PART I

DRIVERS FOR CHANGE

"There is nothing wrong with change,
if it is in the right direction."
—Winston Churchill

Chapter 1

Understanding the Shift toward Evidence-Based Design in Healthcare

"Grant me the serenity to accept the things I cannot change, the courage to change the things I can and the wisdom to know the difference."
—Reinhold Niebuhr

It is difficult to discuss a practice methodology without giving it context within the field in which it is to be practiced. This chapter opens the discussion by defining what evidence-based design is. It continues by identifying drivers for change in healthcare as well as in the design professions and offering a brief synopsis of all four components of this process. It graphically aligns traditional phases of the design process with the shift necessary to be evidence-based. Like every chapter in this book, it offers expert testimony from supporters of evidence-based design who have experienced a positive change as a result of this practice methodology.

The practice of design is constantly evolving. Why? It evolves according to the demands being made on the design professions and transforms according to the practice's ability to respond to that demand. These shifts in evolution are never as obvious as the one that is occurring right now toward an outcome-driven approach to the design of the built environment. Firms are struggling to embrace this shift because, after all, design is an art not a science. Or is it?

A well-designed building is generally aesthetically pleasing, functionally effortless, and extraordinarily experiential, yet measurement of its success is often subjective. The abstract solution of how to divide space and capture light is often studied, but rarely is its impact on behavioral outcomes. If science is the study of the physical world and its manifestations, especially by using systematic observation and experiment[1], then the design of the built environment has a natural place in the world of science. A design with a measurable outcome is so akin to evidence-based medicine that it is only natural that this methodology has caught on with healthcare clients. The growing popularity of this design methodology is being fueled by

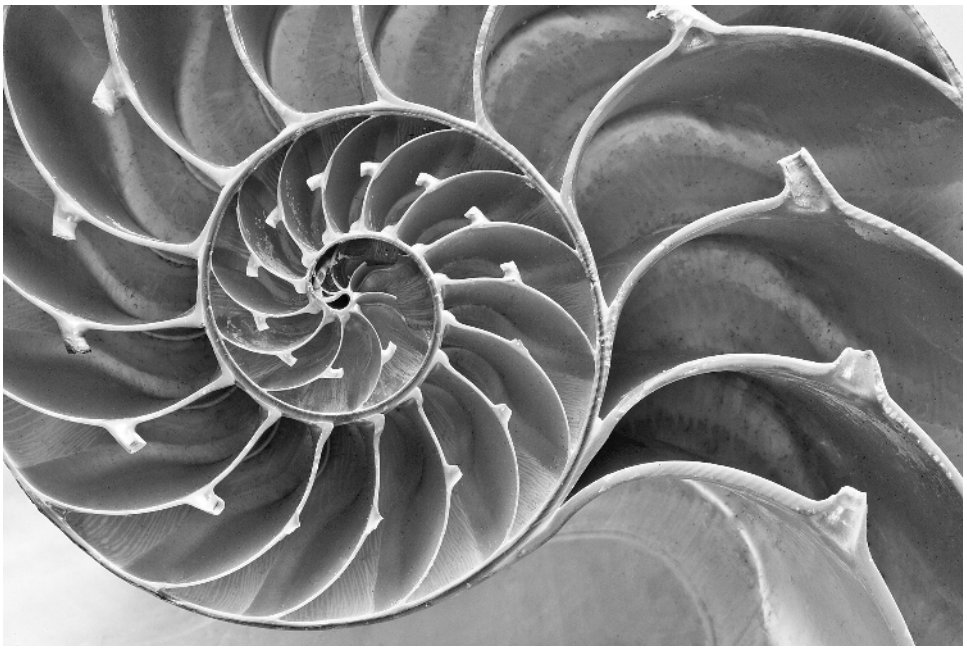

Figure 1.1
Nautilus shell.
Picture by Henry Domke, www.henrydomke.com.

medicine's familiar logic. It is here in the healthcare specialty where the practice of evidence-based design has emerged most prominently. How to embrace this shift in design methodology is the premise behind this book.

An evidence-based approach to design is not new. In fact, it is quite commonplace when it is linked to academia, though rarely does it fall within the basic services of a professional design practice. One problem is that the design of the built environment has not been considered a factor in health and organizational outcomes. (See Essay 2-1.) For example the essential act of hand-washing is conducted in every specialty of design. It is critical to food service and healthcare delivery. How many times have you gone to a new restaurant and sent a dining companion to the restroom to see an amazing bathroom design feature? The design detailing catches your fancy and adds to the overall experience, but does it increase the chance of getting staff to wash their hands? Does making it attractive elicit the action or will smart placement increase the behavior? In healthcare, where the failure to wash hands between examining patients increases the spread of infection, little effort is made to understand how to improve that experience or, more importantly, increase compliance. We need to understand how to improve this outcome. In two separate hospital-user meetings in the last year, Emergency Department physicians asked to reorient the hand-washing sink so they could begin the task of hand-washing while immediately engaging in conversation with the patient

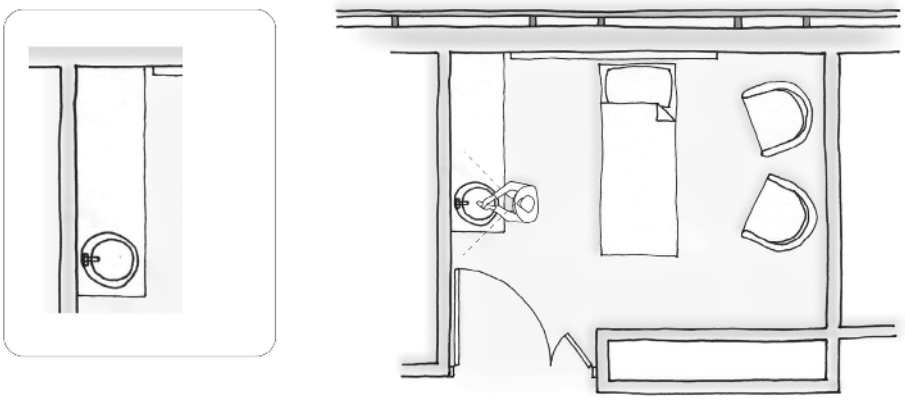

Figure 1.2
Typical emergency exam room layout where caregivers must turn backs to the patient and family while washing their hands at the sink on a parallel wall.

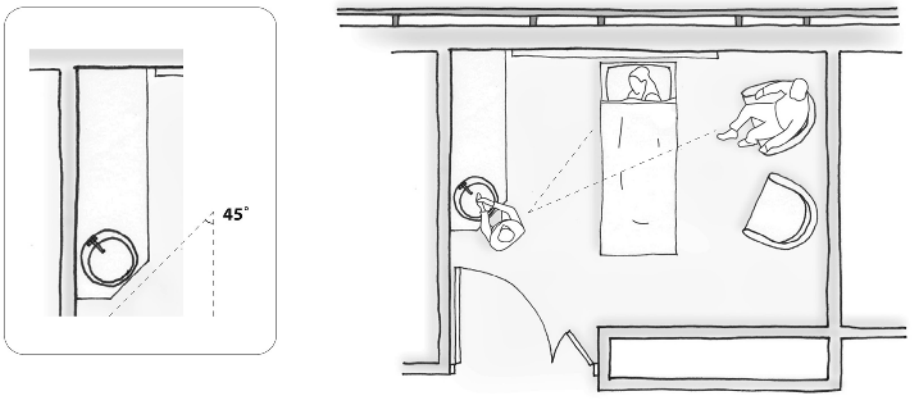

Figure 1.3
At Yale-New Haven Hospital's pediatric emergency room, placing the sink on an angle allows caregivers to maintain eye contact with the patient and family while washing their hands. The design hypothesis is to improve hand-washing compliance and improve staff-to-patient and staff-to-family communications. Studies not yet complete. *Salvatore Associates Architect of Record/ CAMA, Inc.*

or family. (See Figures 1.2 and 1.3.) The jury is out as to whether this change in a design feature will improve compliance, but follow-up measurement will show if in fact a simple design adjustment can improve a chronic flaw in healthcare outcomes. Chapter 2 will look at why important knowledge like this is lacking and what can be done to build a base of knowledge about design features that improve performance statistics such as hand-washing compliance. In evidence-based healthcare design a body of knowledge is being captured, however, like the missing knowledge on how design can improve hand-washing compliance, it has many voids. The importance of adopting an evidence-based approach to build this base of knowledge is that it will contribute to an industry struggling with ways to improve safety and quality services—outcomes we should never take for granted in our healthcare system.

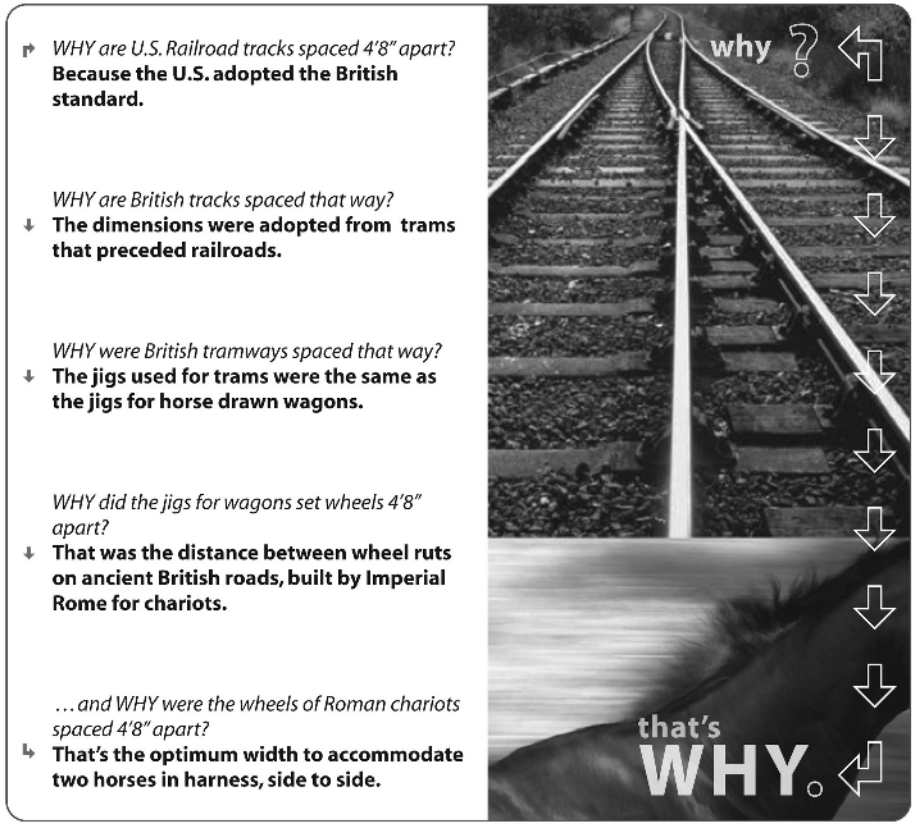

Figure 1.4
Japanese Method of Inquiry asks why five times to get to the root of an answer changing a user's perspective of the status quo.

Stress is at the core of most individuals' healthcare experience. Those who design buildings possess an incredible opportunity to improve life's experiences by reducing an occupant's stress. The hospitality industry makes it its business to transform our hectic lives into a state of tranquility; it has studied lifestyles and knows our wants and desires before we do. Industry researchers inform resort developers who create programs, improve services, and build facilities that will attract our discretionary income. Traveling consumers are continuously realizing the health benefits of incorporating "SPA" into their busy lifestyles, thus increasing their likelihood to spend in these areas.[2] Yet, where else is the need for an improved experience with reduced stress and health benefits more important than in a healthcare setting? A compromised patient seeking medical attention, a worried family member, and an overtaxed clinician trying to administer care and compassion make up a team of most likely candidates for an improved experience makeover. The demand for this outcome is great but documented evidence is slow to get to the design studio. The cycle of innovation for improved clinical prac-

tice models and supporting architecture is offset by antiquated mindsets that see the status quo as too difficult to change. There is an anecdote in the industry that references the origin of railroad track dimensions back to Imperial Rome. It is a silly truth that illustrates the magnitude of consequences one pays in design decision-making lead by fear of change. It is in this sad testimony of flawed decision-making that the real need to change the way we design our healthcare facilities is seen. (See Figure 1.4.)

The most compelling reason to build a database of evidence-based knowledge is the economic one. Too many good ideas get missed for fear that an old operational model can't be changed or worse, that the expenditure is too great, so old models are perpetuated in the name of prudent advancement. The way to dispel that fear is to tie the benefit of a capital expenditure to an operational saving of a design detail. In healthcare it is rare that these two parallel accounting mindsets intersect during the design of a building project. This has slowed innovation because the lack of evidence to support a business case for a better building never reaches the board-room table.

The discussion continues to build around how the design process needs to evolve, an evolution that links design more closely to outcomes, and a financial model of a building's lifecycle. It is at that level of scrutiny that this book will address the methodology known as evidence-based design.

Evidence-Based Design

What is evidence-based design? How do you practice this model of design? Will it cost more? Does it require more/different staff or specialized consultants? These are the most common questions being posed by clients and design professionals. Will design practitioners know how to add the appropriate expertise to their teams so that the appropriate rigor is used? Will the studies be valid to truly build a solid base of knowledge? Will academic programs teach this

Keyword: Evidence-Based Design

Definition: Evidence-based design is:

- An iterative decision-making process that begins with the analysis of current best evidence from an organization as well as from the field.
- It finds, at the intersection of this knowledge, behavioral, organizational, or economic clues that when aligned with a stated design objective can be hypothesized as a beneficial outcome.
- It does not provide prescriptive solutions, but rather a platform from which to add to an existing base of knowledge or to launch innovation.
- It espouses an ethical obligation to measure outcomes and share knowledge gained for particular design successes and failures, ideally in a peer-reviewed fashion, as is common in academia.

In summary: Investigate • Hypothesize • Continue to Prove or Innovate • Measure and Share

methodology in their pre-professional lesson planning? These are the questions academic and practicing researchers are asking.

The Process

Evidence-based design is a process used to:

- develop and design a new building or renovation project
- bring together a balanced team representing client, stakeholders, and appropriate design disciplines including researchers in the investigation, design, and analysis of a project in an interdisciplinary way
- focus on strategic directives that can lead to improved outcomes through the analysis of past design and facility performance intelligence
- support a proven design detail or inspire an innovative concept hypothesized to improve a stated outcome
- commit to a post-occupancy research project to reveal the success or failure of the hypothesized result
- publish in a peer-reviewed journal.

Interdisciplinary teams typically begin a design process with an investigation of existing conditions. They add to this mix intelligence from the existing facility and from previous projects of a similar nature. Occasionally, there is an effort to gather documented intelligence from similar projects either about design solutions or organizational issues that have been published in peer-reviewed literature. It is in this investigation that the potential for a creative design solution and the level of risk needed to improve a strategic objective or a stated outcome will be revealed. This process does not interrupt the standard phases of design, however, it adds a layer of scrutiny and exploration that triggers greater potential for innovation. Before final decisions are made there exists the possibility of live, simulated, or referential mock-ups (see chapter 4) where pre-measurement of critical features can help assure beneficial outcomes. This process also begins to reveal the need for shifts in culture around new delivery models. A process like this keeps the interdisciplinary team focused on outcomes strategically stated by the project guidelines, but with a global perspective of the industry's most current position on

Keyword: Interdisciplinary Team

An interdisciplinary team is balanced representation of all constituencies on a project responsible for the design, building, operations, and use of a facility, with a specific goal to deliver a project within schedule and budget, but more importantly aligned with project goals and desired improved outcomes.

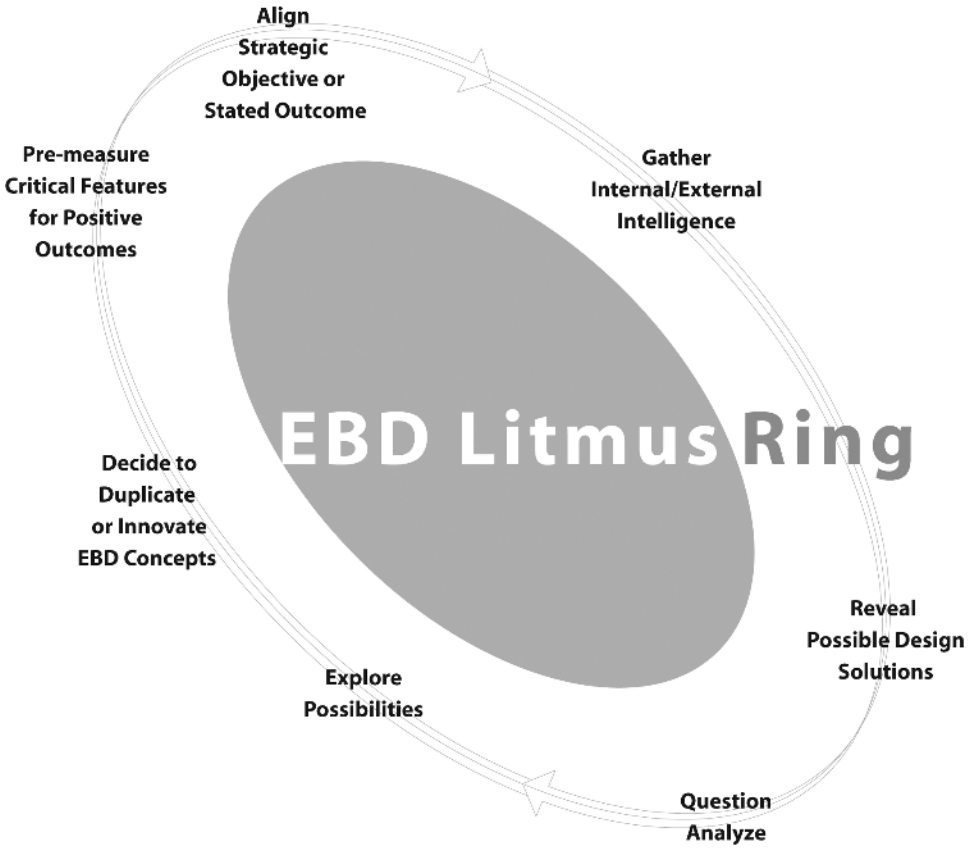

Figure 1.5
EBD Litmus Ring: Depicts an iterative process that aligns evidence-based design decisions with an institution's strategic directives after an informed, exploratory and translational design process that uses critical thinking skills. When the alignment does not occur then the concept should be dropped or modified until it does. *CAMA, Inc.*

a particular solution. The process continually forces strategic alignment for the design team as well as the administrative team. (See Figure 1.5.) This Evidence-Based Design Litmus Ring illustrates how critical thinking in an early design phase can push for the option to innovate or stay the course on a common design solution to a particular organizational outcome. It diminishes the fear associated with risky decision-making and empowers leadership to think beyond "Imperial Rome."

The healthcare industry is continually poised to adopt new procedures, such as evidence-based design, that will offer improvement in the areas of quality and safety. Why then are the design professions slow to adopt a practice that will increase the flow of knowledge and the spread of innovation? Is it fear that it will slow a well-oiled machine and compromise profits? I think not. It is this author's opinion that evidence-based design will drive more business to design firms, as they become strategic partners in the improvement of our health delivery system. Let's explore to what degree a firm should be willing to adopt this design methodology.

The Four Components of an Evidence-Based Design Process

There are four basic components to evidence-based design. They are:

1. Gather qualitative and quantitative intelligence
2. Map strategic, cultural, and research goals
3. Hypothesize outcomes, innovate, and implement translational design
4. Measure and share outcomes

The struggle during most projects is when to conduct the various phases or components of evidence-based design and how to use the knowledge gained to better advance design. The current difficulty is that the process is new and firms are backing their way into what they are calling evidence-based design or using the familiar logic of a post-occupancy evaluation. Post-occupancy evaluations (POEs) use the current design methodology and discover where improvement occurred after the project is completed, as opposed to evidence-based design (EBD), which begins the research process in a pre-design phase. This is happening because all team members are not on board from the start—including the client. The ideal is to begin the process with a full interdisciplinary team in place at the start of a project. Let's take a look at how to integrate each of these components into the standard model of design phases.

EBD Component 1: Gather Qualitative and Quantitative Intelligence

It is customary, throughout the process of design, to gather intelligence. Traditionally it is in the programming phase when qualitative and quantitative intelligence shapes a project. This logic is flawed because often a new project is informed with data that references and perpetuates stale models. The process of evidence-based design by nature of its rigorous inquiry suggests an investigation prior to programming that intelligently informs project goals and guidelines. It gives time for consolidated thought processes early in a condensed design schedule. This time allows a team in a broader context to learn and analyze the existing culture of an organization, its strategic objectives, and discovers whether it is a good match for the best solution currently known in the industry or ready for innovative concepts. It is then that a team can wisely approach evidence-based design as a way to forge new roads and explore innovative ways to improve processes in care delivery allowing for new architectural or design models to emerge. For instance, if a project is considering like-handed rooms then the design team would investigate what those who have trail-blazed before them have learned. They would consider improving upon the previous solution by carefully examining the documented studies. (See Figures 1.6 and 1.7.) It is at this point that a team would also understand a board of directors' objective for taking on such a building project or an administrative team's objective to renovate a unit. It is at this juncture where the team learns about existing norms, standards,

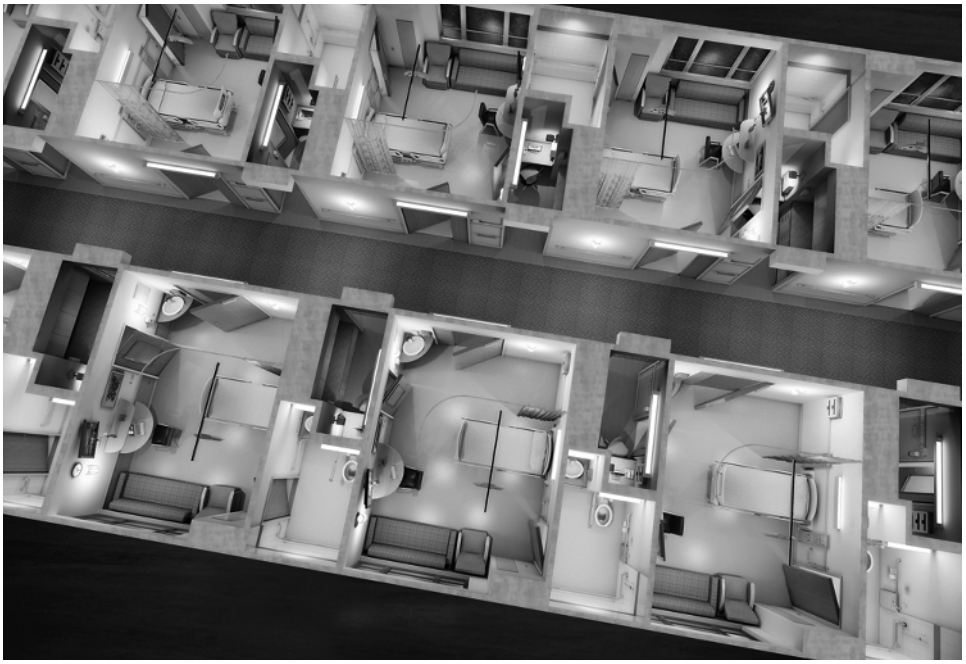

Figure 1.6
Unit design of like-handed room floor-plans. St. Joseph's Hospital (Pebble Project Alumni) is the project that initiated the wild discussion about like-handed rooms very soon after the industry accepted the concept of the single-bedded room. As an innovation, it has inherent in its design clues for the next generation of patient room. The hypothesis is that like-handed room designs reduce medical errors and staff stress. The geometry of this plan has spurred creativity in many subsequent nursing unit designs. Studies not complete. *Courtesy of Gresham, Smith and Partners. Ring & Duchateau (Engineering) and CG Schmidt (Contractor).*

Figure 1.7
St. Joseph's like-handed room design also launched the discussion about headwall-based bathrooms. Linked by a common wall, handrails assist in a trip to the bathroom which could produce a reduction in fall rates. Studies not yet complete. *Courtesy of Gresham, Smith and Partners. Ring & Duchateau (Engineering) and CG Schmidt (Contractor).*

Keywords: Qualitative and Quantitative Research

Qualitative research explores the nature of a problem, issue, or phenomenon. It is an unstructured process of inquiry.[4]

Quantitative research explores the extent of a problem, issue, or phenomenon. It is a structured process of inquiry.[5]

and principles that drive an institution's facilities program. It is at the intersection of all of these issues where a dialogue begins about how to structure a research project that will be beneficial to all. The cost and benefit of this exploration needs to be measured[3] as an added service to the traditional contractual model, because the knowledge gained arms a team with greater potential for innovation. Chapter 2 will go into much more detail on this topic. It is, however, important to note that this activity can occur over and over throughout the design process.

EBD Component 2: Map Strategic, Cultural, and Research Goals

It is in the intelligence gathered that a unique body of knowledge specific to a project is amassed. How to make sense of it all is the art of analysis. For an audience attuned to visual tools, a graphic map is a clear and simple way to show all constituencies' goals (see Figure 1.8). It is in this analysis of the collective intelligence that a team will reveal a clear path for project wisdom and the "big idea" or a project's vision will emerge.

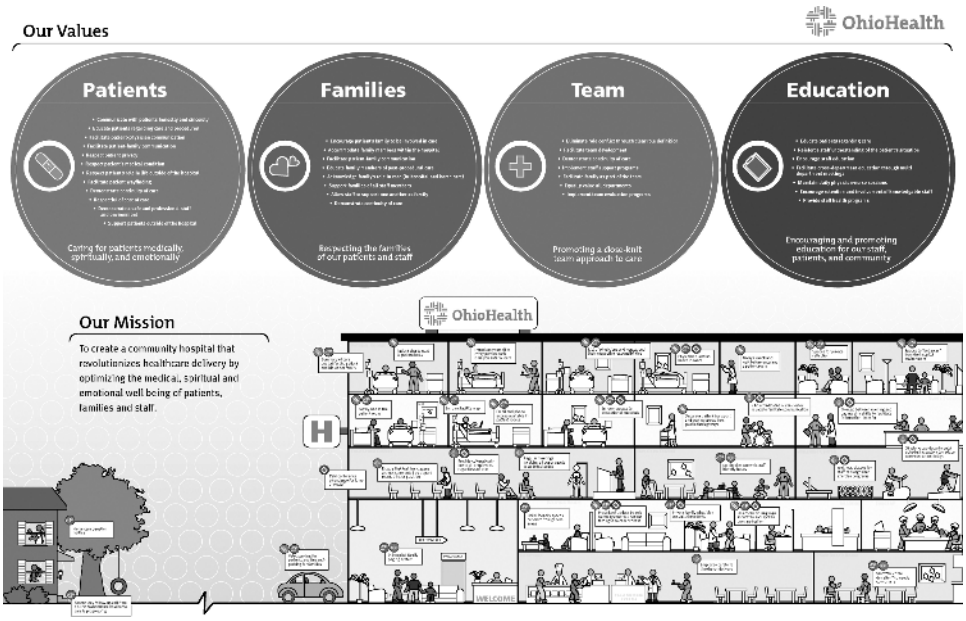

Figure 1.8
Map depicting Ohio Health's institutional values and Dublin Methodist Hospital's (Pebble Project) project design clues deduced from a cultural study that informed a new model for healthcare delivery and hence an innovative facility design. This mapping exercise informed the project's big idea to develop a patient-centered culture that embraces humanity and fosters safety. Studies not complete. *Big Red Rooster.*

Keywords: Visioning and Deep Dive

Visioning: A creative, interactive set of assignments organized in a retreat format, that results in a forward thinking point of view about a familiar problem. (See Figure 1.9.)

Deep dive: Attributed to the work of IDEO whereby designers, anthropologists, and researchers spend days, sometimes weeks, shadowing people to observe how they behave. The results of this research are often quite different from conventional wisdom.[6]

Figure 1.9 *(left)* Visioning session at All Children's Hospital. Jack designs a room after exploring with other pediatric patients and families what about a hospital makes them happy and what makes them sad. Note: Needles made Jack happy because they keep him well! How can you not listen to such wisdom? The goal from the lessons learned is to reduce patient stress. Studies not yet complete.

Figure 1.10 *(right)* Deep dive, Kim Plavcan takes copious notes at Baystate Health while spending the day on a pediatric unit preparing for a renovation project that will serve as a translational study or a living mock-up for a major building project. The hypothesis for the design solution is to improve family-centeredness. Studies not yet complete. *CAMA, Inc.*

"Visioning sessions" or "deep dives" (see Figure 1.9) should be conducted to drill deeper into specific topics. These sessions will create new ideas allowing details needed to support the desired behavior to emerge. It is here that the discussion of a research agenda should occur. This discussion should examine the intersection of all strategic initiatives and stated project guidelines. It should consider the desired innovations and transformations that the institution is committed to for a cultural, organizational, and architectural makeover. And it should connect where the brand lies with respect to its promise to patients, community, and staff. Chapter 3 will explore this component of evidence-based design.

Figure 1.11
It is the "big idea" or project vision that keeps a project and its interdisciplinary team on point. These statements sum up the design intent. It is here where hypotheses emerge and where project researchers see the clues for a research agenda. *Dublin Methodist Hospital (Pebble Project), Karlsberger Architects/ CAMA, Inc.*

EBD Component 3: Hypothesize Outcomes, Innovate, and Implement Translational Design

It is in this component of evidence-based design that the clear statement of a hypothesis activates a research project. Although it may not be completely necessary to hypothesize outcomes, it is in the statement of hypotheses that a team engages in the investment of a design intervention. It is in this moment that the design is more than a good solution; it is a means to an end. The importance of a hypothesis lies in its ability to bring direction, specificity, and focus to a research project. It tells a researcher what specific information to collect, thereby providing greater focus.[7] That stated, it is during schematic design that a design team should hypothesize their outcomes. As evidence-based design is being integrated more and more into design practice it has been difficult to get project teams engaged in the process this soon in a project. Ideally, it is here where schematic design can begin to incorporate new and different approaches to problem solving that are informed by and tied to specific outcomes. (See Figure 1.11.)

Design, as we know it traditionally, begins here. Data has been collected and analyzed, goals and guidelines have been articulated, a research agenda is in place, hypotheses have been articulated, and the entire team is on board with clear directives for the project. There are two methods that lie ahead in the evidence-based process—one is to continue to prove that a known outcome will work in your given conditions, i.e.; that single-bedded rooms reduce the spread of

Keyword: Design Hypothesis

A design hypothesis is an explanation of a design intervention intended to produce a desired outcome used as a basis for further exploration.

infection, the other is to take your hypotheses to uncharted outcomes by introducing a new concept where no evidence is present and prove or disprove a hypothesis, i.e., single-bedded rooms that are like-handed reduce medical errors. (See Figures 1.12, 1.13, 1.14, and 1.15.)

Once these design details are presented and approved it is important to do due diligence before installing the concept into a new building. This is called translational design, whereby knowledge from the design studio can be tested at the bedside. It has its roots in translational medicine.

Similarly in design, the safety and effectiveness of a design concept should be tested. It can be tested in the form of a simulated mock-up, whereby all functions shy of the patient's presence can be tested. It can also be tested in a live mock-up where a patient is in a fully operational space, or in a referential mock-up where one portion of a design is tested in an existing setting, often done with equipment testing. In all of these settings, valuable information is gathered and often a design concept is altered and/or tweaked to conform to the culture and operational models of care present in the facility testing the design intervention. Chapter 4 will explore this component of evidence-based design further.

EBD Component 4: Measure and Share Outcomes

Most important in the process of evidence-based design, is the ability to measure results and to share the knowledge gained. The industry has been slow to introduce new concepts because of the lack of knowledge shared. Although many will anecdotally share experiences, carefully documented research on the effects of a particular design intervention is slow to come from the design studio or hospital's facilities department. It is in this measurement that knowledge gained will inspire another team to develop a concept further or abandon the trend and move on. Measurement from hypothesized outcomes using evidence-based design can occur with a team of graduate students or with researchers on staff at a healthcare facility. They need not

Keyword: Transitional Research

"In the translational research setting, statisticians often assist in the planning and analysis of pilot studies. While pilot studies may vary in the fundamental objectives, many are designed to explore the safety profile of a drug or procedure. Often before applying a new therapy to large groups of patients, a small, non-comparative study is used to estimate the safety profile of the therapy using relatively few patients."[8]

Figure 1.12
University Medical Center at Princeton (Pebble Project), HOK/RMJM Hillier/CAMA's study of like-handed canted rooms with bathrooms on the headwall; 249 square feet. The hypothesis is to reduce medical errors and falls. Studies not complete.

Figure 1.13
University of California Long Hospital, HOK's study of like-handed canted rooms with bathrooms on the headwall. The hypothesis is to reduce medical errors and falls. Studies not complete.

Figure 1.14
Miriam Hospital, HOK/SLAM Collaborative's study of like-handed canted rooms with bathrooms on the headwall; 323 square feet. The hypothesis is to reduce medical errors and falls. Studies not yet complete. *Gregg Shupe Photography.*

Figure 1.15
HCA Stone Oak, HOK's study of like-handed canted rooms with bathrooms on the headwall; 260 square feet. The hypothesis is to reduce medical errors and falls. Studies not yet complete.

be employed at a design firm—in fact, it may be preferred that they are not for the sake of unbiased conclusions.

The reporting can be done at two different levels of scrutiny. Commonplace with most design professionals is the venue of the professional conference attended by one's peers. Other venues include medically related conferences that offer multidisciplinary audiences of architects and designers, hospital administrators and facility directors, and medical clinicians and patient advocates. The most desired way, however, is to submit research for peer review and, if there are human subjects, to an Institutional Review Board (IRB). This action engages academic partners who may assist in the analysis of the data and help construct the argument for or against the design intervention. It is here where the true contribution to the larger body of knowledge is valued. Chapter 5 will explain more about how to engage or partner in the development of this most important component of evidence-based design.

Table 1.1 Integration of Components of Evidence-Based Design into Standard Design Process

Components of Standard Design / *Components of Evidence-Based Design*	I Gather Intelligence	II Map Project and Research Goals	III Hypothesize Outcomes Implement Translational Design	IV Measure	Share in Professional Setting	Share in Peer-Reviewed Setting
Occupancy				✓	✓	✓
Construction Administration Mock-Ups				✓	✓	✓
Construction Documents			✓		✓	
Design Development	✓	✓	✓		✓	
Schematic Design	✓	✓	✓			
Programming/Pre-design	✓	✓				

Levels of Evidence-Based Practice

The beauty of the evidence-based process is that engagement in this methodology can occur gradually as a design team adjusts its approach to design solutions. A first step would be to become familiar with the literature that exists. In time, each of the subsequent components to an evidence-based design methodology can be added, exploring a team's comfort zone and willingness to measure and report. It also takes time to convince clients of the benefits of this process. Until comfort with the evidence-based methodology is achieved, it will be a challenge to convince others to engage in this methodology. Another approach to the process, of course, is to subcontract for those services that are unfamiliar. There are new alliances to be made with those obtaining advanced degrees in design and science and incredible opportunities for colleges and universities to develop advanced degrees in design. See Chapter 7, Growth Opportunities for the Design Professional.

Kirk Hamilton, FAIA, empowered all to find a level within the process of evidence-based design that feels comfortable for the project, the team, and the client. In his *Healthcare Design Magazine* article in November 2003,[9] Hamilton articulates how design practitioners can accept this process without much difficulty. A level 1 practitioner requires a buy-in, using past documented studies as a way to inform new concepts and using the knowledge gained as a platform from which to launch new design concepts.

This book's discussion of EBD (evidence-based design) components 1 and 2 falls into Hamilton's level 1 of practice:

1. Gather qualitative and quantitative intelligence
2. Map strategic, cultural, and research goals

In what Hamilton terms a level 2 practitioner he includes everything a level 1 evidence-based designer would do but adds the ability to "hypothesize the expected outcomes of design interventions and subsequently measure the results."

EBD components 3 and part of 4 are engaged in this level of practice:

3. Hypothesize outcomes, innovate, and implement translational design
4. Measure…

Hamilton's level 3 practitioner would again do all that a level 2 practitioner would do but commits to sharing the gained knowledge through articles written in professional journals or lectures given at professional conferences.

The level 4 practitioner goes one step further and submits the found conclusions to a peer-reviewed journal.

EBD component 4 is subdivided into the final two levels of practice:

4. …and share outcomes. (See Table 1.2.)

Table 1.2 Comparison of Components of Evidence-Based Design to Levels of Evidence-Based Practice

Levels of Evidence-based Practice / *Components of Evidence-Based Design*	I Gather Intelligence	II Map Project and Research Goals	III Hypothesize Outcomes Implement Translational Design	IV Measure	Share in Professional Setting	Share in Peer-Reviewed Setting
Level 4 Meet Academic Standards	✓	✓	✓	✓	✓	✓
Level 3 Share Results Publicly	✓	✓	✓	✓	✓	
Level 2 Hypothesize and Measure	✓	✓	✓	✓		
Level 1 Interpret the Evidence	✓	✓				

This graphic maps stages that a design professional, a design firm, or a healthcare facility can use to find their comfort zone for the adoption of evidence-based design practice. If a project requires only known design interventions, then a level 1 practitioner can be contracted to complete the first component of the evidence-based practice. On the other hand, if the envelope is to be pushed to solve a particular safety or quality issue not yet resolved through evidence-based design, then a level 4 practitioner should be engaged who will use all four components of evidence-based design. Chapter 6 will explore these scenarios further by looking in depth at an evidence-based practice model that is currently operational.

Empowering an Interdisciplinary Team

It is easy to see how it takes a variety of skills to achieve a four-level practice. Conducting a project in an evidence-based way is a tall order unless all of the right ingredients are on hand and the right mix of players is in place. A willing and able client who has a clear vision and is willing to empower a team has to be at the forefront of such an approach. This is not just at the facilities level. Boards of directors need to be engaged so that their long view of an institution's future is

Figure 1.16
Interdisciplinary team visioning for the new El Paso Children's Hospital, El Paso, Texas. Design hypothesis is to provide hope and healing in their design. Studies not yet complete.
KMD Architects/ MNK/CAMA, Inc.

aligned with a project's goals. The CEO has to empower all who will have responsibility for the design and construction. Often a CEO is not capable of articulating how corporate strategy gets interpreted into a facility vision. It is here where confusion abounds. It is in the partnership with an enlightened design leader that these shortcomings can be overcome. See Essay 1-1 to learn about "vision keepers." How top administration empowers lower levels of management and establishes a trust-based approach to decision-making[10] can make or break an institution's ability to successfully follow this methodology of design. If a facility manager reports to a higher-level administrator who lives in fear of proposing new concepts to the c-suite, then innovation is squelched. On the other hand, evidence-based design sends these trailblazers into the higher chambers equipped with credible documentation to support an innovation that is directly linked to a strategic outcome. The first part of building a successful interdisciplinary team is the establishment of a solid link with top decision-makers. (See Figure 1.16.)

Clear design team leadership also sets the pace for keeping all parties in the loop, particularly in the early phases of the project. Most healthcare projects have diverse teams who are under tight schedules and budgets, making it easy to slip into a familiar mindset or design silos. These team players all find comfort in executing the design process the way they have

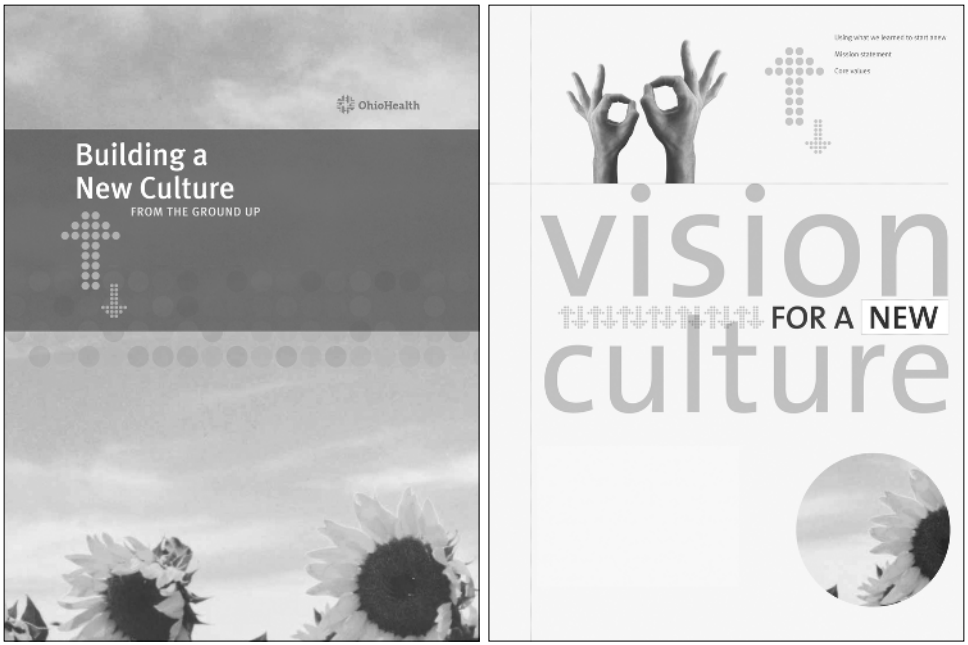

Figure 1.17 *(left)*
Figure 1.18 *(right)*
Culture study conducted by Big Red Rooster for OhioHealth as it prepared to build a new Greenfield hospital—the Dublin Methodist Hospital (Pebble Project). This study drove the early evidence-based design process.

always done so before, making plans and systems almost predictable. The leader may tout an enlightened awareness but the house of cards falls when everyone is not engaged in this process. See Chapter 6 for an example of firm-wide engagement concepts.

Outside consultants are added as needed. It is imperative though to identify who your researcher will be early on. It is in this base of knowledge that you will find the right articles to review, help in the analysis of existing hospital data, and the ability to pose the right questions for significant inquiry. Sometimes it takes a specialized researcher or consulting firm to study the existing and desired culture of an organization to test if the organization is able to make radical transformations and, behave as the new strategic direction intends them to. (See Figures 1.17 and 1.18.)

Make the message clear. It is difficult to transcend from the abstract thinking of design to the analytical mind of the scientist. For those who see in shades of gray the same concept has to be brought into focus in black and white. It is here where a strong graphical approach to documents has to be clear to all who read submitted evidence. Yale University Professor Emeritus Edward Tufte has made information design his life's work. (See Figure 1.19.) The *New York Times* described him as "The Leonardo da Vinci of data." He has authored many books on how to use graphics as a way to clearly present analytical data. For the design team entering into the world of statistical analysis this may be an intriguing way to present your findings to a mixed audience of design and medical professionals.

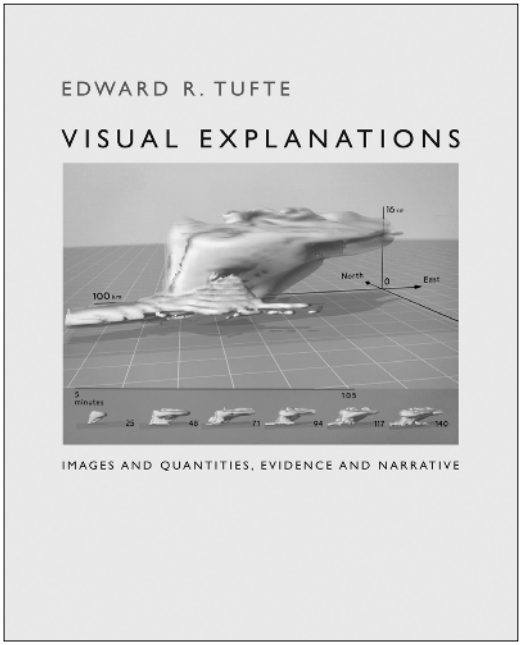

Figure 1.19
Graphical data presentation skills of Edward Tufte.
Reprinted by permission, Edward R. Tufte, Visual Explanations (Cheshire, CT, Graphics Press LLC 1997).

Essay 1–1 Holding to a Clear Vision

Cheryl Herbert, R.N., CEO of Dublin Methodist Hospital, OhioHealth, Dublin, Ohio

The importance of building a multi-disciplinary team focused on the same vision and goals cannot be underestimated. Bringing together the owner, designers, architects, owner's representatives, engineers, construction managers, and even major subcontractors early in a project produces long-term benefits. Sessions during which a consistent facilitator shares the vision, goals, and desired outcomes play an important role in developing a team that will remain steadfast when the going gets tough. "Value engineering" becomes an exercise where, rather than indiscriminately cutting costs no matter the impact on the project goals, everyone works together to achieve the vision and goals in a more cost-effective way. (See Figure 1.20.)

During the design of Dublin Methodist Hospital, the entire project team gathered early in the process for a visioning session as described above. During that 3-hour meeting, the team was empowered to do what was needed to ensure we were successful in our stated goal of "redefining the way patient care is provided." As the owner and project leader, I communicated that the team was to "run until apprehended," meaning I wanted them to

Figure 1.20
Lobby at Dublin Methodist Hospital (Pebble Project), is designed to serve as the community's front door with stress reduction qualities such as an arrival sequence that is customizable and personal, an interior that is blurred with the outdoors, and a gathering space that is full of amenities that distract yet is clear in wayfinding clues for final destination. The design hypothesis is to reduce stress during the arrival sequence. Studies not yet complete.
Photo courtesy Ohio Health/Dublin Methodist Hospital, © 2008. Photography by Brad Feinknopf. Karlsberger Architects / CAMA, Inc. / Big Red Rooster

push the innovation envelope and utilize as many elements of evidence-based design as possible. They were instructed to not let me do anything "stupid" or, in other words, to bring concerns to the forefront sooner rather than later in the project. With that session behind us, the team worked toward common goals. Although budget was a factor, as it is in most projects, decisions were made based on achieving our vision and utilizing evidence-based solutions rather than just making things easier or less expensive to build.

Clear, strong, and consistent leadership was a hallmark of our success. In addition to me, there were others (an architect, a construction manager) who served as "vision keepers." When questions arose that could not be solved by the team, a vision keeper was consulted to make the final call. By limiting decision-making to just a few people, we were assured of consistency even when the construction activity was at its peak and several hundred workers were involved. Each new subcontractor who joined the Dublin Methodist project went through an orientation where the vision and goals were shared, along with an expectation that they would help us accomplish them.

In order to utilize evidence-based design to its fullest, we consulted with The Center for Health Design and became a member of the Pebble Project early in our project. The assistance and resources they provided were invaluable and have been key to our success in building a very different kind of hospital. A consultant usually associated with retail work was brought on board to join the team and help us think in unique ways about the experiences we create for everyone who enters our doors. Being open to hearing from these outside experts and incorporating their work and ideas into our facility has made us what we are today. (See Figure 1.21.)

While not everyone has the luxury we had of building on a greenfield site, there is little that stands in the way of developing a team focused on common goals. One must demonstrate consistency and have the endurance and strength necessary to stay true to the vision when it is challenged, when budget dollars are short, and when issues arise during construction that make it seem next to impossible to achieve all you desire. (See Figure 1.22.)

Throughout our project, it was obvious that evidence-based design helped us keep the team on track and provided rational explanation when we wanted to do things in ways the team had never seen them done. The commitment to this project, built from the very beginning, was tremendous. Our team has much of which to be proud! (See Figure 1.23.)

Keyword: Vision Keeper

A vision keeper is a person or small group of people on the Interdisciplinary Team who hold the team on point and maintain the integrity of the design so that it is always aligned with the project guidelines and developed with the project wisdom.

Figure 1.21
Positive distractions: a respite corner for family and staff just off a nursing unit, which offers a connection to nature and dappled natural lighting—Dublin Methodist Hospital (Pebble Project). The design hypothesis is to improve the family experience and hospital satisfaction ratings. Studies not yet complete.
Photo courtesy of Ohio Health/Dublin Methodist Hospital, © 2008. Photography by Brad Feinknopf. Karlsberger Architects, CAMA, Inc., Big Red Rooster.

Figure 1.22
A patient room design that engages a patient with family and caregivers simultaneously. Physicians are encouraged to consult on the right side of the patient in the family zone. Design hypothesis is to improve communications between staff and families. Studies not yet complete.
Courtesy of Ohio Health/Dublin Methodist Hospital. George C. Anderson Photography, Inc. Karlsberger Architects, CAMA, Inc., Big Red Rooster.

Figure 1.23
Family has been encouraged to become a care partner and must have adequate space to fulfill that obligation. This family zone allows for rooming in, connection to patient and staff, work environment, and access to TV, refrigerator, full bath, and operable window. Design hypothesis is to reduce stress for family care partners. Studies not yet complete.
Photo courtesy of Ohio Health/Dublin Methodist Hospital, © 2008. Photography by Brad Feinknopf. Dublin Methodist Hospital (Pebble Project), Karlsberger Architects, CAMA, Inc., Big Red Rooster.

Drivers for Change in the Healthcare Design Process

In order for change to occur something has to drive it. Often there is more than one variable impacting the field of influence. The need for an evidence-based approach to the design of our facilities is being driven by several factors that are so compelling that the rate of acceptance is occurring rapidly. Change is occurring in the design studio but more importantly the healthcare client is accepting it. Let's take a look at the converging influences.

Healthcare Driver I: A Building Boom

When I started my career in the late 1970s at Yale-New Haven Hospital in New Haven, Connecticut, we jokingly observed that the hospital was really a construction site that administered care to people. Truth is that a healthcare facility, by nature of its complexity and dependence on technology, is always in a state of flux. Current projections are for $45 to $65 billion a year in healthcare construction expenditures.[11] Many drivers are contributing to this

construction boom: The physical infrastructure of our hospitals is aging and not suitable for new technologies, labor shortages in all medical fields have redefined care delivery models, operational inefficiencies have undermined safety and quality of service, and cost of care and expectations of delivery from one of the fussiest generations (baby boomers) are misaligned to name a few. As community hospitals give way to larger systems the opportunity also exists to abandon older campuses and move new facilities to more advantageous locations. This phenomenon has given way to an opportunity to build a freestanding new hospital without the burden of a network of antiquated systems.

Essay 1–2 Futurist's Forecast

Ian Morrison, PhD, Healthcare Futurist, Menlo Park, California

The American healthcare industry is in the midst of an enormous construction boom. A confluence of forces has created an estimated $50 billion per annum annual rate of new hospital construction. What caused the boom? Where is it headed? How can we build these new buildings to serve patients and society at large?

What Caused the Boom?

The wave of new hospital construction through the first decade of the new millennium is driven by a number of factors:

- Aging physical plant. The average age of a hospital plant has been increasing steadily over the last several years as hospitals built in the post–World War II period under the Hill-Burton programs reach the end of their useful life. Throughout America, hospitals' boards are forced to make big financial decisions about building brand new facilities or radical renovations of old facilities.
- Operating income meets cheap money. Since the dark days of the Balanced Budget Act of the late 1990s, hospital finances of the top third of hospitals have steadily improved. While not all hospitals are doing well, the strong financial performers have operating income to support large capital projects, whether acquisitions and mergers or new hospital construction. Add this to the historically low-interest and low-inflation environment that the economy has enjoyed over the last several years and you create opportunity for large-scale projects. Whether the operating income strength of these high performers will remain, or money will still be cheap in the future, remains to be seen. Some would point to the vulnerability of many of these capital projects if, for example, Medicare reimbursement rates were substantially reined in.

- Consumer demand for service excellence. As the baby boom ages and their parents go through the cycle of illness, hospitalization, dying and death, there is growing consumer pressure for better healthcare environments. Generations of Ritz Carlton–staying, office-working, affluent Americans have different expectations of their built environment than the Greatest Generation, who worked in factories or drove buses.
- Earthquake preparedness. The State of California has set rigorous standards for earthquake preparedness, causing an enormous explosion in new and replacement hospital construction in the state. RAND estimates that the cost of meeting the standards over the next 20 years may exceed $150 billion, and cause a "baking in" of higher health costs of $1,000 per capita a year. Such estimates are causing regulators to rethink standards and timetables, but nevertheless earthquakes have been a big driver of California hospital construction and a contributor to the almost $1,000-per-square-foot costs to build hospitals in the state.
- Quality and patient safety. Following the path-breaking publications from the Institute of Medicine, quality and patient safety have become central issues on the national health policy agenda. Hospitals have embraced the work of quality improvement and enlightened hospitals are looking for every avenue, including better buildings, electronic medical records, and radical clinical system redesign to improve performance.
- Transparency and accountability for performance. A major sea change in medical care is taking place where hospitals, health plans, and individual providers are being measured on performance and those measures are increasingly being reported to the public. Whether these measures are actually used by consumers to "shop" for hospitals is debatable. What seems clear is that measurement and public reporting puts powerful pressure on healthcare to improve its performance.
- Evidence-based design. It is in this environment that pioneers such as Roz Cama and the Center for Health Design have emerged to bring to the field of health facilities design, the discipline of evidence-based practice. There is good research about elements of new hospital design, that can improve patient satisfaction and health outcomes, and these innovations can be accomplished in a way that doesn't break the bank in the short run, and saves money in the long run. More and more design practitioners are embracing evidence-based design as a means to help healthcare organizations create true healing environments that are safer and higher-performing.

Will the Trend Continue?

The key vulnerability of the hospital construction boom is financial. If Medicare reimbursement rates tighten, if money becomes more expensive, following a collapse in subprime

capital markets or global economic events, then this boom may get choked off quite rapidly. But, it seems clear that the top financial-performing hospitals will continue to weather such an economic storm, and indeed further distance themselves from the pack economically. This raises a broader public policy question of whether the built environment for patients is becoming profoundly inequitable, with affluent communities in white suburbs having spectacularly high-performing hospital environments and urban hospitals with large Medicaid and uninsured populations having slowly but steadily decaying built environments.

No matter what, we will have to build or replace our aging healthcare facilities. What the right balance is between ambulatory facilities, acute care facilities, and long-term and home-based healthcare is a much broader question than the scope of this book allows. But what is clear, is that when we build new healthcare buildings of any type, we can and should combine the art of good design with science of evidence-based design to help create better healthcare facilities for the patients, families, and communities they serve. This book can really help design practitioners do that important work.

Healthcare Driver II: Needed Base of Knowledge

In 1997 The Center for Health Design™ in a joint project with Johns Hopkins University conducted a meta-analysis of all research that linked the design of the built environment to a health-related outcome.[12] Of the thousands of studies only 84 met the appropriate academic rigor. It would not be until 2004 that the study would be repeated with a team from Texas A&M, Roger Ulrich, PhD and Xiaobo Quan, Georgia Tech, Craig Zimring, PhD, and Anjali Joseph. These scholars would review and analyze thousands of studies to reveal that a body of knowledge in this field is growing. The study, which was commissioned by the Robert Wood Johnson Foundation and The Center for Health Design, was repeated again in 2008. What was learned from these analyses is that there is rich data pertaining to how the design of the built environment impacts healthcare in certain areas. They are:

- Patient-related outcomes
- Staff satisfaction
- Quality
- Safety
- Operational efficiency
- Financial performance[13]

What becomes evident in looking closely at the amount of qualified evidence is that there is more valid data about patient-related outcomes than staff-related outcomes. This may be because the pendulum of patient-centered care has caused us to neglect seeking answers related

to staff issues. As the movement to improve safety and quality of service grows, more evidence-based studies will be conducted and more will be learned about how design plays a role in improving issues related to staff performance and well-being.

Healthcare Driver III: Rapid Developments in Technology

New technologies which drive terms such as wireless, paperless, computer-assisted radiology and surgery, minimally invasive surgeries, digital patient record, flat-screen technology, and bar coding, create paradigm shifts in operational and organizational models which beg for a very different architecture to support these new models of diagnosis, treatment, and care. (See Chapter 6, Evidence-Based Design in Practice.) There exist no right answers at this moment. There is also a bit of skepticism in being a pioneer. Too many new fangled technologies have come down the pike and have failed; so much so that the institution that braved the new world is branded with its failure. Any early adopter stands this risk. (See Figure 2.21.)

Healthcare Driver IV: Quality of Care Initiatives

In 2001 the Institute of Medicine (IOM) highlighted the warts in the healthcare delivery system when it published Crossing the Quality Chasm. The red flag raised was honest and raw. It stated that "Health care today harms too frequently and routinely fails to deliver its potential benefits.[14]" It established six aims for the twenty-first-century healthcare system.

These six aims are adopted by most hospitals and are often presented to design teams to understand in the delivery of design solutions.

Simultaneously, Don Berwick, MD, MPP and the Institute for Healthcare Improvement (IHI) launched a campaign to improve safety in the healthcare systems around the world. On the heels of a "one thousand lives" campaign, where IHI raised the awareness of countless clinicians on how to remember six interventions that could prevent a needless death, IHI has

IOM's Six Aims

1. Safe: Avoiding injuries to patients from the care that is intended to help them
2. Effective: Providing services based on scientific knowledge to all who could benefit and refraining from providing services to those not likely to benefit (avoiding underuse and overuse, respectively)
3. Patient-centered: Providing care that is respectful of and responsive to individual patient preferences, needs, and values and ensuring that patient values guide all clinical decisions
4. Timely: Reducing waits and sometimes harmful delays for both those who receive and those who give care
5. Efficient: Avoiding waste, including waste of equipment, supplies, and energy
6. Equitable: Providing care that does not vary in quality because of personal characteristics such as gender, ethnicity, geographic location, and socioeconomic status.[15]

Keyword: Evidence-Based Value Engineering

A process by which strategically aligned outcomes, design interventions, construction costs, and return on investment are evaluated based on their value to the overall success of the project. When the principles of EBD become the driving factor, not solely cost, then decision-making is informed by the beneficial outcome and its return on the investment over the life of the project.

launched a "five million lives" campaign, a new initiative to protect patients from five million incidents of medical harm over a two-year period from 2006 to 2008.

The work that The Center for Health Design has done to strategically understand how the IOM's six aims and IHI's campaigns go beyond just an operational model to a design intervention has driven the development of the largest field study research project, known as "Pebble"™. The interconnectedness of so many organizations is putting pressure on hospitals to develop solutions for a better model of care.

Healthcare Driver V: Rising Cost of Construction

In the current economic climate, construction budgets are tight. Budgets are locked in by regulatory agencies and/or boards of directors, all of whom have a fiduciary responsibility to keep the cost of healthcare down. Material and labor costs continue to rise and the design suffers through countless rounds of a process that has become known as the oxymoron "value engineering." A more careful analysis of this dilemma is forthcoming, as projects can no longer afford the delays caused by budget paralysis. It will take an evidence-based approach to find a solution to this chronic problem. Construction management firms are very much aware of the evidence-based movement and need to adopt its concept in connecting capital expenses to operational savings.

Drivers for Change in the Design Professions

Design steeped in the arts evolves over time. Design aligned with a scientific mindset has little time to morph once patrons request it. We just explored the external influences for an evidence-based approach in the healthcare arena, but what external forces will compel the design practices into an evidence-based approach?

Keyword: Trend versus Classic

Design that is influenced by industrial design, the influence of materials and products of the time, is attributed to very recognizable "trends."

Design that is influenced by human behavior is attributed to timeless solutions or "classics."

Design Driver I: Marketplace Demand

No greater force than client demand for a service will spark change. In a 2004 Healthcare Design magazine editorial, I noted the phenomenon of the "Flashpoint," stating that we are all on the same evolutionary path and synapsing at approximately the same rate as our colleagues who are paying attention to the same external forces.[16] Evidence-based design has been evolving in discussions over the last ten years, but in the last two, clients are asking for this service in their "Request for Proposals." It is not always clear that they know what they are asking for, but they are asking. As noted above, the external forces are driving change in healthcare, therefore as this flashpoint is occurring, all consultants need to be on board.

Design Driver II: Need for Knowledge

If a closer look is taken at the need to build a body of knowledge, then it is clear a lot of pressure is on the design community to contribute. It is hard to be in the specialty of healthcare without a social conscience. The Ulrich Zimring study[17] recognizes how much is missing; therefore, the need to defend the right to measure our projects must be strong. Ignorance or laziness can no longer be excuses. Chapter 2 will examine a series of scorecards developed as a tool for this study. Using a five star rating—five being ample evidence to no longer debate the issue, one being little evidence has been gathered and reported appropriately—one should be able to see where the lack of knowledge exists and where design projects can contribute.

Design Driver III: Credibility in the Industry

The next biggest driver for change in healthcare delivery can easily be the notoriety gained by the innovators or early adopters in evidence-based design. Most firms are scrambling to figure out what this means to them, their clients, and their bottom line. There has been more press in significant journals and popular tabloids since evidence-based design has taken hold. Ten years ago, as National President of the American Society of Interior Designers (ASID), I was interviewed by the Wall Street Journal and they were clear that they would not write an article about design unless there was hardcore evidence to prove an outcome. In the last few years, the Wall Street Journal has written several articles about design in healthcare settings. What firm/project does not want that kind of exposure?

Design Driver IV: Justification for Innovation

There exists a multiyear cycle for innovation to occur in healthcare. It can take anywhere from five to nine years for a healthcare design team to come up with a "big idea," develop it, and see it through construction and occupancy. (See Figure 1.24.)

Many projects begin the quest to formulate their guidelines by organizing a tour of the industry's best practices. Conservatively looking back in time, if the projects being visited have been open for a year and it took three years to build them and another two years to design and document, and two more to plan, then what is experienced is an eight-year-old "new idea."

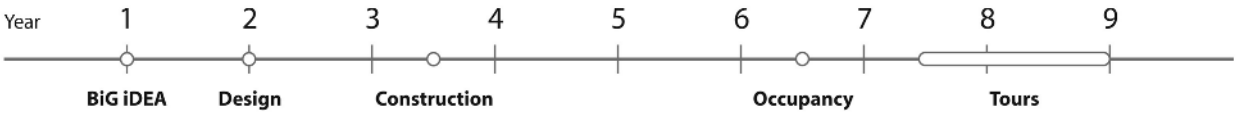

Figure 1.24
Innovation lag time: span of time from one project's big idea to influencing tours. A potentially nine-year-old idea informs a new generation of projects, demonstrating the lag time in healthcare's acceptance of innovative solutions.

That time warp slows innovation and can perpetuate some pretty inappropriate design solutions, especially if they prove negative several years after occupancy. Chapter 4 will explore how evidence-based design triggers innovation in more depth.

Building a Body of Knowledge

Sciences that Contribute to an Academic Base

Most of the scientific evidence available to designers and architects about how the design of the built environment impacts human behavior comes from the study of Environmental Psychology. Much less knowledge is available through the sciences of Neuroscience, Evolutionary Biology, and Psychoneuroimmunology. Environmental Psychology is an interdisciplinary field focused on the interplay between humans and their surroundings. Neuroscience is the study of the brain. Evolutionary Biology is concerned with the origin and descent of a species. Psychoneuroimmunology is a specialized field of research that studies the interactions between social psychology, behavior, the brain, and the endocrine and immune system of the body. There is a need for a post-graduate degree to understand the intersection of these sciences and the influence they have on design, which is to say, only a renaissance mind will capture it all. The dependency on these sciences is being explored in this process of gathering evidence. AIA has partnered with a group of Neuroscientists to truly understand how our brain responds to the environments we design. The work that they are doing needs to inform all projects—which leads to the discussion of knowledge dissemination.

Knowledge Dissemination

The Center for Health Design and the Robert Wood Johnson Foundation have played a significant role in illuminating the highly regarded studies. Tools to make that knowledge readily available are in the works. ASID and the University of Minnesota have developed an online clearinghouse for all research in all specialties in design. InformeDesign, as it is called, provides excerpts from the studies, so at a glance the viewer knows if it is relevant to their design projects. Chapter 2 will look more closely at search engines for literature searches.

Summary

A Call to Arms

World class! How many times have you been requested to design a world-class hospital? A client with that expectation requires a healthcare design consultant at the top of their game who, at a minimum, delivers services that are relevant and create a difference in the marketplace they serve. I was taught early in my career that these characteristics of a service provider either make a brand recognizable or obscure. "Brand," the promise tied to the service you sell, is articulated in your mission statement but also in how you provide clues of that service in your values and in the design of your physical environment. Examine your mission and/or your environment and see what you are promising each and every client you serve. Are you promising world class; are you delivering proven results and better outcomes?

If so, are you:

- analyzing past facility performance, past industry performance?
- hypothesizing improved outcomes as a result of potential design improvements?
- designing to meet industry standards or innovating by designing for new models of care?
- measuring design-driven outcomes?
- sharing the knowledge gained with the industry so it learns from your success and failures?
- partnering with researchers engaged in a peer-review process and then sharing unbiased findings?

If you answer yes, then you are practicing evidence-based design. If not, then let's explore how educational programs, a design practice, a facilities consulting practice, or a healthcare facility can grow and benefit from adopting evidence-based design methodologies, putting you at the top of your game, improving your brand, and delivering world-class quality.

Checklist: Understanding the Shift Toward Evidence-Based Design in Healthcare

1. Definition: Evidence-Based Design is:
   - An iterative decision-making process that begins with the analysis of current best evidence from an organization as well as from the field.
   - It finds at the intersection of this knowledge, behavioral, organizational, or economic clues that when aligned with a stated design objective can be hypothesized as a beneficial outcome.
   - It does not provide prescriptive solutions, but rather a platform from which to add to an existing base of knowledge or to launch innovation.
   - It espouses an ethical obligation to measure outcomes and share knowledge gained for particular design successes and failures, ideally in a peer-reviewed fashion as is common in academia.

Evidence-based design is a process used to:
- develop and design a new or renovation building project
- bring together a balanced team representing client, stakeholders, and appropriate design disciplines including researchers in the investigation, design, and analysis of a project in an interdisciplinary way
- focus on strategic directives that can lead to improved outcomes through the analysis of past design and facility performance intelligence
- support a proven design detail or inspire an innovative concept hypothesized to improve a stated outcome
- commit to a post-occupancy research to reveal the success or failure of the hypothesized result publish in a peer-review journal

2. Components of Evidence-Based Design
   - Gather qualitative and quantitative intelligence
   - Map strategic, cultural, and research goals
   - Hypothesize outcomes, innovate, and implement translational design
   - Measure and share outcomes

3. Hamilton's Levels of Evidence-Based Practice
   - Level 1 Practitioner: Uses past documented studies as a way to inform new concepts and uses the knowledge gained as a platform from which to launch new design concepts.
   - Level 2 Practitioner: Level 1 plus the ability to hypothesize the expected outcomes of design interventions and subsequently measure the results.
   - Level 3 Practitioner: Level 2 plus a commitment to sharing the gained knowledge through articles written in professional journals or lectures at professional conferences.
   - Level 4 Practitioner: Level 3 plus submits the found conclusions to a peer-reviewed journal.

In summary: Investigate • Hypothesize • Continue to Prove or Innovate • Measure and Share

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