

Assessment of Circulation Systems and Movement Efficiency within Pediatric Healthcare Environments in Selected Hospitals in Lagos State.

Grace R. Okon; Oluwatoyin O. Ajayi; & Samuel A. Daramola.

Department of Architecture, College of Environmental Science and Management, Caleb University,
Imota, Ikorodu, Lagos, Nigeria

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ABSTRACT

Efficient circulation systems are essential in healthcare architecture because they influence accessibility, operational efficiency, infection control, wayfinding, and the overall healthcare experience. In pediatric healthcare facilities, circulation planning is particularly important due to the unique needs of children, caregivers, healthcare personnel, and visitors. However, many pediatric hospitals in Lagos State continue to experience movement congestion, poor wayfinding, fragmented departmental relationships, and inefficient circulation patterns that hinder service delivery and user satisfaction.

This study evaluates circulation systems and movement efficiency in selected pediatric healthcare facilities in Lagos State using a mixed-methods case study approach. The selected case studies are the Pediatric Department of Lagos State University Teaching Hospital (LASUTH), Ikeja, and Lifeline Children's Hospital, Surulere. Data were collected through direct observation, architectural analysis, photographic documentation, a structured questionnaire survey administered to 35 healthcare professionals (doctors, nurses, administrators, and facility managers) across both facilities, and a review of relevant literature. The findings reveal that effective circulation systems significantly improve healthcare functionality, workflow continuity, accessibility, patient supervision, emotional comfort, and the overall user experience. The study concludes that well-planned circulation is fundamental to efficient pediatric healthcare delivery. It recommends the integration of child-centered wayfinding systems, therapeutic movement spaces, coordinated circulation hierarchies, and evidence-based planning strategies to enhance the functionality, safety, and user experience of contemporary pediatric healthcare facilities in Lagos State.

Keywords: Pediatric healthcare facilities, circulation systems, movement efficiency, healthcare accessibility, wayfinding, healthcare planning, Lagos State.

INTRODUCTION

Healthcare architecture plays a critical role in shaping healthcare functionality, operational efficiency, patient safety, emotional comfort, and healthcare experience within hospital environments. Beyond providing accommodation for medical activities, healthcare facilities influence movement systems, healthcare accessibility, workflow continuity, patient supervision, environmental comfort, and healthcare delivery outcomes. Consequently, spatial organization and circulation systems remain major determinants of healthcare performance within contemporary healthcare environments.

Circulation systems refer to the movement networks connecting healthcare departments, service zones, emergency units, administrative spaces, and support facilities within healthcare environments. These systems include corridors, staircases, elevators, entrances, waiting spaces, and movement pathways used by patients, caregivers, healthcare personnel, visitors, and support services. Effective circulation systems improve healthcare accessibility, reduce movement conflict, strengthen workflow coordination, and enhance operational

performance within healthcare facilities (Jiang & Verderber, 2019; Adeleye & Akinyemi, 2021; Akubue, 2024).

Within pediatric healthcare environments, circulation systems become particularly important because children are emotionally sensitive users of healthcare spaces. Pediatric healthcare facilities accommodate children who frequently experience anxiety, confusion, emotional discomfort, and fear during healthcare processes. Consequently, circulation systems within pediatric healthcare environments must support not only operational efficiency but also emotional reassurance, movement clarity, healthcare accessibility, and caregiver supervision (Bahrami et al., 2025).

Studies consistently identify circulation hierarchy, spatial clarity, and functional adjacency as major determinants of healthcare efficiency within pediatric healthcare facilities (Ahmed et al., 2020; Kumari & Singh, 2024; Jiang & Verderber, 2019). Poorly organized circulation systems frequently contribute to congestion, delayed healthcare delivery, movement conflict, spatial disorientation, and inefficient workflow within healthcare environments (Anselm et al., 2022; Omole et al., 2023; Ogunyemi & Lawanson, 2022). Similarly, confusing circulation systems and inadequate wayfinding strategies negatively affect emotional comfort and user experience among pediatric patients and caregivers (Ahmed & Muhammad, 2022).

Research within healthcare architecture increasingly emphasizes the integration of evidence-based healthcare planning, therapeutic environments, and child-centered circulation systems into pediatric healthcare design. Contemporary pediatric healthcare facilities therefore incorporate intuitive movement systems, visual accessibility, therapeutic play spaces, colour-based navigation systems, and healing environments into circulation planning (Allahyar et al., 2021; Alhsainat & Kağan Günçe, 2024; Bahrami et al., 2025; Carpmann & Grant, 2016).

In Nigeria, however, several healthcare facilities continue to experience circulation-related deficiencies associated with overcrowding, fragmented departmental relationships, poor circulation separation, limited healthcare accessibility, and inadequate wayfinding systems. Public healthcare facilities within urban areas frequently experience movement congestion and operational pressure due to increasing population growth and healthcare demand (Akinluyi et al., 2021; Abubakar et al., 2022; Akinwale & Kuye, 2022).

Lagos State remains one of the most populated and rapidly urbanizing states in Nigeria, resulting in increased demand for healthcare infrastructure and pediatric healthcare services. Healthcare facilities within Lagos frequently accommodate large patient populations, caregivers, emergency services, healthcare workers, and support personnel within spatial environments that may not adequately support efficient movement systems and healthcare functionality. Consequently, circulation planning remains a critical issue within pediatric healthcare architecture in Lagos State.

Despite increasing research on healthcare planning and hospital circulation systems, limited studies have specifically examined circulation systems and movement efficiency within pediatric healthcare environments in Lagos State. Existing studies frequently focus on general healthcare planning, wayfinding systems, or operational deficiencies without detailed emphasis on child-centered circulation systems and movement efficiency within pediatric healthcare facilities.

This study therefore assesses circulation systems and movement efficiency within selected pediatric healthcare facilities in Lagos State in order to identify circulation challenges, evaluate operational performance, and establish design considerations relevant to pediatric healthcare planning.

The aim of this study is to assess circulation systems and movement efficiency within pediatric healthcare environments in selected hospitals in Lagos State.

The objectives of the study are to:

- i. Examine circulation systems and movement patterns within selected pediatric healthcare facilities in Lagos State;

- ii. Evaluate the influence of circulation efficiency on healthcare functionality and user experience within pediatric healthcare environments; and
- iii. Propose design considerations for improving circulation systems within pediatric healthcare facilities in Lagos State.

LITERATURE REVIEW

This section reviews relevant literature relating to circulation systems, movement efficiency, healthcare accessibility, wayfinding systems, healing environments, and pediatric healthcare planning. The review examines theoretical and empirical studies relevant to circulation performance within healthcare environments.

Circulation Systems in Pediatric Healthcare Facilities

Circulation systems represent one of the most important spatial components within healthcare architecture because they determine movement efficiency, healthcare accessibility, operational coordination, and healthcare functionality. Healthcare circulation systems generally include patient circulation, public circulation, staff circulation, emergency circulation, and service circulation pathways. Effective circulation systems contribute significantly to workflow continuity, emergency response, infection prevention, and healthcare accessibility within healthcare facilities (Jiang & Verderber, 2019; Akubue, 2024; Ozlem et al., 2024).

Research on hospital circulation systems consistently identifies movement hierarchy and functional adjacency as important determinants of healthcare performance. Jiang and Verderber (2019) observed that circulation spaces are frequently overlooked within healthcare design despite their significant influence on movement clarity, spatial orientation, healthcare accessibility, and emotional comfort. Similarly, Akubue (2024) identified circulation hierarchy, pathway separation, and destination visibility as critical planning principles capable of improving movement efficiency within healthcare environments.

Within pediatric healthcare facilities, circulation systems additionally influence emotional comfort, caregiver supervision, and healthcare experience. Bahrami et al. (2025) noted that children respond positively to healthcare environments characterized by visual openness, intuitive movement systems, sensory stimulation, and emotionally supportive spatial environments. Consequently, pediatric circulation systems increasingly integrate colour coding, visual landmarks, therapeutic spaces, and child-centered wayfinding systems into healthcare planning.

Research within Nigerian healthcare environments also highlights several circulation-related challenges affecting healthcare functionality. Anselm et al. (2022) identified congestion, linear movement systems, fragmented departmental relationships, and poor circulation hierarchy as major contributors to operational inefficiency within healthcare facilities. Similar findings by Ogunyemi and Lawanson (2022) revealed that spatial deficiencies and poorly organized movement systems frequently contribute to operational delays and healthcare dissatisfaction within public healthcare facilities.

Spatial Organization and Movement Efficiency

Spatial organization refers to the arrangement and relationship between departments, circulation pathways, support spaces, and healthcare functions within healthcare environments. Effective spatial organization improves movement clarity, operational coordination, healthcare accessibility, and workflow efficiency.

Research by Kumari and Singh (2024) revealed that effective circulation planning significantly improves patient supervision, healthcare accessibility, movement coordination, and operational performance within pediatric healthcare environments. Similar conclusions were established by Jiang and Verderber (2019), Ahmed et al. (2020), and Adeleye and Akinyemi (2021), who identified circulation hierarchy and functional adjacency as major determinants of healthcare efficiency. Similarly, Adeleye and Akinyemi (2021) observed that inefficient circulation systems contribute to delayed healthcare delivery, overcrowding, and movement conflict within Nigerian healthcare facilities.

Functional adjacency additionally remains a major component of movement efficiency within healthcare environments. Effective adjacency planning minimizes unnecessary movement between related departments and improves healthcare coordination. Contemporary healthcare planning therefore emphasizes evidence-based adjacency planning and circulation hierarchy within healthcare environments (Ozlem et al., 2024).

Within pediatric healthcare facilities, movement efficiency additionally influences caregiver interaction, emergency response, environmental comfort, and healthcare experience. Consequently, circulation systems must support clear movement pathways, intuitive navigation, and effective departmental relationships within pediatric healthcare environments.

Wayfinding and Healthcare Accessibility

Wayfinding refers to the ability of users to navigate effectively within complex spatial environments. Healthcare facilities frequently contain multiple departments, circulation routes, support spaces, and movement systems capable of causing spatial disorientation among users. Effective wayfinding systems therefore contribute significantly to healthcare accessibility, movement clarity, and healthcare experience (Ahmed & Muhammad, 2022; Carpman & Grant, 2016; Salawu et al., 2022).

Ahmed et al. (2020) identified poor spatial organization and inadequate wayfinding systems as major contributors to confusion and navigation difficulties within Nigerian healthcare facilities. Similarly, Ahmed and Muhammad (2022) observed that visual accessibility, intuitive layouts, and clear signage systems significantly improve movement clarity and user orientation within healthcare environments.

Wayfinding becomes particularly important within pediatric healthcare facilities because children and caregivers frequently experience emotional stress during healthcare visits. Consequently, contemporary pediatric healthcare environments increasingly integrate visual cues, colour-based navigation systems, intuitive layouts, landmarks, and sensory elements into circulation planning.

Research by Carpman and Grant (2016) further revealed that confusing circulation systems increase emotional stress and dissatisfaction among healthcare users. Effective circulation systems therefore contribute not only to movement efficiency but also to psychological comfort and healthcare satisfaction.

Child-Centered Healthcare Environments

Child-centered healthcare planning focuses on developing healthcare environments that respond to the emotional, psychological, developmental, and social needs of children. Pediatric healthcare facilities differ from general healthcare environments because they accommodate emotionally sensitive users requiring supportive healthcare spaces.

Studies consistently identify therapeutic environments, sensory stimulation, healing landscapes, and play spaces as major components of child-centered healthcare planning (Allahyar et al., 2021; Bahrami et al., 2025). Alhsainat and Kağan Günçe (2024) additionally observed that positive distraction strategies such as colour, artwork, therapeutic landscapes, and sensory stimulation significantly improve emotional comfort within pediatric healthcare facilities.

Within circulation systems, child-centered healthcare planning emphasizes movement clarity, visual accessibility, environmental comfort, and caregiver supervision. Pediatric circulation spaces therefore increasingly integrate healing environments, natural lighting, visual openness, and child-friendly spatial experiences into healthcare planning.

Smart Design Strategies in Pediatric Healthcare Planning

Contemporary healthcare planning increasingly integrates smart design strategies and evidence-based planning approaches into healthcare environments. These strategies include digital modeling, simulation tools, spatial

network analysis, visibility graph analysis, and evidence-based adjacency planning (Jia et al., 2023; Ozlem et al., 2024; Onechojo et al., 2024).

Research by Jia et al. (2023) identified simulation modeling and spatial decision-support systems as effective tools for evaluating movement patterns, congestion points, and circulation efficiency within healthcare facilities. Similarly, Ozlem et al. (2024) emphasized the role of computational design techniques in improving spatial organization and circulation hierarchy within healthcare environments.

Within pediatric healthcare facilities, smart design strategies additionally support child-centered movement systems, healthcare accessibility, therapeutic circulation spaces, and operational coordination. These strategies therefore contribute significantly to healthcare functionality and healthcare experience.

Summary of Literature Gaps

Although existing studies provide important insight into circulation systems, healthcare accessibility, and healthcare planning, limited research has specifically examined circulation systems and movement efficiency within pediatric healthcare environments in Lagos State. Existing Nigerian studies frequently focus on general healthcare planning, spatial deficiencies, or wayfinding systems without detailed emphasis on pediatric movement systems and child-centered healthcare circulation.

Furthermore, limited literature integrates circulation hierarchy, movement efficiency, therapeutic environments, and child-centered healthcare planning within a single pediatric healthcare planning framework. This study therefore contributes to existing knowledge by evaluating circulation systems and movement efficiency within selected pediatric healthcare environments in Lagos State.

METHODOLOGY

Research Design

This study adopts a mixed-methods research approach grounded in comparative case study analysis, structured observation, architectural review, photographic documentation, and a structured questionnaire survey. The mixed-methods approach is considered appropriate because the study seeks not only to capture the spatial, experiential, and behavioural dimensions of circulation systems through direct observation and architectural interpretation, but also to measure healthcare professionals' perceptions of zoning effectiveness, circulation efficiency, and healthcare delivery through a structured, closed-ended instrument. The qualitative case study component enables an in-depth, context-specific understanding of circulation performance within two contrasting pediatric healthcare typologies, while the quantitative questionnaire component provides measurable, comparable data on user perception across both facilities.

Case Selection Criteria

The selected case studies are the Pediatric Department of Lagos State University Teaching Hospital (LASUTH), Ikeja, and Lifeline Children's Hospital, Surulere. The two facilities were purposively selected based on the following criteria: (i) both facilities provide active, functional pediatric healthcare services and possess identifiable circulation systems, departmental relationships, and healthcare planning characteristics relevant to the objectives of the study; (ii) the facilities represent contrasting institutional typologies a large, publicly funded tertiary teaching hospital department (LASUTH) and a smaller, privately operated specialist pediatric hospital (Lifeline) thereby allowing a comparative assessment of circulation performance across differing scales of operation, patient volume, and institutional structure; (iii) both facilities granted the research team physical access for observation and photographic documentation; and (iv) both facilities are located within Lagos State and therefore operate within a broadly similar urban, regulatory, and climatic context, which reduces confounding contextual variables and strengthens the validity of the comparison. It is acknowledged that the use of two case studies, while appropriate for an exploratory qualitative comparison, constitutes a limitation of the study, as discussed in Section 5.1.

Observation Protocol and Data Collection Procedure

Data for the study were obtained through structured physical observation, architectural analysis, photographic documentation, and a review of relevant peer-reviewed literature. Observation visits were conducted at each facility across multiple weekday sessions covering both morning periods of peak outpatient activity and afternoon periods of comparatively lower activity, in order to capture variation in movement intensity and congestion levels. During each session, the research team conducted a structured walk-through of the pediatric department, systematically tracing circulation routes from the main entrance through waiting areas, reception and triage points, consultation and treatment spaces, wards, and emergency access routes. Observations were guided by a structured checklist recording: circulation hierarchy and separation between public, patient, staff, and service routes; incidents of congestion and their location and apparent cause; the presence and clarity of signage and wayfinding cues; sightlines and visual accessibility between waiting areas and departmental entrances; adjacency relationships between related departments; and the presence of child-centered or therapeutic design features such as colour coding, artwork, and play spaces. Photographic documentation was used to record circulation routes, entrances, waiting areas, and wayfinding features, and was subsequently cross-referenced with hand-sketched circulation diagrams produced by the research team to illustrate departmental adjacency and movement pathways within each facility.

Data Analysis Procedure

Descriptive and comparative methods of analysis were adopted in evaluating circulation hierarchy, movement systems, wayfinding systems, healthcare accessibility, therapeutic environments, and healthcare functionality within the selected healthcare facilities. Observation notes, photographic records, and circulation sketches were first organised and coded into five recurring thematic categories derived from the study objectives and the literature review: circulation hierarchy and separation, functional adjacency, wayfinding and signage, congestion and movement conflict, and child-centered/therapeutic features. Coded observations from each facility were then organised into a cross-case comparison matrix (summarised in Table 1, Section 4.1) to enable a systematic, side-by-side comparison of circulation performance between LASUTH and Lifeline across each thematic category. Quantitative data obtained from the structured questionnaire survey (described in Section 3.5) were analysed using descriptive statistical techniques, including frequency distribution, percentages, and mean scores, in order to assess respondents' perceptions of zoning effectiveness, circulation efficiency, and healthcare delivery across the two facilities. Findings from both strands of analysis were subsequently triangulated with evidence from the reviewed literature to situate the observed circulation patterns within broader theoretical and empirical understandings of pediatric healthcare circulation planning, and are presented together in Section 4.

Quantitative Survey Instrument and Respondent Sample

In addition to the qualitative case study procedures described above, a structured questionnaire was administered to healthcare professionals within the two case study facilities in order to obtain measurable data on user perceptions of zoning and circulation performance. The questionnaire was purposively administered to 35 respondents in total: 25 (71.4%) from the LASUTH Pediatric Department and 10 (28.6%) from Lifeline Children's Hospital, a distribution that broadly reflects the relative scale and staff complement of the two facilities. Respondents comprised nurses (11, 31.4%), doctors (9, 25.7%), hospital administrators (8, 22.9%), and facility managers (7, 20.0%); 74.3% of respondents had more than five years of professional experience. The questionnaire consisted primarily of closed-ended statements measured on a five-point Likert scale (Strongly Disagree to Strongly Agree), organised into three sections corresponding to (i) zoning and spatial organization, (ii) circulation systems and functional relationships, and (iii) healthcare delivery and user experience, together with a limited number of open-ended questions on circulation challenges, congestion locations, and design recommendations. It is acknowledged that the respondent sample was unevenly distributed between the two facilities and drawn using purposive rather than probability sampling; this limitation, and its implications for interpreting the comparative results in Section 4.2, is discussed further in Section 5.1.

FINDINGS AND DISCUSSION

Existing Circulation Systems within Selected Pediatric Healthcare Facilities

Findings from the case study analysis reveal that circulation systems significantly influence movement efficiency, healthcare accessibility, workflow continuity, and healthcare functionality within pediatric healthcare environments, consistent with findings by Jiang and Verderber (2019), Adeleye and Akinyemi (2021), and Kumari and Singh (2024). The selected facilities contain multiple movement systems including public circulation, patient circulation, staff circulation, emergency circulation, and service circulation routes.



Figure 1: Exterior View of the LASUTH Pediatric Department, Ikeja (Source: Author's Field Survey, 2026)

The LASUTH Pediatric Department demonstrates complex circulation systems associated with large patient population, high operational demand, and multi-departmental healthcare activities. Public circulation areas within the facility experience significant movement congestion due to overlapping circulation routes and high caregiver presence. Similar findings were identified by Omole et al. (2023), who observed that overcrowding and poor circulation hierarchy contribute significantly to movement inefficiency within healthcare environments.



Figure 2: Exterior View of Lifeline Children's Hospital, Surulere (Source: Author's Field Survey, 2026)

Lifeline Children's Hospital demonstrates comparatively clearer circulation hierarchy and stronger movement coordination within pediatric healthcare spaces. The facility contains more controlled movement systems, stronger visual accessibility, and improved child-centered spatial organization. These findings align with

observations by Kumari and Singh (2024), who identified movement clarity and circulation hierarchy as important determinants of healthcare functionality within pediatric healthcare environments.

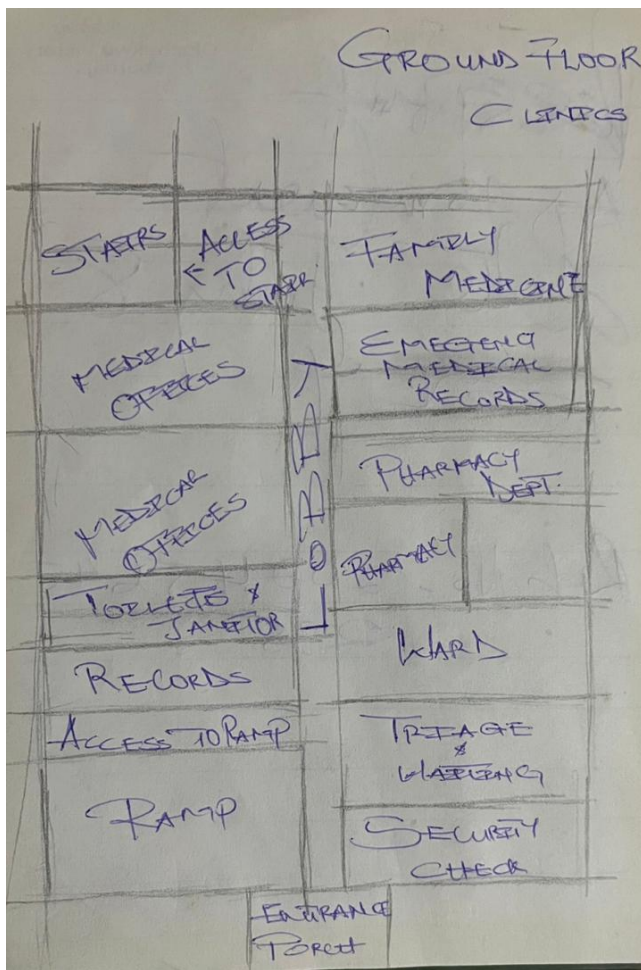


Figure 3: Field Sketch Showing the Observed Spatial Distribution of Functions within the LASUTH Pediatric Facility (Source: Author's Field Survey, 2026)

Table 1: Comparative Summary of Circulation Performance between LASUTH Pediatric Department and Lifeline Children's Hospital

Evaluation Criterion	LASUTH Pediatric Department	Lifeline Children's Hospital
Circulation hierarchy / separation	Weak separation between public, patient, staff, and service routes; overlapping circulation observed	Clearer separation of circulation types; more controlled movement systems
Congestion level (qualitative)	High, particularly during peak outpatient periods and within waiting areas	Low to moderate; movement flows remained comparatively orderly
Functional adjacency	Fragmented; long travel distances between related departments	Improved; shorter distances and stronger departmental relationships
Wayfinding / signage clarity	Limited child-centered wayfinding; navigation difficulty reported for first-time users	Stronger spatial legibility; clearer colour differentiation and departmental visibility
Child-centered / therapeutic features	Limited therapeutic environmental quality due to overcrowding and space pressure	Stronger integration of visually engaging, emotionally supportive interior features
Institutional scale / patient volume	Large tertiary teaching hospital department; high patient volume	Smaller private specialist hospital; comparatively lower patient volume

Note: Qualitative ratings are corroborated by the comparative mean scores obtained from the structured questionnaire survey presented in Section 4.2 (Table 4).

Quantitative Assessment via Structured Questionnaire Survey

To complement and substantiate the qualitative observations presented in Section 4.1, a structured questionnaire survey was administered to 35 healthcare professionals across the two case study facilities, as described in Section 3.5. This section presents the demographic profile of respondents, their perception scores relating to zoning, circulation, and healthcare delivery, a comparative analysis of mean scores between the two facilities, and a thematic analysis of open-ended responses.

Respondent Profile

Of the 35 respondents, 25 (71.4%) were drawn from the LASUTH Pediatric Department and 10 (28.6%) from Lifeline Children's Hospital, reflecting the considerably larger paediatric staff complement of the public teaching hospital relative to the smaller private facility. Female respondents constituted the majority of the sample (25, 71.4%), broadly consistent with the gender composition of the nursing and allied healthcare workforce in Nigerian hospitals generally. By profession, nurses formed the largest group (11, 31.4%), followed by doctors (9, 25.7%), hospital administrators (8, 22.9%), and facility managers (7, 20.0%), giving the sample coverage across both the clinical and operational perspectives on circulation performance. The majority of respondents (74.3%) had more than five years of professional experience, suggesting that perception data reflect a settled, informed view of facility performance rather than a first-impression assessment.

Table 2: Respondent Profile by Facility, Gender, Profession, and Years of Experience

Category	Group	Frequency	%
Facility	LASUTH Pediatric Department	25	71.4
	Lifeline Children's Hospital	10	28.6
Gender	Female	25	71.4
	Male	10	28.6
Profession	Nurse	11	31.4
	Doctor	9	25.7
	Hospital Administrator	8	22.9
	Facility Manager	7	20.0
Years of Experience	6–10 years	12	34.3
	11–15 years	9	25.7
	1–5 years	9	25.7
	Above 15 years	5	14.3

Source: Field Survey, 2026 (N = 35).

Respondents' Perception of Zoning, Circulation, and Healthcare Delivery

Table 3 presents respondents' level of agreement, on a five-point Likert scale, with statements relating to zoning and spatial organization, circulation systems and functional relationships, and healthcare delivery and user experience within their respective facilities.

Table 3: Respondents' Perception of Zoning, Circulation, and Healthcare Delivery (Mean Scores, 5-Point Likert Scale)

Category	Statement	Mean	Rank
Zoning & Spatial Organization	Zoning arrangement minimizes unnecessary movement	4.29	1
	Related departments are located close enough to support operations	4.00	2
	Functional departments are appropriately located	3.97	3

	Current spatial organization supports efficient healthcare delivery	3.77	4
	Public, staff, and service areas are adequately separated	3.40	5
Circulation & Functional Relationships	Circulation routes are easy to understand and navigate	4.34	1
	Movement between departments is efficient	4.06	2
	Functional relationships support workflow efficiency	3.74	3
	Emergency circulation routes are adequate and accessible	3.34	4
	Congestion is minimal within circulation spaces	3.26	5
Healthcare Delivery & User Experience	The layout supports efficient healthcare delivery	3.69	4
	The circulation system contributes positively to patient care	4.23	3
	The environment is easy for caregivers/visitors to navigate	4.37	2
	The facility provides a child-friendly healthcare environment	3.03	5
	Overall, the facility provides a positive healthcare experience	4.40	1

Source: Field Survey, 2026 (N = 35). Scale: 1 = Strongly Disagree, 5 = Strongly Agree.

Across the zoning items, the highest-rated statement was that zoning arrangements minimize unnecessary movement (mean = 4.29), while the lowest-rated was the adequacy of separation between public, staff, and service areas (mean = 3.40) a finding that, read alongside infection control literature (Emmanuel et al., 2020), carries direct implications for a paediatric population that is especially vulnerable to communicable disease. Across the circulation items, wayfinding clarity for staff scored highest (mean = 4.34), while congestion within circulation spaces scored lowest of all items surveyed (mean = 3.26), directly corroborating the congestion identified qualitatively in Section 4.1 and in the open-ended responses discussed in Section 4.2.4. Overall healthcare delivery and user experience recorded generally favourable scores, with satisfaction highest overall despite the comparatively lower scores for circulation congestion and zone separation, indicating that staff experience of care delivery is not solely determined by circulation performance. Within the healthcare delivery section, the widest gap in the entire dataset emerged: "overall, the facility provides a positive healthcare experience" recorded the highest mean score of all fifteen Likert items (4.40), while "the facility provides a child-friendly healthcare environment" recorded the lowest (3.03), with 34.3% of respondents disagreeing or strongly disagreeing. This gap indicates that staff perceive the two facilities as operationally adequate but not specifically designed around the emotional and developmental needs of child patients, reinforcing the child-centered design gap identified qualitatively in Section 4.1 and in the literature reviewed in Section 2.

Comparative Mean Scores Between Facilities

Table 4 compares mean scores between the two case study facilities across the three questionnaire sections, in order to examine whether facility type, scale, or ownership status is associated with differences in perceived zoning and circulation performance.

Table 4: Comparative Mean Scores Between LASUTH and Lifeline Children's Hospital

Section	LASUTH Mean	Lifeline Mean	Difference
Zoning and Spatial Organization	3.82	4.04	+0.22
Circulation Systems	3.58	4.16	+0.58
Healthcare Delivery and User Experience	3.75	4.42	+0.67

Source: Field Survey, 2026. Difference = Lifeline mean minus LASUTH mean.

Lifeline Children's Hospital recorded higher mean scores than LASUTH across all three sections, with the largest gap in circulation systems (+0.58) and the smallest in zoning (+0.22). This pattern is consistent with architectural and operational explanations rather than a simple reflection of facility quality: LASUTH, as a large public teaching hospital, serves a considerably higher daily patient volume than the smaller, private

Lifeline facility, and higher patient throughput places greater demand on circulation capacity and departmental adjacency. It should be interpreted with caution given the uneven respondent split (25 LASUTH, 10 Lifeline) noted in Section 3.5; nonetheless, the consistent direction of the gap across all three sections lends some confidence to the broad conclusion that facility scale and patient volume are associated with perceived circulation performance.

Thematic Analysis of Open-Ended Responses

Respondents were also asked to describe circulation challenges, identify areas of highest congestion, and provide design recommendations in their own words. Responses were grouped into recurring themes, summarised in Table 5; a single response could touch on more than one theme, so theme frequencies do not necessarily sum to 35.

Table 5: Frequency of Recurring Themes in Open-Ended Responses

Question	Theme	Frequency	%
Circulation Challenges	Inadequate waiting space	11	31.4
	Congestion / high patient volume	6	17.1
	Staircase / ramp issue	5	14.3
	Overlap of patient/staff/visitor routes	4	11.4
	Triage-emergency/public separation & privacy	4	11.4
	Distance between related departments	3	8.6
Areas of Highest Congestion	Outpatient clinics / waiting areas	15	42.9
	Central corridor near paediatric emergency	7	20.0
	Reception / registration areas	6	17.1
	Corridors near consultation rooms	5	14.3
	Emergency entrance bottleneck (parking)	3	8.6
Design Recommendations	Larger / more waiting spaces	12	34.3
	Child-friendly design features	8	22.9
	Separate circulation routes	5	14.3
	Improved signage / wayfinding	3	8.6

Source: Field Survey, 2026 (N = 35). Percentages calculated against total respondents; themes are not mutually exclusive.

Inadequate waiting space was the most frequently cited circulation challenge (31.4% of respondents), and outpatient clinics/waiting areas were overwhelmingly the most frequently cited congestion point (42.9%), directly corroborating both the qualitative observations in Section 4.1 and the low mean score recorded for circulation congestion in Section 4.2.2. A specific, unanticipated finding was the repeated mention of a poorly located staircase leading to disproportionate ramp use, raised independently by 5 respondents a facility-specific detail that illustrates the value of triangulating structured survey data with open-ended, ground-level staff observation. Correspondingly, the most frequently recommended design intervention was the provision of larger waiting spaces (34.3%), followed by child-friendly design features (22.9%), together forming a coherent, staff-informed design agenda consistent with the quantitative and qualitative findings presented throughout this section.

Movement Efficiency and Functional Relationships

The findings additionally reveal that functional adjacency and departmental relationships significantly influence movement efficiency within pediatric healthcare environments. Facilities characterized by coordinated adjacency relationships demonstrate stronger workflow continuity, healthcare accessibility, and operational coordination.



Figure 4: Ramp Providing Vertical Circulation within the LASUTH Pediatric Facility, Illustrating Extended Travel Distance (Source: Author's Field Survey, 2026)

Within the LASUTH Pediatric Department, some departments experience movement pressure due to fragmented circulation routes and congestion within waiting spaces. Long travel distances between related departments additionally contribute to operational inefficiency. Similar findings were identified by Adeleye and Akinyemi (2021), who observed that poor circulation planning negatively affects healthcare performance and workflow continuity.

In contrast, Lifeline Children's Hospital demonstrates improved functional relationships and shorter movement distances between healthcare departments. The facility additionally supports clearer circulation pathways and improved supervision within pediatric healthcare spaces.

Wayfinding and Healthcare Accessibility

Wayfinding systems remain major determinants of healthcare accessibility and movement clarity within pediatric healthcare facilities. Findings reveal that visual accessibility, signage systems, circulation hierarchy, and intuitive layouts significantly influence navigation efficiency within healthcare environments.

The LASUTH Pediatric Department demonstrates limited child-centered wayfinding systems within some circulation areas. First-time visitors and caregivers may therefore experience navigation difficulties within the healthcare environment. Similar observations were made by Ahmed et al. (2020), who identified inadequate wayfinding systems as major contributors to spatial disorientation within Nigerian healthcare facilities.

Lifeline Children's Hospital demonstrates comparatively stronger spatial legibility and clearer navigation systems. Colour differentiation, clearer departmental visibility, and reduced circulation complexity contribute positively to healthcare accessibility and movement clarity within the facility.

Child-Centered Healthcare Features and Environmental Experience

The findings further reveal that therapeutic environments and child-centered healthcare planning significantly influence emotional comfort and healthcare experience within pediatric healthcare environments. Facilities characterized by visual openness, natural lighting, colour stimulation, and emotionally supportive environments demonstrate improved healthcare experience among pediatric users.

Lifeline Children's Hospital demonstrates stronger integration of child-centered healthcare features including visually engaging interiors, emotionally supportive spaces, and improved environmental comfort. These findings align with research by Allahyar et al. (2021) and Alhsainat and Kağan Günçe (2024), who identified therapeutic environments and positive distraction strategies as important components of pediatric healthcare planning.

Although the LASUTH Pediatric Department provides functional healthcare services, some circulation spaces experience operational pressure and limited therapeutic environmental quality due to overcrowding and high patient demand.

Comparison with International Evidence-Based Healthcare Design Standards

Situating the findings within international evidence-based healthcare design literature further clarifies the significance of the observed circulation patterns. Guidance such as the Facility Guidelines Institute standards and the evidence-based design literature reviewed by Ulrich et al. (2008) and Brambilla et al. (2019) emphasise clear separation of public, patient, staff, and service circulation; short, legible travel distances between functionally related departments; and the integration of wayfinding and therapeutic design features as core determinants of hospital performance and occupant wellbeing. The circulation deficiencies observed within the LASUTH Pediatric Department including overlapping route types, congestion within waiting areas, and long travel distances between related departments are broadly consistent with the operational challenges that such international guidance seeks to prevent, and mirror concerns raised by Chaudhury et al. (2009) regarding the effect of poorly organised circulation on occupant efficiency and error. By comparison, the clearer circulation hierarchy, stronger adjacency relationships, and therapeutic design features observed at Lifeline Children's Hospital align more closely with these international benchmarks, suggesting that facility scale and resource availability may influence the extent to which evidence-based circulation principles are achieved in practice. This comparison indicates that the circulation challenges identified within Lagos State's pediatric healthcare facilities are not unique to the local context but reflect broader, internationally recognised design and planning concerns, while also highlighting that local resource constraints may shape the degree to which international standards can be realised.

Synthesis of Findings

The synthesis of findings reveals that circulation hierarchy, functional adjacency, wayfinding systems, therapeutic environments, and child-centered healthcare planning collectively influence movement efficiency and healthcare functionality within pediatric healthcare facilities.

Facilities characterized by clearer circulation systems, coordinated departmental relationships, therapeutic movement spaces, and stronger healthcare accessibility demonstrate improved operational performance and healthcare experience. Conversely, circulation congestion, fragmented movement systems, limited wayfinding support, and inadequate therapeutic environments negatively affect healthcare accessibility and emotional comfort within pediatric healthcare environments.

The findings therefore reinforce the importance of evidence-based circulation planning and child-centered healthcare design within contemporary pediatric healthcare facilities, supporting conclusions established by Jiang and Verderber (2019), Bahrami et al. (2025), Allahyar et al. (2021), and Ozlem et al. (2024).

CONCLUSION

This study assessed circulation systems and movement efficiency within pediatric healthcare environments in selected hospitals in Lagos State through qualitative case study analysis and comparative architectural evaluation. Findings from the study reveal that circulation systems significantly influence healthcare accessibility, operational coordination, movement clarity, emotional comfort, and healthcare functionality within pediatric healthcare facilities.

The study further reveals that facilities characterized by effective circulation hierarchy, coordinated functional

adjacency, stronger wayfinding systems, and child-centered healthcare planning demonstrate improved healthcare performance and user experience. Conversely, circulation congestion, fragmented movement systems, inadequate circulation separation, and limited therapeutic movement spaces negatively affect healthcare functionality and healthcare experience within pediatric healthcare environments.

The study therefore concludes that circulation systems remain critical components of pediatric healthcare planning because they influence operational efficiency, healthcare accessibility, emotional comfort, and healthcare delivery outcomes. Integrating child-centered healthcare planning, therapeutic circulation spaces, evidence-based adjacency planning, and coordinated movement systems into pediatric healthcare architecture significantly improves healthcare performance within pediatric healthcare environments.

Limitations of the Study

This study is subject to several limitations that should be considered when interpreting its findings. First, the study relies on two case study hospitals the LASUTH Pediatric Department and Lifeline Children's Hospital which, while providing rich, context-specific insight, restricts the generalisability of the findings to other pediatric healthcare facilities within Lagos State or beyond. Second, although the study incorporates a structured questionnaire survey (Section 4.2) alongside qualitative observation, the respondent sample was unevenly distributed between the two facilities (25 LASUTH, 10 Lifeline) and was obtained through purposive rather than probability sampling; the Lifeline mean scores in particular are based on a smaller sample and may be more sensitive to individual response variation. Third, the quantitative analysis presented in Section 4.2 is descriptive in nature (frequencies, percentages, and mean scores); it does not include inferential statistical testing (e.g., t-tests or ANOVA) to establish whether the observed differences between facilities are statistically significant, nor does it incorporate directly measured indicators such as pedestrian flow counts or timed travel distances. Fourth, although the study includes real photographic documentation and field sketches of both facilities (Figures 1–4) and the comparative summary in Table 1, it does not present formally measured, scaled architectural floor plans of the two facilities, which would have further strengthened the spatial evidence underlying the findings. Finally, observations and the questionnaire survey were conducted over a limited period and may not fully capture circulation and zoning performance during weekends, public holidays, or emergency surge conditions, when movement patterns and congestion levels may differ substantially from those recorded.

Suggestions for Future Research

Future research should seek to address the limitations identified above. Studies involving a larger and more evenly distributed respondent sample, across a larger number of pediatric healthcare facilities in different regions of Nigeria, would improve the generalisability of findings and permit inferential statistical testing (e.g., t-tests or ANOVA) of the differences observed between facility types in this study. Subsequent studies should also incorporate directly measured quantitative indicators including pedestrian flow analysis, timed travel distances, and structured congestion-frequency counts to complement perception-based survey data of the kind presented in Section 4.2. In addition, future studies would benefit from the production of formally measured, scaled architectural floor plans for each case study facility, building on the field sketches and photographic documentation presented in this study (Figures 1–4), to enable a more rigorous visual and spatial comparative analysis. Finally, future research could extend observation and survey periods to include weekends, public holidays, and periods of emergency surge, in order to capture a fuller range of circulation and zoning performance under varying operational conditions.

Recommendations

Based on the findings of the study, the following recommendations are proposed:

1. Pediatric healthcare facilities should integrate clear circulation hierarchy and separation between public, patient, staff, and service circulation routes.
2. Child-centered wayfinding systems including colour coding, visual landmarks, intuitive layouts, and signage systems should be incorporated into pediatric healthcare environments.

3. Functional adjacency between major healthcare departments should be strengthened to improve workflow continuity and reduce unnecessary movement.
4. Therapeutic movement spaces incorporating natural lighting, visual openness, sensory stimulation, and healing environments should be integrated into circulation planning.
5. Evidence-based healthcare planning and spatial analysis tools should be incorporated into pediatric healthcare design processes in order to improve circulation efficiency and healthcare functionality.
6. Existing pediatric healthcare facilities within Lagos State should undergo periodic circulation assessment and spatial evaluation in order to identify operational deficiencies and improve healthcare accessibility.

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