THE NATURE OF EVIDENCE UTILIZED IN HEALTHCARE ARCHITECTURAL DESIGN DECISIONS AT FIVE MIDWESTERN CRITICAL ACCESS HOSPITALS

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The undersigned, appointed by the dean of the Graduate School, have examined the dissertation entitled:

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and hereby certify that, in their opinion, it is worthy of acceptance.

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DEDICATION

To my husband who believed in me, never let me quit, and supported me body and soul.

To my faculty advisor, Dr. Benyamin Schwarz who made me believe I could do anything and was my mentor and friend.

To my parents and family, even though they never really understood what I was doing, were proud of my efforts.

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TABLE OF CONTENTS

LIST OF FIGURES AND TABLES

LIST OF ABBREVIATIONS

AHRQ	Agency for Healthcare Research and Quality
ASHE	American Society of Healthcare Engineers
BM	Board member
CAH	Critical access hospital
CAQDAS	Computerized assisted qualitative data analysis
CEO	Chief executive officer
CHD	Center for Health Design
CMS	Centers for Medicare and Medicaid Services
CNO	Chief nursing officer
COO	Chief operating officer
DHHS	Department of Health and Human Services
EBD	Evidence-based design
EBM	Evidence-based medicine
EBP	Evidence-based policy or practice
EDAC	Evidence-based design accreditation and certification
FP	Facilities person
HRSA	Health Resources and Services Administration
IOM	Institute of Medicine
ORHP	Office of Rural Health Policy

ABSTRACT

Mary A. Stankos: The Nature of Evidence Utilized in Healthcare Architectural Design Decisions at Five Midwestern Critical Access Hospitals
(Under the direction of Benyamin Schwarz)

Building a replacement hospital is a once in a lifetime experience for any healthcare administrator and the design decisions made during the building process can have a lasting impact on stake holders and end users for years to come. Improving healthcare design is integral to improving healthcare itself, and it is essential that healthcare administrators make informed architectural design decisions that will ensure organizational success and improve patient outcomes.

Evidence-based design (EBD) practice is the conscientious, explicit and judicious use of current best evidence from research and practice in making critical decisions, together with an informed client, about the design of each individual and unique project. Utilizing a multi-site case study consisting of critical access hospitals that were in the process of or had built a replacement hospital in five Midwestern states, I sought answers to two questions: (1) how do hospital administrators and architects define and use EBD during the healthcare design process, and (2) what is the nature of the evidence that is used in this design process?

I learned from these case studies that the tenets of EBD were not well understood by either the hospital administrators or the architects, and that decisions on designs were heavily weighted towards experiential evidence as compared to evidence from empirical research, which may have contributed to certain design missteps in the built replacement hospitals. Use of an EBD process, as proposed and supported by the Center for Health

Design, may provide for knowledge transfer of evidence and allow healthcare administrators to participate in evidence-informed decision making, provided participating architects are knowledgeable in EBD and its potential benefits.

CHAPTER 1 – INTRODUCTION

INTRODUCTION

Evidence-based design (EBD) fits well into a framework of improving healthcare systems through the use of decisions and practices based upon compelling evidence, as called for by the Institute of Medicine (IOM) (Committee on Quality Health Care in America, 2001). Defined as the explicit and judicious use of current best evidence from research and practice in making critical decisions about the design of each individual building project, EBD has been shown to contribute to optimal outcomes for patients and staff (Chaudhury et al., 2005; J. Stichler, 2012; J. F. Stichler & Hamilton, 2008; R. Ulrich et al., 2004; R. S. Ulrich et al., 2008). Nonetheless, the everyday healthcare administrators' and architects' design decisions are often informed not by empirical research, but by tacit/experiential knowledge, normative theories, and anecdotal precedents (K. Hamilton, 2009). Unfortunately, healthcare design decisions based on local incidents or limited evidence can result in insufficient outcomes that do not meet patient, staff, or physician needs. Moreover, the foundation of evidence that currently supports healthcare design is still growing, and in many ways is incomplete to assure better, safer, or improved outcomes. When healthcare designers, architects, and hospital administrators rely on the limited scope of research in healthcare design, it can result in higher costs and unanticipated problems. Clearly, there is a need for a greater understanding of what EBD means to hospital administrators and healthcare designers, and how EBD is used, or not used, in the design process of hospitals and other healthcare facilities (K. Hamilton, 2009).

BACKGROUND

Hospital administrators are ultimately responsible for making design decisions affecting the healthcare environment that impact the overall quality and delivery of care at their hospitals (J. F. Stichler & Hamilton, 2008). The healthcare system predisposes them to use EBD from a political, theoretical, and marketing perspective; however, the lack of an extensive body of knowledge, the unpredictability with regard to patient and staff outcomes, and the associated costs make using EBD controversial (Stankos & Schwarz, 2007) (R. Tofle, Schwarz, Yoon, & Max-Royale, 2004). Nevertheless, there is a compelling case for the judicious use of EBD in healthcare design (Chaudhury et al., 2005; B. L. Sadler, DuBose, & Zimring, 2008; J. F. D. R. N. F. Stichler, 2008; R. Ulrich et al., 2004). What is not well known is how EBD is understood by healthcare administrators and architects, and how it is, or is not used, during the design process to inform or influence design decisions made by hospital administrators and other departmental leaders.

In the past 20 years there has been tremendous focus on errors in healthcare and a worldwide initiative to improve patient safety across the continuum of medical care. The Institute of Medicine's seminal report, *To err is human: Building a safer health system*, (Donaldson, Corrigan, & Kohn, 2000) was the first to recognize the growing problem of medical errors created by the complexity of technology and the advancement of clinical knowledge. In this report, medical errors were estimated to be responsible for 98,000 deaths per year and to cost U.S. consumers more than $2 billion a year (Donaldson et al., 2000). The IOM report galvanized the country and put the issue of patient safety at the forefront for all healthcare leaders.

In the IOM's follow-up report, C*rossing the quality chasm* (Committee on Quality Health Care in America, 2001), the Committee on the Quality of Health Care set out to establish quality as an organizational and system priority in healthcare. They challenged all hospital administrators, board of directors, healthcare organizations, clinicians, and patients to work together to redesign healthcare processes in accordance with several rules that included the utilization of evidence-based decision making (IOM, 2001). The IOM's intention of applying to healthcare delivery was principally targeted to the employment of clinical knowledge in patient care, also known as evidence-based practice or evidence-based medicine (EBM). Academic and administrative healthcare leaders readily accepted this challenge and found that evidence-based policies, practices and guidelines used in the delivery of medical care could also be used in other aspects of the organization and gravitated to using anything that could be called or shown to be evidence-based.

The physical environment in hospitals plays a significant role in how nurses, physicians and other healthcare providers function on a daily basis (Clancy, 2008; Roger S Ulrich, Zimring, Quan, & Joseph, 2006). Poorly designed environments have been identified as a contributing factor to the development of medical error (Chaudhury, Mahmood, & Valente, 2009; Clancy, 2008; Roger S Ulrich et al., 2006; R. S. Ulrich et al., 2008). James Reason (1995) theorized that human errors in healthcare were shaped by circumstances and that "the likelihood of an unsafe act being committed is heavily influenced by the nature of the task and by the local workplace conditions" (p. 88). Therefore, it stood to reason that changes in the design and layout of the workplace might result in decreased errors and an improvement in patient safety (Bogner, 2003; Reason,

1995). The IOM's support of evidence-based decisions to reduce medical errors caused hospital administrators who were familiar with the broad tenets of EBM, to make the seemingly logical leap to evidence-based design (EBD) (D. K. Hamilton, 2003). It was a way for healthcare organizations to demonstrate to insurance companies, the federal government, healthcare consumers, and the community at large that they were making design decisions informed by evidence that guaranteed specific patient and staff outcomes (K. Hamilton, 2004). Moreover, various government agencies, such as the Agency for Healthcare Research and Quality (AHRQ) have called for the implementation of EBD both large and small scale to ensure the physical environment contributes to the healing process (Clancy, 2008).

EBM was first defined by Sacket et al. (1996) as "the conscientious, explicit and judicious use of current best evidence in making decisions about the care of individual patients." EBM represents a systematic process of evaluating scientific research that is used as the basis for clinical treatment choices (Claridge & Fabian, 2005). Evidence-based design (EBD) has been defined by Hamilton (D. K. Hamilton, 2003; K. Hamilton, 2004) and others (Joseph, 2006; J. F. Stichler & Hamilton, 2008; J. F. D. R. N. F. Stichler, 2008) as design decisions based upon the best available information from credible research and evaluation of existing projects, which requires critical thinking by the design professional because the chosen research is rarely an exact fit to the proposed design problem. However, debate surrounds whether there is a sufficient body of evidence in healthcare design that can be widely applied to solve the myriad of healthcare design ills (Stankos & Schwarz, 2007) (R. B. Tofle, 2008). As Stankos and Schwarz (2007) and Tofle (2008) have pointed out, the number of empirical studies that support

EBD is limited as compared to EBM, which is supported by thousands of research studies that are reviewed and graded/assigned an impact score based on its scientific rigor (Collaborative, 2018). This potentially makes the available evidence in design too narrow in quantity and quality to be described or utilized as a knowledge base. In many instances, hospital administrators and designers, who believe they are utilizing tested and proven design evidence, may in fact only be replicating a healthcare design trend which may or may not deliver the expected outcome (Stankos & Schwarz, 2007).

The healthcare industry has been experiencing its first big building boom in over 75 years, and while healthcare construction spending remains flat over the past 8 years, it continues to be significantly higher than prior to 2002 at over $41 million a month (U.S. Bureau of the Census). It is likely that decisions made today concerning hospital design will impact the quality of care for the next 20 to 40 years (Clancy, 2008). Healthcare leaders and administrators are faced with a once in a lifetime opportunity to build hospitals that can have the potential to reduce errors and improve patient safety, and EBD is being held out by many as the most predictable manner in which to reach this goal (R. Ulrich et al., 2004; Roger S Ulrich et al., 2006). Nonetheless, the question remains whether EBD truly is based on rigorously tested evidence or a reiteration of normative ideas and trends and limit the ability to sustain improvements in healthcare delivery and safety.

The Joint Commission published its position on the design of a patient-safe environment (Feldbauer, Boan, Nadzam, Finis, & Nadzam, 2008). In this position paper the Joint Commission emphasized the importance of using EBD, but cautioned that healthcare design is still at a stage where it is important to review all information

carefully and critically (Feldbauer et al., 2008). It recommended that before starting an EBD process, hospital leaders should ask themselves whether the environment encouraged discussion of evidence as part of its approach to decision making, and if the organizational structure supported the identification, review and synthesis of evidence, then communicating this to decision makers (Feldbauer et al., 2008). Other multidisciplinary professional organizations, such as the American Society of Healthcare Engineers (ASHE), and academic leaders call for caution utilizing EBD in new construction and renovation projects, and recommends that hospital administrators find the evidence in support of facility design decisions (Dickerman & Barach, 2008).

The utilization of evidence-based design fits into a framework of improving healthcare systems. Best solutions in healthcare design should be based on evidence from research; however, more often it is not evidence, but precedent of what works or has worked in the past that passes as the substitute for evidence (Stankos & Schwarz, 2007). Healthcare design decisions can be frequently informed exclusively by tacit/experiential knowledge, normative ideas or theories, based on individual views of how things ought to be, not as they truly are (Lang, 1987).

EBD use in hospital building should be explicit and influence the design decisions made by healthcare designers and administrators in order to build hospitals that meet the needs of both patients and staff. Hospital administrators and healthcare designers need to understand the implications of whether or not they use EBD in their building designs, because the foundation of evidence that supports healthcare design in some instances is limited and use of trends or precedents as evidence can result in increased costs and unsatisfactory outcomes. Furthermore, the flip side of this, i.e. that of building more of

the same - can freeze into place problems that hospitals are always dealing with, such as hospital acquired infections, worker fatigue, that may be otherwise extenuated by the use of EBD (Feldbauer et al., 2008). Therefore, having a greater understanding of what EBD is and how it is to be used in the design process would be beneficial to help hospital administrators and healthcare designers to identify potentially effective strategies they can implement to improve the quality and value of healthcare designs (Feldbauer, et al. 2008).

RESEARCH QUESTIONS

In a pilot study I conducted titled - *The influences of EBD on hospital administrators' design decisions in a small midwestern rural hospital undergoing facility renovation,* using a qualitative approach, I found that EBD did not explicitly influence design decisions made by hospital administrators and architects. Nonetheless, it was their perception that evidence was used throughout the design process (see Figure 4). I found the findings of my pilot study intriguing and wanted to develop a better understanding of how hospital administrators, and architects use EBD in making healthcare design decisions.

This research project takes a qualitative approach through rich data contextually embedded in the healthcare design process to answer the research questions of (1) how do hospital administrators and architects define and use EBD during the healthcare design process, and (2) what is the nature of the evidence that is used in the design process. It is hopeful that findings and interpretations of the data collected could improve the

healthcare design process and assist in a greater understanding for using the tenets of EBD in hospital design.

For the purposes of this study, EBD is defined to mean the explicit and judicious use of current best evidence from research and practice in making critical decisions about the design of each individual building project (Stricher & Hamilton, 2008).

CHAPTER 2 - LITERATURE REVIEW

EVIDENCE-BASED DESIGN AND HEALTHCARE DESIGN: A HISTORICAL PERSPECTIVE

Broadly utilizing the definition of EBD, we can find instances of EBD throughout the history of healthcare building. Historically, we see EBD being used early on from a tacit based perspective i.e. design approaches not codified in rules and laws, but learned by doing, and later on as a combination of tacit and explicit knowledge from outcome-based research. During the first millennium, charitable care or acts of mercy were provided to the sick by the church (Thompson & Goldin, 1975). Initially, medical care was administered to patients in great open halls in monasteries, but due to social changes in Europe in the14th and 15th centuries and a growing trend towards personal privacy, the monastic hospitals began using private rooms (Thompson & Goldin, 1975). The innovation of utilizing private patient rooms was seen not as a measure to provide patient dignity and respect, but rather as a means to house the undesirable patient, such as lepers, insane persons, plague victims, and pensioners (Thompson & Goldin, 1975). Noblemen and gentlewomen seeking medical care from monastic hospitals generally paid for the privilege of a private room (Thompson & Goldin, 1975).

Medieval society did not understand the *science* of how diseases, such as the plague or leprosy were spread, but knew enough - through the process of accumulated reflective knowledge, e.g. tacit knowledge, that the plague and leprosy were contagious. Thus, contaminated patients required isolation in private rooms to prevent the spread of the disease in monastic wards. From an environment-behavior perspective, we

understand privacy as an interpersonal boundary-control dialectic process that involves the restriction and seeking of interaction (Altman, 1975) The use of a private room in monastic hospitals in the 13th and 14th centuries provided individuals with a way of controlling personal access, thus provided them with the ability to protect their privacy, but for only those who could afford privacy were granted this privilege.

Hospital building plans up to and through most of the 19th century were as far from the ideas of EBD as can be imagined. Hospital plans were derived from architectural forms that were originally designed for other purposes. Instead of planning for the needs of the sick, the function of caring was fitted into existing architectural forms (Thompson & Goldin, 1975). At about the same timeframe that derived plans were predominately being utilized in healthcare design; architects began to question the feasibility of ignoring end user needs. This resulted in the development of designed hospital building plans that could meet specific user needs. In the hospital-derived plan, the architectural pattern dominated, whereas a designed plan sought to meet the needs of patients and focused on improving on important patient issues, such as sanitary conditions (Thompson & Goldin, 1975). Over time it became clear the derived plans for hospitals presented real and potential dangers to patients, e.g. poor ventilation, fire hazards, and unsanitary conditions. This resulted in a development of the pavilion hospital (Thompson & Goldin, 1975). The pavilion hospital was the dominant form of hospital type for the next 100 years and was specifically designed to accommodate the inpatient. The pavilion was known as a sanitary code embodied in a building (Thompson & Goldin, 1975). Patient wards were open and ventilated on both sides, connected to a corridor and to other similar pavilions. Architects looked to limit ward sizes to 24-36

patients in order to assure the best patient to nurse ratios so that the nurse's time and strength were used efficiently (Thompson & Goldin, 1975).

The focus on patient care and evidence-based understanding of medical treatment ushered in a new era known as the Nightingale period (S. Verderber, 2009). In her seminal works, *Notes on nursing* (1859) and *Notes on hospitals* (1863) , Florence Nightingale set the standards for patient ward development and theories of nursing practice (Stephen Verderber & Fine, 2000). The new idea of sanitary measures and ease of nursing supervision resulted in Nightingale's rejection of the 18th century corridor plans and double wards. Nightingale's requirements for functional patient wards were based on normative ideas from her own experiences as a nurse, and the miasmatic theory of disease. The application of evidence from tacit and explicit knowledge of the time served as Nightingale's basis for environmental reform that focused on ventilation, cleanliness, and adequate supervision (Thompson & Goldin, 1975). As the evolution of hospital design progressed in the late 19th and early 20th century, driven by a greater understanding of medical science, there remained instances of Nightingale's normative ideas embodied in the ward design standards, such as use of white or pink cement walls, lacquered oak floors, and the conspicuous absence of private rooms, which Nightingale abhorred and believed prohibited appropriate observation of the patient (Nightingale, 1863). The Nightingale ward was utilized by hospitals exclusively and its use prevailed until the mid-twentieth century. Eventually, private rooms were added to hospitals to accommodate patients requiring isolation and for affluent patients who sought and paid for privacy (Thompson & Goldin, 1975).

At the turn of the 19th century hospital administrators in the US and in Europe began to support the use of private patient rooms and believed them to be financially and medically feasible. This led to one of the great debates in hospital building in the 20th century - multi-occupancy patient rooms versus single patient rooms. The debate over patient room density was quietly discussed in the early part of the 20th century, and forced into submission during the depression, but became a heated discussion by the 1950's & 1970's with proponents on both sides of the issue (Thompson & Goldin, 1975). Complicating matters further was the availability of federal monies for hospitals building via the Hill-Burton Program (1946), which regulated the building of 4 & 6 patient wards through awarding of financial grants (Thompson & Goldin, 1975).

Over the past two decades there has been an increase in the number of single occupancy patient rooms available in the US. Evidence from research that supports the use of the private patient rooms include: cost efficacy, patient safety, and therapeutic impacts (Chaudhury et al., 2005; R. Ulrich et al., 2004). Researchers in this area have concluded the benefits of a single patient room are measurable and sustainable and agree the single patient room has an impact in reducing nosocomial infections and medical errors predominately due to limited patient access. In this debate, the evidence from research was compelling enough for the American Institute of Architects (AIA) to include the private patient room as a minimum standard in its building requirements for hospitals (AIA, 2006). The AIA healthcare building standards were developed with the support of the US Department of Health and Human Services, and have been adopted by 42 states as the building code for hospitals (AIA, 2006) This illustrates how evidence

from multi-disciplinary research becomes codified and wider accepted as minimum standards of practice in building design.

ARCHITECTURAL THEORY

The practice of architecture and design requires knowledge on an array of phenomena and makes the epistemological framework of architecture divided between the paradigms of science and art/philosophy (Groat & Wang, 2002b). Due to architecture's dichotomous nature, controversy arises as to what types of theories constitute the most important basis for architectural knowledge, and what architectural theories should look like. Jon Lang (1987) described design theories as occupying two different spheres; one based on phenomenal realities and the other general prescriptions for action. Thus, theories in design are conceptually divided into either positive, also known as analytical theories, or normative theories (Hillier, 1996; Lang, 1987).

Analytic theories are analogous to scientific theories, which are sets of statements, some of which state laws or singular facts. Theories contain both observable and unobservable properties. The statements of theory are interrelated, which can unify diverse phenomenon, and have explanatory and predictive powers (Klemke, Hollinger, Rudge, & Kline, 1998). Scientific theories deal with how the world *is*, not how it *might be*. Positive theories do more than simply describe the real world, they explain it. The goal of positive theory in design is to enable designers to derive a large number of descriptive statements from a single explanatory statement, so architectural knowledge can be built upon a sound theoretical foundation (Lang, 1987). As such, successful design theories consist of simple but powerful generalizations about the world that permit

predictions of future outcomes (Lang, 1987). Architectural theories should be systematic and open themselves to discussion and challenge, as noted by Popper. Karl Popper stated that good theory must hold out the promise of a real improvement by making connections between up to now unconnected things and must predict a consequence of a new kind. He specified that what is wanted and needed from positive theory "is truth and new truth" and "not just the truth but interesting truth" (Kessler, 2004, p. 307).

Normative theory was described by Lang (1987) as "an ambiguous term" (pp. 13). It is ambiguous because normative theories consist of statements on worldviews and ideologies of what ought to be and not how things are. They represent the designer's aspirations as compared to what reality is (Hillier, 1996). As Lang (1987) states, "The scientific method provides rules for description and explanation, not for creation. A design may be derived from scientifically formulated positive theory, but this does not make it scientific. Normative theory is based on an ideology or world view even if this is not explicitly stated" (p. 16). Normative theories rely upon individual interpretation, good-bad, right-wrong, desirable-undesirable, and are not predictive of specific outcomes (Lang, 1987). As such, normative theory should never be mistaken for science, because it is value-laden (Lang, 1987). Although, we do understand historically and pragmatically that science is not necessarily value-free. Nevertheless, normative theories serve a purpose in architecture and many naturalists have argued that normative questions are important, because these questions do involve a value judgment, and help distinguish between the philosophical issues of good and bad (Godfrey-Smith, 2003). In design, normative theories help the designer make decisions and can be prospective, because it

provides designers with guidelines and principles to follow, but can result in a variety of empirical outcomes (Groat & Wang, 2002b).

Normative theories are not testable under empirical laws, and can be considered to have polemic origins, persisting because they have either practical application and/or have gained professional acceptance (Moore, 1985). Polemical theories in architecture sometimes are mistaken or confused as scientific theory by designers. These types of theories are related to design activity and are very strongly stated opinions that set normative guidelines for what to do in architecture (Groat & Wang, 2002). As normative theories, they cannot withstand the scientific scrutiny as defined by Popper (as cited in (Curd & Cover, 1998), or Kuhn (1997). According to Popper (as cited in Curd & Cover, 1998) determining the difference between what is science/analytical and what is not/normative is "neither a problem of meaningfulness or significance, nor a problem of truth or acceptability. It [is] the problem of drawing a line between empirical sciences and all other statements." Popper proposed demarcation criteria, which were the necessary conditions and characteristics that a discipline or theory must posses so that it can be differentiated from that which is not science. His demarcation criteria included the following: the theory must risk refutation; it must forbid certain things to happen; there must be genuine tests of the theory to try to refute (falsify) it; and only falsification tests count as evidence (as cited in Curd & Cover, 1998). Kuhn (1997) describes two scientific activities called normal science and revolutionary science. Theory to Kuhn (1997) is a way of trying to explain the world we experience - our day to day reality, yet when irreconcilable irregularities in the know reality occur it creates a paradigmatic shift, and our reality is replaced with a new one. Based on this philosophical view, Kuhn

(1997) provides us with a list of five characteristics to judge the adequacy of a scientific theory, which include: accuracy, consistency, scope, simplicity, and fruitfulness. Moore (as cited in Groat & Wang, 2002) provides an evaluation tool for theories in environment-behavior research that consists of six components, similarly to Kuhn's adequacy scale of theory. Moore's (as cited in Groat & Wang, 2002) six components include: a set of propositions about some aspect of the universe, logical connections between propositions, a set of conclusions drawn from the first two components, linkages to empirical reality, a set of assumptions underlying the theory, and statements made about connections that are testable in principal.

These concepts are useful in evaluating architectural theories used in the design process, such as territoriality (Sack, 1986) and personal space (Sommer, 1969) because it defines a theory's origins, conjectures made, methodologies used for testing, testability, and applicability to design. However, architectural theories/treatises, such as postmodernism, structuralism, and deconstruction do not fit well into this scientific demarcation framework, because these theories are not scientific, but polemic in origin, and must be characterized differently. Therefore, normative architectural theories are characterized by its attitude towards a subject matter in a prescriptive, proscriptive, affirmative, or critical manner (Nesbitt, 1996)(Nesbitt, 1996). As Nesbit (1996) defines it prescriptive theory offers new or revived solutions for design problems and promotes standards and methods; proscriptive theory defines what should be avoided in design, i.e. good urban architecture is the absence of negative attributes, and critical theory evaluates a design and its relationship to the society it serves. The attributes of architectural theories as stated by Nesbitt (1996) are more closely linked to worldviews of how the

world should be, as compared to how it actually is, and focus on the origins of practice and art.

Proponents of a scientifically based architectural knowledge base, such as Rapoport (2000) believe that any theory of design must be predicated on understanding environmental-behavior relationships. Moreover, that testing and evaluating design theories is one of the only ways to build a body of design knowledge (Rapoport, 1969). Rapoport (2000) is most interested in theories for their ability to explain, "explanation is *understanding* – one wants to know why things are as they are or why the world (or the part of it in the domain of concern) is the way it is and how it works." (pp. 112). His basic premise is that while there are many ways of interacting with the world; the only way to do this cognitively is through science, and this can only be accomplished through the use of explanatory theories. A fundamental goal of design theories is to develop an understanding of the connection between the qualities in the physical environment that contribute or have consequences for the quality of life (Moore, Tuttle, & Howell, 1985). It must go beyond the simple relationship between *form and function*, and provide for the designer a rich understanding of why there is a relationship between form and function. As Bill Hillier (1996) points out, until we understand the fundamental causal connection between form and function, we cannot acquire purposeful knowledge in architecture.

Environment behavior research (EBR) provides the foundation necessary to understand and explain the connection between the form - the phenomenon of the building, and the function – the people who use it, not as a determinant of social behavior or specific outcomes, but as the vehicle in which these activities may or may not play out. Gary Moore (1985) discusses an organizing framework in EBR that consists of four

components: the idea that any EBR question is founded in terms of place, environmental user groups, social-behavioral events and time; the proposal that the role of theory is to make clear the relationship between these dimensions; the process of repeating EBR and it applications; and the context of cultural and environmental factors that act upon the field. The replication and predictive powers of environment-behavior based architectural theories is what separates these theories from normative theories. Bill Hillier (1996) speaks of a need for an analytical theory in architecture and finds that the need is greater as architecture advances. However, unlike Lang and Rapoport, Hillier (1996) finds the answers to architectural knowledge not in environmental behavior, but in the non-discursivity of objects and buildings. He believes that an analytical theory is necessary to retain the autonomy of creative innovations on which advancements in architecture depends. Thus, in his opinion, what has passed before as architectural theory was nothing more than precepts for building, and while useful as cannons can never be considered a scientific theory (Hillier, 1996). Instead he proposes architectural theories as analytical -normative complexes that provide both the knowledge and the means of design within a single proposition (Hillier, 1996).

Zeisel (2006) discusses two different types of knowledge in design: explicit knowledge and tacit knowledge. He equates explicit knowledge to a form of scientific knowledge that can be shared with a broader community, whereas tacit knowledge is knowledge that cannot be made explicit, and is not codified in rules or laws, but is commonly learned by doing (Zeisel, 2006). For Zeisel (2006) explicit knowledge is made up of theories, which are a summarization of past experiences in a set of statements that has internal coherence, is transferable to other situations, connected to new

experiences through testing, and can derive new testable statements about previously unknown experiences. Exemplars and models exemplify tacit knowledge, which provides designers with the ability to ask questions and make comparisons (Zeisel, 2006). However, too frequently, designers rely heavily upon tacit knowledge, which creates reciprocal boundaries and the effect of design becomes limited, lost, or useless.

The central epistemological concept and philosophy of science that Rapoport (2005), Zeisel (2006), Lang (1987), Moore (1987), and Hillier (1996) espouse in support of architectural theory is evidence. The theory of evidence/confirmation is an account of the relationship between the statements that make up a scientific theory and statements describing observations, which make the observations, support the theory (Godfrey-Smith, 2003). Evidence "is the kind of thing which can make a difference to what one is justified in believing or what is reasonable for one to believe" ("Evidence", 2006). As we already know from philosophy of science and demarcation criteria, we cannot prove a theory, but we can use evidence to support one theory over another (Godfrey-Smith, 2003). However, evidence is not just a simple conglomeration of observations, and to be of value it must be connected to theory. Popper argues, "all observation involves interpretation in light of our theoretical knowledge, or that pure observational knowledge, unadulterated by theory, would, if at all possible, be utterly barren and futile" (as cited in Miller, 1985, p. 48-49). We must make a large number of assumptions in order to bring the theory and the observations into contact with each other, whenever a theory is tested by comparing it with observations (Godfrey-Smith, 2003). Ultimately, the aim of scientific testing is to choose between rival hypotheses about the hidden structures of the world, to work out a whole new explanation or to just work out the details, and

sometimes the aim is to understand general patterns or to reconstruct particular events in the past (Godfrey-Smith, 2003).

Due to the dichotomous nature of architectural theory and practice, it is nearly impossible to make broad generalizations as a whole about any building project; however, what evidence provides the designer with is the ability to make a form of inference called a projection. According to Godfrey-Smith (2003) inferences made from a number of observations of cases allows the researcher to make predictions about the next case, but not to generalize to all cases. However, the problem of using evidence, as a basis for making predictions in design, is the evidence could be wrong, especially if it is based on too few observations, not connected to theory or not rigorously tested. Therefore, insufficient evidence cannot be used to explain causal relationships between design and outcomes that can lead to meaningful predictions in design (R. Tofle et al., 2004). This is illustrated in the use of evidence-based design (EBD) in healthcare building. The quality and quantity of evidence from environments that links a design intervention to its outcome within healthcare is limited (Stankos & Schwarz, 2007). However, despite this insufficiency of evidence in support of a particular healthcare design theory, architects will use the limited amount of available information to justify building hospitals in a certain way. Rather than explaining a causal connection built upon evidence from research, the hospital design risks becoming a design trend and instrumentally rational, that is - a good way of achieving a goal that the designer is pursuing, whatever that goal might be (Godfrey-Smith, 2003).

In architecture, we must define the strategy for investigating the world, and describe what sort of connection to the world we are likely to achieve by following the

strategy (Godfrey-Smith, 2003). Adopting a scientifically based approach to architectural theories, as compared to a purely normative approach, provides the discipline with the ability to respond to issues, conduct research necessary for its progress, to develop logical normative statements for its action, and to recognize its limits of understanding (Lang, 1987). The traditional split seen between the scientific and the practical in architecture is neither possible nor desirable when it comes to design (Rosmarin, 1984). Design is about what has already been realized and what is possible, and architects are challenged with creating analytical theories that address the connection between the form and its reality (Schwarz, 2007). Theories in architecture must have the generative powers in art and also have analytical powers found in science, and as such be both analytical and descriptive (Hiller, 1996).

THE DESIGN PROCESS AND EBD IN HEALTHCARE

Evidence-based design (EBD) is defined as the explicit and judicious use of current best evidence from research and practice in making critical decisions about the design of each individual building project (J. F. Stichler & Hamilton, 2008). Zeisel (2006) discusses how evidence from environment-behavior research (EBR) can be used in the design process in a cooperative manner to solve design and research problems. This cooperation is realized as reciprocal benefits from shared knowledge, the incorporation of new elements, invention of shared methods, and the general broadening of understanding (Zeisel, 2006). Amos Rapoport (2000) tells us that built environments are purposeful, and that design can benefit by bringing together existing information from research in order to discover patterns, mechanisms and interactions that lead to new

concepts and models. Thus, by applying explanatory theories from EBR, designers can improve the built environment, and EB science can learn from its application (Rapoport, 2000). Healthcare design is benefiting greatly from this cooperation between designers and EB researchers in the building of new hospital environments, which can impact patient outcomes and staff efficiency (R. Ulrich et al., 2004). We look to the use of EBD in healthcare in order to closely examine the tie between design and research.

A growing body of rigorous, scientific research is showing how the design of the hospital environment affects the safety and wellbeing of patients and staff, and in particular, how design can play a role in improving patient outcomes through prevention of iatrogenic patient injury, and reducing airborne and contact spread nosocomial infections (AHRQ, 2017; R. S. Ulrich et al., 2008). Evidence from empirical research on air quality have resulted in recommendations from the Centers for Disease Control (CDC) for the design of ventilation systems in surgery that use laminar flow with HEPA filters, which can reduce the spread of air borne contaminates (Sehulster & Chinn, 2003). Several studies performed on decreasing nosocomial infections rates and staff hand washing have resulted in a satisfactory body of evidence for designers to consider increasing the number of available sinks in any new hospital design (Zimring et al., 2013). However, the questions that have yet to be answered specifically is how many sinks are necessary, and where should they be optimally located on a nursing unit to achieve the stated objective, e.g. more hand washing by staff. Therefore, the body of evidence that directs healthcare designers on the number of and placement of sinks is incomplete, but designers will utilize existing evidence/ information to advocate for more sinks inside and outside patient rooms, adapting research to their images of healthcare

design (Zeisel, 2006). Herein lays the concern of using evidence from a limited number of empirical studies in the design of hospitals, are we really utilizing tested and proven design evidence from research, or are we only replicating healthcare design trends that may or may not deliver an expected outcome (Stankos & Schwarz, 2007).

The role of the environment in causing or preventing patient injury from falls is widely accepted; however, there is no conclusive evidence that correlates environmental interventions with reduced falls (Zimring, et al. 2006). Research by Vassall, et al. (2000) suggests that patients fall when attempting to get out of bed, and they recommend increasing patient observation as an intervention to minimize falls. Based on this research, healthcare designers are recommending environmental strategies that increase observation and improve assistance for patients in the hopes of reducing patient falls (Zimring, et al., 2006).

One such design strategy is the acuity adaptable room, which are single patient rooms that can adapt to the individual acuity needs of its occupant (Chaudhury et al., 2009). The design of an acuity adaptable room supports the presence of family through dedicated family space, and more continuous observation by the nurse through decentralized nursing stations. In one study that examined patient fall rates after the implementation of the acuity adaptable room, the researchers noted that patient fall rates decreased by 70% (A. Hendrich, 2006; A. L. Hendrich, Fay, & Sorrells, 2004). While the use of acuity adaptable rooms holds promise as a solution to patient falls, as suggested by the evidence from this study, the body of evidence is insufficient to advocate the wide-spread support for building such patient room types. Evidence "is the kind of thing which can make a difference to what one is justified in believing or what is

reasonable for one to believe" (Evidence, 2006). The problem of using evidence, as a basis for making predictions in design, is that the evidence could be wrong, especially if it is based on too few observations, not connected to theory, or not rigorously tested. Insufficient quantity and quality of evidence cannot be used to explain causal relationships between design and outcomes that can lead to meaningful predictions in design (R. Tofle et al., 2004). As such, this strongly advises that more research must be done to support design recommendations that include acuity adaptable patient rooms as the answer to preventing patient falls, as compared to other design solutions such as decentralized nursing stations alone, or different types of private patient rooms that support family involvement.

In developing the performance program, the designer has occasion to make user needs visible and evidence-based research is helpful in determining performance criteria (Zeisel, 2006). EBD can be used to draw out knowledge concerning a particular design problem and should ultimately influence it throughout the design process. This does not mean that the designer must use only the body of knowledge that constitutes healthcare EBD but should ensure that it informs the process and decide whether or not it can solve the stated problem.

Recent nursing research on preventing patient falls does not focus on the style or layout of the patient room, but rather the quality and completeness of communication amongst team members concerning patient risk of falls and patient needs (Dykes et al., 2010). Dykes' et al. (2010) research focused on the visual cues nurses, physicians, and ancillary service personal could use to quickly communicate, evaluate and implement the necessary nursing interventions to prevent inpatient falls. This led to the development of

a fall prevention toolkit called T.I.P.S – Tailoring Interventions for Patient Safety, which included a poster-sized copy of the patient's individualized fall prevention interventions utilizing standardized iconology displayed prominently in the patient's room (Dykes et al., 2017; Hurley, Dykes, Carroll, Dykes, & Middleton, 2009). The failure to consider this body of nursing research in attempting to solve the problem of patient falls can result in poor design or high construction/design costs that do not prevent patients from falling. Therefore, in the absence of definitive evidence from multi-disciplinary research projects that strongly support the fall prevention benefits of building acuity adaptable rooms in hospitals, designers should consider the acuity adaptable room as only part of or one of the solutions within the domain of acceptable responses, as there are many potential environmental solutions that can impact patient falls (Zeisel, 2006).

According to Rapoport (1969), unevaluated designs are simply assertions and testing and evaluation are the only way of deciding whether a design is successful and contributes to a body of knowledge. Post-occupancy evaluations provide the designer and the researcher another opportunity to cooperate and make tangible the design decisions that leads up to the design, which can affect future design decisions, and to test theories on which design decisions are based (Zeisel, 2006). In healthcare, The Center for Health Design's Pebble Project is considered to be an incubator/accelerator of evidence-based design. The project has been in place since 2000 and currently has dozens of ongoing and completed design/building projects (www.healthdesign.org/research/pebble). The Pebble Project participants are granted access to design experts, literature, existing research, and are asked to collect certain quality and safety measures/observations to add to the database of information on

building design. Becoming a Pebble Partner is based on an application process and an ongoing healthcare building project. While the Pebble Partner can avail themselves to the information in the database, or to experts in the field, and submit data, partners are not forced to actively participate. As such, the information collected in the database can be incomplete, and/or not based on design evidence, and reliance on anecdotal or non-standardized/generalizable outcomes can result in unpredictable results. Moreover, observations in the absence of theory for building and design is unreliable, because measuring the effectiveness of interventions becomes a critical factor in the causal explanation of any design intervention, and if the quality of the research or the quantity of the research is lacking, the evidence is insufficient to support the design decision (Stankos & Schwarz, 2007).

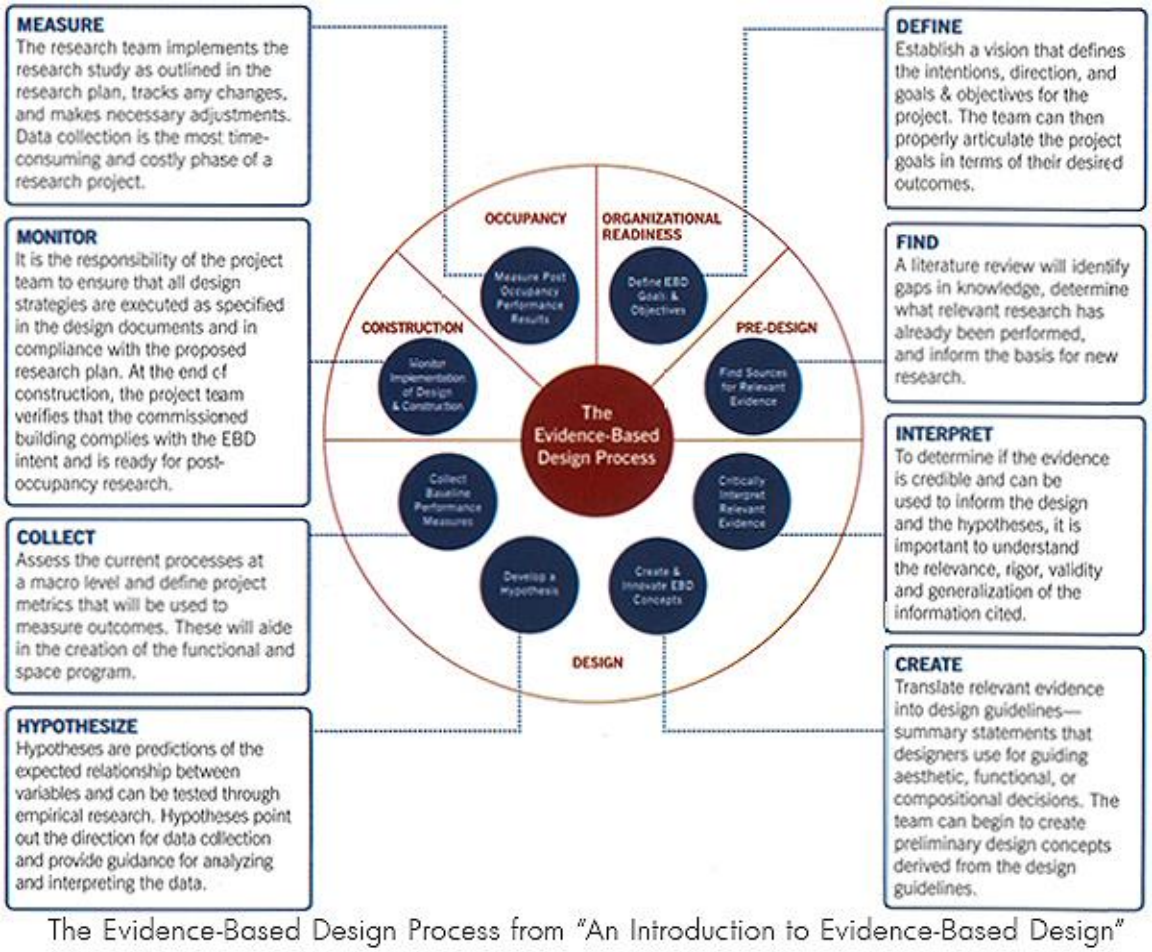
To broaden EBD acceptability among healthcare architects and to address growing criticism concerning the limited use and reliability of EBD adoption in the field, the Center for Health Design developed a design evidence-based policy and a certification called EDAC – Evidence-Based Design Accreditation and Certification (Malone et al., 2008). EDAC has been branded by the Center for Health Design as an expression of expertise that can be utilized by architects and interior designs to communicate to others in the field, and to clients, their greater understanding and use of EBD. The necessary knowledge base to become an evidenced-based practitioner is contained within a three-volume study guide, which reviews the history of EBD, interpretation of evidence, and integration/application of evidence in design practice (Malone et al., 2008; McLaughlin, 2010; Quan et al., 2009).

According to the Center for Health Design, EBD practice is iterative and there is an emphasis on using evidence to inform design decision making and to become generative, as such providing the necessary base to inform future design (Quan et al., 2009). EBD research activities are classified into two categories: using existing evidence to inform design and creating new evidence to answer questions. The distinction between the EBD process and what is referred as the typical healthcare design process is that it incorporates relevant evidence that educates the project team and guides design strategies, referred as the EBD features, and it creates new evidence that emerges from the posited EBD approaches. It is said that the typical design process – planning/programming, designing, and construction, which is known by all designers, essentially remains the same, but the healthcare EBD designer applies specific EBD practice steps to ensure use of relevant evidence and the creation of new evidence (Quan et al., 2009).

The process in EBD practice is separated into 8 non-linear steps identified as (see Figure 1 below):

- Defining EBD goals and objective
- Finding sources of relevant evidence
- Critical interpretation of the relevant evidence
- Create and innovate EBD concepts
- Develop the hypothesis
- Collect baseline performance measures
- Monitor design and construction
- Measure post occupancy results

Figure 1. EBD process (Quan et al., 2018, p. 32)



The Evidence-Based Design Process from "An Introduction to Evidence-Based Design"

According to the Center for Health Design, inclusion of these steps makes EBD practice different in the sense that rather than hurrying through the planning and programing to get to the design phase, the design team spends time at the beginning of any project to purposefully strategize, collaborate, plan, research, and hypothesize potential EBD solutions. This predesign stage is approached through the lens of the vision, business case, and organizational goals and objectives (Quan et al., 2009).

From the perspective of the designer and hospital, evidence used to make design decisions can be from many sources and is contextually based within a range that swings

from the subjective – opinions and precedents, to the objective that include the quasi-experimental and randomized controlled trials (Harris, 2008). Combining the different forms of collected data for a project is thought to attain the most useful information and insights for design decisions (Quan et al., 2009). Information is gathered about a specific design issue from literature reviews, experiential knowledge, review of existing data from within the facility – such as demographic data, needs analysis, staff and patient surveys, etc., site visits to other facilities, and peer-reviewed journals (Quan et al., 2009). The reliability and credibility of collected data/information is something each designer must determine to ensure it can inform the design and the hypothesis and in order to configure this information into guidelines for the design project. The development of hypotheses includes the design strategy and desired outcomes that match the goals and the objectives of the project vision. Baseline metrics are identified and collected in order to measure outcomes of the design plan, which are conducted through planned studies or post-occupancy evaluations (Quan et al., 2009). While many of the steps are conducted during the predesign phase of the project, several of the steps are reviewed and/or repeated during the design phase to develop conceptual designs and tie in design innovations with expected or hypothesized outcomes (Quan et al., 2009). Schematic designs when developed correctly early within the EBD practice process, the design criteria include the established EBD goals. Once completed mock-up environments can be developed prior to construction to test EBD hypothesis. During the construction and occupancy phase, the designer makes sure that the design intent is directly linked to the EBD goals. The final stage of the EBD design process is to measure post-occupancy

performance results. This includes the time necessary to measure and share the results of the research conducted based upon the initial research plan (Quan et al., 2009).

Potential issues with this process are whether the right hypotheses/research questions are being asked, or if the right literature or evidence is applied to the problem, especially if evidence is other than research based. Moreover, few architects gather data on the built environment from a post-occupancy evaluation (POE), or attempt to gather quality data from the hospital post-occupancy to ensure the hypothesis was proven, i.e. problem solved, removed, or improved. One of the greater concerns of being an iterative process is that in healthcare design you are stuck with the decisions made, and there is no guarantee that "lessons learned" would then be employed the next time nor guarantee better outcomes due to the lack of a theoretical base (Stankos & Schwarz, 2007) Nonetheless, as an evidence based practice, use of this EBD process could result in improving the rigor of information used in making design decisions.

CHAPTER 3 - RESEARCH METHODS

WHY USE A QUALITATIVE RESEARCH APPROACH?

Research proposals arise from a framework, or as Michael Crotty (1998) refers to it -*scaffolding*, made of four elements that provide the researcher with stability and direction in the research process. The four elements identified by Crotty (1998) are methods, methodology, theoretical perspectives, and epistemology. In choosing how each of these elements are addressed the researcher not only informs the broader aspect of the approach, but also guides the collection and analysis of data (Crotty, 1998). Similarly, John Creswell (2003) utilized Crotty's framework to ask three essential questions that he believed to be the core of all research design:

- What are the knowledge claims being made?
- What are the strategies of inquiry?
- What are the methods of data collection and analysis? (Creswell, 2003, p. 5).

By combining these core elements, the researcher formulates the different approaches to research. In order to decide which research process best answers the proposed question(s), the researcher needs to first evaluate the type of knowledge claims she brings to the study, consider the inquiry of strategy to be utilized, and specify the methods (Creswell, 2003). According to Creswell, the researcher can then determine the approach to the research question(s) as to whether it is quantitative, qualitative or mixed methods (Creswell, 2003).

Knowledge Claims, Research Questions, and Approaches

Knowledge claims are important to the research process because they represent the researchers' worldview, and assumptions about how they learn and what they will learn (Creswell, 2003). Individually, researchers tend to have a very specific way they interpret the world around them, and is evident in the type of research process they choose to use (J. W. Creswell & Clark, 2007).

Epistemologically, quantitative research is grounded in a post-positivist paradigm, and lends itself to logical, causative, deterministic a priori theories (Creswell, 2007). Post-positivist knowledge claims are conjectural and seek to develop *true statements* that represent reality (Creswell, 2003). Objects in the world have meaning in and of themselves outside of consciousness (Crotty, 1998). The reality that underscores post-positivism is value free, and uncontaminated by human bias and misconceptions. It relies on a foundation of scientific knowledge that adheres to a formula of rigorous application and testing of phenomena/theory (Guba & Lincoln, 2005). Quantitative research relies upon testing of theories through the identification of independent and dependent variables, controlling and measuring variables. A research problem that focuses on testing multiple interventions in order to identify the best outcome is well suited for a quantitative approach.

Contrast this paradigmatic view to that found in the epistemological perspective of qualitative research. Qualitative inquires do not conform to preconceptions of *the norm*, but seek a deeper understanding of the complexities, inconsistencies, and variants present in human nature (Schoenberg & Rowles, 2002). It is an approach used by researchers in the study of complex phenomena that exposes the richness of people's

lives and experiences (Denzin & Lincoln, 2011). Research problems best suited for qualitative inquiry ask how, when, and where, and revolve around meaning and interpretation of experiences.

The qualitative researcher's work is grounded in a passion for her own life experiences and a need to look deeper into the different levels of meaning that cannot be achieved through scientific approaches (Schoenberg & Rowles, 2002). Qualitative researchers not only learn about the experience of others, but also have the opportunity to examine their own experiences that affects what is being researched and discovered (Patton, 2002). The researcher's cultural, personal and historical experiences play a pivotal role in shaping the interpretation of data. Unlike quantitative research, qualitative inquiry is emergent, as the plan for research cannot be tightly prescribed, and the researcher is cognizant that the process may change once data is collected (Creswell, 2007).

Knowledge claims in qualitative inquiry are contextual, constructed through subjective meaning, which is negotiated socially and historically (Creswell, 2003). Meaning is as varied as there are people in the world, so knowledge is never certain and there is no one truth, but multiple truths. Qualitative theories hold that the world is constructed day be day and reality is equivalent to one's perspective. The goal of qualitative inquiry is to find the meaning behind the behavior of individuals, not to predict it, so it focuses on the essence of meaning (Oliver, 2008). Another worldview that frames qualitative inquiry is participatory and is action oriented, resulting in change for the participant, institution, and the researcher (Creswell, 2007).

The subjective framework founded in the paradigms of constructivism, participatory, and interpretivism can serve as a theoretical lens or perspective that guides the study and assists the researcher as to what issues are important to examine (Creswell, 2003). The qualitative researcher does not set off to test theories, but to develop theoretical orientations and to make sense of how others interpret the world, thus making the qualitative process inductive rather than deductive. Theory in qualitative studies is the end point that builds from the data through the development of categories or themes (Creswell, 2003).

Qualitative Research Methods

The strategy of inquiry used in a qualitative study influences the methods used for data collection and the analysis. In general, data collection is a series of interrelated activities to answer the research questions (Creswell, 2007). These activities include locating the site or individual(s) to study, gaining access and developing rapport with participants so they provide good data, and purposeful sampling (J. W. Creswell, 2007; J. A. Maxwell, 2012). Data collection approaches include observations, interviews, document and artifact review, and audiovisual materials.

Observation involves collecting data from the field and taking notes on what has happened, as well as what does not happen. The first purpose of observational data is to describe the setting, the activities that occurred, the people who participated, and the meanings of what was observed from the point of view of the observed (Patton, 2002). The different levels of engagement distinguish observational methods by the researcher in the study setting. Advantages of observations are that the researcher has firsthand experience with participants; she can record information as it emerges, and it makes

exploring difficult or uncomfortable topics easier (J. Creswell, 2003). Specific limitations of this method include the potential for seeming intrusive, and the inability to use confidential information gathered form observations. The researcher may have poor skills of observation thus resulting in poor data collection, and in some instances - establishing rapport with particular groups may be difficult (Creswell, 2003).

Data collection from observations occurs along a continuum of observer and/or participant positions. The level of engagement is dependent upon the research problem and qualitative strategy utilized (Patton, 2002). The research can be completely immersed as a participant and her role as researcher concealed, which is beneficial if one is performing an ethnographic study on marginalized individuals, such as prisoners; however, ethical issues may arise as to the covertness of such observations (Patton, 2002).

Another method of data collection in qualitative research is the interview. Qualitative interviews are generally characterized by the "collection of rich, person-centered, contextualized data through a collaborative participant-researcher effort based on good rapport" (Schoenberg & Rowles, 2002, p. 130). Features common in any interview is the goal of "capturing a rich and colorful mosaic of data", and extensive background material on the participants personal situation (Schoenberg & Rowles, 2002). We interview participants because we cannot directly observe such things as feelings, thoughts, and intentions, or behaviors that took place at another time (Patton, 2002). Interviews are recorded either in an audio or video format and transcribed later for data analysis. Notes can be written instead of recording the interview; however, such note taking can be distracting and discontinuous to the interview process. As in observations

there are multiple types of interview styles and include: the informal conversation or unstandardized interview, the general interview guide approach or semi-standardized interview, and the standardized open-ended interview. In addition, there are several modes to the interview approach and can be individual or face to face, focused group, telephone, and on-line.

The researcher needs to determine the style and mode of interview based on what is practical and what will result in the most useful information to answer proposed research questions (Creswell, 2007). Problems or concerns that can adversely affect data collection in interviews are affected wording that creates emotional responses or inhibits the participant's responses, double loaded questions, complex long questions, closed-ended questions, researcher bias, inarticulate participants, and poor interviewer skills. Because the interviewer/researcher skills are crucial to the quality of the information obtained, the researcher must encompass the following attributes: a fundamental linguistic competence, the ability to show up at the right time and place, the ability to engender trust, and a general respect for local customs and norms (Schoenberg & Rowles, 2002).

Data analysis in qualitative research is the process of making sense out of text and image data. The first step in data analysis is preparing the data for analysis that allows the researcher to conduct different analyses. These analyses bring the researcher deeper into the data so that interpretation of the larger meaning of the data can be expressed (Creswell, 2003). The process of data analysis in qualitative research is reflective because the researcher is always reading all the data to get an overall sense of the information and constantly asking analytical questions (Creswell, 2003). The researcher

codes segments of the data with short titles that summarizes and accounts for each piece of data and helps the researcher develop abstract ideas (Charmaz, 2006). Coding, according to Charmaz (2006), is "the first step in moving beyond concrete statements in the data to making analytic interpretations." It allows you to explain the data and define what is happening as the researcher tries to understand what it means. The researcher must always stay close to the data in the initial coding phase, attempt to see action in each segment of data, and avoid trying to apply the data into preexisting categories. In this manner, the researcher is less likely to miss important information, and more importantly it improves validity (Charmaz, 2006). Researchers have a choice of doing word by word coding, line by line coding, or incident to incident coding, but the form of coding the researcher chooses is dependent upon the data collected and the level of abstraction necessary (Charmaz, 2006).

The next step in qualitative data analysis is focused coding or the development of categories, which are more directed, selective, and conceptual than initial codes. This allows the researcher to synthesize and explain larger segments of data than cannot be done in the initial coding phase (Charmaz, 2006). In this step the researcher is looking for a way of reducing the total list of codes by grouping topics that are related to each other (Creswell, 2003). The researcher can also do axial coding, which permits the researcher to construct an axis of subcategories around a major category. The process of coding results in the identification of themes and become the major findings of the qualitative study. The themes are used as an integral part of the interpretation and the development of a storyline, a theoretical model, a case, or a general description of a phenomenon. The next step in the analysis of qualitative data is memo-writing. Memos

are a way of analyzing ideas about the codes and categories developed from the data. Memo writing throughout the research process keeps the researcher involved in the analysis and helps crystallize questions and directions the researcher should pursue (Charmaz, 2006). Memo-writing is a crucial step in the analytic process because it forces the researcher to stop doing other things and focus intensely on a single category to find the meaning within (Charmaz, 2006). The final step in the data analysis process is the interpretation of the meaning of the data in a report of findings.

Validity and reliability issues can arise with any qualitative method, analysis, or conclusion, because validity and/or reliability are not guaranteed just because a prescribed procedure of qualitative inquiry was followed. Validity is defined as the correctness or *credibility or authenticity* of a description, conclusion, explanation, or interpretation (Guba & Lincoln, 2005). Reliability in qualitative research refers to the *dependability* of collected data (J. A. Maxwell, 2004). While there are multiple threats to validity and reliability, the main two threats that can occur in qualitative research are researcher bias and reactivity. Researcher bias, or subjectivity, can influence the selection of specific data that fit a researcher's established theories or preconceptions, as well as the fixed selection of only data that stands out (J. Maxwell, 1992). Reactivity is the influence the researcher has on the setting and/or the participants, which can cause unwanted variability in outcomes. However, it is impossible to remove the researcher's influence, as it is part of qualitative study, instead the researcher must be aware of it and understand it and should use it productively (Maxwell, 2004).

Strategies utilized by the qualitative researcher to improve validity and reliability are:

- Triangulation, crosschecking information so when the different procedures or sources are in agreement then there is corroboration
    - Theory triangulation
    - Data triangulation
- Member checking to determine accuracy of findings, participant feedback
- Use of rich/thick descriptions to relay findings, use of exact quotes
- Clarifying of researcher bias, reflexivity
- Presentation of discrepant information that is opposite of developed categories, also known as the negative case
    - Negative sampling
- Prolonged fieldwork
- Peer review or debriefing to improve accuracy of the account
- Utilization of an external auditor to review the research project
- Theoretical saturation. (Charmaz, 2006; J. Creswell, 2003; Finlay, 2006; Johnson, 1997; J. A. Maxwell, 2004).

Qualitative inquiry for the researcher starts with a worldview and theoretical perspective consistent with the desire to examine problems that explore the meaning behind human behavior. The process of qualitative research design begins by choosing a strategy that best addresses the research question(s) and is followed by choosing appropriate methods for collecting data. The final step in the qualitative process is data analysis and interpretation and the development of memos that help the researcher conceptualize the data. At all times the researcher must keeping in mind strategies to offset validity and reliability threats to their qualitative inquiry.

THE STUDY DESIGN

In any research project the research question serves multiple purposes, but mainly it is to explain what the study will attempt to learn or understand. It also helps focus the study and provides guidance on how the study is to be conducted (J. A. Maxwell, 2004). I had to decide the central questions to be answered and the best approach. Strategies utilized by qualitative researchers are narrative, phenomenological, case study, ethnography, and grounded theory. Narrative research is a form of inquiry that involves the study of one or more individual life stories that is retold by the researcher (Creswell, 2003). Phenomenological research studies the lived experience to identify the essence of that experience (Creswell, 2003). Case studies is an in depth exploration of an event, program, process, or individuals where data is collected over a specific timeframe (Yin, 2003). Ethnography is the study of an intact culture or group in a naturalistic setting over a period of time (Patton, 2002). Grounded theory attempts to originate a general, abstract theory of a process, or interaction grounded in the perspectives of the study participants (Charmaz, 2006). The type of strategy chosen by the qualitative researcher depends on the research problem and individual preferences, as there may be more than one approach, which can adequately address the research question.

The research questions on understanding *how healthcare administrators and architects use evidence-based design in making healthcare design decisions* is well suited to the case study approach for three reasons: 1) the type of questions posed, 2) the extent of control the investigator had over the events, and 3) the focus on contemporary versus historical events (Yin, 2003). The *how* research questions posed in this study require an explanatory approach as compared to an exploratory approach, because it is focused on

operational links within a bounded system over time, instead of looking at frequencies of occurrences or incidents (J. Creswell, 2007; Yin, 2003). Case study is the best approach when there are bounded cases, and we are looking for comparison of several cases (Stake, 1995). As such, the case study illustrates for us how the culture works, rather than the understanding of a particular problem (J. Creswell, 2007). The events under study, the influence of evidence on design decisions and processes in the building of a new hospital is of a contemporary nature, and no ability of the investigator to manipulate the behaviors of individuals (Yin, 2003). Case study as a research strategy illuminates a decision, why it was made, how it was implemented, and the end result (Yin, 2003).

The collective case study or multiple-case study, allows the researcher to illustrate issues from several research sites in order to show different perspectives on the issues (J. Creswell, 2007). The essence and the advantage of using the case study to answer my research questions were its concentration on the study of the phenomenon, how design decisions are influenced by EBD, which is embedded in a real-life context (Groat & Wang, 2002a). Analysis outcomes emanating from more than a single case are more powerful, especially if under the varied circumstances of the cases similar conclusions can improve the external generalizability of findings, as compared to the single case (Yin, 2003).

What is it about these research questions that compel me to seek deeper or richer knowledge on how hospitals make design decisions? As a registered nurse and risk manager for over 25 years, I have been interested in understanding risk and exploring strategies to remove or mitigate risk to improve patient safety and patient outcomes. In my current position as the Senior Director of Risk Management for a state hospital

association, I routinely respond to questions from clients on risk mitigation from either a regulatory or clinical perspective. Regulatory risk management focuses on how state and federal statutes and administrative rules affect hospital operations and systems, treatment of patients, and professional licensure. Clinical risk management, on the other hand, predominately is concerned with improving the quality and safety of health services. This is done through the identification of circumstances and situations that place patients at risk of harm and the potential for development of claims and litigation. Identification and understanding of how healthcare risk present or develop is an essential component of clinical risk management, as you cannot change/improve what you are not aware of. Information gathering or data collection and risk assessment/analysis, which occurs along the lines of qualitative based research, is routinely performed to ensure a thorough understanding of the events that lead to the issue or risk. The risk manager then is responsible for developing a plan to reduce or eliminate the risk, and evaluating the potential costs associated with the plan/decision made to address the risk.

On a daily basis I receive calls or emails from risk managers or directors of quality or patient safety from either small rural or large urban hospital systems to provide guidance on general quality and patient safety questions concerning hospital and ambulatory facility practices, such as physician credentialing and privileging, nursing policy and procedures, informed consent, nurse triage, medical record documentation and communication among healthcare practitioners, etc. I routinely review the risk management and patient safety literature to provide not only advice for clients, but also for the development of risk improvement projects and programs. Several times during the year I am asked to perform a risk management assessment or survey for either an

entire hospital, high-risk area, i.e. ICU, ED, OR, OB, or physician office practice. Utilizing my 20 plus years of experience as a risk manager, I evaluate operational practices to determine whether the practice or policy exposes the healthcare facility to unnecessary risk, or if I believe the practice can directly affect patient safety. Data is gathered from interviews of key hospital personnel and professional staff, and appropriate documents are reviewed. A report is generated discussing the overall findings and analysis of risk, and recommendations are provided that will improve or remove the risk. Typically, the final report of findings and recommendations are prioritized, and reviewed with the client. Once the report is submitted to the client, I provide assistance to them on how to implement recommendations.

In the early 2000's I consider a return to school to determine how to further develop my interests in risk management and my professional career. I was at the time a registered nurse with over 20 years of bedside experience in emergency, medical-surgical, critical care, and OB nursing, and I had a master's degree in healthcare law. I became interested in healthcare building design, because I was starting to see a significant increase in the number of hospitals building new facilities and wondered how design affect patient safety. Were there things a hospital could do to decrease risk and improve patient safety? Initially, I was unsure on how to approach my then admitting crude curiosity in the effects of design on risk, but with the recommendation and encouragement from my faculty advisor, Dr. Benyamin Schwarz, I soon was guided to explore how I might be able to combine my training and experience into an academic endeavor.

Case Study Selection – Sampling

The strategy in using purposeful sampling is the ability to compare and contrast, and identify similarities and differences in the phenomenon studied until saturation is achieved (Palinkas et al., 2015). Purposeful sampling in qualitative research allows me to extract rich-data in an effective way to illuminate the questions under study from limited resources (Patton, 2002). To do this, I must identify and select individuals or groups that are experienced in the phenomena being studied (J. W. Creswell & Clark, 2007). To understand how the phenomenon is understood among different people, in different settings and times, multiple case sampling must be purposeful to maximize the diversity relevant to the research questions and to show the different perspectives on the issue (Creswell, 2005). While themes from multiple case studies are not generalizable due to the different contexts of each of the case studies, it is best generalized by ensuring to select appropriate representative cases in the qualitative study (J. Creswell, 2007; Yin, 2003). A homogeneous sample allows us to describe a group in some depth (Patton, 2002).

The unit of analysis for this multiple-case study was focused on the event of building a new/replacement facility or renovating an existing facility in healthcare, and included persons that shared a similar culture (Patton, 2002). I limited the case studies to finding healthcare facilities that met one or more of five essential inclusion criteria that would assist in explaining the phenomenon of the nature or type of evidence and how evidence was used to inform healthcare building decisions. (See Table 1)

The unit of analysis/site selection was limited to hospitals, as compared to any "healthcare building", based mainly on the investigator's familiarity with hospital

buildings, and the availability and number of EBD research articles in healthcare. The Center for Health Design's Knowledge Repository, a database focused on providing designers, architects, and students access to a library of healthcare design research revealed the number of research articles on EBD in a hospital setting at nearly 2 to 1 as compared to other types of healthcare buildings, such as clinics or ambulatory facilities (CHD https://www.healthdesign.org/).

Table 1 - Hospital selection criteria

1. Newly built hospitals that have been occupied in the last 1-5 years, and/or
2. A new hospital that is under construction and will be occupied within the next year, and/or
3. New hospital wings or inpatient buildings that have been built and occupied in the last 1-5 years, and/or
4. New hospital wings or inpatient buildings that are under construction and will be occupied within the next year, and/or
5. Hospitals reported to have utilized EBD in their building project

Hospitals span a wide range of types: general or acute care, specialty, critical access, and psychiatric; size or capacity: large, small, single hospital, integrated system; population/location: urban, rural; level of service: medical center – teaching institutions, regional, district, or local; and ownership: voluntary - nonprofit, tribal, government, etc. (Medicare Hospital Information database accessed May 6, 2017) https://data.medicare.gov/Hospital-Compare/Hospital-General-Information/xubh-q36u. The majority of medical centers are large integrated healthcare systems located in urban

areas, whereas local hospitals are small limited service healthcare facilities located in urban or rural areas.

Hospital types included in this study were not initially limited to any one type of hospital; however, it became evident early on in the sampling process that gaining access to hospital buildings and administrative leaders at larger urban healthcare organizations would be a significant challenge. It was made clear after several attempts and months of outreach to contact and seek permission to do this qualitative research at several large specialty hospitals in the Chicago, IL area that I was doomed to failure due to a lack of response and/or interest from researchers and administrators at the hospitals. Also, it became clear through this process of recruitment, that there would be few opportunities to schedule interviews with busy administrative leaders who run from meeting to meeting throughout the day. Moreover, it was also likely that administrative leaders who were involved in design decisions were no longer employed at the hospital or had moved on to other roles and would be unavailable to be interviewed for this study. Through this initial attempt at hospital selection, it became apparent I would need to re-focus my efforts for site selection on smaller local hospitals providing general care. As observed by Bernard (2002) and Spradley (1979), just as important as choosing the right sites to study, is the availability and willingness of individuals to participate in interviews and to communicate opinions in an expressive and reflective manner.

As the principle investigator in this study, as mentioned above, I have extensive experience as a risk management consultant working with locally based general care hospitals. One hospital, located in rural Illinois, met two of the selection criteria, having just completed the building of a replacement hospital, and reported the use of EBD in

their new facility. The hospital, to be known as Hospital #1 in this study, was contacted and agreed to participate in this multi-case study. The CEO granted me permission to contact and schedule interviews with key administrative persons, including the CEO, review available building related documents, and to interview the contracted architect. It was through this hospital relationship that I was exposed to "CW", who had been the hospital's healthcare financial advisor during the early phases of the building process. CW was a well-known independent financial advisor working with hospitals throughout the Midwest to help healthcare organizations finance new hospital buildings. In 2010, DHHS and HRSA, through the Office of Rural Health Policy (ORHP), published a manual on Critical Access Hospital (CAH) Replacement that outlined the process for hospitals seeking financial support for building a replacement facility (DHHS, 2010). CW's work with several hospitals as a financial advisor was featured in the Manual, he was well known by CAH executive leaders, and his consultative services were frequently sought out by other hospitals looking to build replacement facilities. I contacted CW and shared my research aims and selection criteria for case study sites. CW was able to assist me in identifying and recruiting several hospitals in the Midwest that met my hospital selection criteria, and most likely would be amenable to participating in the study.

My relationship with CW crystalized the strategic approach for optimal sampling - snowball sampling. Snowball or chain sampling identifies cases of interest from persons who know people who know what cases are information- rich (Miles & Huberman, 1994). Chain sampling involves utilizing persons who are well connected to the phenomenon under study, to help the researcher identify critical cases. The researcher follows this chain of contacts in order to identify and select critical cases that

can be used as the sample set or case studies (Patton, 2002). While I had not initially set out to only include hospitals in the Midwest region of the U.S., it ended up being preferable, because as unfunded research, the Midwest region represented manageable, low cost, local travel, rather than expensive, cross-country travel for me.

The majority of work CW did as a consulting financial advisor was for CAHs seeking information on how to fund new hospital construction. Sampling from a single hospital-type created homogeneity by limiting variables with regard to financial structure, services provided, the communities served, and aided in enhancing comparisons and differences. Moreover, my experience with the first hospital in this study proved CAHs to be more accommodating and provided more of an opportunity to interview key decision makers.

Legislation enacted as part of the Balanced Budget Act of 1997 created the CAH, a specially designated, small rural hospital that qualifies for cost-based payments for Medicare services. To be designated a CAH, a rural hospital must meet defined criteria as indicated in the Conditions of Participation under 42CFR485, and additional requirements found in subsequent federal acts (CMS, 2016). The CAH is designed to reduce the financial vulnerability of rural hospitals and to improve access to healthcare for the rural communities they serve. Primary eligibility requirements for the CAH designation:

- CAH must have 25 or fewer acute care in-patient beds
- It must be located more than 35 miles from another hospital
- It must maintain an annual average length of stay of 96 hours or less for acute care patients, and

- It must provide 24/7 emergency care services (CMS, 2016)

As of April 2016, there are more than 1,300 CAHs, which represents nearly all-rural hospitals in the US. The majority of these hospitals were built using Hill-Burton Grant Program monies that were available in the 1940's and 1950's, and many CAHs have renovated or done major overhauls of their existing buildings in the intervening 70 years (DHHS, 2010). However, by 2008-2009, only a handful of CAHs had, or were on track to build, a replacement facility. Those that rebuilt, reported improvement in performance and operational efficiencies, as well as other tangible and intangible benefits including: better physician and staff recruitment, improved customer and employee satisfaction, better quality of care, and an economic boost to the local economy (Purria, 2011).

Possible case study sights were discussed with CW, and four CAH sites were chosen. Initial contact was made by CW to the CEO's of the chosen CAHs, using e-mail as the principle form of communication. In these e-mails, CW introduced me to them, explained the basic tenets of the research project, and I would contact them about the possibility of their participation in the research project. I contacted each CEO via e-mail, and set-up phone calls to discuss their potential involvement. Three of four hospitals contacted in this way agreed to participate in the study. The one CAH that declined indicated they were in the process of preparing for a Joint Commission survey and could not devote the time necessary to participate in this study.

The timeframe between building a new hospital, or renovating and occupying it, was an important selection criterion, because organizational memory of whom and how

design decisions were made was crucial to data collection and the understanding of many aspects of the research questions. Nevertheless, to expand recruitment options, an additional criterion was added to the original hospital selection requirements, hospitals that were in the facilities planning/design phase – not yet under construction. The new criterion was grounded within the phenomenological underpinnings being studied, and fit into the defined process for building a replacement CAH (DHHS, 2010). This allowed me to find and recruit a final CAH for my multiple-case study.

Figure 2 – CAH replacement phases (DHHS, 2010)

Five hospital sites were chosen for the multiple-case study, because it was believed this number would allow the collection of rich data from a variety of similar organizations, and to ensure that I was able to reach a point of saturation concerning my explanatory inquiry. Obtaining comprehensive understanding in qualitative research is dependent on saturation, which is achieved from continuing to sample until no new substantive information is acquired (Miles & Huberman, 1994). According to Patton (2002 – pg. 244) in his book "Qualitative Research and Evaluations Methods" there are "no rules for sample size in qualitative inquiry." He states sample size is dependent on "what the researcher needs to know, the purpose of the inquiry, what's at stake, what will be useful, what will have credibility, and what can be done with the available time and resources." Ultimately, validity and meaningfulness in any qualitative inquiry has to do more with the richness of information from the selected samples than it has to do with

sample size (Patton, 2002). Therefore, the decision concerning sample size is one of judgment and negotiation, based on the best manner to cover the phenomenon, given the goals of the study, and interest of involved persons (Patton, 2002).

The first case study was purposefully selected based on the hospital meeting the first and last hospital selection criteria (see Table 1), and a pre-existing relationship with myself. The next three hospitals were chosen based on recommendations and introductions from CW, the CAH healthcare financial advisor. These hospitals met the first or second, and/or the last criterion. The fifth hospital was chosen based on a recommendation from one of the healthcare architects interviewed and was in the early stages of planning a replacement hospital, but had not yet started construction, which met my newly added criterion.

Collectively, the case study hospitals met the following criteria: a CAH located in the Midwestern region of the U.S. planning, or building, or built a replacement facility occupied within 1-5 years of building completion. All of the hospital case study sites provided similar medical services, including radiology, laboratory, inpatient and outpatient surgery, inpatient medical care, and ambulatory/clinic services. Only one of the five hospitals provided OB services. Most hospitals were non-profit government or privately owned, and only one of the five case study sites were considered to be a for-profit hospital owned by a national for-profit hospital corporation of over 200 healthcare-based organizations across the U.S. Total square footage of the replacement hospitals was 57,000 to 71,000 sq. ft. built on a single level – except one, which planned a two-story building, with the total number of patient beds ranging from 18 to 25. Final

building costs for the 4 replacement hospitals were between $22 million to $29 million. (See Table 2)

CAH CEO agreements to participate were confirmed by e-mail. CEOs were provided assurances that the names of individuals and the hospital would be anonymous. Anonymity in a case study is not generally desirable, but can be justifiable if the case study is on a controversial topic or if the final case study subsequently affects those that have been studied (Yin, 2003). Anonymity was preferred in this multiple-case study, because I was exploring the use of EBD in the building of the new hospitals, and if such had not been used, it may suggest to some that the new facility may not be safe or somehow less than what it could have been if EBD had been utilized. In addition, I believed offering anonymity to potential hospitals and potential respondents would help in the recruitment of case study sites. To simplify the identification of the hospitals, I decided to identify each hospital by a number 1 through 5. (See Table 2 – Case study critical access hospitals - hospital ID and demographics)

Table 2 - Case study critical access hospitals – hospital ID and demographics

Hospital ID#	Ownership	Location	Original Hospital Build Year	Building Phase	Completed Date	Occupied Date
Hospital #1	Voluntary non-profit - private	IL	1950	Built	2009	2009
Hospital #2	Government-Local	MO	1949	Built	2007	2007
Hospital #3	Voluntary non-profit - private	NE	1918	Built	2009	2009
Hospital #4	Voluntary non-profit - private	IA	1939	Construction	2012	2012
Hospital #5	Proprietary	MO	1950	Planning	N/A	N/A

Hospital ID	Number of Beds	Sq Footage	Community size	Replacement building	Date of site visit
Hospital #1	18	57,000	19,104	Yes	8/2/09
Hospital #2	25	64,000	12,402	Yes	5/17/11
Hospital #3	24	68,000	8,363	Yes	8/1/11
Hospital #4	25	71,000	15,932	Yes	8/26/11
Hospital #5	N/A	N/A	33,381	Yes	6/30/11

The Participants

Participants interviewed in this qualitative study were administrative persons from the case study sites, hospital governing board members directly involved in the planning and decision-making process concerning the building/designing of the replacement hospital, and the principle architects. An administrative leader was defined as any person employed by the hospital directly responsible for the strategic and financial operations of the hospital, and generally responsible for making key decisions that affected overall organizational performance on a day to day basis. Hospital board members were defined as individuals on the hospital's governing board who were responsible for ensuring the hospital met its mission and vision of the organization and considered to be legally responsible for the operation of the organization. These responsibilities included long-range planning, quality of care, oversight of medical credentialing, financial oversight, and board oversight (Culica & Prezio, 2009). The principle architect was the main or contact architect responsible for the replacement facility design and building.

I identified the key administrative persons I wanted to interview for this study, and they included the following administrative persons:

- Chief Executive Officer (CEO)
- Chief Operations Officer (COO)
- Chief Financial Officer (CFO)
- Chief Nursing Officer (CNO)
- Facilities Director or Manager (FP)

Vested in these administrative persons at the CAH was the authority to influence either financial, and or design decisions concerning the building process. In some instances, the CEO (RS) at Hospital #2, identified other persons he felt suitable for interviewing, which included Hospital #2's Administrative Assistant (VR), because she had been at the hospital for over 30 years and her input was often sought on key decisions concerning the hospital design. In addition, there were other staff persons interviewed at Hospital #2, but their input into the design decision process was more as stakeholders who would be the ones that used the space, as compared to the administrative leaders who actually determined design outcomes.

The trustees to be interviewed were identified by the CAH CEOs as being present during the design/building process, but possibly not a current board member - having rotated off after serving his or her term and would be willing to participate in an open interview about the building process. One of the CAH's governing board members (Hospital #1) interviewed in this study was no longer on the hospital board at the time of his interview, but he had been actively involved in the decisions made concerning the building of the replacement hospital. For at least three of the hospital case sites, hospital board member names were not given/shared, or available for interview.

The CAH CEOs were the primary contact and were responsible for contacting the administrators, the hospital board member, and the principle architect to inquire about their willingness to participate in the study and express the need to set-up meeting dates/times for interviews. All participants confirmed their willingness to be interviewed, and the CEOs' administrative assistants coordinated the interview times with the administrative leaders based on the mutually agreed upon date of case site visit by the

researcher. I reached out to the hospital board member and architects to be interviewed independently via e-mail and phone call and scheduled mutually agreed upon times for interviews.

Data Collection Methods

The data for case studies can come from a variety of sources of evidence, but generally fall within basic types of information: observations, interviews, documents, and audiovisual (Yin, 2003) (J. W. Creswell, 2007). The evidence sources most relevant to this research project were documents, audiovisual, and interviews (See Table 3 for interview schedules and Table 4 for inventory of other types of data collected). The use of direct- and/or participant-observation was not data that was specifically collected for this multiple-case study, because I was time and financially limited, and only one of the five study sites was still in the planning stages. Although, observations of the interviewees were noted, such as body language, during the course of interviews performed. This information was used to suggest the comfort or ease, which the interviewees had with regard to the subject matter being discussed. Nonetheless, the absence of this source of evidence, does not diminish the quality or validity of the data sources used, especially when augmented by the use of more than one source of evidence/data (J. Creswell, 2003; Yin, 2003).

Table 3 - Interviewees

Hospital ID	Type of Organization	Person interviewed	Role of individual	Interview type
Hospital #1	Hospital	AB	CEO	In Person
Hospital #1	Hospital	RB	Building/facilities	Phone
Hospital #1	Hospital	BM	Board member	Phone
Hospital #1	Hospital	SB	Other hospital - Quality Director	In Person
Hospital #1 & #3	Architectural Firm	SC	Architect	In Person
Hospital #2	Hospital	RS	CEO	In Person
Hospital #2	Hospital	PS	Other hospital – ED Manager	In Person
Hospital #2	Hospital	SG	Building/facilities	In Person
Hospital #2	Hospital	WD	CFO	In Person
Hospital #2	Hospital	MB	CNO	In Person
Hospital #2	Hospital	KW	Board member	Phone
Hospital #2	Hospital	VR	Other hospital – Admin Assistant	In Person
Hospital #2	Hospital	PD	Other hospital – Surgery Manager	In Person
Hospital #2	Architectural Firm	JS	Architect	In Person
Hospital #3	Hospital	BH	CNO	In Person
Hospital #3	Hospital	RL	CEO	In Person
Hospital #4	Hospital	TM	Building/facilities	In Person
Hospital #4	Hospital	LB	CNO	In Person
Hospital #4	Hospital	MW	CFO	In Person
Hospital #4	Hospital	CS	CEO	In Person
Hospital #4 & #5	Architectural Firm	LD & SB	Architect	In Person
Hospital #5	Hospital	BK	CEO	In Person
Hospital #5	Hospital	DB	VPO	In Person
Hospital #5	Hospital	KL	CNO	In Person
Hospital #5	Architectural Firm	MT	Architect	Phone

Table 4 - Documents

Hospital ID	Data Type	Title	Source
Hospital #1	Document	Health and safety design review	Joint Commission
Hospital #1	Document – meeting minutes	Planning committee	Hospital
Hospital #1	Document – meeting minutes	Campus master planning, board agenda	Hospital
Hospital #1	Document - report	Progress report	Architectural consultant
Hospital #1	Document - proposal	Campus master plan	Architectural consultant
Hospital #1	Document - report	Rural Hospital Replacement Facility Study	National Rural Health Assoc
Hospital #1	Document - meeting minutes	Board meeting	Hospital
Hospital #1	Document - plan	Strategic business plan	Hospital
Hospital #1	Document – power point	CAH – report to the board	Hospital
Hospital #1	Document – power point	Current Status: Hospital Design	Hospital
Hospital #2	Audiovisual - pictures	Site visit pictures	Hospital
Hospital #2	Audiovisual - designs	Floor plan	Hospital
Hospital #2	Audiovisual - designs	CEO rendering	Hospital
Hospital #3	Document - plan	Final master plan	Architectural firm
Hospital #3	Document - manual	Architectural Project Manual	Contractor
Hospital #3	Document - plan	Proposal master plan	Architectural firm
Hospital #3	Document - report	Campus master plan	Architectural firm
Hospital #3	Document - report	Progress report	Architectural firm
Hospital #3	Document- meeting minutes	Board of Director Regular Meetings	Hospital committee
Hospital #3	Document- meeting minutes	Building meeting	Hospital committee
Hospital #3	Document – power point	Gaming session	Architectural firm
Hospital #3	Document – memo	Hospital planning efforts	Hospital
Hospital #3	Audiovisual - designs	Schematic drawing	Hospital
Hospital #3	Audiovisual - pictures	Site visit pictures	Hospital
Hospital #4	Audiovisual - designs	Architect renderings	Architectural firm
Hospital #4	Document – power point	Trends - Patient Rooms in Rural Hospitals	Architectural firm
Hospital #4	Document – power point	Impact of HIT in Today's Rural Hospital Design	Architectural firm
Hospital #4	Document – power point	Proposed Master Site Development	Architectural firm
Hospital #4	Document – power point	Planning process	Architectural firm
Hospital #4	Audiovisual - pictures	Site visit pictures	Hospital
Hospital #4	Audiovisual - video	You Tube - groundbreaking	Hospital

Data collection at the 5 CAHs and at the architectural firms was conducted over 2 years and in two different timeframes. The initial research proposal was developed and presented in February of 2009 and approved shortly thereafter. As previously indicated, some time was spent trying to recruit larger urban hospitals as case sites. We recognized after receiving negative responses from chosen hospitals, or waiting months with no responses from other hospitals, that our efforts to recruit larger multi-specialty urban hospitals would not be successful mainly due to the lack of some pre-existing relationship or internal contact. In July of 2009, I contacted and received an assent from the CEO at a CAH I had a pre-existing working relationship. The initial site visit was scheduled and conducted on August 2, 2009. I interviewed administrative leaders and reviewed available documents on the building process. Shortly after the site visit, I took a break from completing the research, until such time that additional hospitals could be identified and recruited into the multiple-case study. The second timeframe for data collection began in March 2011, when CW was contacted, and plans were put into motion to identify additional potential case study sites that met recruitment criteria. Once these sites were identified, recruitment started in earnest, and 4 additional hospitals accepted my invitation to participate in the case study. Site visits of the 4 remaining case study hospitals took place in a 5-month period from April 2011 to August 2011.

The majority of the data was collected on-site, on the day of the site visit, or within a few weeks of the site visit. Site visits were either one or two days, depending on the number of persons interviewed or the number of documents to be reviewed. Typically, interviews were conducted on day one, and document review occurred on day two; however, some interviews were conducted on day two as well. Field notes were

taken from reports, plans, or meeting minutes archived by the hospital, or I was provided copies of original documents to take with to use off site. Field notes contained the description of those things believed to be significant and note worthy regarding my research questions (Patton, 2002). Case site Hospital #2 had occupied their replacement hospital for 5 years and indicated they had not retained/preserved any of the committee meeting minutes or documents on the building of the new facility, or perhaps did not want to retrieve or grant access to these documents to me, as such there were very few documents to review. Case site Hospital #5 was in the early stages of planning a replacement facility, and indicated they had few documents to share, and granted me access to none.

Audiovisual data, in the form of digital pictures, were taken at three of the five case study sites in 2011. Pictures were only taken with permission of the hospital and with the CEO present. Pictures did not include any hospital patients, but in some limited cases, pictures did include visitors or staff, especially when lobby pictures or nurses' station pictures were taken. Pictures of the hospital exterior, common areas/lobby, and non-patient care areas and patient care areas were taken by to gather visual information/data about certain design elements in the built environment. Two of the five case study sites had no digital pictures, as Hospital #5 was in the early design planning stages and had not started construction – so there were no pictures to take of the building environment. The hospital pictures taken of case study site Hospital #1 in 2009 were lost when the camera phone used to take these photographs was damaged in 2010.

Architectural firms visited as part of this study, did not openly share documents, although two firms did provide schematic designs or floor plans for the replacement

facilities they designed for the hospitals. One architectural firm provided me with copies of two Power Point presentations used to communicate to their hospital clients the design process, and trends in hospital rooms for CAH.

In qualitative research there are several different types of interview methods that can be utilized by a researcher (J. W. Creswell, 2007; Patton, 2002). For this qualitative research project, I chose the focused, semi-structured interview method, because I had only one chance to interview architects and hospital persons, it allowed me to build rapport and trust with the respondents, thus giving the interview a more conversational tone, yet focused on the specific aims of the study (Flick, 2009).

Focused interviews involve the use of an interview guide of open-ended questions (Patton, 2002). The goal of using the interview guide is to ensure the same basic line-of-inquiry is followed with each person interviewed, and how I can best use the limited available time allotted with each respondent. The interview guide allowed me to stay on topic, but permitted me the ability to explore or probe subjects within my line of inquiry to obtain rich data as to the individual's ideas about what evidence-based design is and what role it played in the decisions made in the design process, if any (Patton, 2002). See Table 5

Table 5 - Interview guide

1. Tell me what does evidence-based design mean to you?
2. What are some of the goals or objectives of building a new hospital?
3. What was your role in the design process?
4. When was evidence-based design discussed in the design process?
5. How did evidence-based design influence some of the decisions you made concerning what you wanted from the design process?
6. How did you measure success of your design/hospital?
7. What were you trying to accomplish through the design process?

All interviews were conducted individually, and the majority was face-to-face at the hospital, and at the architectural firms' office. There was one exception to the individual interviews, as Hospital #4's architects requested they be interviewed together, since they were partners and worked on the plans together for the replacement hospital. The advantage of the face-to-face interview was it allowed for observation of the individual or group dynamics, as indicated above, to gauge their comfort on the topic, and was preferable to other types of interviews. Nonetheless, due to scheduling conflicts a limited number of interviews had to be conducted by phone. All respondents were given an informed consent form (see Appendix A) to sign, either in person or by fax. Consents allowed for the digital recording of the interviews. The digital recordings were necessary, because the semi-structured interviews contained open-ended questions, and discussions frequently diverged from the interview guide.

This permitted me to maintain rapport with the respondent and keep the interviews conversational, which is essential in unstructured interviews.

Interviews were conducted in offices, small conference rooms, or in private places on a hospital unit. Although the interviews were recorded, handwritten notes were taken to note room layout, positioning of participants in the room, ambient conditions, non-verbal behaviors, and any interruptions that occurred during the interview. Interviews were scheduled for 30 to 45 minutes, and guiding questions were asked in any order that best suited the flow of the interview. Some interviews, such as the interviews with Hospital #2 CEO and Hospital #3 CEO lasted 64 minutes and 52 minutes, respectively, whereas some of the other interviews, such as with Hospital #2 Board Member lasted less than 20 minutes. The interviews were not started until a rapport was established through introductions and explanation of the research project between the interviewee and me. The questions asked set the stage for the discussion of the meaning of evidence-based design to the individual, at what point it was discussed in the building/decision process or if it was considered at all, and what influences it may have had on design decisions made in the project (See Table 5, Interview Guide). Interviews were transcribed verbatim by a local individual trained in transcription (80%), and through a professional transcriptionist service (20%) in 2012, and 2017 (https://www.rev.com/transcription). Once transcribed, I reviewed the transcription against the MP3 digital recording by for accuracy of transcription.

Data Analysis

Once the site visits and all interviews were completed, I reviewed the gathered documents and reviewed transcriptions of interviews to begin data analysis.

Unfortunately, due to personal obligations/requirements, the data analysis was halted for a number of years after its completion; however, once it was picked up again, all data sources were re-reviewed and organized.

To assist in data analysis, I used computerized assisted qualitative data analysis (CAQDAS) software (Gilbert, Jackson, & di Gregorio, 2014). I initially began to manually code the transcribed interviews, but realized the number of interviews requiring coding, and attempting to keep track of emergent and secondary codes would become extremely difficult to organize and analyze in a Word-based document or on paper. Moreover, I recollected many of the organizational difficulties I experienced when performing analysis in my pilot project that was completed in for Qualitative Research Methods – 8950, titled: "The Influences of Evidence-Based Design on Hospital Administrators' Design Decisions in a Small Midwestern Rural Hospital Undergoing Facility Renovation". In the pilot project, when I began data analysis after transcription of interviews, and utilizing a grounded theory approach as described in Charmaz (2006), it was often difficult to keep track of the multitude of initial codes, and as they were assigned to thematic "buckets." Utilizing paper, colored pens/cards, and Microsoft Word based programing was minimally assistive, and eventually led to a quagmire of information, which was sometimes difficult to manage and keep track of during the analysis and writing of the discussion section in the pilot project. Recalling how challenging this approach was for just a few interviews from one case study, and a belief that the original pilot project data could have been more richly mined for greater insights, I concluded CAQDAS would be the correct direction to go when working on data

analysis for large groups of data collected from interviews, site visits, pictures, schematics, and other documents in this research project.

As Richards (2014) indicated in his book *Handling Qualitative Data: A practical guide*, generating qualitative data is "ridiculously easy", because something as simple as an hour long interview with a single person can produce up to 25-50 pages of data, and it is the volume and complexity of this amount of data that makes it increasingly difficult to reduce and contextualize it in a meaningful way (Bazeley & Jackson, 2013). Nonetheless, despite consideration for using an electronic coding system, I also realized there would be a need for using a manual process in my analysis for data that would be difficult to import into a database, and for some data that required a singular, focused analysis.

I decided the best approach to data analysis was to use CAQDAS, which does not do the organizing or coding for the researcher, but permits the efficient storage, management, and reconfiguration of data for analytic reflection (Saldaña, 2015). The CAQDAS system used in this research project was NVivo11 for Mac from QSR International (www.qsrinternational.com). There was a software upgrade in 2018 and data was transferred to the NVivo 12 for Mac. According to Bazeley & Jackson (2013), the use of a computer in qualitative data analysis is not to "supplant time-honored ways of learning from data", but to help manage the data to increase effectiveness and efficiency of learning. Utilization of the computer allows the researcher to record, sort, match, and link data when answering research questions and specific aims of a study (Bazeley & Jackson, 2013). Ultimately, CAQDAS is a tool that can help the researcher sift through a large amount of data, and hopefully adding rigor to the analysis process. It

ensures a more complete set of data for interpretation than what might be available through a manual process, because the computer software can assist in the query thoroughness and test for negative cases. Nonetheless, it cannot be claimed that the simple use of CAQDAS will create an intellectual masterpiece, but the use of this tool in qualitative analysis can hopefully contribute to a more robust analysis (Bazeley & Jackson, 2013). Over the years, critics of computerized data analysis suggested a lack of closeness to the data, and conversely that users of CAQDAS were too focused on coding, which can result in losing sight of the "big picture" (Gilbert et al., 2014). However, qualitative software was designed so researchers could achieve closeness with their data, as well as distance, so abstraction and synthesis could be accomplished and permit the ability to easily switch between the two (Bazeley & Jackson, 2013).

As it was decided to use CAQDAS as one of the tools to collect, sort, organize the collected date from hospital sites, the question of which CAQDAS software program would be best to use in this situation was explored. In recent years, the proliferation of CAQDAS software available made the choice of choosing one software program difficult, but in the end I choose NVivo 11 by QSR International largely due to its network of support for first-time users of the software, and its lower cost for a limited one-year license for student use. A one-year student license was purchased from QRS International, and the NVivo 11 for Mac software downloaded. In preparation for use of NVivo 11, I participated in three separate training courses – one in person course for NVivo 8 taken in St. Louis, MO, and more recently a self-paced tutorial on-line course of Introduction to NVivo 11 for Mac and Moving on with NVivo for Mac. Rather than using the example tutorial project provided in the training, I decide to upload the

documents and interviews from my dissertation project. In this manner, it permitted me the ability to begin working with the data immediately to ensure re-immersion into data that had been collected in year's prior.

A project named "Dissertation" was created in NVivo, and transcribed interviews were uploaded into the project, as well as site pictures, and various electronic documents, such as e-mail communications, and some meeting minutes. There were several electronic and paper documents that could not be uploaded into the software due to the system's storage/size limitations, as were advised by a QRS International instructor that as the database approaches 1 GB the software runs slower and may shut down. Therefore, I decided to limit the data upload to those sources that were the most complex, available in an electronic format, and with the richest amount of data.

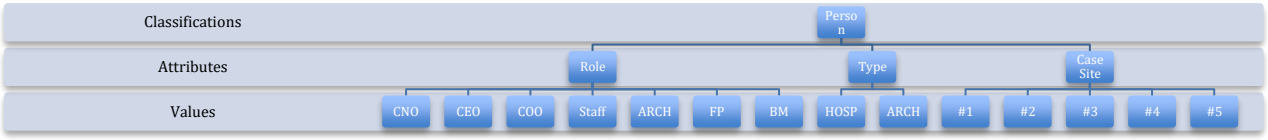
As I started to import my internal and external sources, it allowed me the opportunity to review and reflect on the collected data. In NVivo there are two types of sources that can be imported into the system: internal and external. Internal sources are data collected by the investigator, such as interviews, documents, videos, pictures, social media, etc. (Bazeley & Jackson, 2013). When importing internal sources, these sources are organized into self-determined files for reference. Some of the internal source files developed for this study included: transcribed interviews, audio interviews, pictures, designs and plans, and e-mails. External sources are generally hyperlinks to webpages or other external sources, which I did not utilize to any degree, as the majority of information was directly accessed via the Internet as needed.

Under the Source Section of the database, there is a source referred to as Memo. Initially, I developed a "Journal" file under the memo source, which was recommended by the software manufacture to assisted me in identifying movements through the data from initial thoughts to final conclusions; however, I did not feel that journaling was the best approach for me to use, and I opted as a pragmatic methodological choice to write memos, as described by Charmaz (2006). Memo writing is a form of free thinking and reflection on the data without regard to correctness (Miles & Huberman, 1994). The NVivo software allowed me to link memos either to a transcribed interview or node. This was referred to as a "linked source memo." Rather than write one primary memo linked to a single internal source or document, instead I choose to create memos from certain concepts, observations, reflections, or identified themes, found in the data and linked them as necessary, or I choose to simply write these memos to be used as additional reflection and concept development. Also, when reviewing the transcribed interviews, I utilized annotations, which are essentially comment fields, or footnotes and served as context reminders on particular segments of text. This information is maintained within the text of the transcribed interview, and can provide frames of reference or context as needed when reviewing the interviews (Bazeley & Jackson, 2013).

Once the data was uploaded, I had to flag the data or sort it in NVivio, in order to develop specific cases or units of analysis. According to Bazeley & Jackson (2016), a case is a "core structural element in NVivo" and unites all the different attributes or components of the qualitative data. For each case in NVivo, the software allows me to manipulate multiple data collection points. Case nodes are developed and basically serve

as receptacles or containers that hold all the data, of all types, for each case regardless of the source. The case nodes in this project or units of analysis were the five hospital sites, and the individuals interviewed at each site. After creating the case nodes and adding the qualitative data, I added categorical or scaled values to the cases. This is done through classification in NVivo. I created two case classifications, one for *people* and one for *place*, although I realized the *place* case classification was not nearly as useful as the *people* case classification when analyzing the data. The cases under *people* were those individuals interviewed, and the attributes I identified as being significant were position/title, the type of environment the person interviewed worked in, and the place in which the person worked (see Figure 3). Classifications and attributes are useful in an NVivo project, because it can be used as a tool to compare subgroups and for filtering data (Bazeley & Jackson, 2013). In this analysis, it allowed me to compare responses or opinions from various administrators or healthcare architects using NVivo queries process.

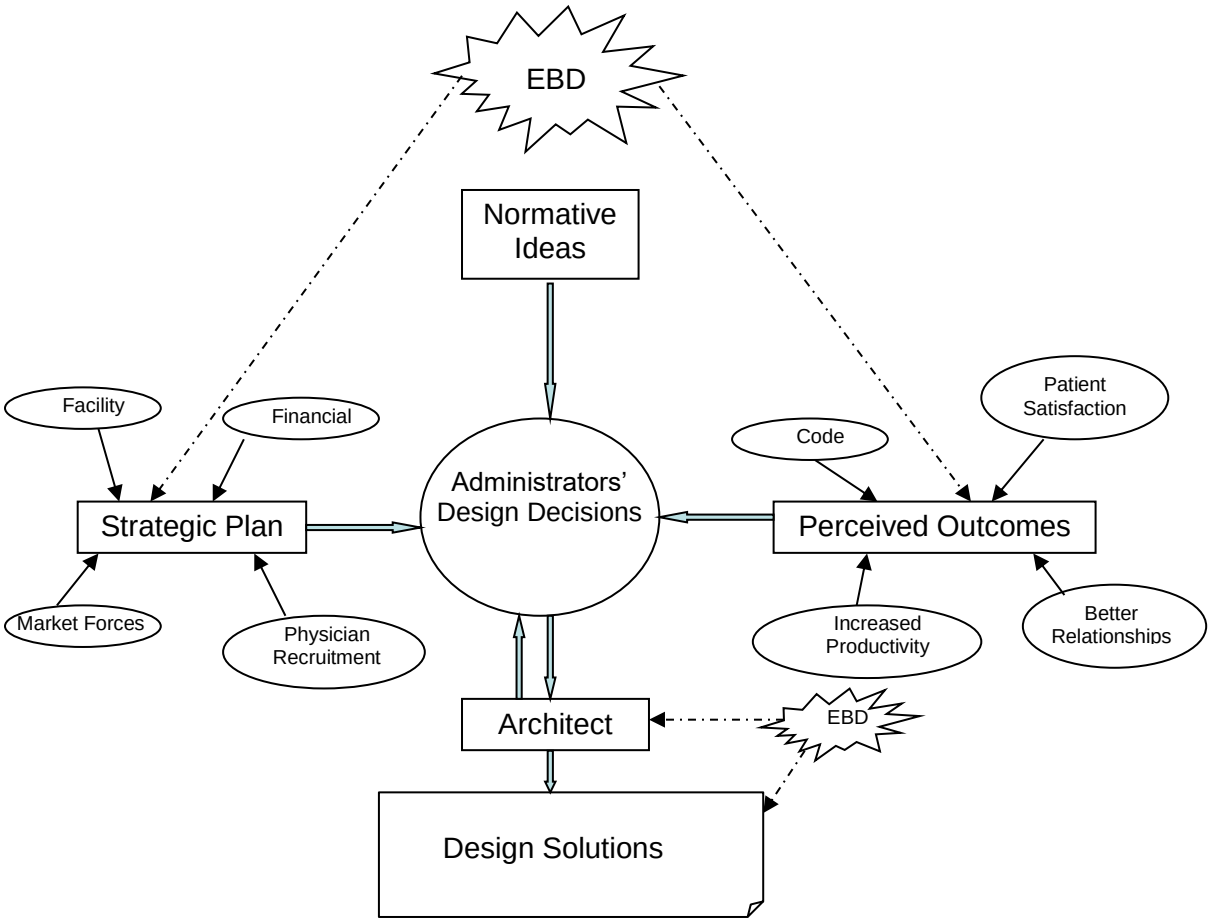
Figure 3 – Classifications, attributes, values



In the beginning of this project in NVivo, I was provided the option of developing a concept map using the mapping section of the software, but I chose to use the concept map developed in the afore mentioned pilot project. The concept map helped me in

clarifying the conceptual framework or theoretical underpinnings of this study (J. A. Maxwell, 2012). In my unpublished pilot project *The influences of evidence-based design on hospital administrators' design decisions in a small midwestern rural hospital undergoing facility renovation,* I developed the following concept map – Figure 4, where I concluded EBD did not explicitly influence the design decisions hospital administrators made, but intrinsically believed all design decisions made were somehow informed by "the evidence." However, the types of evidence used in the design decisions were not empirical research outcomes based, but desired internal hospital-based goals. Therefore, I noted having a greater understanding of EBD concepts and how it should be used when making certain design decisions could be beneficial to hospital administrators when trying to identify potentially effective strategies, they can implement to improve the quality and value of healthcare designs (Feldbauer, et al. 2008). The analytic concepts developed during my pilot project helped to guide the process of identifying and refining thematic concepts in the early stages of our analysis.

Figure 4 - Concept map - The assumptive use of EBD in the decision-making process of hospital administrators & architect in the renovation project of a rural hospital



Coding is one of the ways of analyzing qualitative data (Saldaña, 2015). Codes are short phrases that are salient summations of a portion of collected language or visual data (Saldaña, 2015). In qualitative research, codes serve as "critical links" between data and meaning (Charmaz, 2006). Coding is not an exact science, but an interpretive act by

the coder, and is subject to the researcher's discipline, ontological orientations, and conceptual frameworks (Saldaña, 2015). Codifying data permits the data to be divided, reorganized, and linked together to aid analytical thinking so we can find the patterns in coding. Once patterns are revealed, we can synthesize or combine these patterns or themes to form a new whole that results in the foundations of understanding of our research aims (Saldaña, 2015).

In NVivo codes are stored as nodes and arises from the definition of a point of connection in a branching network (Bazeley & Jackson, 2013). Nodes are made for each topic or concept similar to the manual process of "cutting and pasting" text into buckets. Essentially, a node represents all of the data that arises from a single code. Once a node is made, a reference point is made in the exact location coded in the original source document. The software is able to locate and retrieve all the coded passages at that node from the document records and does not copy or cut the source document. Instead, it preserves the location in its original context, and passages can be coded at multiple nodes (Bazeley & Jackson, 2013). I could view highlighted text for each of the sources where such was coded at a node but be able to see the text that surrounds the coded section in order to provide a richer contextual understanding. Also, I could see the number of times a particular code was used in the study, and the frequency in which it appeared in any source document. This was used as information only, as the frequency of a particular code does not denote relevancy or importance (Charmaz, 2006).

Initially, I did do some manual contemporaneous coding, or pre-coding, which occurred early in the data collection process as documents were gathered, and persons interviewed. Patton (2002) points out that the line between data collection and analysis is

far from absolute due to the emergent nature of qualitative research, and it is common during fieldwork that ideas and direction for analysis will occur. As the concept map, this also helped with a starting point for my analysis.

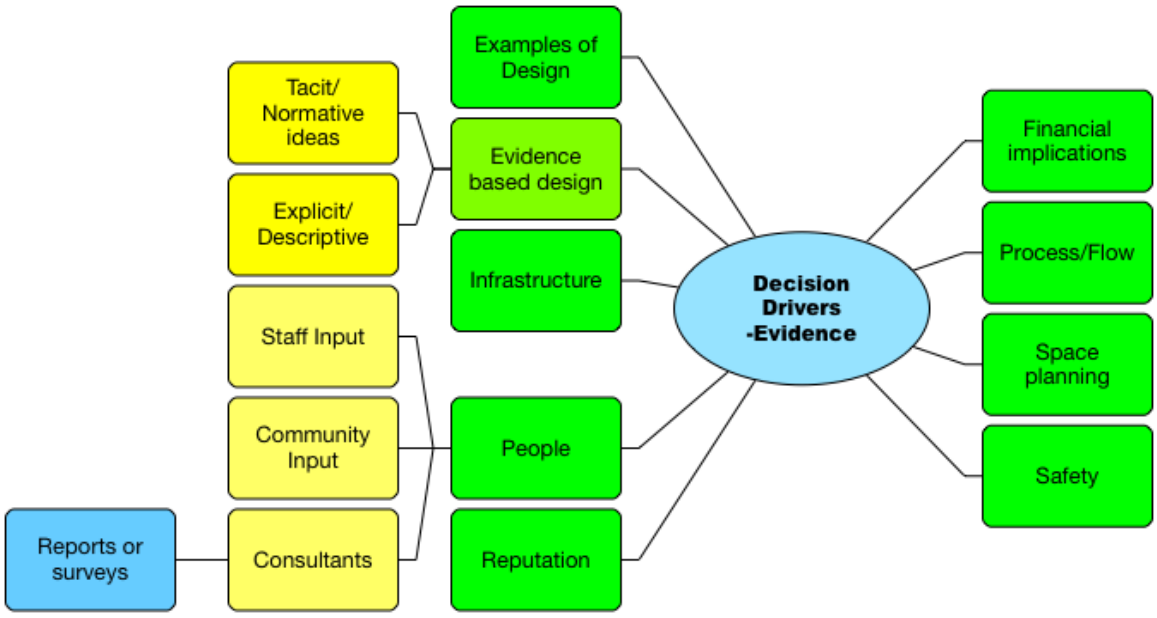
Transcripts were read in NVivo and individual nodes were created at open codes. All interview transcripts were coded line-by-line on a descriptive level to ensure analysis of all data. Codes were labeled and described to ensure that codes were appropriately identified and contained common ideas and concepts. I could monitor what was being coded in a source document by viewing the coding strip, which was running contemporaneously next to the text. The option of un-coding was utilized when text was erroneously coded at a particular node, or if incorrectly coded.

At first, this level of detailed coding took 8 hours or more, and after only three interviews I had created nearly 100 original open codes. Moreover, it was becoming increasingly difficult to remember what codes had already been developed, which resulted in duplicative codes. I made constant comparisons amongst the open codes within a particular document or interview, then compared within the common data sources, and between data sources (Charmaz, 2006). It was clear that the codes needed refinement to make the codes more useable, and I started to notice certain patterns in the data, so open codes were refined into focus codes to explain larger segments of collected data from interviews (Charmaz, 2006). Focus codes were analyzed further until a pattern of categories or themes emerged. For example, focused codes that dealt with the effect of process and patient flow on design decisions were grouped together into a sub-category of process. In NVivo nodes could be merged together without losing the node sites.

Finally, axial coding was used to bring the data back together into a coherent whole to better understand the experience of influencing factors and the conceptual relationships between the subcategories and main categories identified in the case study (Charmaz, 2006; Corbin & Strauss, 1990; J. Creswell, 2003). Axial coding permitted the opportunity to assemble the open codes into new ways, and to identify a central phenomenon, explore the causal conditions, identify context, and intervening conditions (J. Creswell, 2007). In NVivo these are called tree nodes, and our codes were organized into top-level nodes or parent nodes, and subcategory or child nodes under the tree node. To determine top-level nodes in our tree node I began by sorting and grouping the data using a visual model or logic diagram to further understand the data. Developing this hierarchical structure provided me with conceptual clarity and highlighted coding patterns more clearly (Richards, 2014). For example, in this study there were many different factors that either drove or influenced the design decisions made by the healthcare administrators. The axial code or tree node that brought the data back together was called "Decision Drivers", which allowed me to look at all of the codes that influenced decisions made by the hospital administrators (See Figure 5). Some of the other nodes developed aside from Decision Drivers were:

- Types of Evidence Used
- Goals of Design/Building
- Decision Process
- Meaning of EBD

Figure 5 - Decision driver tree – logic diagram



Another grouping that required code refining was Evidence. Evidence was a theme - and there seems to be two types of evidence - evidence that is bore from tacit knowledge - that of experience and explicit knowledge or research. Moreover, and perhaps a better way to approach the difference type of evidence utilized in decision making, this category should focus more on how evidence is defined, what did the CEOs, CNOs, CFOs, BM, architects see as "evidence" how did they define it - as it is in the literature or as something else.

Memo writing was a critical element in analyzing the data. This process allowed us to think about our data in a new light, making connections to themes and case comparisons. NVivo permits the user to link memos to particular codes or to internal source documents; however, we predominately recorded our thoughts and ideas we saw emerging from the data as we coded. Several of the findings were based on these written

memos. In addition to memo writing, in NVivo we were able to run matrix coding queries, which allowed us to do comparisons between hospital cases and individual attributes, as well as text searches for specific words. For example, a query was done on CEOs and infrastructure issues to compare and contrast the effects of these types of concerns on decisions, or the word “handrail” was queried/search in all internal sources to see if handrails were treated the same by all the subjects.

CHAPTER 4 – FINDINGS

WHAT TYPE OF EVIDENCE WAS USED TO MAKE DESIGN DECISIONS?

EBD theory as discussed in the early 2000's in the design community focused on evidence from a positivist theoretical perspective, as compared to a normative approach, and called for the application of evidence from empirical research in healthcare design to provide reliable, reproducible patient outcomes, such as decrease in patient falls, less pain, faster recoveries, fewer infections, a decrease in medical errors, and improved safety. Since then, as discussed earlier in the literature review, EBD theorists have moved from this single focal viewpoint of evidence from research to one that supports evidence from a variety of resources, including:

- Research: white papers, trade magazines and peer reviewed journals
- Organizational data
- Experiential knowledge or learning
- Best practice examples from other organizations or projects
    - site visits and case studies
- Social media
- Client/Patient preferences

This broader view of what constitutes the "evidence" in EBD allowed practitioners to adopt an "evidence-based practice" (EBP) approach to design, because it increased the number/type of evidential options a practitioner could use when making design decisions in the programming process. Programming, according to Pena and Parshall (2001), is a process of problem solving. It provides the designer with information on the scope of the

project and the specific criteria for a successful solution (Cherry, 1999). Evidence-based practice is not considered to be separate from programming, rather it is a layer or filter that should be used to ensure design decisions are informed by rigorously established objective evidence. As such programming utilizing an evidence-based policy does not preclude or conclude that programming is not informed by research-based outcomes, but nor is it bound by it as evidence-based practices in medicine, nursing, and other healthcare professions.

I understand from the data in this study the evidence utilized by hospital administrators in making design decisions was extremely varied, arising from a variety of sources, ranging from the experiential to the experimental, as indicated in our logic tree outlined above (see Figure 5). With this expanded definition in mind, we can see various themes of "evidence" that were considered to be prominent in the data collected in the following areas:

1. The financial impact and design decisions
2. The Aging Structure and the Delivery Model of Care
3. Location of hospital and landlock
4. Departmental adjacencies
5. Deinstitutionalization of hospital aesthetics
6. Experiential v. experimental
7. Designing for the nursing process
8. Making the case for patient safety
9. Design as solution or end goal

Lastly, I looked at how the respondents defined EBD and helped illustrate for us their level of understanding in comparison to the greater worldview of EBD.

1. Healthcare administrators' perception of EBD
    a. Patient room design as examples in defining EBD
2. Architects' perception of EDB

The Financial Impact and Design Decisions About Renovating or Building New

One of the first building decisions that had to be made by all the Hospital Administrators and Governing Hospital Board Members was whether or not money should be invested in improving the original hospital building, or if a new hospital should be built. As seen in Table 1 above, the original hospital buildings in the multi-case study ranged from 62-96 years old at the time of our site visits. Several hospitals did major renovations in the early to mid-1990s, and all hospitals contemplated renovations, as an option to deal with infrastructure and growth issues, prior to making the decision to build a new building. Renovation costs were estimated from $3 million up to $10 million, depending on what type of building issues were being addressed, which would have to be repeated in 6-7 years. As one of the CEOs told me:

> [T]he bottom line was that the infrastructure was bad that it was going to cost us around 10 Million dollars just to get a bit of a face lift and update the plumbing and all the HVAC that we needed to do and when we said oh my gosh, 10-12 Million to renovate a 60 year old building and for 16-17 Million and we can build new.

Generally, Hospital Administrators utilized some sort of cost/benefit analysis to determine the gains versus the potential losses of renovations. Cost/benefit analyses performed by Administrators were both formal and informal. Hospital #1 hired engineers to provide an analysis or report of whether the HVAC and plumbing/sewer systems in the original hospital building could be updated, the associated costs for those improvements, and the length of time the renovations would last before another one would have to be done. However, for the majority of the Hospital Administrators, the decision to build a new hospital was born from discussions at hospital-based meetings and board meetings that drew on organizational strategic plans, and the effects of renovation projects on the organization's financial stability and market share.

The CEOs from 4 of the 5 hospitals discussed in interviews the reasons behind their decision not to renovate their existing buildings. Many of the issues were infrastructure and mechanical, such as HVAC, plumbing, and elevators. The CEO from Hospital #3 said that trying to renovate the original 1918 building and add on additional renovations was "silly."

> I mean, we're at a point where we can hardly, you know, and the heat of the summer we have trouble, I don't know, we have to send employees home early because parts of the hospital would get so hot. I mean, it's just, you've patched stuff together so long, you know, and you've had different leaders and different engineers and maintenance people. You know. And you've patched all these wires and, I mean, it's just, you just get to the point where it's so expensive and so difficult to, to do things and to meet those codes that you have to do something.

One CEO mentioned problems with HVAC systems were "patient and staff dissatisfiers," because of the difficulties encountered in maintaining reasonable temperatures in the heat of summer or cold of winter due to inadequate systems and poor insulation. Several of the CEOs expressed concern about the hospital's inability to meet CMS life safety code building requirements, particularly fire safety codes (State Operations Manual Appendix I – Survey Procedures for Life Safety Code Surveys, 2016 at https://www.cms.gov/Regulations-and-Guidance/Guidance/Manuals/Downloads/som107ap_i_lsc.pdf, accessed June 23, 2017). The CEO of Hospital #4 said that while it was acceptable and easy enough to seek and be granted a waiver by CMS to bypass the life safety standards due to the age of the building, in his opinion it was not safe nor fair to staff or patients to work around the standards meant to ensure the safety of all.

Similarly, Facility Persons (FP) and Board Members (BM) discussed the deleterious effects of infrastructure issues in older buildings on operational functions. The BM from Hospital #1 visited the boiler rooms, and said it was a core system that could "bust at any time." At Hospital #2 the BM indicated the last straw for her was that one of two elevators in the building was totally shut down and could not be repaired, and the service maintenance company for the second elevator said they could no longer provide repairs under the current contract. The FP from Hospital #4 discussed how the old hospital's "internal workings" were getting old, and no matter how many times they renovated the building, it had reached its capacity to meet the needs of the organization.

> Ah, just the infrastructure. Just the piping, you know, and the sewer piping and how many times the electrical system has been added onto and it's

> reaching its capacity. Ah, you know. The roof, I mean, between the deck and the drop ceiling it's so crammed full of stuff from all the add-ons there's no room to maneuver up there.

Nearly all Hospital Administrators agreed the financial burden necessary to keep the older building functioning at less than acceptable levels was nothing more than "pouring money" into a worn out structure and it would not provide the hospital with what it needed to operate profitably, efficiently, and safely.

One of the strongest driver/evidence influencing design decisions at all of the hospital case sites was financial in nature. Whether it was the amount of return on investments, loss of depreciation for existing buildings, or increased reimbursement, financial drivers were nearly almost always front and center in the decision-making process. Certainly this type of evidence utilized in making design decisions does not deviate from any building project undertaken for personal or commercial use buildings (Kumlin, 1995). Nonetheless, the interviews and review of documents revealed financially based decisions were the priority, as compared to the overall project scope or intent for building.

Once hospital administrators and board members decided renovations would not be the solution to the myriad of challenges inherit in an older building, the next question was whether or not they could afford to build a new hospital. A report performed by Stroudwater Associates, a national healthcare consulting firm, called the Rural Hospital Replacement Facility Study – "How replacement facilities impact operations and the bottom line: Findings from the field", was used by CEOs from Hospital #1, #2, #4 as a

touch point to initiate conversations and to build their cases with Hospital Board Members and community officials in support of building a new hospital (2004-2008).

The Stroudwater Associates Annual Report is an analysis of various financial and efficiency measures of participating hospitals. In 2008, there were 45 participating facilities that had built replacement hospitals. The report provided a summary of overall financial growth, utilization, and number of full-time employees (FTE) pre- and post-building. Participating hospitals experienced 7.2% increase in revenue growth in the first and second years after building the replacement facility, a 6.8% growth in utilization of outpatient services, and a total of 3.8% increase in FTEs. Participating hospitals reported negative cash flow due to start-up costs associated with the new construction, which recovered in subsequent years, and was offset by efficiencies realized through the replacement facility. The authors of the report specified the importance of not utilizing the report as evidence of a cause and effect approach or a "build it and they will come", rather as insight to what could be possible (Shell, 2008). The 2016 Stroudwater Associates report reflects collection of data and analysis up to 10 years post-occupancy on utilization, satisfaction/efficiencies, and financial growth for replacement facilities.

To better understand the financial risks and benefits of building a new facility, all of the 5 case study hospitals retained a financial advisor specializing in healthcare financing. The use of a financial advisor helped the hospitals navigate the financial landscape and to find the most cost-effective financing strategy. In its report, "CMS Critical Access Hospital Replacement Process: The Manual", it discusses the importance of working with an independent financial advisor to assist in the development and management of overall project schedule, perform debt capacity analysis and set financial

parameters, identify CAH credit profile and explore financing options, perform financial feasibility studies, and communicate information to the community and Hospital Governing Board (DHHS, 2010). As previously mentioned in this report, CW – the financial advisor used by 4 of the 5 case study hospitals to assist the hospitals in understanding the financial impact of building a replacement facility and developing a financial plan for funding costs. Hospital #5 did not retain CW; however, they were aware of him and the services he provided but being part of a for-profit organization utilized an internal person from the Hospital Corporation to assist in the financial analysis and planning.

In addition to funding, CW also helped hospitals determine the amount of square footage they could afford to build based on costs per square footage and made recommendations for architectural firms and construction companies. According to the CEO at Hospital #4

> [CW] is absolutely essentially. Some kind of, either your auditor or really an outside financial consultant to come in and tell you, can you build? Can you afford to build? Do you have the cash flow? You know, is your organization set up in such a way that you would benefit from building potentially, you know, um. It, it, because the way critical access is you gotta be careful about the square footage and departments and the way you staff and some of those types of things so. That piece is absolutely essential. An outside financial person other than your CFO, and your auditor, and you're pals, you know, [you have to have] somebody to come in and just tell you raw. You know, can you do this? Does it make sense to

> even spend the money on the architectural designs and start, cause you got to spend money ahead. You know, you, you, you're buying property potentially. You're, you're looking at plans, you're spending on financial analysis of, you know. So then it's, what size of a facility can you build, you know. What, again, what can you afford based on your current cash flows assuming, you know, flat growth or a little grow, you know, what, what size facility.

Financial decision drivers were core to all building decisions but were ever present concerning the main decision to build a replacement facility versus renovations. In some instances, CEOs discussed how it was not feasible to not think about building a replacement facility due to the increase in reimbursement hospitals would receive from Medicare, and the increase in depreciation that is realized when building new.

The Aging Structure and the Delivery Model of Care

The aging infrastructure played an important role in the decision to consider building a replacement facility, but another factor that was noted as significant was the changing delivery model for patient care in the 21st century. The CFO from Hospital #2 said:

> You know, we were basically, our physical plant was making us a Band-Aid station. Because we could only take care of [some] emergencies and we could take care of our end of life patients. Anybody else was going elsewhere because we did not have the space or the ability to put in the

> technology that health care was requiring. And so that, to me was number one as to why we would need to rebuild in a different site.

The CEO from Hospital #4 indicated:

> When it originally started [discussions about building a new hospital] I say most of the focus was on patient care and how best to deliver the patient care and what was needed for the best patient care. And what they were lacking here [in the original hospital building].

Over 50% of the persons interviewed, including CNOs, CEOs, BM, FP, COOs, and architects all discussed the delivery system transformation in healthcare from an inpatient model to an outpatient model as an important factor that helped in directing the decision towards building a replacement facility. The BM from Hospital #1 indicated that 40-50 years ago a patient undergoing an appendectomy stayed up to two weeks in the hospital as an inpatient. Today, most uncomplicated appendectomies are done on an outpatient basis, with the patient being discharged to home in less than 8 hours post-operatively.

The seismic shift from an expensive inpatient care setting to a cost-effective outpatient setting initially took root in the 70's, and ushered in an era of value and quality over volume starting in the 90's, and continues today with healthcare systems looking to provide more than just simple outpatient clinic-based care (Davis & Russell, 1972) (Jun, Jacobson, & Swisher, 1999). Hospital Administrators felt they were poorly situated in existing hospital structures to accommodate an increase in outpatient services, and this

adversely affected reimbursement and their ability to provide competitive services. Hospital #4 attempted to convert inpatient rooms into outpatient clinic space, but it was inefficient and did not allow for adequate patient flow or judicious use of staff. In addition to changes in how medical care was delivered, surgical care has advanced as well. The need for computers and specialized equipment, such as scopes for minimally invasive surgery, cramp existing operating rooms to overflowing, and surgical hallways being used to store expensive equipment when not in use.

Another concern brought by Hospital Administrators was how hospital business is done today in a critical access facility. Dedicated space in older buildings for laundry and nutritional services were no longer necessary, since much of it was outsourced to companies specializing in these services, making these dedicated spaces obsolete; however, the locations of these spaces made them undesirable to re-purpose for patient-based services. Spaces in older buildings were often seen as either insufficient or wasted by Hospital Administrators, and did not support necessary or vital functions, and if they did, this would only be accomplished at great costs through renovation and upkeep. Nonetheless, it was not just space in the older facilities, but the layout of the buildings that created a variety of staffing issues, inconveniences for patients, and prevented future growth because the hospital was landlocked.

Location of Hospital & Landlocked

The CEOs and other hospital administrators from Hospital #1, #2, #3, and #4 all indicated the original buildings were built on what was considered to be the outskirts of the town, but over the past 60-90 years, the towns started to grow around the hospital creating situations where the hospital was considered to be landlocked, and the only

growth possible was up, which was not always optimal or permitted. Several of the administrators complained about the inability to provide adequate parking for staff, patients, and guests, or to have a safe place for a helicopter to land for emergencies. For some, hospitals were prohibited by city ordinances to build anything above their existing number of stories, but not that they would have, since it was not practical. The CEO of Hospital #4 told me:

> You don't have, I mean we're sitting on a city block. We're land locked now. There's houses built all around us, [whereas] this was the edge of town. And so all these houses have grown up around us and we've got this city block that we sit on and we're just crammed in here. We can't grow. We don't have enough parking. It's unsafe. You know, on the streets and driving around this building. It's just, you know, it's a burden for the neighbors. It's just, it's not a good, I mean, so. All those things, even those little things, I mean. It, it all kinda comes together. Now we're somewhere where we have plenty of land. Um, we can add on to the building in the future if we need to. We have plenty of parking and safe parking for our patients and employees. Um. You know, we can expand some services.

And the FP from Hospital #4 said:

> As you probably seen when you pulled up to the building we're pretty much landlocked right now. When this hospital was built back in the day it was on the edge of town and then the town has grown around the hospital. We're on about a 4 acres sight here. So we're very limited with adequate

> parking and being able to expand this building, so. One thing that was consideration for us was to find, you know, we're trying to build this facility to last another 70 years like this one has so we're trying to be very forward thinking in our thought and we wanted to get 25-30 acre site that we could build on so it wouldn't be landlocked. So our people that take over after us have options and are able to grown with the needs of that time. We're on a 4-acre site here and we're building on a 30-acre site at the new site.

Departmental Adjacencies

Quite frequently Hospital Administrators and Board Members discussed the issues associated with departmental adjacencies, how one department relates spatially to another department. In the older buildings, poor spatial relationships between departments created untenable conditions, which either exposed patients and staff to unsafe conditions, or created staffing issues that resulted in unnecessary financial burdens in order to meet statutory licensing requirements concerning staffing numbers in clinical departments such as Labor and Delivery, or the Emergency Department, or in Radiology. Building a new hospital was one of the ways in which the hospital could overcome these spatially related issues. The FP at Hospital #4 indicated that it was important to bring areas closer together in order to share staff.

> Well, efficiencies of staff. We wanted this [new] building to be as, as efficient and safe as possible. Ah, currently [in the old hospital] our medical surgical floor is on second floor and, ah, the ER is on first. You know, when you get a nighttime situation when there's minimal staff here,

> [you have] to split your staff if somebody comes to the ER. So, we want to look at a unified nurse's station where everybody is in the same location. One side of it services the med surg and the other side serves the ER so you can gain some efficiency in staff and get some cross training of staff. And make sure staff gets an opportunity to work both departments so their comfortable in those situations, so. Yeah, that's, that is a major change for us moving to the new building, so.

The CNO at Hospital #4 concurred with the FP, that to be effective and efficient, it made sense for the medical surgical unit and the emergency departments to be closer together, so that nurses could provide assistance as needed to the busier unit, without being separated by walls and levels.

> However, when we have especially, at night, um we never had dedicated ER service or a RN for the ER at night, and we covered that from the floor. Well right now [in the old building] that's up [the nurse is up] on [the] second floor so if, an ER patient came in that patient, that nurse had to go downstairs, one of the nurses had to go downstairs to take care of that ER patient and they could be down there the rest of the night literally by themselves.

The CEO at Hospital #5 indicated that the inefficiencies of a vertical building created difficulties in efficiently utilizing frontline staff.

> Well I think one of the, the first things was the current facility [old hospital] is so inefficient. I mean we've got the two nursing floors and the

> way when we look at the grid, if you look at you know, each nurse is supposed to have five patients. And so when you get to that sixteenth patient we have to open this floor because we can only get fifteen downstairs.

The CEO from Hospital #1 indicated that the lack of departmental adjacencies was the main impetus for building a new facility, since no amount of renovations would improve the problem of physical layout of the building.

> Number one on the list was, um, adjacencies of departments for ease of patients. You know, of moving around within the facility and also the added benefit of, um, just the staffing perspective. How could we improve our efficiencies with staff in terms of the layout of the building?

Deinstitutionalization

One of the themes frequently discussed during the interviews was the desire to make the hospital less institutional looking or feeling. In some instances, it was the starting focal point for hospital designs. The CEO from Hospital #2 spoke about how he started with a basic design that was "lodge-like" for the hospital lobby. He indicated the design he thought of originated when he was working for the Indian Bureau as a hospital administrator in New Mexico. He liked the homey feeling of the lodge and thought he could recreate that design outline in Missouri. Likewise, the Board Member (BM) from Hospital #2 also agreed on the importance of making the hospital feel "warm and welcoming", not "cold and clinical". To that end she talked about the fireplace in the lobby, the types of colors chosen used throughout the hospital, and the strategic use of

community designed quilts hung in some of the rooms as artwork. In her opinion, this all added to the "homey" feeling of the hospital.

The CEO from Hospital #5 referenced the importance of making the hospital feel more "hotel-like" and to use higher-end materials to give it a "plush" feeling. Also, the COO from Hospital #5 desired to make the hospital less institutional by the use of softer finishes and colors to complete the hospital design. He indicated he had visited a CAH in a tourist area, which to him felt like a "Hilton" or "Marriott" hotel as compared to a hospital, due to that hospital's profuse use of glass, wood, and marble in the lobby.

For other hospital administrators, in order to support this impression of a non-institution or aura of hospitality, they wanted their hospitals to differentiate and separate the inpatient care areas from the outpatient care areas. In many cases, it was to preserve privacy for inpatients, but more intentional was the desire to keep outpatients away from what some administrators considered to be undesirable aspects of patient care, such as observable pain and suffering, to maintain the up-spirited environment or illusion of hospitality.

Architects also spoke about deinstitutionalization of the hospital, to focus on the experience of the patients, and "create as much of a healing environment, calming environment that is de-institutionalized as possible. A place that's home-like, or hotel-like or hospitality-like." Some architects discussed the importance of placing outpatient services immediately adjacent to the main lobby or central courtyard to prevent outpatients from having to access the "bowels" of the hospital, but to stay separate and close to the entrance or courtyard where there is "lots of natural light" and "it's pretty."

The Experiential vs. Experimental

One type of evidence relied upon quite frequently by decision makers in this study was experiential in nature – what they believed would work for them from their perspective/world view, and knowledge base. Several administrative leaders were instantly ready and amenable to make general and specific design decisions based on what they thought would work from design examples seen/observed from examples or models of newly built hospitals. At all of the study sites, the architects took administrative leaders/decision makers on tours of hospitals recently built by themselves, their architectural firms, or others to provide administrative leaders with tangible information of what the architects proposed or substantiated from the master building plans. Depending on the hospital or architect, hospital administrators may have toured 1-6 examples of new hospital buildings. Included in these hospital tours/visits was the ability for administrative leaders to interview key personnel at the visiting site, so they could discuss openly with other administrative leaders what aspects of the design worked or failed to perform as expected. These building examples served as evidence for decision-making for many of the administrative leaders, who focused on repeating what was interpreted as design successes/meeting building goals, i.e. decentralized nurses' stations, patient room layouts, and exterior ornamental features, such as a clock tower. Also, decision makers used these design examples as "lessons learned" about what not to do, and how to modify design plans to ensure mistakes were not repeated, and limit what they perceived as design failures. One of the decision makers at Hospital #2 stated: "Well it seems self-explanatory that what you're doing is based on prior practices and

designs and whether or not they worked. And so there's evidence to prove that - yes this works."

The CEO from Hospital 4 discussed how they actually used hospital site visits to make specific design decisions/changes in their plans based on whether they thought something would work at their facility based on their understanding of building/design goals for their community, patients, and staff.

> [You} know when [you] say evidence-based, has someone studied it and you talked to other facilities and you say does this system work for you. What improvements have you seen [done]? We were looking at some added privacy for our post-surgical patients. We had some open bays and we were going to add glass walls for some privacy and things. And I was concerned about the size of it, you know, and getting the equipment in there and staff being able to get on both sides of the bed and stuff and so we called [the example hospital]. They have a similar thing [design] so you talk to them. Is the perceived or hopefully real benefit of privacy if adding this worth getting in the way of the caregivers or whatever? Or is it too small or is it still big enough. Or how is it, you know, those types of things. And what we did was take the [example hospital] design and, and work[ed] from it and [it] quickly morphed it into our hospital.

Similarly, the COO from Hospital #5 indicated

> [I]t's definitely an amalgam of [hospitals]. We started with [the example hospital) up in [City Name] Illinois, and that was kind of like the WOW,

> that's a critical access hospital? And that was kind of what we wanted. You know if you just picked that up and dropped it down here that'd be perfect. But then as you get to looking at what are the differences between what services they provide and what is their patient needs versus ours it was like okay well this isn't going [to work]- It wouldn't necessarily be a perfect fit.

The BM from Hospital #2 discussed how the hospital site visits provided clarity for them concerning room configuration, and how they could achieve by modifying their designs as compared to the model hospital.

> We visited 3 or 4 different hospitals. In one hospital, we walked in and immediately felt that the construction of the room, the configuration of what was in the room was not very user friendly. It was difficult to get around the end of the bed and to sit in the chair that was by the bedside. It appeared to be cramped. And we knew right away this is not what we want[ed].

In addition, the CNO from Hospital #4 said the following about how seeing examples of building types helped her decide how the units were to be laid out.

> You know [the visits to other hospitals] gave us your pearls of wisdom. You know, we continue to do that even yet. And we're pretty much into the [process of design you know, and] it's almost too late to be making some changes, but even now we went to [City Name], Iowa, who just

> moved into their new hospital there, um, critical access hospital. And asking them what advice do you have [for us[and what works and what doesn't work. And, although their hospital is very nice, I'd like to hope that ours is gonna be just as nice if not better. But you could certainly tell by looking at their facility what's important to them. And now you look at our hospital and what we're emphasizing.
>
> You know, making every effort to do that [visit other hospitals] was very, very beneficial. I will tell you that at fairly early on he [the Architect] took us to [City Name], Kansas and it was a hospital they built. And again, our hospital, if you would look at our plans and you would look at their plans you could see huge similarities. You know, that's what our hospital was basically based on, [City Name], Kansas Hospital. And we went down there and it was just lovely, you know.

The FP from Hospital #1 discussed how a hospital site visit helped illustrate for him and other decision makers the importance of departmental adjacencies to improve workflow efficiencies. However, it was not just the site visit itself, but the discussions the administrative decision makers had with staff at the model hospitals. Hospital administrators felt they learned from the model hospital's mistakes and had the opportunity not to repeat those mistakes by resolving design errors in their own plans.

> [T]he surgery department next to the OB [obstetrics]department was a change that we made early on, after, it was actually it was after our visit at [Example Hospital] in Iowa. Where we saw how they had done it with

surgery and OB being right next to one another. We said, oh, well that looks like a good [idea]. Well we came back and just changed the whole plan after that. So, [for] efficiency of staffing, um, [for] energy consumption, um.

Well besides the OB, we were looking at the way they had done their [rooms, and] at that time we were still deciding on inpatient [rooms], inboard vs. outboard bathrooms. So going there and seeing their bathroom, we ended up with a very similar design [to] what they have, with the inboard bathroom and a shower, [and] is very similar to what they've got.

…After going to [visit the example hospital], they, um, I was talking to [MC] the plant OPS guy, they… made some mistakes that we learned from.

It's, [from] visiting [Example Hospital] we learned things that was working well for them and things that didn't work so well. That's, the proof is right there, and so we, we altered our design based on what we saw there, good and good and bad.

Well when we went [for a hospital visit] it was quite a few department managers who went, and they saw the benefits of swapping those departments [ED and Surgery] around immediately. And it was, it was a no brainer for them. It's like we have to find a way for this to happen. Um, and without completely just, you know, throwing the design, our plan

> away and starting fresh, we were in a point where we had already invested, you know, a certain amount into our design

The CEO from Hospital #3 utilized multiple site visits of model hospitals as a deciding factor as to what decision makers wanted in their hospital design. He indicated that they took what they perceived as the best elements of the model hospitals and adopted it into their designs and removed those design elements that they thought would not work for them, such as the long corridors and separate spaces for staff and public. He does not mention evidence from research but focuses on what his experience or others experience was or would be from his perspective to decide what he thought would achieve the best outcome from design.

> When [our] doctors really started, [to] see the ER design, one of our doctors [that does moonlighting in an ER] came back, and said [to us] this is the ER you need here, so our staff went and looked [at the hospital he worked at], and came back and agreed.

> We toured a number of facilities. Ah, we took our managers and our team plus some [others]. We went to (City Name], Missouri, and [City Name], Nebraska. Also, I drove down to Oklahoma to see some facilities that I'd heard good things about. The idea [was that] we wanted to go and take all the best designs from everyone, and there were certain things we didn't like that maybe made sense there, but we didn't think [it did for us]

> [At Example Hospital] we felt that the corridors were just really long that people were having to walk long distances. And we wanted ours to be

> shorter distances for patients and ultimately, we came up [with current design]. We liked the ones [designs] where they tended to separate the staff areas from the public areas.

The FP from Hospital #4 indicated the design for their hospital started with the core design from another hospital and decisions regarding design modification were done one their own, not by the architects advising them.

> You know the architect brought us a design that he had done previous in [City Name], Kansas and I don't know if we were given any direction on you should build this way vs. this way. We basically started with another design that we already went and looked at that was build and then we changed it [the design] 100 or 1,000 times to make it ours. I don't know that we were ever really presented, you should do this or instead of this. It was really a collaborative effort. It was what we wanted.

The COO/CNO from Hospital #3 utilized the site visit as a pivotal deciding factor as to whether to build a central nursing station, or to decentralize the nursing unit by designing pods of rooms/care. Prior to the model hospital the COO/CNO had decided that was the direction in which the design of the patient unit was headed; however, after the site visit she had changed her mind. Listening to the hospital administrator about the problems they were experiencing with the pod design and understanding CAH staffing requirements was sufficient to make the CNO change her mind about the basic design configuration on the patient care units.

> [We visited hospitals] in Nebraska, and there were pros and cons to the decentralizing [of nursing stations]. To me there were about as many cons as there were pros and it really is just [about] exactly how you function to provide [patient] care. And it ended up that I felt that putting the computers in the rooms would offer us that ability to be able to care for the patients in the rooms and be able to chart what we needed to chart, because we were currently going back to the nurses station to do that. I went away from the decentralized nurses stations and one of the things that [the Example Hospital] shared with me is that what doesn't work is, in a critical access hospitals when your patients are here and go so fast is that you may start with a pod of four, [then] 3 get discharged and so you end up with 1 patient in your pod, well then you're going to another pod to take care of [your other] patients. So [as the bedside nurse] you have one here [in your pod] and then you might have 2 in the next pod and then [since you have empty beds patients] are admitted in your pod. So then you're going back to your pod. And I really felt as I looked at our admission and dismissal process that we were going to be doing a lot of running from pod to pod and I just I didn't like that. I didn't like that, so I just broke back away from that. We talked about it for quite a while.

The Architect from Hospital #2 describes how he used designs form other facilities and arranged tours for hospital administrators for them to see how the designs could work in their new hospitals.

> And how we led that process [of design] is we provided them drawings of how we had designed other departments in the past and had also, um, I don't know if we had [this] County's staff tour other facilities, but we'll run tours in other facilities where they can interview those other department heads and look at their model and see how that works or doesn't.

The value of evidence from personal experience - logic, common sense, etc, also seemed to play a central role in the design decision-making process. The FP from Hospital #4 indicated that all evidence was filtered through his own experience and had to make sense to him before he would agree to various design decisions. The CEO from Hospital #3 vindicated the importance of doing their own testing with mocked-up patient rooms - and it was only through this experience where they convinced enough to make certain decisions concerning patient room design. The CEO from Hospital #3 went on to say their personal experiences were so influential and valuable that even if there were research articles in support of a certain design feature that they would not accept it without first experiencing it themselves.

> I said, then we tested it off our own experience more than anything. Does this really drive with how we want to do things? Um. So. The architect for instance wanted all the rooms to be exactly the same, same handed, same everything in the facility. And we talked about it and said we don't want that because, um, we felt like for us we, we liked two styles of rooms and because we felt like there were some people that were weak on the right

> side some weak on the left and we could put them in rooms based on that to where they, um, could have more natural movements.

The CFO from Hospital #2 discussed the importance of making design decisions based on the previous experiences of health workers.

> No, I think it, it came more from experience, the experience of the people working. Um, we knew, not we, because I hadn't been there that long, but, you know, [CEO #1] brought in a lot of insight, ah, we have two board members that are nurses that brought in a lot of insight. Our DON [Director of Nursing] has been here for 30 years.

While nearly all of the administrative decision made decisions as filtered through their own experiences or normative approaches, a few of the administrative leaders and department managers did discuss the use of empirical evidence from research in helping guide design decisions. Those who understood that research had or could play a role in design decisions generally did their own on-line searches to find the evidence necessary to support a design decision and were disappointed when the architects failed to bring it to them.

The COO/CNO from Hospital #3 indicated that she did not feel the architects were very helpful in providing such information and she ended up doing her own search, looking for articles on nurse unit layouts. However, the vast majority of the administrative leaders did not look up or discuss evidence form research articles, as discussed earlier – they believed that either everything brought to the design process by the architects was evidence-based, or that it was simply present.

> I, ah, you know what, you just had to get, you just had to go online, and, and bring down, um, bring down just some research based online, um. It was not supplied to me by [the architect]. That was quite disappointing to me. I thought, um, if I asked him for it he would, um, he would give me some but not really enough.

Nurse Stakeholders and the Nursing Process

Other types of evidence administrative leaders considered when making design decisions were drawn from stakeholders, i.e. nurses, lab technicians, radiology technicians, etc. Stakeholders play a crucial role in designing spaces, since they are the end users (Cherry, 1999). In the case studies, stakeholder input was gathered during the programming phase or after schematic designs were completed, and when feasible, stakeholder design requests were incorporated into the final designs, or during the construction phase.

> We brought every department manager in and they all got input on how they wanted their space designed. What their needs were. How many exam rooms they needed? And our architect would take down all those notes. He had all the sketches and he would take that back and then put that into the next design, their needs and then obviously we had to kind of play police on it, you know.
>
> But every manager had multiple opportunities to meet with the architect. We encouraged the managers to bring 1 or 2 front line staff from their departments with them, so everybody had a part in it. But like I said, front

> line staff, all managers had an opportunity to meet with the architect during the programming phase and he met with them at least, some of them, 4 and 5 times. Some 2 or 3 times was enough. But he always went back and implemented their changes. We crunched it out and looked at it and said we can't do this, or we can do this and then they put their input in. Ah, when the final design came around, I went and sat with every manager and we went through it. Everybody signed off and said yes I approve of this and we've got those. During the construction process, ah, I have been taken tours down there of the, the managers and the, their staff. So they've seen it from when the walls started going up on the exterior they've been through there multiple times. We have caught things that we decided lets, lets change this and fortunately we were in a position financially with our contingency funds that we could do a lot of change orders on this job so.

In some instances, stakeholder input was not considered to be helpful in making decisions for a variety of reasons, including effects on building timelines, indecisiveness or disagreement concerning the optimal design amongst stakeholders, non-compliance with building code, and financial or space limitations. Nonetheless, evidence gathered through interview of staff was essential in several of the design decisions made by administrative leaders.

The COO/CNO from Hospital #3 discussed the importance of having the nurse stakeholders' involvement in designing the spaces they would be using to ensure it met their needs and supported the process of nursing and how they practiced it:

> When I started out [in the design process] I had staff 100% engaged, and after a while it became so overwhelming, [so] I just had small groups meet and then I showed the designs every month and where they were going. And you could have staff involvement up to a point and after that you just have to make decisions where plug-ins go and where light switches are, and it's, you, if you have to wait to ask for every little thing it's way too much. They need to do their job [nurses] and so I had someone help me in OB [area] and someone help in the emergency room and then I ended up with med surg and then they have their people that they all talk to – " what do you think we should do with this? What do you think we should do with that?" And they [selected nurse representatives] also went to the other emergency rooms and looked and other OB areas and looked. I would say our OB director probably did one of the best jobs I've ever seen in a design. It's actually a better design, I'll tell you, than the Women's Cen that [we] just came out [to see].
>
> I think it [EBD] was referenced, but yet the final decisions were more on our own process of how we're going to flow patients. Ah, because, even though you would read, um, the designs, um, they didn't work here. They didn't work for critical access hospitals. It might be a good design for a telemetry floor.

Many of the nurse stakeholder's interests were focused on optimizing the nursing process – assessment, diagnosis, planning/outcomes, implementation, and evaluation (American Nurse Association, 2018, Practice and Policies.

https://www.nursingworld.org/practice-policy/workforce/what-is-nursing/the-nursing-process/.) Several administrative leaders saw the new building as an opportunity to support newer nursing care models that decreased stress, improved nurse satisfaction, and maximized patient-centered care delivery. Decentralized nursing or pod based nursing removes the centralized nurses' station as the hub of communication and information, and replaces it with a number of decentralized nursing areas or pods (Parker, Eisen, & Bell, 2012). To adopt this nursing model of care it requires designing and building nursing pods, or nurse staff workspaces throughout a nursing unit. These workstations can be located at the center of a small set of patient rooms or directly outside individual patient rooms. The workspace usually has an observation window that allows the nurse to monitor the patient (Parker et al., 2012).

The CEO and CNO at Hospital #3 discussed wanting to change the unit design to more of a decentralized design, to support a more patient centered model of care, but ultimately opted for a traditional nursing layout with a centralized nursing station, since they believed such a nursing model could adversely affect staff/patient ratios and patient safety.

> Now originally, ah, we liked the idea of putting, ah, nursing workstations outside each of the patient rooms so that, ah, you could look in at two rooms at once. Our nurses didn't really want to practice that away, but we thought eventually that's where we'll go [decentralized nursing care] to where instead of doing work at the nurses' station it will be in the patients [room] and [immediately] outside [the patient's room].

Some administrative leaders also felt nursing staff relied too heavily upon how work was done or how they used to do work in the older hospital/facility. They believed the nursing staff developed specific habits in order to accommodate the barriers and limitations in the older, outdated hospitals, and here was the opportunity to improve nursing work by overcoming these barriers. The COO at Hospital #2 said the following:

> So, we started talking about processes, which became important of, of the scheduling process or where are we going with centralized scheduling, if so then where does everyone check into and where do they go. So you have to know how you want things to function before you can, before you can build the design. I also spent quite a bit of time looking at nursing stations design. Um, whether we wanted the substations and how you actually wanted your room design. Because your rooms, you can't lay out your rooms until you know how you want to function. And how your process works, whether you want, um, centralized med station or if you're going to do individual med stations in front of each room or whether you're going to do your report outside the room so you're going to have a substation outside. So, if you don't know the processes of how they're going to work then you can't figure out how you're going to build it. It was very evident in talking to all the managers that we came back with that no one was thinking about how they're going to be delivering healthcare in 10, 15, 30 years. They were only thinking about, I wish I had a little more space over here by that refrigerator. And, so we had to really take our managers and talk to them about future design and how this

> would work, as that was a concept that it doesn't seem that anybody got. And even [after] talking with the nurses about substations and pods you know it was foreign [to them], it was a foreign design. Most of my nurses have been here for years on end. So they were like, oh, I don't know if I want to work in pods or not.

Moreover, it was the belief of the CEO at Hospital #3, as a captive market in their small rural communities, nurses had limited exposure or experiences outside of practicing nursing in their old facility, so may be unaware of care models that could improve efficiencies, satisfaction, and safety. As such, the idea of what nursing could be or do was often a driving factor in design decision-making, sometimes even in opposition or ignoring stakeholder/nursing input. In healthcare there is a linear correlation between nursing care and patient satisfaction, and since Medicare reimbursement is based on quality and perceived value, as measured by patient satisfaction, it was critical for administrative leaders to make decisions they believed would ensure better nurse care delivery (Tzeng, Ketefian, & Redman, 2002).

> Of course they [the nurses] had a strong feeling about how their area should be, and it was a real challenge cause we wanted to honor that but also some of them had never worked in another facility other than ours, so they were either overcompensating for issues they'd had or didn't want anything changed, or we're trying to design the building to fit our [the hospital's] process when those processes where only the way because of our lousy old building.

Making the Case for Patient Safety

Making the new hospital safer for staff and patients was a goal for many of the decision makers in this study, but the evidence used to substantiate such decisions was not always clear or well understood by the hospital administrators. Several of the CEO's discussed making the hospital grounds safer from crime or criminal acts, while others discussed safety in relationship to environmental factors, such as non-skid surfaces for showers, or infection control, or improvement in technology. The CEO from Hospital #4 said:

> Personal safety for the staff and for the patients. I mean we have a room that's like a lock down room. You can lock a patient in a room and it's like the ceiling and everything they can't get out. You know, if somebody goes crazy on us and we shut that door we can lock them in there, things like that. The foyer when you come in late at night, you can't get anywhere to anything.
>
> During the day it's all open [access to the hospital]. And then at night it's closed off to protect the staff and patients. If someone gets buzzed and they start going crazy we at least have time to call the police and all that. So there's safety, but there's the privacy. All the patient care goes on in a closed area. You know, you walk into a foyer and you can't see into a patient room.

The CFO from Hospital #4 discussed how the bigger rooms would be safer for all patients, and that the new hospital permitted them to utilize more or expand current technology to improve safety, specifically a new Electronic Health System (EHS). She

concludes from her world view, from her experience that the bigger rooms and full implementation of the EHS will increase safety and security without understanding what impact these changes will have on patient safety and patient outcomes.

> So, there'll be some added safety for the patients, as far as those 2 rooms, which we call them the bariatric rooms. They wouldn't necessarily have to be bariatric rooms we could use them for whatever we needed. They're just a little bit bigger. I think upgrade in technology will make it safer for the patients. We're installing an electronic medical record. We're started to go live with that process in the first part of September we'll be implementing the first part of it. The doctor's – 3 or 4 of the doctors, will go actually live with it in the middle of October, and then the rest of them will come on when we move [to the new hospital]. But then getting that technology base in there [the new hospital], I think, hopefully, we'll add some safeguards to the patient records and the doctor will have access to the whole record when they're looking at it rather than just bits and pieces from…

The CEO from Hospital #3 indicated there were limited discussion about certain design elements known to improve infection control, but overall very little debate.

> I don't remember any discussion of aging. The interior designer did bring in some of those elements, um, we also assigned our infection control team to review all that stuff and say does this look reasonable? And so she went out and read a lot of the APIC guidelines and, ah, and came back

> with questions. Ah, but, but I don't, I don't remember a lot of those things really just being debated

Thus, *safety* was used as a broad term by the healthcare administrators encompassing several different types of *safety* related issues, not necessarily limited to improving *patient safety* as defined by the Agency for Healthcare Research and Quality (AHRQ). AHRQ defines patient safety as applying safety science methods to achieve a trustworthy system of health care delivery, and preventing patient harm that arises from the delivery of medical care and maximizes recovery from adverse events (Emanuel et al., 2008). Complexity theory sets the stage for the risk of error in healthcare and patient harm, specifically that in an open, interacting system, unpredictable events will happen. The better the design, the more resilient it is to impending failures, the more likely it can be prevented and recovery quickly. Safety systems include design of materials, procedures, culture, training, and the physical environment (Emanuel et al., 2008). For the most part patient safety occurs at the microsystem, or the immediate environment in which care occurs and the locus of where the successes or failures of all systems to ensure safety converge (Emanuel et al., 2008).

Some administrative leaders thought they were designing specifically for patient safety – utilizing the science of patient safety to make healthcare safer, but it was clear that it was not knowledge based on research evidence, but rather a general understanding of a patient safety oriented concern, and a belief that they could improve safety by designing elements into the room. Regardless, of whether they knew if the design actually improved safety, the belief that it would make the space safer for patients was sufficient to drive decisions. The CEO from Hospital #1 said:

> We were going to go [build] the single patient rooms. Really came into play on how the rooms were designed from their [the architects] perspective. Small thing, but big thing. I guess this falls in this evidence-based design piece. But falls are a big deal. Them [the architects] designing where the bed would be and. [We] were not even thinking about the fact [where the bed was located from the bathroom] they [the architects] developed from where the patient would get out of the bed most proximal to the bathroom. There's a handrail that follows all the way around the room and right into the bathroom. I mean, that's a small design issues that I don't think anyone of us would have thought about but it's such a big deal in terms of patient safety.

The CEO from Hospital #2 indicated he was not aware of any specific decisions made from a patient safety perspective, but rather the architects already contemplated the necessary patient safety design elements and presuming safety present because the new facility was built. Moreover, CEO #2 equated patient safety as equivalent to building to satisfy building code requirements:

> Not that I can remember [making any decision based on patient safety] specific[ly].
>
> May have been. Yeah. Seeming like they [patient safety] were just kinda taken care of, I mean. As part of the architects just kinda did that, you know. It wasn't anything specific that we asked for that I can think of.
>
> Of course, a lot of it [patient safety] is [building]code.

While nearly all hospital administrators were focused on safety as one of the ultimate goals of successful design, few considered it as something that needed to be researched or understood, but rather that it would happen as a result of building a new hospital.

Design as Solution or End Goal

Nearly all hospital-based persons interviewed discussed the problem of inefficient staff use in older buildings due to the location or building verticality in regard to patient care areas. In a CAH nurse staffing is limited and having to dedicate 24/7 a nurse in an area to deliver episodic care, such as in an emergency department, is not desirable, and in some instances not possible. The BM from Hospital #2 indicated:

> So,you know there were some options there [old facility] for, ah, very adequate rooms - but, staffing became very complicated if you have to, operate on two floors.

The CNO from Hospital #5 discussed the impracticality of a vertical building and providing both supervision and assistance to a lone nurse working night shift.

> It also has put us in the position many times, even as [of] today, we have one nurse on third floor taking care of five patients by herself. Now [in the older building], that [nursing] supervisor and um, uh, is gonna come back and forth, check on them [the nurses].

Similarly, the CNO from Hospital #4 discussed the burden of trying to adequately and safely staff patient units when the physical demands and lack of proximity adversely affected both efficiency and effectiveness.

> However, at night, we never had dedicated ER service or a RN for the ER at night and we covered that from the floor. Well right now that's up on second floor so if, an ER patient came in that nurse had to go downstairs, one of the nurses had to go downstairs to take care of that ER patient and they could be down there the rest of the night literally by themselves.

The CEO at Hospital #3 further discussed some of the challenges he faced in adequately staffing the emergency department due to the limitations of the physical environment, statutory requirements, cost, and need.

> Ah, concerns that we had with a low volume ER. But that so that it's hard to justify staffing it all the time and yet having it separated from all the other care areas, ah, security issues…And then the second floor had Med Surg and then the third floor had surgery and, ah, so. We see in the ER, oh, 1800 patients a year. Which for our size community we could easily be seeing twice that based on some communities. For us it's just, it's just lower. And so it seemed like because they were down on this, the, the other floor we'd have to assign a, a nurse, which at the time before we had the state clarify that it would never be allowed, um though it's done at other [State] Hospitals. We would usually sign an LPN, who would just sit there and read a novel and ah, then everybody would do the real work up

> on the second floor and then sometimes you get really busy [in the ED] and then that one LPN was overwhelmed. And it was, it was hard…It just felt like a waste of nursing resources.

So, while changes to make patient care areas on one level, or sharing a single nurses' station may seem like a reasonable design solution, it may not be sufficient to solve the problem without thoroughly understanding the issue and/or goals, and testing whether those design solutions actually worked and are sustainable. This was the case with Hospital #3. As indicated above, the CEO of the hospital discussed the inefficiencies of having to staff the ED with a dedicated RN. They believed the departmental adjacencies on a single level in a new hospital afforded them the luxury of only having to staff one area – the medical/surgical area, and pull nurses to work in the ED as needed, because they were now on the same level and very close to each other. However, what no one had contemplated was that the ED in the older building also served as an entrance point for radiology and other outpatients, since radiology and the ED shared a common desk, radiology personnel could direct these patients to the ED and call for nursing assistance. In the new facility, radiology and the ED were separate units, so there was no hospital staff in or near the ED, resulting in upset and confused ED patients. This necessitated having to staff the ED desk 24/7, an issue the hospital had thought it resolved with the new hospital design. So, while design solved one problem, it created another.

> The downside we've had is, ah, it no longer shares a desk with imaging and so when [ED] patients come in during the day there may not be anybody there and so we've had a couple of people banging on doors and

> not able to get in. Cause we also decided well, we need to lock it down [the ED] because if no one's going, someone's not going to be there we don't want them to come in and pass out and not have, not have us know it. So, we're still working through some of those. Um, and having to assign additional staff after all to be in the ER, though instead of a nurse we sometimes use EMT's or others that we trained to be tech, ER techs. Um, thought the initial's still have to be an RN. And then on weekends we just staff with the RN.

THE RESPONDENTS DEFINTION OF EBD

Healthcare Administrators' Perception of EBD

How did hospital administrators describe or define EBD? For some, EBD was anything the architects suggested or recommended with regard to design, but for others, evidence was defined as leading trends in technology or building design – what others were doing. EBD was described as malleable – it was whatever you wanted it to be or what the architects told you it should be. For few, it was the study and science of design – research performed that provided the evidence to build a certain way in order to improve patient outcomes. One of the CEOs from the case studies went as far as to say that because the facility was built, EBD permeated the entire building project. Hospital Administrators interviewed believed EBD was intrinsic in the nature of what the architects brought to the design process.

The COO/CNO from Hospital #3 understood EBD as designing with evidence to improve patient outcomes or satisfaction but indicated that building codes and requirements took precedent and drained the final designs of any EBD. She made it

appear as if EBD was restricted by regulatory requirements, which in truth could hamper the building of some EBD concepts. Nonetheless, she was not sure what elements/designs represented EBD in their new hospital building:

> Define it [EBD]? Evidence-based design to me would be, designing your room so that evidence has proved that if you put the light here patients can see better. Or if you put the cords here patients aren't going to trip. Some of it [EBD] I would say we listened to and some of it gets thrown out of the window when you have your architects it has to go here and your electricians design tell you it has to go here…And, and so it ends up being so caught up in what you've, what you've read and then the manufactures that you choose and what's going to work in your own facility. I can't say that you end up with evidence-based design at the end.

Several of the hospital representatives were unsure or uncomfortable on how to define EBD and stumbled on a definitive response to this question or felt there was little 'science' in what was held out as EBD. The CNO from Hospital #4 struggled with articulating her thoughts as to what was EBD, but her example used strongly suggests she believed EBD was vested in reliance on what others were saying was necessary for the future of patient care. To my question of EBD, she said:

> That's a hard question. Evidence based design I would say, um. I think you do have to do a little bit of research with that, you know. On and do some listening and, and looking and, and reading up on it. And saying, you know, um, that if everybody is saying you need to include booms, for

> instance in your OR and that's what the future is bringing then you probably better be looking at that, you know. And, are they expensive? Yes. But do they pay for themselves? Yes.

The CEO from Hospital #4 said he doubted the science behind EBD, as he believed much of the research was self-motivated by architects and manufacturers in efforts to increase budgets, and indicated that if EBD was implemented in the hospital designs it would eventually have to be tested to determine its veracity. Furthermore, he goes on to discuss EBD as unnecessary, since some things are evident and speak for themselves. He also equates EBD with what he refers to the cutting edge of medicine.

> [I]t [EBD]cost money, and it takes time and, and all that. So, even if there was research, we tend to doubt it cause a lot of it's done by the company [the architectural firm] themselves or, or whatever. And then you know, um, you know we might call somebody like you [surveyor, risk manager] and say is that real [EBD or design outcomes/predictions]?
>
> I mean, there [is] definitely, you know, a lot of the equipment in surgery. We have booms, you know, gets [surgical equipment] out of the way. I don't need a study to tell me that's gonna create more room, more space, [and] it's more convenient. We do, you know, we can't afford to be on the cutting edge of very many things. We are in some areas but, you know, you go into a, a surgery, a state of the art surgery in Omaha or Kansas City, or New York and, you know, I guarantee you everything's goings to be up in the ceiling, you know, and these booms that come down and, so

> we did a lot of that stuff and, and it creates more space. Staff can move around. It's more convenient for the doctor and easier for them [to move around].

Many hospital administrators found EBD to be represented in the technologies or advancement of technologies placed in hospital designs. The CEO from Hospital #1 responded to a question of what she thought represented EBD in patient rooms in her new hospital with the following:

> One of those [EBD] designs is the nurse call on the phone system was, you know, is one of the pieces in terms of how, how that totally integrates because we went to the wireless phones for the nurses and the phones are tied into the nurse call and so. And so no matter where that nurse is, they can immediately answer a light remotely and communicate with the patient in a bed. You know, rather than waiting and, you know, some of the issues around delayed response to patient lights, and again from a safety perspective. Are they [the patients] getting up on their own? What about pain? That was a pretty big issue and not that expensive issue [to fix].

A Board Member from Hospital #2 equated having a good reputation as an architect essentially guarantees that the design of the building is based on evidence.

> Well I, I don't know if this is, I don't know if this really does that but, but, my perception is that when you hire professionals that have a good reputation and they design something that that looks like to you it will

> work based on your experience of being in a hospital for ever so many years, um, then to me that's, it hasn't, there's, their what they, what the architects do has to be based on evidence.

The CNO from Hospital #5 defined EBD as what has worked in the past and has been researched, but also suggests a sort of "cart before the horse" mentality in that she specifies that research can be found to support "what we are doing", i.e. design decisions and plans:

> I think any evidence-based, whether it be medicine practice, design, is- is looking at what's been tried, what's- what's worked, what studies are there, what research is there to support what we're doing.

Using Patient Room Design as Examples to Define EBD

When hospital administrators were asked to point out what in the building they saw as encompassing EBD, participants frequently referred to the patient room design as exemplifiers of EBD. The CEO at Hospital #1 identified the use of handrails in the patient room as an EBD element in the overall design of the room. She indicated it would improve patient safety and decrease the number of falls by providing the patient a guide directing them into the bathroom, thus preventing a fall. When asked about the evidence supporting this hypothesis, she was not able to substantiate that such research existed. In her opinion, the mere idea of the handrail in the room had to be evidence-based, since it was the architects who made the recommendation for a handrail guide. According to CEO#1 she said she "relied" on the architects to bring forth ideas that originated in research evidence, so she trusted if they made a recommendation, then the architects must have known it was evidence based. Further, it appeared that the concept

of a handrail in a patient room was an idea that made logical sense to her. CEO#1 could come to the same conclusion as the architects making the recommendations, without seeing the research evidence to support its use, because it made sense to her that a handrail that guided the individual to the bathroom in the patient room would decrease the number of patient falls. The following exchange is indicative of this type of thinking:

CEO #: And. You know. It just. It wasn't one thing. It [use of EBD] just was [and] permeated the whole process.

Mary: What do you mean permeated the whole process?

CEO#1: With what they [architects] brought in terms of what I would call. You know. Really truly. Evidenced-based

Mary: So you relied?

CEO#1: Really relied on them.

Mary: Yeah. So you relied on them to provide you with how you should make your decisions with regards to the building of this facility because you believed that they had the expertise to provide you with that information.

CEO#1: We were going to go [build] the single patient rooms. Really came into play on how the rooms were designed from their [the architects] perspective. Small thing, but big thing. I guess this falls in this evidence-based design piece. But falls are a big deal. Them [the architects] designing where the bed would be and. [We] were not even thinking about the fact [where the bed was located from the bathroom] they [the

architects] developed from where the patient would get out of the bed most proximal to the bathroom. There's a handrail that follows all the way around the room and right into the bathroom. I mean, that's a small design issues that I don't think anyone of us would have thought about but it's such a big deal in terms of patient safety.

Mary: Okay. Um. And so did they [the architects] present you with any information that if we put this hand rail here or is it just more that, you know, it made logical sense that if you put a hand rail then patients are less likely to fall.

CEO#1: More logical.

Mary: More logically, than specifically research based.

CEO#1: Them [the architects] saying. You know. Gee. We had a hospital that [we used handrails in the patient room to the bathroom], you know, we were able to [decrease] their fall rate dropped ten percent because there [are] handrails now.

Despite the CEO's profound belief in the handrail as an important designed patient safety measure to prevent patient injury, she falteringly admitted and hoped that evidence drove the design recommendations, and "not just it seemed logical from our perspective. But I have to believe that there was concrete. More concrete information behind those recommendations."

The Facilities Person (FP) from Hospital #1 had similar rationale as to how the use of handrails in patient rooms could prevent falls. He indicated nursing research was the "proven fact[s]" or evidence used by the architects in recommending the handrails in patient rooms as a fall prevention measure. Similar to the CEO, the FP from Hospital #1 used experiential knowledge to conclude the handrails would impact fall rates merely because it made sense to him, not that the evidence from research specifically supported use of handrails in this manner. While both hospital administrators from Hospital #1 came to the same conclusion - handrails in patients' rooms arose from empirical knowledge embedded in EBD, they arrived at their normative conclusions along different paths. The CEO believed the architect's decisions by their very nature were based on existing EBD, whereas the FP surmised the recommendations made by the architects were based on empirical knowledge gathered from nursing research; therefore, making the design decision of handrails in patient's rooms EBD. Here is the discussion we had about the handrails and evidence:

Mary: Can you give me some examples of that [EBD in the building design]?

FP#1: The handrails in the patient rooms, you know, certain number of patient falls are the direct result of patients trying to get up out of the bed and go to the toilet. Um, so it's, it's a proven fact that you can have assistance between the bed and the bathroom, 100% of the way then your falls are going to be decreased. So we, based on that, made a conscious effort to put handrails, um, from the bathroom all the way around to the patient's bed, so. And their bedside is located so they just get up on the floor and they have a handrail to, to, follow all the way into the bathroom.

Mary: Okay. When you say, “it’s a proven fact” did they [the architects] show you the numbers or?

FP#1: Fall, it’s a percentage of fall, or you know. Shelia [Quality Director] probably was the one who came up with that for, you know, how many falls happen in a patient’s room and how many of those are related to toilet, going to the toilet.

Mary: I see. So research is somebody else found and presented.

FP#1: Yeah. Oh, it’s out there, it’s out there. We didn’t do our own.

Mary: Okay. So then, um. Based on that the recommendation was made by the architects or by the hospital?

FP#1: Um. I think it was the architect.

Mary: Said to put the…

FP#1: Said this is what you need to do.

Mary: And that was based on? His understanding of the research or communication from the facility [hospital]?

FP#1: It was prob, it was, yeah, it was the communication from us saying, we understand there’s an issue how do we address it. They said well, this is probably the best way to do it.

Mary: So it was a solution they suggested?

FP#1: Yeah. Put handrails up.

Mary: Okay. With regard to the facility itself, can you tell me, um, what elements that are in this facility right now that you considered to be evidence-based?

FP#1: Um, the handrails for sure.

The Director of Quality (DQ) from Hospital #1 also believed the handrails in patient rooms were EBD but did not or could not articulate why she thought this was the case. She thought overall there were fewer falls since the move to the new hospital; however, staff had reported falls that occurred in or near the bathroom. It was her opinion the "safety feature" the handrail represented was not being communicated to the patients by the nursing staff, and she proposed staff and patient education as a potential solution to improving its use, thus decreasing falls in the bathroom.

> "If we're saying you know, "Please notice that there's rail that lead you from your bed straight into the restroom and- and the rails continue in there." Um, I think if we educated our patients better on that, we might still, I ... The safety feature is there. I just don't think we're telling them."

Other patient room features discussed as EBD by hospital administrators, involved discussions around "same-handed" rooms. Same-handed patient rooms is a design concept where the physical environment is standardized either to the left or right. Each patient room is architecturally the same, as compared to a mirror-image patient room, which is essentially the same room, but the opposite of the previous room

(Cahnman, 2006). Two hospitals, Hospital #1 and Hospital #3 were offered the option by the same Architect to build standardized same-handed rooms in the replacement facility. Hospital #1 built their replacement facility utilizing this design concept, believing this reflected the latest in EBD, brought to them by their architects, while Hospital #3 questioned the concept, and refused the proposal. At the time both of these facilities were built, the research was still being conducted to provide evidence as to whether the additional cost outweighed the benefits gained by increasing efficiencies and improved patient safety (Pati, Cason, Harvey Jr, & Evans, 2010). The CEO from Hospital #3 said their group questioned the concept and rationalized that nurses and physicians were both left- and right-handed, so what would be gained by building standardized same-handed rooms. As such, they decided against spending the extra money to build same-handed rooms, a cost that was estimated at an additional $3000 to $5000 per room, or up to $125,000 for this CAH.

> The architect for instance wanted all the rooms to be exactly the same, same handed, same everything in the facility. And we talked about it and said we don't want that because, um, we felt like for us we, we liked two styles of rooms and because we felt like there were some people that were weak on the right side some weak on the left and we could put them in rooms based on that to where they, um, could have more natural movements.

Research done in this area over the past number of years has shown that room handedness plays little to no role in improving patient safety, but rather how the room is standardized with equipment location and layout may be the key to ensuring will

optimize operational performance (Pati et al., 2010; Pati, Cason, Harvey Jr, Evans, & Erwin, 2012). CEO #3 did not know that was the case, but he reasoned that not everyone was right-handed, which was sufficient for them to not build same handed rooms. Nonetheless, when comparing the understanding of EBD between CEO #3 and CEO #1 and CEO #5, it appears that CEO #3 has a more comprehensive understanding of EBD. The CEO from Hospital #3 said:

> My understanding is that evidence-based design is making decisions about how things are structured or done in ways that have been trying to be scientific, where there's, I don't know if proof [is] the right word, but, where some type of rigorous testing has occurred. Sort of used the example earlier, about it makes sense that hand washing under one of those [sinks] is going to save infection, but does it really do that?

One of the Architects, when asked about the design concept of standardized same-handed rooms, indicated EBD was the basis for building patient rooms in this manner, because hospital staff can do their work quicker, more efficiently, and reduce the number of medical errors. However, the basis for his evidence was not empirical research evidence, but user evidence from a single source, and a personal belief that all medical training only involved approaching and caring a patient from the right side.

> But, evidence-based design now is telling us that if you design what's called same handed rooms, in other words every single patient room that the physician or the nurse go into they're all laid out exactly the same. Then the incidences of error are actually less in a room like that. And

> they've done studies to prove that vs. the old method where architect are, are trained to have a bathroom on one wall and all the plumbing shared on that one wall. So, you have one set of plumbing lines come up through the center of the wall and then they turn left and they turn right for two separate bathrooms. Well the result of that is you have opposite, opposite hand rooms. And at, a doctor actually told me that. He didn't really understand what he was saying, and I really didn't either at the time but it was probably oh, it was several, it was probably like 12 or 15 years ago. And he was talking to me about exam rooms. And he said I don't understand why people lay out rooms that are different from each other. Cause, he said, when I go into an exam room I want to have, I want the patient, I want to be able to grab with my left hand and, and get a, a script pad. And, with my right hand know that the sinks right there, for example. And he said I go in so many rooms and it's, it's laid one way one time and it's laid out the opposite way, so you have to, have to think about where you're, what you're doing in the room.

Research completed by Pati, et al. (2012), concluded that general standardization, defined as the "following of one or more universal rules in order to maintain a certain type of uniformity across multiple instances" is of greater importance when compared to physical environmental handedness in patient rooms. Moreover, standardized same-handed rooms had the potential of creating workarounds that could lead to the development of unintended errors in care (Pati et al., 2012). The lack of a firm research evidentiary basis or understanding by the architect of design concepts recommended to

Hospital Administrators can result in misinformation and misunderstanding, and inadvertently led to design decisions that can adversely affect the process of patient care well into the future.

Architects' Perception of EBD

Several of the architects in this study were asked about their definition of EBD and their answers varied. The Architect from Hospital #2 defined EBD as an understanding of patient needs or as he referred to "walking in the patient's shoes." He equated EBD as being focused on the overall patient experience, not of scientific research, so in his opinion; anything that contributed to a healing environment, or deinstitutionalizing the hospital experience was sufficient support to recommend it as "evidence" to a client, such as maximizing the number of windows in the hospital design to support circadian rhythms. The Architect from Hospital #2 did not reference any of the research in this area, but instead focused on an intuitive understanding of patient needs and on the healing process from an experiential normative perspective. It was his opinion that research in design did not prove anything, but simply supported what he and other healthcare architects have already known and have been doing for years. In fact, he cautioned against any architect relying on any type of research in design, because design research had a tendency to focus on only one aspect of a problem, such as patient safety, rather than the entire patient experience. The Architect from Hospital #2 said:

> And so sometimes with these research projects they'll take one issue, and it's the driving priority for everything.

He believed healthcare design was more complex than a one size fits all, and it required a higher level of understanding of client and stakeholder needs to ensure everybody found the final result to be a good fit for their needs. Further, the Architect from Hospital #2 equated EBD to "smart design" that takes into account future and unknown needs of the facility, and stated quite frankly that their firm's reputation and success was built on his intuition, and smart design, not EBD:

> We do not or have not highlighted evidence-based design per say, but I guess we, we represent that to our clients as smart design or, ah, deinstitutionalized environment and package it in that way.

The Architect from Hospital #2 believed there was a place for research in healthcare design and it was his opinion that "good" design research could be found in building recommendations and codes, as published in the FGI Guidelines for Design and Construction of Hospitals and Outpatient Facilities or in state and federal building codes (Institute, 2014). An example he used was the recommendation for single patient rooms. Once this concept was confirmed by research to be "good" design, then codification or adoption by professional organizations was sufficient support to recommend or incorporate these design ideas into programming and design processes across the field; however, until such time that EBD had been codified, he did not feel it was something he had to do, or should do. He said:

> And so I don't necessarily know that there is data out there that says if we orient the nurses station 45 degrees to the hallway that we'll have fewer falls or people will be happier. But if it looks better and people like it

> better then that, you know, that one there is one that I'll just differ to say okay, they say it will work better, okay. I don't know how you would quantify it until you actually build it and see whether it worked or not but uh, but I so yeah I guess. But I wouldn't say they are necessarily the same thing but I think. But I think best practice, ultimately could be quantified if somebody has taken the time. I just don't know who has or hasn't.

This definition or interpretation of EBD put forth by the Architect from Hospital #2 were similar to the definition of EBD as held by the Architects from Hospital #4. Both of these architects believed EBD was more experiential than empirical research, but in contrast to the patient experience as the basis for that evidence, as espoused by the Architect from Hospital #2, they focused on the hospital's locality and community needs. To these architects, EBD hinged on how they interpreted the hospital's ability to meet the community needs in their locality. For example, the Architects from Hospital #4 wanted to make sure the hospital was visible from the major highway that ran through town, and the Emergency Department was one of the first things the community saw when they came to the hospital. These were design elements held out as evidence-based design concepts to make the hospital more visible in the community. The architects made reference to precedent, or what had been built before by themselves or other architects, but felt strongly while precedent provided a foundation for the design, it did not define the design, as the area/location and the community needs had to be carefully considered to ensure the hospital was not "over designed" and met community expectations as a healthcare facility.

According to the architects, it is their successes and subsequent experiences that define EBD, "[We] designed quite a few of these [CAH], and seen them actually executed, built and operated and there are certain things that work in these hospitals and we as designers must recognize what draws and makes the hospital successful. You talk about EBD; we bring our experience to the table." Recommendations made by the architects to their clients were based on what "we took from our experience and what we think is the best", and they work hard on selling this to the client, until they agree with them that this is the best way to approach the design concept.

An example given to me by the architects to illustrate this point was a design problem and how they manipulated or modified state building codes in order to combine nursing stations/units – such as medical/surgery with the emergency department, so the physical layout could support/improve efficiencies in staffing. The Architects from Hospital #4 indicated that in many states there are state requirements that there is a nursing station on all care units, which could require the building of two separate nursing stations – one for the ED and one for the medical/surgical areas. The architects were able to successfully manipulate the building codes through creative design to satisfy state building codes by combining and signifying a shared ownership of a single nursing station, i.e. the emergency department owns the left side of the nurses' station and the medical/surgical unit owns the right side of the nurses' station. However, this design approach/explanation did not always satisfy the state regulators, and the architects had to approach the state and advocate for an exemption for a single nursing unit with a shared nursing station to share staff and improve efficiencies. When I asked them about performance of a post-occupancy evaluation (POE) to determine how effective the

change in design was for the facility, they indicated that none had been done. Instead they relied on anecdotal communications or feedback from their former clients of how much they liked the new layout. In their opinion, these positive opinions set the stage to repeat this type of design at other CAH replacement hospitals.

For all of the architects interviewed, EBD was not information embodied in empirical research, but the cumulative knowledge from their experiences. The architects involved in these hospital case studies used their experience, what they learned themselves from building other CAH, to define EBD. The Architect from Hospital #4 said:

> We watch our projects and we try to watch our projects after they're buil[t]. That's the only way we're going to get feedback if what we did was right or not…That's another evidence-base [design concept] that we found. We get mixed reviews on computers inside the room…

One of the Architects from Hospital #4 discussed how the research on same-handed rooms was not supportive in improving outcomes, or affecting patient error rates, and overall increased building costs, yet he and his colleague were continuing to offer and build same-handed rooms for clients, focusing not on the evidence, but the "trend". He indicated he learned more from personal experience of what he should or not do concerning patient room design as compared to research. He discussed an issue about room numbers and their location relative to the patient door. The nurses and managers at one of the hospitals he built complained that placing room number signage in the middle of two patient rooms created confusion and resulted in patient errors – wrong medication,

wrong treatments. The design solution was to put the room number signage on the opposite sides of the doors, not in the middle on a single sign; however, there was no formal measurement as to whether this design solution decreased wrong patient errors. Nonetheless, the Architect indicated that he would now make sure this information/evidence would be used in future designs.

The Architect from Hospital #2 indicated he learned from making observations of end users behaviors, and by acted upon these observations - including them in his designs, and then naturally these design changes would improve outcomes for the nurse, patient, and family. This excerpt from Architect #2's interview illustrates how he concludes that decreasing steps between various nursing activities will result in a less exhausted nurse, so the nurse is able to increase the nurse to patient time, which will improve patient outcomes - patient and family satisfaction, and result in the nurse making fewer errors.

> Watching and making sure that we save footsteps for the medical staff, for the nursing staff. That if the, if a nurse is well rested and not having to run back and forth to soiled and clean rooms and supply rooms and med rooms and can spend more time with the patients side and not running around through facility that she's fighting or he's fighting then that, improves the outcomes. Improves patient and visitor and family satisfaction, and naturally, a person [nurse] that's focused and not exhausted would produce less errors.

Further, the Architect from Hospital #2 believed that what was being presented as EBD could be inconsistent/conflicting; therefore, may be untrustworthy, since the "truth" or promise of specific healthcare design was unknown. In the following excerpt from the interview with the Architect from Hospital #2, he discusses EBD as trends in specific healthcare design, which hold s the promise of better outcomes, so much so that these "trends" become adopted as codes.

> Yeah, that [EBD] is a little difficult for us, because there are a number of studies out there and a number of them conflict and it's difficult to know what is really the truth, first of all. What really the truth is, and then it's also difficult to know I guess what outcomes this investment may actually, actually produce. Now we are seeing a trend for example away from Neonatal Intensive Care Units that have sort of the dorm style nursery. Where bassinets are just in a row in one big room maybe partitioned off by a curtain only. To moving more to a private room model and I've been to some presentations and read papers on the, ah, improved outcomes of a private room model for a Neonatal Intensive Care patient and the parent or the care givers involved in the, and the increased of a, ah, physical contact at the, that the parent or the care giver actually holds the baby more if they have privacy in a room setting like that. There's a reduction in noise contamination from other babies or other families or medical staff tending to other babies. And that improves outcomes and that certainly something that the industry is adopting and we're seeing changes in codes that are

requiring larger and larger and even private rooms for Neonatal Intensive Care.

In our discussion the Architect from Hospital #2 used the example of lighting systems that mimic the spectrum of light from the sun as being an EBD element to consider, not because there has been research or that he knows of the specific research done on this with regard to patient outcomes is that the Architect from Hospital #2 believes that while there may be sufficient evidence available to build or design with EBD, the financial constraints can limit the use of EBD, even if it promises better outcomes.

> The budget does affect a lot of that [use of EBD] Well for example, there's a lot of evidence on lighting design and trying to match the circadian rhythm or the, excuse me, the light color that the sun achieves, cool in the morning white at noon, red spectrum in the evening and how that light effects, the hormones of the brain, and the, and the sleep cycle and how that good sleep starts with having good and the right light exposure in the morning. And that cycle is what really helps with really good sleep. You know lack of noise and other things affect sleep as well. But there are a lot of systems out there that provide color change in artificial light so we can, if we cannot provide ample sun lit spaces and have to rely artificially in medical areas, there are systems that can change the brightness level that effect, you know, energy efficiency as well. [T]hose systems are very expensive, and, I think we're only seeing that in the larger more urban hospitals and not a critical access hospitals. And. So

> we just strive to provide ample window when we can, but we are limited on that to because glass in glazing systems. It is the most expensive per square foot material that you could put on the building. If our patient rooms and areas we certainly provide sometimes the entire wall, as you see here, in windows and, but, um. And try to have, ah, views in dining and public areas. And, ah, sky lights and clear story and such. But that's an example where there's evidence out there, that it, that it improves lives but, um, right now is cost prohibited because of all the, um, the controls required to accomplish that kind of a light performance, lighting performance.

While some hospital administrators believed that everything presented or proposed by their architect was evidenced-based, there were a few that thought the architects knew little about EBD. The CEO from Hospital #3, and the CNO from Hospital #4 were disappointed that the architects they worked with failed to bring forth evidence-based design concepts that could improve patient outcomes, and it was something they felt they were ill prepared to do on their own. The CEO from Hospital #3 thought architects failed to have the scientific background necessary to understand EBD or knew enough about EBD to sufficiently advise the hospital or to make a compelling case on what types of design elements would or could result in measurable changes in error rates or improved patient outcomes. Further, there was a difference between how the majority of CEOs, FPs, and BMs thought about architect's ideas and recommendations representing EBD, as compared to the majority of nurses/CNOs. The CNO at Hospital #3 was "disappointed" by the lack of assistance she received from their

architect. She indicated she did most of her own research on nursing process and design, because the architectural firm did not bring anything for them to review to help in the decision process. In the end, she did not believe that anything in their new hospital represented EBD.

CHAPTER 5 – DISCUSSION

DISCUSSION

It has been said the built environment and the delivery of healthcare cannot be separated (Malkin, 2002). The building, the furnishings and fixtures and its location, availability of equipment, and the colors used in healthcare design influences how the quality and safety of healthcare is provided and perceived by stakeholders and end users (Berry et al., 2004; Blair L Sadler et al., 2011; R. S. Ulrich et al., 2008). According to Ulrich, et. al (2010), improving healthcare building is integral to improving healthcare itself. As such, to some, it makes perfect sense that all healthcare organizations would want to build their new facilities utilizing the best available evidence not only to improve patient outcomes and control costs, but to place hospitals in the best possible position for the future (Roger S. Ulrich et al., 2010). Critical access hospital's future viability, with regard to renovating or building a replacement facility, depends greatly upon the dollars spent today on building, and the capability of meeting tomorrow's healthcare demands and care delivery (Purria, 2011). Utilizing a qualitative multi-site case study of critical access hospitals in five Midwestern states I sought answers to two questions: (1) how hospital administrators and architects define and understand/use EBD, and (2) what is the nature/types of evidence that is used by them in the healthcare design process?

The optimal use of research evidence that guides design decisions is referred to as EBD, and is defined by the design community to mean the conscientious, explicit, and judicious use of current best evidence in making decisions in healthcare design (Jaynelle F. Stichler, 2010; R. S. Ulrich et al., 2008). The hope of EBD is to improve healthcare

facilities and patient outcomes, while closing the gap between design research and practice. According to Malone (2008) research builds the foundation of scientific knowledge that all stakeholders can use to make design decisions.

EBD has been considered the parallel to EBM, but it is not its equal, due predominately to its lack of theoretical knowledge and ability to test theory (Stankos & Schwarz, 2007). Moreover, much that is labeled as EBD lacks explanatory theory in which to build a library in design that can predict outcomes and routinely be applied in various healthcare building types. EBD is noted as an incomplete discipline, but since the building of healthcare facilities cannot be postponed until such time, many propose and believe it is necessary to balance what is available with common sense and established design features (McCullough, 2010).

When asking administrative leaders, hospital board members, and architects about what EBD meant to them, I found the answers provided by respondents to be divergent, and it appeared there was no one taxonomy used to describe or define EBD. Participants pointed to the general application of the design process as being EBD, believing if the architects brought it to the table for discussion, all of it was research informed evidence. And, as a continuum to this thinking, if the architects built it, then it must be EBD.

According to Zimring, et al (2008), EBD represents a change in the way healthcare organizations think about delivery and maintaining of buildings. Instead of looking at the physical environment or building simply as cost centers, hospital administrative leaders need to utilize an EBD approach that includes a structured process focused on establishing agreement on principles underlying the design, articulate goals to

achieve these principles, and set measurable expected outcomes (Zimring, Augenbroe, Malone, & Sadler, 2008). The role of the CEO and other administrative leaders in the process of design is pivotal, and it is necessary for them to accept this complex leadership challenge to ensure distance from the routine and small improvements generally achieved in building/design efforts (Zimring et al., 2008). In particular, Zimring, et al (2008) establishes the CEO as the healthcare leader that determines success of any healthcare building project.

The EBD decision is explicitly tied to any hospital's most significant building goals in regard to patient satisfaction, improvement in quality, and patient safety, but there are external forces that can affect these decisions, including financial restrictions, the EBD body of knowledge, quality focuses, and shortened quality acquisition cycles (Zimring et al., 2008). Hospital administrators must work towards balancing external factors when making design decisions to overcome roadblocks to using an EBD approach. Overcoming EBD barriers begins with awareness by the healthcare administrator concerning the connection between EBD and improved safety, quality, and patient satisfaction. Once this is done then the healthcare administrator can begin to identify the lack of research-supported evidence, lack of knowledge and experience with EBD, and inconsistent or undisciplined decision-making (Zimring et al., 2008).

Comparing how design decisions are made utilizing an EBD process as to how decisions were made in these case studies, it was evident that CEOs and other healthcare leaders were not utilizing a formulated EBD approach in making their design decisions. The majority of the CEOs were not well informed on what EBD was and how it could improve or assist in achieving building goals focused on improved patient outcomes and

satisfaction. As such, design decisions that could have benefited from an EBD process, were not controlled or fully explored by decision makers. Only one of the five CEOs interviewed was able to coherently articulate a definition of EBD; moreover, while some were skeptical others explicitly stated they did not believe in the research supporting EBD. This lack of a core understanding concerning how EBD can be used in building design may have resulted in decisions that were not well thought out, or perhaps even incorrect for proposed goals and objectives, such as the decision not to add decentralized nursing stations to change the model of nursing care. This also allowed architects to convince some CEOs that certain design aspects were founded on evidence, when in actuality it was simply the application of the architect's normative ideas or conceptual precedents of how design should or would work for the hospital. In several of the case studies, a failure of the CEOs to understand the concepts and implementation of EBD may have limited what goals were attained or sustainable and did not necessarily result in making the hospital safer or improve overall patient outcomes.

Zimring, et al (2008) proposed ten strategies to successfully implement EBD in healthcare design decisions. These included: to start with a problem that the project is trying to solve with facility design; avoiding silo thinking by using an integrated multidisciplinary approach to solve design problems; maintaining a patient/family approach; focusing on financial operating impacts; having a disciplined approach in criteria management – give stakeholders a mandate and resources on how they would manage care in the future; establish qualitative criteria linked to incentives; use strategic partnerships to accelerate innovation; perform simulation throughout the process; look to make improvements over the life-cycle of the building; over inform and communicate.

While one can argue that these ten strategies can be applied to any design approach in seeking success, the overall limited number of empirical research studies in healthcare design and a lack of understanding of what EBD is, or can be, a primary obstacle restricting the obtainment of optimal design and building goals.

Despite the fact that EBD as a standalone policy has been held out as the "golden standard" in healthcare design, it was reported in a 2010 survey sponsored by Herman Miller Healthcare and published by the Center for Health Design that over 80% of healthcare professions utilized research in their design process, but only 72% used EBD (Taylor, 2011). Sponsors of the survey questioned this discrepancy - why only 72% reported using EBD, when over 80% indicated they used research in their designs? It was thought by the surveyors that healthcare designers failed to differentiate between EBD and simple informed design, using the terms synonymously and creating the discrepancy in the survey results (Taylor, 2011). Since 2008-2009, the terms "research informed" and "evidence informed design" have appeared in the lexicon of terminology used by healthcare designers to emphasize that all healthcare design is informed by evidence, but not necessarily rigorous empirical research. However, unlike EBD, which over the years has been studied and defined, the design community has yet to clarify exactly what these terms mean, resulting in hampering the development of a healthcare theoretical database (Peavey & Vander Wyst, 2017). The design community, recognizing that EBD lacked a sufficient number of empirical studies to prescribe building and design requirements, sought to develop an evidence-based policy in which all evidence potentially has relevance along a continuum of scientific rigor, and not just evidence arising from empirical research (Malone et al., 2008). This evidence-based policy,

however, raises a number of questions. For example, if all evidence may be considered relevant; is some evidence more credible and actionable than others, and if so; how does the architect and healthcare administrator make decisions based upon this myriad of choices? How do they weigh the evidence? In our case study of 5 Midwestern CAHs, we were able to identify some of the types of evidence utilized by architects and healthcare administrators in making design decisions, and were categorized as: the financial impact of building; the aging physical structure; location of the hospital; departmental agencies; deinstitutionalization; designing for the nursing process; the case for patient safety; design as solution/goals; and influences/evidence from administrator experiences vs. the experimental studies.

One of the factors that played a significant role in design decision-making was the financial impact or cost of building a new facility. According to McLaughlin et al (2010), the estimated budget for a building project is part of a facilities master plan and generally does not include the planning/budgeting necessary to inform an EBD project. The need for capital funding must be contemplated as a leading factor in the development of the preliminary budget. As such, a business case must be made to hospital leadership early in the project planning process in order to obtain a commitment to support an EBD project and to realize the return on investment (B. L. Sadler et al., 2008).

All of the hospitals in this case study made the decision to build a new facility, as compared to renovating the older facility, predominately due to the inability of renovation to achieve goals for improved patient experiences, healthcare transformation – delivery of care, increased revenue, and ongoing and sustainable compliance with hospital life safety codes (The Joint Commission, 2020). This decision to build new was

supported by local data and reports, such as the hospital strategic plan, and through recommendations from various experts and entities.

Hospitals in the case study indicated that they achieved several of the goals espoused in the facility master plan – since building a new hospital provided administrators the opportunity to modify the physical environment to meet revenue challenges, shifting focus of care from inpatient to outpatient, healthcare transformation and competition, sustained compliance with building code, and community visibility.

The issue of deinstitutionalization and departmental adjacencies were also important factors in design decision-making for hospital administrators. As indicated in the findings, the primary design goal of Hospital #2 was to make the hospital feel less hospital-like and more approachable. Similarly, the CEO at Hospital #5 sought to make the hospital more hotel-like and plush in amenities; however, underlining these ideas of deinstitutionalization by administrators was the concept/need to separate the patients and visitors from the undesirable aspects in the delivery of patient care. This could partially be accomplished when final finishing materials were chosen for the interior, but it was essential to contemplate it early during the planning stages to ensure there was adequate space/distance between inpatient and outpatient aspects of the facility. The facility master plans developed in the predesign period in the case examples identified and addressed these issues as part of the strategic goals of the organizations, as it had in my pilot study, without necessarily addressing it from an EBD perspective.

Departmental adjacencies were important pieces of information/evidence used in making design decisions for the hospital administrators, predominately due to safety and

economics - the need to share staff between nursing units. In older vertical buildings – the sharing of staff between the emergency department, med/surg, and obstetrics was not possible due to the physical disconnect between units, which were located on separate floors. Staff was therefore unable to move freely from unit to unit to provide assistance in areas that needed temporary help during periods of higher census, or to shift staff when there were nursing shortages. Building single level hospitals with nursing unit adjacencies allowed administrators to use limited resources and staffing more efficiently and effectively to improve safety and allowed them to meet minimum regulatory requirements.

Hospital #1 was statutorily required under the Illinois Hospital Licensing Act to maintain one nurse on the OB unit, even if the unit was unoccupied, and required to staff up to two nurses once a mother and baby were present (Illinois Joint Committee on Administrative Rules). The new hospital building allowed them to share/move staff easily between the three nursing areas – medical/surgical, obstetrics, and the emergency department. The decision to develop these adjacencies was discussed early in the process and was considered by the CEO of Hospital #1 as a specific example of EBD. In contrast, the Architect for Hospital #1 never really discussed how or when this issue was discussed, nor did he identify it as EBD when asked about what he considered to be EBD in his designs. The process of evidence-based practice as outlined by the Center for Health Design and espoused in the EDAC study guide series was not integrated into the typical design process, but rather was a product of the design process itself. So, while evidence was used to accomplish a goal of more efficient and effective use of staff it was not done through the lens of EBD.

At Hospital #4 they were faced with a similar problem regarding maximizing available staff through unit adjacencies. The emergency department and the medical surgical unit were located on separate floors. Again, it was no easy task for staff to move from one area to another, and it created a potential patient safety risk by leaving a nurse alone and isolated in the unit. In an effort to create adjacencies that would improve nurse sharing and flexibility, the Architects from Hospital #4 developed a design solution that permitted the sharing of a single nurses' station – dedicating one side of the nurses' station to the emergency department and the other to the medical surgical unit in the hope it would meet state building code requirements. The design modification had worked in some areas, but did not always satisfy state regulators, and as such the Architects found themselves having to make their case to the State to support the design. While the Architects from Hospital #4 introduced the designs they believed were the solution to staffing efficiency – it had not been consistently tested or evaluated to ensure its continued recommendation would be a solution that could work for all hospitals faced with the same or similar issues.

The CEO at Hospital #3 discussed how spatial challenges limited effective use of nursing staff, and he believed, like others, that having a single-level building design with unit adjacencies would solve the problem of requiring a dedicated 24/7 nursing staff on a unit that experienced episodic work/patients. While the new adjacencies of the medical surgical area and the emergency department allowed for the efficient use of nursing staff, what had not been considered during the pre-design stage was how the emergency department served as an entry point for the hospital. The hospital believed it had solved one problem – efficient use of nursing staff but failed to identify what issues the change

would create – an observed entry point for both patients and visitors. In the end, the hospital continued to staff the new emergency department with a dedicated person 24/7.

According to Quan et al (2009), the physical environment in a healthcare setting is part of a holistic system, and any one-design element can and will affect multiple healthcare challenges concurrently. In each of the cases discussed above, an EBD process had not been integrated into the pre-design/planning process. Failure to ask the right questions or to find/evaluate the available and appropriate evidence at the beginning of any design project can result in uninformed design decisions, failure to meet goals, or solve identified problems.

Several of the hospitals in this study looked to the nursing process to make design decisions. They evaluated how nurses delivered care in existing spaces and sought to make changes that allowed nurses to be more efficient and to spend more time at the patient's bedside. Evidence was gathered from stakeholder interviews and hospital administrators made design decisions that incorporated these needs/wants into the final designs of nursing units. One of the nursing models of care considered by a hospital in this study was nursing pods, which required decentralized nursing stations (Parker et al., 2012).

The Institute of Medicine report *The Future of Nursing: Leading Change, Advancing Health* (Nursing, 2011) recommends nurses be contributors in the design of clinical care delivery to improve patient outcomes. Healthcare leaders are challenged to develop and sustain environments that are conducive to evidence-based care delivery and capable of restoring joy in work (Friese et al., 2014). Nursing units are designed to have

either a centralized or decentralized nurses' station. Nursing units with centralized nurses stations increase opportunities for face to face communication and mentoring, but are known to increase nurse work and distance from patients (A. Hendrich, Chow, M. P., Skierczynski, B. A., & Lu, Z. , 2008; Pati, Harvey Jr, Redden, Summers, & Pati, 2015). Decentralized units have shown that nurses spend more time with patients, respond quicker to patient calls, and spend less time walking (Gurascio-Howard & Malloch, 2007). More nursing unit designs are incorporating decentralized nurses' stations outside patient rooms (Zborowsky, Bunker-Hellmich, Morelli, & O'Neill, 2010). Pod nursing is a model of nursing care delivery that allows nurses to work in small teams or microsystems. Generally nurses are grouped and care for a designated number of rooms with a decentralized station (Reiling, Hughes, & Murphy, 2008).

In this case study, the COO/CNO from Hospital #3 was quite convinced that moving towards a pod based nursing model was the way they would improve patient care, and nurse satisfaction, but she failed to understand the important relationship between the model of nursing care and the design of the physical environment. Critical limitations in her understanding from research on how the interplay between the physical environment and the nursing care model prevented her from considering the type of environmental changes that could have resulted in successful implementation of the proposed nursing care model. In the end, Hospital #3 built a more traditional nursing layout, which effectively prevented nurses from practicing in pods, thus ignoring the research/information on pod nursing, and opting for a layout that their staff found most comfortable.

A major concept or step in the EBD practice model is assessing the evidence. What are the ways to assess or evaluate evidence in practice? No evidence is the same and should not enjoy the same level of confidence, and if not evaluated critically can lead to its inappropriate use – sometimes with negative consequences. There is no common accepted and understood mechanism for assessing evidence that community or healthcare stakeholders can use and as such there was heavy reliance on the architects to be the EBD experts, to translate findings and to choose information from research studies and incorporate it into the design. However, even within this small case study the interviewed architects interpreted EBD differently and uniquely based on their collected personnel experiences, and not by a textbook definition. The Architect from Hospital #2 felt designing with evidence was not learned, but intuitive – knowing what patients wanted and needed, and in his opinion all the evidence that was necessary was codified in building code – so EBD, as interpreted by the architects was more experiential than experimental. This is illustrated in the "what is EBD" discussion that arose in the interview with the CEO from Hospital #1 and me, who attributed the use of handrails that led to the bathroom in patient rooms as defining EBD.

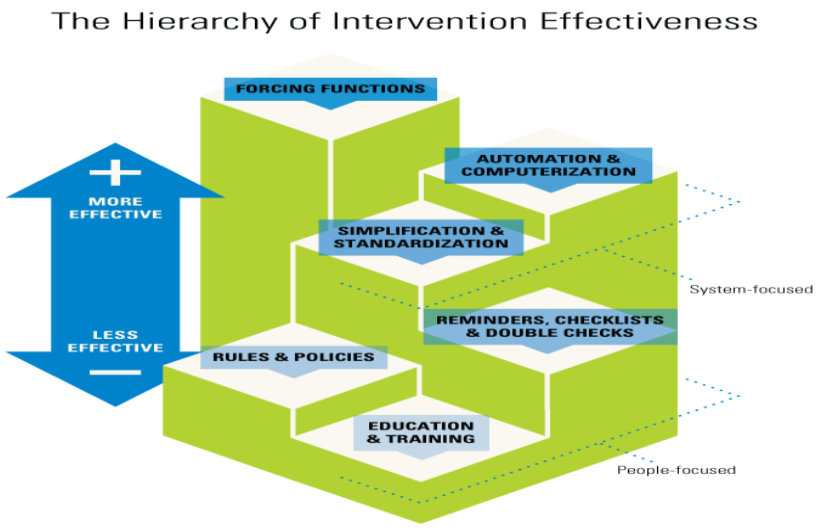
This definition or example of EBD was also echoed by the FP from Hospital #1 that the physical aid of the handrail would improve patient safety and decrease the number of patient falls. The common point in regard to their concepts or understanding of EBD both came from the architect. The Quality Director from Hospital #1 also thought the handrails in patient rooms represented an EBD patient safety feature, and believed the post-occupancy increase in the number of patient falls was attributable to the nurses not understanding or forgetting the intent of adding the handrails in patient rooms. She

thought she needed to re-educate the nurses about the purpose of the handrails, so they in turn could remind patients to use the handrail when going to the bathroom.

From a human factors perspective, on the hierarchy of effectiveness for implementing safety improvements, education or training is considered to be the least effective, because it is reliant on individual vigilance, whereas forcing functions, such as found in physical environmental design changes/improvements, are considered the gold standard in effecting change/improvements - See Figure 6 (McDaniel). As such, if using EBD would have provided a higher level of effectiveness through its use, as believed by these hospital administrators from Hospital #1, then the presence of the handrail in the room would be sufficient to reduce the number of patient falls, and on-going patient education on the use of the handrail would be generally unnecessary. Yet, we know it was not effective, as patients were falling, and the hospital considered additional training of patients and staff to improve use of the handrail; however, the essential question never asked or considered is whether a handrail in a patient's room that goes from the bed to the bathroom is efficacious in preventing patient falls, or could this been seen as a forced function? More significantly, the unsupported belief that handrails in patient hospital rooms are in fact an EBD element that hospital staff could rely upon to prevent patient falls may actually prevent the implementation of other evidence-based nursing interventions that could be used more effectively to prevent patient falls and injury. As Zeisel points out, handrails are only one response to an infinite array of equally good potential responses of a domain of acceptable responses (Zeisel, 2006).

Figure 6 – Hierarchy of intervention effectiveness - (McDaniel)

https://patientsafe.wordpress.com/the-hierarchy-of-intervention-effectiveness/



Here in lies the concern of relying on the belief that all design decisions and everything that is built is based upon empirical research or is identified as EBD. Reliance increases risk if the conclusions of design are untested, or not clearly understood as to how it can improve safety and prevent injury. Evidence-based designers must recognize that there are potential negative consequences associated with the application of unsupported or erroneous conclusions from research (Viets, 2009). This response from the CEO at Hospital #5 exemplifies the concern, as he clearly believes by his statement

below that grab bars/handrails, technology, and everything built assures improvement in patient outcomes in the absence of research.

> There's grab bars and things like that for patients to get out of bed so you don't have falls and things like that. There's just more space for equipment. It's not as crowded. The technology of the beds. you know, the bed alarms and all that stuff is going, you know, to a whole new level. You've got the closest, when you get, step off the bed you're right to the bathroom. So, it reduces falls, reduces the risk of falls.

As discussed earlier, the healthcare administrators relied on the architects to be the EBD experts, to translate findings and to choose information/evidence from the hospital and research studies and to recommend/incorporate it into the overall design. This was reflected in the case studies, as this type of experiential evidence seemed to be the most prevalent, as compared to empirical, research-based knowledge. Individual experiences, information obtained from site visits, and discussion with peers at these site visits served as critical sources of evidence and assisted healthcare administers in formulating their design decisions. It helped them to make comparisons between what they thought they wanted from the built environment as compared to what the experience was. Having the ability to experience a designated space or to see it in operation helped hospital administrators in deciding nursing unit layouts, lengths of the hallways, and patient room layouts, or how they would make changes to their building designs based on their own experiences and personal history. Nonetheless, experiential evidence is helpful, but on a scale of evidence should not be the main decision drivers when attempting to accomplish specific building goals.

The central role of designers in the EBD model is to assist healthcare decision makers in identifying and evaluating evidence, because they are not trained to consume research literature (Pati, 2011). This is considered to be one of the most challenging aspects of EBD – understanding and translating research into understandable information that informs design (Quan et al., 2009). The CEO from Hospital #3 seemed to think that evidence from research was optional and intentionally withheld by the architect to move the project along, and that generally architects were not consumers of research science, so unlikely to be able to translate the knowledge effectively to decision-makers.

> But it's hard for them because they're trying to appease the client and the code and the builder and they're just trying to get it done and I'm not sure that there's a lot of incentive for the architect to really hold things up and say no wait. Ah, there is this new study here…
>
> [W]hile architects are knowledgeable about buildings I don't know about their scientific background I'm not saying they do or don't. I just don't know that they're really trained to have those discussions and interpret what's strong evidence and what's not. I think they can include it but I don't know that they're going to be best equipped to discuss the why's with clients, especially in a way that's convincing to us.

Architects should seek high-quality evidence that increases the effectiveness of EBD and establishes a relationship between design and outcomes, establishes the extent of the effect, and be assured that the design intervention is responsible for a proposed improvement and not some other change (Harris, 2008). Good evidence is well communicated to a wide range of adopters and addresses the concerns of the majority

(Harris, 2008). To ensure credibility and relevance the architect and his/her team should evaluate the available literature for research that is valid and reliable (McLaughlin, 2010).

The architects represented in this case study did not fully understand EBD, the role of EBD, or the scope of how EBD could be applied to their design projects. The architect respondents defined EBD as the sum total of their successes, lessons learned experiences, and precedent. The information about the same-handed room and patient room handrails communicated to the hospital did not arise from a knowledge base from research, but rather the personal normative views of the architect, which led the administrative leaders at Hospital #1 to incorrectly believe and rely upon the fact that handrails themselves would prevent patient falls.

Several of the healthcare administrators, like the CEO from Hospital # 3 felt that architects did not understand EBD, and some of the hospital administrators indicated that if they wanted to understand what elements of their project could be improved by applying EBD, they were compelled to do their own research, but in the end they did not know how the knowledge could or when it should be applied or considered so was of little use. Architects, as the experts in building planning and design, should take the lead in assisting healthcare administrators in identifying and understanding the evidence, and the role that EBD can play in the design of healthcare facilities, and to ensure that hospital administrators can engage in evidence informed design decision making.

Evidence-informed decision making (EIDM) involves integrating the best available research evidence with contextual factors including community preferences, local issues, and available resources (Armstrong et al., 2013). In order for EIDM to

operate efficiently and effectively, research evidence needs to be conceptualized, conducted, and communicated in a way that is meaningful to decision-makers. Barriers to EIDM occur when there is a lack of time and resources, decision-making process, poor quality or limited availability of research, and poor reporting of research (Armstrong et al., 2013). One strategy used to improve EIDM is known as knowledge translation. Knowledge translation is informed by and builds upon conceptual understandings of the translation of research into practice through the processes of diffusion, dissemination, and implementation (Armstrong et al., 2013). It is proposed that architects involved in healthcare design and building need to be proficient in identifying, understanding, and implementation of research evidence to ensure that EIDM takes place and that healthcare administrators have the information necessary to make decisions that best assists them in meeting design and building goals. EIDM should be integral in EBD practice, and throughout all of the steps described earlier in the EBD process so that the right evidence is collected and reviewed/assessed, the right questions/hypothesis are asked, and the results are collected and measured so it could inform future designs.

In EBD practice the final step in the process is to measure post-occupancy performance. The post-occupancy evaluation (POE) allows designers and researchers to assess the effectiveness of a building, and evaluate success and failures of design decisions made during a building project (Shepley, 1996). It is considered one of the most common types of research used to inform EBD (Harris, 2008). It can be seen as bridging the gap between research and EIDM (Poot et al., 2018). As such, it must be more than visiting the site after the building is occupied, but an evaluation of performance in meeting design goals articulated in the EBD building plan (McLaughlin,

2010). Objectives of a POE is to provide feedback to the design team, provide information to support future designs, generation of new knowledge, clarification of programming issues, and justification of design decisions (McLaughlin, 2010). Despite its stated importance in the EBD process, none of the hospitals or architects in the case study budgeted or conducted a POE. None of the architects interviewed indicated that they formally included this process, but instead relied upon word of mouth from the community or healthcare persons on how the sites were functioning. In one instance, the Architects from Hospital #4 discussed how they obtained post-occupancy information from informal phone calls with healthcare administrators who either praised or complained of various design decisions. As such, the opportunity to learn how certain design features functioned or impacted patient outcomes, i.e. handrails in patient rooms, same-handed rooms, department adjacencies, or single nurses' stations, served to meet the hospital's building, professional, and overall patient safety goals remains unknown and potentially at risk of being repeated or excluded in future hospital designs.

Implications of this research

The theoretical foundation of EBD as of yet has not been established and may not be for many years to come; however, it is imperative that hospitals that are built today be able to meet future community needs and reliably improve patient outcomes. Typical design and building processes do not adequately meet the complex needs of healthcare design and building today, and it is incumbent upon healthcare administrators building new facilities to make design decisions that assures they can meet specified goals.

I set out to answer two questions in this multi-site case study of 5 Midwestern CAHs – to better understand how healthcare administrators and architects defined and

used EBD, and what type of evidence was used to make architectural design decisions. At these hospitals I learned that the tenets of EBD were not well understood by either the hospital administrators or the architects, and that decisions on designs were heavily weighted towards experiential evidence as compared to evidence from empirical research, which may have contributed to certain missteps in the built environments.

To improve the use of EBD within the scope of any healthcare design project it is recognized that we cannot rely solely on evidence from credible empirical research, but that there must be a focus and incorporation of all available evidence with an evaluation or assessment of the quality and relevance of that information. Moreover, there has to be a mutual understanding between designers and healthcare administrators of the role EBD plays and its effects on planning, design, and building.

EBD practice may be the best approach to ensure healthcare facilities are built intentionally to meet stated building and EBD goals. EBD practice is defined as the conscientious, explicit and judicious use of current best evidence from research and practice in making critical decisions, together with an informed client, about the design of each individual and unique project (J. F. Stichler & Hamilton, 2008). The EBD process is an eight-step framework for developing, building, and evaluating an EBD project, and provides for knowledge transfer and evidence-informed decision making. To begin this process, designers must be informed on the subject of EBD and trained in evaluating both local and research based evidence and its effect on planning and design (Quan et al., 2009). EBD designers need to engage healthcare administrators in the process by providing concise knowledge on available evidence from research, in the

development of the EBD questions to be answered/solved, and effectively and meaningfully participate in post-occupancy evaluations.

APPENDIX A

Informed Consent Form

Title of study:	What is the Nature of Evidence Utilized in Healthcare Design Decisions?
Principal Invest:	Mary A. Stankos, BSN, MJ, PhD Candidate
Institute:	University of Missouri, Columbia, MO

Introduction:

I am a PhD candidate in the Department of Architectural Studies in the School of Human Environmental Sciences at the University of Missouri. I am exploring the nature of evidence used by hospital administrators and healthcare architects when making decisions in building a new facility. You have been asked to participate because you were an active participant in a building project within the last three years.

Purpose of this research study

Purpose of the study is to better understand the healthcare design process by having a greater understanding of the nature of evidence used in hospital design and exploring how hospital administrators, architects, and interior designers define and use evidence-based design.

Procedures

In this qualitative study I will ask you questions related to your understanding of evidence-based design and your participation in making design decisions. This interview will be recorded and will take about half an hour of your time.

Possible risks or benefits

There is no risk involved in this study and there is no direct benefit to you. However, the results of the study may assist others who are in the process of building a new healthcare facility.

Right of refusal to participate and withdrawal

You are free to choose to participate in the study or withdraw at any time from the study. Also, you may refuse to answer some or all of the questions if you don't feel comfortable with those questions.

Confidentiality

The information provided by you will remain confidential. Nobody except the principal investigator and the faculty advisor will have access to the interviews. Your name and the name of the hospital will not be disclosed at any time. However, the data collected will be seen by my dissertation committee and may be published in a design research journal and

elsewhere without disclosing your name or the name of the hospital. Further, you may be identified in the study by your job title only.

Available Sources of Information

Should you have further questions you may contact me or Benyamin Schwarz, PhD, my faculty advisor, in the Department of Architectural Studies, University of Missouri, Columbia at (573) XXX-XXXX.

1. AUTHORIZATION

I have read and understand this consent form, and I volunteer to participate in this research study. I understand that I will receive a copy of this form. I voluntarily choose to participate, but I understand that my consent does not take away any legal rights in the case of negligence or other legal fault of anyone who is involved in this study. I further understand that nothing in this consent form is intended to replace any applicable Federal, state, or local laws.

Participant's Name (Printed or Typed):
Date:

Participant's Signature:
Date:

Principal Investigator's Signature:
Date:

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PUBLIC HEALTH

CHAPTER I: DEPARTMENT OF PUBLIC HEALTH

SUBCHAPTER b: HOSPITALS AND AMBULATORY CARE FACILITIES

PART 250 HOSPITAL LICENSING REQUIREMENTS, Part 250 C.F.R.

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VITA

Mary A. Stankos was born to Joseph (deceased) and Motoko Stankos on February 22, 1960 in Chicago, Illinois, and is the middle child of 4 siblings. She is married to Charles Brown, PhD who is a professor at the University of Missouri, College of Veterinary Medicine in the Department of Veterinary Pathobiology. Mary attended the University of Illinois at Chicago, College of Nursing where she earned her BSN in 1982. As an Illinois registered nurse, Mary worked at Michael Reese Medical Center from 1982 to 1992 working in the ICU, Emergency Department, and the Department of Surgery as a Program Coordinator.

In 1991 Mary received her Master of Jurisprudence from Loyola Law School. She was the recipient of two half year tuition scholarships and was granted an assistantship in the Department of Health Law at Loyola Law School for her first year. Mary became a risk manager at the Illinois Hospital Association (IHA) in 1995. She remains at IHA and was promoted to her current position as Senior Director of Risk Management, responsible for providing risk management and patient safety advice and services to client hospitals, physicians, and healthcare practices.

In 2005 she began her journey in seeking her PhD in Architectural Studies. Mary's area of study during graduate school focused on the relationship and role of evidence-based design on patient safety. During this time, she published a first author paper with her faculty advisor Dr. Benyamin Schwarz titled *Evidence-based design in healthcare – a theoretical dilemma*, which was published in the 2007 inaugural issue of the Interdisciplinary Design & Research e-Journal. She graduated with her PhD in December of 2020.