HEALTH CARE ENVIRONMENTS AND PATIENT OUTCOMES
A Review of the Literature

ANN SLOAN DEVLIN is the May Buckley Sadowski ‘19 Professor of Psychology at Connecticut College. She received her B.A., M.A., and Ph.D. degrees in psychology from the University of Michigan. Her current research interests involve personality differences in perceptions of health care architecture; gender and correlates of way finding, such as mental rotation; and the environmental design of way-finding systems.

ALLISON B. ARNEILL received her B.A. and M.A. in psychology from Connecticut College. She currently works at the Harvard University Development Office as a staff assistant specialist. She has a long-standing interest in health care architecture and interior design as they relate to wellness.

ABSTRACT: This review of the literature on health care environments and patient outcomes considers three research themes: patient involvement with health care (e.g., the role of patient control), the impact of the ambient environment (e.g., sound, light, art), and the emergence of specialized building types for defined populations (e.g., Alzheimer’s patients). The article also describes the challenges presented in doing high-quality research focused on health care environments and contrasts the contributions made by two different traditions: architecture and behavioral science. The implications of managed care and opportunities for research are considered.

Keywords: health care architecture; managed care; ambient environment; patient-centered care; postoccupancy evaluations (POEs)

The role of the environment in the healing process is a growing concern among health care providers, environmental psychologists, consultants, and architects (Devlin, 1992, 1995; Martin, Hunt, & Conrad, 1990; Ruga, 1989;...
Ulrich, 1992, 1995). Moreover, the belief that the traditional, institutionally
designed health care facility has no bearing on the wellness of its patients as
long as the level of care is superb is in question (Ulrich, 1992). Researchers
are finding that changes and additions made to the health care facility’s physi-
cal and social environment with the patient in mind can positively influence
patients’ outcomes (Davidson, 1994; Ulrich, 1984; Verderber & Reuman,
1987). Likewise, health care professionals are finding that “sensitive design
can enhance recovery [and] shorten hospital stays” (Lemprecht, 1996,
p. 123). At the same time, the role of the physical environment and facilities
themselves are not universally included in routine patient satisfaction assess-
ments. For example, in a survey measuring whether patients were satisfied
with their hospital experience, no items directly related to the physical envi-
ronment were included (Harris, Swindle, Mungai, Weinberger, & Tierney,
1999). Yet patients mention the importance of such aspects of the environ-
ment as cleanliness, comfort, and privacy when asked about their rooms
(Bruster et al., 1994).

Although this gap exists between research findings and applications,
increasingly, health care providers understand that the physical environment
of health care settings can affect patient health, and articles linking health
care design and well-being appear with more frequency in design journals.
For example, the September/October 2002 issue of Architecture Boston was
devoted to the topic of health. Ulrich (1991) contended that “research has
linked poor design to such negative (patient) consequences as anxiety, delir-
ium, elevated blood pressure levels, and an increased intake of pain drugs”
(p. 97). Unfamiliar environments in clinics, hospitals, and nursing homes can
produce psychological stress that can negatively affect healing and wellness
(Ulrich, 1991). Today, designers and planners of health care facilities face an
enormous challenge. To be successful, they must accommodate sophisticated
clinical interventions and complex medical technology while providing a
humane, therapeutic environment. They must also respond to rapid change at
multiple levels in technology, care and treatment methods, reimbursement,
regulation, and demographic trends in health status, among other factors
(Allison & Hamilton, 1997).

The purpose of this article is to explore the literature on health care envi-
ronments and their impact on patient outcomes. This body of literature is
diverse in terms of focus and findings. Although the early research focused
on the hospital environment, more recent research has examined a range of
facilities from ambulatory care centers to Alzheimer’s units. Researchers
have examined the influence of such topics as ambient stressors (e.g., noise),
nature, and patient control. The research has been done by leaders in many
fields including architecture, consulting, health care, and psychology.
Despite the progress that is being made, with some foundations supporting the process (Beatrice, Thomas, & Biles, 1998), the research is still accumulating and gaps do exist—some of them related to the difficulty in doing this research. Before discussing the environmental influences that are known, it is important to discuss both the challenge of doing this research and the recent changes in health care that involve its physical design.

**THE CHALLENGES OF RESEARCH IN HEALTH CARE SETTINGS**

A number of researchers have commented on the limited number of studies dealing with person-environment fit in hospitals. “Apart from issues of lifestyle, aesthetics, or their specific relation to the reconstituted hospital and medical center, the field of health architecture had not fostered a tradition of research” (Verderber & Fine, 2000, p. 190). There is a “paucity of nursing research that focuses on congruous person-environment interactions; that is, environmental patterns that promote harmony within the individual” (Kolanowski, 1992, p. 10). Similarly, Lawton, Liebowitz, and Charon (1970) commented, “The merits of the physical design of a treatment setting are much discussed, but infrequently tested empirically” (p. 231). Another plea is for more sophisticated approaches to research. As Epstein (2000) noted, “Future studies of patient-centered care will require more than just the application of quantitative ratings to observational data” (p. 806).

Rubin and Owens (1996) combed through more than 38,000 articles to find those even remotely related to patient outcomes that are influenced by variables in the environment. Just fewer than 50 articles met their criteria, and most of those were poorly designed from a methodological standpoint. Even two well-known studies, those by Ulrich (1984) about the positive effect of views of nature for patients recovering from surgery and by Miller, White, Whitman, O’Callaghan, and Maxwell (1995) about premature babies who gained more weight when their hospital stay used light cycled on diurnal patterns, were subject to criticism (Weber, 1996).

A number of problems explain why this research has been slow to accumulate. These include the fact that architecture lacks a tradition of research, that medicine has overlooked the role of the physical environment in patient well-being, and that the research process in health care settings is exceedingly difficult. Regarding architecture’s lack of power to make an impact, “The criteria upon which far-reaching decisions are based too often rest upon flawed assumptions and a lack of ‘hard data.’ This statement of course is old...
news (perhaps the oldest news) indeed to environmental design researchers and research-based designers” (Verderber & Refuerzo, 1994, p. 281). Regarding research, Malkin (1992) commented on the difficulty of doing good research because of the problems with experimental control and also stated, “For many design questions, there is no sound research yet available to inform the designer’s personal intuition, sensitivity, and experience” (Malkin, 1991, p. 28).

Another problem sometimes cited is the difficulty practitioners have with understanding research that appears in academic journals. Increasingly, though, researchers recognize the need to make their findings available in nonacademic journals. As an example, the summer 2002 issue of Cure included an article on healing environments with an overview of Ulrich’s research on the benefits of good health care design (Steele, 2002). Another example of the move to make findings more available is a new database project entitled InformeDesign (where research informs design). This Internet project is a collaboration between the University of Minnesota and the American Society of Interior Designers (ASID). Although not limited to research on health care, the Internet Web site, to be launched in the fall of 2003, will disseminate research-based design criteria in a way that is interpretable to a nonresearch trained audience (Martin & Guerin, 2002).

Another area in which progress can be made is the use of research to evaluate the impact of finished projects. Few firms routinely incorporate what are called postoccupancy evaluations (POEs) in their work (Shumaker & Pequegnat, 1989). POEs evaluate how well facilities perform the functions for which they were intended. But the firms of Kaplan, McLaughlin, and Diaz (K/M/D) and Caudill, Rowlett, and Scott are cited as those that value the information that POEs can provide (Shumaker & Pequegnat, 1989). Verderber and Refuerzo (1994, 1999) also put forward the concept of research-based design or design that is driven by research. Translating the information from 25 POEs, they formulated 40 guidelines for community health care centers in Louisiana. Findings from their research were used to plan the West Monroe Community Health Center. These included the fact that no single footprint fits all needs, the necessity of zoning based on function for interior spaces, the importance of natural daylight (including the use of full-height windows), and the creation of room-to-room transparency (being able to see from one room to the location of another). They also listed the importance of using residential imagery, legible entrances, and separate entrances for patients and staff. Verderber and Refuerzo suggested that, rather than beginning the design process from scratch each time, one might better ask, “How do we want to adapt this body of knowledge to our new clinic?” (1999, p. 238).
Members of the health care profession who make design decisions need to recognize the benefit that POEs can feed into future designs (Zimring & Welch, 1988). As an example, Zimring and Welch (1988) cited K/M/D who evaluated a psychiatric hospital to prepare for another project with the same client. In fact, McLaughlin of K/M/D has been credited with establishing the importance of the POE in the health care arena (Bobrow & Van Gelder, 1980). The firm of K/M/D is also credited with the design of a triangular nursing unit and with refining the concept of the single-bed hospital room.

THE EVOLUTION OF HEALTH CARE DESIGN

The evolution of health care architecture has led to research on specific building types that differ in many ways from the general hospital. As early as the 1970s, designers were considering the challenge of hospital design in an era of increasing technology and rapid change. McLaughlin (1976) found many problems with what is called the matchbox-and-muffin scheme (patient towers arising from supporting services). In McLaughlin’s view, the hospital is “the most changing of building types, and its physical life is uniquely characterized by modification” (p. 118). Hospitals with a radial corridor design were popular beginning in the 1960s and were recommended for staffing efficiencies and reduced walking distance for staff as well as more opportunity for observing patients, among other advantages (Trites, Galbraith, Sturdavant, & Leckwart, 1970; Verderber & Fine, 2000). Verderber and Fine (2000) argued that the triangular or saw-tooth design ultimately surpassed the radial design in popularity because the triangular design created fewer irregularly shaped spaces and offered more privacy for patients. Nesmith (1995) also discussed the fact that hospitals must constantly be concerned with designing for change in the future. As an alternative to the matchbox-and-muffin design, McLaughlin selected the village as a prototype—something that is being hailed today with the decentralization of services. The village approach makes the addition of services much easier than in the matchbox-and-muffin scheme.

In their extensive review of the evolution of health care architecture, Verderber and Fine (2000) discussed a number of tensions that have characterized the transformation of health care. These are (a) bigness versus smallness, (b) compactness versus linearity, (c) low-rise versus mid- or high-rise design, and (d) centralized versus decentralized approaches. They further noted that the single-family detached home, the roadside hotel, and the suburban shopping mall have also influenced the way we conceptualize health care design. Nesmith (1995) also cited the shopping mall as a building type for health care that makes patients comfortable because of its familiarity.
Ultimately, the decentralization of health care came to dominate building form, and this decentralization, especially within separate building types, provided the chance to create a less forbidding image for the architecture of health care (Verderber & Fine, 2000). “The term functional deconstruction, as used here in the context of health architecture, consists of the dissection of existing internal components and their redistribution either within the medical center or elsewhere in the community landscape” (Verderber & Fine, 2000, p. 135). The dramatic atrium (influenced by the architecture of hotels and malls) was described as the defining characteristic of the hospital in the late 1980s, but, according to Verderber and Fine (2000), this dominance was brief because cost containments led to a variety of consequences. With fewer choices for patients because of HMO or PPO restrictions, hospitals did not need to try as hard to attract patients. By the mid-1980s, in their argument, there were pleas to attend to regional characteristics. Finally, the deconstructed health village emerged as a solution to the conflict between modernism and postmodernism (Verderber & Fine, 2000). The work of K/M/D is cited as pivotal in changing the function and appearance of health care architecture (Verderber & Fine, 2000). Specifically, in the St. Vincent Hospital in Santa Fe, Verderber and Fine talked about K/M/D’s horizontal as opposed to vertical emphasis, which created the possibilities for courtyards, and the low-rise approach with irregularly shaped space, which, in turn, permits future growth. This project is described as a “compact, changing village” (McLaughlin, cited in Verderber & Fine, 2000, p. 94). The emphases that emerged were (a) horizontality, (b) expandability, and (c) regionalist appearance (Verderber & Fine, 2000).

In the last 10 years, a number of authors in addition to Verderber and Fine have traced the evolution of priorities in health care design. Nesmith (1995) said that the 1970s and 1980s emphasized change related to growth and technology, whereas the mid-1980s to early 1990s stressed creating a more welcoming environment for the patient. During this time, health care focused on specialized populations (e.g., the cancer patient, the Alzheimer’s patient, the woman as patient, the rehabilitation patient). Entire books have been devoted to specialized kinds of units (Rostenberg, 1986). In response to the question of what is next, Nesmith stated that the next concern will be value: “By this I mean the planning and design of health systems and facilities which most effectively deliver actual and perceived quality care” (p. 6). A second principle she identified involves the facility as tool and healer:

The second principle combines two philosophies: that the physical settings of health care delivery support productivity and effectiveness, and that they are an end in themselves—aiding in the healing and wellness process through psycho-
physiological effect. . . . Important elements of this approach will include more comprehensive application of recent research findings on the effects of color, light quality, acoustics, outlook, air quality, and individual control. (p. 7)

She also claimed that one of the most notable trends in the health care field is the growth in the number of ambulatory care centers and outpatient care facilities. Because of the differences in the strictness of building codes in acute-care hospitals, ambulatory care facilities are seen as an opening for more progressive and sensitive design (Nesmith, 1995).

An overview of the elements in supportive health care is also provided by Williams (1988) who listed unit design, spatial considerations, sound, light, color, thermal considerations, and weather. What is important to the patient has even been related to Maslow’s hierarchy of needs (Liberakis, 1971). Beatrice et al. (1998) cited seven areas of patient-centered care: (a) respect for patients’ values, preferences, and expressed needs; (b) coordination and integration of care; (c) information and education; (d) physical comfort; (e) emotional support and alleviation of fear and anxiety; (f) involvement of family and friends; and (g) transition and continuity of care. Malkin (1991) pointed to the following dimensions that are important to consider in health care design: scale, relationship of indoor and outdoor space, materials, acoustics, lighting, legibility, variety, and special population needs. The 1990s, according to Malkin, were to present two challenges: (a) how to create a healing environment, and (b) how to design for special patient populations. In addition, because what will be a healing environment for one person may not be identical to the form needed for another, “The most important thing is to provide control, so that the patient has options and is able to decide what is best” (Malkin, 1991, p. 35).

What do patients want? Nesmith (1995) suggested that “hospital architecture with a high-tech image seems to attract patients and instill confidence in the hospital’s ability to provide the latest medical procedures. At the same time, people are attracted to healthcare environments that are reassuringly familiar” (p. 11). Verderber and Fine’s (2000) recent book, updating an earlier treatise on the hospital by Thompson and Golden (1975), nicely captured the current trends in health care architecture:

The bases for postmodern reactionism in the healthcare milieu were, besides ‘patient-centered care,’ a new emphasis on surface, texture, and ornament, on traditional building massing and internal configuration through more legible interior spaces and circulation patterns (even at times recalling Florence Nightingale’s provisions), and on the reincorporation of nature as a therapeutic design element, and on the degree to which the building was attractive, up-
lifting, and comprehensible in the eyes of the patient. (Verderber & Fine, 2000, p. 7)

SUMMARY

With regard to the research on the physical environment and patient outcomes, three broad themes emerge from the authors discussed thus far: (a) patient involvement in their health care, (b) the ambient environment (i.e., sound, light, nature), and (c) special populations.

PATIENT-CENTERED CARE

One response to the pressures in health care has been to emphasize what has been called patient-centered care. What has emerged as a priority in health care is providing the patient with choice—a concept that is fundamental to environmental psychology (Proshansky, Ittelson, & Rivlin, 1970); the belief that giving patients control may influence their medical outcomes is growing. In fact, a primary goal of patient-centered care is to increase the patient’s control over his or her environment (Birdsong & Leibrock, 1990; Sherer, 1993; Ulrich, 1992; Weber, 1996). Individuals who believe that they have control over situations are more resistant to life’s hassles (Raybeck, 1991). In the hospital setting, lack of control is a major problem, and it can increase stress and affect wellness (Ulrich, 1992). Lack of control has also been found to be associated with depression, passivity, elevated blood pressure, and reduced immune system functioning (Ulrich, 1991). Confusing way-finding cues, lack of privacy, noise, lack of personal control over television, and lack of a view out a window are some of the factors that contribute to a loss of sense of control in hospitals (Ulrich, 1992).

Taylor (1979) pointed out that “the hospital is one of the few places where an individual forfeits control over virtually every task he or she customarily performs” (p. 157). In a discussion of how patients cope with their loss of control and depersonalization in the hospital, Taylor (1979) suggested that patients develop into the good patient—the compliant one—or the bad patient—the resistant one. She suggested that the good patient may actually be in a state of anxious or depressed helplessness, whereas the bad patient may be in a state of anger and reactance against the removal of freedoms. She further argued,
Both helplessness and reactance produce physiological, cognitive, behavioral, and affective consequences that can strongly interfere with the course of recovery and that helplessness and reactance in patients evoke reactions in hospital staff that also have undesirable consequences for treatment and recovery. (Taylor, 1979, p. 157)

The role the patient plays, therefore, strongly influences the control he or she has in the hospital. Two ways to change the traditional patient role and to increase patients’ sense of control in the hospital environment are to increase their freedom of choice of daily rituals and allow them access to education and information.

Patients’ choices in the hospital can be expanded (or curtailed) in a number of ways. For example, in a study of the effect of the inability to control the selection of television programs, blood donors in the waiting room of a blood bank had higher stress levels on days when the television was on than on days when the television was off (Ulrich, 1992). Ulrich (1992) concluded that the lack of choice of program created more stress than did not having the option of television at all.

The issue of control was also studied when questionnaires were administered to patients in 16 hemodialysis units asking them about their perceptions of control over four factors in their treatment environment: acoustics/noise, lighting, temperature, and privacy (Steptoe & Appels, 1989). A significant number of patients reported little or no control over bright lighting, uncomfortable temperatures, irregular noise levels, and lack of privacy. Furthermore, this lack of control over the environment created additional stress to patients who were already experiencing stress related to their illness.

Whether we call it functional deconstruction or new residentialism, the village emphasis discussed by McLaughlin (1975) and Verderber and Fine (2000) earlier gives the patient greater choice, reduces stress, and decentralizes patient services (or centralizes them from the patient’s perspective). “Residentialism, as much an attitude as an architectural style” has been “embraced by providers, architects, and the public as a valid expression of emerging philosophies of patient-centered care” (Verderber & Fine, 2000, p. 318).

Although the phrase is frequently heard, the meaning of patient-centered care is not unambiguous, and “health care executives are struggling to find a clear definition for one of the field’s hottest catchphrases” (Sherer, 1993, p. 14). Some cite an increase in the efficiency of how care is delivered and a concomitant increase in the quality of service coupled with a decrease in cost.
as the goals of patient-centered care (Cleary, Edgman-Levitan, Walker, Gerteis, & Delbanco, 1993). In patient-centered care, services, roles, and workflow are designed from the perspective of the patient (Cleary et al., 1993).

Although patient-centered care is frequently mentioned as a priority in the health care arena, there is relatively little concrete evidence about its effects. Redman and Jones (1998) evaluated the impact of the patient-centered model in two community hospitals. Using structured interviews of unit-based nurse managers \((n = 22)\) and non-nurse department heads \((n = 4)\), a number of themes emerged; not all were positive responses to the changes. Many new demands were related to the reorganization, and, even though they were interviewing participants 6 months after implementation, there were problems related to the redistribution of the workload. This study looked at the nurse manager—a different group than had previously been examined with regard to the issue of the patient-centered model. “These findings increase the importance of evaluating the impact of model implementation beyond the immediate patient care units affected by the model” (Redman & Jones, 1998, p. 52). The results point to the importance of a support network for managers when such patient-centered models are implemented.

Despite incomplete agreement, one of the fundamental aspects appears to be the delivery of service that is organized around patients (and, therefore, is more decentralized) than around specialized departments. “Basic tenets include decentralization of services, cross-training of employees, work redesign, and physical and geographical reorganization of delivery systems as they are brought closer to the bedside” (Sherer, 1993, p. 14). J. Philip Lathrop, vice president of Booz Allen Health Care in Chicago quoted in this article, stated, “Patient-centered care addresses fundamental structural problems that overcompartmentalize, overspecialize, and rely on only one operating approach for all patients” (p. 14). But as Sherer noted, many health care executives want to see the data that demonstrate the superiority of this approach. Sherer acknowledged the difficulty in assessing the outcomes. Much of the research involves subjective measures of satisfaction, and, within that category, very little can be called good research design (control groups are often unmatched, pretest measures are not gathered). The most significant impact of patient-centered care is claimed to occur in the patient room (size, arrangement, and décor) and in the reconfiguration and redefinition of the central nursing station (Sherer, 1993, p. 23).

THE PLANETREE MODEL

Among the better known, patient-centered care programs is the Planetree model (Martin et al., 1990), which emphasizes creating a homelike environ-
ment for patients. Two of its other goals are training patients to be partners in their health care and increasing the satisfaction of nurses. Although rigorous outcome studies had not been completed at the time Martin et al. (1990) wrote their article, preliminary results for a Planetree unit at the Pacific Medical Center indicated greater satisfaction among Planetree patients than patients on a traditional medical-surgical unit with a similar length of stay. The authors noted that “the Planetree philosophy is gaining wide acceptance from hospital managers” (p. 600). Orr (1995) discussed the Planetree philosophy when reporting on a study at the University of Washington that showed that a Planetree unit was positively evaluated by physicians who, initially, had been reticent to embrace the concept: “The physical environment truly enhanced the physician’s perception of the quality of care that was delivered” (Orr, 1995, p. 84). But Orr, a health care consultant, claimed that the idea of giving patients access to information in the form of reference libraries in patient units is one “few hospitals appear to embrace” (quoted in Sherer, 1993, p. 24).

Following their earlier article (Martin et al., 1990), Martin et al. (1998) discussed the renovation of a 13-bed medical-surgical unit along Planetree lines (to create a more comfortable, calming, and home-like environment) at the Pacific Medical Center in California. In this randomized trial, patients were either randomly assigned to a Planetree unit \( (n = 129) \) or other units \( (n = 112) \) or assigned to the only available bed in the Planetree unit \( (n = 186) \) or other units \( (n = 333) \). Hypotheses were that a stay on the Planetree unit would improve patient satisfaction, health education, involvement of patients in their own care, health behaviors, perceived health status, and use of services. Patients were interviewed at admission, 1 week after discharge, and at 3 months and 6 months following discharge.

Although there were some differences in the characteristics of patients on the Planetree unit versus other units, at discharge, the Planetree patients were significantly more satisfied with their stay than were those on other units. This satisfaction involved architectural aspects as well as technical aspects. They were more satisfied with the extent to which nurses were involved in their care and with the opportunity to see their support network (family and friends). At the same time, there were no significant differences in the involvement of physicians nor of patients’ perceptions of the control they had over their health, although the Planetree patients stated that they learned more about self-care and illness. This study is described as one of the few methodologically rigorous experiments dealing with hospital units that are patient centered. The patient satisfaction and patient education aspects do appear to differ, but it is noteworthy that there were no differences in the health behaviors of patients in different units. The authors commented that
with relatively short hospital stays (about a week), it is difficult to change lifelong behaviors.

In a study involving two renovated (Planetree) units versus a non-renovated unit, Devlin (1995) compared patient, nursing staff, and visitor evaluations. The renovated units were designed under the Planetree model within a larger general hospital. The study evaluated users’ reports with an instrument employed by Davidson (1994) in which respondents rated five variables (care, being, choice, environment, and communication) on a visual analog scale. In addition to the variables used by Davidson, Devlin added change (whether the patient thought that aspects of the unit should be changed) and responsiveness (how responsive the hospital unit was to patients’ needs). One or both of the Planetree units were evaluated significantly more positively than the unrenovated unit in terms of care, being, environment, communication, and responsiveness by patients, visitors, and staff (Devlin, 1995). However, independent of the unit they were on, nurses rated a number of variables (the care they were able to provide, the availability of choice on the unit) lower than patients or visitors did. Furthermore, there was no significant difference across units in the number of days patients spent on the units, in the number of visits patients reported having, or in the number of visits family members or others reported making. Nor was there any difference across units in the stress reported by nurses on the Health Professions Stress Inventory. Thus, the benefits of the patient-centered model of care as reflected in this study of Planetree units may be confined to the subjective assessment of the quality of the patients’ experience.

The effects of the patient-centered model on health care outcomes is still unclear, although it is apparent that the idea of control can positively affect health outcomes by reducing stress. With regard to specific patient-centered models like Planetree, the advantages that have thus far been documented appear to be qualitative in nature in terms of patient satisfaction.

THE AMBIENT ENVIRONMENT

In the comments of Nesmith (1995), Williams (1988), Beatrice et al. (1998), Topf (2000), and others, the ambient environment, in terms of sound, views, and lighting, has been the subject of a significant amount of research. Typically, the research approach involves isolating an environmental variable, such as sound, and examining it to see if it negatively or positively affects certain aspects of patients’ outcomes.

Although not all ambient variables turn out to be stressors, many, such as sound, have been examined from this perspective. Topf (1994) discussed ambient stressors as those that are “chronic, negatively valued, conditions of
the physical environment that are uncontrollable (i.e., inescapable) and that potentially result in stress” (p. 289). Topf (1994, 2000) suggested that research on environmental stress and health can effectively be addressed through enhancing person-environment fit, called enhancement of person-environment compatibility (EP-EC). Reminiscent of the work of Lynch (1981), who described the performance dimensions for good city form, Topf (1984) offered a framework for studying the negative physical factors in the environment including noise, temperature, lighting, and density. An important aspect is perceived control and, in turn, exercised control (as in the use of earplugs to attenuate unwanted noise).

Sensory overload is particularly acute in the intensive care unit (Baker, 1984, 1993), and there has even been a suggestion that critical care units may be hazardous to one’s health (Dracup, 1988) because of the stress they create. Baker (1984) identified four variables that may negatively affect the patient: (a) lighting that alters circadian rhythms, (b) the perception of crowding brought on by the presence of people who are unfamiliar, (c) smells and tactile sensations that may be unwelcome, and (d) noise from a number of sources.

**Noise.** Of those four variables, the most often examined from the standpoint of research in the health care environment appears to be noise. Noise is the presence of unwanted sound. Describing the physical properties of noise, Baker (1984) stated that it is “nonperiodic waveforms, random in fluctuation, not harmoniously related, that interfere with desired signals” (p. 69). Annoyance is the term given to the psychological reaction to noise. Sound is typically measured using a meter with an A-weighted scale in dB(A). Hearing loss occurs at 90 dB(A) (Baker, 1984).

Describing the noise levels recorded from 4 intensive care and 2 general care units of 3 hospitals in a large metropolitan area, Hilton (1985) reported that decibel levels from equipment were as high as 90 dB(A) at times. Above decibel levels of 60 dB, sounds negatively affected rest and sleep. There was markedly more noise in intensive care units (ICUs) in the larger than in the smaller hospitals, which Hilton attributed to the greater number of patients per room in the larger hospitals. To reduce this factor in the environment, a number of behavioral suggestions were made, including closing doors when possible, reducing volume on telephones, and dimming lights (which, in turn, tends to lower voices). Other suggestions included purchasing quieter equipment and training staff. The ratio between number of patients and equipment per room suggests that one-person rooms are preferred to reduce noise.

Not only is noise an annoyance, but it also has the potential to affect the healing process, because noise can disrupt sleep (Simpson, Lee, & Cameron,
1996). A proliferation of noises, some of which are not even identifiable by employees, may lead to confusion and stress. In a study of 33 audiosignals commonly heard on a ward, only half of the critical alarms and only 40% of those categorized as noncritical were identified correctly (Cropp, Woods, Raney, & Bredle, 1994). Cropp et al. (1994) suggested that health care providers develop a system of alarms that is graded to reflect differences in importance. They also suggested that placing doors on rooms and using alarms that sound only in a central nursing station might buffer sound. Noise can also be reduced by carpeting (Snyder, 1966), which also has the benefit of reducing the likelihood of falls. The use of carpet is also part of a movement to humanize hospitals and may be appreciated more by patients than staff (Cheek, Maxwell, & Weisman, 1971), but negative staff reactions may be tied to the process of inadequate consultation about such change.

Using a posttest-only experimental design with volunteers in a sleep lab, Topf, Bookman, and Arand (1996) examined the effects of noise on the subjective quality of sleep. Volunteers were randomly assigned to hear audiotaapes of an actual critical care unit (CCU) or quiet. Experimental and control groups differed on a number of variables, and participants in the noise condition took longer to fall asleep, spent less time sleeping, and awakened more often. Further, sleep deprivation may be associated with a number of negative physiological outcomes including immunosuppression and lower protein synthesis (Topf & Davis, 1993). Participants in a similar experiment in a sleep lab (exposure to audiotaape of CCU sounds or quiet) did, in fact, have poorer REM sleep as measured with 7 or 10 indicators (including REM activity) and shorter REM durations (Topf & Davis, 1993).

And although the patient’s recovery is paramount, the effect of hospital noise on staff is also of concern. The statement that the guards do more time than the inmates regarding prisons applies to health care settings, as well. In a survey of 100 critical-care nurses involving self-report measures of stress and sensitivity to noise (Topf & Dillon, 1988), results indicated that telephones, alarms in equipment, and the beeping of monitors for patients were identified as annoying. A measure of burnout was correlated with the degree of noise-induced stress. The study also pointed out that the sounds that disturb staff (e.g., beeping alarms) may differ from those reported to disturb patients (e.g., loud talking in the hallway). Another report involving this research on critical-care nurses focused on measures of health (Topf, 1988). It revealed that noise-induced stress could account for 6% of the independent variance in headaches on the job and that individual differences, such as sensitivity to noise, were also contributors. The author pointed out that this self-report research needed to be confirmed by experimental studies, which, if support-
Music. At the other end of the spectrum from noise, the role of music to attenuate the anxiety surrounding hospitalization has been examined (White, 1992). The use of music is an example of an intervention that could be part of a holistic approach, although mixed results of its benefits have also been reported (Davis-Rollans & Cunningham, 1987; Zimmerman, Pierson, & Marker, 1988). In one pre-post experimental design involving hospitalized patients (White, 1992), the experimental group was exposed to 25 minutes of classical music selected by the investigator, whereas the control group had a 25-minute rest period without music. An anxiety measure, heart rate data, and respiratory rate were included as dependent measures. The experimental group showed statistically significant improvement in all the measures, and, although the controls also had a statistically significant drop in the state of anxiety following their rest period, the drop was greater for those exposed to music.

Although less convincing because no control group was used, research by Updike (1990) also suggests that music can benefit ICU patients. Blood pressure, heart rate, mean arterial pressure, double product index (the product of heart rate and systolic blood pressure divided by 100), as well as emotional responses were measured. Responses indicated a drop in systolic blood pressure when patients were exposed to music. Theoretically, this research (and others) suggests that emotional responses can be modified when music moves through the auditory cortex, activates the limbic system, and, in turn, affects emotional reactions. “Music therapy effectively reduces anxiety, stress and the experience of pain” (Guzzetta, 1989, p. 610). Guzzetta used a pretest/posttest experimental design in a study of patients in a CCU who were randomly assigned to music therapy, relaxation therapy, or control groups. The relaxation (or relaxation plus music therapy) outcome measures were apical heart rates, peripheral temperature, cardiovascular complication, and qualitative responses to sessions (i.e., “How helpful were they?”) Patients chose three music selections they wanted to hear. Results indicated that both the relaxation group and the relaxation plus music group had significantly fewer complications than the control group. Although the music therapy alone was more effective in raising peripheral temperatures, it is not clear that music by itself is better than relaxation alone, although Guzzetta pointed out that music may have the advantage of shutting out unwanted noise (because headsets are worn). In a study discussed in Rubin and Owens’s (1996) review of the literature, patients exposed to music that they chose during laceration...
repair reported less pain during the surgical procedure (Menegazzi, Paris, Kersteen, Flynn, & Trautman, 1991). The fact that patients’ pain decreased when they listened to music they had chosen reinforces Minckley’s (1968) theory that the ability to control environmental stimuli, such as noise or music, is a key component of tolerance of and positive coping with environmental interference. Similarly, Moss (1988) examined changes in anxiety related to hearing music in adults admitted for elective arthroscopic surgery. The findings showed decreases in preoperative to postoperative anxiety in patients who listened to music compared to control groups (cited in Rubin & Owens, 1996).

The research on noise suggests that its reduction can positively affect health. Music also appears to have beneficial effects, and may, in turn, shut out unwanted sounds.

THE PATIENT ROOM: WINDOWS, VIEWS, AND ART

In the process of providing a more welcoming environment, the patient room is of particular importance. The challenge for the designer is to create a residential feel while preserving whatever technology is deemed necessary. In the evolution of health care architecture, Verderber and Fine (2000) discussed the shift from a staff-centered (modern) to a patient-centered (postmodern) room. In this transformation, the role of the window and the view it affords are of special significance.

The presence or absence of a window and the view it affords include one aspect of the physical environment that has been demonstrated to affect patients’ experiences in the hospital (Rubin & Owens, 1996; Ulrich, 1984; Verderber, 1982, 1986; Verderber, Grice, & Gutentag, 1987). In a study using hospital records to examine the effects of views out of windows on patients recovering from gallbladder surgery, Ulrich (1984) found that patients recovering from surgery in rooms with a view of nature versus a view of a brick wall “had shorter postoperative hospital stays, had fewer negative evaluative comments from nurses, took fewer moderate and strong analgesic doses, and had slightly lower scores for minor postsurgical complications” (p. 421). In a similar study, Wilson (1972) looked at incidences of delirium and depression in postoperative, major surgery patients with and without windows in their rooms. Wilson found that patients in intensive care units without windows had significantly higher incidences of organic delirium than did patients in rooms with windows. These findings suggest that windows may have healing and stress-reducing effects on patients and should be considered in hospital and waiting room design.
In related research by Verderber (1986), 125 staff and 125 inpatients of physical medicine and rehabilitation (PMR) units viewed 64 4x5-inch color photographs that depicted the PMR units from 11 hospitals. Rooms in patient living areas, treatment areas, and staff areas ranged from windowed to windowless. Photographs with highest preference were of trees and lawns, neighborhoods surrounding the hospital, people outside the unit, and vistas (both near and far). “In hospitals, the representation of nature—be it ocean, sky, or forest—appears to help satisfy human informational needs” (p. 459).

Keep (1977) reported that “satisfaction is generally achieved when window area occupies 20-30% of the window wall” (p. 600). In a study on the value of windows, Verderber and Reuman (1987) concluded that involvement with windows and views helps the patient develop a “perceptual and cognitive link with the external environment” and positively affects the therapeutic process (p. 121). Verderber (1986) also found that window conditions in most hospital settings often contrast with patients’ ideal window views found in research.

One reason windows may be of value to the patient is that they are a source of natural light. Heerwagen and Heerwagen (1986) examined people’s preferences for daylight versus electric light in office spaces and found that people preferred daylight to electric light for psychological comfort, for office appearance and pleasantness, for visual health, and for general health. Windows may be of therapeutic value because they provide a soothing, peaceful distraction. Researchers have found that people much prefer scenes of nature to cityscapes and urban environments (Kaplan, Kaplan, & Wendt, 1972), that scenes of nature have more positive effects on physiological states (Ulrich, 1981), and that scenes of nature influence faster recuperation from stress than do scenes of the urban environment (Ulrich, Dimberg, & Driver, 1990; Ulrich et al., 1991).

Now, innovative ways to bring art and nature into health care settings are available. These include the electronic window of nature that simulates the passage of daylight from dawn to dusk, created by Joey Fischer/Art Research Institute Limited and used first in the United States at Stanford (Seligmann & Buckley, 1990). Recent books on health care feature other examples of this same idea such as an angiography lab that is backlit with a photograph of trees and a waterfall on the ceiling at Grace Hospital in Detroit and a CT scanning suite at St. Mary’s Hospital in Grand Rapids, Michigan, where there is a photograph on the ceiling depicting underwater scenes (Malkin, 1992; Nesmith, 1995).

Ulrich (1992) is one of a small group of researchers who regularly use outcome measures other than patient or staff satisfaction reports on the
physiological changes (e.g., lower blood pressure) that can occur through the use of serene artwork. These scenes typically involve water or other forms of nature. Ulrich discusses the importance of positive distraction—“an element that produces positive feelings, effortlessly holds attention and interest, and therefore may block or reduce worrisome thoughts” (1992, p. 24). The most effective of these distractions, he claimed, are “(1) nature elements such as trees, plants, and water; (2) happy, laughing, or caring human faces; and (3) benign animals such as pets” (1992, p. 24). These elements, he argued, have an evolutionary significance.

Ulrich’s (1992) research shows that views of nature that reduce blood pressure and increase muscle relaxation can facilitate reactions to stress in as few as 5 minutes. Ulrich noted, “All art is not created equal” (1992, p. 25) and cited research on the psychiatric ward of a Swedish hospital where patients were favorable toward art containing scenes of nature but less comfortable with art that was described as abstract.

Furthermore, in another study, open-heart surgery patients postoperatively viewed a nature scene (of either water or trees), an abstract scene, or no scene. Those exposed to the nature scene with water reported less anxiety postoperatively than did those exposed to other types of scenes or the control. In addition, those who viewed the abstract scenes reported higher anxiety than did those without any pictures (Ulrich, 1992). Beyond health care environments, studies in personality and individual differences have demonstrated that subjects like nature paintings that are complex, free of tension, and representational rather than expressionistic or semi-abstract (Zuckerman, Ulrich, & McLaughlin, 1993). Commenting on a POE, McLaughlin (1975) stated, “None of the hospitals studied had extensive art on the walls. However, based on other data one can assume that detailed representational paintings or prints would be appropriate for all areas, but particularly for long term use areas” (p. 34). These findings fit with the direction that has been taken in selecting paintings for health care environments that are representational and feature scenes of nature. The role of nature is also being emphasized in the use of gardens in healing (Cooper Marcus & Barnes, 1995). “Patients, visitors, and staff come to the garden to help themselves feel better” (Cooper Marcus & Barnes, 1995, p. 57).

Lighting and color. In health care environments, consideration needs to be given to lighting—both its color and quality (Koch, 1991). The quality of lighting is important for populations, such as the institutionalized elderly, that spend long periods of time indoors. Chronic diseases such as cataracts and glaucoma, in tandem with senile miosis (in which less light reaches the
retina), point to the importance of light for the institutionalized elderly (Kolanowski, 1992). At the same time, precautions must be taken to manage glare. What is recommended is bright, indirect lighting. “Hospitals are notorious for lacking cues as to time of day, and the resulting disorientation is well-documented” (Kolanowski, 1992, p. 12).

Benya (1989) discussed the various areas for improvements in the lighting of health care environments. Among the areas to be improved are the ways in which source color are rendered, the reduction of glare, more daylight, the reduction of institutional lighting, softer lighting, and an emphasis on residential aspects of lighting (so that it looks more like what you would find in a residence). At least in the opinion of some designers, lighting can play a critical role in the perception of the hospital environment, and “the overall effect is far greater in both aesthetic and psychological value when weighed against the cost of other types of architectural improvements” (Benya, 1989, p. 58).

The use of color to enhance mood, improve way finding through color cues, and reduce patient disorientation, has also been examined (Cooper, Mohide, & Gilbert, 1989). To attract attention to particular areas (e.g., activity areas) the authors’ advice was to paint them with bright colors. For restricted areas, the advice was pale colors.

Color often plays an important role in way-finding systems despite the existence of users who are colorblind. Health care environments frequently use color to direct patients (e.g., “Take the green elevators to the third floor.”). Although important, the literature on way finding is not reviewed here in depth because many of the prescriptions for way-finding systems apply to building types in general and are not specific to health care facilities. For those interested in reading more about the topic, a book by Carpman and Grant (1993) on health care design reviewed research and design recommendations for way finding in health care environments.

SPECIALIZED BUILDING TYPES AND UNITS

The third emphasis in research has been on specific building types for specific patient populations. The decentralization of hospital care has been accompanied by an increase in units for special patient populations, and one population that has been chiefly responsible for a number of health care building types is the elderly. Moving beyond nursing homes, four architectural types of continuing-care retirement forms emerged by the mid-1990s (Verderber & Fine, 2000). Verderber and Fine described these as (a) the pastoral campus type, (b) the denser suburban type, (c) the new, urbanist village type, and (d) the urban high-rise type. More research has probably
been done on outcomes for the elderly in their buildings than on any other population, much of it by the Philadelphia Geriatric Center under the guidance of M. Powell Lawton. Lawton put forward the environmental proactivity hypothesis, which suggests that environmental resources will be put to better use in people of higher competence. A second hypothesis involves environmental docility, which suggests that “environmental press accounts for a greater proportion of behavioral outcomes as personal competence diminishes” (Lawton, 1985, p. 507) and that docility will increase as limitations of the individual encounter environmental barriers or constraints. These hypotheses point to the importance of control, or of a command center, for the elderly, which supports autonomy (e.g., having a telephone or television within reach of a favored chair, much like what is depicted for Mr. Crane, the aging father on the Frasier television series). Others have demonstrated that changes in the physical environment of the elderly who are hospitalized can improve their ability to perform tasks of daily living (Landefeld, Palmer, Kresevic, Fortinsky, & Kowal, 1995). Creating a home-like atmosphere that also addresses the sensory limitations of the elderly can additionally improve outcomes (Alvermann, 1979).

Many of the building types address the substantial subpopulation of the elderly with dementia and Alzheimer’s disease. “Many of the problems experienced by people with dementia and their caregivers are linked directly to the planning and design of the environment” (Cohen & Weisman, 1991, p. 20). The Abram and Helen Weiss Institute (Lawton, Fulcomer, & Kleban, 1984; Liebowitz, Lawton, & Waldman, 1979) is what has been called a prosthetically designed nursing home in the sense that it staves off further deterioration. “The open treatment area is intended to diminish the effects of disorientation and memory loss by giving residents an almost complete view of all areas from anywhere in the space” (Liebowitz et al., 1979, p. 59). However, when this research was done, a variety of changes occurred including better lighting in bedrooms, a reduction in the number of people sharing bedrooms, and increased programming. It, therefore, was not clear which changes were responsible for the fact that patients did not deteriorate.

Cohen and Weisman (1991) described the prosthetic effect for patients of environments, including the Weiss Institute, designed for those with dementia in their book, Holding on to Home: Designing Environments for People with Dementia. Other recommendations for the physical environments of patients with dementia came from work by Peppard (1986) and a book by Calkins (1988). Calkins endorsed the butterfly plan in which two clusters of bedrooms are arranged around the nursing station to permit visual monitoring of patients by staff members. Although design changes have received a
good deal of attention for the elderly as a patient population, the staff also
play a significant role, and staff training can be a significant component of
patient-centered care for the elderly (Inouye et al., 1993). Thus, some of the
protective effects of patient-centered care for the elderly can come in the
form of geriatric nursing expertise.

In terms of design for patients with dementia, what is recommended is
noninstitutional in character (including human scale, soft architecture, elimi-
nating environmental barriers, use of reminders from the past, spaces for
familiar tasks like cooking, and display areas). “The environment should
have sufficient cues so that people with dementia do not resort to wandering
as a consequence of disorientation” (Cohen & Weisman, 1991, p. 70). The
suggestion is made that continuity in paths (like a loop) is useful because
dead ends cause frustration. Outdoor spaces are also helpful as are green
houses, sunrooms, and areas for plants. Design configurations that include
central open areas (like a widened hallway) or open activity areas (Kromm &
Kromm, 1985) are popular because these spaces have been shown to reduce
disorientation and lead to increased time spent in social areas with a parallel
reduction in time spent in bedrooms (Liebowitz et al., 1979).

Increases in the level of functioning for patients with dementia have been
reported when patients were admitted to a unit specially designed for them.
Results indicated improvements in the level of functioning for both mental
and emotional status coupled with the functions of daily living at both 4 and
13 months following intervention (Benson, Cameron, Humbach, Servino, &
Gambert, 1987). Additions included an orientation board and color-coding
for each patient’s door with his or her name and picture also displayed next to
the door. Although doors were not locked, they were alarmed, and a double-
door knob arrangement was used because, as the authors commented, few
dementia patients can turn both knobs at once. Beyond physical changes in
the environment, each resident had an individualized treatment plan. “Our
data suggest that a specially designed dementia unit can benefit selected
patients within the nursing home setting” (Benson et al., 1987, p. 322). This
result was accomplished with the same level of nursing staff. Although
patients’ improvements were not cognitive, they included other important
behaviors including social, group interaction, grooming, and eating.

However, some have questioned whether special care units (SCUs) for
dementia patients that are segregated necessarily result in improvements
(Mathew, Sloan, Kilby, & Flood, 1988). In a study involving 34 patients in
two comparison settings, patients in the dementia unit were not better,
cognitively, than controls. But one obvious benefit in the dementia unit was
the lack of restraints. Other researchers have avoided the use of restraints by
successfully incorporating visual barriers to conceal doorknobs (Namazi, Rosner, & Calkins, 1989). Some have tried grid patterns created with tape on the floor in front of a door, because many demented patients apparently perceive two-dimensional grid patterns as presenting a barrier (Hussian & Brown, 1987). Other research on Alzheimer’s units (Hyde, 1989) suggests that, although many views exist about the basic goals of such units, a shared belief is that the environment can help compensate for patients’ cognitive and sensory deficits to encourage mastery of the environment including the activities of daily living.

Other models for addressing the needs of the elderly have been created including the Acute Care of Elders (ACE) units (Palmer, Counsell, & Landefeld, 1998). The goal of ACE units is to foster independent functioning in patients and to prevent a “dysfunctional syndrome.” Primary nurses also have an expanded role in ACE units. Covinsky et al. (1998) also described ACE units. ACE units stress enhancing personal control through (a) patient-centered nursing care, (b) prepared environments, (c) planning for discharge, and (d) medical care review. Physical changes made include carpeting in corridors and patient rooms, clocks and calendars in every room, and use of patterns with visual contrast in carpets and wall coverings to enhance way finding and orientation. Bathrooms have elevated seats; levers rather than knobs are used for doors. Floor lighting at the bedside promotes safe transfer at night. There is a large commons space for all patients that provides space for activities that promote socializing and exercising. Regarding the ACE unit, Covinsky et al. talked about a prepared environment in which walking is encouraged by carpeting all patient rooms. At discharge, patients on the ACE unit were more likely to improve and less likely to decline. However, 3 months later, the patients from the ACE unit were similar to non-ACE patients in their abilities to perform activities of daily living. Similar to some of the results reported earlier with regard to patient-centered units like Planetree, some improvements of patients on units with the interventions may not be extended in time (Martin et al., 1998). Counsell et al. (2000), however, described research on ACE units in which the decline in activities of daily living (ADL) was less frequent for those on the ACE unit than for others receiving usual care. In that study, patient and provider satisfaction improved without a concomitant increase in costs.

Other types of designs for specialized patient populations include birthing centers (Vogler, 1990) and rehabilitation centers. One design innovation for physical rehabilitation that has been positively reviewed is called Easy Street Environments, in which patients practice navigating grocery stores, bus stops, banks, and restaurants before facing the real environment (Guynes, 1990).
MANAGED HEALTH CARE, RESEARCH OPPORTUNITIES, AND NEW INITIATIVES

These specialized centers and smaller building types are, in some measure, the result of the revolution in health care known as managed care. External forces, such as legislation and changes in the insurance industry, have a tremendous capacity to effect change. In particular, managed health care has significantly affected the architecture of the health care environment. Much of the publicity surrounding the rise of managed health care has planted a negative image of its impact on the patient with practitioners declaring that they can no longer provide the services that they think their patients require. However, the gap between member satisfaction with HMOs and other types of health plans may be narrowing (Walker, 2002), and there may be positive aspects of managed health care in terms of its impact on the physical environment. When diagnosis related groups (DRGs) increased competition, some providers thought it possible to distinguish themselves through design (Voelker, 1994). It has been argued that a new paradigm in health care architecture is needed—one that replaces the monumental and enduring with structures that reflect caring and flexibility (Arneill & Nuelsen, 1992).

Regarding the changes that managed health care has created, Bruce Arneill—past president of the National American Institute of Architects Academy on Architecture for Health and chairman of the S/L/A/M Collaborative, an architectural firm that has done a substantial number of health care projects—commented,

Due to competition, lower reimbursements from the government, and the demand by “educated, computer-literate clients” for better quality care, curing, and healing, the behavior of doctors, nurses, and administrations has changed. Also, the demands for functionally and aesthetically better environments for diagnosis and treatment, and curing, healing, and caring have gone through a metamorphosis. (personal communication, October 16, 2002)

As an example of the change in the way health care is now approached by architects, Arneill stated,

Another good example of the change is the fact that the Academy on Architecture for Health for the American Institute of Architects has grown in the last 25 years from approximately 100 members to almost 4,000... Also, the American College of Healthcare Architects has been formed to establish credentialing for healthcare architects based on education, training, experience, and exams and assures that good programming, planning, and design is
Arneill explained that the profession of health care architecture has undergone a substantial change in status compared to its standing in the field after World War II. At that time, health care architects or architectural firms had little status in design quality in the field of architecture. Now, however, not only are health care architects held in higher esteem, but there are those who even subspecialize, for example, in cancer centers, women’s centers, and so forth. Arneill stated that “Ninety percent of this advancement and change has taken place since the advent of managed care in the mid-1970s” (B. P. Arneill, personal communication, October 16, 2002).

The monolithic hospital is being replaced by a variety of buildings types, including ambulatory care centers, primary care centers, outreach facilities, and wellness centers. These now constitute the majority of new construction (Fitzgerald, 1996). Such new construction is argued to enhance the image that providers present, attract groups of payers, and increase the share of the market that providers control (Fitzgerald, 1996). The emphasis seems to be on satellite feeders, and these outpatient facilities and medical office buildings are argued to provide not only greater convenience for patients but also easier staff flow (Fitzgerald, 1996). Even when renovation occurs within general hospitals, the impetus seems to be the creation of units within units, such that intensive care and sub-acute care units form entities within the larger hospital itself. This kind of chunking or grouping has the potential to make patients and families more comfortable because of the idea that the whole is broken down into more manageable parts.

This new construction by the health care industry has presented environment and behavior researchers with a tremendous opportunity to build on a solid foundation of research findings. Although quality research is difficult to do in the health care environment because of the many variables involved in the challenge of experimental control (Voelker, 1994), we have an obligation to follow the advice of Kenneth Schwartz, quoted in an article about the 2nd International Conference on Health and Design in Stockholm, Sweden: “Design research results need to be impressive, when presented to a hard-nosed world” (Martin, 2000, p. 518). Collaborations are emerging that may help to produce just this kind of hard-nosed evidence in the form of evidence-based design (Tarampi, 2002). One example is The Pebble Project (Bilchik, 2002; Varni & Marberry, 2001). The Pebble Project (so named to indicate that the work is hoped to have a ripple effect) is a collaboration between the Center for Health Design and a number of health care organizations around the country who are measuring design-based health care outcomes. Although
the research is ongoing, preliminary data indicate a variety of encouraging findings. These include a 62% decrease in medication errors at a new unit in the Barbara Ann Karmanos Cancer Institute in Detroit, six fewer nosocomial infections (those caused or aggravated by hospital life) per month in private patient rooms at Bronson Hospital in Kalamazoo, Michigan (Bilchik, 2002), and a decrease in patient falls by 75% at the new Comprehensive Cardiac Critical Care unit at Methodist Hospital, Clarian Health Partners, in Indianapolis (Marberry, 2002). These findings and others reviewed in this article indicate that we have the tools to do the kind of research that will lead to evidence-based design, and providers are becoming more willing to support such efforts. More and more, they realize the potential of research to improve patient well-being and the health care system.

REFERENCES


