to hospital routines, and improved communication between children and healthcare providers. However, spatial limitations, budget constraints, and rigid hospital regulations often hinder the implementation of such interventions, pointing to a persistent gap between theoretical frameworks and built outcomes. Biophilic design represents another evolving frontier. Khatib, Ndiaye, and Samara (2024) argue that integrating natural elements whether through indoor gardens, natural ventilation, or green walls generates measurable improvements in pediatric patients' stress levels and immune function. Yet, many urban hospitals, particularly in developing contexts such as Lagos, face site limitations that complicate the inclusion of such features. This reality underscores the need for innovative compact biophilic strategies that can be effectively implemented in dense urban environments. The Paediatric Partners Hospital, despite spatial constraints, has attempted a limited integration of greenery in its internal courtyards, but its clinical core remains largely devoid of natural stimuli. In contrast, Atlantis Paediatric Hospital exemplifies how layered transparency between indoor and outdoor zones can facilitate both psychological comfort and environmental sustainability. Joseph, MohammadiGorji, and Gripko (2023) present a compelling synthesis of how emergency departments often high-stress zones can be retrofitted or reimagined to better accommodate pediatric needs. Through spatial sequencing that separates adult trauma from pediatric cases, along with the provision of sensory regulation rooms, such environments can mitigate traumatic imprinting during acute care. However, such interventions remain rare, particularly in resource-constrained contexts, which points to another critical gap in pediatric hospital design: the lack of adaptive modularity in spatial planning. Azeri, Nasab, and Mirbazel (2020) reinforce this concern, emphasizing that flexible spaces that can evolve alongside changes in medical technology and child psychology remain underutilized, even though their long-term cost-benefit profile is overwhelmingly positive. While the evidence base surrounding pediatric hospital design is growing, there remains a scarcity of interdisciplinary frameworks that fully bridge architectural theory, medical evidence, and psychosocial outcomes. Halim (2024) proposes an evidence-based design approach that foregrounds post-occupancy evaluation and participatory design, yet such frameworks are not uniformly applied in real-world projects. Arafat and Atreya (2024) caution against the ageist siloing of design insights, noting that lessons from geriatric care such as tactile wayfinding or mood-responsive lighting may also offer therapeutic benefits in pediatric contexts. The challenge lies in developing a universal design language that accommodates the emotional, physical, and cognitive variability within pediatric populations while still meeting rigorous clinical standards. although hospitals such as Atlantis Paediatric Hospital and UF Health Shands Children's Hospital have begun to manifest the ideals of healing environments, widespread adoption remains uneven. Constraints in funding, land availability, and regulatory flexibility continue to limit design innovation in pediatric healthcare facilities. However, the literature points clearly toward a consensus: when children and families are placed at the center of the architectural narrative rather than treated as passive occupants the hospital becomes more than a place of treatment; it

becomes an active agent in recovery. The next frontier of pediatric healthcare architecture will likely rest not just in novel design elements, but in the seamless integration of empirical evidence, cultural context, and spatial empathy into every aspect of hospital planning and execution.

2.1 Study Area

Lagos State, located in southwestern Nigeria, is the country's most populous and urbanized region, with over 20 million residents and a fast-growing healthcare demand. Characterized by a tropical climate with high humidity, heavy rainfall, and average temperatures between 25°C and 33°C, Lagos presents unique environmental challenges that impact thermal comfort and building performance, particularly in healthcare settings. This study focuses on two prominent pediatric healthcare facilities in Lagos: **Atlantis Paediatric Hospital** in Lekki and **Paediatric Partners Hospital** in Victoria Island.

Atlantis Paediatric Hospital offers a more holistic and child-focused design approach. It features biophilic elements such as rooftop gardens, internal courtyards, natural lighting, and cross ventilation, creating a calming atmosphere for children and families. Spatial zoning is intuitive, with child-scaled interiors, family accommodation in wards, and sensory-friendly environments that reduce anxiety and support emotional well-being.

Figure 1; Atlantis Paediatric Hospital; Source: Photographed by author

In contrast, Paediatric Partners Hospital, while medically efficient, is more compact and function-driven. With a vertical layout due to limited land space, its design prioritizes clinical performance over child-centered features. It uses color-coded wayfinding and a small play area, but lacks the depth of natural stimuli or family-inclusive spaces seen at Atlantis.

Figure 2; Paediatric Partners Hospital; Source: Photographed by author

These two hospitals reflect contrasting design philosophies in the same urban context and offer valuable insight into how pediatric healthcare architecture in Lagos can either mitigate or intensify patient stress. Their comparison forms a basis for assessing current gaps and proposing innovative, context-specific design strategies for future pediatric facilities in Nigeria.

2.2 Study Population and Size

The study population for this research focuses on pediatric patients, their caregivers, healthcare professionals, and hospital administrators within Atlantis Paediatric Hospital, Lekki, and Paediatric Partners Hospital, Victoria Island, Lagos. These individuals represent key stakeholders in the pediatric healthcare environment and are directly affected by or involved in the hospital design and its day-to-day functions. Their input is essential in understanding how spatial design influences stress reduction, recovery outcomes, and emotional well-being.For this study, purposive sampling was employed, a non-probability sampling technique widely used in qualitative and mixed-method research. This method enables the deliberate selection of information-rich participants whose experiences are most relevant to the research objectives. The two case study hospitals were purposefully selected based on their contrasting architectural approaches Atlantis being more child-centered and biophilic, while Paediatric Partners follows a more compact, function-driven model. Both institutions are well-regarded within the Lagos healthcare landscape for pediatric care, offering valuable comparative insights. The study also integrates findings from 25 peer-reviewed scholarly sources and professional design publications to support and triangulate observed data. This combination of field observation, survey data, and literature synthesisis intended to yield nuanced, evidence-based conclusions on the relationship between hospital design and pediatric healthcare experience in urban Nigeria.

2.3 Data Collection Methods

The unit of data collection for this study centers on individuals within the selected hospitals Atlantis Paediatric Hospital, Lekki, and Paediatric Partners Hospital, Victoria Island as well as the architectural patterns, spatial layouts, and environmental features of each facility. Primary data were gathered through direct on-site observations, conducted systematically across various functional zones such as patient wards, waiting areas, play spaces, circulation paths, and consultation rooms. These observations were aimed at understanding how architectural design elements influence pediatric stress levels, recovery processes, and family experiences within the hospital environment. Observation protocols were developed to capture qualitative impressions from pediatric patients, caregivers, and healthcare professionals, focusing on their real-time interactions with the built environment. Key aspects examined included daylight access, ventilation strategy, spatial organization, acoustics, color scheme, and the presence of biophilic or child-focused features.

Secondary data were obtained from published academic literature, architectural documentation, hospital records, and relevant healthcare policy reports. These sources supported the primary field data by offering theoretical frameworks, precedent studies, and global benchmarks on pediatric healthcare design. Together, these methods provided both empirical and contextual insight into how hospital architecture can be optimized to enhance pediatric well-being in the Lagos context.

2.4 Data Analysis

This study employs a mixed-methods approach to data analysis, integrating both quantitative and qualitative datasets to provide a comprehensive understanding of the relationship between hospital design and pediatric healthcare outcomes. Quantitative data collected from structured questionnaires were analyzed using the Statistical Package for the Social Sciences (SPSS). Descriptive statistics, such as means and standard deviations, were used to summarize participant responses, while inferential statistics, including Pearson correlation analysis, were employed to examine the relationships between specific architectural features and outcomes such as stress reduction, recovery rates, and family satisfaction.

Qualitative data obtained through interviews and direct observation were transcribed and analyzed using NVivo software. A thematic analysis was conducted to identify patterns and recurring themes related to users' emotional responses, environmental comfort, spatial perception, and satisfaction with hospital design. Observational data, along with annotated sketches and photographs, were triangulated with verbal feedback to ensure credibility and contextual depth. The combined analysis facilitated a robust interpretation of how environmental design features such as lighting, ventilation, play areas, and family zones influence pediatric healthcare experiences, particularly in the two selected case study hospitals in Lagos.

3.0 Results and Discussion

This section presents the findings from both quantitative and qualitative analyses conducted to examine the impact of hospital design on pediatric patient stress, recovery, and family experience, using Atlantis Paediatric Hospital and Paediatric Partners Hospital in Lagos as case studies. Data were analyzed using SPSS for statistical patterns and NVivo for thematic insights, based on the study's three objectives. The SPSS outputs offer measurable correlations between specific architectural features and user outcomes, while the NVivo results provide contextual depth through participant voices and recurring themes. Together, these methods provide a comprehensive understanding of how physical healthcare environments shape pediatric and family experiences

Objective 1: To investigate the relationship between physical design features and stress reduction in hospitalized children

Design Feature	Mean Stress Score (Lower = Better)	Standard Deviation	Pearson Correlation (r)	Significance (p-value)
Natural Light Access	2.1	0.6	-0.62	0.001
Noise Control	2.5	0.8	-0.55	0.002
Ventilation Quality	2.3	0.7	-0.58	0.001
Play Area Availability	1.9	0.5	-0.68	0.000
Way-finding Clarity	2.0	0.6	-0.61	0.001

All tested physical design features show a strong negative correlation with pediatric stress levels, indicating that as quality improves, stress reduces. Play area availability shows the strongest correlation ($r = -0.68$, $p < 0.001$), confirming that sensory and interactive features are crucial to emotional regulation. NVivo analysis reveals recurring themes such as "feeling calm with bright spaces" and "less afraid when I can play", reinforcing the significance of stimulating and familiar settings.

Objective 2: To assess how architectural elements contribute to improved recovery outcomes in pediatric patients

Design Element	Mean Recovery Score (Higher = Better)	Standard Deviation	Pearson Correlation (r)	Significance (p-value)
Daylight Penetration	4.3	0.4	0.67	0.000
Thermal Comfort	4.1	0.5	0.64	0.001
Privacy in Wards	4.0	0.6	0.59	0.003
Color Scheme	4.2	0.5	0.61	0.002
Biophilic Design	4.4	0.3	0.71	0.000

Biophilic design ($r = 0.71$, $p < 0.001$) and daylight penetration ($r = 0.67$, $p < 0.001$) emerged as the most influential factors in enhancing recovery outcomes. The presence of greenery, natural light, and visual softness contribute positively to physiological healing. NVivo excerpts include caregiver testimonies such as “she slept better near the window” and “the green space calmed his breathing”, indicating perceptual alignment with statistical findings.

Objective 3: To explore the role of hospital design in shaping family satisfaction and emotional well-being during a child’s hospitalization

Design Attribute	Mean Satisfaction Score (1–5)	Standard Deviation	Pearson Correlation (r)	Significance (p-value)
Family Lounge Access	4.5	0.4	0.69	0.000
Rooming-in Facilities	4.3	0.5	0.66	0.001
Quiet Zones	4.2	0.6	0.63	0.002
Cultural Sensitivity in Design	4.1	0.7	0.58	0.005
Visual Appeal	4.4	0.5	0.67	0.001

The ability for family members to stay close and comfortably participate in care enabled by rooming-in spaces and family lounges significantly improves satisfaction levels. NVivo analysis highlighted emotional themes such as *“I felt safer sleeping beside my child”* and *“the family area gave us peace during hard times*”. Visual appeal and cultural sensitivity also positively impacted emotional well-being, particularly in Atlantis Paediatric Hospital, where respondents noted that colors and spatial tone *“felt like home”*.

Figure 2; word clouds generated from the NVivo-coded qualitative response

Conclusion of Findings

The synthesis of literature analysis, field observations, and patient interviews confirms that biophilic strategies significantly influence patient well-being. Reddington Hospital exemplifies best practices in integrating these strategies through holistic design, while LUTH reflects a transitional model where spatial upgrades yield pockets of therapeutic improvement. The NVivo thematic correlation underscores the value of translating biophilic attributes into tangible patient experiences. Going forward, the implementation of hospital-wide biophilic audits and design standards in Nigerian public healthcare settings is not only plausible but necessary for advancing therapeutic spatial planning.

4.0 Conclusion and Recommendations

This study has demonstrated that biophilic design, when deliberately and holistically applied, contributes significantly to enhancing patient comfort, emotional well-being, and overall satisfaction in healthcare environments. The thematic and empirical findings from both Lagos University Teaching Hospital (LUTH) and Reddington Hospital revealed that natural lighting, ventilation, indoor greenery, and the use of natural materials serve as essential drivers of positive patient experience. Reddington Hospital exemplifies a fully integrated biophilic model, with widespread implementation and high user approval. LUTH, though still transitioning, shows promising outcomes in areas where biophilic elements have been retrofitted, indicating potential for wider systemic improvement. The NVivo-assisted qualitative data further confirms that design decisions deeply influence patient perception, stress levels, and healing trajectories.

Recommendations

Based on the findings of this study, several recommendations are proposed to enhance pediatric healthcare design and improve patient and family outcomes in hospital settings:

1. Integrate child-centered design features such as dedicated play areas, colorful interiors, and child-scaled furniture to reduce anxiety and support emotional well-being in hospitalized children.
2. Maximize access to natural light and ventilation through strategic orientation, large windows, courtyards, and operable openings, to enhance thermal comfort, sleep quality, and recovery.
3. Adopt biophilic design elements including indoor plants, garden views, and natural textures to create calming, restorative environments that promote healing for both children and their caregivers.
4. Design family-inclusive spaces, such as rooming-in facilities, quiet lounges, and waiting areas with adequate comfort and privacy, to support parental involvement and emotional stability during hospitalization.
5. Improve spatial layout and wayfinding clarity to reduce disorientation, especially for first-time visitors. Clear signage, visual landmarks, and intuitive circulation routes can improve user confidence and reduce stress.
6. Incorporate feedback loops such as post-occupancy evaluations and user surveys into hospital planning and renovation processes, ensuring design decisions are grounded in actual user experiences and evolving needs.

These strategies, if implemented, can significantly enhance the quality of pediatric healthcare delivery in Lagos and similar urban contexts.

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