

Research article

Designing health-inducing spaces for children: The role of building–landscape integration

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ARTICLE INFO

Keywords:

Pediatric healthcare architecture
Building–landscape integration
Health-inducing space
Child-centered design
Therapeutic landscape
Evidence-based design
Typological clarification
Cross-case evaluation

ABSTRACT

As the restorative value of nature gains increasing recognition in child-centered healthcare, pediatric facilities are being redefined as environments that support wellbeing, developmental needs, and family life. Yet the spatial integration of buildings and landscapes remains underexamined in pediatric healthcare design. This study investigates how building–landscape integration in contemporary pediatric healthcare architecture—examined in terms of spatial configuration, quality, and affordances—generates health-inducing spaces and associated outcomes for children. A qualitative research design is adopted, combining a structured review of 19 publications with a comparative analysis of 10 case studies. The selected projects reflect the main forms of integrating open space into the building structure and are therefore classified into courtyard- and atrium-based types. In addition, case study evaluation is based on six healing mechanisms and four corresponding impacts. The results indicate that health-promoting pediatric settings depend less on isolated natural features than on the structural integration of landscaped spaces within buildings. Such integration generates care practices that support medical processes, articulated through four parameters: (1) spatial experience, (2) sensory engagement, (3) social participation, and (4) agency. The study offers a transferable analytical framework for qualitative architectural design evaluation which can serve as a reference for future healthcare projects addressed to children and youth.

1. Introduction

Pediatric healthcare design is evolving beyond clinical performance as the sole measure of quality. Today, children's hospitals are expected not only to support treatment but also to reduce stress, accommodate family presence, and create environments that remain intelligible and emotionally manageable even after repeated visits. Evidence-based research has shown that the design of healthcare environments can influence anxiety, satisfaction, and perceived quality of care in pediatric settings, yet the empirical base remains limited compared with those in adult healthcare settings (Bock et al., 2021). A recent study on child-friendly healthcare advances the discussion, pointing out that a child-friendly setting is not just a more welcoming hospital space but also a care environment that preserves dignity, encourages participation, and addresses children's developmental and emotional needs, both spatially and organizationally (Huang et al., 2025).

This reframing matters because children do not experience hospitals as passive occupants but rather as active participants in spatial environments, engaging with them through movement, waiting,

uncertainty, curiosity, and space-based treatment routines. Pediatric environments must go beyond functional efficiency; they also need to be legible, inclusive, and adaptable to different ages, abilities, and patterns of use. Applied design research in children's hospitals demonstrates that visual guidance, emotional cues, and child-friendly environmental features can help reduce anxiety during diagnosis and treatment (Sathyanarayanan and Caldas, 2025; Zheng et al., 2024). Within this broader shift, the exposure of pediatric patients to landscape and natural features is increasingly significant. Recent research on children's hospital architecture has shown that landscape elements, from vegetation to water features (Allahyar and Kazemi, 2021), can positively influence children's cognitive and emotional responses during medical routines. Further reviews of healing gardens similarly argue that outdoor environments should no longer be treated as optional amenities but as integral components of hospital design. They support children's physical, emotional, and developmental well-being and provide a stronger policy foundation for the integration of outdoor spaces into healthcare environments (Din et al., 2023).

Peer review under the responsibility of Editorial Office of *Landscape Architecture and Sustainability*.

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<https://doi.org/10.1016/j.las.2026.100045>

Received 26 March 2026; Received in revised form 17 May 2026; Accepted 18 May 2026

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Drawing on the above, a central question emerges regarding how physical space and natural features can be integrated (Kousidi, 2024a). For children, the therapeutic value of nature depends on its accessibility from everyday routes, visibility from waiting and treatment areas, and links to play, rest, orientation, and family presence. Reviews of biophilic design emphasize that natural elements are most effective when integrated into wider care settings (Miola et al., 2025)—a principle realized through architectural interfaces that mediate interior-exterior relationships (Kousidi et al., 2025a). In this sense, building-landscape integration is not merely stylistic (Zhu et al., 2025) but a contemporary design challenge balancing healthcare demands, care, and environmental responsiveness (Kousidi et al., 2025b). These design concerns have a long pedigree in modernist architecture for children, where spatial and environmental features, and their impact, were central to design thinking (Kousidi, 2024b). Within this context, the present article examines how contemporary pediatric healthcare architecture shapes the relationship between built structure and landscape, focusing on how this relationship promotes health-supporting functions and assesses its impact. By considering the effective integration of architecture and landscape, the study aims to elucidate the multiple ways in which child-centered healthcare architecture interacts with open spaces to define user- and site-specific health-promoting environments.

2. Methodology

This study employs a qualitative research approach, combining a structured literature review with a comparative case study analysis, to investigate how spatial design influences health-promoting conditions in pediatric healthcare environments. The study is organized into two main sections: (1) a targeted literature review on pediatric healthcare architecture, healing environments, and landscape-based design, which identifies key architectural and landscape design strategies to establish a theoretical framework that can inform the case study analysis; and (2) a comparative qualitative case study approach of contemporary pediatric healthcare projects, selected for their explicit engagement with building-nature integration—courtyard- and atrium-based building types—to support health-inducing environments. In particular, the case study analysis explores how these environments can promote healing by addressing four key aspects: enhancing spatial experience, encouraging sensory engagement, facilitating social participation, and strengthening children's sense of agency. This integrated methodology offers a systematic cross-case comparison and identifies design insights that can inform future pediatric healthcare design.

3. Literature review

3.1. Selection criteria

To improve methodological transparency, this review was conducted as an articulated literature corpus with defined search and screening steps (Fig. 1). Since studies on pediatric healing environments are dispersed across healthcare journals, architectural design literature, and publications in other disciplines, the article systematically reconstructs the search process that underpins the review. Searches were conducted in Scopus, Web of Science Core Collection, and Google Scholar, complemented by backward citation tracking and publisher-site searches for books and book chapters that are not consistently indexed. Search strings combined four concept clusters: (1) pediatric settings (e.g., child*, pediatric, children's hospital, clinic, hospice); (2) spatial design domains (architecture, interior design, hospital design, landscape design); (3) healing or health-promotion terms (healing, therapeutic, restorative, supportive design, health-promoting, well-being); and (4) child-experience terms (play, positive distraction, sensory, family, affordance, wayfinding). The temporal scope was limited to 2010–2024, focusing on current pediatric healthcare design discourses that explicitly address spatial design strategies, with an

emphasis on building-landscape integration and the evaluation of pediatric healthcare settings and their impact. This review is not presented as a meta-analysis but as a structured, design-focused synthesis, aimed at identifying common approaches to health-inducing spaces across a diverse range of architectural and interdisciplinary evidence.

Screening occurred in two stages: first, titles and abstracts were reviewed for relevance to pediatric healthcare settings and the spatial design of buildings, interiors, landscapes, or transitional spaces; second, full texts were compared for conceptual relevance and evidence sufficiency to ensure the final selection included a balanced mix of empirical and design-led research. The final corpus includes studies of children's hospitals, hospices, outpatient clinics, pediatric public spaces, and other healthcare environments that offer insights into child-centered design.

Together, these references capture the multifaceted research on strategies for building-landscape integration in pediatric healthcare settings. Table 1 presents the analytical framework used to position each source in relation to building features, design strategies, and contributions. It is organized into three main categories: health-inducing outdoor, landscaped, and integrated spaces. Although the depth of empirical evidence varies across the selected publications, the corpus provides thematic breadth to support a comparative discussion of how architectural and landscape design strategies contribute to healing processes in childhood care environments.

3.2. Classification process

The classification of the reviewed literature identifies five key references addressing health-inducing outdoor spaces, primarily focusing on therapeutic landscapes and gardens. It also highlights nine references focused on health-inducing landscaped indoor spaces, and ten references exploring health-inducing integrated spaces. Fig. 2 presents a bibliometric-style keyword co-occurrence map of children's health-promoting design strategies based on these references. It identifies four health-promoting impacts: (1) improving spatial experience, (2) emphasizing sensory engagement, (3) supporting social participation, and (4) enhancing children's agency. These impacts demonstrate how architectural design can promote healing experiences by aligning spatial features with children's behavioral, emotional, social, and developmental needs.

Fig. 3 illustrates the taxonomy of the building-landscape integration strategy, linking healing mechanisms to various spatial relationships. It shows that integrating building, landscape, and care in pediatric healthcare environments should be understood across three connected spatial layers: (1) spatial configuration, which refers to efficient building-landscape connections, sequences, and transitions; (2) spatial quality, which refers to nature accessibility/visibility and inclusive atmosphere; and (3) spatial affordances, which refers to age-responsive facilities and diverse activities. Given the unique cognitive, emotional, and behavioral traits of children, research on health-promoting environments in pediatric settings often employs qualitative or mixed-method approaches, including (1) post-occupancy evaluation (POE) and patient feedback, (2) behavior mapping and spatial-use metrics, (3) approaches involving child participation, and (4) surveys conducted through interviews and questionnaires, in order to assess, on the one hand, children's spatial experiences and, on the other hand, behavioral responses to the built environment.

3.3. Theoretical definition of health-promoting impacts

The four impact categories presented in Fig. 2—improving spatial experience (ISE), emphasizing sensory engagement (ESE), supporting social participation (SSP), and enhancing children's agency (ECA)—function as interpretive design-impact categories. They translate established theories of health-supportive environments into spatially observable criteria for analyzing pediatric healthcare architecture. Conceptually, these criteria are grounded in supportive design theory,

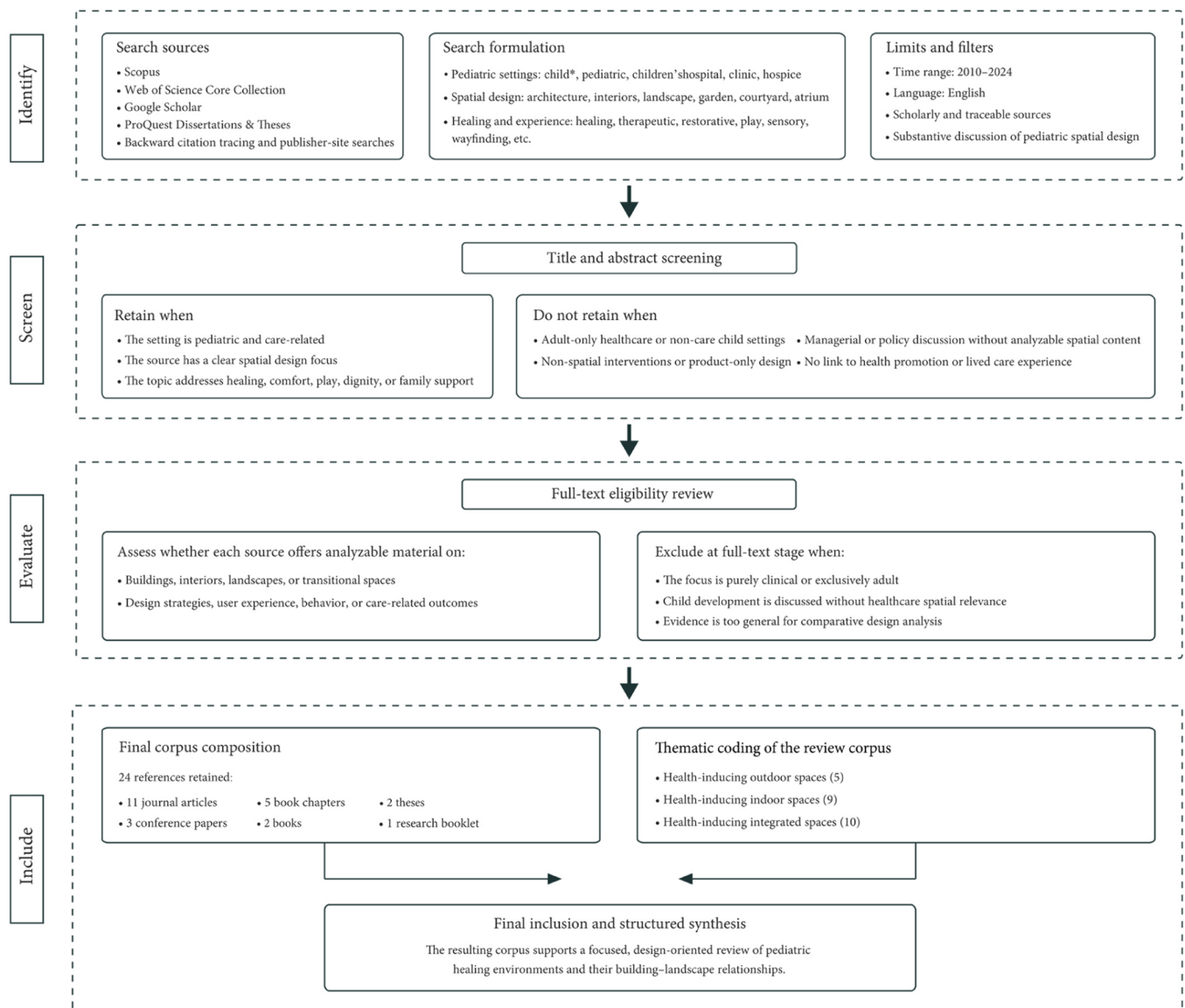


Fig. 1. Integrated literature search and screening workflow.

attention restoration theory, biophilic design, and the notion of potential space.

ISE refers to the extent to which building–landscape integration enhances orientation, legibility, and perceived manageability in pediatric healthcare environments. Drawing on supportive design theory, this category emphasizes environmental conditions that reduce stress by facilitating spatial comprehension, perceived control, and access to social support (Ulrich, 1991).

ESE refers to the degree to which the environment offers restorative sensory engagement through repeated contact with natural systems, environmental variation, and perceptual modulation. This dimension is connected to biophilic design frameworks, which emphasize repeated multisensory interactions between users and natural systems (Kellert et al., 2008; Browning et al., 2014).

SSP denotes the capacity of spatial settings to support family presence, informal encounters, shared waiting, play, education, and social routines during care. Extending the compatibility component of attention restoration theory (ART) into architectural terms, this category emphasizes the integration of communal and landscape settings into everyday care environments that support children's preferred activities and routines (Kaplan, 1995).

ECA addresses the concept of the “potential space” between child and caregiver, where imagination and play are fostered, connecting these experiences to creativity, responsibility (Winnicott, 1971), and, by extension, the cultivation of agency. In this context, the child is understood as an active participant in space, engaging through both activity and movement, with the spatial environment serving as a catalyst for the development of autonomy.

3.4. Spatial layers of building–landscape integration

3.4.1. Spatial configuration

The arrangement of functional spaces in pediatric healthcare settings, particularly circulation patterns, plays a crucial role in shaping the care environment. In the literature, spatial configuration is understood not merely as the arrangement of functions but as a generative framework that links clinical processes with children's care experience, influencing how healthcare environments are perceived and used by children and families (Pinhão, 2016; Verderber, 2010). In this context, circulation—comprising distributional, transitional, and connective spaces—is crucial to spatial configuration (Samuel, 2010). In pediatric healthcare settings, children often move through different spatial

Table 1
Corpus overview of references informing the review.

Theme	Citation	Building feature	Design strategy	Contribution
Theme 1: Health-inducing outdoor spaces	Moore and Cosco (2010)	Outdoor settings and health-supportive design	Climbing structures, swings, water/sand play, and shady seating	Provides behavior-mapping methods that link spatial components to activity and social interaction
	Cooper Marcus and Sachs (2013)	Children's hospital gardens	Shade, movable seating, wheelchair-friendly paths, multisensory plantings, interactive features, and privacy	Offers clear design guidance for therapeutic outdoor rooms linked to daily care routes
	Reeve et al. (2017)	Multi-layered healing gardens	Multifunctional gardens (e.g., adventure/rehab); sensory-rich landscapes	Shows how gardens support respite, rehabilitation, sensory relief, and emotional recovery
	Nieberler-Walker et al. (2020)	Healing gardens at a children's hospital	Co-locate indoor and outdoor spaces; maximize green areas; encourage sensory stimulation; integrate landscape features	Frames healing gardens as programmatic infrastructure and proposes an integrated landscape process
	Russo and Andreucci (2023)	Child-friendly green space	Support physical activity; ensure accessibility and safety; reduce heat and noise; promote attention restoration and stress relief	Consolidates pathways linking green space to activity, restoration, and stress reduction
Theme 2: Health-inducing landscaped indoor spaces	Adams et al. (2010)	Pediatric hospital lobbies/atria	Multi-story and glass-roofed public spaces with seating and plantings	Shows that lobbies/atria influence socialization, wayfinding, and comfort, while exposing gaps between design intent and children's actual experiences
	Verschoren et al. (2015)	Indoor public space at the children's hospital	Home-like environment, age-appropriate play, views of greenery, and user-controlled settings	Illustrates that child-friendly design extends beyond color and theme to include normalcy, control, and flexibility
	Dwiputri and Swasty (2019)	Environmental graphic design in children's hospitals	Informative, engaging, and educational environmental graphic media	Identifies a color-coding strategy to differentiate areas, clarify the hospital's complex layout, and enhance placemaking
	Fricke et al. (2019)	Therapeutic indoor environments in child and adolescent healthcare	Interior access to daylight and nature, privacy, spatial orientation, and sensory-supportive environments	Proposes that sensory-supportive indoor environments enhance children's emotional comfort, orientation, and psychosocial well-being
	Bock et al. (2021)	Pediatric hospital indoor environments	Daylight access, views of nature, reduced noise, private rooms, and child-centered interior environments	Shows that restorative indoor environments reduce anxiety and improve comfort and satisfaction in pediatric healthcare settings
	Habbak and Khodeir (2023)	Interior environments in pediatric healthcare	Controllable multi-sensory stimulus zones; optimized lighting and acoustics; low-stimulation retreat options; indoor-outdoor integration	Identifies sensory-responsive strategies, including lighting, acoustics, retreat, and interactive zones
Theme 3: Health-inducing integrated spaces	Verderber (2010)	Children's hospital indoor-outdoor environments	Accessibility, a clear routing system, and safe, clean seating areas	Frames pediatric hospitals as age-responsive environments combining activity, safety, and outdoor access
	Pinhão (2016)	Evidence-based overall pediatric hospital design	Gardens along daily care routes, outdoor areas for socializing, and sensory experiences	Synthesizes healing-environment factors and links them to hospital typology and urban integration
	Buie (2020)	Children's hospital indoor-outdoor environments	Views, rooftop, and sensory gardens; playful yet realistic wayfinding; positive distractions; patient-controlled room lighting	Develops an age-responsive, family-centered framework with gardens, lounges, and positive distractions
	Jiang (2020)	Public/shared spaces in pediatric healthcare	Art and environmental aesthetics; sound and lighting interventions; garden accessibility	Synthesizes evidence on art, play, sound, lighting, and garden access in shared healthcare spaces
	Dziobek-Beppler (2021)	Interior, exterior, and transitional spaces in pediatric healthcare	Play-based positive distraction; sensory and atmospheric regulation; legibility, orientation, and symbolic wayfinding	Unifies play, atmosphere, safety, orientation, and participation within a pediatric design logic
	McLaughlan and Willis (2021)	Pediatric healthcare architecture and landscape settings	Mood-enhancing colors, integration of nature and daylight, and opportunities for exploration and surprise	Shows how color, daylight, nature, and visual communication establish an age-inclusive environment
	Zook et al. (2022)	Corridor, courtyard, and public-space design	Spatial layout of public green areas and interstitial spaces	Explains how interstitial spaces shape access, encounters, and the social experience within hospitals
	Besselsen (2024)	Overall healing environments for childcare	Sensory modulation, biophilic elements, privacy, and accessibility	Expands the framework of children-focused healing environments

environments rather than staying in isolated rooms, making spatial sequencing a central component of the spatial experience. Within circulation systems, transitional spaces carry particular importance—such as corridors, atria, waiting zones, and interstitial areas—that are no

longer understood as neutral connectors; rather, they enable social connections (Evans, 1978) while fostering orientation, allowing supervision, and prompting positive distraction and pause. Wide corridors, ample waiting nodes, and atria can reduce stress and promote

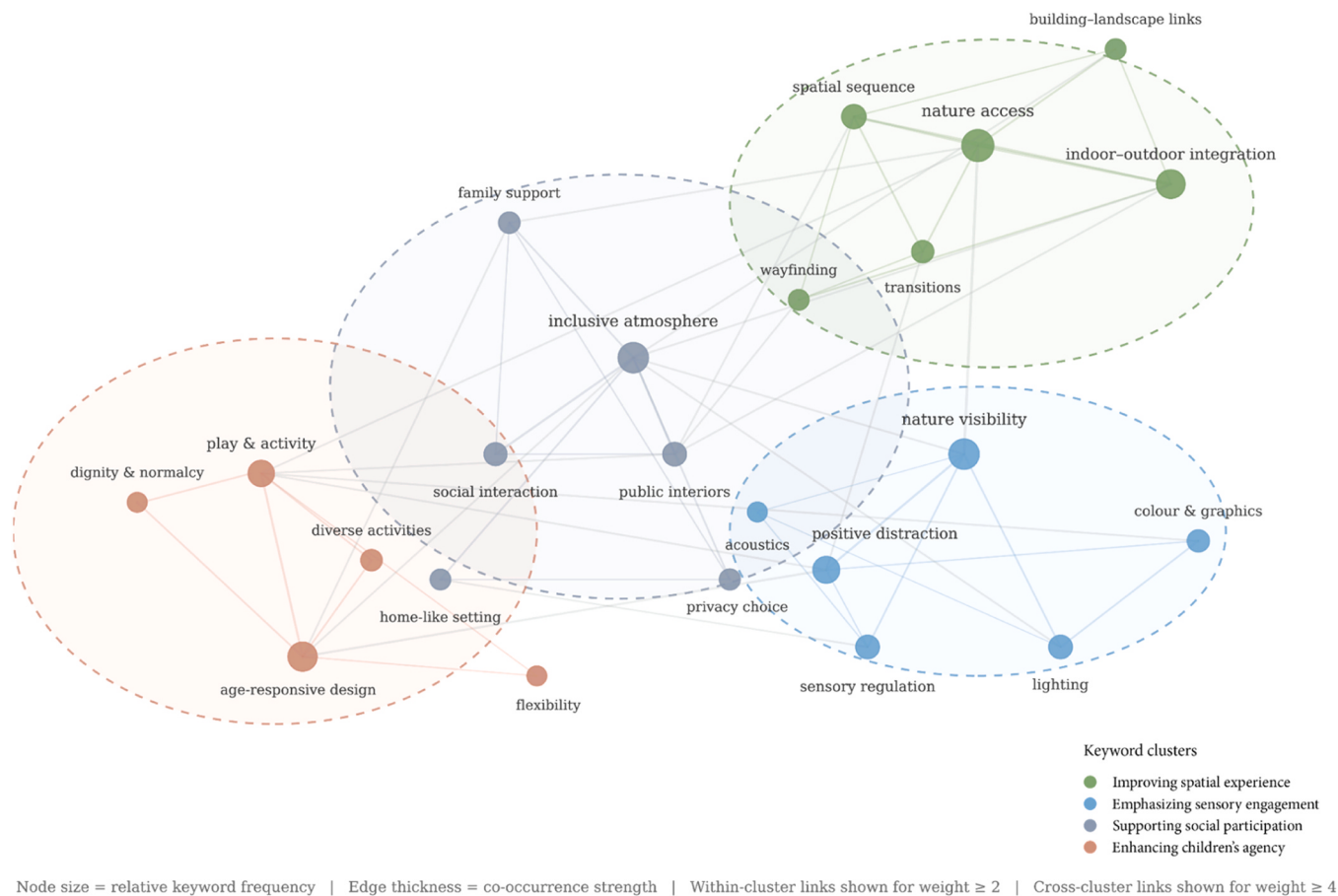
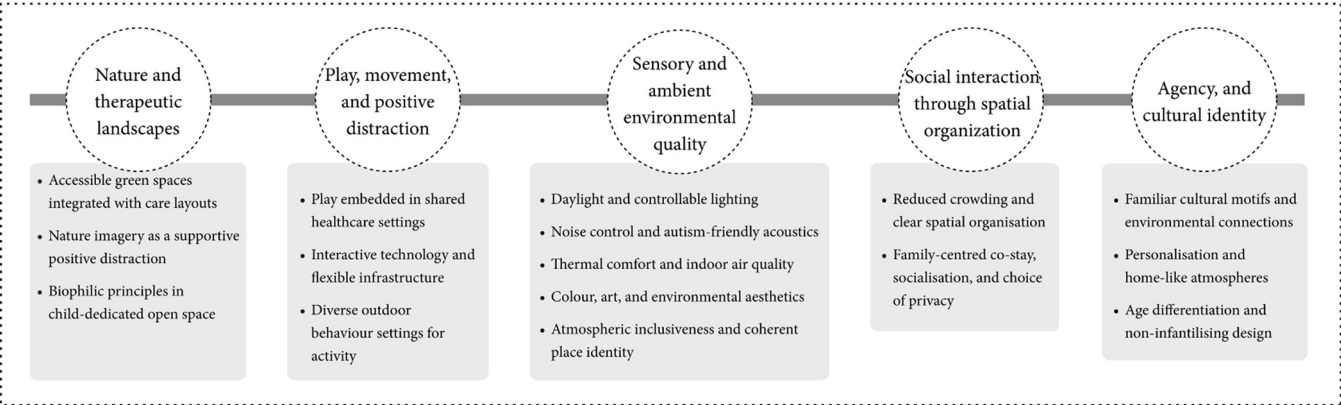


Fig. 2. Bibliometric-style keyword co-occurrence map of children's health-promotion design strategies derived from the 19-reference review corpus.

Healing Mechanisms



Spatial Translation: Building-Landscape Integration

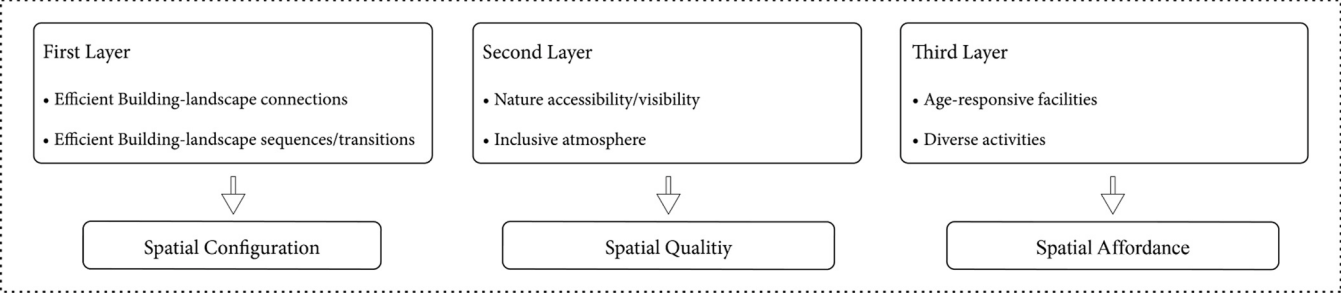


Fig. 3. Analytical diagram of the review framework on healing mechanisms.

family engagement, as well as foster observation, play, and involvement (Adams et al., 2010; Jiang, 2020; Zook et al., 2022). Child-friendly design requires age-appropriate scale, flexibility, visibility, and opportunities for choice, rather than relying entirely on decorative themes (Buie, 2020; Dziobek-Bepler, 2021; Verschoren et al., 2015). In particular, the literature emphasizes that spatial configuration, informed by the relationship between the building and its surrounding landscape, should accommodate diverse medical practices and the varying needs of patients. Outdoor environments are most beneficial when they are visually connected to interior spaces and accessible for everyday use, reinforcing the therapeutic potential of the surrounding landscape (Cooper Marcus and Sachs, 2013; Reeve et al., 2017).

3.4.2. Spatial quality

Spatial quality encompasses not only physical elements but also immaterial aspects—such as daylight, sound, temperature, and air quality, which shape children's perceptual and emotional experiences. Human well-being depends not on a single environmental feature but on the overall coherence of these conditions, as spatial quality is closely connected to sensory regulation. In this context, environmental factors, such as adaptable lighting, reduced noise, and opportunities for retreat, are viewed as part of the functional care environment and are identified as crucial in shaping emotionally-supported settings (Besselsen, 2024). Additional elements such as color, texture, and visual elements may enhance wayfinding and positive distraction, but their effectiveness depends on whether they contribute to an inclusive and coherent atmosphere, rather than relying on simplistic visual themes (McLaughlan and Willis, 2021). Indoor spatial quality is further enhanced by landscape features that provide views and access, incorporate seasonal changes into the indoor atmosphere, and allow connection with nature (McLaughlan and Willis, 2021; Russo and Andreucci, 2023). Attention is therefore focused not only on optimizing individual spatial features but also on creating structured connections between indoor and outdoor spaces, the building and the landscape.

3.4.3. Spatial affordances

Spatial affordances—a concept originally introduced in ecological psychology as the action possibilities that the environment offers to an individual (Gibson, 1979)—refer here to the action, encounter, and meaning opportunities that environments provide for children and families. In pediatric care, children engage with space through movement, observation, and play rather than through passive occupancy; behavior-mapping research shows that the value of environments lies in the activities and encounters they invite (Moore and Cosco, 2010). One consistently reported affordance is positive distraction: waiting areas, lobbies, corridors, and gardens can offer manageable engagement, curiosity, or play within the context of medical routines (Adams et al., 2010; Dziobek-Bepler, 2021; Jiang, 2020). As care unfolds, affordances become closely tied to everyday use, especially in relation to outdoor spaces. Research indicates that therapeutic landscapes are valued less for their visual appearance than for the actions they enable—sitting, wandering, playing, talking, resting, and sensory engagement (Cooper Marcus and Sachs, 2013)—which contribute to emotional relief, family gathering, physical activity, and attention restoration, reinforcing their role as health-supportive infrastructure (Nieberler-Walker et al., 2020; Reeve et al., 2017; Russo and Andreucci, 2023). In later stages of care, especially during prolonged or repeated visits, affordances increasingly support retreat, agency, and normalcy. Pediatric environments must facilitate not only activity and interaction but also sensory regulation, privacy, and temporary withdrawal. Research on children with varied sensory and cognitive needs highlights the importance of low-stimulus and retreat spaces that enable transitions between engagement and calm, while other studies emphasize privacy gradients, accessible comfort, and contemplative settings as elements of child-centered care (Besselsen, 2024). Age-responsive, home-like environments further offer meaningful choices in co-stay, social contact, and access to

restorative spaces, supporting everyday routines within institutional care (Buie, 2020; Pinhão, 2016; Verschoren et al., 2015).

3.5. Research gap

The literature review reveals that health-promoting environments for children and youth rely on more than isolated therapeutic features, emphasizing the importance of legible and meaningful spatial sequences, dynamic relationships between buildings and sites, and spatial qualities that shape perception and comfort, influence behavior and action, and reflect practices of care. However, despite this extensive body of work, the evidence remains inconsistent. Many studies focus on individual project elements that integrate effective green spaces—such as interior gardens, atria, and vegetated corridors—or on features that simulate or evoke nature, rather than exploring how integrated architectural strategies operate across the entire building. Even when indoor-outdoor continuity is recognized as important, building-landscape integration is often discussed in theory rather than demonstrated through detailed, case-based, comparative analysis. Therefore, exploring how buildings and landscapes can be co-designed to embed therapeutic support into the everyday spaces, routes, and environments of pediatric care is essential. Moving from the literature review to the case study analysis, the article aims to provide a more qualitative and holistic understanding of childhood healing spaces and address the current gap in well-documented examples of building-landscape integration in pediatric healthcare design.

4. Case study analysis

The case study analysis section presents contemporary pediatric healthcare architecture projects, demonstrating high-quality spatial and environmental strategies, examining their capacity to create health-inducing spaces for young users. These include children's hospitals, pediatric centers, and hospices, primarily developed in European contexts over the past two decades, accommodating a range of care models and lengths of stay (Table 2). To ensure consistency, the selection is guided by three criteria: (1) the structural integration of architecture and landscape within healthcare programs; (2) articulated spatial configurations, particularly those featuring enclosed open spaces such as courtyards, atria, and light-wells; and (3) documented contributions to user experience, especially concerning everyday spatial practices and their impact on children's well-being. The case study analysis draws on visual research tools, such as architectural floor plans, photographs, and diagrams, with findings presented through thematic evaluation tables.

Across the selected cases, projects that integrate open or semi-open landscaped spaces into the building structure emerge as a design approach. This integration provides the basis for the critical, comparative, qualitative analysis of ten design projects, which are classified into two typological categories: (1) courtyard-type hospitals and (2) atrium-type hospitals. This classification framework enables a more systematic examination of how different forms of building-landscape integration influence different definitions of health-inducing spaces (Fig. 4).

The analytical framework proposed in this study combines primary spatial layout with secondary therapeutic landscape mechanisms. The former identifies the main way in which architecture engages with landscape, while the latter explains how specific healing effects are realized in everyday pediatric care environments. This two-layer approach allows for cross-case comparison without reducing complex projects to a single morphological classification.

4.1. Courtyard-type hospitals

Courtyard-type hospitals create health-promoting environments through a direct building-landscape integration, a sequence of open-air rooms that are structurally embedded within the building mass. In

Table 2
Selection of 15 contemporary pediatric healthcare architecture projects.

Project	Architect	Location	Year
Evelina Children's Hospital	Hopkins Architects	London, UK	2005
Robin House Children's Hospice	Hoskins Architects	Balloch, UK	2005
Meyer Children's Hospital	Anshen + Allen, CSPE	Florence, Italy	2007
Lady Cilento Children's Hospital	Conrad Gargett Lyons	Brisbane, Australia	2014
Alder Hey Children's Health Park	BDP	Liverpool, UK	2015
Royal Children's Hospital	Land Design Partnership	Melbourne, Australia	2015
Mother-Child and Surgical Center	Nickl & Partner Architekten	Vienna, Austria	2016
Kaiser-Franz-Josef-Spital			
Perth Children's Hospital	COX and JCY Architects	Perth, Australia	2018
Princess Máxima Center	LIAG architects	Utrecht, Netherlands	2018
Queen Silvia Children's Hospital,	White Arkitekter	Gothenburg, Sweden	2021
Children's Hospice House for Julia	Čtyřtěstí	Brno, Czechia	2024
Children's Hospital of Zürich	Herzog & de Meuron	Zürich, Switzerland	2024
Juliana Children's Hospital	MVSA Architects	The Hague, Netherlands	2024
Children's Hospice	Renzo Piano Building Workshop	Bologna, Italy	2024
Children's Hospital at the Lausanne University Hospital	GMP & Ferrari Architectes	Lausanne, Switzerland	2025

contrast to schemes that place greenery mainly at the perimeter, the five selected cases—the Mother-Child and Surgical Center Kaiser-Franz-Josef-Spital (2016), the Princess Máxima Center (2018), the Children's Hospice House for Julia (2024), the Children's Hospice (2024), and the Children's Hospital of Zürich (2024)—utilize planted courtyards, terraces, or enclosed garden rooms as the primary ordering elements. This arrangement breaks down large volumes into smaller, more legible clusters, while maintaining care routes in continuous relation to daylight, weather, and the outdoor space. In so doing, it aligns closely with the literature that describes therapeutic landscapes as integral care infrastructure rather than mere amenities (Cooper Marcus and Sachs, 2013; Nieberler-Walker et al., 2020; Zook et al., 2022).

Within this category, design strategies vary in density and degree of enclosure. At the Mother-Child and Surgical Center Kaiser-Franz-Josef-Spital, a system of incised courtyards and terraces distributes light deep into the clinical plan and diminishes the scale of a complex acute-care program (Wagenaar and Mens, 2018a). The Princess Máxima Center and the Children's Hospice House for Julia projects adopt more domestic, cloister-like arrangements, featuring low-rise wings, timber-lined corridors, and sheltered courts that support family co-stay, play, and quiet engagement with nature (Caballero, 2024; Fernández-Galiano, 2025a; Sayer, 2024). The Children's Hospice project extends this approach to the site scale, employing a lightweight structural system, water, and tree cover to create a protected landscape of respite (Fernández-Galiano, 2025b). By contrast, the Children's Hospital of Zürich reinterprets courtyard logic into an internal “main street” punctuated by green courts and linked to roof-level patient rooms, demonstrating that even a large-scale hospital program can be experienced as a sequence of neighborhoods rather

than as a single institutional block (Binswanger et al., 2021; Davidovici, 2021; Koshta, 2024).

4.2. Atrium-type hospitals

Atrium-type hospitals establish a mediated integration between building and landscape through a central or peripheral interior void instead of an open courtyard. The five selected cases—the Robin House Children's Hospice (2005), the Evelina Children's Hospital (2005), the Meyer Children's Hospital (2007), the Queen Silvia Children's Hospital (2021), and the Juliana Children's Hospital (2024)—feature an atrium that serves as a filter space, climate moderator, public core, orientation element, and setting for waiting and informal encounters. Compared with courtyard-type schemes, these projects tend to organize healthcare functions, centrally or vertically, through full-height glazed halls, winter-gardens, and multistorey filter spaces that shape multiple visual connections, admit daylight, and enable collective visibility into the building's core. This spatial configuration corresponds to research showing that transitional spaces in pediatric settings, such as lobbies, corridors, and waiting areas, are active components in mediating between interior space and surrounding landscape rather than merely transitional zones (Adams et al., 2010; Jiang, 2020; Dziobek-Beppler, 2021).

Within this category, each example interprets the building–landscape integration model differently. Robin House Children's Hospice bridges the domestic hospice rooms and the surrounding landscape through a communal hall and a sheltered internal gathering space, set against extensive views. Evelina Children's Hospital and Meyer Children's Hospital develop the atrium as an indoor street animated by artworks, color diversity, and transparency (Architecture Today, 2017), while Queen Silvia Children's Hospital intensifies this model through visible play-oriented communal zones, framed by indoor planting, which turn rehabilitation and waiting into collective activity (Komiske, 2012). By contrast, Juliana Children's Hospital extends this principle into a contemporary multi-storey care environment, where internal voids, balconies, and glazed edges create layered visual connections across units, mitigating impressions of isolation (Wagenaar and Mens, 2018b).

5. Results and discussion

This section moves from case study classification to analytical comparison, placing a particular focus on how the selected projects contribute to elucidating health-inducing design in pediatric healthcare environments. The analysis is structured around a set of healing mechanisms and their associated impacts, enabling a systematic evaluation of how design strategies shape health-related outcomes. These healing mechanisms are derived from the theoretical framework established in the literature review, particularly the themes of spatial configuration, quality, and affordances. The corresponding building–landscape integration impacts—spatial experience, sensory engagement, social participation, and agency—that contribute to healing processes are summarized from the case study analysis. Through critical comparison, this section demonstrates how these strategies are applied in practice and how they collectively foster health-promoting environments in pediatric healthcare settings.

5.1. Cross-case evaluation of healing mechanisms

Table 3 evaluates six operational healing mechanisms derived from the preceding review and examines their presence across the ten representative cases. The comparative matrix shows that each case type organizes these mechanisms through distinct architectural logics, which in turn condition how landscape is integrated into everyday care practices.

Among the five courtyard-type hospitals, the Princess Máxima Center and the Children's Hospital of Zürich demonstrate the most comprehensive combination of health-inducing mechanisms. In both cases, the multi-courtyard floor plan, evoking a mat-building,

1. Courtyard-type hospitals

01 Mother-Child and Surgical Center Kaiser-Franz-Josef-Spital



02 Princess Máxima Center



03 Children's Hospice House for Julia



04 Children's Hospice



05 Children's Hospital of Zürich



Fig. 4. Classification of building–landscape integration within pediatric healthcare architecture. Note: The photo sources are listed in [Supplementary Material_Photo Sources](#).

incorporates courtyards as formal elements, while integrating repeated landscape contact, legible circulation, child-centered activity nodes, and differentiated settings for pause, play, and family co-presence. The integration of multiple courtyards further supports thematic differentiation and accommodates a wide range of everyday activities.

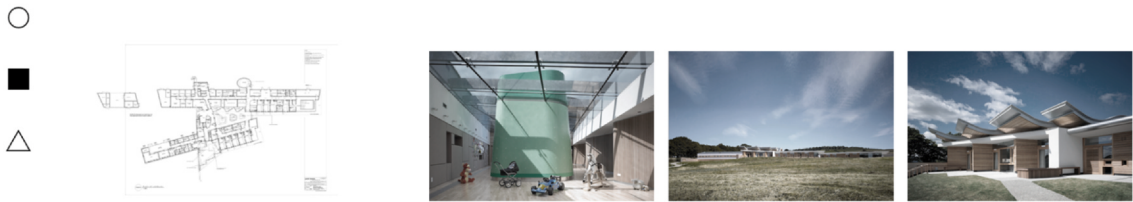
By contrast, the Mother-Child and Surgical Center Kaiser-Franz-Josef-Spital represents a more intermediate condition. Its incised courtyards and glazed corridors provide direct access, visual contact with planting, and improved spatial orientation, but age-specific programming and atmospheric differentiation remain underdeveloped. The Children's Hospice House for Julia is distinguished by its large central courtyard, which features greenery, seating, timber paving,

water features, and swings. Its high accessibility and multifunctional use promote active engagement, strengthening children's sense of calm and belonging. The Children's Hospice, in turn, demonstrates the strongest visual integration with nature among the five projects. Its elevated structure and floor-to-ceiling glazing open interior spaces to expansive landscape views, while the surrounding site also acts as a protective buffer that enhances privacy. However, its relatively limited direct physical access to outdoor space weakens the otherwise strong connection between building and landscape.

Compared with courtyard-type hospitals, which rely on distributed contact with outdoor space, atrium-type hospitals tend to produce a more centralized and internally coherent spatial structure. The case

2. Atrium-type hospitals

06 Robin House Children’s Hospice



07 Evelina Children’s Hospital



08 Meyer Children’s Hospital



09 Queen Silvia Children’s Hospital



10 Juliana Children’s Hospital

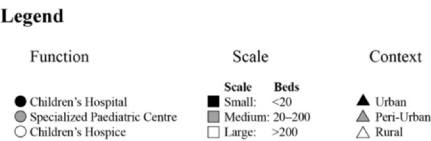


Fig. 4. (continued)

study results show that Evelina Children’s Hospital, Meyer Children’s Hospital, Queen Silvia Children’s Hospital, and Juliana Children’s Hospital all organize circulation, waiting, play, and visual communication around a central or layered atrium. Evelina Children’s Hospital and Juliana Children’s Hospital show stronger integration of planted interiors, terraces, and floor-to-ceiling windows. In contrast, the atrium

in Meyer Children’s Hospital functions more as an organizing element for internal circulation, while still maintaining a more limited but effective visual connection with the exterior landscape. Among them, Juliana Children’s Hospital shows the most effective combination of a large central atrium, high accessibility, and age-responsive activity settings, allowing the space to support both

Table 3

Cross-case evaluation of ten representative pediatric healthcare settings through healing mechanisms.

Categories	Projects	Health-inducing mechanisms					
		Spatial configuration		Spatial quality		Spatial affordances	
		Building-landscape connections	Building-landscape sequences/transitions	Nature accessibility/visibility	Inclusive atmosphere	Age-responsive facilities	Diverse activities
Courtyard-type hospitals	01	○○	○○○	○○	○	○	○
	02	○○○	○○○	○○○	○○○	○○○	○○○
	03	○○○	○○	○○	○○	○○○	○○○
	04	○	○	○○○	○○○	○	○
	05	○○	○○○	○○○	○○○	○○	○○○
Atrium-type hospitals	06	○○○	○○○	○	○○	○○	○○
	07	○○○	○	○○○	○○	○	○○○
	08	○	○○	○○○	○○○	○○	○○
	09	○○	○	○○	○○	○○○	○○○
	10	○○○	○○○	○○○	○○○	○○○	○○○

Notes: Circle count indicates the extent to which each mechanism is explicitly developed in published plans, sections, photographs, project descriptions, and case-related literature. ○ = limited evidence or localized expression; ○○ = moderate evidence across more than one spatial or programmatic domain; ○○○ = strong evidence of repeated, spatially integrated expression. Blank cells indicate that the mechanism is not clearly evidenced in the available project material. See [Appendix A](#) for source materials, coding thresholds, and case-by-case evidence.

Table 4

Health-promoting impacts across ten representative pediatric healthcare projects.

Categories	Projects	Health-Inducing Impacts			
		ISE	ESE	SSP	ECA
Courtyard-type hospitals	01	+++	++	+	+
	02	+++	+++	+++	+++
	03	+++	+	+	+++
	04	+	+++	++	+
	05	++	+++	+++	+++
Atrium-type hospitals	06	++	+	+	++
	07	++	+++	++	++
	08	+	+	+	++
	09	+	+++	+++	+++
	10	+++	+++	+++	+++

Notes: ISE = improving spatial experience; ESE = emphasizing sensory engagement; SSP = supporting social participation; ECA = enhancing children's agency. + = limited potential, ++ = moderate potential, +++ = strong potential.

movement and everyday use by children. Evelina Children's Hospital, although successful as a social and gathering space, appears to serve a broader institutional public rather than being specifically oriented toward children's activities. Robin House Children's Hospice represents a hybrid condition: its communal hall is less monumental than hospital atria, yet it translates similar spatial logics into a domestic hospice setting, balancing collective life, retreat, and children's play. Queen Silvia Children's Hospital is distinguished by its winter-garden therapy room that incorporates a variety of landscape elements and supports diverse therapeutic activities. Nevertheless, compared with the other atrium-type cases, this space functions more as a dedicated therapeutic room than as a shared transitional public interior.

5.2. Health-promoting impacts across two integration types

[Table 4](#) further summarizes the case study findings by evaluating four health-promoting impacts—improving spatial experience (ISE), emphasizing sensory engagement (ESE), supporting social participation (SSP), and enhancing children's agency (ECA)—across ten representative pediatric healthcare projects. It illustrates how different integration types support distinct health-promoting impacts in pediatric care.

In courtyard-type hospitals, Mother-Child and Surgical Center Kaiser-Franz-Josef-Spital most clearly supports orientation and readability through its use of incised courtyards and glazed corridors. The Princess Máxima Center and the Children's Hospital of Zürich extend this strategy to larger, more complex institutions. By combining distributed courtyards with legible routes and child-centered communal nodes, both projects strengthen spatial orientation while supporting everyday use. The Children's Hospice House for Julia and the Children's Hospice are particularly effective in fostering a sense of belonging, as rooms, gardens, and shared domestic life are closely interwoven rather than spatially separated. In particular, Children's Hospice House for Julia, with its large central courtyard, play facilities, timber paving, and seating, creates a distinctly home-like atmosphere while also supporting creativity and exploration.

Atrium-type hospitals have a clear advantage in SSP because the atrium functions as a shared indoor space rather than a dispersed outdoor area. Robin House Children's Hospice, Evelina Children's Hospital, and Juliana Children's Hospital illustrate how a central communal space can improve visibility, informal interactions, and family co-presence. The latter project demonstrates the strongest overlap between SSP and ECA through its integration of child-oriented activity settings and transparent circulation connections. The Meyer Children's

Table 5
Structural integration characteristics and design strategies in courtyard- and atrium-type hospitals.

Operational characteristic	Courtyard-type hospitals	Atrium-type hospitals	Design implication
Interface continuity	Locate courtyards and terraces beside key care spaces and circulation routes	Frame the atrium as a central interior landscape shared by public and care spaces	Landscape becomes an everyday interface
Walkable pathways	Link patient rooms, waiting areas, and greenery through short loops or courtyard sequences	Arrange circulation around a legible central void	Movement supports orientation and restoration
Sightline-flowline coupling	Direct corridors and rooms toward courtyards, planted edges, or sky views	Connect floors visually with balconies, bridges, and transparent edges	Users remain visually connected while moving
Care-process integration	Connect gardens with therapy, play, family, respite, and end-of-life spaces	Place waiting, play, dining, therapy, and social areas around the atrium	Nature becomes embedded in care routines

Hospital shows that ISE within this type depends more on interior spatial coherence than on direct outdoor access. In contrast, the winter-garden therapy room at the Queen Silvia Children’s Hospital features landscape elements and horticultural therapy, which particularly support high ESE and ECA.

5.3. Structural integration in pediatric healthcare settings

The cross-case findings clarify that the therapeutic potential of landscape depends on whether natural elements are structurally integrated into the organization of movement, visibility, waiting, family co-presence, therapy, and play. In this study, structural integration refers to the incorporation of landscape systems into everyday pediatric care environments.

Structural integration is operationalized through four characteristics: (1) interface continuity, (2) walkable pathways, (3) sightline-flowline coupling, and (4) care-process integration. Interface continuity refers to the repeated presence of landscape across circulation and care environments. Walkable pathways allow children, families, and staff to encounter nature through legible daily routes and spatial sequences. Sightline-flowline coupling describes the alignment between movement and visual orientation, reinforcing accessibility and spatial legibility. Care-process integration refers to the incorporation of landscape-related settings into waiting, therapy, play, rehabilitation, and family-support environments. Therapeutic value therefore depends less on the isolated presence of greenery than on the repeated spatial integration of landscape within everyday care environments (Table 5).

The two integration types identified in the case study analysis offer different but transferable design strategies (Table 6). Courtyard-type hospitals rely on distributed landscape contact across circulation and care environments, whereas atrium-type hospitals concentrate orientation, visibility, and social interaction within centralized interior voids.

Table 6
Simplified typological synthesis of structural integration in courtyard- and atrium-type pediatric hospitals.

Dimension	Courtyard-type integration	Atrium-type integration
Spatial typology	Distributed courts / terraces / roof gardens	Central atrium / conservatory / winter garden
Core mechanism	Repeated lateral contact with nature; smaller-scale neighborhoods and calm pauses	Concentrated vertical visibility and social life; shared orientation hub and activity setting
Typical strength	Route legibility, daylight, room-to-garden relationships, domestic scale	Collective visibility, protected indoor activity, wayfinding, all-weather social participation

6. Conclusions

This study contributes to pediatric healthcare design by positioning building-landscape integration as a primary architectural strategy for therapeutic environments. It synthesizes research on healing environments, therapeutic landscapes, child-centered interiors, and evidence-based design within a coherent analytical framework organized around three spatial features: configuration, quality, and affordances. Through comparative case study analysis, the study moves from conceptual synthesis to key design principles selection. It identifies two recurrent modes of integration—courtyard- and atrium-based buildings—showing that each establishes a distinct spatial logic for organizing practices of care through engagement with nature. These contributions should be considered in light of certain limitations. The analysis relies on published architectural documentation rather than post-occupancy evaluation or clinical data, and its direct applicability to other patient groups or healthcare settings remains to be tested. Future research should address these gaps through empirical validation to assess the effectiveness and adaptability of the proposed guidelines. At the same time, the article makes a methodological contribution by bridging evidence-based and qualitative design research through a combination of literature review, case study analysis, and impact synthesis. This integrated approach shifts the focus from isolated design features to coordinated spatial strategies, highlighting how architecture structures perceptual, relational, and behavioral processes in healthcare environments. The value of this qualitative interpretation therefore lies in its transferability: it presents a framework for understanding contemporary children’s hospitals and a structured basis for redefining the role of design in shaping health-supportive spaces beyond their physical attributes.

Funding

This work was supported by the China Scholarship Council (CSC) under Grants [number 202006250046] and [number 202307820026].

Ethical statement

All data analyzed in the current research were obtained from publicly available datasets. According to the corresponding author’s institution, a secondary analysis of publicly available data does not require Institutional Review Board approval.

CRedit authorship contribution statement

Zhihang Lin: Writing – review & editing, Writing – original draft, Visualization, Software, Funding acquisition, Conceptualization.

Stamatina Kousidi: Conceptualization and definition of the research topic, Methodological framework development, Formal analysis, Writing, review & editing, Project administration, Supervision. **Liheng Zhu:** Writing – original draft, Validation, Investigation, Funding acquisition, Data curation.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgements

We sincerely thank Professor Binxia Xue and Tongyu Li from the Department of Architecture and Design at Harbin Institute of Technology for their generous invitation and thoughtful coordination during the development of this work. Additionally, we appreciate the funding provided by the China Scholarship Council (CSC), which made this research possible.

Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at [doi:10.1016/j.las.2026.100045](https://doi.org/10.1016/j.las.2026.100045).

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