2026
March
coou African Journal of Environmental Research *Vol 7, No. 1 2026. pp 201-215*

EVALUATING THE ROLE OF ARCHITECTURAL ELEMENTS IN CREATING CHILD-FRIENDLY PAEDIATRIC HEALTHCARE ENVIRONMENTS IN KADUNA, NIGERIA

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Abstract

The design of paediatric healthcare environments has gradually shifted toward evidence-based approaches that enhance well-being, psychological comfort, and recovery outcomes. However, in Nigeria, such facilities are often treated as generic healthcare buildings, with limited attention to the specific needs of children. This study examines the role of architectural elements in creating child-friendly environments through an empirical assessment of three (3) purposively selected paediatric healthcare facilities in Kaduna State, Nigeria. A mixed qualitative–quantitative observational approach was employed to assess six (6) key variables: colour and lighting, natural materials, spatial organization, child-scaled design, play zones, and biophilic elements. The results indicate that spatial organization is the most developed element across all case studies, reflecting a strong emphasis on functional efficiency. In contrast, child-centered features, particularly play zones and child-scaled design were largely absent. Biophilic elements and the use of natural materials were also poorly integrated. The analysis of the results further revealed a consistent discrepancy between functional and empirically informed design attributes. The study highlights a significant gap in the design of existing paediatric healthcare facilities and proposes a responsive design framework that integrates evidence-based principles with child-centered strategies. It is recommended that future paediatric healthcare facilities in Kaduna, Nigeria integrate child-centred architectural elements particularly child-scaled design, play zones, biophilic features, and family-centred spaces alongside improved use of colour, lighting, and natural materials to enhance child-friendly environments and support patient well-being and recovery outcomes.

Keywords: Biophilic elements; Child-centered design, Evidence-based architecture, Paediatric healthcare, Spatial organization.

INTRODUCTION

Healthcare architecture has evolved from focusing primarily on functionality to a more holistic, human-centred design approach (Firoozi & Firoozi, 2026a). This transformation is driven by the emergence of evidence-based design (EBD), which provides a basis for decision-making by demonstrating practical relationships between the built environment and health outcomes (Halawa *et al*., 2020; Sulaiman & Mahmood, 2024). Contemporary healthcare facility design increasingly recognises that the built environment is more than a

backdrop for medical treatment; it actively contributes to patient well-being, staff efficiency, and the overall experiences of individuals within these facilities (Li *et al*., 2024; Rowe & Knox, 2023). Architectural interventions should therefore create environments that integrate therapeutic, psychological, and operational requirements.

Paediatric facility design requires an understanding of user considerations. Children constitute a distinct user group, with physical, emotional, and cognitive needs that differ from those of adults (Dumble & Chong, 2022). Unlike adult, children often lack the psychological maturity to understand medical procedures (Hardy & Nortjé, 2022). Hence, they may perceive the built of environments as intimidating, or threatening. Therefore, paediatric healthcare design must go beyond functional considerations; it should incorporate architectural features that provide comfort, reassurance, and positive experiences, while supporting medical effectiveness and a healthy working environment (Bahrami *et al*., 2025).

The spatial and sensory characteristics of healthcare environments play a critical role in shaping children's perceptions and interactions (Allitt *et al.*, 2024; Rios-Vega *et al*., 2024). Elements such as colour, lighting, scale, materials, and spatial configuration influence how children experience and respond to their surroundings (Llorens-Gámez *et a*l., 2022). Studies in healthcare design and environmental psychology indicate that environments characterised by harsh lighting, dull colours, and large, impersonal spaces increase stress, anxiety, and resistance to treatment among paediatric patients (Kong *et al*., 2022; St-Jean *et al*., 2022). In contrast, Craig *et al*. (2024) revealed that environments that incorporate playful elements, natural features, and child-scaled spatial configurations have been shown to enhance emotional well-being, engagement, and overall recovery outcomes

Despite the studies supporting child-friendly, healing-focused design, implementation remains limited in paediatric of Nigeria's cities. Limited financial, and technical resources for new healthcare infrastructure for new healthcare infrastructure, inadequate policy support, and rapidly urbanising populations make design consideration focus more on capacity as well as operational efficiency over experiential and therapeutic considerations (Balogun, 2021; Elsey *et al*., 2019). In Kaduna State, paediatric hospital environments often reflect orthodox adult-oriented design, with standard layouts, clinical aesthetics, and minimal child-centred features. Most paediatric hospitals in Kaduna exhibit this significant gap, with minimal use of natural materials and a lack of child-scale design, resulting in environments that fail to provide holistic care for young patients.

This study aims to assess the influence of architectural elements on creating child-friendly environments in paediatric hospitals in Kaduna State, Nigeria. To achieve this, the specific objectives are: (i) to identify the strengths, weaknesses, and systemic gaps in existing paediatric healthcare design; (ii) to evaluate key architectural variables comprising colour and lighting, natural materials, spatial organisation, child-scaled design, play areas, and biophilic elements within selected healthcare facilities; and (iii) to develop an inclusive framework to guide the design of future child-centred hospitals in Nigeria.

LITERATURE REVIEW

Healthcare architecture has increasingly embraced evidence-based design (EBD) principles, reflecting a growing recognition that spatial arrangements, environmental quality, and material selection can impact health outcomes (Firoozi & Firoozi, 2026b). EBD establishes a scientific link between architectural interventions and measurable improvements in recovery process, staff efficiency, and performance of healthcare facilities (Brambilla *et al*., 2019; Van der Zwart & Pilosof, 2020). Within the evidence-based design (EBD) framework, paediatric healthcare facilities present a unique challenge, as children have physiological, cognitive, and emotional characteristics that differ from adults (Dumble & Chong, 2022). According to Westwood et al. (2023), children's sensitivity to environmental factors such as colour, lighting, scale, and texture shapes their perception of space, modulates stress, and influences coping during hospitalization.

Therefore, designing healthcare environments for children requires careful attention to colour, lighting, scale, and texture, as these factors support recovery, regulate stress, and facilitate coping, highlighting the role of child-centred design in creating effective paediatric healing environments.

Evidence-Based Design in Paediatric Healthcare

Evidence-based design (EBD) is a framework used to guide healthcare design by incorporating empirical research into the decision-making process. Its implementation aims to reduce stress levels during hospital stays for children and their families, improve patient satisfaction, and achieve the best possible healing outcomes (Pauli-Bock *et al*., 2021). Within paediatric settings, EBD is characterised by three primary areas of focus: sensory experiences, spatial organisation, and interactions with nature (Babbu, 2024). Sensory experiences include all elements that influence children's emotional and behavioural responses, including colour schemes, natural and artificial lighting, acoustics, and materials. Spatial organisation refers to the design of circulation patterns, ward layouts, and child-scaled zones that provide safety, autonomy, and orientation. Studies by Huizi et al. (2024) and Deng *et al*. (2025) indicates that through biophilic design, children's interactions with nature reduce stress levels, promote faster recovery, and enhance cognitive engagement (Kellert & Calabrese, 2015)..

Child-Centred Design Principles

Child-Cantered Design (CCD) places the developmental and psychological needs of children at the forefront of healthcare environment design. Concepts from biophilia (i.e., love for nature and living things), topophilia (i.e., love for particular environment), and ecophilia (i.e., love for nature) itself influences children's well-being (Asha & Radhakrishnan, 2025). Examples of strategies commonly used to achieve CCD include play areas, child-scaled furniture, engaging colour schemes, and tactile elements. Play areas has long been recognised as a means through which children cope with emotions, regulate themselves, and regain a sense of normalcy during medical treatment (Schipperijn et al., 2024) . Studies by Cabrita Gulyurtlu (2025) and Godino-Iáñez *et al*. (2020) demonstrated that even minimal incorporation of play elements that include outdoor play spaces or the integration of indoor

and outdoor areas enhances children's positive perception of hospitals, reduces stress-related behaviours, and increases the likelihood of cooperative participation in treatment.

Colour, Lighting, and Materiality

The choice of colour, lighting, and materials is one of the most critical factors directly influencing a child's experience in healthcare facilities. Evidence indicates that exposure to warm, bright, and soft-coloured palettes can create feelings of comfort. Conversely, very bright, dull, or sterile palettes may increase anxiety among children (Nair *et al*., 2022). Natural light has also been shown to benefit paediatric patients, as sunlight positively regulates circadian rhythms, creates a calming atmosphere, enhances mood, and improves recovery times (Blume *et al*., 2019). Children's tactile experiences with materials are another important factor in shaping their interactions with healthcare environments. The tactile qualities of finishes and the use of organic materials, such as natural wood and stone, provide sensory stimulation, warmth, and psychological comfort (Singh, 2025). However, Ahmed *et al.* (2025) revealed that most paediatric care in low- and middle-income countries continue to rely on traditional clinical facilities, which do not support a child-centred approach to care.

Spatial Organisation and Child-Scaled Design

The importance of spatial organisation is critical to achieving a balance between efficiently providing care and enhancing the patient experience. Effective circulation routes, ward layouts, and zoning of treatment and recreational areas can promote operational efficiency and smooth workflow while reducing anxiety for both children and their caregivers (Bayraktar Sari & Jabi, 2024). Child-scaled design involves modifying spatial dimensions, furniture, fixtures, and visual perspectives to accommodate the developmental needs of children, creating accessibility, comfort, and a sense of control for young users of the space (Möhring & Szubielska, 2023). Research on Pediatric patients' Satisfaction revealed a dissatisfaction of children with regards to child-centred environment (Uchegbu *et al*., 2023; Mbonu & Umeora, 2025). This omission creates the need for a holistic approach to paediatric patients' satisfaction.

Play Zones and Biophilic Design

The incorporation of play zones and biophilic design features such as indoor plants, water features, natural ventilation, and views of the outdoors contributes significantly to creating healthy, healing environments for children. Such features are linked to lower stress levels, reduced pain perception, and increased happiness in children (Al Khatib *et al*., 2024). Play zones provide children with opportunities to engage in therapeutic activities, socialize with peers, and improve physical health through exercise. Du *et al*. (2026) revealed that hospitals incorporate play zones and biophilic design features achieve better patient outcomes, a higher quality of patient experience and improved behaviour. Recent studies indicates that paediatric healthcare facilities in Nigeria, lack both play zones and biophilic design features (Idakwoji *et al*., 2025; Umar, 2025). This highlights the need for design-specific interventions to enhance the built environment of paediatric facilities.

Research Gap and Theoretical Basis

Although global studies promote the adoption of child-centred design in healthcare facilities, there remains a wide gap within Nigeria. Many existing studies are either adult-oriented in focus or adopt theoretical frameworks without empirical analysis. Therefore, this study seeks to address this gap by evaluating six architectural variables that include colour and lighting, use of natural materials, spatial organization, child-scaled design, play zones, and biophilic features in hospitals with paediatric units within Kaduna state. This study links evidence-based design, biophilic theory, and environmental psychology in providing empirical findings and design interventions for child-centered healthcare facilities in Nigeria.

RESEARCH MTHODOLOGY

The study employed a mixed-methods observational framework to assess the influence of architectural features on child-friendly environments in paediatric hospitals. This approach enabled the qualitative evaluation of spatial elements and quantitative transformation of these features, allowing comparisons across the selected healthcare facilities. According to Wasti *et al*. (2022), the mixed-methods is widely recognised as an effective method for evaluating both the experiential aspects of healthcare environments and their performance.

Study Area and Case Selection

Three (3) paediatric healthcare facilities in Yusuf Dantsoho Memorial Hospital, Barau Dikko Specialist Hospital, and Ahmadu Bello University (ABU) Zaria Teaching Hospital were purposively selected in Kaduna based on accessibility, capacity, and suitability for the research objectives. The sampling approach ensured that the selected hospitals represented different design typologies while serving significant numbers of paediatric patients, thereby providing a representative sample. Case selection was guided by the following criteria: the presence of dedicated children's ward(s), variability in spatial configurations, and the facility size.

Data Collection

The technique for data collection comprised of visual observation, structured checklists, and photographic documentation. An observational checklist was developed to assess six key architectural elements identified in the literature as important for child-focused healthcare: colour and lighting; natural materials; spatial arrangement or spatial organisation; design scale appropriate for children; play areas or spaces for free play and recreation; and biophilic design elements. Each variable was scored using a Likert-type rating scale: 1 = Poor, 2 = Fair, 3 = Good, 4 = Very Good, and 5 = Excellent. This approach allowed qualitative observations to be converted into quantitative data for further analysis.

Data Analysis

The data analysis mainly involved converting the Likert rating into percentage scores, which enabled comparison across Yusuf Dantsoho Memorial Hospital, Barau Dikko Specialist

Hospital, and Ahmadu Bello University (ABU) Zaria Teaching Hospital. Also, the relative performance of each variable was rated. The data were presented using statistical visualization methods, such as bar charts, to effectively communicate the study's results. The credibility and reliability of the study were strengthened using triangulation of qualitative observations, photographic documentation, and quantitative scores.

Conceptual Framework

A conceptual framework was developed to illustrate the relationship between architectural interventions and healing outcomes in paediatric hospitals (Figure 1). In this framework, colour, lighting, and natural materials are positioned as key determinants of sensory comfort; spatial organisation and child-scaled design are framed as contributors to accessibility and autonomy; and play zones and biophilic elements are identified as drivers of therapeutic engagement and stress reduction. This aligns with the multidimensional nature of healing environments, that integrate operational efficiency with child-centred design principles.

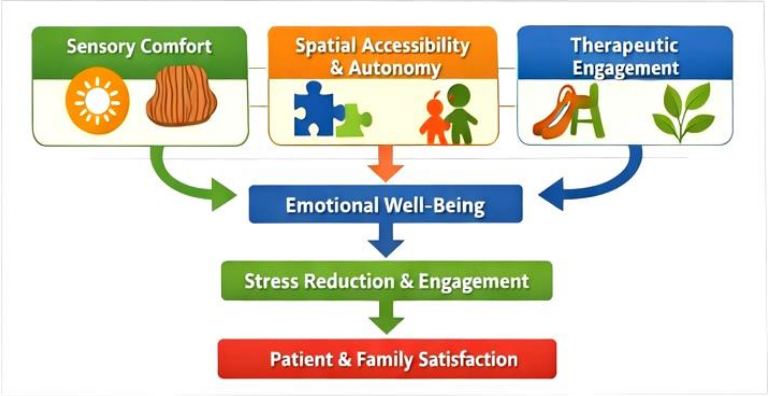

Figure 1: Conceptual Framework of Child-Centered Architectural Interventions in Paediatric Hospitals
Source: Author (2026)

RESULTS AND DISCUSSION

The study assessed three paediatric healthcare facilities in Kaduna, with focus on six (6) key architectural variables comprising; (i) colour and lighting, (ii) natural materials, (iii) spatial organisation, (iv) child-scaled design, (v) play zones, and biophilic elements. The results revealed both operational strengths and substantial deficits in child-centred design, aligning with previous studies that indicated the presence of systemic gaps in existing paediatric healthcare environments in Nigeria.

Evaluation of Key Architectural Variables

The results presented in Table 1 revealed considerable differences in the performance of the six architectural variables across the three case studies. Spatial organisation consistently recorded the highest scores, indicating that all facilities prioritise functional efficiency,

circulation, and operational workflow. In contrast, child-centred variables, particularly child-scaled design and play zones, recorded the lowest scores across the hospitals, indicating a substantial lack of attention to the experiential and developmental needs of paediatric patients.

Table 1: Comparative Assessment of Architectural Variables

Architectural Variable	Likert Scale Interpretation			Mean Score	Rank
	Hospital A	Hospital B	Hospital C		
Colour & Lighting	20% - Poor	40% - Fair	60% - Good	40.0%	2
Natural Materials	20% - Poor	40% - Fair	40% - Fair	33.3%	3
Spatial Organisation	40% - Fair	60% - Good	80% - Very Good	60.0%	1
Child-Scaled Design	0% - Very Poor	20% - Poor	20% - Poor	13.3%	6
Play Zones	0% - Very Poor	0% - Very Poor	80% - Very Good	26.7%	4
Biophilic Elements	20% - Poor	20% - Poor	40% - Fair	26.7%	4

Note: Hospital A = Yusuf Dantsoho Memorial Hospital, Hospital B = Barau Dikko Specialist Hospital, Hospital C = Ahmadu Bello University (ABU) Zaria Teaching Hospital.

Source: (Fieldwork, 2026)

The analysis of the study's results revealed moderate performance in variables such as colour and lighting, indicating partial consideration of sensory comfort. Similarly, natural materials and biophilic elements recorded relatively low to average scores, reflecting limited integration of nature-based and therapeutic design strategies within the three hospitals. These findings indicate a consistent pattern in which operational priorities take precedence over child-centred considerations, highlighting the presence of systemic gaps in the design of paediatric healthcare facilities within the study area.

Figure 2 presents the percentage performance of the six architectural variables across the selected hospitals. The results show spatial organisation as the highest-performing variable across all cases, while child-scaled design consistently ranks the lowest. Play zones indicated considerable differences across the facilities, suggesting inconsistent provision. These findings support the results in Table 1, clearly indicating performance gaps among the variables. The good performance of spatial organisation contrasts sharply with the poor performance of child-scaled design and the uneven distribution of play zones. Such findings suggest the limited integration of evidence-based, child-friendly strategies in the evaluated hospitals and highlight the need for a more holistic approach to the design of paediatric healthcare environments.

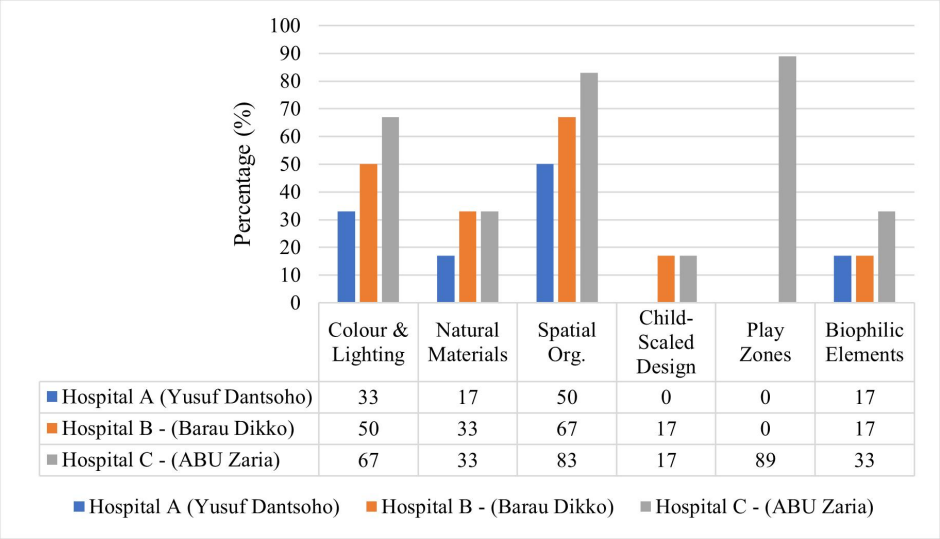

Figure 2: Comparative Performance of Architectural Variables
Source: (Fieldwork, 2026)

Discussion of Findings

Colour and Lighting: The assessment of colour and lighting across the three hospitals yielded a mean score of 40%, ranking 2nd among the six variables. Hospital A scored 20%, Hospital B 40%, and Hospital C 60%, reflecting moderate consideration of sensory comfort. While some effort was made to incorporate daylight and diverse interior colour schemes, the overall performance remains inconsistent. These findings conform with research, which indicates that warm, vibrant colour palettes and adequate natural lighting can help reduce anxiety and improve mood in paediatric patients (Singh *et al*., 2024). The moderate scores suggest that colour and lighting are partially addressed but are not optimised to fully meet children's needs.

Natural Materials: Natural materials indicated limited integration across the hospitals assessed, ranking 3rd, with a mean score of 33.3%. Hospital A scored 20%, while Hospitals B and C scored 40%. The minimal use of tactile and organic materials indicates their non-prioritisation for sensory comfort and warmth. Earlier studies suggest that natural materials such as wood can help improve emotional comfort, reduce stress, and support the recovery process (Dematte *et al*., 2022; Ojala *et al*., 2023). However, the low scores observed likely reflect Nigeria's standard construction practices and budgetary constraints typical in healthcare infrastructure.

Spatial Organisation: Spatial organization recorded the highest mean score of 60%, ranking 1st among the six architectural variables. Hospitals A, B, and C scored 40%, 60%, and 80%, respectively. These results indicate that circulation patterns, ward layouts, and operational workflows are prioritized to achieve functional efficiency. On the other hand, child-centred design features were largely absent in two of the healthcare facilities, indicating a considerable gap between operational functionality and the therapeutic needs of paediatric patients. This pattern aligns with findings from paediatric healthcare facilities in other developing countries.

Child-Scaled Design and Play Zones: Child-scaled design and play zones were among the lowest-performing variables across the three hospitals. Child-scaled design ranked 6th with a mean score of 13.3%, while play zones ranked 4th with a mean score of 26.7%. Hospital A scored 0% for both variables, Hospital B scored 20% for child-scaled design and 0% for play zones, and Hospital C scored 20% and 80%, respectively. These results highlight a critical gap in addressing children's physical and therapeutic needs. The absence of child-friendly features, play areas, and interactive elements limits opportunities for physical engagement, stress reduction, and emotional expression. Jiang (2020) revealed that positive distractions through play areas are vital for supporting emotional well-being, developmental outcomes, and recovery in paediatric patients.

Biophilic Elements: Biophilic elements performed poorly, with a mean score of 26.7%, ranking 4th. Hospitals A and B scored 20%, while Hospital C scored 40%. The limited incorporation of natural elements, indoor plants, and visual connections to outdoor environments suggests that therapeutic benefits associated with nature are largely unexploited. According to Jimenez *et al*. (2021), exposure to such elements has a significant impact on health outcomes, highlighting the missed opportunities in the three hospitals assessed within Kaduna.

Implications for Child-Centred Design

The findings of this study revealed a pronounced disparity between operational efficiency and child-centred design in paediatric hospitals in Kaduna. While spatial organisation is consistently prioritised, critical child-focused elements such as play zones, child-scaled furniture, and biophilic features are largely absent. Colour and lighting are moderately addressed, suggesting limited attention to sensory comfort with inconsistent implementation. These results have vital implications for the architectural design of such facilities, as outlined below.

i. The lack of child-centred features indicates that children's physical, psychological, and emotional needs are inadequately supported in existing hospital environments. Without dedicated play areas, appropriately scaled spaces, and therapeutic natural elements, children are deprived of opportunities for physical well-being, stress reduction, and active engagement. Such elements have indicated a strong ability to improve recovery outcomes and well-being.

ii. The alignment of functional requirements with child-centred strategies is vital in paediatric healthcare environments. Evidence-based interventions that include child-scaled furniture, dedicated play areas and recreational zones, and the use of nature-based materials, can help create a supportive paediatric environment. Biophilic features, such as indoor plants, visual connections to nature, and water elements, can enhance mood, reduce anxiety, and promote physical well-being among paediatric patients.

iii. Healthcare facilities in Kaduna State with paediatric units have continuously faced financial constraints and design norms that prioritise operational efficiency over evidence-based, child-focused strategies. Therefore, integrating child-centred design

requires strategies that support the physical, emotional, and cognitive development of children, while enhancing caregiver satisfaction and overall well-being.

DESIGN RECOMMENDATIONS AND PROPOSED FRAMEWORK

The empirical findings revealed systemic gaps in paediatric healthcare environments in Kaduna. To address these gaps, this study proposes the following design recommendations to guide the development of future paediatric hospitals in Nigeria.

Design Interventions

i. *Colour and Lighting:* Use of warm pastel palettes, accent colours in paediatric zones, and large windows or skylights to maximise natural daylight. Controlled artificial lighting should reduce glare and maintain visual comfort.
ii. *Natural Materials:* Incorporate natural tactile surfaces such as timber and soft fabric to provide a greater tactile sensory experience and reduce the institutional sterility of hospital spaces.
iii. *Spatial Organisation:* Maintain functional ward layouts for staff efficiency, while incorporating child-friendly spatial zoning, wayfinding signage, and safe circulation pathways.
iv. *Child-Scaled Design:* All design elements, such as furniture, fittings, door handles, etc., should be scaled down to children's size. Rounded edges and visual markers should be included to improve usability and safety.
v. *Play Zones:* Provision of dedicated indoor and outdoor play areas, strategically located near wards without interfering with clinical operations. Such spaces should be visually stimulating, safe, and easily accessible.
vi. *Biophilic Elements:* Integrate healing gardens, indoor planters, water features, and visual connections to nature. Landscaping should serve therapeutic purposes rather than aesthetic ones.
vii. *Family-Centred Spaces:* Provide waiting areas, patient lounges, and patient accommodation that enable or support families and caregivers to be with the patient, while maintaining infection control and operational flow.

Proposed Design Framework

The proposed framework synthesises empirical results, literature, and practical interventions as presented in Table 2.

Table 2: Proposed Design Interventions

Variable	Present Status	Proposed Intervention	Expected Impact
Colour & Lighting	Moderate	Warm pastels, skylights	Reduced anxiety, improved mood
Natural Materials	Low	Timber, tactile finishes	Enhanced sensory comfort
Spatial Organisation	High	Maintain efficiency & child-oriented zones	Balanced workflow & child comfort
Child-Scaled Design	None	Furniture, fixtures scaled to children	Improved autonomy & engagement
Play Zones	None	Indoor & outdoor age-appropriate areas	Positive distraction & stress relief
Biophilic Elements	Minimal	Healing gardens, visual nature	Stress reduction, recovery enhancement
Family-Centred Spaces	Limited	Comfortable lounges, proximate accommodation	Enhanced caregiver support & patient comfort

Source: Author (2026)

CONCLUSION

This study examined the role of architectural elements in creating child-friendly environments within paediatric healthcare facilities in Kaduna. Empirical assessment of three hospitals revealed that while spatial organisation is relatively well developed, essential features such as play zones, child-scaled design, and biophilic integration were largely absent. The findings highlight a vital gap between functional hospital design and the empirical and developmental needs of young patients. The study reveals that elements such as colour, natural materials, child-scaled spatial arrangements, and access to play and nature are critical for promoting well-being and supporting recovery. Consequently, a responsive design framework was developed, linking empirical gaps to design interventions. The framework emphasises the incorporation of spatial accessibility, biophilic design, and family-centred spaces into architectural design strategies, enabling architects to systematically address child-centred deficiencies. The findings of this study contribute to the discourse on healthcare architecture, particularly within Nigeria. Future research should evaluate implemented design interventions to measure their influence on children's well-being, caregiver satisfaction, and staff efficiency.

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