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Integrating Narrative Inquiry and Thermal Comfort Simulation for Empathy-Driven Healthcare Design: A Case Study

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ABSTRACT

Designers have an important role to play in shaping healthcare environments, not only by addressing functional needs but also by creating experiences that reflect empathy and care for patients, families, and staff. This paper draws on a case study that employed narrative inquiry as a design approach to explore how empathy can be embedded into the design process. The study was conducted in a design hospital focusing on a patient care center, where to engage with a variety of narrative techniques, listening to stories, creating visual and written accounts, and reflecting on these through design. In addition, the CBE Thermal Comfort Tool was used to evaluate and simulate indoor environmental conditions, ensuring that thermal comfort parameters complied with ASHRAE Standard 55:2023. The process revealed that empathy-driven approaches not only encouraged engagement but also led to creative and often unexpected design solutions that sought to support the patient as a whole person. The thermal comfort assessment using the CBE Tool confirmed that maintaining operative temperatures between 21–24℃ and relative humidity of 40–60% fostered a sense of comfort, calmness, and trust conditions that align with empathetic and patient-centered care. The study suggests that placing empathy at the forefront of the design process allows healthcare spaces to move closer to genuinely patient-centered care by advancing an operational design framework that systematically links narrative-based empathy exploration with measurable environmental performance evaluation. Narrative analysis revealed three core experiential needs recurring across the narratives: (1) patient empowerment and control, (2) emotional restoration and stress relief, and (3) support for relational and family presence. These needs were systematically translated through a Design Translation Matrix into specific interior strategies, including empowerment zones replacing conventional waiting areas, interior healing gardens integrated with treatment circulation, and configurable treatment spaces supporting private and semi-private care scenarios. Thermal comfort simulations conducted across six finalized design proposals demonstrated consistent compliance with ASHRAE Standard 55:2023, with all schemes maintaining operative temperatures within 21–24℃, relative humidity between 40–60%, and PMV values approaching neutrality (mean PMV = −0.07, PPD ≈ 5%).

1. INTRODUCTION

Empathetic design may be understood as a life-affirming practice because it places patients, their families, and the wider circle of caregivers at the center of attention, encouraging a culture of care that is both holistic and humane. In our view, narrative inquiry provides a particularly useful way of working toward this goal, since it allows designers to consider the thoughts, emotions, and lived experiences of others in a manner that goes beyond surface needs. By grounding design decisions in stories, whether told, written, or visual, there are opportunities to create healthcare environments that connect with the physical body but also with the emotional, spiritual, and relational aspects of human experience. The paper aims to explore and demonstrate an integrated framework that combines narrative inquiry with evidence-based design (EBD) and thermal comfort assessment. It clarifies that the case study is not presented merely as an illustrative example, but as a methodological vehicle through which the proposed integration of empathic, experiential narratives and quantifiable environmental performance is examined in practice. The case study presented here comes from a design hospital in which students were asked to develop proposals for a care center. Narrative inquiry became the principal method for this design hospital, helping participants to investigate patient, family, and staff perspectives through multiple modes of storytelling. Importantly, the use of first-person narratives brought members of the jury into closer contact with the

realities of care, situating them within the hospital experience rather than outside it. What emerged were design proposals that were recognized for their originality, but more importantly, for their capacity to link EBD principles with the subjective dimension of lived experience. It suggests that this blending of narrative inquiry and EBD points toward a new design process, one that has the potential to heighten compassion, affirm the whole person, and rethink what it means to design empathetically in healthcare contexts. Beyond meeting emotional and functional needs, maintaining physical comfort, especially thermal comfort, is a key part of creating empathetic healthcare environments. The way patients and staff experience temperature, air movement, and humidity can affect their mood, recovery, and overall well-being. To help assess and control these factors, the CBE Thermal Comfort Tool [1] provides a practical method for evaluating indoor conditions in line with ASHRAE Standard 55. Using such tools supports designers in making informed decisions that connect human experiences with measurable environmental quality, leading to spaces that feel both caring and comfortable. Narrative inquiry is critical because it enables access to the lived experiences of patients, families, and caregivers, capturing emotional responses, perceptions, and temporal sequences that shape how healthcare spaces are understood and remembered. These narratives reveal experiential needs such as feelings of safety, dignity, anxiety, or calm that cannot be fully identified through quantitative measures alone. However, experience in healthcare settings is not only psychological or emotional; it is also deeply influenced by physical environmental conditions. Among these, thermal comfort represents a fundamental and quantifiable component of experience, directly affecting stress levels, well-being, recovery, and overall satisfaction with care.

In the hospital setting, the inner worlds of patients, their families, and caregivers often raise a simple but unsettling question: What if you could actually stand in someone else's shoes, see what they see, hear what they hear, feel what they feel? Would you act differently? The answer, of course, is almost always yes, and in this context empathy takes on a sharper meaning, for hospitals are places where illness and healing constantly push against one another, and where the giving and receiving of care becomes part of daily life [2]. For those of us involved in design and design education, this recognition serves as both a challenge and an opportunity: how might spaces be shaped in ways that genuinely respond to such human experiences? The project described here began with a design charrette in which students first viewed the film *Empathy: Exploring Human Connection* and then were asked to reflect on whether a better understanding of what patients and staff see, think, and feel might change their design decisions [3-5]. Over a concentrated forty-eight-hour period, they worked through this prompt, developing responses in the form of short narratives told through words and images. When these early ideas were shared with healthcare and design professionals, they revealed not only imagination but also a kind of freshness that suggested students were energized by the task rather than constrained by it. Importantly, the narrative form itself helped the students to enter more directly into the perspectives of patients, families, and caregivers. It also encouraged them to think about space in temporal terms, almost like a story unfolding from a beginning to a middle and finally to an end, a perspective that naturally reinforced the principles of patient-centered design.

In developing reality-based narratives for the project, the students had to do much more than simply imagine scenarios; they were expected to carry out secondary research and collect information that would give substance to their stories. Part of this process involved visits to care centers and similar healthcare facilities, and these experiences seemed to broaden their awareness of precedents while also providing a number of unexpected insights. Another important source of material, and at times the basis for story content, came from their attempts to engage with the relevant scholarly literature. In this way, the work combined experiential learning with empirical knowledge, and both informed the narratives that followed. Over roughly three months, the students read and discussed stories from literature [6, 7], which became a touchstone for their own narrative exercises. Their stories, while uneven in style, captured a range of perspectives from those seeking treatment to those providing care within designed spaces. Individual perceptions were then linked back to empirical findings, and many of the students began to see that EBD was more persuasive when coupled with the subjective voices of patients and caregivers. Narrative inquiry was not only a tool for generating ideas but also a method of communication: at both the midpoint and final reviews, each team presented their designs using a first-person voice-over to accompany images of the project. This storytelling approach engaged outside specialists and gave a different kind of energy to the critiques.

Despite the growing body of literature on empathic and patient-centered healthcare design, several critical gaps remain. First, empathy is frequently discussed as a professional attitude or ethical value, rather than being operationalized as an actionable design framework capable of guiding concrete spatial decisions. Second, narrative inquiry and environmental performance assessment are often treated as parallel but disconnected approaches, resulting in limited integration between qualitative lived-experience narratives and quantitative measures of indoor environmental quality, particularly thermal comfort. Third, existing studies rarely demonstrate a traceable pathway linking patient and caregiver experiences to specific design interventions and their measurable environmental outcomes.

Accordingly, this study is structured around three interrelated research questions that guide the investigation. First, it asks how narrative inquiry can be used to uncover empathic design opportunities in healthcare interior environments by revealing the lived experiences of patients, families, and caregivers. Second, it examines how insights generated through narrative inquiry can be translated into concrete and evidence-based interior design strategies. Third, it investigates how thermal comfort simulation, using the CBE Thermal Comfort Tool, can be applied to assess and validate the contribution of these strategies to the quality and performance of the physical healthcare environment.

2. LITERATURE REVIEW

2.1 Empathy design

Empathy has long been described as a central quality for healthcare providers [8, 9], yet it is also a quality that designers should cultivate as part of their practice and professional mindset. These studies [10, 11] of IDEO make this point by framing design thinking as a blend of empathy, integrative thinking, optimism, experimentalism, and collaboration. They argued that when designers take a "people first" approach,

they are more likely to imagine solutions that meet both obvious and less visible needs, drawing from close attention to human behavior and the small details of everyday life [10, 12]. Such careful attention to lived experience may be useful in any design sector, but in the context of healthcare, it seems particularly pressing, as the stakes involve health, well-being, and recovery. Listening carefully, watching attentively, and reflecting on what one sees and hears are habits that nurture empathic design. Fakhry and Mohammed [13], Frontczak and Wargocki [14] suggested that by attempting to move closer to the lives of potential users, designers improve the chances of creating environments and products that respond more directly to people's needs, though as Ghabayen et al. [15], Guidi and Traversa [16] have noted, the very language of "end user" carries certain assumptions drawn from technology and positivist traditions. Even so, the idea at least recognizes that a connection between people and design exists [17, 18]. In practice, user-centered approaches try to shape products or environments around what people want and need, rather than forcing individuals to adapt themselves to the design. This is rarely a linear process, but often one of iteration, testing, revising, and testing again. Hendy et al. [19] described this cycle as involving observation, the capture of data, reflection and analysis, brainstorming, and eventually the development of prototypes. The value of such a process lies in its capacity to produce outcomes that are not only functional but also intuitive, sustainable, and creative. Although much of the scholarship around empathic design has concentrated on product design [19], web design [20], or human factors research [13], it seems that healthcare environments remain an area where these ideas could be pushed much further. More generally, empathic design can be situated within the wider tradition of human-centered design, which aims to build both cognitive and affective understanding of users and stakeholders by paying close attention to everyday experiences, emotions, and practices [21, 22]. The methods involved often require immersion and direct engagement, allowing design teams to uncover expectations and aspirations that may not be immediately visible. These kinds of insights, rooted in lived experience and emotional nuance, provide perspectives that complement and sometimes challenge what is revealed through conventional research techniques such as surveys or market analysis [23, 24].

2.2 Empathy in healthcare

Empathy has long been recognized as an essential element in healthcare because it influences not only the quality of the interaction but also the outcomes of care itself. Studies over the past few decades have connected empathy to improved patient satisfaction [24], better clinical results [25], and even reductions in malpractice claims [26, 27] and medical mistakes [28]. The Institute for Patient- and Family-Centered Care notes that the way care is experienced is just as important as the technical delivery of treatment, pointing out that good communication with patients and their families, along with their active participation in treatment and policy development, has a real effect on outcomes. In everyday practice, this means that many different health professionals, whether doctors, nurses, therapists, technicians, or social workers, have chances to show empathy in ordinary encounters, perhaps by listening carefully, explaining things honestly, or simply speaking with compassion. Doing so often makes patients feel more confident and engaged, while also making professionals themselves more effective. The Association of American Medical Colleges has even emphasized empathy as a key educational goal for future physicians [29], and within interior design education, similar recognition has been given, with accreditation bodies stressing the importance of empathy in preparing the next generation of designers [30]. Empathy also stands in contrast to isolation; it supports connection and collaboration [31]. In healthcare settings, this is visible in the way emotionally engaged physicians communicate, reducing anxiety and helping patients cope more successfully, which strengthens the whole continuum of care [31, 32]. Research across psychology, psychoanalysis, social theory, and patient–provider communication continues to confirm the significance of empathic processes [33, 34]. Moreover, it has been shown that physicians who act with empathy are not only more effective healers but also more satisfied in their work [35, 36]. Even describes empathy as forming a cycle of healing in which patients disclose more about their symptoms, leading to better diagnosis and treatment, which in turn reinforces patient confidence and recovery. Building on this idea, Vankova research has highlighted several types of care that optimize the healthcare experience: care that is grounded in kindness and dignity, care that acknowledges the role of families, care that considers the impact of physical environments, and care that attends to patients' psychological, social, and spiritual needs [36]. In practice, this model translates into patient-centered care that values education, choice, family involvement, holistic healing, food and nutrition, and even the broader community [37]. At the center of these approaches, and uniting both healthcare and design, is empathy, which continues to emerge as a necessary principle for how spaces and services should be conceived in order to truly support patients.

2.3 Narrative in design inquiry

Aminpour et al. [3], in Design Thinking for Interiors, used real narratives to show how interior spaces affect people in powerful and sometimes unexpected ways. Their work illustrates that when we pay attention to memorable design, we begin to see how much spaces and objects matter in shaping behavior, values, and even cultural practices. This kind of close study makes interior environments more meaningful, not only to designers but to society in general. For this reason, narrative inquiry has been used as a method to better understand the connections between people and their environments. In design education, it has been shown to encourage self-reflection, bring multiple perspectives into the process, and help students think about designing for the "whole person" rather than for function alone. Importantly, narrative work draws on both subjective and objective viewpoints. It recognizes that feelings, perceptions, and facts all mix together in practice, and, as Barnes et al. [8] explained, stories are not just descriptions of what happened; they are interpretations. In studio work, especially in healthcare design, such narratives often combine evidence with the emotional weight of human experience. They can highlight conflicts, trade-offs, or tensions in decision-making, which, as Sonday et al. [38] suggested, means stories are less about solving problems and more about uncovering them. Because they capture detail and nuance, narratives become a way for students and professionals to communicate the impact of interior design, whether through writing, visuals, or oral accounts [4]. This has particular value in healthcare, where empathetic design is essential. Cary's study [39], for example,

describes a hospital room project designed specifically to support patients, a model that has influenced many other designers. In these cases, storytelling becomes not just a reflection but a tool for learning and for practice. Narrative inquiry, by opening access to inner thoughts, motivations, and challenges, offers a way to link design thinking with the lived experiences of patients, families, and caregivers. Projects like "Adopt A Room" show how powerful this approach can be when it is tied to empirical principles as well as to human emotions, reinforcing the importance of empathy in shaping holistic healthcare environments.

2.4 Thermal comfort as a component of empathetic healthcare design

Thermal comfort has been widely recognized as a key factor influencing the quality of healthcare environments. It not only affects patients' physical well-being but also shapes their emotional responses, satisfaction, and perception of care [40]. Research has shown that comfortable thermal conditions can reduce anxiety, improve rest quality, and accelerate recovery among patients, while also enhancing concentration and productivity among healthcare staff [41]. To accurately assess and optimize these indoor conditions, tools such as the CBE Thermal Comfort Tool [1] provide valuable guidance in alignment with ASHRAE Standard 55, helping designers evaluate thermal conditions based on occupant feedback and environmental parameters. Integrating such scientific tools into empathetic and human-centered design approaches ensures that healthcare environments become not only efficient and sustainable but also deeply responsive to human needs for comfort, dignity, and emotional well-being [42].

3. METHODS

In this case study, empathy in healthcare design was explored by creating prototypes for a care facility, and narrative inquiry was used as the main approach alongside principles of EBD. The aim was to consider the perspectives of patients, family members, and staff, and to see how empathy could shape the design process and outcomes. The project itself required the design of a two-story facility, about 33,000 square feet, which included a wide range of spaces: public zones such as the main lobby, public restrooms, a resource center, and a pharmacy; clinical spaces for radiation and infusion and their necessary support areas; and staff zones including offices, meeting and conference spaces, and break areas (refer to Figure 1). Interestingly, although the project brief emphasized the importance of empathy, it did not explain how this should be addressed, which meant that each team interpreted empathy in its own way. Some groups proposed cafés or healing gardens, others suggested places for alternative medicine, spirituality, wellness, or advocacy, and in this way, the idea of empathy took on different forms depending on the design team. The process itself unfolded in phases that combined research, collaboration, and narrative inquiry. At the start, authors reviewed more than thirty-five peer-reviewed articles from journals such as *Health Environments Research and Design Journal*, *Journal of Interior Design*, *Environment and Behavior*, and *Journal of Nursing Administration*, which gave them perspectives on empathy, healthcare, the patient and caregiver experience, and how design influences these areas. This literature review was followed by benchmarking, on-site observations, and interviews that allowed us to hear directly from patients. Each team also spoke with at least one nurse, resident, or physician who worked in healthcare and could share professional experiences of patient care. These different sources of information, academic, observational, and personal, were then combined to inform the students' narratives and design proposals.

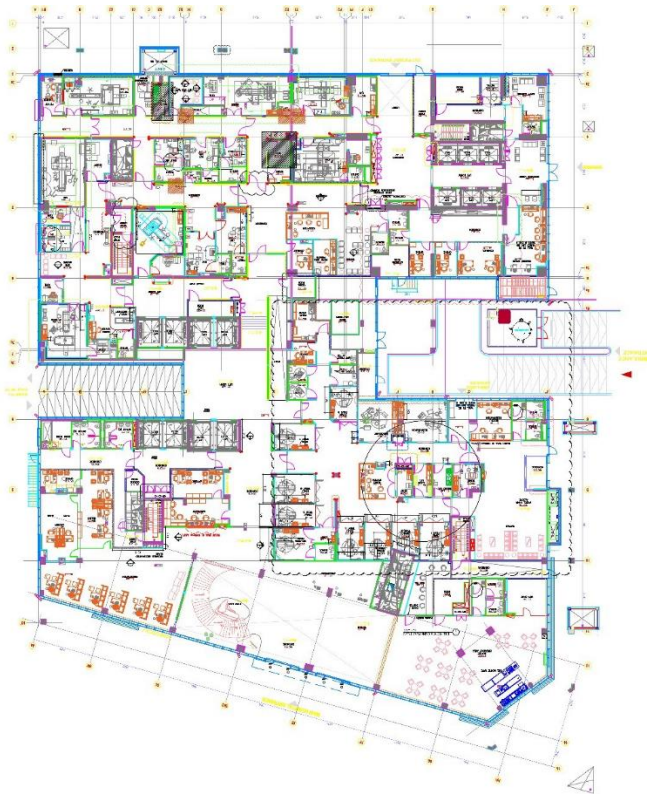

Figure 1. Project plan
Note: This figure was prepared by the authors

The design process combined EBD principles with narrative approaches. First-person patient accounts were examined, and narrative dialogues were developed to capture emotions, circumstances, and lived experiences. This method expanded the design framework beyond visual and aesthetic considerations to include sensory dimensions such as sound, smell, and movement, all of which influence the healthcare experience. Narrative techniques also provided a way to articulate design intentions more effectively and were carried forward in the creation of digital iBooks that documented both the process and the outcomes. These records became useful tools for communicating with review panels and for focusing on particular aspects of the work. By bringing forward the voices of patients, families, and caregivers, the narratives revealed sources of stress, fatigue, and emotional demand, which in turn informed ideas for supportive interior environments. Reflecting on the approach, it is evident that without engaging deeply with narrative and empathy, the design outcomes would likely have been less innovative and less responsive to the realities of care.

3.1 Literature search and selection strategy

The reviewed articles were systematically selected through a structured search strategy implemented across Scopus, PubMed, and Google Scholar. Searches used combined keywords: empathy in healthcare design, patient-centered

interior design, narrative inquiry in design, and EBD. Boolean operators were applied, e.g., (empathy AND healthcare interior design) OR (narrative inquiry AND design AND health environments). Inclusion criteria required that sources: (a) were peer-reviewed journal articles, (b) addressed empathy-driven, narrative-driven, or EBD approaches in healthcare interiors, (c) included direct links to spatial or environmental design decisions, and (d) were published in English between 2003 and 2025. Articles were excluded if they focused solely on clinical empathy without design relevance or discussed general healthcare management without interior spatial implications.

In addition to narrative inquiry and qualitative analysis, the study incorporated a quantitative assessment of the physical environment to better understand users' comfort conditions. The CBE Thermal Comfort Tool [1] was employed to evaluate thermal comfort parameters such as air temperature, relative humidity, mean radiant temperature, air velocity, and metabolic rate. Data were collected through on-site environmental measurements and occupant feedback, which were then compared against the comfort ranges defined by ASHRAE Standard 55. This combination of empirical data and narrative insights allowed for a more holistic understanding of how environmental factors interact with emotional and psychological experiences in healthcare spaces.

3.2 Rationale for narrative inquiry and EBD as a combined design

Narrative inquiry is appropriate for this research because the study seeks to understand how empathetic meanings are experienced, interpreted, and operationalized into interior design decisions, which requires capturing temporal, emotional, and sensory nuance rather than frequency-based thematic saturation typical of grounded theory or survey-supported phenomenology. Narrative inquiry enables exploration of decision causality inside lived experience, aligns with design-thinking iteration, and effectively communicates spatial intentionality through first-person experiential reconstruction. Combining narrative inquiry with EBD ensures methodological complementarity: narratives decode the why behind spatial emotional needs, while EBD validates the measurable environmental and ergonomic parameters supporting those needs. This integration supports emotionally-informed spatial innovation grounded in empirical indoor comfort standards.

3.3 Narrative data analysis and design translation matrix

The narrative materials (written first-person stories, interview-based dialogues, and oral narrative presentations) were analyzed using a qualitative narrative-thematic analysis approach. Analysis proceeded in four structured stages. First, all narrative texts and presentation transcripts were compiled and repeatedly read to achieve immersion and familiarity. Second, an open coding process was conducted in which meaningful segments of text were coded inductively, focusing on emotional expressions, experiential needs, environmental perceptions, and references to spatial challenges or supports (e.g., anxiety, dignity, control, fatigue, comfort, social connection). Coding was initially carried out independently by two members of the research team, both with backgrounds in interior design and healthcare environments. Third, codes were compared, discussed, and consolidated through iterative meetings, during which discrepancies were resolved through analytical discussion and reference back to the raw narratives, ensuring consistency and analytical reliability. Codes were then clustered into higher-order narrative themes representing recurring experiential patterns across participants (e.g., empowerment, restoration, privacy, togetherness, sensory relief).

In the fourth stage, these validated narrative themes were systematically translated into spatial implications through the development of the Design Translation Matrix. This matrix was constructed by mapping (1) coded narrative themes and emotional needs against (2) identified spatial challenges, followed by (3) proposed interior design strategies, and finally (4) implemented spatial interventions within the design prototypes. Each design move was explicitly traced back to supporting narrative evidence and relevant EBD literature. The matrix was iteratively refined during design reviews, allowing narrative insights, design decisions, and environmental performance considerations (including thermal comfort parameters) to inform one another. This process ensured a transparent and traceable pathway from lived experience narratives to concrete interior design solutions.

3.4 Data, participants, and ethical considerations

In this study, the "narratives" were not treated as fictional stories, but as structured experiential accounts developed through a narrative inquiry framework. They took three complementary forms: (1) short first-person written narratives produced by design students to reconstruct patient, family, and caregiver experiences; (2) narrative dialogues informed by semi-structured conversations with healthcare professionals (nurses, physicians, and residents) and informal interviews with patients during site visits; and (3) oral narrative presentations delivered by student teams during mid-term and final design juries, where design concepts were communicated through first-person storytelling supported by visual sequences. Participants were recruited purposively. The primary participants were senior interior design students enrolled in the healthcare design studio, while secondary narrative sources included healthcare professionals and patients encountered during educational site visits to care centers. Healthcare professionals were selected based on their direct involvement in patient care, and patients were approached on a voluntary basis to share experiential insights rather than clinical data. All contributors were informed about the academic purpose of the study, that participation was voluntary, and that no identifying personal information would be recorded. Verbal informed consent was obtained prior to conversations, and narratives were anonymized and used only to inform design development and thematic interpretation. The study followed institutional ethical guidelines for educational research involving human participants, ensuring confidentiality, non-intervention, and the exclusive use of experiential, non-medical information.

3.5 Thermal comfort simulation inputs and modeling process

Thermal comfort simulations were conducted using the CBE Thermal Comfort Tool in accordance with the analytical framework of ASHRAE Standard 55:2023. Input parameters were established based on standardized assumptions for healthcare environments rather than arbitrary estimates.

Metabolic rate values were selected to reflect typical activities observed in ambulatory healthcare settings (e.g., seated patients, standing or walking staff), referencing ASHRAE Standard 55 and ISO 7730 guidelines. Clothing thermal resistance (Clo) levels were set to represent common hospital conditions, accounting for lightweight patient garments and standard healthcare staff uniforms. Air velocity, relative humidity, and mean radiant temperature inputs were derived from the environmental conditions specified in the final interior design proposals and aligned with comfort ranges recommended by ASHRAE.

The simulations were conducted on the finalized design schemes after spatial layouts, zoning, and material strategies had been defined. Each of the six student proposals was spatially modeled to reflect room volumes, occupancy patterns, and programmatic functions. Environmental assumptions were then entered into the CBE tool to test whether the proposed interior conditions satisfied thermal comfort criteria. Spatial modeling and environmental definition were developed using standard architectural and interior design software (e.g., AutoCAD and SketchUp) to generate the final plans and volumetric configurations that informed the simulation inputs. Output data (PMV, PPD, air temperature, air speed, and humidity) were analyzed individually and subsequently averaged to represent overall environmental performance across the cohort.

3.6 Case study context and educational setting

This research is grounded in a design-hospital case study conducted within an advanced healthcare interior design studio. The "design hospital" refers to a professionally structured academic simulation that replicates real-world healthcare design practice, integrating architectural programming, evidence-based research, stakeholder consultation, and formal design reviews.

Authenticity was reinforced through site visits to operational care facilities, engagement with healthcare professionals, and the application of healthcare design guidelines and standards. Students worked under the mentorship of faculty specializing in healthcare interiors and environmental design, and their projects were evaluated at midterm and final juries by panels composed of academic staff and external professionals from healthcare and design disciplines. These juries functioned not only as assessment mechanisms but also as critical feedback environments that shaped the iterative development of both the narratives and the design solutions. While situated in an educational setting, the case study reflects conditions, challenges, and design decision processes comparable to those encountered in professional healthcare interior practice, supporting its relevance and representativeness.

4. RESULTS AND DISCUSSION

An empathy-centered design approach in healthcare does more than generate creative ideas; it opens up possibilities for seeing the built environment as part of the healing process. What makes this approach distinctive is its ability to recognize that the people using these facilities often live with ongoing pressures and challenges, and therefore require spaces that are sensitive to their circumstances. The design work combined evidence-based research with narrative inquiry, using personal stories to reveal experiences that numbers alone could not capture. By grounding these narratives in empirical findings, the process strengthened the case for patient-centered care and helped to frame design decisions in ways that were both rigorous and humane. The resulting prototypes highlighted a range of empathy-driven features, from spaces that supported quiet reflection and spiritual needs to areas encouraging social connection, artistic expression, and even alternative medicine. Healing gardens, art therapy rooms, and advocacy spaces were included alongside waiting areas and infusion zones, giving patients a sense of choice and control. Across different solutions, empathy was interpreted in three main ways: as patient empowerment, as attention to the whole person, and as the creation of restorative settings. Each interpretation was shaped by stories and observations collected through interviews and site visits, which, when combined with the findings from benchmarking and EBD research, produced design strategies that were both innovative and firmly rooted in the realities of healthcare practice.

Beyond demonstrating that narrative inquiry supported empathy-driven design outcomes, it is important to consider why narrative proved effective in this context. From a cognitive and psychological perspective, narrative operates as a powerful meaning-making structure through which individuals organize experience, simulate social reality, and emotionally engage with others' situations. Unlike abstract data or functional briefs, first-person stories activate what cognitive psychologists describe as "mental simulation," enabling listeners and readers to imaginatively enter another person's perspective, anticipate emotions, and experience embodied responses. This process supports empathic concern by linking spatial conditions to human vulnerability, dignity, fear, or hope, rather than to isolated performance criteria alone. Neuroscientific and psychological research suggests that narrative engagement stimulates affective and perspective-taking processes that are closely associated with empathy, emotional resonance, and moral imagination, thereby allowing designers to perceive patients and caregivers not as user categories, but as whole persons situated within unfolding life contexts.

Narrative also fosters design innovation by restructuring how problems are cognitively framed. Instead of approaching healthcare interiors as technical problems to be optimized, stories present them as evolving human situations marked by tension, uncertainty, and relational complexity. This reframing encourages abductive reasoning, where designers explore possibilities, imagine alternative futures, and test speculative responses rather than applying predetermined solutions. In this study, narratives functioned as cognitive scaffolds that connected emotion, temporality, and environment, allowing design teams to identify latent needs that would likely remain invisible through conventional programming methods. By situating thermal comfort, spatial configuration, and sensory qualities within lived experience, narrative inquiry transformed performance variables into ethical and experiential design questions. It is this shift from problem-solving toward meaning-making that explains how narrative not only evokes empathy but also catalyzes creative, non-obvious design interventions in healthcare environments.

4.1 Design empowerment

This project centered on the design of a healthcare facility where empowering the patient was placed at the heart of the concept, raising the question of how interior environments can

actively support motivation and resilience. Unlike conventional treatment centers, the design intentionally avoided waiting rooms and instead introduced "empowerment zones" that welcomed patients, family members, survivors, and advocates into open and supportive spaces. The public empowerment space, illustrated in Figure 2, provided a central hub for advocacy and education with resources and activities reinforced by positive sensory cues such as freshly baked cookies at reception and large interactive touch screens. Moving vertically through the facility toward treatment areas, visitors entered the private empowerment zone, shown in Figure 3, which was designed for prayer, meditation, reflection, or quiet small-group interaction. These areas also encouraged reading, relaxation, and connection with nature, helping patients feel less constrained and more in control. Such design choices are consistent with research showing that access to social support environments can reduce stress and illness-related depression for both patients and families [43]. As the design developed, challenges emerged regarding the relationship between public and private empowerment spaces. At a midpoint review, jurors commented that although the idea of empowerment was clear, too much emphasis had been given to resource areas, resulting in separation between zones and a weak connection to clinical treatment spaces [44]. This feedback led to a rethinking of circulation and space allocation, shifting some program elements to strengthen transitions and create a more equitable distribution of areas. The revision ultimately reinforced empowerment as a continuous theme across the facility, rather than a concept limited to isolated zones, and provided a patient experience grounded in dignity, autonomy, and meaningful engagement.

Figure 2. The public empowerment space
Note: This figure was prepared by the authors

Figure 3. The private empowerment zone
Note: This figure was prepared by the authors

The design emphasized the importance of advocacy spaces that could serve patients, staff, families, and the wider community by providing access to new research findings, treatment options, and opportunities for outreach, as illustrated in Figure 3. These spaces were deliberately infused with technology so that patients and their families could also connect to the larger global community in a virtual way, which in turn offered another layer of empowerment. A further example is shown in Figure 4, where a story wall located near the radiation treatment area displayed five patient messages of peace and hope. This wall became a visual and emotional focal point for those passing through the corridor, combining images and words to reflect lived experiences in a way that was both moving and inspiring. The intent behind these moves was not only to improve the physical setting but also to signal a shift in the traditional healthcare relationship. Rather than reinforcing the old model where professionals controlled the flow of information, and patients were passive, the design sought to activate patients and families, helping them claim their place as central members of the care team [36]. Studies suggest that patients who are engaged in this way tend to report greater satisfaction with their care [45], while also benefiting from more continuity and quality through opportunities for choice and control [36]. In practice, the advocacy and learning spaces supported not only individual education but also social interaction, whether through online forums, access to reference materials, or participation in webinars and support groups. By situating knowledge alongside community-building, the design gave patients and families multiple ways to take ownership of their journey. At its heart, the project demonstrated how advocacy, education, and shared experiences could be translated into the built environment, helping patients and caregivers work together with providers as genuine partners in care.

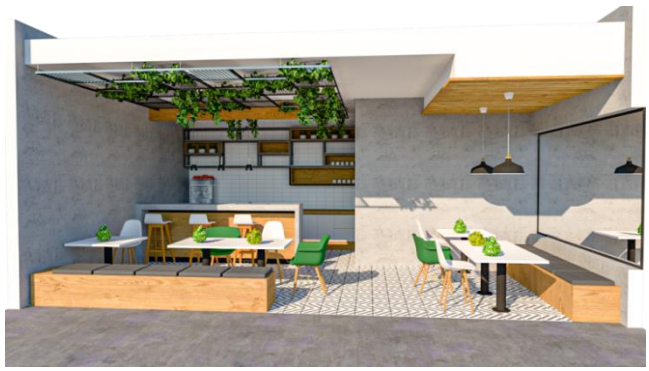

Figure 4. Advocacy center
Note: This figure was prepared by the authors

4.2 Healing design

The design work here was framed around the idea of healing, a theme that is broadly understood across cultures, and it drew heavily on the principles of biophilia. The intention was to create spaces that felt soft, embracing, and reflective, with an emphasis on quiet moments and the presence of nature. One of the main goals was that a healing garden could be seen from nearly every point in the facility, making it a constant reference. As illustrated in Figure 5, these gardens were shaped as three-dimensional pockets within the building itself. They established a very close connection with nature and also brought in water in several forms, moving, still, or dripping, so that the physical, emotional, and spiritual needs of users

could be addressed. These areas were visible from many parts of the facility, including the main lobby, radiation and infusion treatment areas, and a range of staff, patient, and family respite spaces. The common circulation route that connected the gardens was marked out with deliberate shifts in floor and ceiling treatments, which not only supported wayfinding but also reinforced the role of the gardens in orientation. This strategy acknowledged earlier research that links exposure to nature with lower stress levels and improved restoration, alongside other health benefits [43]. As the project progressed, the focus widened to consider not only patients but also other groups. This led to the introduction of an additional healing garden linked to a community café for patients, visitors, and staff. The café offered fresh food in a setting designed to encourage informal conversation and socialization, while staff respite spaces were deliberately relocated to sit alongside the gardens, giving caregivers a direct opportunity for renewal. In this way, the design narrative expanded to include a broader community of users, strengthening the idea of healing. The healing gardens were ultimately understood as a point of connection to beauty and restoration [36], reinforcing findings that design has a measurable impact on communication, satisfaction, and the overall healthcare experience [46]. As Hartley & Benington and colleagues note, design changes that make environments more comfortable and aesthetically engaging can reduce patient stress and improve perceptions of care quality [43].

Figure 5. Healing gardens
Note: This figure was prepared by the authors

In this project, particular attention was given to the creation of art therapy spaces, which were intended to provide opportunities for self-expression as well as moments of creative flow for both patients and their families (see Figure 6). These areas were conceived as flexible, open environments where social interaction could take place naturally, helping to foster a genuine sense of community. The decision to include such spaces is consistent with research that links positive distraction to a measurable reduction in patient stress [43]. The idea did not arise in isolation; it was informed by experiences with the local center's arts-in-medicine program, where patients, relatives, and staff engaged in a wide range of creative practices from drawing and painting to yoga and other forms of movement. This kind of participation revealed how powerfully the act of creating together can strengthen bonds across different groups, extending beyond the clinic to include university members and the wider community. Within the ambulatory facility, these encounters shaped a distinctive environment in which creativity itself became part of the healing process. At the same time, the design moved past aesthetics to acknowledge the needs of caregivers. Conversations with staff revealed a strong desire for restorative areas that contrasted with the typical break room, places where they could briefly step away, reflect, or regain composure in the face of the daily emotional demands of care. The healing gardens served this purpose, envisioned as small oases for staff while remaining open to patients and families. Moreover, each garden was planted with distinct species to create recognizable visual landmarks, reinforcing orientation and wayfinding throughout the building.

Figure 6. Art therapy spaces
Note: This figure was prepared by the authors

4.3 Human-centered design

Although this solution drew on ideas from earlier examples, it introduced its own distinctive qualities, shaped by the metaphor of the patient's journey. That journey was rarely solitary; rather, it involved caregivers, relatives, and friends whose roles shifted over time and whose presence carried different forms of energy and support. The design was therefore organized around flexibility, allowing treatment zones to be experienced as private, semiprivate, or shared, depending on the circumstances. The private treatment option (Figure 7) was intended to minimize stress and maintain dignity by offering full-height partitions with both physical and acoustic separation, while still leaving sufficient space for family or companions. Adjacent porch areas with views of nature opened further possibilities for reflection or conversation. In contrast, the semiprivate option (Figure 8) balanced individual privacy with opportunities for communal support and continuity of everyday life, for instance, by providing surfaces where writing or work could continue, a need voiced in family interviews. Some schemes even explored the potential for outdoor treatment when the weather allowed. During the midterm critique, however, questions were raised about circulation and functionality: how would staff move through the zones, how would supplies reach their destinations, and how would patients and companions navigate the facility? In response, circulation diagrams were developed to track these movements, prompting adjustments in spatial layout. These refinements reduced the need for staff "work-arounds," improved efficiency, and created clearer pathways for all users. In the end, the story was revised to incorporate these changes, underscoring how the interplay of movement, space, and relationships could meaningfully shape the healing environment.

Designing treatment environments provides an opportunity to move beyond spaces that only accommodate clinical interventions, towards settings that actively support a holistic model of care. Such environments should not only address symptoms but also recognize the central importance of patient

autonomy, choice, and control. Equally significant is the acknowledgement that care is rarely experienced in isolation; patients are almost always accompanied by family members and supported by healthcare staff. Research has repeatedly shown that the involvement of family can strengthen both the quality and continuity of care [36, 47]. Their presence reduces anxiety and stress for patients [43, 48] and contributes to higher levels of comfort and satisfaction [49, 50]. These findings point to a clear implication for healthcare design: treatment spaces should be configured not simply for efficiency of medical procedures but as environments that welcome family participation and foster collaborative, patient-centered care.

Figure 7. Private treatment option
Note: This figure was prepared by the authors

Figure 8. Semiprivate option
Note: This figure was prepared by the authors

Integrating narrative inquiry with thermal comfort simulation revealed inherent methodological tensions that required careful negotiation. Narrative approaches privilege subjectivity, multiplicity of meanings, emotional nuance, and divergent interpretation, whereas thermal simulation is grounded in objectivity, standardization, and convergent numerical outputs. In practice, this created productive contradictions. Narratives often articulated experiences of discomfort, vulnerability, or calm in ways that were ambiguous, context-dependent, and resistant to quantification, while simulation demanded fixed assumptions about metabolic rates, clothing insulation, and environmental parameters. This risked reducing complex lived experiences to simplified thermal variables, or conversely, allowing emotionally compelling stories to overshadow environmental performance constraints.

These tensions were reconciled through an iterative translation process rather than a unidirectional validation model. Narrative insights first framed the experiential problems such as anxiety in confined treatment corridors or emotional fatigue among staff while thermal simulation subsequently tested whether proposed spatial responses could physically support these experiential goals. When discrepancies emerged (for example, when a narratively desirable space configuration conflicted with comfort performance ranges), design revisions were undertaken to recalibrate both experiential intentions and environmental strategies. In this sense, neither narrative nor simulation was positioned as superior; instead, they functioned as complementary epistemic lenses, one generating empathic meaning and design direction, the other imposing measurable constraints and performance accountability.

The value of this integration lies precisely in what neither method can achieve alone. Narrative inquiry without simulation risks remaining at the level of evocative but unverifiable design intention, vulnerable to romanticization and limited technical rigor. Thermal simulation without narrative risks optimizing conditions for an abstract "average user," detached from the psychological, social, and ethical dimensions of care. Their combination enabled the study to bridge experiential depth with environmental credibility, transforming thermal comfort from a neutral technical criterion into an empathetic design instrument, and transforming narrative empathy from an affective stance into spatially and environmentally testable propositions. This hybrid approach thus supports a more holistic design epistemology in healthcare—one capable of addressing both how spaces perform and what they mean to those who inhabit them.

4.4 Design translation matrix

Patient narratives describing anxiety in confined clinical corridors led to substituting traditional waiting rooms with open empowerment zones emphasizing community, sensory positivity, and interactive technology.

Caregiver accounts highlighting emotional exhaustion directly informed relocating staff to respite areas adjacent to interior healing gardens for psychological restoration and visual relief. Family narratives expressing the need for togetherness during treatment shaped the creation of configurable treatment pods supporting fully private and semi-private/shared experience modes using full-height acoustic partitions or collaborative table-surfaces. These decisions evidence a traceable pathway from narrative-based emotion coding → spatial challenge identification → prototype revision → final interior configuration.

4.5 Recommendations for the CBE Thermal Comfort Tool

Figure 9 shows the results from the CBE Thermal Comfort Tool [1]. The analysis indicates that the thermal conditions in this scenario are ideal and comply with ASHRAE Standard 55:2023.

Based on the findings of this study and supported by the CBE Thermal Comfort Tool [1] and ASHRAE Standard 55, the following thermal parameters are recommended to promote comfort, health, and emotional well-being in healthcare environments (see Table 1):

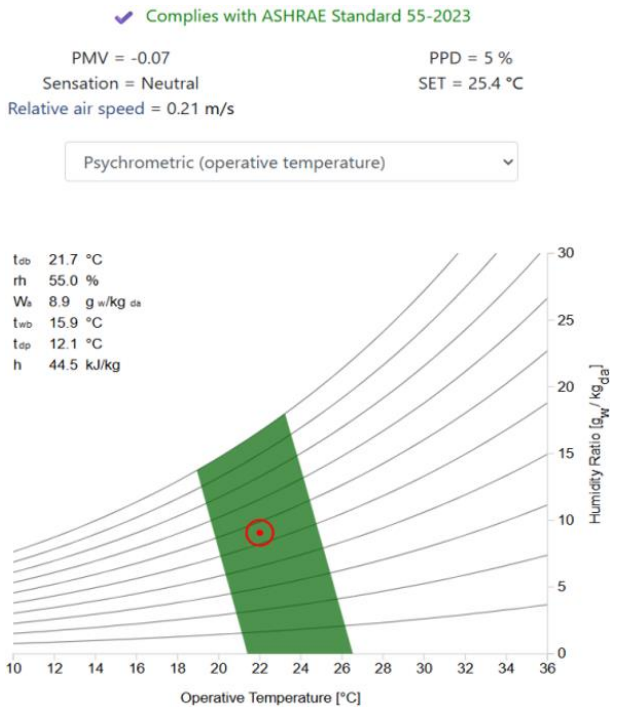

Figure 9. The CBE Thermal Comfort Tool
Note: This figure was prepared by the authors

Table 1. The CBE Thermal Comfort Tool

Indicator	Value
PMV = −0.07	Very close to zero, this means the thermal sensation is neutral, with no feeling of being hot or cold.
PPD = 5%	The Predicted Percentage of Dissatisfied is very low, only about 5% of people may feel slightly uncomfortable.
Sensation = Neutral	Confirms that the current temperature achieves a balanced and comfortable thermal sensation for most users.
Air speed = 0.21 m/s	Gentle, natural air movement is comfortable and free from draft discomfort.
Dry-bulb temperature (Tdb) = 21.7°C	The actual air temperature inside the space.
Relative humidity (RH) = 55%	Within the ideal range (40–60%), ensuring good comfort and respiratory health.
Wet-bulb temperature (Twb) = 15.9°C	Indicates good balance between air temperature and humidity within the comfort range.
Dew point (Tdp) = 12.1°C	Low enough to prevent condensation or excess moisture.
Specific enthalpy (h) = 44.5 kJ/kg	Represents the total heat content of the air suitable for air-conditioned environments.
Standard Effective Temperature (SET) = 25.4°C	Reflects the actual thermal sensation felt by the body; around 25°C is perceived as very comfortable.

Thermal comfort parameters were derived from environmental simulation outputs of six student design proposals, not one. Each proposal was modeled individually through the CBE Thermal Comfort Tool, and resulting comfort indicators (PMV, PPD, air speed, temperature, and humidity) were aggregated as mean values to represent overall environmental performance across the design cohort. Reported values (e.g., PMV = −0.07, PPD = 5%, Air speed = 0.21 m/s, Tdb = 21.7°C, RH = 55%) reflect the average of the six simulated design conditions, confirming consistent compliance with ASHRAE 55:2023 across all proposals, with minimal variance and neutral thermal sensation.

The results indicate an excellent balance between temperature, humidity, and air movement, providing a neutral and comfortable thermal sensation for nearly all occupants.

These conditions align with the recommendations of ASHRAE 55 (2023) and the findings of Al-Dweik et al. [1], confirming that achieving thermal comfort is a fundamental aspect of empathetic, human-centered healthcare design that promotes well-being, safety, and dignity.

While Table 1 reports thermal comfort indicators in numerical terms, the relevance of these values extends beyond physiological neutrality to the emotional and psychological experience of healthcare environments. Operative temperatures in the range of approximately 21–24°C combined with relative humidity levels of 40–60% correspond to conditions under which the human thermoregulatory system requires minimal adaptive effort. When the body is not occupied with correcting sensations of cold, heat, dryness, or dampness, cognitive and emotional resources are freed, reducing low-level physiological stress. Research in environmental psychology and healthcare design consistently indicates that thermally neutral environments are associated with lower autonomic arousal, reduced irritability, and improved mood stability, all of which contribute to subjective feelings of calmness and safety.

In healthcare settings specifically, thermal discomfort has been linked to heightened anxiety, restlessness, sleep disturbance, and reduced tolerance to pain or waiting, whereas thermally balanced environments support relaxation, attentional comfort, and a sense of bodily ease. This bodily ease plays a critical mediating role in trust formation: when patients experience physical comfort, they are more likely to perceive the environment as supportive, controlled, and professionally managed, which in turn fosters confidence in the care context and in those who operate within it. Within this study, the convergence of neutral PMV values, low PPD percentages, and moderate humidity ranges indicates conditions that minimize sensory distraction and physiological strain, thereby enabling healthcare interiors to function not only as technically compliant spaces but as emotionally stabilizing environments. Under such conditions, calmness is not an abstract aesthetic quality but an embodied response, emerging from the alignment between environmental performance and human perceptual thresholds.

4.6 Limitations

Despite the value of integrating narrative inquiry with thermal comfort simulation, several methodological limitations must be acknowledged. First, the primary narrative agents in this study were design students rather than patients themselves. Although narratives were informed by site visits, informal patient conversations, and engagement with healthcare professionals, the empathic reconstructions ultimately remain mediated interpretations. Students' empathy, while pedagogically and design-wise valuable, cannot fully substitute for sustained, systematic involvement of patients or vulnerable user groups. As such, the narratives may partially reflect designers' assumptions, cultural perspectives, or educational framing rather than the full

complexity of lived clinical experience.

Second, narrative methods carry an inherent risk of idealization and dramatization. The construction of first-person stories and experiential dialogues may amplify emotionally resonant moments while underrepresenting routine, ambiguous, or contradictory aspects of healthcare life. While this expressive quality supports engagement and creative exploration, it may also produce selective emphasis that privileges compelling scenarios over less visible but equally significant conditions. Without formal longitudinal qualitative protocols, narratives should therefore be understood as interpretive design instruments rather than empirical representations of patient reality.

Third, although thermal comfort simulation provided performance-based grounding for the design proposals, the absence of a physical or post-occupancy environment limits the practical conclusiveness of these results. Simulated comfort ranges demonstrate plausibility and compliance with standards, but they cannot fully capture dynamic interactions between occupants, building systems, materials, and behavioral adaptation. Consequently, simulation outcomes in this study function as design validation tools rather than predictive guarantees. Future research should extend this work through prototyping, full-scale mock-ups, or post-occupancy evaluations to empirically test how empathetic design intentions and thermal conditions are actually experienced in use.

5. CONCLUSION

This article argues for the use of narrative as a powerful means to create more meaningful and inspired healthcare environments. Through storytelling, designers are able to gain deeper insight into the lived experiences of those who inhabit these spaces, cultivating empathy and fostering a mindset that places patient-centered care at the forefront. The central challenge for all contributors to healthcare, whether clinicians, designers, or administrators, is to remain attentive and responsive to the preferences, needs, and values of patients, ensuring that these values guide both clinical decisions and spatial design. Narratives drawn from patients, families, and staff begin with individual experiences yet extend outward to shape lessons for broader practice. Integrating quantitative comfort assessment tools such as the CBE Thermal Comfort Tool enhances this process by providing measurable insights into the physical parameters that support emotional and psychological well-being. Well-crafted stories not only connect designers more profoundly to the realities of caregiving and healing but also serve as a vehicle for embedding empathy within the design process. In this way, narrative inquiry emerges as a method capable of unlocking human-centered design and ensuring that healthcare spaces reflect both functional and emotional dimensions of care.

Future research should extend this framework into real-world healthcare construction and renovation projects, where narrative inquiry can be embedded within participatory processes involving patients, families, clinicians, and facility managers, and where environmental simulations can be validated through full-scale prototyping and post-occupancy evaluation. Expanding the framework to integrate additional performance dimensions such as acoustic comfort, lighting quality, indoor air quality, and circadian support would further strengthen its capacity to address the multisensory nature of empathetic healthcare environments. Moreover, the development of digital or collaborative platforms that combine narrative collection, qualitative analysis, design translation matrices, and environmental performance tools could enhance interdisciplinary communication and operationalize this approach for professional practice. By situating empathy-driven narratives within an expanding ecosystem of measurable environmental indicators, future work can move this research from an educational case study toward a scalable methodology for human-centered healthcare design.

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