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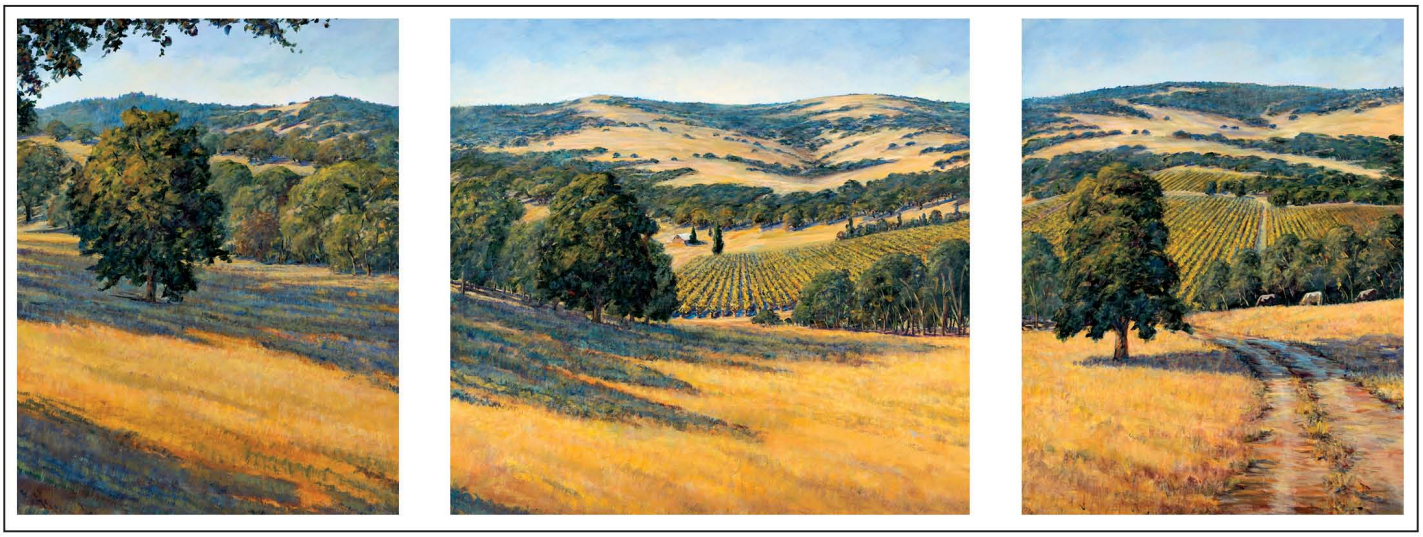

Good Health Care by Design

Essays

Evidence shows that changes in the architecture, design, and decor of health care facilities can improve patient care and in the long run reduce expenses. These essays detail the state of the research, look inside two hospitals that put some of these innovations into practice, and consider how design fits into the moral mission of health care.

Fable Hospital 2.0: *The Business Case for Building Better Health Care Facilities*

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Despite deep and vocal disagreements over health care reform, virtually everyone believes that the current system is not economically sustainable. We are spending too much and getting too little in return. This recognition has spurred health care leaders to examine every aspect of hospital operations. But what about the health care building itself, the physical environment within which patient care occurs? Too often, cost-cutting discussions have overlooked the hospital structure. Changes in the physical facility provide real opportunities for improving patient and worker safety and quality while reducing operating costs.

The "Fable hospital," an imaginary amalgam of the best design innovations that had been implemented and measured by leading organizations, was an early attempt to analyze the economic impact of designing and building an optimal hospital facility.[1] The Fable analysis, published in 2004, showed that carefully selected design innovations, though they may cost more initially, could return the incremental investment in one year by reducing operating costs and increasing revenues. Reactions to the Fable paper varied. Many felt it presented a compelling case and stimulated health care leaders and architects to think differently about balancing one-time building costs with ongoing operating costs. Others voiced skepticism about whether the benefits were as great as described and asked for more evidence.

Today, the Fable hospital is no longer imaginary. During the past six years, numerous hospitals have implemented many of its attributes and have evaluated their impact on patients, families, and staff.[2] Several are members of the Center for Health Design's Pebble Project, a group of organizations that apply evidence-based designs to improve quality and financial performance. Two Pebble hospitals are featured in essays accompanying this article. These and other pioneering organizations and their architecture/design teams are introducing such interventions as larger single-patient rooms, which reduce the incidence of health care-associated infections; wider bathroom doors, which reduce patient falls; HEPA filtration and other indoor air quality improvements, which reduce health care-associated infections; appropriate task lighting in medication dispensing areas, which reduces medication-related errors; hydraulic ceiling lifts in patient rooms and bathrooms, which reduce patient and staff lift injuries; and art and music, which reduce anxiety and depression and speed recovery.

Since 2004, much has changed that affects decision-making about health care construction and design. It is time for a fresh look at the Fable hospital. Drawing on the latest design and health care knowledge, research, the 2010 health reform law's emphasis on value and quality improvement, and our collective experience, we present Fable hospital 2.0.

The Changing Health Care Landscape

Five major health care trends are relevant to our analysis: the growth of evidence-based design, the safety/quality revolution, pay for performance and increasing consumer transparency, sustainability and green design, and access to capital.

Blair L. Sadler, Leonard L. Berry, Robin Guenther, D. Kirk Hamilton, Frederick A. Hessler, Clayton Merritt, and Derek Parker, "Fable Hospital 2.0: The Business Case for Building Better Health Care Facilities," *Hastings Center Report* 41, no. 1 (2011): 13-23.

The growth of evidence-based design. The Center for Health Design's definition of evidence-based design is "the process of basing decisions about the built environment on credible research to achieve the best possible outcomes." That evidence is much more abundant. In 1998, a review found fewer than one hundred solid studies.[3] A 2004 analysis found more than six hundred worthy studies.[4] In 2008, a team found twelve hundred methodologically sound studies.[5]

Facility design guided by credible research has become the standard for architects and designers, as witnessed by conferences focused on evidence-based design and the appearance of new publications.[6] More than five hundred health care and design professionals have been accredited by the Center's Evidence-Based Design Accreditation and Certification program, which was launched in 2009. Although the growth of evidence-based design has provided considerable guidance, other evidence comes from management, finance, computer science, human resources, ergonomics, supply chain distribution, and conservation.[7]

The safety/quality revolution. Two landmark Institute of Medicine reports, *To Err is Human*[8] and *Crossing the Quality Chasm,*[9] documented that thousands of patients were dying unnecessarily in American hospitals and presented powerful recommendations for reducing that number, sparking a widespread reexamination of care processes. In addition, the 2010 health reform law provides for developing a national quality improvement strategy. The safety/quality movement has also been stimulated by some collaborations led by the Institute for Healthcare Improvement. The 100,000 Lives Campaign and the Protecting 5 Million Lives from Harm Campaign mobilized more than four thousand hospitals to implement changes designed to reduce events that harm patients. Evidence-based design helps hospitals pursue the quality goals contained in the IOM reports.[10] When combined with process improvements and cultural change, it can measurably enhance an organization's safety and quality goals.[11]

Pay for performance and increasing transparency. Payers are no longer willing to pay for poor performance. They are adopting a new concept, called value-based purchasing or pay for performance, in which payment is based on performance or quality measures. Under the health reform law, Medicare is scheduled to adopt a pay for performance approach beginning in 2012. This new payment system will have a profound impact on the business case for quality improvement.

The Centers for Medicare and Medicaid Services (CMS) and the National Quality Forum have identified a list of "never events," errors that are largely preventable and should never occur in hospitals. Medicare will no longer reimburse for the incremental costs incurred by certain preventable errors. Medicaid and commercial payers are beginning to follow suit. It seems reasonable to assume that within three years, few payers will reimburse hospitals and physicians for the costs of preventable harm. *Building designs that help reduce preventable harm are becoming key elements in a hospital's survival strategy.*

In this age of transparency, patients increasingly have access to hospital performance data concerning patient outcomes and service quality. Since October 1, 2008, the CMS has required hospitals to give all Medicare patients the opportunity to complete a survey (Health Care Attitude and Patient Perception Survey) about their care experience. Hospitals that are safe, pleasing, and comfortable are likely to be rated high by patients, potentially influencing hospital choice, market share, and bottom-line results. In addition to specific questions about noise and cleanliness, the survey concludes with a "willingness to recommend," the response to which is likely to be influenced by the hospital environment.

Sustainability and green design. Environmentally sensitive design strategies are becoming standard practices in health care organizations, leading them to improve the health and safety of building users, reduce operating costs, and demonstrate corporate social responsibility. In a 2007 survey of health care leaders planning capital projects, 90 percent said they were incorporating or planning to incorporate green concepts despite the perception of higher capital costs—clearly indicating that sustainable design has become integral to this generation of health care construction.[12] Capital cost premiums related to green design strategies differ among projects. In one survey, the incremental costs ranged from zero to 5 percent.[13]

The benefits of sustainable design include improved indoor air quality, reduced consumption of energy and potable water, and staff satisfaction and retention. Energy efficiency is generally the first place that health care executives look for a measurable return on investment. In the 2007 survey, leaders of thirteen projects certified by LEED, a green building certification program, predicted average annual energy demand reductions of 22 percent.

A limited but growing body of evidence links indoor air quality to health status. Measures to reduce indoor pollutants include the use of paints, adhesives, and other materials that emit little or no volatile organic chemicals like formaldehyde. These measures are becoming mainstream and cost-competitive.

Access to capital. It is an overriding tenet of capital investment in building projects that demonstrating financial sustainability with economic and investment returns sufficient to pay capital providers will generate access to more capital. Health systems with successful economic models will be operating hospitals whose building and care delivery processes are designed with a focus on quality, coordinated care, patient and employee safety, and economic sustainability.

Creating Fable 2.0

Like its predecessor, the Fable 2.0 hospital is an imaginary facility located in a medium-sized American city. It is a new three-hundred-bed regional medical center built to replace a fifty-year-old institution. Fable 2.0 provides a comprehensive range of inpatient and ambulatory services. It is

located on a donated urban site, so the cost of the land is not included in the calculations.

Fable 2.0 is approximately 600,000 square feet (2,000 square feet per bed) and costs $350 million to construct. Construction costs have increased substantially since 2004. According to Turner Construction, the average cost per square foot in an average city has more than doubled, from between $170 and $185 per square foot, to approximately $450 per square foot today. While construction costs in some areas are significantly higher or lower, we chose $450 per square foot as our baseline.

Fable hospital's leadership promotes superior clinical quality, safety, patient-focused care, family friendliness, staff support, efficiency, community responsibility, and ecological sustainability. Reflecting the latter goal, Fable 2.0 decided to achieve a sustainable building that met LEED's gold-certified level using a range of construction and operational initiatives. Management engaged an experienced, interdisciplinary health care design and construction team that was philosophically aligned with the organization's culture and values. The hospital board, medical staff, and management were actively involved in discussions about evidence-based design and its impact on ongoing operating costs.[14] The premium associated with the proposed innovations for the original Fable hospital was approximately 5 percent of total construction costs. For Fable 2.0, the premium was estimated to be 7.2 percent because of a longer list of evidence-based features, and approximately 8.4 percent when the list included design features that look promising but are not backed by research-based evidence.

The business case to build better health care facilities is stronger today than it was when the "Fable hospital," an imaginary amalgam of the best design innovations, was first proposed.

As can be seen from the tables, the payback for the Fable 2.0 investment should occur within three years—longer than the one year estimated for the original Fable hospital, but still a reasonable return by any business standard. A primary factor in the longer payback period is that our financial calculations no longer include increased revenue projections. We continue to believe that design innovations will often bring important economic benefits, but there is enough variability to make average revenue estimates unreliable.[15] We also believe that some hospitals that incorporate evidence-based design features will secure additional philanthropy. In Fable 2.0, we have been even more conservative in ascribing cost savings to evidence-based environmental design because, to be effective, design interventions must be part of a bundle of proven process improvements and cultural change.

Paralleling developments in evidence-based design is "target value design," a lean construction project process that enables designers to reduce waste and add value. Using target value design, Sutter Health reduced costs by over 20 percent during design and construction of its Cathedral Hill Hospital in San Francisco.[16] Target value design may help solve the problem of high initial costs.

Evidence-Based Innovations

We have organized recommended design innovations into two categories. The first, set out below and outlined in Table 1, are supported by research in peer-reviewed journals. The second (Table 2) includes innovations that are supported by experience but not yet deemed evidence-based.

Larger single rooms. Single-patient rooms are the most effective intervention and, as recommended by the Facility Guidelines Institute, have become the standard in most newly constructed or renovated hospitals. Single-patient rooms improve clinical outcomes by reducing hospital-acquired infections, adverse drug events, and falls. They also improve patient satisfaction. Increasing room size by one hundred square feet allows family members to stay overnight with the patient, increasing their satisfaction and involvement in care.[17]

Acuity-adaptable rooms. Hendrich and colleagues were among the first to present evidence that transferring patients from one level of care acuity to another can contribute to medical errors. While including infrastructure for monitoring equipment in patient rooms increases construction costs, it decreases transfers. Reducing patient transfers avoids diagnostic and treatment service delays, reduces medication errors and patient falls, reduces staff work load, and increases patient satisfaction.[18]

Larger windows. Increasing window size can increase light and enlarge views. Natural light and nature views are calming and instrumental in patient recovery and improved outcomes. The calming effect also benefits hospital staff.[19]

Larger patient bathrooms with double-door access. Many patient falls occur between the bed and the bathroom or in the bathroom itself. Enlarging patient bathrooms and widening bathroom doors help staff or family members assist patients moving to and from the bed and the bathroom.[20]

Ceiling-mounted patient lifts. Hospital staff experience a high rate of musculoskeletal injuries caused by lifting patients

Tables: Calculations of Costs and Benefits

Each design intervention was priced based on national averages as calculated by Turner Construction, a leading health care construction firm, and by our own experience. The figures are estimated averages; actual costs will vary.

Table 1. Costs of Evidence-Based Design Innovations

Innovations	*Additional Construction Costs*	*Design Details and Cost Calculations*
Larger Single-Patient Rooms	$13,500,000	Increase all 300 single-patient rooms by 100 sq. ft.: 100 sq. ft. x 300 beds @ $450/sq. ft.
Acuity-Adaptable Rooms	$202,500	Additional medical gases and monitor mounts to provide ICU/step-down capabilities with plug-in monitors for all 45 single-patient step-down rooms; all other rooms are conversion ready: 45 rooms @ $4,500/room
Larger Windows	$225,000	Increase typical patient room window size from 3 ft. x 5 ft. to 5 ft. x 8 ft. for all single-patient rooms: 300 rooms @ $750/room
Larger Patient Bathrooms with Double-Door Access	$2,880,000	An increase of 32 sq. ft. with a 4 ft. doorway for each of the 225 ADA-compliant private bathrooms: 225 bathrooms @ $12,800/room
Ceiling-Mounted Patient Lifts	$2,805,500	Patient lift equipment, track access to most rooms, including bathrooms, for all ICU and step-down rooms, as well as 10 general nursing unit rooms: 75 ICU/step-down rooms @ $18,100/room, 80 nursing unit rooms @ $18,100/room
Enhanced Indoor Air Quality	$374,400	Improved ventilation: HEPA filtration and increased air change rates for all air handling units serving patient care areas: 36 air handling units @ $10,400/unit
Decentralized Nursing Substations (Alcoves)	$135,000	Alcoves with direct views of patients for 270 non-ICU rooms; alcoves include charting, medications, supplies, alcohol rub dispensers, and access to computerized physician order entry; assumes substation between mirrored rooms with inboard toilets: 135 substations @ $1,000/substation
Hand-Hygiene Facilities	$235,875	Hand-washing sinks in all 300 patient rooms, automated alcohol-based hand-rub dispenser at each bedside in all 135 nursing substations: 300 sinks @ $750/sink; 435 alcohol rub dispensers @ $25/hand dispenser
Medication Area Task Lighting	$100,000	Increased lighting controls and intensity levels for all medication dispensing and staff work areas
Noise Reducing Measures	$600,000	Sound-absorbing materials, high-performance acoustical ceiling tiles, and carpet with antimicrobial properties in all patient care areas. Sound-absorbing wall materials with an extra layer of drywall, and acoustical ceilings with improved noise reduction in all 300 patient rooms
Energy Demand Reduction	$525,000	Reduce energy demand by 15% below baseline building performance:[1] accomplished by enhanced building commissioning
Water Demand Reduction	$550,000	Reduce potable water use by 30% with high-efficiency fixtures and by using nonpotable water for irrigation: $0.50/sq. ft. x 600,000 sq. ft. = $300,000 for water-efficient fixtures; $250,000 for rain water and condensate collection and detention tank for irrigation
e-ICU Comprehensive Remote ICU Monitoring Capability	$1,950,000	e-ICU infrastructure and equipment for each of the 75 patient rooms in ICU and step-down unit: 75 rooms @ $26,000/room

Healing Art	$640,000	Allowance beyond typical art budget to provide healing art for public and patient care areas; Fable hospital also rotates loaned artwork from local artists and solicits donated art: $500,000 increase in artwork budget, $140,000 for lighting enhancements
Positive Distraction Measures	$483,000	Additional allowance for music and other distraction measures in procedure areas and patient rooms: 345 rooms and procedure areas @$1,400/room
Healing Gardens	$1,000,000	Atrium, indoor plantings, fountains, outdoor gardens including meditation and strolling gardens, outdoor dining and meeting areas, playground, and pond
Total	**$26,206,275**	**Construction Cost Premium for Evidence-Based Innovations**
Percent Premium of Construction Cost	**7.20%**	**$26,206,275 or 7.20% of $350,000,000 construction cost**

1. Relative to American Society for Heating, Refrigerating and Air Conditioning Engineers standard 90.1-2007.

Table 2. Costs of Experience-Based Innovations: Supported by Experience but Warranting Further Study

Innovations	*Additional Construction Cost*	*Design Details and Cost Calculations*
Family/Social Spaces	$1,000,000	Space on each nursing unit to accommodate families and enhance involvement in the healing process; includes family rooms, kitchen, dining room, communication and business rooms, and sleeping rooms
Improved "Way-Finding"	$200,000	Enhanced navigation aids include landmarks, differentiated ceiling heights and lighting effects, information areas, space for volunteers, color-coded departments, distinctive doorways and openings, and open views to public spaces, atriums, and healing gardens
Health Information Resource Center	$240,000	An area with Internet-accessible health information: 800 sq. ft. @ $300/sq. ft.
Respite Areas	$200,000	Private reflection spaces for family and staff (separate) located on each nursing unit: eight 100 sq. ft. areas @ $250/sq. ft.
Staff Gym	$500,000	A gym with exercise equipment, changing rooms, toilets, and showers: 1,500 sq. ft. @ $300/sq. ft.; $50,000 for equipment
Decentralized Nursing Logistics	$600,000	Additional space on each nursing unit for medication, nutrition, linens, supplies, communications, consultation, and other nursing services: eight 250 sq. ft. spaces @ $300/sq. ft.
Environmentally Responsible Materials	$300,000	Local, regional, and recycled materials with little or no toxic content; "green" cleaning maintenance protocols $0.5/sq. ft. x 600,000/sq. ft.
Total	**$3,040,000**	**Construction Cost Premium for Experience-Based Innovations**
% Premium of Construction Cost	**0.87%**	**$3,040,000 or 0.87% of $350,000,000 construction cost**
TOTAL Construction Cost Premium (Evidence-Based and Experience-Based Innovations)	**$29,246,275**	**$29,246,275 (8.36% of $350,000,000)**

in and out of bed or a bathroom. Patient lifts are relatively new and are connected to the ceiling over the bed and extend into the bathroom. Using ceiling lifts reduces staff back injuries, staff sick time, and hospital costs.[21]

Enhanced indoor air quality. HEPA filtration is 99.97 percent effective in removing harmful particulates to reduce health care-associated infections. Infections can be reduced further if outside air is exhausted after a single use, rather than recirculated, as is standard in American hospitals today. In Fable 2.0, all of the air is exhausted after a single use.[22]

Decentralized nursing substations. Traditionally, hospitals were designed with one centralized nurse station per floor, but Fable 2.0 has decentralized stations, allowing nurses to see into the patients' rooms and respond to problems more quickly. Decentralized stations help reduce patient falls and allow nurses to spend more time in direct patient care.[23]

Hand-hygiene facilities. Hand hygiene is the most important measure for preventing the spread of pathogens. Convenient access to sinks in all patient rooms and other points of care helps increase hand-washing compliance.[24]

Medication task area lighting. Medication dispensing errors are reduced when lighting is improved because clinicians can read medication labels and prescriptions more accurately. Considerable research has shown that performance and errors are affected by lighting levels.[25]

Noise-reducing measures. Noise is a common problem for patients and staff, causing patients sleep deprivation, slower recovery, and increased stress. Fable 2.0 uses multiple strategies to quiet the building, including high-performance, sound-absorbing acoustical ceiling tiles, carpeting where possible, sound-absorbing finishes, noise and vibration-isolated mechanical rooms, wireless pagers, space for private discussion, reduced alarm sounds, and single-patient rooms.[26]

Energy demand reduction. Reducing fossil fuel use saves operating dollars, cuts carbon emissions, and lowers airborne emissions linked to community health problems (such as asthma). Energy demand is reduced through a high-efficiency building envelope and glazing, high-efficiency mechanical equipment, and heat recovery systems.[27]

Water demand reduction. As large water consumers, hospitals save money by implementing measures like low-flow fixtures, rainwater capture, and high-efficiency food service equipment. Water conservation measures do not include replacing hand-washing sinks with alcohol-gel alternatives, as water is often necessary to remove dirt from hands.[28]

Electronic intensive care unit. The e-ICU system is a remote, high-tech surveillance system, providing electronic, real-time connections to hospital ICUs. Using this system, which includes vital sign indicators and visual monitoring capabilities, physicians monitor the condition of multiple patients and communicate efficiently with staff, patients, and family. The use of e-ICU has reduced mortality rates, shortened the average ICU stay, and reduced costs.[29]

Healing art. Certain types of artwork in public and patient care areas can improve patient health outcomes. Art that depicts calming views of nature can reduce anxiety and depression and speed recovery.[30]

Positive distraction measures. Distraction can play an integral role in the patient healing process. In addition to art, calming music in patients' rooms and procedure areas can speed recovery and decrease patients' pain, length of stay, stress, and depression.[31]

Healing gardens. Well-designed indoor and outdoor gardens reduce stress and improve outcomes by providing positive distraction and restorative nature contact for patients, families, and staff.[32]

Experience-Based Innovations

While the following design innovations lack published research evidence, they have produced positive results in practice. We recommend that health care organizations consider them, and we have included them in our overall cost calculations.

Family/social spaces. Family support and involvement in patient care can enhance clinical outcomes and increase satisfaction with the hospital experience. Hospitals can foster these benefits by incorporating family gathering spaces, such as dining and kitchen spaces, business centers, and sleeping rooms.

Improved "way-finding." How easily patients and families can find their way into and around a hospital can exacerbate or reduce stress and anxiety. Visitor-friendly signage reduces confusion and staff time in giving directions.

Health information resource center. Readily available health information improves patient self-care in the hospital and following discharge. A library provides reliable information and can foster more productive communication.

Respite areas. Quiet spaces for reflecting and meditation help caregivers, patients, and families relax and contribute to improved satisfaction.

Staff gym. Exercise is an important source of relief and rejuvenation for people who work in demanding and stressful settings. Easily accessible exercise facilities can increase staff recruitment and retention and improve staff health.

Decentralized nursing logistics. Areas in or close to patient rooms for storing frequently used supplies and equipment and for having consultations can increase nursing productivity and time devoted to patient care.

Environmentally responsible materials. Careful selection of building materials can benefit both building occupants and the local community. Avoiding materials that emit toxic chemicals can improve indoor air quality and reduce public health impacts. Selecting local materials can also benefit the local and regional economy.

The Economic Benefits of Fable 2.0

Central to the Fable hospital concept is the importance of analyzing and estimating the impact of evidence-based design interventions on outcomes and operating costs. At-

tempting to analyze the incremental costs and benefits of design improvements is a daunting task. Similar to the health care quality improvement field, available evidence is regarded as inadequate by some in part because it often cannot be collected in a randomized controlled trial.[33] Also, the "average" hospital baseline keeps evolving, leading to questions about what design elements are considered "standard practice" and what innovations constitute "added costs" and require evidence. Most importantly, successful, specific environmental design improvements are usually part of a bundle of integrated facility and process improvements. Trying to isolate the effect of any one element is difficult and requires careful judgment.

We have analyzed ten design innovations that we believe are evidence-based and cost-effective. Using examples from the best available data and our own judgments, we reached conclusions about what portion of an improvement should be credited to design innovations. We have been conservative in our estimates. These calculations are based on specific examples and average costs. Leaders of individual projects will need to tailor their own estimates and analyses to their specific experiences. Details are shown in Table 3.

Few payers will reimburse hospitals and physicians for the costs of preventable harm. Building designs that help reduce harm are key elements in a hospital's survival strategy.

1. Fewer patient falls. Fable hospital reduced patient falls significantly. We attributed 30 percent of the reduction to variable acuity rooms, larger patient bathrooms with double doors, decentralized nursing stations, family space in each patient room, and electronic ICU capability.

2. Fewer patient transfers. Designing acuity-adaptable patient rooms by installing additional monitoring and other equipment enabled Fable to significantly reduce patient transfers, resulting in fewer errors, improved patient and family satisfaction levels, and reduced costs. In Fable 2.0, we were considerably more conservative than in the original Fable and assumed variable acuity rooms in the ICU step-down area only. We attributed 60 percent of the reduction to design improvements.

3. Reduced adverse drug events. As a result of larger private rooms, acuity-adaptable rooms, lower noise levels, and better task lighting, Fable measurably reduced adverse drug reactions that harm patients. We attributed 20 percent of the reduction to design improvements.

4. Fewer health care-acquired infections. As a result of larger single rooms, acuity-adaptable rooms, improved air filtration systems, and widely available hand-hygiene dispensers, Fable reduced health care-acquired infections. We attributed 20 percent of the reduction to design improvements.

5. Reduced length of stay. Using a combination of larger windows, calming views of nature and art, and positive distractions such as music, Fable reduced the need for anxiety and pain medication and overall length of stay. We attributed 10 percent of the reduction to design improvements. Many of the other design recommendations mentioned above also contribute to quicker recovery and shorter length of stay.

6. Reduced nursing turnover. An improved work environment—including such features as increased natural light, lower noise levels, patient ceiling lifts, improved location of supplies and medications, staff wellness and respite areas, and enhanced family involvement in care—helped reduce nursing turnover in Fable. We attributed 10 percent of the reduction to design improvements.

7. Fewer staff injuries. As a result of ceiling lifts in patient rooms and bathrooms, larger private rooms, larger bathrooms with double-door access, and staff exercise facilities, Fable reduced staff injuries. We attributed 50 percent of the reduction to design improvements.

8. Lower mortality and shorter length of stay in intensive care. Electronic ICU capability helped reduce Fable patient mortality and length of stay. We attributed a 40 percent reduction in cost per patient day to design improvements.

9. Reduced energy use. With high-efficiency building construction, high-efficiency equipment selections, and zoning of mechanical systems to operations, Fable measurably reduced energy use. We attributed an 18 percent reduction in energy cost per square foot to design improvements.

10. Reduced demand for water. Water conservation measures markedly reduced Fable's water consumption. We attributed a 30 percent reduction in potable water consumption to design improvements.

Crossing the Cost/Quality Chasm

The business case for building better facilities is even stronger today than in 2004 when the original Fable hospital was described. The costs of infections, falls, and errors are greater; the number of proven effective design interventions is larger; the willingness of payers to reimburse hospitals for harm they cause is ending; and the expectations of consumers are greater in an environment of increased transparency and

Table 3. Improved Outcomes and Cost Savings

We calculated the following savings based on published information. We used our best judgment to attribute a portion of the savings to evidence-based design improvements and attempted to be conservative.

Improved Outcomes	*Savings or Increased Revenue*	*Calculations*	*Design Details*
Patient Falls Reduced	$1,534,166	300 beds @ 80% occupancy = 240 beds or 87,600 patient days; three falls per 1,000 patient days = 263 falls/year; $17,500/fall = $4,602,500 spent on falls/year. Incidence of falls ranges from 2.3 to 7/1,000 patient days. Average cost of patient falls in hospitals is $17,500.[1] Pebble Partner Clarion Methodist Hospital reduced falls by 80%.[2] **Design features help reduce falls by one-third.**	Acuity-adaptable rooms, larger patient bathrooms with double-door access, patient lifts, decentralized nursing substations, family/social spaces
Patient Transfers Reduced	$877,500	25% of 19,500 patient stays are in the ICU/step-down unit. Assuming one transfer per patient stay, 4,875 transfers x $300/transfer = $1,462,500 for transfers each year. Average direct cost of one patient room transfer is $300.[3] Pebble Partner Clarion Methodist Hospital reduced transfers by 90% in its redesigned cardiac care unit.[4] **Design features help reduce transfers in ICU/step-down units by 60%** (assumes no reduction in transfers in medical or surgical units).	Acuity-adaptable rooms
Adverse Drug Events Reduced	$617,400	0.9 adverse drug events/100 patient days x 87,600 patient days per year = 788 events/year; assuming 56% are preventable, 441 preventable events x $7,000/event = $3,087,000 spent on preventable adverse drug events/year.[5] One study showed that medication-dispensing errors were reduced by one-third with higher work surface lighting levels.[6] Clarion Methodist showed a reduction in medication errors of 70%. **Design features help reduce adverse drug events by 20%.**	Larger private patient rooms, acuity-adaptable rooms, medication task area lighting, noise-reduction measures, e-ICU
Health Care-Associated Infections Reduced	$355,400	Two health care-associated infections (HAIs)/1,000 patient stays x 19,500 patient stays/year = 39 HAIs/year; average incremental cost/HAI patient = $43,000; 39 x $43,000 = $1,677,000.[7] **Design features help reduce health care-associated infections by 20%.**	Larger single-patient rooms, hand-hygiene facilities, HEPA filtration, improved indoor air quality[8]
Length of Stay Reduced	$1,092,975	87,600 patient days/4.5 days average length of stay =19,500 patient stays. One study showed a reduced length of stay of one day/stay as a result of increased access to sunlight.[9] Being conservative, we used a half-day reduction: 0.5-day reduction/stay x $1,121/day[10] = $10,929,750. **Design features contribute to length-of-stay reduction by 10%.**	Larger windows, increased natural light, noise-reducing measures, healing art, healing gardens
Nursing Turnover Reduced	$478,500	At 5.45 staff/occupied bed, Fable has 1,310 full-time employees, 395 of whom are nurses; attrition of 14%, or 55 nurses/year x $60,000 recruiting and training per nurse = $3,300,000 in nursing turnover costs per year. Bronson Methodist Hospital reduced nursing turnover from 14% (national average) to 10%, a decrease of 29%. Fable reduced nursing turnover by 29%, or $957,000.[11] **Design features help reduce turnover costs by 50%.**	Larger windows, noise-reduction measures, healing art, healing gardens, staff respite areas, and single-patient rooms

Nurse Injuries Reduced	$2,132,000	821,600 nurse hours/year x 20 patient handling injuries per 100,000 hours worked = 164 nurses injured/year,[12] calculated at $26,000/injury,[13] or $4,264,000 in patient handling staff injury costs/year. **Design features help reduce patient handling injuries by 50%.**	Larger patient bathrooms with double-door access, patient lifts
e-ICU Savings	$2,239,056	Cost-savings of $2,556/patient[14] x 2190 patients (in 75 ICU rooms) in Fable = $5,597,640. **The e-ICU model, dependent on design features, helped reduce ICU patient costs by 40%.**	e-ICU
Energy Demand Reduced	$653,400	Average U.S. hospital energy cost per year: $6.05/sq. ft., or $3,630,000. Dell Children's Medical Center of Central Texas reduced source energy demand by 45%.[15] The average hospital achieving LEED certification can expect approximately 18% reduction in energy demand. **Energy use reduction of 18%.**	Energy-conserving building envelope and glazing, fuel-efficient heating and cooling systems, heat recovery system
Water Demand Reduced	$51,765	Average U.S. hospital water consumption: 300 gallons/bed/day, or 32.8 million gallons/yr.; average cost of water is $2,720 per million gallons (not including sewer, heating, or other treatment). **Water demand reduction of 30%, or 9.84 million gallons; $26,765 per year plus $13,000 reduced sewer charges and $12,000 for lower treatment/heating surcharges.**	Low-flow fixtures, rainwater capture, high-efficiency food service equipment
Total Annual Savings	**$10,032,162**	**$29,246,275 total premium costs/$10,032,162 annual savings = a return on investment within three years.**	

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ease of comparing outcomes and experiences. In describing Fable 2.0, we were conservative in ascribing economic benefits to evidence-based design improvements. Despite this, Fable 2.0 provides a return on the incremental costs of design within three years. Health care leaders, architects, designers, and researchers have a growing body of evidence about how to build better hospitals. Existing health care facilities can also undertake high-impact innovations that improve care.[34]

The cost/benefit estimates contained in Fable 2.0 will vary according to the type of patient population and the region of the country. Our objective has been to broaden the conversation from one focused exclusively on capital costs to one that includes balancing capital costs and operating savings. We hope that health care and design leaders will strengthen their commitment to building better caring environments. Health care is one of the most personal and consequential services that people use. We should use our best available research and experience to build health care facilities that serve patients and staff better and cost less to operate.

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Case Study: *Dublin Methodist Hospital*

BY CHERYL HERBERT

Several years ago, we built a new hospital from the ground up in Dublin, Ohio, for the OhioHealth system, and we found ourselves presented with an opportunity to try to put the Fable hospital concept into practice. This planned ninety-four-bed community hospital was intended to serve the growing northwest quadrant of Franklin County, along with areas to the west and northwest. With tertiary facilities already a part of the OhioHealth system, Dublin Methodist was intended to provide primary and secondary care. Our goal was to be as innovative as we could afford to be, to challenge the status quo at every turn. Our stated purpose was to "redefine the way patient care is provided" through the development of a less-stressful healing environment, with an emphasis on patient safety and the patient/family experience. In addition, we promised the community a high level of customer service and elected to incorporate a fully electronic medical record management system in the new facility. The senior leadership and the board of directors of OhioHealth fully supported these efforts.

When planning began in 2004, it was apparent that evidence-based design could help to achieve many of our goals. We became aware of evidence-based design from Rosalyn Cama, a consultant on our architectural team who supported its use and employed its principles. The Fable hospital article provided guidance as we began our design journey.

First and foremost, we chose single-bed rooms, although they were not required by the American Institute of Architects until 2006. The evidence for this decision was strong;

Cheryl Herbert, "Case Study: Dublin Methodist Hospital," *Hastings Center Report* 41, no. 1 (2011): 23-24.