A Comprehensive Perspective On Innovation In Hospital Building Design: Recognizing The Background Of The Gap Between Research And Practice

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ABSTRACT
In the architecture industry, few sectors demand innovation and adaptability like healthcare design. The evolution of healthcare architecture has been marked by a constant pursuit of creating spaces that not only accommodate medical needs but also prioritize patient comfort, staff efficiency, and overall wellness. As we step into a new era, several trends are reshaping modern healthcare design, paving the way for enhanced healing environments. There is still a problem with moving research into innovations, even though there is an obvious demand for better hospital building design. The relationship between research and other factors influencing design innovation is not well understood, even though the literature identifies the Research/Practice divide as the key challenge. Taking a broader view of design, this research seeks to comprehend the innovation system in healthcare facility architecture. The Integral Design Framework was utilized to analyze the relationships between research and innovation in 77 highly cited articles. This was subsequently employed to plot the factors influencing two groundbreaking epochs in the history of hospital architecture. The findings paint an oversimplified image of innovation, implying that it happens at the intersections of diverse knowledge domains. Social changes, political decisions, architectural design trends, medical and technology breakthroughs are some of the essential aspects that have been found to affect new knowledge, which in turn has led to inventions. Research informing the design of hospital buildings has not had a holistic viewpoint, according to analyses using the Integral Design Framework, which has stifled design innovation. In order to spur innovation and reduce the Research/Practice divide, it is essential to re-formulate research questions in a more comprehensive manner.

Keywords: innovation, hospital, gap, healthcare design, architecture.

1. INTRODUCTION

The term "healthcare design" refers to an umbrella term for a wide range of disciplines that work together to improve patient care. These include, but are not limited to, architectural, information system, process, organizational, infrastructure, instructional, interaction, industrial, and building design (1). Despite the interconnected nature of healthcare facility design, this article focuses on hospital architecture as the most intricate sort. Research interests in the long-lasting impacts of hospital building design on patient healing processes, workplace performance and turnover, organizational efficiency, and emotions, self-esteem, security, and well-being have been generated by the recognition that 'place' can significantly impact these aspects of a person's life (2,3).

Despite mounting information on the consequences of healthcare facility design (4), many hospital building designers still fail to adequately explore these topics. (5,6) all agree that there is a widening gap (the R-P gap) between the research evidence base and design practice in architectural design. According to several sources in the field of healthcare, such as (7) the Research/Practice (R-P) gap prevents innovative hospital design, which in turn reduces the likelihood of improvements in occupant health and wellbeing and leads to repetition of similar shortcomings. According to the literature, the R-P gap is the most important factor influencing design innovation in hospital buildings. However, it is not yet obvious how research, various types of new information, and other variables interact to influence design innovation. By looking at the bigger picture of design, innovation, and research in this field, this paper hopes to shed light on the intricate system of innovation in hospital building design. What can we learn about the character of innovation in this setting from the peer-reviewed literature on hospital building

design? And how has new knowledge (research) interacted with other contextual factors in cases where innovation has affected hospital building design?
To gain a deeper understanding of the intricate system of hospital design innovation, this article proposes the Integral Design Framework, a system thinking approach that has been created to evaluate the value of research in the built environment from an impact-driven standpoint (8). With this framework, we want to do two things: first, get a more complete picture of what drives innovation, and second, zero in on the most important parts of innovation as they pertain to the built environment, considering the effects on four key areas of knowledge: building performance, user experience, policy/practice, and the economy/ecology. First, two case studies are analyzed to understand the historical background of innovation; second, the framework is used to map the interrelationships between research and innovation in the literature on hospital building design. When it comes to hospital building design, the study finishes by outlining the key aspects that affect the spread and development of new ideas.

2. BACKGROUND

2.1. Advancements in hospital architecture

According to various sources (9), innovation is the process of continuously improving an existing product, service, or business model in order to make it even better. According to (10), the innovation system components, and players in the network engage in a non-linear, non-sequential, and iterative process of value co-creation. In hospitals, the innovation system is comprised of several parts. First, there are the technologies, which are tools used by actors. Second, there are networked actors and human resources, who can solve problems and have opportunities to build their capacity. Third, there is infrastructure, which consists of institutions, policies, structures, and financial resources. Fourth, there is communication and collaboration, which allows researchers, innovators, and others to exchange ideas and interact. Lastly, there is knowledge, which includes data and indigenous knowledge that actors used, produced, or conveyed (11). It is worth mentioning that there is a startling lack of research on architectural innovation in hospital design. This section emphasises the significance of Research Informed Design and Evidence-Based Design as valuable tools for creating additional innovation and accomplishing group goals (12). Evidence-Based Design (EBD) is a branch of Evidence-Based Medicine (EBM) that uses the "current best scientific findings and evidence related to the physical environment's effects on wellbeing, and its critical interpretation to guide significant design decisions" (13). According to (7), research-informed design (RID) is "the process of applying credible research in integration with project-, client-, or population specific empirical inquiry" that guides design decisions. This method incorporates both existing scientific findings and new project-specific prototypes or research prior to building final designs. After reiterating "the importance of discovering new knowledge and feeding forward that knowledge to foster future innovations," the Centre for Health Design (2009) laid out an eight-step procedure for EBD.
A few organizations—including the American Institute of Architects, the Centre for Health Design, the National Institute of Building Sciences, the Federal Emergency Management Agency, and the Australasian Health Infrastructure Alliance—have compiled and updated design manuals that serve as guidelines for hospital construction and renovation in various nations. Improvements to the functionality and safety of healthcare facilities are frequently informed by such standards, which can be seen as an evidence base for hospital design. To minimise the R-P gap—the time it takes for research to inform guidelines and design practice—and make good use of such an evidence base, information must be updated continuously and in a timely manner. According to (14), most design is 'far below the optimal practice that the EBD research evidence says is attainable' since design practice is not keeping up with research in this area. In a similar vein, (14) discovered that although 73% of organisations often perform Post Occupancy Evaluation (POE) studies, the results are seldom utilised to enhance design and construction practices. Just as there were major roadblocks to EBM's growth, there are now major ones to the complete integration of EBD and POE into architectural practice.

2.1.1. The R-P gap refers to the discrepancy or lack of alignment between the requirements and preferences of patients (R) and the design and functionality of healthcare buildings (P).

The main barrier to innovation in hospital building design, according to the research, is a widening R-P gap (15). (16) all state that the following are negatively impacted by design decisions based on unsubstantiated ideas: hospital function, patient perceptions of healthcare organisations, hospital programmes and planning, the relationship between the hospital and its environment, patient healing processes, staff performance, emotiAs medical and technological progress quickens, the R-P gap widens, making the issue worse (17). When it comes to healthcare facility design, there are six main categories of factors that contribute to the R-P gap. To begin, research by (4) shows that the majority of design professionals are clueless when it comes to incorporating research into their work. Reason being, design

baccalaureate programmes sometimes overlook the significance of teaching students to apply research. Second, healthcare design is suffering from a lack of translational developers, scientific evidence that is difficult to understand, and short project timelines, all of which contribute to this misunderstanding (18).
The results of studies won't be used very often if people can't access or read them (15). As a third point, it might be difficult to generalise research results and even more difficult to convert unstructured scientific information into "tangible and meaningful design concepts" that can guide actual design choices (19). Fourth, doing EBD and bringing the findings into the design process is an extra expenditure for both design firms and clients (20). As (21) has stated, nearly all healthcare design decisions in North America are made by "experienced design practitioners" with a history of expertise and a thorough grasp of their customers' problems. Consequently, the fifth point is that established practice is often resistant to new data. Finally, researchers in the field of environmental behavioural design (EBD) rarely interview actual building occupants.
As a result, governments may not see design-centric knowledge, which makes policy translation difficult (4). Despite the extensive discussion surrounding the negative impacts and causes of the R-P gap in healthcare design, one could argue that the significance of this gap is exaggerated and reflects an incomplete or oversimplified understanding of the innovation environment of hospital building design. This article proposes systems thinking as a method for overcoming this myopia by expanding knowledge of the setting of innovation in healthcare facility design.
The majority of hospital design research has taken a multi-perspective approach, looking at topics such as building performance, the psychological and physiological effects of the built environment on users, and the policies and practices that contribute to the long-term viability of these concepts. Jones claims that a more methodical strategy is emerging because of the recently found transdisciplinary uses of design science (2014, p. 93). (1) state that designers may adapt to varied system difficulties by applying systematic design principles to different design results, such as product and service systems, information systems, and social organisational systems. The numerous moving parts that make up innovation systems in design, as well as the effects of the interactions between academia, businesses, nonprofits, and governments, are best understood through a systemic viewpoint (22). One way to look at design innovation from a systemic viewpoint is with the help of the Integral Design Framework. This work makes use of it as it was created with the express purpose of comprehending the effects of design research from a transdisciplinary perspective. The Integral Design Framework is an offshoot of several theories that have taken a systemic view of the built environment's design process (e.g., Integral Theory, Integral Sustainable Design, Systemic Design, and Innovation Ecosystems) (23). Figure 1 shows the four sections of the Integral Design Framework, which, in order of intended impact, characterise research in the built environment domain: On the one hand, we have "Products and Processes," which involves studying and enhancing performance (for instance, in relation to physical objects like buildings) (UPPER RIGHT (UR)); on the other hand, "People and End-users," which involves creating better user experiences via novel interactions among digital assets, physical locations, people, and technology (UPPER LEFT (UL)).
Culture and Society: on the lower left (LL) is a section on creating new policies and practices to enhance the functioning of culture and society.
Creating innovative services and company models that are compatible with the present economic and ecological circumstances (LOWER RIGHT(LR)) (8) states that...
It is believed that the knowledge that usually results in innovation and new value is located at the crossroads of the four quadrants. When new knowledge from one quadrant spreads and is adopted by other quadrants in the system, it can cause a transformative change. Therefore, systemic influence can be achieved by incremental systemic improvements (24). As an example, think about the cascading effects of process improvements: new experiences, new business models, new policies, etc. Various studies have introduced innovation frameworks for different purposes; however, most of these studies have sought to understand the following: the processes and outcomes of innovation; the drivers and effects of innovation; and the crosslayer interaction between science, technology, and business ecosystems (25). In healthcare, innovation frameworks have either looked at the effects of interventions on medical, service, and organisational facilities' capacity for innovation (11) or at the factors that drive the necessity of innovation (26). Instead, this paper proposes the Integral Design Framework to articulate the interconnections between healthcare facility design innovation and the interdisciplinary research that has accelerated these effects.

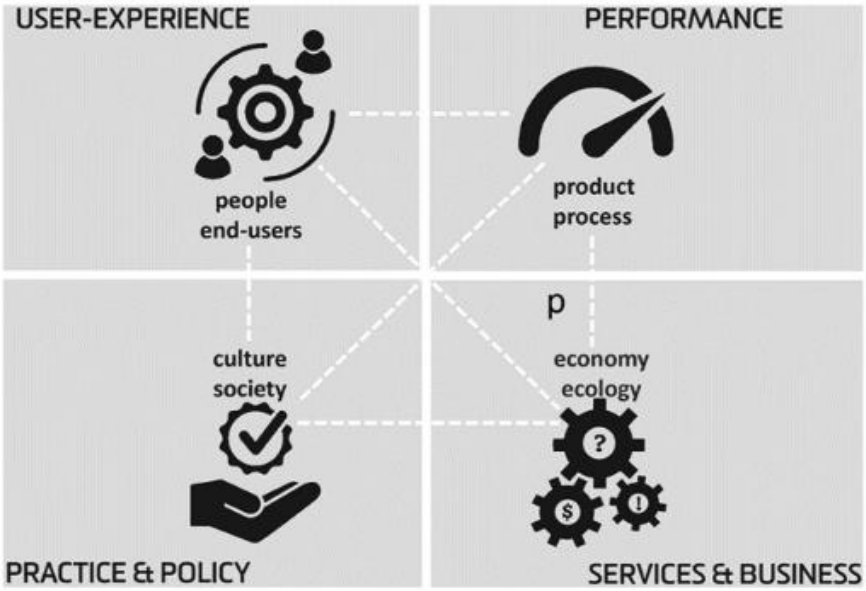

Figure 1. the four areas of impact for the architecture, engineering and construction sector for improvement (Kocaturk 2018).

3. METHODOLOGY

All three interconnected phases make use of the Integral Design Framework. To begin, it is employed to determine the knowledge domains that have contributed to this body of study by analyzing highly referenced publications within the framework of hospital building design. The next step is to use the framework to examine the areas of knowledge that have produced an effect. In this article, we look at two case studies that showcase innovative hospital building designs and analyze their respective circumstances. Third, the framework is used to examine seminal books on the development of hospital architecture to identify the driving factors for innovation. The framework provides a clearer understanding of the connection between innovation and the effect of research across these important texts. Thus, the Integral Design Framework offers an abductive method for charting the origin, development, and dissemination of design innovation in healthcare facility architecture. Here are the three steps of the analytical process: A- Frequently referenced research on hospital facility design was mapped using the Integral Design Framework. One problem with database searching, according to (27), is that you might miss some really useful material since there are so many different methods to build search strings, find synonyms, and set search constraints. According to several sources, including (28, 29), the snowball technique is the most effective and dependable approach when this problem arises in reviews of interdisciplinary research. This work follows the (29) snowball technique as the research is exploratory and focuses on several disciplines.

1- To start, we searched Google Scholar, Art and Architecture Resources, Web of Science, and Scopus—three of Elsevier's primary databases—to find the 24 most referenced publications on hospital building design. Based on an iterative process, the following terms were found to be the most commonly used in this field: ('hospital design', 'hospital environmental quality', 'hospital architecture', 'healthcare architecture', 'healthcare facilit*', 'healing environment*', 'hospital building design', 'healthcare building design', 'hospital physical characteristic') AND [('length of stay','safety', 'performance', 'energy','materials', 'air quality', 'daylight', 'thermal comfort', 'Indoor air', 'green building', LEED) OR ('well being', 'performance, wellness, stress, quality of care, perception', 'health policy', 'care philosophy')]). According to (29), the snowball method's acknowledged potential bias is reduced by using a wide variety of terms. Works published in English and subjected to peer review between the years 2000 and October 2019 were eligible for inclusion.

2- Then, both forward and backward snowballing were employed. Here, citation tracking databases (e.g., Google Scholar, Scopus, and the Web of Science Core Collection) were searched for works that cited the initial 24 papers. The lead author subsequently reviewed the abstracts and titles of any further publications that were found. We ended the forward and backward rounds after three cycles since we couldn't find any fresh and relevant papers in the fourth iteration.

3- Going forward, we examined the abstracts and conclusions of the 77 papers that were chosen after three rounds. According to the Integral Design Framework's four quadrants, the primary author assigned each study's major points and keywords to a specific node.

4- Lastly, a Radar chart was made to show the mapping that came from transferring the study to Excel.
b- The nature of the interaction between knowledge domains, contextual factors, and innovation was explained by mapping two case studies describing significant innovations—one from the 1980s and one from the late 1960s—against the Integral Design Framework. Because of their significance and the abundance of documentation surrounding them, these case studies were chosen to illustrate the development of hospital design. The wealth of information gathered from these two cases shows how many different factors affect design innovation across many different fields of study.
c- To further understand how various factors have influenced the transformation of information into innovative experiences, this study conducts a critical analysis of thirteen seminal works on the subject of hospital design evolution (30). Taken as a whole, these works trace the history of healthcare from the first wave of fast transformation following World War I, focusing on the so-called "developed countries" of the Americas, Europe, Oceania, and Oceania.

4. RESULTS

4.1. Evidence for the impact of place

There is mounting evidence from correlational studies that one's physical environment may have a profound effect on one's mental and emotional health as well as their sense of safety and self-esteem. When planning healthcare facilities, it is crucial to keep in mind the influence of the built environment on people's health and wellbeing. This is particularly the case when it comes to hospitals, the most intricate type of healthcare facility.
The correlation between hospital architecture and outcomes like reduced staff turnover, enhanced organizational efficiency, better workplace performance, and reduced risk of illness has been known to medical professionals, architects, and environmental psychologists for some time. Innovation in hospital building design has the potential to significantly impact healthcare quality, healing rates, and the elimination of inefficiencies and mistakes made in the past.

4.2. Investigating the relationships between integral design Hospital building design literature quadrants

the articles that were eligible were sorted into four columns according to the following criteria: people and end-users (UL), product and process (UR), society and culture (LL), and economics and ecology (LR). Take, for example, a research that seeks to increase the occupant experience and the building's performance. It would be labeled as UL. The interconnections between various fields of knowledge are then shown by mapping these codes in a radar graphic. A survey of the literature on hospital building design reveals.

4.3. Two examples of using the integral design framework to examine new product features

Earlier, we mapped the hospital building design literature using the Integral Design Framework to investigate the connections between different areas of knowledge and innovative design. In this study, we use the Integral Design Framework to analyze two case studies that illustrate two distinct eras of groundbreaking hospital building design—the late 1960s and the 1980s—and to determine how cross-domain interactions prompted and enabled these advances. In order to round out the first analysis, this second one asks how innovation has occurred in connection to developments in many supplementary areas of study and contextual factors. After being labeled as variables, the interconnected areas of knowledge are placed in the four corners of the Integral Design Framework: UR, UL, LR, and LL. Before the 1970s, the most extensive research, analysis, and development project carried out in the UK was the Greenwich District Hospital (1966–1969), according to the literature (31). Other hospital projects throughout the nation were influenced by the innovative architectural design ideas that came out of it. Here are a few examples of what's new: structural solutions like perimeter beams and structural columns; interior design that maximizes room flexibility and makes a good first impression; innovative service designs that shorten inpatient stays and encourage more outpatient treatment; extensive signage; and new approaches to indoor environmental quality (32).

Figure 3. Innovation Strategy

Francis et al. (1999) state that the Ministry of Health developed a model for a full hospital design by incorporating modern technical breakthroughs in medical, building construction, and hospital management. Following is an explanation of how these developments resulted from synergies between the policies and services put in place by the DHSS, RIBA, and EDRA, as well as the information gleaned from studies of both the physical and mental aspects of our built and natural environments. Figure 3 shows the location of the research and knowledge domain intersections throughout the four quadrants of the Integral Design Framework, where the innovative architectural design of Greenwich District Hospital took place. (33) note that since the early 1960s, when medical science and technology made great strides, architectural design innovation has mainly focused on mechanization and automation ideas to make hospital buildings more efficient and lower infection rates (UR). As a result of healthcare policy changes and economic downturn, the UK's National Health Service (NHS) building program, as well as research and development funded by the department of health and social security, were brought together in 1961 to publish the first health building notes (34). As a result of the pressing need to replace aging hospitals in an effective manner, health building notes for hospital service, hospital building cost, and district general hospitals were published. Significant progress in streamlining operational rules and procedures in medicine and nursing was generated from the health building notes, which reflected a convergence of efforts to enhance the facility's performance while also implementing innovative medical practices. The remarkable uniformity of hospital planning, design, equipment, and specification (across UR and LL) was a direct result of the information acquired across these disciplinary boundaries. In the '50s and '60s, researchers looked into the effects of the built environment on people's bodies and minds. Aiming to improve building performance and user experience (as specified in the Integral Design Framework across UR and UL), this research set out to do just that. A Design Team Operation component was required by the RIBA's 1963 Stage Mfeedback in order to evaluate the efficiency and efficacy of projects (35). Designers gained useful information for informing future designs from this new service's examination of building performance (UR and LR). Preiser simultaneously performed the first post-occupancy evaluation studies for a small number of building types, including UL and UR dorms and malls, respectively (35). First conducted in the United States in 1969, the conference was an environmental design research association gathering. The goal of this new venue for academics and practitioners was to improve the built environment's effects on people and its interaction with natural eco-systems (UL) by better study, education, and practice (EDRA, 2019). These new developments in research, together with changes in societal norms and the weight given to the opinions of patients, nurses, and architects, prompted fresh iterations of the design procedure (UL and UR). Enoch Powell, the British minister of health, suggested a 10-year plan to build hospitals, signaling a change in healthcare policy and political aim. Design standards (LL and LR) backed the program (36). The hospital buildings division of the department developed a set of standard operating policies and designs aimed at "a synthesis of the best current ideas in hospital policies, planning, building technology, environmental service design, and dimensional co-ordination" (UR and LL) in response to mounting demands for cost reduction in hospital building programs following post-war inflation (31). Along with these Greenwich hospital design advances came new regulations and

an increase in community care inside the National Health Service (NHS) hospitals (LL) (36). The second case study looks at how the late 80s saw innovative hospital construction designs. (37) described the patient-centered care approach as a novel paradigm for healthcare delivery that rethought every facet of patient care to boost quality while cutting costs. As an innovative aspect of their business strategy, the Plane-tree hospitals were the first to create it. Changes in healthcare policy and the introduction of new services following the introduction of private finance models were major factors in the development of the method and its guiding principles. Environmental trends towards sustainability are increasing the demand for enhanced energy performance, which in turn was fueled by information gained from research studies on the effects of the interior environment on the psychological wellness of occupants (UL, UR and LR). A broader view of the seminal events and groundbreaking research of the 1970s and 1980s is required to comprehend this innovation system (See Figure 4). Prior to the Private Finance Initiative's (PFI) 1991 launch, financial concerns remained paramount in hospital facility construction. During this time, the NHS sold NHS property to fund new constructions, created new policies, and encouraged research on space usage and cost reduction (UR, LL, and LR, respectively) (32). 'The required procedural framework for managing and processing NHS capital construction plans' was released in 1986 by the Department of Health and Social Security (DHSS) in response to budget shortfalls. The code was known as CARICODE. Newly formed service to oversee NHS hospital programming, planning, design, budget cost, construction, and commissioning was born out of the confluence of preexisting scientific knowledge with newly established policies and practices (34). There was a surge in the construction of private hospitals about the same time as the postmodern architectural style was on the rise; this prompted several design advances and improvements to the user experience and the building's performance in healthcare facilities (UL, UR and LR). (38) asserts that, as far as hospital architecture is concerned, "the tower lost its allure and hospitals spread horizontally."

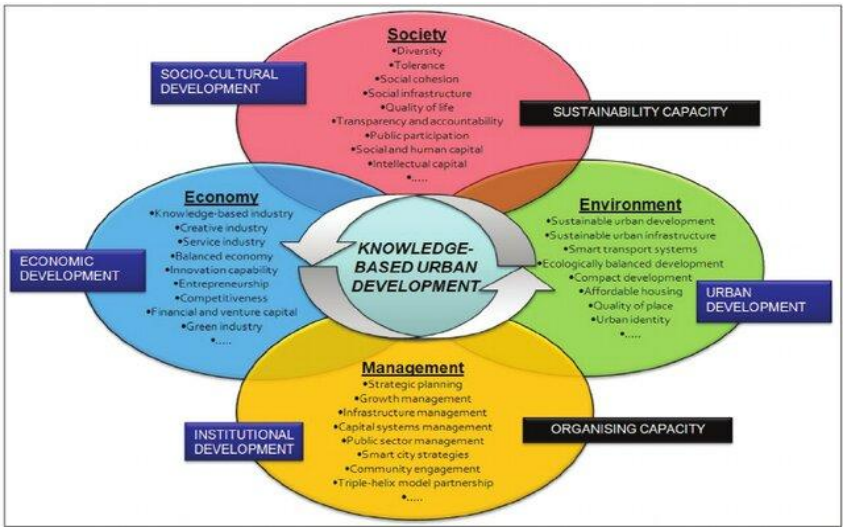

Figure 4. Local knowledge-based urban development (Edvardsson et al., 2012)

changing from towering and sleek to blocky and slippery. Some areas of the hospital were warm and welcoming, while others resembled commercial centers. Private rooms became the ideal, and hospitals shifted their focus from medicine to the patient. Hospitals began to provide funds for the purchase of artwork once architects uncover the restorative potential of natural settings (40). During this revolutionary phase, the Integral Design Framework was used to map the crucial research projects in the higher quadrants (See Figure 4). The field of environmental psychology has undergone two major transformations in recent decades, with the first being the "Social Shift of Environmental Psychology," which saw an emphasis on experiential and symbolic approaches rather than structural ones, and the second being the "Environmental Shift of Environmental Psychology," which saw an increase in the use of green design principles and other forms of sustainability. Notably, healthcare designers began to pay attention to evidence-based design (EBD) after the evidence-based medicine approach was successful (in 1972). Roger Ulrich released the first major EBD research in 1984 that looked at how a patient's natural surroundings affected their recuperation. His notion of helpful design followed in 1990 (32). In addition, Preiser and White produced the first POE textbook in 1988 (41), and developed nations carried out several notable POE studies on government buildings and public works projects. These studies lay the

groundwork for future advancements in hospital building design with an emphasis on the top quadrant of the Integral Design Framework, which deals with user experience and building performance.

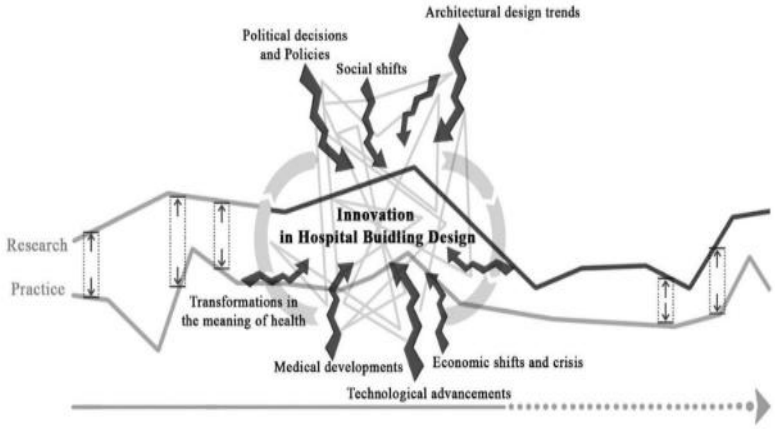

Figure 5. The impacts of various variables on innovation in HBD (the shifting gap between research and practice has been depicted randomly) (42).

5. DISCUSSION

With this research, we hope to better understand the interconnected systems of innovation in healthcare facility design and the factors that influence its spread throughout the field. This study was guided by two research questions. A primary question posed was, "What can we learn about the character of innovation in this setting from the literature on hospital building design?" Research shows that not many scholars have taken a methodical approach or viewed their field via a systematic perspective. That instance, one may claim that there has been no revolutionary shift or new value since there has been little meaningful research produced across knowledge fields. This discovery sheds light on the mystery of the R-P gap, a prevalent topic in discussions about the relationship between the amount of literature and the rate of innovation in hospital building design (7,15). "When innovation has happened and had an effect on hospital building design, what has been the relationship between new knowledge (research) and other contextual factors?" was the second study question. According to the first case study, innovative hospital building designs of the 1960s were greatly influenced by the economic crisis, changes in healthcare policy, and political intentions. The influence of research was accelerated by changes in societal expectations and advancements in medical science and technology, which allowed for the cross-pollination of information across many fields. The second case study, which focused on innovation in the 1980s, confirmed these findings. Our review of the literature and examination of two watershed periods in the history of hospital design innovation, taken as a whole, point to the importance of bridging gaps in knowledge across disciplines as a major roadblock to innovation. While studying the Integral Design Framework, most studies have concentrated on the top two quadrants, ignoring the relationships between them. In contrast, cross-domain knowledge has improved the development of new policies, design practices, services, and business models. Furthermore, the broader context of design, innovation, and research in this field is of critical importance. Although most previous studies have focused on how the R-P gap hinders innovation in hospital building design and the potential for occupant health and wellness improvements, these results imply that this perspective simplifies the broader innovation context (4,15). From what we can tell from a survey of seminal studies on the topic, a few factors and interrelationships play a substantial influence in the innovation and spread of hospital building design. Here, the historical process of design innovation is portrayed as complex and multi-dimensional. Because of the many other factors that affect the R-P gap in tandem with it, it is important to see it as only one component of a much larger and more intricate picture. Medical and technology breakthroughs, societal changes, governmental choices and regulations, conflict, and architectural design trends are just a few of the numerous aspects that may be seen when looking at groundbreaking times in hospital building design. According to (26), there are several reasons why the health sector needs innovation. These include shifting patient needs, new technologies, budget cuts, social concerns, supply chain necessities, sustainability obligations, and long-term health problems. As shown in Figure 5, the complicated background of hospital design innovation may be simplified diagrammatically. In this case, we see that the R-P gap is dynamic, meaning it changes over time in response to the different impacts of different contextual factors. (33, 38 and 43) all support this understanding of the complexity of innovation

dynamics, but they never provide a full description. According to these results, in order for research to be innovative and have a bigger impact, it needs to be rethought and reformulated. It is essential to understand the connections between innovation and the many contextual factors that affect the translation of hospital design evidence into design practice in order to influence future innovations. Because this broader innovation environment is obviously relevant to the attempts of healthcare architects, designers, practitioners, and legislators to improve hospital building design and reduce the R-P gap.

6. CONCLUSION

Improvements in care quality, healing rates, and efficiency, as well as the elimination of errors and inefficiencies, can be achieved via design innovation in hospital building construction, according to the literature. The number of studies conducted in this area has been growing, but unfortunately, very little new information has been derived from them. So far, the majority of studies have highlighted the R-P gap as the main challenge to innovation. The absence of timely innovation in hospital building design may be explained, however, by utilizing the Integral Design Framework to analyze innovation and the knowledge that is produced at the intersections of its four quadrants. Research that does not cross knowledge areas has stymied design innovation, according to this study. To back up this claim, we'll look at two critical times in hospital design innovation and the knowledge domains that sparked them, as well as the relationships between these domains and other factors that have spurred innovation in hospital design since World War I. As the combined studies show, the ecology of design innovation is complicated, and it would be a mistake to see the R-P gap as the main roadblock to advancement in hospital design. The authors of this study hope that academics, healthcare developers, policymakers, and stakeholders would rethink their research topics and use transdisciplinary methods to create a bigger splash. Knowledge should be generated by exploring the interdependencies throughout the four quadrants of the Integral Design Framework. Acquiring more of this information speeds up the process of design innovation, which helps bring the R-P gap down. The nature of the gap between research and practice is constantly changing due to social shifts, political decisions and policies, war, architectural design trends, medical and technological advancements, and other important variables and relationships that play a role in the evolution and diffusion of innovation. Revisiting important ideas influencing the R-P divide and laying the groundwork for future research are both made possible by comprehending the interconnectedness of these driving variables. These innovation factors, their interrelationships, and the effects they have on innovation processes and systems may be the subject of in-depth investigation in future studies. Improving hospital architectural design, raising health quality, and making better treatment for future patients all depend on studying these factors and how they interact to influence innovation in hospital design.

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