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THE BEST MEDICINE FOR FIXING THE MODERN HOSPITAL

THE LATEST MEDICAL BREAKTHROUGH IS THE HOSPITAL ROOM ITSELF.

BY RUSS MITCHELL

Rarely is nurse Cindy Steckel possessed by fantasies of unspeakable revenge. Toilet design, however, does provoke her fury. Whoever is responsible for the slim-doored, cramped configuration of patient bathrooms in most American hospitals draws her scorn. "I don't know if there wasn't such a thing as a walker back then," she says. "But if I could get my hands on the guy who designed these...!"

To anyone not yet jaded by the American health-care system, the idea that a hospital would provide a bathroom too tiny for an old person with a walker seems inane. But for decades, American hospital architecture was based on crude, now-outdated notions of efficiency and economy. Hospitals were designed for the wants and needs of doctors and hospital administrators. Patients weren't ignored--but they weren't top priority, either.

"Pleasant rooms aren't only more comfortable; they're therapeutic."

Now, health care reform is fundamentally changing the way hospitals are run, and with it the way they look. A combination of crushing costs, government edicts, and fierce competition for the millions of newly insured patients that will result from federal health-care legislation has put the patient front and center.

In part the impetus for the new-look hospital is bureaucratic: Medicare and private insurers are moving away from the traditional fee-for-service model, in which they pay doctors and hospitals for

each procedure they perform. Instead, they are beginning to adopt flat-fee payments that cover entire episodes of care--a knee replacement, say, or an arterial bypass operation. Such contracts long ago became standard practice in almost every other industry. Besides making the entire process more efficient, flat fees would put an end to long lists of billable items like \$150 Tylenol tablets. Medicare has also begun paying bonuses for hospitals that provide effective, high-quality treatment and penalizing those that don't meet basic standards or that have high rates of avoidable hospital readmissions.

Recently, [Kaiser Health News](#) analyzed Medicare data revealing that 2,217 hospitals--over a third of them--will face such penalties this year. Publicly available quality ratings, online and in publications such as Consumer Reports, add competitive pressure. What hospital wants to score "worse than average" for "bloodstream infection following surgery" on HealthGrades.com?

The changes dovetail with years of research showing that the color, shape, layout, and accoutrements of a hospital room have a direct effect on health. The typical hospital room, with its beige walls and stingy windows, carries a dim, funereal cast and works against patient well-being. The standard twin-bedded configuration doesn't help, fostering the spread of infection, making sleep difficult, and giving people at their sickest the dignity of life in a freshman dorm. By contrast, rooms that allow patients to see light and nature can speed healing and reduce delirium, pain, and anxiety. In other words, pleasant rooms--particularly private rooms--aren't only more comfortable; they're therapeutic.



Patients and doctors will be able to have video consultations with other members of the medical team. | Courtesy of HOK

These forces are turning the nearly \$3 trillion health-care industry inside out. While few completely new hospitals are in the works-- their number in the United States has remained at around 5,800 for nearly a decade--existing institutions are replacing old buildings and adding large wings, specialty centers, and outpatient clinics. Indeed, health care is one of the few sectors in the construction industry to be holding its own; in 2011, commercial construction in the United States declined 4%, while health care construction grew by 0.9% to \$39.7 billion. VHA, a network of 1,350 non-profit hospitals, last year reported that 67% of its members had construction projects underway.

All those new facilities are giving designers a chance to remake the hospital to thrive amid disruption and flux. The most visible result: patient quarters that resemble hotel rooms more than depression-inducing sickrooms. The new rooms in the Scripps Prebys Cardiovascular Center designed by architecture firm HOK and now under construction in La Jolla, California, are a prime example. Painted sky-blue and aqua-green, trimmed with cherrywood panels and with windows filling the entire outside wall, the rooms (all of which will be private) are designed to evoke nature and invite sunlight. They will provide more space for friends and family, easier access for staff, and safer pathways for patients as they move about. And the toilets will be big enough not only for

walkers but also for wheelchairs.

Tomorrow's hospital rooms will also be fully wired to help patients engage with the outside world and their own treatment. At the Kaiserslautern Military Community Medical Center in Germany, which will serve soldiers returning from the Middle East, instead of a TV hanging from a metal bracket showing a ghostly soccer game no one is watching, the entire wall opposite the bed will be an interactive video screen. Patients will be able to look at photos of the grandkids, stream Netflix, surf the Web, and Skype with their friends. They will also be able to see schedules for doctors' visits, call up staff bios, and hold video chats with teams of physicians.

The improvements don't stop with the patient rooms. New nursing stations will let staff monitor their patients more efficiently, reducing mistakes. Operating theaters will be more flexible, allowing performance of multiple tests and procedures without moving patients around. Hallways and facades will feature works of art.

Modern medicine has produced an astounding cornucopia of technology: medical devices, pharmaceuticals, imaging equipment, surgical tools. The hospital itself will now be part of that arsenal.

The first hospital was a hole in a rock. Archeologists have uncovered signs of caregivers moving in and out of these quarantine chambers. The Egyptians and Greeks provided zones for the sick, but the approach was mainly palliative. Before the dawn of modern medicine in Europe, the burden fell on families to care for the sick in their homes; the homeless might find refuge in a hospital run by nuns or monks.

The early hospitals of the modern era were dark, dirty, nightmarish warehouses for the seriously ill. In the mid-19th century, Florence Nightingale created large hospital wards with high ceilings, clean air, and bright outside light, presaging today's focus on light and nature. (She also professionalized nursing.) Europe stuck with the ward model well into the 20th century, but prosperous, individualistic America moved to four-bed and then two-bed

hospital rooms. These rooms were cheap-to-build rectangles with beds, a sink, and a toilet. At the time, nobody considered that the room itself could affect a patient's health, for better and for worse.

The last couple of decades, however, have produced a large body of research into the environmental and architectural effects on patient health, much of it peer-reviewed and appearing in scientific and medical journals. In 2005, a team at the University of Pittsburgh Medical Center studied the effect of sunlight on the recovery of patients who'd just had spinal surgery. Comparing patients on brighter and darker sides of a room, the experiment concluded that sunlight significantly reduced both pain and the need for analgesic medication. Dozens of other studies have reached similar conclusions on patient exposure to nature and art, classical music, colored walls, and the presence of family members. And starting in 2014 up to 30% of a hospital's Medicare quality score, which influences a hospital's payments, will be based on patient satisfaction.

Other recent research has looked at how hospitals contribute to patient harm. The most consequential study (it made the front page of the *New York Times* on Nov. 30, 1999) concluded that medical errors, along with falls and medication mistakes, were responsible for up to 98,000 deaths in American hospitals each year, making preventable hospital errors the fifth leading cause of death, behind only maladies like heart disease and cancer. The report, by the Institute of Medicine of the National Academy of Sciences, declared: "Health care is a decade or more behind many other high-risk industries in its attention to ensuring basic safety." In a recent op-ed piece in the *Times*, Dr. Sanjay Gupta said the death toll from these factors could now be 200,000 a year. Nor are better results beyond the realm of good practice. According to a report by the Institute of Medicine published this September, 75,000 needless deaths could have been averted in 2005 if every state had delivered care on par with the best-performing state.

Till recently, hospitals had little financial incentive to curb such outcomes. Under the fee-for-service model, the more procedures doctors and hospitals perform, the more revenue they accrue, whether the procedures are necessary or not. Perversely, hospitals have raked in extra income for treating conditions

acquired at the hospital; if a patient gets a staph infection from, say, a dirty IV after a splenectomy, the hospital can charge both for removing the spleen and treating the infection. Starting in 2008, the federal Centers for Medicare & Medicaid Services began denying payments for certain infections, falls, and medication errors under rules developed during the George W. Bush administration. Private insurance companies are beginning to follow suit. Hospitals are finally giving patient safety its due.

Innovation in architecture, says Chuck Siconolfi, begins by clarifying the problem. Whippet-thin, with a darkly mischievous look that recalls John Waters, but more handsome, Siconolfi is director of health-care innovation, planning, and design at HOK, one of the world's largest architectural firms and a leading designer of health-care facilities. Hospital design in the new millennium, he says, starts with this question: "Who is in these hospital beds?"

The answer today is the sickest of the sick. Refinements in technology and surgical techniques allow millions of patients to be treated in outpatient clinics. "Fifteen years ago, you injured your knee skiing," he says. "They'd have kept you overnight or a couple of days. Today they send you home that afternoon."

With few admitted for minor surgery, hospitals now house mainly those suffering from serious heart problems, neurological issues, severe trauma, and a host of other risky, complicated maladies. They're on a lot of meds. About 40% of hospital stays are for patients who are over 65 and hence particularly vulnerable to accidents and treatment errors. All of these factors are key issues in hospital design.

When HOK began creating the University Medical Center of Princeton at Plainsboro, in New Jersey, a replacement hospital building that opened this past May, fall prevention was a top priority. Nurses wanted clear sight lines into the room, so they could see if someone was struggling to get out of bed. Presenting the design problem was the usual culprit: the toilet. The safest place for the toilet is near the patient, along the wall on the same side of the room as the bed. But putting it there would obstruct the nurse's view of the patient's head.

Solving the problem, says Siconolfi, involved a lot of iterative discovery. After polling the client about the scope of the job, the architects generated drawings and then got feedback from users-- patients, doctors, nurses, orderlies, food workers, family. Put the toilet near the window? It cuts into the view, reduces natural light, and cramps visitor space. Putting it on the wall opposite the bed forces the patient to cross the room, the leading cause of nasty falls (and leaves less room for a media screen.) The architects translated their revisions into virtual mockups on a computer screen, then 3D full-size models built with foam walls and furniture, finally a mock-up of a room containing the real goods.

The solution to the toilet-sightline problem at Princeton: the parallelogram. By canting the room at angles like a diamond on a playing card, the toilet can go near the patient, along the same wall as the patient's head and near the front door, but recessed so that the nurse can see the patient from head to toe. The arrangement also gives the patient better views of the window and the video screen.

The room's layout is novel, too. The space is divided into three zones: family, patient, and clinical staff. The entire window area is given over to the family and other visitors, with extended seating below the window, transformable into a bed. The patient zone includes the bed, the toilet, and the media wall. A remote control gives the patient power over the TV and Internet, as well as the window shades, light, and temperature controls; no more calling for the nurse to turn the heat down a notch. The staff zone has a dedicated sink separate from the patient's bathroom, a computer screen for electronic records, and a medicine supply cabinet refillable from the hall, allowing for accurate, timely deliveries and minimizing patient exposure to microbes.

For all the architectural innovation, the most significant change is the shift to private rooms, which will both improve care and save money. As numerous studies show, sharing a hospital room significantly increases the chance of acquiring a life-threatening infection. The infection rate for those in private rooms is far lower. "It should be obvious that when two patients are separated in different rooms, you have much less cross-contamination," says Dr. George Tingwald at [Stanford University Medical Center](#).

Tingwald, a gray-haired man with the friendly face of a family practitioner, directs medical planning at the center. A former executive at the architecture firm Skidmore, Owings & Merrill, he's one of a handful of professionals licensed both as an architect and a doctor. A major upgrade and expansion now underway at Stanford will add 144 hospital beds--all in single, private rooms. "It costs less to operate a private room hospital," says Tingwald, "so everyone is doing it." In fact, almost no one in the United States is building two-bed rooms now, and in some states, health codes require that all rooms be private.

That private rooms can curb infection is easy to understand, but to say they save money seems counterintuitive. And indeed, a private-room hospital is costlier to build, with more square feet per patient. But hospitals are able to recover those costs, and then some. One way is through higher occupancy rates--potentially 90% to 95% at an all-private hospital compared with 75% or so for a double-room facility. The reason for the difference is that anybody can be assigned to a private room; for double rooms, hospitals must consider gender and age. The main costs savings, however, will come from avoiding penalties (and earning bonuses) as Medicare and private insurers boost quality requirements.

Finding hard numbers to show the payback on design improvements is tough without access to hospitals' internal financial records. Blair Sadler, a senior fellow at the Institute for Healthcare Improvement and a former hospital CEO, led a team in 2011 that evaluated the costs and benefits of the best "evidence based" hospital design, including larger single patient rooms, bigger windows, cleaner air systems, and decentralized nurse stations placed closer to the rooms. For a typical 300-bed hospital with a \$350 million price tag, such amenities cost an additional \$30 million. But the changes yielded annual savings of about \$10 million, giving a payback of only three years. "The rooms we have now are way outdated," says nurse Steckel, who is the chief nursing and operations officer at Scripps Memorial La Jolla. "Now, the rooms for patients will look and feel rich, but don't cost rich."

New hospital design isn't limited to patient rooms. The operating theater is changing too.

Lauren McKenna is a space programmer. Nothing to do with NASA or Elon Musk's SpaceX. Her job, at HOK, is figuring out how much floor space a hospital needs, with the help of published research.

McKenna's background is in finance, but she looks all-architect: black outfit, black stockings, dark hair in a bun, rectangular glasses with a muted black and gray tortoise-shell finish. Her job is unusual in architecture. She crunches through databanks packed with peer-reviewed medical studies from scientific journals and devises ways for health-care systems to boost quality while reducing costly square footage.

Consider medical robots, which are fast becoming standard assistants in surgery. Their micro-movements make for smaller and more accurate incisions that heal faster than cuts made by even the most skilled human hands. Younger, tech-savvy surgeons are especially enthusiastic about robot surgery. The precision of robots in operations like heart-valve replacement and ovarian tumor removal can trim two full days off a hospital stay. Faster healing means quicker discharge. And with patient days reduced, fewer rooms are needed, saving big on both construction and operational costs. Hospitals can opt to use that freed-up space for planned expansions in service. McKenna works with clients to choose the best tradeoffs. Her software program has bar graphs that rise or fall depending on the square footage that a technology or treatment requires. "It gives hospitals the choice," she says.

Making facilities flexible can also save both lives and space. At the Prebys heart center in La Jolla, HOK designed hybrid operating rooms. The time needed to get a heart attack victim from the emergency room to the surgical table is critical for survival. New Medicare standards introduced under the ACA reward hospitals that shorten the lag time between the decision to treat with heart surgery and the surgery itself. Rushing doesn't help. A well-thought-out process does.

In a typical hospital, a heart-attack patient first goes to a room for catheterization, where a long probe is sent through blood vessels to the heart for X-rays. If surgery is warranted, a trip down the hall to the operating room comes next. Each room visited entails

additional transfers between gurney and table, increasing the chance of infection and falls; the delays hurt too. HOK's hybrid ORs contain versatile gear that lets the staff conduct both diagnostic procedures and surgery without having to move the patient from place to place. "You do a cath, and if that's not enough, you can open up [the patient] to do more," says Steckel. "The patient is already on an operating table. You have the equipment right there."

No one pretends hospital architecture can solve all the ills plaguing U.S. health care. Given an aging population and a culture expecting high levels of medical service that someone else pays for, the problems run deep. Better-designed hospitals, though, save money by reducing hospital stays; they keep patients safer; they help them feel better about their experience, speeding their recovery. Intelligent building design isn't a cure by itself, but truly efficient health care will be impossible without it.

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