

THEORY TO PRACTICE OF EVIDENCE-BASED DESIGN IN HEALTHCARE: EXAMINING ULRICH' STUDY

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ABSTRACT

Evidence-based medicine (EBM) has clear roots in evidence-based design (EBD), an approach in which design decisions are supported by scientific evidence. The basic theoretical framework of EBD and its translation into scientific theory in the architectural field of the positive effect of environmental issues on healthcare settings was created by the pioneer, Roger Ulrich. This paper examines the implementation of EBD in healthcare environment design, exploring its transition from theory to practice, with a focus on the foundational principles of EBM. This study addresses the gap in the literature arising from the limited number of studies examining the methodological transition from EBM to EBD in depth, and by discussing this transition in its historical, conceptual and methodological dimensions, it makes visible the epistemological foundations of EBD in architectural design decisions and contributes to the literature by presenting a methodological framework for its applicability in the design of healthcare facilities. It also focuses on examining the analogies, parallels, relationships, and limitations of the transition from EBM to EBD. In addition, this paper dwells on the principles and contributions of EBD in healthcare architecture, taking into account the framework of Ulrich's pioneering work. It also evaluates the implications of this EBM-based approach on the discipline of healthcare architecture and presents a possible direction for future research and practice.

Keywords: Evidence-Based Design, Healthcare Environment, Evidence-Based Medicine, Ulrich.

1. INTRODUCTION

The roots of the evidence-based design are based on the rigorous observational approach of Florence Nightingale, who recognized strong relations between environmental conditions and the healing of the soldiers during the Crimean War and associated their mortality and morbidity with them statistically (Burpee, 2008). Nightingale's focus on improving welfare led her to write "Notes on Hospitals" in 1863, where she highlighted and systematically documented the impact of physical surroundings and social welfare on the healing environment for patients (Straus, 2011). Nightingale's groundbreaking and research-driven methodology serves as a beacon of inspiration providing a solid foundation that highlights the complex and vital connection between the design of built environments and the overall wellbeing of patients.

During the 20th century, the rise of evidence-based medicine, inspired by Nightingale's contributions, resulted in a fundamental change in the healthcare sector, promoting clinical choices grounded in the best existing research (Burpee, 2008). Evidence-based medicine (EBM) is a methodological approach that incorporates individual clinical expertise - drawn from a healthcare professional's years of practice and experience- with the best existing scientific findings gathered from rigorous and systematic research (Sackett *et al.*, 1996; Walshe and Rundall, 2001). Moreover, this approach has transcended its origins in healthcare and medicine, inspiring innovation in diverse fields such as architecture.

Healthcare environments are physical spaces where some individuals work while others receive care. These environments are recognized as an environmental factor that can

significantly contribute to addressing various preventable issues stemming from hospitals (Sadler, DuBose and Zimring, 2008). Recognizing that environmental factors positively influencing healing are key design elements, incorporating them into hospital design exemplifies the principles of "evidence-based design," a modern movement shaping today's healthcare facilities (Wagenaar, 2006). Evidence-Based Design (Figure 1), which originated in the 1980s and derives its name from Evidence-Based Medicine (EBM), is a practice in which hospital buildings base design-decisions about the built environment on reliable research to acquire the best healthcare and patient outcomes, such as human health, patient recovery, and the overall comfort of healthcare environments (Burpee, 2008; Shannon *et al.*, 2020). From an architectural standpoint, EBD approach encourages a re-evaluation of healthcare design based on health outcomes, influencing from program distribution within the hospital typology to the spatial layout and qualities. Additionally, this design approach considers the benefits for both patients and staff, along with environmental and economic advantages (Selçuk, 2022). It enhances ecological and social performance when integrated with a sustainably and appropriately designed healthcare environment (Ahmad, Verma and Kamal, 2023; Read and Meath, 2025). In this context, it dwells on the importance of considering spatial metrics that affect outcomes of humans and healthcare (Burpee, 2008).

Roger Ulrich, who is one of the pioneers of evidence-based design (EBD) in architecture, promoted the use of scientific data in the design of healthcare environment design. Ulrich's (1984) study found that patients benefit from having natural views from the hospital room windows. This study's findings supported the integration of nature into the design of healthcare buildings. It also contributed to the development of a new methodology for evidence-based design in healthcare architecture. Ulrich's work has created a link between architecture and health, supported by scientific data, ultimately arguing that healthcare spaces should be designed based on evidence to support patient recovery (Birinci and Birol, 2022).

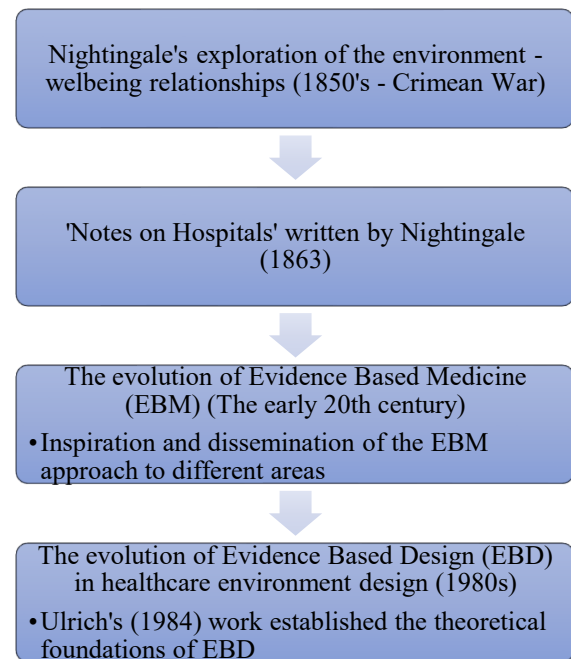


Figure 1. The development of Evidence Based Design (EBD)

The purpose of this study is to examine the transition and evolution of the evidence-based medicine (EBM) methodology used in the field of medicine to the architectural field as evidence-based design (EBD), and the realization of this change in the design of healthcare facilities, taking into account Roger Ulrich's pioneering work. This study aims to make a significant contribution to the literature by discussing the analogies, parallels and limitations in transformation encountered in integrating EBD which is reflection from EBM, into architectural practice, especially in the field of healthcare. While EBD is widely discussed in the context of healthcare design in the existing literature, the methodological transfer and transformation process between this concept and its origins, EBM, is often superficially addressed. In particular, comprehensive studies examining the conceptual and methodological dimensions of the transition from EBM to EBD are limited. This lack leads to a lack of visibility into the epistemological foundations of EBD in architectural design decisions, thus perpetuating uncertainties about how evidence is generated and used in the design process. This paper explores how the principles of EBM have influenced the formation and application of EBD in healthcare architecture. Therefore, by filling this gap in the literature, this study aims to offer two key contributions: First, it more fully defines the place of EBD in healthcare

architecture by relating its historical and methodological development to the EBM framework. Second, it aims to guide future research by providing a methodological basis for discussions on how EBD can be integrated into decision-making processes in healthcare facility design. While the study provides a methodological framework that increases the contribution of EBD to the architecture of healthcare environment and its reflections on care outcomes, it also includes important findings for future studies on how EBD can be applied more effectively in healthcare facilities design.

2. CONCEPTUAL FRAMEWORK OF EBD FROM ROGER ULRICH

The initial understanding of the evidence-based approach, considering the relationship between nature, human well-being, and care, was to some extent based on assumptions about their values or anecdotal evidence (Bates, 2018; Selçuk, 2022). In the 1980s, a more systematic analysis was introduced through Roger Ulrich's famous study, showing that patients with views of hospital gardens made quicker recoveries (Ulrich, 1984). Ulrich's work was pioneering in establishing the cornerstone of inspiring principles and practices in evidence-based design (EBD) in healthcare architecture (Figure 2). His work showed how such things as accessibility to nature, stress reduction, the role of daylight, noise reduction and acoustic control, wayfinding, and spatial organization can significantly influence patient outcomes (Hamilton, 2003; Burpee, 2008).

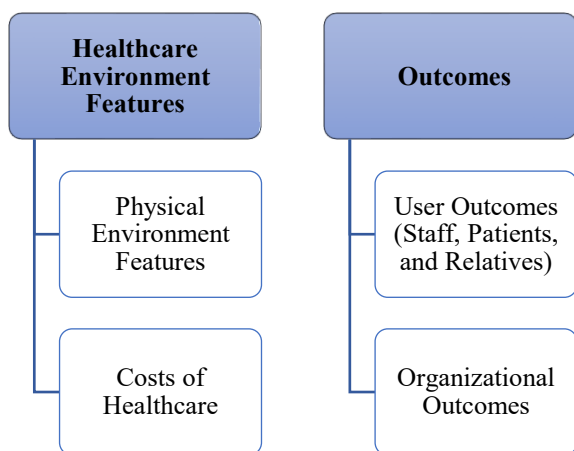


Figure 2. Theoretical Framework of EBD from Ulrich (2010) principles and practices (Altered from Selçuk (2022))

Roger Ulrich's work has made essential contributions to evidence-based design (EBD) by examining the reflections of the physical environments of healthcare facilities on patients and staff. Ulrich's (2008) research focused specifically on patient safety, emphasizing the importance of spatial arrangements to reduce infection rates, prevent patient falls, and minimize medical errors. Additionally, his studies on patient outcomes have demonstrated the positive effects of design elements such as natural light, green spaces, and acoustic control on pain management, stress levels, and length of hospital stay (Ulrich, 1984). In addition to focusing on patients, Ulrich's research focused on job satisfaction and the effectiveness of healthcare professionals. In time, the research based on Ulrich's work and considering EBD, increased in number in the healthcare design environment. On the other hand, research based on Ulrich's work has shown that spatial and physical designs, such as healing gardens, enhance patient outcomes and cut care costs (Sadler, DuBose and Zimring, 2008). Ulrich's work established the theoretical foundations of EBD, advocating the necessity of a human-centered design approach in healthcare buildings, and allowed this methodology to develop as an applied tool.

3. TRANSITIONING FROM EBM TO EBD AND ITS REALIZATION IN HEALTHCARE ARCHITECTURE

The evidence-based medicine (EBM) method that is grounded in clinical practice and scientific data analysis has recently gained popularity in medical practice (Sackett *et al.*, 1996) just as the healthcare design field has shifted towards analyzing the interrelation between the healthcare environment's design and the outcomes for individuals who use it—such as patients, staff, and visitors—to create spaces that enhance patient and care outputs (Hamilton, 2003). Applying this approach in the architecture is known as 'evidence-based design' (EBD). Therefore, based on available scientific evidence, EBM and EBD aim to increase the positive outcomes in their respective fields. At this point, there are some analogies and parallels in the transformation of EBM into EBD in the field of architecture, especially in terms of purpose. This section discusses the relationships in the transformation and how EBD is realized in the field of healthcare architecture.

3.1. Analogy between EBM and EBD

Although EBM and EBD, come from different fields, they share common similarities in their methodological perspectives. For instances, while EBM relies on the best existing evidence to support clinical decision-making (Sackett *et al.*, 1996), EBD informs design decisions with science-based evidence. These approaches aim to eliminate the gap between practice and research, and to build a bridge between theory and application. Clinical studies in EBM provide usable information and evidence to improve patient health outcomes (Hamilton and Watkins, 2008). Similarly, research considering EBD has also shown the positive impact of environmental design on patient safety, the healing process, and healthcare professional satisfaction (Ulrich, 1984). Moreover, the core reflection of EBM on EBD in healthcare architecture lies in their shared systematic research and outcome-driven processes to guide transformative changes in care environments.

On the other hand, another analogy between EBM and EBD gives priority to empirical data in the decision-making process to embrace a results-oriented approach. While EBM enhances standard procedures in clinical practice, EBD supports design standards to advance care outcomes in healthcare structures. The primary principle of EBM, that of considering best evidence for each patient care (Sackett *et al.*, 1996), is reflected in EBD by optimizing the spatial design considering available scientific research for individual and collective needs. These analogies show that both approaches are methodologies that emphasize the relevance of scientific knowledge in practice and that EBD bears similarities to EBM.

3.2. Parallels between EBM and EBD Methodologies

There are remarkable parallels between EBM and EBD, two similar methods in different disciplines, in their process-oriented nature and result evaluation approaches. Both methods offer a scientific evidence-based framework for decision making processes (Sackett *et al.*, 1996; Ulrich *et al.*, 2004). While EBM is based on systematic reviews and randomized controlled trials to improve patients' treatment processes (Sackett *et al.*, 1996), EBD relies on case

studies and empirical research to improve patient satisfaction and staff efficiency (Ulrich, 2001; Hamilton, 2003).

On the other hand, second strong parallelism is that EBM and EBD depend on a "hierarchy of evidence¹," which means they use empirical research to guide these processes and enhance healthcare outcomes. In EBM, meta-analyses and randomized controlled trials are considered high quality evidence, while in EBD, case studies, experimental data, and post-occupancy evaluations are used to guide decision making processes (Ulrich *et al.*, 2004). In this way, like EBM, EBD is accepted as a theoretical framework and a tool that provides applicable and measurable results.

Another parallelism is that both methodologies conclude by considering observability during the evaluation process in the field. While the efficacy of clinical interventions in EBM is usually assessed by patient outcomes, treatment responses, and mortality rates (Guyatt *et al.*, 1992), EBD assesses the outcome of design decisions through measures like patient satisfaction, recovery time, and healthcare professionals' job satisfaction (Ulrich, 1984; Ulrich *et al.*, 2008). For example, evidence obtained from the healthcare environment shows that some aspects, such as natural light and noise control, are very efficient in preventing hospital-acquired infections (Joseph, 2006). Thus, it demonstrates how evidence-based design (EBD)' is realized in healthcare facilities.

Finally, both methodologies emphasize the cost-effectiveness associated with applied outcomes. Just as EBM supports cost savings in unnecessary medical interventions, EBD provides that well-designed healthcare facilities lower patient care costs and enhance employee productivity (Sadler, DuBose and Zimring, 2008).

3.3. Problematic Issues during Transformations From EBM To EBD

While there are parallels between the transition from EBM practice to EBD in the healthcare architecture, the transformation is also fraught with challenges and limitations. The most

¹ Hierarchy-based evidence is a system in which scientific research is ranked according to its quality

and reliability (Tannenbaum, Stacy Sebastian and Sullivan, 2021).

fundamental limitation in the field of architecture is that while EBM benefits from controlled and measurable experiments and results, EBD often faces limitations due to the complexity of its variables and real-world constraints, as the design is an ill-defined problem (Zimring, Joseph and Choudhary, 2004). Moreover, EBM focuses on measurability and precision issues in medicine, since EBD focuses on a complex issue such as design, it limits the simultaneous measurability and therefore precision of many parameters such as spatial variables and subjective design decisions. While EBM generally works with rigorous methodological tools such as meta-analyses and randomized controlled trials (Sackett *et al.*, 1996), EBD has more limited methods for assessing the long-term effects of design elements (Ulrich, 1984). For instance, when investigating the effect of natural light on patient recovery, it is hard to isolate this effect from other environmental elements. In addition, another related challenge faced by EBD stems from the multidimensional nature of the design. Design elements (e.g. light, acoustics, use of color) interact with each other and it is extremely difficult to measure the impact of each element alone (Hamilton, 2003). This multidimensionality complicates efforts to precisely evaluate the effects of design decisions.

Another important limitation arises from the context-specific nature of EBD. While standard treatment protocols in evidence-based medicine can be generalized across a broad population, evidence-based design decisions are often tailored to specific geographies, cultures, or user groups. In this context, a design strategy that is appropriate for one hospital may not be effective in another local context (Joseph, 2006). While this increases the need for flexibility in the design process, it limits the capacity to produce generally valid evidence.

In the transition from evidence-based medicine to evidence-based design, the high costs of design-driven interventions constitute a significant constraint. While in EBM the cost-effectiveness of treatment protocols can be analyzed with clinical data, in EBD, these analyses require measuring the long-term effects of design elements. For example, studies on the effect of natural light on patient recovery have shown that such design interventions

shorten recovery time (Ulrich *et al.*, 2008). However, increasing windows or using sophisticated lighting systems to optimize natural light significantly increases construction and maintenance costs. In the study of Sadler *et al.* (2008), it was stated that healing gardens increased patient satisfaction, but the design and maintenance of these areas created serious financial burdens. Although this demonstrates that EBM is a generalizable method with relatively low-cost solutions, it highlights the costlier nature of EBD to investigate and is a more context-specific method.

Finally, although evidence-based design (EBD) is an effective method for enhancing patient and staff experiences in healthcare environment design, it poses a significant challenge in its implementation because long-term effects must be evaluated. EBM is focused on treatment outcome measurement in the short term, while the practice of EBD are more likely to occur over long time, and there is not enough research to systematically evaluate these long-term outcomes (Ulrich *et al.*, 2004). For example, the impact of acoustic regulations in healthcare buildings can affect not only patient satisfaction and stress levels in the short term, but also staff productivity and burnout rates in the long term (Hsu *et al.*, 2012; Johansson *et al.*, 2016). In addition, the methods used in EBD applications are often context-specific, as they may vary depending on culture, requirements, or changes in design, making it difficult to generalize long-term effects and draw universal conclusions from the evidence. The limited availability of research in the literature that systematically assesses the long-term impacts of design elements reduces the scientific credibility of EBD (Ulrich *et al.*, 2008). It diminishes its methodological strength relative to EBM. In the light of information, it underlines that advanced research methods and long-term study programs are needed to evaluate the lasting effects through EBD comprehensively.

The issues mentioned above indicate that transitioning from EBM to EBD is complex due to different disciplinary requirements. Moreover, it explains that these two methodologies have different dynamics and backgrounds in terms of their applicability in their fields.

4. CONCLUSION

Evidence-based approach, which started in the field of medicine with EBM, is a methodology that enables the effective use of scientific evidence in medical decision-making processes. As it became widespread in medicine over time, it created an exemplary profile in different disciplines and pioneered the emergence of similar methodologies that emerged as a reflection of this, such as EBD in the field of architecture. With the emergence of EBD in the field of architecture, the number of studies aimed at understanding the impact of environmental factors on improvement processes in healthcare buildings has begun to

increase. In this context, evidence-based design (EBD) has come to the fore in the discipline of architecture, especially in healthcare design, and has become a method that takes user experiences into consideration and supports human-centered design decisions. Roger Ulrich's work showing the healing effects of environmental factors in healthcare buildings formed the basis and main principles of EBD and played a pioneering role in the widespread application of this methodology in healthcare architecture. Ulrich's study that looks at the impact of design features like natural light, acoustic control, and green spaces, is a paradigm shift for healthcare architecture.

Table 1. Summary Tables of Findings between EBM and EBD

	EBM – Evidence-Based Medicine	EBD – Evidence-Based Design
Analogies	It supports clinical decisions based on best available evidence.	It supports design decisions with scientific evidence.
	It provides usable information and evidence to improve patient health outcomes.	It demonstrates the impact of environmental design on patient safety, the recovery process, and staff satisfaction.
Parallels	It is process-oriented with systematic reviews and randomized controlled trials.	It is process-oriented with case studies, empirical data, and post-occupancy evaluation.
	Outcomes are evaluated by patient recovery, treatment responses, and mortality rates.	Outcomes are evaluated by patient satisfaction, recovery time, and job satisfaction.
Problematic Issues	It is based on measurable and generalizable protocols.	It is limited to complex and context-specific variables.
		Long-term effects have been limitedly studied.

One of the issues that form the focus of this study is the analogies and parallels in the transition processes between EBM and EBD (Table 1). Although both methodologies are implemented in different disciplines, they have similar approaches in emphasizing decision-making processes based on scientific evidence. For example, in EBM, randomized controlled trials are considered the strongest source of evidence (Sackett *et al.*, 1996), whereas in EBD, case studies and experimental designs serve a similar role in evaluating the effects of design decisions (Ulrich, 1984; Hamilton, 2003). Furthermore, EBM's development of treatment plans based on individual patient characteristics is quite similar to how EBD focuses on its users' needs. These similarities and parallels between the two methodologies, as methods in two different disciplines, show that EBD has developed as an approach derived

from EBM and supports the need for scientifically evidence-based design decisions in healthcare environments.

On the other hand, in the transition from EBM to EBD, some problems have emerged in the applications of the two methods due to structural and methodological differences between disciplines. While EBM generally focuses on short-term clinical outcomes, the effects of EBD occur over the long term and generalizable results are difficult to obtain due to the context-specific nature of the design. In addition, while clinical data in EBM can be both generalized and measured more easily, since the field of EBD is part of a multidimensional study such as architecture and health, it is difficult to make both one-dimensional measurements and generalize the results. Despite these limitations in transformation, Evidence-Based Design has

become a method that contributes significantly to making design decisions in healthcare buildings based on scientific evidence and information.

As a result, this paper examines the transition process from EBM, a method in the field of medicine, to EBD, a method based on scientific data in the field of architecture, and the realizations of EBD in the field of health architecture and some limitations in its application. Future studies may contribute to broader acceptance of this methodology within the architecture discipline by focusing on assessing the long-term effects of EBD and resolving context-specific problems. In this way, the environment can be prepared for more sustainable and human-oriented healthcare facilities designed with design decisions in light of reliable results, as they are based on scientific data like EBD.

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