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of emergency services, rather than the anesthesiology chief, is the one ultimately responsible for ED procedural safety.

PRIMARY TARGETS AND COLLATERAL DAMAGE

Yealy cautions that the issue is squarely on the use of propofol in the ED, rather than any wider controversies over other specialties administering the drug. ASA president Lema concurs that, despite his presentations, the organization does not view EDs as their primary target in the propofol campaign.

“Clearly, our concerns are more with office-based use than . . . emergency rooms or ICU usage, because those are generally located in hospitals, where there is a number of support personnel. That is opposed to an office, where the only doctor may be the proceduralist.”

He believes ASA and ACEP have a good working relationship, and notes that ASA has been allied with emergency physicians on other key issues, such as the timelier placement of psychiatric patients.

“In general, I think that anesthesiologists and anesthesia as a specialty fully support emergency physicians and the difficult task that they have to care for America’s acutely ill patients,” Lema said. “Hopefully, we can play our role to facilitate their role.”

Even though his presentations carry a heavy emphasis on the economic impacts for ASA members, Lema insists that the concerns are based on what is best for patients. “We have basically drawn a line in the sand and asked for the safe use of a drug that has no reversal agent to it. . . .” he said.

Calling emergency physicians “poachers” is just part of a “lecture that I had designed to awaken anesthesiologists across the country to let them know that we are a fully mature specialty” now subject to inter-specialty rivalries, Lema said.

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THE COST OF KOI: EVIDENCE-BASED DESIGN IN EMERGENCY MEDICAL FACILITIES

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The cost and benefits of koi, Japanese gardens and tree-lined vistas may not strike many emergency department (ED) directors as a topic of interest, but an emerging body of literature is suggesting these and many other components of “evidence-based design” have direct relevance for everything from patient outcomes to staff productivity.

“The environment counts,” says Mark S. Smith, MD, chairman of emergency medicine at Washington Hospital Center and Georgetown University School of Medicine and director of ER One, a federally funded project to design a prototype ED capable of handling disasters ranging from emerging diseases to terrorism. “It has a profound effect on people’s ability to work . . . Architecture matters, design matters, materials matter, sound and light matter.”

As clinicians and others have gained knowledge about the nonmedical variables affecting patients’ experiences, including physical and procedural components of hospitals, an empirical design philosophy has arisen in parallel to evidence-based medicine (EBM). In recent years, evidence-based design (EBD) has been an increasingly influential component of hospital architecture and planning. Interest in EBD is driven in part by related concerns about sustainable construction, in part by recognition of the medical error problem in the wake of the Institute of Medicine’s relevant studies, and in part by the administrative axiom that “you can’t manage what you can’t measure”; the movement is beginning to receive attention in the nonspecialist media.

Since the ED is so often patients’ primary portal of entry into a hospital, and since inefficiencies anywhere in the institution can affect the performance of the ED, emergency medicine and EBD potentially have much to gain from each other.

COMMON SENSE PLUS UNCOMMON RIGOR

With both EBM and EBD, the practice predates the formal term. “Evidence-based medicine has been around since the scientific revolution,” says D. Kirk Hamilton, FAIA, FACHA, one of the movement’s chief practitioners and theorists, “but the term hasn’t really been defined until [David] Sackett and people like that started writing about it in the ‘90s. The Center for Health Design (CHD) has existed since the ‘80s.” This organization, the EBD movement’s rough equivalent of the Centre for Evidence-Based Medicine at Oxford University, promotes the use of research to guide health care architecture and planning. The CHD’s Pebble Project, a series of research collaborations with 43 health care organizations and 4 corporations, has been facilitating studies of design outcome relationships in the US since 2000. Other institutions that have become prominent in EBD include Texas A&M University’s Center for Health Systems and Design, Sweden’s Karolinska Institute, and the Academy of Architecture for Health, a component of the American Institute of Architects.

EBD adds an objective dimension to subjective ideas about environmental influences on patients’ well-being, including light, space, noise, air quality, materials, traffic flow, triage procedures, infection control, ergonomics, aesthetics, navigation, and access to specialty services. As this form of thinking has spread among architects and hospital officials, it has also extended attention to the experiences of medical staff and patients’ family members. Surprisingly clear benefits, EBD
advocates say, have followed from adjustments in elements as fundamental as floorplans or as seemingly superficial as waiting room amenities.

In Dr. Smith’s experience, “small configuration changes can have very large effects.” His department at Washington Hospital Center is researching a host of environmental variables, including infection-reducing features such as a decontamination system using vaporized hydrogen peroxide (Vapor Sure, Steris), silver-ion-impregnated antimicrobial coatings for toilet facilities (Agion Technologies), and seamless wall materials (Corian, Dupont) that may harbor fewer pathogens than conventional textures do. In partnership with the furniture manufacturer Herman Miller, Smith’s group is installing and studying a central physician/nursing station with adjustable height countertops, on the theory that better ergonomics reduce fatigue and improve performance. Washington Hospital Center was also an innovator in calming its tough urban atmosphere by placing a Japanese garden with a waterfall and koi in front of the ED.

One of his group’s most surprising findings was as simple as moving a desk. In a congested greeting zone, he reports, “waiting patients could fully view into the clinical care area. We made one change: our ED staff just took the greeting booth and moved it to a different position, divided up the waiting space and the triage space, and it was like a calm had passed over the area.”

Other institutions have observed similar gains from design changes that reduce sources of anxiety, give patients or staff greater control over their environment, or streamline procedures. Quality of sleep scores rose from 4.9 to 7.3 (on a 1-10 scale) when St. Alphonsus Regional Medical Center, Boise, Idaho, redesigned rooms to reduce noise; Methodist Hospital in Indianapolis reduced patient falls by 75% when it opened a treetop view had shorter length of stay, more positive evaluations in nurses’ notes, and lower analgesic intake than comparable patients whose windows faced a brick wall. The preference for nature views is hardly surprising, but the credible correlation between beliefs that environmentalists and architects held intuitively and measurable markers of medical outcomes was something new. Kirk Hamilton describes the paper’s reception as a conceptual watershed: “The blockbuster info was [that] this reduced length of stay and cut the use of expensive analgesics. Suddenly, this sort of touchy-feely California idea had been tied to very important quantitative information that was meaningful to management and clinicians.”

Some comments on EBD have critiqued the field’s researchers for leaning too heavily on n = 1 sample sizes. Reports on some environmental effects, such as a Pittsburgh ED team’s 1991 observation that playing patient-selected music during uncomplicated laceration repair was associated with lower pain scores, could strike different observers as reasonable, obvious, or merely curious. However, as studies accumulated (and became the topic of interdisciplinary communications through the CHD’s conferences), the field acquired the status of a formal discipline.

“At the outset,” recalls Hamilton, “in the early and mid-eighties, it was considered a fringe concept,” but it steadily moved toward the mainstream. By 1998, the field had matured enough for meta-analyses of the rigor of published studies: Rubin and colleagues at Johns Hopkins identified 85 EBD reports that met basic criteria for scientific rigor (eg, study designs using randomization) and concluded that 80% of these studies found positive associations between environmental variables and patient outcomes. In 2003 Hamilton was the first author to publish a formal definition: “Evidence-based design is a process for the conscientious, explicit, and judicious use of current best evidence from research and practice in making critical decisions, together with an informed client, about the design of each

being.... There are so many variables, and how do you isolate and control for that one variable you’re trying to assess? You often have to settle for surrogate measures.”

The perceived difference between hard science and “soft” psychological or quality of life variables can make some interdisciplinary conversations about design difficult. But the more EBD creates a body of quantitative knowledge about medical outcomes, the easier it becomes for physicians, administrators, and architects to speak in mutually recognizable terms. With construction and renovation booming in the US health care sector—in 2006, reports Architect magazine, this was a $41 billion industry—clarity in these conversations has substantive consequences in both clinical and financial terms.

YESTERDAY’S FRINGE, TODAY’S SCIENCE

One milestone in the recognition of EBD’s potential contributions to medicine was a small, elegant study by Roger Ulrich, PhD, appearing in Science in 1984. Ulrich found that post-cholecystectomy patients whose hospital windows offered a treetop view had shorter length of stay, more positive evaluations in nurses’ notes, and lower analgesic intake than comparable patients whose windows faced a brick wall. The preference for nature views is hardly surprising, but the credible correlation between beliefs that environmentalists and architects held intuitively and measurable markers of medical outcomes was something new. Kirk Hamilton describes the paper’s reception as a conceptual watershed: “The blockbuster info was [that] this reduced length of stay and cut the use of expensive analgesics. Suddenly, this sort of touchy-feely California idea had been tied to very important quantitative information that was meaningful to management and clinicians.”

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individual and unique project.”11 (The similarities to the Centre for Evidence-Based Medicine’s generic definition as articulated by Sackett are intentional, Hamilton reports.)

Hamilton acknowledges that the term is easy to use loosely. “If somebody says, ‘Oh, well, what are the evidence-based projects?’ the honest answer is ‘Well, there may not be as many as you would think.’ There have been evidence-based concepts embedded into projects, but who can say whether a project really is evidence-based or not? If you make one decision, like choosing a carpet on the basis of a flame-spread rating that Underwriters Lab has researched, is that enough? Many would say no, that’s standard practice. If you’ve got an NIH grant or NSF grant to spend millions researching virtually everything, and had experts from around the world consult with you on all the decisions, everybody would agree, ‘Yeah, that’s an evidence-based project.’”

CAPACITY, ATMOSPHERE, AND THROUGHPUT

At the Philadelphia-based architectural firm Francis Cauffman (formerly Francis Cauffman Foley Hoffmann), president James Crispino, AIA, observed in the 1990s that publications on EBD were echoing some of the research he and his colleagues had been independently conducting on lighting, environmental control, and other workspace variables for health care clients.

“About 7 years ago,” Crispino reports, “we basically decided as a group that all of our projects were going to incorporate [EBD] principles to the extent we could.”

Much of the firm’s work aimed at increasing the familiarity of inpatient rooms for patients and families, replacing the disturbing institutional atmosphere with features more commonly found in hotels, but Crispino and colleagues also discovered that planning for optimal function through an entire hospital meant going beyond room-scale upgrades and analyzing the full range of patients’ experiences in the facility. The firm’s work involves comprehensive attention to institutional capacity and trafficking procedures along with details of room design, lighting spectra, and materials.

The first consideration in designing a new ED that will avoid rapid obsolescence, Crispino finds, is estimating fluctuating capacity requirements on both the departmental and institutional levels. “Generally what you’ll see when a new department opens is an increase of 8 to 10% in the volume the initial year it’s open,” he says, as emergency medical technicians (EMTs) are usually eager to take patients to a community’s newest facility. Jaime Rivas, MD, medical director at 2 hospitals in the California Emergency Physicians Medical Group (Palomar Medical Center in Escondido and Pomerado Hospital in Poway), after seeing hospitals in his organization expand but still quickly overflow, concurs with a cinematic baseball analogy: “If you build it, they will come.”

“The basic ED planning model for us . . . says you design the department for the peak shift of the peak day 5 years after the ED is open,” Crispino says. With 2 to 3 years typically dedicated to construction, the process thus requires a 7- or 8-year trend-line extrapolation from research into recent patient volume data, local demographic variables, and market share relative to other nearby hospitals (taking closings into consideration).

When a hospital’s capacity is overstretched, the ED usually bears the first and worst burden. “The ED ends up becoming the holding unit for the entire complex,” Crispino says, echoing the experiences of emergency physicians nationwide. The proportion of patients coming into the ED who are ultimately admitted, he has found, has risen to 25-30%, and this group constitutes about half of a hospital’s admissions (Crispino estimates the latter figure at 50-60%; Hamilton gives a more conservative 45%). The ED is no longer a back-of-house component of today’s hospitals; for many patients it is the front door. Contemporary designs reflect this reality by placing ED entrances for both walk-in patients and emergency medical services (EMS) vehicles toward the front, separate from entrances for non-emergency drive-up traffic and staff in order to keep the ambulance bay unobstructed, but at least as prominent as the main non-emergency entrance.

Because so many contemporary patients are uninsured or underinsured, using the ED as a de facto primary care gateway and often delaying a visit until it is unavoidable, they increasingly tend to be severely ill.

“The other wrench thrown into the statistics,” comments Rivas of Palomar Pomerado Health, is that “it’s not so much the low-acuity stuff that’s bogging the departments down; people are just sicker.”

The second priority for modern ED design is thus infection control. Over the past 8 to 10 years Crispino and colleagues have designed heating/ventilation/air conditioning (HVAC) systems that atmospherically isolate the ED and waiting room from the rest of the hospital. Surgical suites and intensive care units have successfully used separate HVAC for about 25 years, he reports; the observation of coughing and sneezing patients among crowds in waiting rooms (“You went in with a broken arm,” he says, “and you left with the flu”) makes it logical to test the same HVAC approach in ED areas. Quantitative evidence confirming the intuitive clinical benefit, Crispino estimates, is probably 1 to 2 years away.

Beyond separate HVAC lies the infection control ideal of negative-pressure ventilation. An ED that sees about 75,000 patients in a year, Crispino calculates, might occupy 25,000 to 28,000 square feet of space. Negative-pressure ventilation for a space that size is extremely expensive and consumes considerable energy; it is common to reserve negative-pressure capability for a certain subset of designated isolation rooms while maintaining separate circulation and filtration for the remainder of the department.

A few institutions, however—perhaps anticipating the era of extensively drug-resistant tuberculosis, severe acute respiratory syndrome, and hazards yet unknown—are moving toward full negative-pressure availability. Washington Hospital Center’s Smith estimates that many hospitals, particularly older
buildings, recirculate 50 to 70% of their air; plans for the new ED One facility include 100% non-recirculated air and negative-pressure capability in all rooms. “The first version of anything is going to be expensive,” Smith acknowledges, “but the third, fourth, fifth incarnations are going to be a lot less expensive.”

At patient transfer points, inefficiencies both spatial and procedural can worsen crowding. Ambulance access, says Crispino, requires an unobstructed path and dropoff point capacity 30 to 50% beyond normal levels to handle surges. Since EMTs may take brief breaks after a delivery—sometimes leaving vehicles running to keep defibrillator batteries charged, holding up queues and letting exhaust fumes into the ED—he group designs entry areas with looping driveways, separate ambulance parking, and remote power outlets. This system, developed for Mercy Fitzgerald Hospital in Upper Darby, Pennsylvania, in the late 1990s, speeds ambulance bay turnover for a minimal up-front expense on asphalt and electrical lines.

Triage desks should accommodate 3 or 4 nurses (one is never enough, since taking patients to the treatment area leaves the desk unattended). Bedside registration,12,13,14 which Crispino estimates is now used in 50-60% of the nation’s EDs, can shorten time to evaluation and reduce departures without treatment. The California Emergency Physicians group assigns a physician’s assistant to triage lower acuity cases; this rapid evaluation process has achieved an average systemwide time to provider of 42 minutes (one hospital cut this figure to 8). “You can discharge sometimes anywhere from 20 to 40 patients from triage without ever getting to a room,” says Rivas. Universal or “acuity-adaptable” rooms, requiring minimal reconfiguration for different clinical situations, minimize transfer between specialty areas, saving labor and reducing infectivity. Admission delays remain the most important cause of overflows; since “the ED is considered the only infinitely expansible space in the hospital,” as Smith comments, design analysis should view congestion and diversion as “not an ED problem, [but] a whole-hospital problem.”

“NOTHING IS TOO GOOD FOR ORDINARY PEOPLE”

EBD has the potential to reframe physicians’ thinking about the environment where they work and where patients and family undergo some of the most demanding, disturbing events of their lives. A well-designed hospital, in this view, is not an option or a luxury; it is a complex system whose components bear on the quality of medical practice, and the rational refinement of those components is as essential to responsible patient care as equivalent refinements in nursing, EMS, drug and device manufacturing, or any other field auxiliary to medicine.

One important corollary ensues, a particularly apt one for ED practice: just as all patients deserve prompt professional care regardless of socioeconomic level, they also have an equal claim to the benefits of an efficient, humane, stress-minimizing, respectful space. “The notion that a quiet suburban hospital should have a nicer ambience than a gritty urban hospital I reject,” says Smith. “I think every patient deserves to be in a lovely environment.”

Crispino’s firm has worked for community hospitals along the full social continuum, from affluent areas (eg, Lankenau Hospital in Wynnewood, Pennsylvania, on Philadelphia’s Main Line) to some of the nation’s most troubled urban neighborhoods (eg, Our Lady of Lourdes Medical Center in Camden, New Jersey). While high local crime rates make security and sightlines indispensable considerations in many settings, Crispino considers institutional, bulletproof, punitive-looking ED designs a counterproductive anachronism. Expressing the philosophy that one should “design for the behavior you expect,” his group added a running-water sculptural feature to the Lourdes ED to increase the sense of calm; he is a strong proponent of amenities, privacy, and other physical signals of respect in all hospitals regardless of budget.

“If you expect people to act like they’re in prison, then design a prison. And then you’ll get what you designed for . . . . If you walked into the Lankenau ED and you walked into the Lourdes ED,” he adds, “you wouldn’t be able to tell the difference.”

“Everyone talks about the risk of violence in the ED,” notes Smith, but “the incidence of violence is remarkably low, given the spectrum of clientele that seeks services. If you were to do a survey on how many people who are coming to seek emergency care have a criminal record . . . . it’s probably not insignificant in certain EDs. Yet the bad behavior is not exhibited in the ED. Why? It’s almost a tacit compact: bad behavior is checked at the door in exchange for this agreement that the physician, nurse, the whole health care system is going to work in the best interests of that patient.” He cites the “broken windows” argument of sociologists James Q. Wilson and George Kelling15—the idea that well-maintained, orderly public spaces deter both petty crime and more violent behavior—as a strong rationale connecting physical and aesthetic signals to the maintenance of that tacit compact. Smith also admires the optimistic flip side of the Wilson-Kelling thesis, a principle articulated by British-Russian architect Berthold Lubetkin, designer of the 1938 Finsbury Health Centre: “Nothing is too good for ordinary people.”

As the field evolves and its database expands, a charge sometimes lodged against EBM may at some point be applied to EBD as well: does attention to the measurable relations of design features and clinical benefits make health care architecture formulaic? Kirk Hamilton has considered the possibility. ‘You have doctors who say ‘I don’t want to practice cookbook medicine,’ and we have architects who don’t want to practice cookbook architecture. However, I would contend that a true evidence-based practitioner could never allow for a standard to be rigid and formalized, because the evidence changes every day. . . . I like to say ’No one has yet done a serious, scientifically valid study on a building that you haven’t built yet.’” Since architects’ work has the peculiar property of
existing in the future tense, and since every commission presents site-specific demands, there is little risk that EBD will result in one-size-fits-all facilities.

Nor is it likely to run out of challenges. “Nobody in any ED anywhere in America,” Hamilton has found, “has an ED that they consider perfect.”

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