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Hospital facilities and the role of evidence-based design

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Abstract

Purpose – Drawing on recent research related to hospital facilities, this paper aims to discuss the role of evidence-based design in facility planning and design as a key element in helping the field of facility planning and management continue to strengthen professional practice.

Design/methodology/approach – The discussion draws on relevant literature and recent research.

Findings – Evidence-based design is having a major impact on planning and design of hospital facilities, and can play a similar role for other facility types.

Originality/value – Calls for evidence-based design for healthcare facilities abound. This paper discusses important issues surrounding the implementation of an evidence-based design approach that need to be considered for this approach to be successful in all types of facilities.

Keywords Hospitals, Evidence-based practice, Facilities

Paper type Viewpoint

Introduction

From its modern beginnings with the founding of the International Facility Management Association in 1980, the field of facility planning and management has striven to strengthen its professional practice. A key element of that goal has been to build a research infrastructure that leads to more informed decisions about the wide range of impacts facilities have on the business enterprise. While that goal has been pursued to some extent with respect to the corporate workplace (Becker, 2004; Becker and Steele, 1995; Brill *et al.*, 1984; Duffy, 1992; Horgen *et al.*, 1999; Marmot and Eley, 2000; McCoy and Evans, 2005; Vischer, 2005), with some success, it has become a major focus of health care facilities planning and design, under the umbrella term "evidence-based design" (Marberry, 2006; Ulrich *et al.*, 2004). To implement evidence-based design principles means to utilize the "best information available from research" when making design decisions that should, in the end ". . . result in demonstrated improvements in the organization's clinical outcomes, economic performance, productivity, customer satisfaction, and cultural measures" (Hamilton, 2003).

There are several reasons for the interest and emphasis on using formal research to guide facility decision-making in the health care sector. One is that over $200 billion is expected to be spent over the next decade on hospital construction (Suttell, 2007). To increase the likelihood of designing facilities that function well for patients and staff and are cost-effective, hospital administrators and facility planners are drawing on evidence-based design to increase the likelihood that new facilities will generate the expected outcomes. Unlike the corporate office sector, where a poorly designed environment may cause dissatisfaction and annoyance, inhibit effective communication, or contribute to relatively minor health problems, in a hospital context the consequences of getting the design wrong can be far more serious, including death.

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The purpose of this paper is threefold. First, it reports on the findings from a study assessing the relationship between the physical attractiveness of outpatient facilities on patients' perceived quality of care to illustrate the role evidence-based design can play in facility planning and design. Second, it suggests directions for research on facilities and their relationship to teamwork and collaboration among multi-disciplinary care teams. Third, it discusses some of the issues associated with implementing evidence-based design, and suggests ways in which more formal academic research can be combined with practice-based research to garner the benefits of systematic assessment in the context of real world time and resource constraints.

Health and facility design

Changes in medical technology, difficulty attracting and retaining registered nurses, a more competitive business environment, a more informed and demanding patient population, and alarming data about the quality of care in our hospitals are driving the hospital construction boom (Kimball and O'Neil, 2002; Ulrich *et al.*, 2004). The Institute of Medicine (IOM) estimates, for example, that as many as 98,000 Americans die each year as a result of medical errors and nosocomial (hospital-acquired) infections (IOM, 2001; Kohn *et al.*, 1999). Millions more suffer from non-lethal medical events, including errors in the amount and type of medication dispensed to patients (Ulrich *et al.*, 2004).

These quality of care issues are central to the fundamental business enterprise of a hospital, and have been linked to many different facets of facility design: multiple vs single patient rooms, poorly functioning ventilation systems, crowded and noisy medication rooms, flooring materials that contribute to falls; and to the design and layout of nursing units that make it difficult to observe patients, that are crowded and noisy, inhibit teamwork and communication, and whose distance from patient rooms contributes significantly to nurse fatigue (Marberry, 2006). In a recent comprehensive review of the literature, researchers at Texas A&M and Georgia Institute of Technology identified more than 600 studies demonstrating the impact of hospital design on outcome measures including reductions in staff errors and stress as well as the amount of pain experienced and medication required by patients. Their conclusion was two-fold: first, there is more than sufficient evidence from the scientific literature to guide current hospital design; and second, utilizing that information to improve hospital design does have a significant impact upon patient and staff outcomes (Ulrich *et al.*, 2004). The Center for Health Design, a leading proponent of evidence-based planning and design, has also recently published a series of white papers reviewing the evidence for the effects of lighting, noise, and other environmental factors on quality of care outcomes (Brannen, 2006; Cohen, 2006; Guenther *et al.*, 2006; Harvie, 2006; Rossi and Lent, 2006; Schettler, 2006).

In no other type of facility has design been shown, through systematic research, to have such a significant effect on outcomes considered essential to the long-term survival and performance of the organization. For that reason, many in the healthcare industry have turned to evidence-based planning and design as a means of making more informed decisions about hospital facility designs that can help attract and retain nursing staff, improve patient safety, and generate high levels of patient satisfaction and confidence in their quality of care. A recent study (Becker and Jones-Douglas, 2006) illustrates how research can help facility professionals, architects, and hospital administrators make more informed facility decisions.

The Cornell Weill study

Virtually all of the research on patient-centered care to date has focused on in-patient rather than outpatient facilities and services. Despite the fact that hospitals are spending millions of dollars to improve the physical attractiveness of their facilities, particularly public areas such as lobbies and waiting areas, no studies have examined in a hospital setting and with actual patients whether the attractiveness of outpatient physical settings in which patients wait affects perceived quality of care. To provide more systematic evidence about whether the investment in more attractive patient areas increased the perceived quality of care, Becker and Jones-Douglas (2006) collected data on patients' perceived quality of care and the relationship to perceived and actual waiting times in both primary waiting areas and in exam rooms in six outpatient facility practices that varied significantly in physical attractiveness.

Using a combination of patient surveys and direct observation of the time spent by 750 patients in the primary waiting area and in the exam room before the doctor entered the exam room, and with the doctor, the researchers found that patients' perceived quality of care was significantly higher in the more attractive physical settings. They also found that patients significantly overestimated waiting short periods of time (which was associated with higher quality of care) and underestimated waiting longer periods of time (associated with lower quality of care) in the more attractive facilities. Patients' ratings of the quality of their interaction with staff were also higher in the more attractive settings. This was important because patient's ratings of their interaction with staff were the most highly significant factor influencing perceived quality of care.

For hospital administrators under pressure to invest their limited resources in facility designs that contribute significantly to highly valued organizational outcomes, these findings are important. In the hospital context, patient satisfaction counts because it has been associated with commitment to return to and recommend the hospital to others (Clark and Malone, 2006). For hospital administrators and boards of directors who may be skeptical about the value of spending money on non-medical elements of the healthcare environment (rather than on medical equipment, for example) this research provides a rationale grounded in more than personal opinion and values about why such an investment is worthwhile. In a highly competitive healthcare marketplace, patients' perceived quality of care is a fundamental and highly valued business outcome.

Teamwork and communication

The Becker and Jones-Douglas (2006) study illustrates how research can shed light on one area in which hospital planners and designers have increasingly focused as they work to implement a more patient-centered care environment. Other research has shown that a second area of particular concern is the ways in which hospital design and new information technologies may contribute to improved quality of care by supporting more effective communication and interaction patterns among both clinical staff and patients, and among the diverse professional that form the patient care team (Coiera, 2005; IOM, 2001).

Understanding how teams function and how to improve communication and interaction patterns, whether among closely knit teams in operating theaters or among loosely-coupled clinical professionals on a med/surge unit, is critical given that

research has found that the vast majority of hospital mishaps results from inadequate communication processes among members of health care teams (Coiera, 2000; Kohn *et al.*, 1999; Patient Safety and Clinical Quality Program, 2005). Much of this communication is, in fact, informal, unplanned, and opportunistic.

In the UK, for example, a major national study of care teams (Borrill *et al.*, 2001, p. 27) found that:

> Old-fashioned demarcations between staff mean some patients see a procession of health professionals … Information is not shared and investigations are repeated … Unnecessary boundaries exist between the professions which hold back staff from achieving their true potential.

The same report went on to conclude that:

> The best and most cost-effective outcomes for patients and clients are achieved when professionals work together, learn together, engage in clinical audit of outcomes together, and generate innovation to ensure progress in practice and service.

Teamwork in the hospital context

High performance teams can be thought of as "a small number of people with complementary skills who are committed to a common purpose, performance goals, and an approach for which they hold themselves mutually accountable" (Katzenbach and Smith, 1993, p. 45). The increasing focus on multi-disciplinary care teams is being driven, in part, by the increasing number of older patients, often with co-existing ailments (multiple co-morbidities) whose complex treatment plans require the collaboration of multi-disciplinary professionals (McKee and Healey, 2002).

The benefit of teams, and the effective communication patterns that underlie them, take many forms. Kalisch and Begeny (2005) cite benefits of nurse-physician and interdisciplinary teams that include meeting the complex needs of patients (Mickan and Rodger, 2000), improving patient care (Kaissi *et al.*, 2003; Liedtka and Whitten, 1997), increasing staff satisfaction and organizational effectiveness (Horak *et al.*, 1991), and strengthening overall healthcare delivery (Wood *et al.*, 1994). Rafferty *et al.* (2001) found that nurses who reported a higher level of teamwork were more satisfied with their jobs, planned to stay in them, and were likely to have a lower burnout score.

Barriers to effective teams and communication

A number of factors have been identified that create barriers to effective teamwork and communication between different professional groups, such as doctors and nurses (West and Pillinger, 1996). Gender is one issue. Doctors are predominantly men, while the rest of the health care service professions are mostly women. Education is another. Great variation exists among professionals such as doctors, nurses, physical therapists, nutritionists, pharmacists, and social workers in educational background and professional training. These differences translate into perceived status differences that influence the nature and frequency of communication across disciplines and the experience of working in teams (Iedema *et al.*, 2005). Other factors that have been identified as barriers to effective teamwork include large team size, instability of the workforce and assignments, the absence of common purpose, and "*inhibiting physical environment"* (italics added) (Kalisch and Begeny, 2005).

The physical environment, teams, and communication

To date, the effect that the physical environment (e.g. lack of and cramped spaces, design and layout of work stations and corridors) has on communication patterns, particularly informal communication, has received little attention. While poor physical design may constitute a barrier to teamwork and communication, good design of the physical environment can be viewed as an affordance or "opportunity" to overcome social and organizational barriers more often discussed in the literature. For example, when work processes benefit from a better understanding of others skills and knowledge, as well as a free exchange of information and opinions, more open work areas with a high degree of visual contact have been shown to be more effective than more closed offices and workspace (Becker and Sims, 2001).

Communities of practice and informal communication and learning

The role of the physical environment in improving informal communication patterns rests on several related conceptual frameworks, including the work on "integrated workplace strategies" and organizational ecology (Becker, 2004, 2007; Becker and Steele, 1995), communities of practice (Brown and Duguid, 1991; Lave and Wenger, 1991), social networks (Cross and Parker, 2004; Davenport and Prusak, 2000; Haythornthwaite, 1998), and "heterogeneous learning" (Iedema *et al.*, 2005).

Organizational ecology and communities of practice

Organizational ecology conceptualizes the workplace as a system in which physical design factors both shape and are shaped by the work processes, the organization's culture (e.g. formal and informal values, norms, expectations, policies and practices), patient characteristics, workforce demographics, and medical and information technologies (Becker and Steele, 1995). From the social network perspective, knowledge emerges and is sustained in a social context (Cross and Parker, 2004). The communities of practice framework (Lave and Wenger, 1991) emphasizes that informal learning and knowledge sharing depend on and exploit networks of connections among people who share a common interest or task. The communities of practice concept emerged from ethnographic analysis of how groups actually worked and communicated in practice. Brown and Duguid (1991) found, for example, that customer support staff learned the "tricks" of their trade not by attending formal training sessions or reading company manuals, but by drawing on the experience and insights of others with whom they worked. Knowing who to contact, and getting good information, required developing contacts among a wide range of people doing the same kind of work. Communities of practice were the social infrastructure supporting informal learning and communication that generated high-quality performance.

Informal learning and the active give and take among people from different disciplines that characterizes innovative problem-solving (Allen, 1977), includes work-related information and knowledge (from technical skills to organizational culture); person-related information (understanding skills, abilities and work styles of one's own team and department and the organization as a whole, as well as trust); corporate attitudes, values and behaviors that shape communication and interaction patterns (Becker, 2007).

Team members who are bounded by informal relationships, similar work roles and a shared context form the community of practice. In such a community, learning

through participation, rather than through more passive acquisition of knowledge, is the primary mode through which learners master the skills and knowledge needed to become competent members of a team (Lesser and Prusak, 1999). From this network of personal relationships comes the cooperation and trust that forms the social capital that provides community members with the "resources" (e.g. information, support, training) they need to learn and do their job well.

The potential, or affordances, of a medical units' physical design to transform the way in which a multi-disciplinary care team interacts was described by Gilleard and Tarcisius (2003) in a study of a large 1,860 bed acute general hospital in Hong Kong. They found that the introduction of alternative workplace strategies on a pediatric ward of doctors and allied health professionals (e.g. clinical psychologists, physiotherapists, social workers, dietitians) significantly improved communication patterns, helped resolve conflict and increased cooperation, and resulted in higher levels of service quality from the patients' perspective. Traditionally, the various professional disciplines working on the unit operated independently from each other in providing rehabilitation and clinical support services to patients. The organizational distance was exacerbated by the physical separation of departments on different floors with wide and long corridors separating them. Gilleard and Tarcisius (2003, p. 22) describe the impact of the combination of physical and organizational separation on patients:

> ... parents and children frequently had to "knock" on the doors of different departments, disciplines or even hospitals to seek assessment and treatment. A typical treatment programme might require the child (and their family) to attend the hospital on multiple days ... Naturally, patients and parents were often exhausted, discontented and frustrated by these multiple visits. Treatment was fragmented and communication among medical and allied health professionals disjointed.

The redesign of the pediatric unit created "one-stop shopping." The unit was composed of one large open plan area and four smaller individual working areas. The "Big Gym" was used by a variety of professionals who worked together as members of an integrated team. Children visited one joint assessment clinic used by all the allied disciplines. Whereas previously the design reflected the professional silos of the different disciplines, the new space was divided with respect to patients' rehabilitation needs. The open plan made it easy for the various disciplines to better understand the work of their colleagues. Using a combination of surveys and interviews, the researchers found front line staff scores for professional status, communication, working environment and service quality improved. Of particular relevance here is that because specialists were no longer isolated, transfer of knowledge – both tacit and explicit – became easier. Judgments that had been defined largely within disciplinary medical boundaries became more holistic. Communication among the various disciplines and patients was also enhanced. Information about the social background of patients and their families, which was found to be important in formulating rehabilitation plans, was more easily incorporated into discussion and treatment plans. With improved communication mutual trust increased, making it easier to resolve conflicts immediately by compromise and collaboration.

Iedema *et al.* (2005) cite research at a new Scottish Hospital (Marcus and Cameron, 2002) which found that the design of corridors, the layout of different functional areas, and the provision and design of recreational facilities had a major impact on the quality of communication between staff, patients, and visitors.

Health facilities research at Cornell

Currently, our Cornell health facilities research group is actively conducting studies designed to explore the extent to which ecological factors such as the design, layout, and spatial use patterns of a medical unit influence the effectiveness of patient care teams. In particular, our aim is to investigate the influence of the physical environment of medical units on informal, opportunistic communication patterns among different professional members of patient care teams such as those found on intensive care units in most hospital settings. One study, for example, is examining the impact on communication and interaction patterns of the patient care team of centralized, hybrid, and decentralized nursing unit pods and workstations. Decentralized pods have become the accepted form of best practice in current nursing unit design although there is little systematic research confirming that they are used by nurses as intended. Our preliminary data suggest they may not be. Given the vast amounts of money being invested in nursing unit designs that include more decentralized nursing pods, understanding how such facility designs work in practice is of fundamental importance.

Evidence-based design as a guiding principle

The development of facility planning and management as a profession depends, we believe, on the field supporting evidence-based academic research of the type described above. It is necessary but not sufficient. The reason is simple. No study answers or even addresses, once and for all, all the factors that may influence performance, whether medical errors, employee satisfaction, worker productivity or any other outcomes of interest. Evidence-based design is a never-ending process of knowledge accretion: different studies together, and over time, build confidence in our understanding of the consequences of decisions we make about the planning, design, and management of the built environment.

For the practitioner, this constantly shifting knowledge landscape can be highly unsettling. How can you base a decision on evidence that may not hold up next month or a year from now? The answer is that it makes no more sense to blindly apply the findings from an academic research study than to ignore all research and to just go with "what feels right". Research provides insights that can guide decisions. It does not make them. The great value of academic research is that the findings are likely to be more robust than other forms of inquiry because they have used methodologies designed to reduce the likelihood that the results occurred by chance, or simply reflected personal values and preferences.

While the term "evidence-based design" implies formal research, "evidence" comes in many forms. These range from formal academic research to in-house institutional research, professional experience, and informal "best practice" benchmarking. Further, the data and information generated by these different ways of knowing are filtered through the various lenses of diverse stakeholders involved in planning, designing, funding, managing, and using a facility: management, architects and planners, users, government agencies and regulatory bodies, and the community in which the facility operates. The value of different forms of evidence comes in helping shape and test these ways of knowing, and in assisting facility planners, designers, managers, and users to synthesise them into a design solution for a specific project. Thus, the seemingly simple concept that "evidence-based design" will lead to better outcomes is, in practice, much more complex.

Practice-based evidence

Practitioners, of course, cannot ever wait for all the evidence to be in. Nor can they rely only on even the best evidence that was generated in a context that may be different from their own. Hence, the need for and value of practice-based research. Practice-based evidence takes many forms and has three key criteria. The first is that the research is done in the institution that is embarking on a significant construction project. The findings are project specific. The second is that the time frame for collecting evidence is quite short, more often days or weeks rather than months or years. As such, the research will almost always be less rigorous than academic research. Its primary purpose is to generate insight and stimulate debate grounded in empirical evidence, rather than relying only on previous experience or preconceptions. Third, the form of the data and its method of collection vary enormously. Interviews, focus groups, surveys, archival records, and systematic observation are all likely. What distinguishes the use of these techniques from academic research is that they are applied in a shorter time frame and with fewer data points.

Informal benchmarking (e.g. visiting other similar facilities), talking with colleagues, one's own personal experience, etc. all provide relevant information and insight. However, it seems to us that the concept of "evidence-based design" without necessarily following all the canons of academic research, still implies something more structured and formalized than, for example, simply visiting other interesting facilities, running a small scale "quick and dirty" survey or conducting focused interviews with nurses on how they are responding to the design of an ICU may not generate publishable findings because of the small sample size, but the results can generate insights grounded in a more systematic assessment than, for example, concluding that everything is working well because the person who managed a project says so, or because no one has filed a complaint! Spending a week, in the context of hospital planning, carefully observing and recording how often decentralized nursing pods are used, and for what purposes, followed by interviews with staff, provides a different kind of insight into whether the design is really increasing the ease and frequency, for example, of nurses observing patients than would visiting another hospital. In combination with more academic research, as well as personal experience and what has been gleaned from talking with others and visiting different facilities, the understanding of how design is affecting desired outcomes can be significantly increased.

As is true of academic research, no definitive answers will emerge from practice-based research. It is also the case that facility planners, architects and other stakeholders in planning and designing facilities are not going to park personal and professional experience at the door, and rely only on formal research, even when it is available. There is no reason they should, in fact, since good decisions are most likely to emerge from a lively debate about all the forms of evidence available and its implications for practice. The challenge is for all the stakeholders in a project to translate the various forms of evidence into useful information, specific to the particular context and institution, through a collective-problem solving process. A key part of that process is discussing and comparing the site-specific data and professional experience with academic research findings, taking into consideration the particular economic, social, culture, and political factors that form the context within which a particular design is developed and implemented.

Evidence as risk management

Evidence-based design is a form of risk management. At the heart of risk management is the need to assess the likelihood, the probability, that some event will occur (Loosemore, 2006). Evidence from diverse sources can increase our confidence in the probability that certain outcomes will occur and that we have considered as many relevant factors as possible that may impact on these outcomes. The amount that one invests in anticipating coping with that event depends not only on the likelihood of it occurring, but also on its likely consequences. The frequency of a serious earthquake hitting California or Japan may be low, but because the consequences if (when) it does occur are enormous, we put in place building regulations and construction codes, for example, that significantly increase costs now in anticipation that these will improve health and safety – and possibly save lives and reduce costs – at some unknown point in the future.

Loosemore (2006) notes that risk management is neither a precise science nor a "particularly well-developed artform" He makes the point that:

> Effective risk management is most fundamentally a human process of systematic, rigorous and creative thinking underpinned by some simple tools and techniques … Organisations which recognise the limitations of numbers in risk decision-making and become more attuned to the political, social, emotional and ethical aspects of risk management are more likely to understand the full diversity of risks facing them.

Clearly, similar aspects are important in determining the research findings that are used to guide design decisions and that constitute the filters for assessing potential facility solutions. Evidence-based design cannot, by itself, guarantee efficient and effective facility solutions, but it is likely to generate ones that are more likely to achieve their intended objectives.

In the context of hospital facilities, as noted earlier the nature of the research underlying evidence-based design is very broad (Ulrich *et al.*, 2004). The challenge going forward is to understand both the systemic implications of design decisions, and the social, organizational and technical forces that help shape their effects. Achieving this requires a mix of quantitative and qualitative methods that, in combination, are better able to tell the full "story" of a design intervention, measuring not only targeted clinical and operational performance outcomes, but also helping make sense of the complex web of factors that generated them. This is the essence of the concept of organizational ecology. The findings from such studies are the bedrock of evidence-based design.

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