Evidence-Based Design and Research-Informed Design: What's the Difference? Conceptual Definitions and Comparative Analysis

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Evidence-Based Design and Research-Informed Design: What's the Difference? Conceptual Definitions and Comparative Analysis

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Abstract

Objective: This article provides critical examination and comparison of the conceptual meaning and underlying assumptions of the concepts evidence-based design (EBD) and research-informed design (RID) in order to facilitate practical use and theoretical development. **Background:** In recent years, EBD has experienced broad adoption, yet it has been simultaneously critiqued for rigidity and mis-application. Many practitioners are gravitating to the term RID to describe their method of integrating knowledge into the design process. However, the term RID lacks a clear definition and the blurring of terms has the potential to weaken advances made integrating research into practice. **Method:** Concept analysis methods from Walker and Avant were used to define the concepts for comparison. **Results:** Conceptual definitions, process descriptions, examples (i.e., model cases), and methods of evaluation are offered for EBD and RID. Although EBD and RID share similarities in meaning, the two terms are distinct. When comparing evidence based (EB) and research informed, EB is a broad base of information types (evidence) that are narrowly applied (based), while the latter references a narrow slice of information (research) that is broadly applied (informed) to create an end product of design. **Conclusions:** Much of the confusion between the use of the concepts EBD and RID arises out of differing perspectives between the way practitioners and academics understand the underlying terms. The authors hope this article serves to generate thoughtful dialogue, which is essential to the development of a discipline, and look forward to the contribution of the readership.

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In a 2011 survey, 72% of healthcare design professionals reported using evidence-based design (EBD; Taylor, 2011). However, much discussion has shown many of these individuals may not differentiate between EBD and research-informed design (RID), instead using the terms synonymously (Hamilton, 2014; Marberry, 2016). This ambiguity of terms hampers the theoretical development and rigorous application of both concepts. In a recent editorial, Stichler (2016) called for a greater clarity of the terms surrounding the use of research and evidence in the healthcare design process. While EBD has received focused scrutiny and a defined process, RID remains largely undefined (Cama, 2009; The Center for Health Design [CHD], 2008). This article serves to offer clarification of these concepts, their uses, definitions, processes, and historical context.

Although forms of evidence (e.g., standardized material testing, case studies) have long been used to inform building codes and design decisions, the term EBD has only been in existence since the late 20th century, and the first known definition of EBD did not occur until 2003 (Hamilton). In recent years, EBD has experienced both broad adoption and simultaneous critique for being too ridged and misapplied. Although the levels of evidence and methods for using EBD are becoming increasingly clarified (Pati, 2011; Stichler, 2010b; Taylor & Hignett, 2014; The CHD, 2009a, 2009b), it seems many practitioners are gravitating to the term RID, feeling that it more accurately represents their use of research in the design process (Marberry, 2016).

This concept analysis offers a critical examination of the conceptual meanings and underlying assumptions of the concepts EBD and RID in order to facilitate the practical use and theoretical development.

Methods of a Concept Analysis

Methods from Walker and Avant (2011) were adapted to structure this comparative concept analysis to include the following steps: (1) identify uses of the concepts in the literature; (2) provide a conceptual definition of the terms; (3) determine the concepts' attributes, antecedents,

and consequences; (4) describe model cases exemplifying the two concepts; and (5) provide implications for healthcare design practice. This concept analysis examines the concepts from many perspectives to understand the history, origins, and common uses of the concepts (Walker & Avant, 2011, p. 161).

The analysis begins with an investigation into the constructs of EBD and RID through addressing the constituent parts and terms of the concepts and their varied use and meaning across disciplines. Evidence-based practice (EBP) and research-informed (RI) practice span numerous disciplines, and a multidisciplinary literature is included in this analysis.

Background

At a foundational level, EBD and RID address the ways one acquires and applies knowledge to the design problem. Evidence is a source of knowledge; whereas research can be both a source of knowledge and the process of creating new knowledge. It is vital to understand the different types of knowledge and how they influence and apply to design.

All knowledge is not created equal—things that are measurable (e.g., temperature, time), and knowledge that can be gained systematically (e.g., explicit, observable), will naturally carry more scientific credibility than topics that are not directly measurable (e.g., emotional energy, creativity). Research is considered a form of explicit knowledge gained through observation and measurement and created through a deductive or inductive process, whereas evidence can be many forms of knowledge including tacit expert opinion or personal experience. Research is a systematic and scientific investigation that ultimately creates new knowledge. With replication of findings, this new knowledge becomes evidence that leads to EBPs. Although research findings may lead to evidence, the processes of research versus EBP (e.g., design, medicine, nursing) are significantly different. It is essential to make the distinction between *applying* evidence/research (e.g., EBD, RID) versus *creating* evidence/research (e.g., research; see Research section for more detailed description).

Research is a systematic and scientific investigation that ultimately creates new knowledge.

It is essential to make the distinction between applying *evidence/research (e.g., EBD, RID) versus* creating *evidence/ research.*

Uses of the Concepts in the Literature

Evidence-Based Medicine (EBM) and EBP

The foundations of the EBP movement are rooted in Archie Cochrane's book *Effectiveness and Efficiency: Random Reflections on Health Services* (1972). Cochrane urged those in the healthcare field to move away from basing decisions on anecdote, tradition, and theory and transitioning toward a more reliable source, evidence, and in particular randomized controlled trials. The first uses of the term *evidence-based* dates back to the early 1990s, when it was used to describe EBM by the Cochrane collaborative and the *Canadian Task Force for the Periodic Health Examination* (Brownson, Fielding, and Maylahn, 2009; Evidence-Based Medicine Working Group, 1992; Satterfield et al., 2009). EBM was defined as, "the conscientious, explicit, and judicious use of current best evidence in making decisions about the care of individual patients" (Sackett, Rosenberg, Gray, Haynes, & Richardson, 1996, p. 71). This new way of practicing represented a paradigm shift from traditional medicine toward a new model focused on the integration of clinical research in decision-making (Guyatt et al., 2000).

EBP has emerged as a unifying paradigm across a multitude of health-related disciplines (e.g., medicine, nursing, psychology), with a shared aim to enhance cross collaboration, accelerate the transfer of information and ideas between research and practice, benefit patient outcomes, and ensure value in care (Satterfield et al., 2009). Many forms of EBP, especially evidence-based (EB) nursing, have strong parallels with EBD in the methodology, theoretical development, and implementation in practice (Pati, 2011; Viets, 2009). The conceptual model of EBP developed by Satterfield and colleagues (2009) had five main components—(1) the best available research evidence; (2) client's/population's characteristics, state, values, needs, and preferences; (3) resources (including expertise); (4) environmental and organizational context; and (5) decision-making. These elements emerge as a unifying framework across all EBPs from EB psychology to medicine, nursing, and public health, and these elements should be considered as a part of EBD practices (Satterfield et al., 2009).

EBD: Defining Terms, History, and Use

Evidence. Although dictionary definitions describe evidence as something that demonstrates truth, proves, or is a visible sign of something else (Evidence, 2016a, 2016b), scientific definitions recognize evidence as, "any empirical observation about the apparent relationship between events" (Guyatt et al., 2000, p. 1292).

Evidence includes an array of sources of knowledge, ranging from systematic literature reviews to practice guidelines and expert opinions (Brownson et al., 2009; Pati, 2011; Stichler, 2010a, 2010b). Due to the range of knowledge, the scientific world has a hierarchy of evidence with meta-analyses of randomized controlled trials as the strongest evidence, and opinions of recognized experts, or case studies, as the weakest evidence (Table 1, adapted from Pati, 2011; Stetler, 2002; Stichler, 2010a).

When assessing the strength of evidence to inform decision-making, one must weigh the quantity (e.g., number of studies, sample size), quality (e.g., rigor), appropriateness (e.g., applicablity to context), and the feasibility (e.g., degree of difficulty of successful implementation) of the evidence contribute to its strength in informing decision-making (Pati, 2011; Stichler 2010a). Critical appraisal tools (CATs) are helpful to systematically evaluate the quality of evidence and strength of recommendations from a body of evidence or research. Using these CATs helps to assess the validity, reliability, potential limitations (e.g., confounding variables, sample size), and relevance of the evidence and can

Table 1. Levels of Evidence for Healthcare Design.

Level 1 (strongest)	Meta-analysis and systematic reviews of randomized controlled trials or experimental studies
Level 2	Single experimental study (randomized, controlled)
Level 3	Single quasi-experimental study (e.g., nonrandomized, concurrent, or historical controls)
Level 4	Systematic, interpretive, or integrative review of multiple studies of observational or qualitative research
Level 5	Single nonexperimental study, correlational, descriptive, mixed methods, and qualitative research
Level 6	Published evaluation data (e.g., facility evaluations, mock-ups) that were systematically collected and were verifiable
Level 7	Consensus opinion of authorities (e.g., a nationally known guideline group with strong peer review)
Level 8 (weakest)	Opinions of recognized experts, case studies

Note. Adapted from Pati (2011), Stetler (2002), and Stichler (2010a). These levels should be used in conjunction with critical appraisal of quality at each level.

greatly strengthen one's understanding of the strength of EB recommendations from a body of research (Crowe & Sheppard, 2011; Taylor & Hignett, 2014). These forms of appraisal are also heavily used in research to assess single articles and bodies of combined research. For a deeper dive into the frameworks and tools that critically appraise and evaluate evidence, see Crowe and Sheppard (2011); Pati (2011); and Taylor and Hignett (2014).

Even in disciplines with a comprehensive body of evidence, there still exists the real possibility that there is insufficient evidence for a given clinical or practice question (Pati, 2011; Stetler & Caramanica, 2007). For this reason, definitions of evidence may also include data generated through nonscientific means that still provide evidentiary support (Pati, 2011). Evidence can be divided into *external* (e.g., published research, recognized guidelines) and *internal* (e.g., quality improvement projects, the health system's data on patient and staff

outcomes), both of which are considered a valuable part of decision-making (Pati, 2011; Steler & Caramanica, 2007).

Based. Common definitions depict a *base* as the fundamental principle, groundwork, or foundation (Based, 2016a, 2016b). For a word or concept to be based on something else, it must encompass the fundamental principles, central aspects, and essential framework of the original notion in order to build support for a new model or idea. This suggests that evidence frameworks and knowledge bases are the essential foundation of EBD.

EBD. The origins for EBD in healthcare environments trace back to Nightingale's *Environmental Theory* (Nightingale, 1863) and became increasingly popularized with Ulrich's (1984) landmark study, which showed the impact of a window view on patient recovery. EBD draws on the established disciplines of environmental psychology and other fields that have provided a body of research, built over the last 60 years or more, that examines how the physical environment impacts the way people think, feel, and behave (Barker, Wright & Gonick, 1953; The CHD, 2009a, 2009b). The foundations of EBM have provided the genesis for EBD methods and theory development.

The first recognized definition of EBD was in 2003, when Hamilton outlined EDB as "the deliberate attempt to base design decisions on the best available research evidence" and that "an evidence-based *designer*, together with an informed *client*, makes decisions based on the best available information from research and project evaluations." This definition drew inspiration from the definition of EBM (Sackett et al., 1996). Hamilton (2003) proposed four levels of EBP for healthcare designers that address how the evidence is implemented into practice and disseminated. In that defining article, RID is used interchangeably with EBD, adding to the conceptual confusion of this foundational term (Hamilton, 2003).

The CHD defined EBD as "the process of basing decisions about the built environment on credible research to achieve the best possible

outcomes" (2008, p. 1). However, this definition has received much debate into what constitutes credible research and application, and there has been a shift to critically examine the research study's generalizability, applicability, methodological clarity, fidelity, and overall quality (Moore & Geboy, 2010; Pati, 2011; Rashid, 2013; Taylor & Hignett, 2014). While not explicitly stated in the definition, the expanded the CHD model of EBD emphasizes the importance of working in partnership with the client and interdisciplinary team to foster understanding of the client and population needs, preferences, and resources (Cama, 2009; The CHD, 2009b).

The CHD (2009a) formalized an eight-step process of EBD that includes "(1) define evidence-based goals and objectives, (2) find sources for relevant evidence, (3) critically interpret relevant evidence, (4) create and innovate evidence-based design concepts, (5) develop a hypothesis, (6) collect baseline performance measures, (7) monitor implementation of design and construction, and (8) measure post-occupancy performance results" (p. 2).

However, EBD scholars continued to craft their own understanding of an EBD process that fits within a larger *EBP* context (Hamilton & Watkins, 2009; Marquardt & Motezek, 2013; Stichler, 2010a). For instance, Marquadt and Motezek (2013) offer a counter EBD process, starting with defining of a research question and strategy, selecting papers, appraising the research quality, weighing the evidence, developing design recommendations, and implementing and evaluating design decisions (see Table 2 for a comparison of EBD, research, and RID process steps).

The term EBD may mistakenly conjure images of concrete proof of the "right" design decision for different facility types. This misconception may be caused in part by the difference between the commonly used definition of evidence as "proof," versus the scientific understanding of evidence, which divides evidence into gradients where only the highest levels can start to show causation. There are anecdotes of practitioners inaccurately viewing EBD as a set of solutions or interventions that can be directly and universally applied to the physical environment (Cama,

2009; HKS Inc., 2011). However, it is the *process*, not the product, of EBD that is emphasized as valuable (The CHD, 2009b).

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RI Practice and Informed Design

RID is a much less developed concept, lacking a defined meaning or process. For this reason, it is vital to draw on parallel concepts from other fields. The bulk of the existing literature on "research-informed" practices comes out of the education discipline, and not from healthcare related disciplines (Bentley et al., 2013; Meyer, Bowden Templeton, Stinson, & Codone, 2016; University of Bedfordshire, 2010). Research-informed teaching (RIT) strives to thoroughly understand current issues and perspectives that inform the development of teaching curriculum through literature review and empirical investigations (Bentley et al., 2013, p. 3). RIT engages students in both secondary research (e.g., literature review) and original research (e.g., empirical, observational) as a part of the educational and problem-solving process. Similarly, RI curriculum design (Bentley et al., 2013) and informed design (Burghardt & Hacker, 2014) processes involve the same two components (i.e., literature review and empirical investigation during the design phase) and applying these components in an iterative process to create something new. The informed process involves using the combination of existing research and combining that with a personal, project-based inquiry to increase the level of confidence in the final product's ability to achieve its design objectives.

RID: Defining Terms, History, and Use

Research. The research process includes "the systematic investigation into and study of materials

Table 2. Matrix of Steps for Research, EBD, and RID.

Steps	Research	EBD	RID
	Adapted from Polit and Beck (2008) and Stichler (2010b)	Adapted from the Center for Health Design (2008)	Adapted from Burghardt and Hacker (2014)
1	Identify problem, research question, or hypothesis(es)	Define evidence-based goals and objectives (with client and interdisciplinary team)	Clarify design problem and project-based goals and constraints
2	Perform literature review	Find sources for relevant evidence	Identify research on related problems and populations
3	Use of a theoretical framework to explain the relationships among variables	Critically interpret relevant evidence, assess evidence applicability, quality, and strength	Assess research applicability, quality, and strength. Use research to assess variables that affect performance
4	Select an appropriate research design to test the hypothesis	Create and innovate EBD concepts	Use knowledge gained from Steps 1–3 to generate design options
5	Identify measurements to quantify variables	Develop a hypothesis	Design evaluation, choose the best option using research to weigh pros/cons
6	Select the sample	Collect baseline performance measures	Develop a prototype (e.g., virtual, physical)
7	Data collection and analysis	Monitor implementation of design and construction	Design testing, evaluate prototype using empirical observation or testing with target audience
8	Statistical and data analysis	Measure post-occupancy performance results	Iterative improvement, use results from testing to drive greater research inquiry, to improve, and to iterate the design process
9	Disseminate results in publications and presentations including study limitations, recommendations, and implications for practice	Disseminate post-occupancy performance results through publication and presentation	Communicate process, share process and lessons learned

Note. EBD = evidence-based design; RID = research-informed design.

and sources in order to establish facts and reach new conclusions" (Research, 2016b) and, in contrast may be used commonly to mean, "the activity of getting information about a subject" (Research, 2016a). Research is defined as a "systematic investigation, including research development, testing and evaluation, designed to develop or contribute to generalizable knowledge" (Protection of Human Subjects, 2009, p. 9).

Research creates new knowledge; is systematic, rigorous, generalizable and hypothesis-driven, or theory based; and includes the transparency and the dissemination of findings (Protection of Human Subjects, 2009; The Belmont Report, 2016). Research is both a process of producing knowledge as well as a form of

knowledge. Research can be qualitative (e.g., patient interviews, observation) or quantitative (e.g., number of patient falls, satisfaction scores). Research can be used as a type of evidence for decision-making and constitutes many of the higher levels of evidence (e.g., experimentation, meta-analysis); however, it only makes up a small slice of the available evidence on a topic.

Informed. Common definitions characterize *informed* as having information or being prepared with knowledge (Informed, 2016a, 2016b). An informed individual is able to utilize data, information, and knowledge to guide their decisions in the appropriate manner.

RID. Currently, there is no operational definition of RID related to the design of the built environment; this article serves to fill that gap. The earliest mentions of RID in healthcare design originated from the same article where EBD was first defined (Hamilton, 2003). There have been a number of publications that have used the words interchangeably (Hamilton, 2003, 2015; Stichler & Hamilton, 2008).

One of the only examples of the term RID being used in the architectural design literature without reference to EBD is "research-informed design principles" for Alzheimer's design (Geboy, 2009, p. 217). A veteran environmental design researcher, Geboy, argues that being "informed by" rather than "based on" research provides more latitude for designers to apply professional expertise and first-person investigation (e.g., site tours, user engagement; L. Geboy, personal communication, September 3, 2016). L. Geboy stated, "the goal of both [EBD and RID] is the same—trying to increase the level of confidence [in design decisions], but from my perspective, the term 'informed' provides the pathway for allowing a designer's practice knowledge to come through in the design solution" (personal communication, September 3, 2016). This sentiment is echoed in the parallel multidisciplinary definitions of informed processes from the above section.

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EBD and RID: Comparing Terms, History, and Use

Comparing the concept of EBD and RID reveals assumptions for both. *Evidence* is broadly defined to include a range of information from expert opinion and case studies to systematic reviews. *Research*, however, is narrowly defined to include only systematic investigations such as
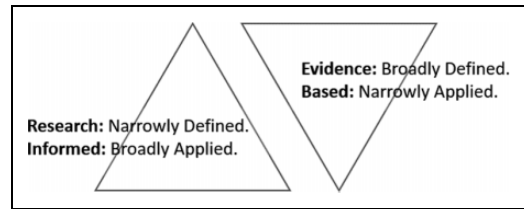

Figure 1. RI vs. EB comparison. Evidence is broadly defined including a range of information from expert opinion, case study, to systematic reviews, and so on. Research is narrowly defined including only systematic investigations, such as systematic literature review and controlled studies. Based is narrowly applied requiring that decisions can be founded on a base of existing knowledge; whereas informed is broadly applied incorporating information as a part of decision-making.

observational studies, systematic literature reviews, and experimental trials. Additionally, the term *based* is narrowly applied requiring that decisions can be founded on existing knowledge; whereas *informed* is broadly applied, incorporating information as a part of decision-making (see Figure 1).

Critical Attributes, Antecedents, and Consequences

Antecedents and Consequences

Antecedents of RID and EBD closely align; they include the presence of a design problem or project, the availability of relevant evidence and/or research, the motivation to improve decision-making, and a designer and/or team that is educated in, or open to learning, the process of using an EBD or RID approach.

The current literature indicates that consequences of EBD and RID include the production and dissemination of additional evidence, the design of a physical environment, improved design decision-making, and improved outcomes. Although improved outcomes (e.g., safety, quality, return-on-investment) are assumed to be a consequence of EBD and RID, there are limited empirical studies to demonstrate the consequences of these processes as they compare to traditional processes. The evidence that comes from an EBD process can come in many forms, foremost from postoccupancy results, indicated

Table 3. Matrix of Critical Attributes for EBD and RID.

Attributes	RID	EBD
Process	Identification of problem and goals; iterative testing, learning and application; and part of project delivery schedule	Identification of problem, goals and vision fluid inclusion of the eight-step EBD process as part of project delivery schedule
Resources	Credible research, empirical exploration, and client and population information	Credible evidence, interdisciplinary team expertise, and client and population information
Evaluation	Evaluation of research strength, quality, and applicability; testing/prototyping to facilitate design decisions; and evaluate design alternatives	Evaluation of evidence strength, quality, and applicability, and measurement of impact after completion
Application	Apply knowledge gained from project-specific empirical inquiry, prototyping, and research literature review to inform an environmental design	Project specific, context dependent, application of evidence, and client preferences to create an environmental design
Goal orientation	Focused on continuous improvement in designing to achieve project objectives within given constraints (e.g., design that meets the needs of the client and population) and share process and lessons learned	Focused on designing to achieve project objectives (e.g., patient outcomes) and add evidence for future projects through post-occupancy results
Definitions	*RID*: The process of applying credible research in integration with project-, client-, or population-specific empirical inquiry to inform the creation of environmental design and achieve project objectives	*EBD*: The process of making decisions about the creation of an environmental design by critically and appropriately integrating the sum of credible evidence, practitioner design expertise, client or population needs, and preferences and resources, in the context of the project, in order to achieve project objectives

Note. EBD = evidence-based design; RID = research-informed design.

as the eighth step of the EBD process, in order to demonstrate measurable change in outcomes (The CHD, 2009a). However, the evidence that comes from an RID process is most likely to come from testing and evaluation done during the design process. EBD requires an interdisciplinary design team to include owners, users, consultants, designers, and researchers (The CHD, 2009b, p. 8). Having representation from diverse perspectives and individuals with research expertise is an important part of successful RID processes as well.

Critical Attributes

Critical attributes are outlined in Table 3. EBD is inherently focused on the *goal* of improving healthcare quality outcomes (e.g., patient safety, efficiency). This goal is endeavored through the eight-step process of EBD, using the knowledge *resources* from the existing body of evidence, along with a client and interdisciplinary team. EBD requires *evaluation* and appropriate *application* of the available resources to design an environment.

RID demonstrates a focus on meeting the goals and needs of the client and the population. This is achieved through the use the *resources* of existing research as well as empirical testing and prototyping throughout the design phase to *evaluate* possible design solutions. This knowledge is *applied* iteratively to the creation of a final design that meets the project-specific goals within existing constraints. Sharing results (i.e., knowledge gained through processes or measured outcomes) is a goal of both EBD and RID processes.
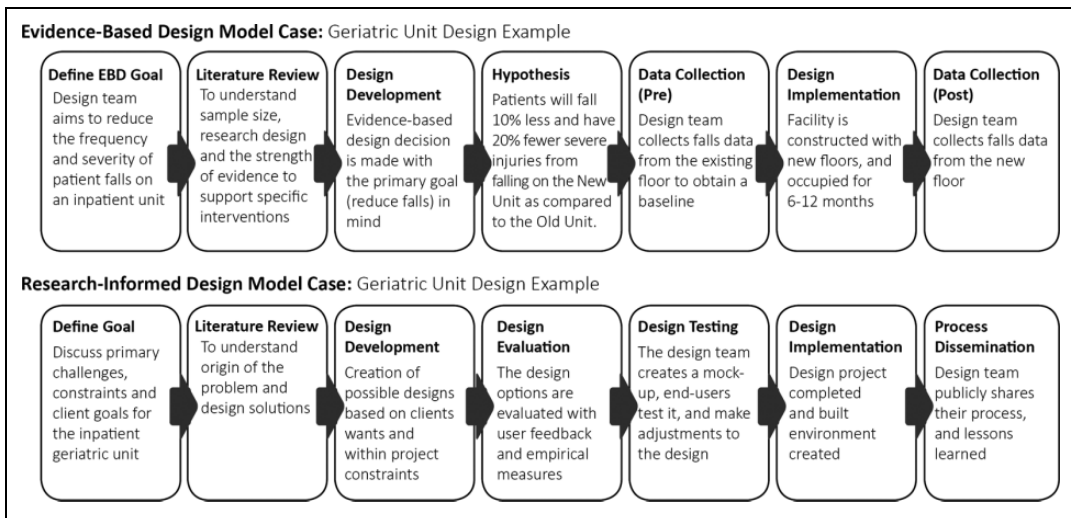
Figure 2. Model case examples of evidence-based design and research-informed design using an example geriatric inpatient unit design.

Model Cases

Examining the processes outlined for EBD and RID reveals both similarities and differences in their application (Burghardt & Hacker, 2014; The CHD, 2008). The following model cases serve to explicate how the RID and EBD processes can look when applied to a project (see Figure 2). The model case uses an example project from the perspective of a team designing a geriatric inpatient unit.

Definitions

Based on this analysis, it is proposed that EBD can be defined as the process of making decisions about the creation of an environmental design by critically and appropriately integrating the sum of available, credible evidence, practitioner design expertise, and client or population needs, preferences, and resources, in the context of the project, in order to achieve project objectives. This definition has been modeled from numerous established definitions and defines the client as a constituent that the environment is meant to serve, for instance, the patient, clinical organization, and end user of the environment (Hamilton, 2003; Institute of Medicine, 2001; Moore and Geboy, 2010; Sackett et al., 1996; Satterfield et al., 2009; The CHD,

2008). Figure 3 demonstrates the proposed conceptual model for EBD.

EBD can be defined as the process of making decisions about the creation of an environmental design by critically and appropriately integrating the sum of available, credible evidence, practitioner design expertise, and client or population needs, preferences, and resources, in the context of the project, in order to achieve project objectives.

Although RID has been discussed for many years, no known definition of RID has yet been published. Based on this analysis, it is proposed that RID can be defined as the process of applying credible research in integration with project-, client-, or population-specific empirical inquiry to inform the creation of environmental design and achieve project objectives (Bentley et al., 2013; Burghardt & Hacker, 2014; Moore & Geboy, 2010). *Credible research* includes qualitative, quantitative, and mixed methods approaches with the highest standards of rigor suitable for their methodology. *Empirical inquiry* is original observation, prototyping or experimentation (e.g., mock-ups, interviewing users,
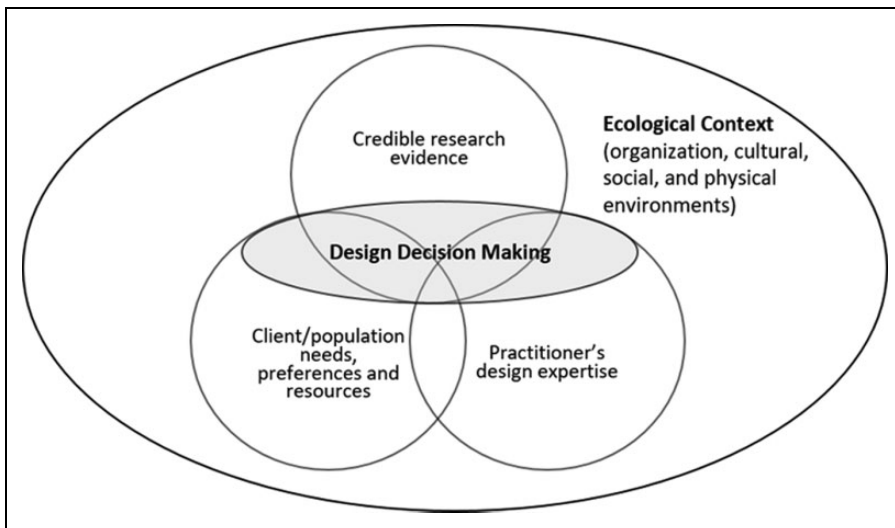
Figure 3. EBD conceptual model. Adapted from Satterfield et al. (2009).

behavior mapping); here it is applied to better understand specific projects', clients', or populations' concerns (e.g., causes of staff burnout, walking distance in different design configurations). *Project objectives* are the stated aims or hypotheses, which the design is created to facilitate (e.g., decreased nurse walking distance, reduced medical errors). The advancement of both RID and EBD necessitates the dissemination of results and lessons learned in order to evolve and grow the evidence and research available.

> *RID can be defined as the process of applying credible research in integration with project-, client-, or population-specific empirical inquiry to inform the creation of environmental design and achieve project objectives.*

Discussion

EBD and RID processes share critical conceptual similarities and distinctions. When comparing EB and RI, EB is a broad base of information types (evidence) that are narrowly applied (based), while the latter references a narrow slice of information (research) that is being broadly applied (informed) to create an end product of design. In practice this can mean that their outcomes may be similar.

> *When comparing EB and RI, EB is a broad base of information types (evidence) that are narrowly applied (based), while the latter references a narrow slice of information (research) that is being broadly applied (informed) to create an end product of design.*

Evidence helps to establish best protocols using the summation of disciplinary knowledge; whereas *research* acknowledges the bounds of disciplinary knowledge and uses inquiry to expand those limits. EBD, by dictionary definition, would be understood as design rooted in confirmed environmental interventions or solutions. This may help to explain why many practitioners feel that EBD is looking backward to confirm, while the design practice is looking forward to innovate. However, as described earlier, the formal process of EBD went beyond definitional meanings and the CHD's outlined eight-step process, and acknowledges the importance of discovering new knowledge and feeding forward that knowledge to foster future innovations (The CHD, 2009b).

There is overlap in the processes outlined for EBD and RID, yet there are also clear

differentiations. During the design phase of a project, the EBD process often relies primarily on available knowledge that one can "find," and create additional knowledge after the building is constructed (The CHD, 2008, p. 2, 2009a, 2009b, p. 1). This is distinct from the RID process, where both gathering existing research and generating new, project-specific research and/or prototypes occur before arriving at a final design. As defined, the process of EBD focuses on research occurring either before or after the design process; whereas the RID is more iterative integrating research as a cyclical part of the design process. In both EBD and RID, the client and/or population of end-users should play an integral role. Primary research or active inquiry on a project can help to provide a systematic way to capture and utilize the client's input.

In practice, although there may be great variation in the way project teams gather, evaluate, and apply evidence; there is often little nuance in the way these projects present themselves. This lack of clarity or distinction may contribute to a diminished incentive for practitioners to advance their use of evidence or research in practice. Much of the confusion between the use of the concepts EBD and RID arise out of differing perspectives between the way practitioners and academics understand the terms. For instance, the term *research* may connote interpretations of gathering information; however, in a scientific practice, research makes up many of the higher quality levels of evidence (e.g., observational studies, randomized control trials). Furthermore, the term *evidence* may feel like the strongest version of proof, but through understanding the academic definitions of evidence, one can see that evidence is inherently layered, offering varying degrees of quality and value for decision-making. *Informed* appears to be most frequently used when there is a weaker base of directly applicable information to aid in decision-making. In these instances, practitioners feel they cannot *base* decisions on the limited evidence available, rather one must use the evidence available to *inform* one's decisions. Part of the theoretical confusion may also stem from practitioners deciding to use specific terminology that they feel will help to market or differentiate their practice to offer a competitive age.

This is not unique to the design discipline and accounts from EBM speak of the problem of the "evidence-based 'quality mark'" being misappropriated to give benefit to specific interests. EBD is not void of these same struggles (Greenhalgh, Howick, & Maskrey, 2014, p. 5).

The danger of confusing these terms is that one obscures the defined processes of the established field of EBD and does not acknowledge the unique attributes of RID. This has the potential to weaken not only the practice of EBD but also the advances made integrating research into practice. While the use of RID may be more accurate to how a given practitioner is using knowledge in their design process, this does not mean that the two terms become synonymous. Rather, this may call for a reexamination of the process of EBD to more appropriately fit the design processes that naturally occur during a given project, so that the knowledge (e.g., research or evidence) is an invaluable part of fostering innovation and achieving collective aims.

Conclusion

In talking with respected colleagues over the process of creating this article, it is clear each person has a distinctly different understanding of the relationship between EBD and RID. This article is not meant to be the end of the discussion but rather to promote further dialogue and provide a critical resource for that debate.

It is understandable why these terms have become intermingled, both concepts describe the use of knowledge to improve the design process. Despite this, EBD and RID are inherently separate, although they share overlaps and commonalties.

Main points:

- The inconsistent use of terms throughout disciplines and types of definitions hampers interdisciplinary progress and collaboration.
- There are misperceptions as a result of the differences between the academic understanding of terms as compared to the terms' common usage.
- There is confusion between the application of knowledge (e.g., how knowledge is used in design decisions-making) versus the type

of knowledge (e.g., the degree to which knowledge is rigorous, anecdotal, or generalizable).

- Using correct terminology can foster clear expectations between practitioners, clients, and researchers.
- More investigation into the concepts EBD and RID is needed to understand how they are distinct, overlapping, and/or complementary.

Like sustainability or EBM, the naming of the certification or process makes the movement stronger, but it can also make the term more prone to overuse and misuse. Although the medical field may have largely adopted the term EBM, it continues to struggle with what that evidence looks like when it is applied to decisions in the real world (Greenhalgh et al., 2014; Stankos & Schwarz, 2007). There is a greater recognition that evidence needs to be population specific in order to have the maximum intended impact (Brownson et al., 2009). Virtually, no form of knowledge can be applied without taking into consideration the situation or problem it is being applied to, and thus, the active engagement of the designer is vital in creating an informed solution. For healthcare design specifically, there are no cookbook style answers, but the EBD movement has made strides in outlining a standard process of finding those answers.

The problem designers have is not in using evidence to inform their design decisions, but rather it is with the term EBD, its misuse, and the rigidity with which its process is perceived. While some want a concrete toolbox of solutions, others resent this—either way, it doesn't exist. Suggestions can exist, but a one-size-fits-all solution that complements the client, culture, climate, building type, occupants, and financial constraints and is not something EBD or RID can provide.

The authors hope that this article serves to generate dialogue critical to the development of a discipline and look forward to the contribution of the readership.

Implications for Practice

- Facilitate a more universal understanding of the concepts from multiple stakeholders to foster clear expectations between practitioners, clients, and researchers.
- Advance theoretical development through providing a review of the concepts from multiple perspectives, historical understandings, and definitional meanings.
- Propose a more inclusive definition and conceptual model of EBD that aligns with the large EBP paradigm to speak to EBD's broader goals.
- Propose a definition for the term RID in the environmental design context, and explicate its processes and application.

References

Barker, R., Wright, B., & Gonick, M. (1953). *Adjustment to physical handicap and illness: A survey of the social psychology of physique and disability.* New York, NY: Social Science Research Council.

Based. (2016a). In *Merriam-Webster.com*. Retrieved from https://en.oxforddictionaries.com/definition/based

Based. (2016b). In *Oxford Dictionaries*. Retrieved from https://en.oxforddictionaries.com/definition/base

Bentley, Y., Richardson, D., Duan, Y., Philpott, E., Ong, V., & Owen, D. (2013). Research-informed curriculum design for a master's-level program in project management. *Journal of Management Education, 37*, 651–682.

Brownson, R. C., Fielding, J. E., & Maylahn, C. M. (2009). Evidence-based public health: A

fundamental concept for public health practice. *Annual Review of Public Health*, *30*, 175–201.

Burghardt, D., & Hacker, M. (2014). Informed design: A contemporary approach to design pedagogy. *International Geoscience and Remote Sensing Symposium, 1*, 1–5.

Cama, R. (2009). *Evidence-based healthcare design*. Hoboken, NJ: John Wiley.

Cochrane, A. (1972). *Effectiveness and efficiency: Random reflections on health services*. London, England: Nuffield Provincial Hospitals Trust.

Crowe, M., & Sheppard, L. (2011). A review of critical appraisal tools show they lack rigor: Alternative tool structure is proposed. *Journal of Clinical Epidemiology*, *64*, 79–89.

Evidence. (2016a). In *Merriam-Webster.com*. Retrieved from http://www.merriam-webster.com/dictionary/evidence

Evidence. (2016b). In *Oxford Dictionaries*. Retrieved from https://en.oxforddictionaries.com/definition/evidence

Evidence-Based Medicine Working Group. (1992). Evidence-based medicine: A new approach to teaching the practice of medicine. *Journal of the American Medical Association*, *268*, 2420–2425.

Geboy, L. (2009). Linking person-centered care and the physical environment. *Alzheimer's Care Today*, *10*, 228–231.

Greenhalgh, T., Howick, J., & Maskrey, N. (2014). Evidence based medicine: A movement in crisis? *British Medical Journal*, *348*, g3725. Retrieved from http://doi.org/10.1136/bmj.g3725

Guyatt, G. H., Haynes, R. B., Jaeschke, R. Z., Cook, D. J., Green, L., Naylor, C. D., Wilson, M. C., & Richardson, W. S., & the Evidence-Based Medicine Working Group. (2000). Users' guides to the medical literature: XXV. Evidence-based medicine: Principles for applying the users' guides to patient care. *Journal of the American Medical Association*, *284*, 1290–1296.

Hamilton, D. K. (2003). The four levels of evidence based practice. *Healthcare Design*, *3*, 18–26.

Hamilton, D. K. (2014). Research informed design, best practice, and fresh perspectives: Can we all get along? *Health Environments Research & Design Journal*, *7*, 94–97.

Hamilton, D. K. (2015). Applied research in practice: Partnering with clients and academia. *Health Environments Research & Design Journal*, *8*, 158–160.

Hamilton, D. K., & Watkins, D. (2009). What is evidence-based design. In *Evidence Based Design for Multiple Building Types* (p. 9). New York, NY: John Wiley and Sons Ltd.

HKS Inc. (2011). *Is Evidence-Based Design Merely Common Sense Design?* Retrieved from http://www.hksinc.com/insight/is-evidence-based-design-merely-common-sense-design/

Informed. (2016a). In *Merriam-Webster.com*. Retrieved from http://www.merriam-webster.com/dictionary/informed

Informed. (2016b). In *Oxford Dictionaries*. Retrieved from https://en.oxforddictionaries.com/definition/informed

Institute of Medicine. (2001). Crossing the quality chasm: A new health system for the 21th century. Washington, DC: National Academy Press.

Marberry, S. (2016). What people are saying about evidence-based design vs. evidence-informed design. In *saramarberry.com*. Retrieved from http://bit.ly/2bZTEzC

Marquardt, G., & Motzek, T. (2013). How to rate the quality of a research paper: Introducing a helpful algorithm for architects and designers. *Health Environments Research & Design Journal*, *6*, 119–127.

Meyer, A. S., Bowden Templeton, G., Stinson, M. A., & Codone, S. (2016). Teaching research methods to MFT master's students: A comparison between scientist-practitioner and research-informed approaches. *Contemporary Family Therapy*, *38*, 295.

Moore, K. D., & Geboy, L. (2010). The question of evidence: Current worldviews in environmental design research and practice. *Architectural Research Quarterly*, *14*, 105–114.

Nightingale, F. (1863). *Notes on hospitals 3rd Edition*. London, UK: Longman, Green, Longman, Roberts, & Green.

Pati, D. (2011). A framework for evaluating evidence in evidence-based design. *Health Environments Research & Design Journal*, *4*, 23–42.

Polit, D. F., & Beck, C. T. (2008). *Nursing research: Generating and assessing evidence for nursing practice*. Philadelphia, PA: Lippincott Williams & Wilkins.

Protection of Human Subjects. (2009). *Definitions*, 45 C.F.R. §46.102. Department of Health and Human Services. Retrieved from https://www.hhs.gov/ohrp/regulations-and-policy/regulations/45-cfr-46/

Rashid, M. (2013). The question of knowledge in evidence-based design for healthcare facilities: Limitations and suggestions. *Health Environments Research & Design Journal, 6,* 101–126.

Research. (2016a). In *Merriam-Webster.com*. Retrieved from http://www.merriam-webster.com/dictionary/research

Research. (2016b). In *Oxford Dictionaries* Retrieved from https://en.oxforddictionaries.com/definition/research

Sackett, D. L., Rosenberg, W. M. C., Gray, J. A. M., Haynes, R. B., & Richardson, W. S. (1996). Evidence based medicine: What it is and what it isn't. *British Medical Journal, 312,* 71–72. Retrieved from http://doi.org/10.1136/bmj.312.7023.71

Satterfield, J. M., Spring, B., Brownson, R. C., Mullen, E. J., Newhouse, R. P., Walker, B. B., & Whitlock, E. P. (2009). Towards a transdisciplinary model of evidence-based practice. *The Milbank Quarterly, 87:* 368–390.

Stankos, M., & Schwarz, B. (2007). Evidence-based design in healthcare. *Interdisciplinary Design & Research E-Journal, 1,* 1–15.

Stetler, C. (2002). *Evidence-based practice and the use of research: A synopsis of basic concepts & strategies to improve care.* Washington, DC: NOVA Foundation.

Stetler, C. B., & Caramanica, L. (2007). Evaluation of an evidence-based practice initiative: Outcomes, strengths and limitations of a retrospective, conceptually-based approach. *Worldviews on Evidence-Based Nursing, 4,* 187–199.

Stichler, J. (2010a). Weighing the evidence. *Health Environments Research & Design Journal, 3,* 3–7.

Stichler, J. (2010b). Research or evidence-based design: Which process should we be using? *Health Environments Research & Design Journal, 4,* 6–10.

Stichler, J. (2016). Research, research-informed design, evidence-based design: What is the difference and does it matter? *Health Environments Research & Design Journal, 10,* 7–12.

Stichler, J. F., & Hamilton, D. K. (2008). Evidence-based design: What is it? *Health Environments Research & Design Journal, 1,* 3–4.

Taylor, E. (2011). How are you using evidence-based design? *Healthcare Design, 11,* 128–139.

Taylor, E., & Hignett, S. (2014). Evaluating evidence: Defining levels and quality using critical appraisal mixed methods tools. *Health Environments Research & Design Journal, 7,* 144–151.

The Belmont Report. (2016, March 15). Retrieved from http://www.hhs.gov/ohrp/regulations-and-policy/belmont-report/index.html

The Center for Health Design. (2008). Definition of evidence-based design for healthcare. Retrieved from https://www.healthdesign.org/certification-outreach/edac/about

The Center for Health Design. (2009a). *An introduction to evidence-based design: Exploring healthcare and design. Guide 1.* Concord, CA: Author.

The Center for Health Design. (2009b). *Integrating evidence-based design: Practicing the healthcare design process. Guide 3.* Concord, CA: Author.

Ulrich, R. S. (1984). View through a window may influence recovery from surgery. *Science, 224,* 420–421.

University of Bedfordshire. (2010). *A guide to research informed teaching & research informed learning.* Retrieved from http://bit.ly/2kfGKNr

Viets, E. (2009). Lessons from evidence-based medicine: What healthcare designers can learn from the medical field. *Health Environments Research & Design Journal, 2,* 73–87.

Walker, L. O., & Avant, K. C. (2011). *Strategies for theory construction in nursing* (5th ed.). Norwalk, CT: Appleton & Lange.