THE BIOETHICS OF BUILT SPACE

HEALTH CARE ARCHITECTURE AS A MEDICAL INTERVENTION

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The architectual design of hospitals and long-term care facilities can have profound effects on patients' freedom, patient outcomes, and clinicians' performance. Because certain aspects of these built environments are akin to medical interventions, these design elements require ethical scrutiny and empirical study. They also give rise to new moral obligations to patients at the individual and population levels.

Architecture inherently reflects the normative preferences of its time; today, the ethical concerns about buildings and construction tend to focus on environmental impact. While those matters are significant and worthy of greater attention, here we focus on how design in the health care setting can raise medical ethical concerns. Decisions made in health care architecture have myriad effects on patients, families, and staff.[1] Design is being employed increasingly often to alter specific behaviors, mediate the interactions of those within the health care spaces, and affect patient outcomes.[2] We propose that advances in design science and understanding of its powerful effects are now such that, in some instances, the built environment in health care should be considered analogous to a medical intervention. As with medical interventions, the intentional use of the built environment to effect perceptual and behavioral changes in patients or residents should be appropriately disclosed, as should harms caused by a building itself.

But while some of these effects bear on individuals such that an informed consent process may be sufficient, others have population-level impacts that can persist for generations. In the latter instances, mandatory reporting, appropriate oversight, or corrective measures may be necessary to ensure protection and equitable care for all patients.

What might be called the "science of control" includes work in medicine, neuroscience, and psychology that is being employed to several ends. We

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focus on two purposes to which these efforts have been turned. First, a significant portion of this work is aimed at manipulating the behavior of patients and residents of long-term care facilities with neurocognitive impairments, generally to ensure personal safety and minimize conflicts with staff. This is a laudable goal, as recent experience with Covid-19 has highlighted serious shortcomings in care of older people in the United States and Canada; but questions about freedom, consent, and disclosure remain largely unasked and unanswered.[3]

Second, other work focuses on improving patient outcomes or the performance of health care teams. It is known, for example, that as the number of steps necessary to reach a sink increases, the percentage of those who wash their hands decreases.[4] There is evidence that in some intensive care unit (ICU) designs, certain rooms correlate to better (and worse) outcomes, raising questions about equity and fairness. In other cases, certain designs seem to correlate with the use of certain procedures over others, raising questions about intentionality and choice.[5]

As a result of this innovation and discovery occurring outside the boundaries of traditional care delivery and oversight (such as a provider-patient relationship or research protocol), important ethical questions emerge. While the following is not an exhaustive treatment, we aim to bring attention to the issues, provide ethical analyses, and make some recommendations on how to proceed. We begin with the following case studies, which divide the issues roughly along the two distinctions described above. The first case study highlights examples of design interventions in the science of control in long-term care settings. The second case study includes examples of design science in service of improved hospital outcomes.

To date, there has been little ethical investigation of these practices, as the elements affecting control are not providers, researchers, or medications, but the hospital or long-term care facility building itself. Is there a salient difference between using medications to limit wandering of persons with dementia and using architecture to induce psychological states that achieve the same end? Broadly, this raises issues about the nature of the built environment, what those responsible intend to do with it, and whether obligations are engendered alongside our increasing knowledge of its effects.

If evidence suggests that patients in less-visible ICU rooms tend to have poorer outcomes, then we have a duty to address that possible problem seriously.

A brief explanation of architectural decision-making is in order to identify some of the moral agents in the following cases and discussion. While health care architects act as agents of the facility's owners and are responsible for the technical design, their actions are constrained within a design process that includes health care administrators, caregivers, engineers, constructors, and governmental authorities. During longer projects, some of the key decision-makers may leave their contributing organizations, and some decisions are revisited by their replacements. However, even after a project is completed and the design team disbanded, decisions continue to be adjusted by the operators of the building. Moral agency for any single decision, or even the aggregate of decisions, will seldom rest with a single contributor. Patient-level representatives have limited autonomy in this process, and patients must rely on the decisions made for them by this collective.

Case Study: Design Trends in Dementia Care

Although architecture cannot necessarily treat disease, it can be an important tool in care strategies. The bioethical connection between architecture and dementia is neurological: the brain regions affected in the early stages of Alzheimer's overlap with the areas important for spatial navigation.[6] Research into these impacts has revealed losses in perceptual abilities in persons with dementia that may limit their navigation of certain settings in which others move around without difficulty. Instead of managing the challenging behaviors through traditional methods (such as locking exterior doors, physical restraint, or the use of medications),[7] design-based approaches use the perceptual differences of persons with dementia to decrease dangerous behaviors. For example, persons with dementia and certain sensory impairments often avoid shiny floors and surfaces with extreme glare,[8] grid patterns on floors,[9] and black areas in or on floors (such as black floor mats),[10] design elements that may induce a fear of falling into a hole and thus discourage a resident from attempting to exit. As these interventions rely on creating a misperception of the space, the grid pattern has been shown to lose its deterrent effect when the method is applied in front of glass doors; the view to the outside presumably entices the resident to approach.[11] Nursing homes around the world are putting these and other understandings about design to use in behavior management.

Because an illusion must successfully deceive in order to be effective, the natural progression of illusion is complete immersion. De Hogeweyk, the original "dementia village," is set in The Netherlands. Instead of limiting wandering, the facility promotes permissive wandering but combats the confusion and spatial disorientation experienced by people with dementia by means of a created reality. In the dementia village, residents are free to visit amenities such as shops, a café, and a pub; purchases are made with fake money, lending a sense of realism to transactions. Anecdotal reports from De Hogeweyk note less agitation and fewer behavioral disturbances in addition to fewer doses of psychotropic medications, although no formal studies to date have attempted to quantify the village design on outcomes.

Similarly, The Village Langley, a new, five-acre *Truman Show*-esque development in Langley, British Columbia, is designed to create an artificial reality for patients living there with dementia.[12] Billed as "a small community nestled in a quiet neighborhood," the project is a purportedly "therapeutic golden cage" modeled on De Hogeweyk.[13] Like De Hogeweyk, The Village Langley creates a sense of freedom, but that sense is entirely illusory; the bus stops are fake, and there is no open door to the outside world. Residents are encouraged to believe that they are free to go wherever they wish while they are being guided by various design elements.

Finally, the memory care unit in Chagrin Valley, Ohio, resembles a town of the 1930s or '40s, when many of its residents were children. In most nursing facilities, when a resident becomes restless and requests to go home, the typical approach is to use sedatives to pacify the patient and nudging to facilitate the action the caregivers seek. In this facility, the anxious resident is escorted to a fake bus stop to wait for a bus that never comes. After some time, the resident forgets their request and is escorted back to their room, presumably never having felt trapped, confused, or panicked.[14] These architectural elements are designed to avoid the indignities of sedation, prevent the panic ensuing from feeling trapped or unable to leave, and give the resident, who is unable to safely act on their own, a sense of autonomy and control. These examples highlight the use of deception and illusion in the modern design of some innovative dementia-care facilities.

Case Study: Design for Outcomes in Hospital Care

One conclusion to draw about all the residential designs in the above case study is that there is a demonstrable need for more research into the interventions described. Nowhere is that more apparent than in the literature on how architecture can be used to affect outcomes. In 1984, a small retrospective study (n = 46) conducted by an environmental psychologist examined hospital stays in postoperative patients. One group's hospital window faced a brick wall, the other's a park.[15] The group facing the park had shorter hospital stays and took fewer doses of pain medications. This pivotal study launched the field of evidence-based design, as architects found evidence to support what had been instinctive beliefs. In 2008, a literature review cited some 1,200 evidence-based design studies,[16] many of which examined nature's role in treatment, with findings supporting the hypothesis that access to nature and views of nature reduced stress, lowered blood pressure, and diminished the need for pain medication.

But in 2013, a large retrospective cohort study of over 12,000 ICU patients found that rooms with windows or natural views did not improve outcomes or reduce the costs of in-hospital care for general populations of medical and surgical critical care patients.[17] Yet while the 2013 study seems to cast doubt over the absolute requirement that patient rooms have windows, that research had its own limitations. Ambient light levels were not measured, nor was room orientation, and some commentators have raised questions about the unknown amount of time patients had their eyes open during the study, owing to the patient's potential sedation, blindness, or brain injury.

While the utility of some architectural interventions remains inconclusive, there is compelling evidence that outcomes may be affected by other variables in the immediate built environment. A 2020 literature review noted eight environmental factors that have been found to affect patient outcomes: form (shape of interior space), unit layout, floor material, room features, visibility of medical equipment, nature, lighting, and music.[18] The review described several significant examples:

ICU room visibility. A resident physician working in an ICU observed that corner rooms, which cannot be seen by nursing staff and physicians as easily as centrally located rooms, appeared to be associated with worse patient outcomes. The physician subsequently conducted an empirical study and found that severely ill patients may experience higher morbidity and mortality rates when assigned to ICU rooms poorly seen by nursing staff and physicians.[19]

Treatment intensity. The physical design of health facilities affects how the spaces within are used and therefore can influence treatment intensity. An assessment of twelve labor-delivery suite facilities' floor plans and design features revealed compelling relationships between several design elements and the medical care provided to patients. Some labor-and-delivery facility designs were associated with markedly differing rates of vaginal versus cesarean births. Both clinical decision-making (such as when to perform a cesarean) and differential experiences of the patients were linked to facility designs.[20]

Patient falls. A retrospective cohort study found that, for shared-room designs, the incidence rate of in-hospital patient falls was significantly lower among patients hospitalized in window beds than those in beds located away from the window. The study's authors suggested that bed location could be part of a strategy for preventing in-hospital falls.[21]

Infection control. The 2008 review of evidence-based design studies suggested that the physical environment influences nosocomial infection rates by affecting all three major transmission routes—air, direct contact, and water.[22] Across studies, infection rates are lower with good air and water quality, greater physical separation or space per patient, and more accessible handwashing stations. A 2016 McGill University study quantified design and handwashing compliance, finding that for every additional meter walked to a sink, provider handwashing likelihood decreased by 10 percent.[23] Most recently, Covid-19 infection rates have been linked to design standards for Canada's nursing homes; facilities built to an older design standard accounted for 33 percent of nursing homes, but 57 percent of the deaths that occurred.[24]

Research into outcomes has also begun to focus on design's impact on staff members' delivery of care. Transitioning from centralized toward decentralized nursing stations has been a debated topic in health care design research and practice. While the 2008 literature review found that decentralized nursing stations increased staff effectiveness (by reducing staff walking time and increasing patient-care time),[25] a more recent systematic review of the available empirical evidence found mixed results, with inconsistent findings for decentralized designs. The review went on to say that the literature on the topic was "of very low quality and show[ed] inconsistency in associated outcomes."[26] Design characteristics, for example, were found to be diverse among studies, with a range of architectural solutions lacking standard definitions for decentralized nursing stations or consistent categorization of nursing-station type. While much has been written about the effect of the built environment on human experience, even perception, the impact of the built environment on burnout and staff turnover remains largely unexplored.

Two Sets of Ethical Concerns

The case studies presented above reveal ethical issues that, while interwoven, can be broadly divided into two general types of ethical concerns. The first involves the limiting or affecting of individual patient or resident choices. These issues are comparable to those that arise in traditional discussions about the use of deception[27] and "nudging"[28] and include concerns about freedom, informed consent, and surrogate decision-making. The second type revolves around obligations that may arise with emerging knowledge of how architecture impacts patient outcomes. These issues include research, reporting, and population-level concerns. Issues related to elements of the built environment that alter or effect staff behavior and clinical decision-making fall into this second set of concerns.

> **The problems with surrogate decision-making in medicine are exacerbated by the scope of the effect on the patient when their built environment becomes a medical intervention.**

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Deception and nudging. As trust is the basis of the therapeutic enterprise, the use of deception in medicine is challenged by the obligation to be truthful. Deceptions and nudges are justified, if they can be justified at all, only by preventing greater harm than they themselves cause. The harms include the damage done to the right of the patient to be fully informed and act freely, the risk of harm to the therapeutic relationship, and the risk of harm to trust in medicine as a whole. This is a high standard, to be sure.

Deceptions in this setting are comparable to placebos. Rather than inducing a seemingly medicinal effect, deceptions are used to obscure certain areas or access points and to create a sense of place and belonging in long-term care facilities. Obscuring access to a staff space for reasons of safety and creating an immersive environment that leads people to believe that they are somewhere else (even that they are living in a different time) involve new concerns—is there a right to reality, or is living in a false world in some cases appropriate? More will be said about this later.

Nudging is defined by Richard Thaler and Cass Sunstein as "any aspect of the choice architecture that alters people's behavior predictably without forbidding any options or significantly changing their economic incentives."[29] Nudging is, on some accounts, aimed at triggering what Daniel Kahneman refers to as "System 1" decision-making mechanisms—those faster, less-conscious processes that are experienced as immediate, with no sense of voluntary control. Proponents of nudges reason that patients are still free to choose otherwise; system 1 mechanisms can be overridden with more deliberate thought about what one wants (that is, by "System 2").[30] In situations where the patient or resident does not override system 1, the presumption is that, because the person could have done so and merely chose not to, the nudge is ethical.

Among the examples in the case studies, the use of floor patterns to influence the behavior of people with dementia is one that may appear to allow individuals to make a system 2 decision.[31] However, translating the justification for nudging to this case is immediately suspect because the justification presumes that the patient has the ability to move between system 1 and system 2. In persons with dementia, cognitive issues such as loss of short-term memory can leave system 2 unusable. Rather than forming an intention to pursue some goal by proceeding through a series of choices and actions, persons with dementia often lose track of the initial goal, whereupon "fast" system 1 mechanisms intervene to guide their actions. The person then proceeds on the fly, but with decision points that are not tethered to the initial intention, leaving the person to pursue tangents or set new goals—from which they may also diverge.[32]

In the setting of dementia and long-term care facilities, the intention to affect a resident's choice, such as where to walk, often capitalizes on the person's disability. So rather than their decision-making mechanisms, it is the disease itself that is determinative. In this sense, arguments supporting deception and nudging fail insofar as the resident may not be able to truly choose otherwise or may need to overcome a fear response to do so. If the former, the resident is not free to choose otherwise; if the latter, the intervention is coercive rather than merely nudging. This is not to say that the intervention is unethical but, rather, that it is unlikely to be grounded in this sort of justification.

Other justifications for deception and nudging may be found in the idea of supported decision-making, particularly for people who are marginally autonomous or have dynamic impairments.[33] In this decision-making model, the person with impaired capacity freely chooses to be supported by a trusted party who assists them to exercise their self-determination. A person at the margins of autonomy may consent to be steered away from certain activities, actively relying on others for their judgment of what is in the person's interests. A person with waxing and waning capacity may be able, under certain circumstances, to reaffirm consent to such limits. Rather than viewing the floor pattern as a nudge, they may see it as a guardrail of sorts. In this way, self-determination is ultimately preserved.

While the goals of assuring resident safety and reducing staff-patient conflict are laudable, there is something almost sinister about how these goals are achieved. Employing a person's disability to control their behavior is in direct conflict with the broader societal movement toward the inclusion and self-actuality of persons with disabilities over the past fifty or so years, and especially since the Americans with Disabilities Act of 1990. And yet the balance of harms and benefits depends on one's perspective. The potential benefits of the design-based interventions described in our first case study are many: lowering patient stress, reducing conflicts with staff, sparing patients the indignities of being sedated, and lessening the potential for injury. These benefits may be achieved at the cost of limiting abilities that residents have little, if any, of to begin with, such as reasoned decision-making.

However, it could be contended that the means of these interventions are fundamentally at odds with the principles of care for vulnerable members of society—independent of the harms and benefits involved. The nature of the intervention also may be an issue. Using artificial world building to convince a person with dementia that they are somewhere else, in some other time, or doing something else may be abhorrent to an aging person who can no longer live independently. It is just these sorts of choices—ones in which a value consideration is decisional—that an informed consent process is designed to solve.

Freedom and informed consent. It seems unreasonable to argue that using neuroscience and medical research to develop strategies for controlling people's behavior by inducing psychological states in them and then employing those tools to help confine them in medical facilities is somehow not a medical intervention. And that's a reasonable description of some of the architectural elements described above. Further, if these strategies are, in effect, medical interventions, then patients' consent should be sought for them. But how can people with dementia or otherwise diminished capacity consent to such things?

Some ethicists have suggested advance deception directives,[34] but as Onora O'Neill has argued, informed consent already cashes out in practice as the right to accept or refuse the interventions on offer, and no more.[35] If current practices are anything to go by, the freedom to refuse at all may be a bridge too far. Often, elderly persons are removed from their homes—very much against their own wishes—and placed in long-term care if they suffer too many falls or are deemed unable to care for themselves. Sometimes, the desire to remain in one's home is taken as evidence of a lack of capacity to act in one's best interests. Similarly, interventions to employ the science of control could come to be widely accepted. Indeed, they could proliferate so broadly that there could at some point be no alternative to them.

Other ethicists are concerned with the "carceral" character of nursing homes and long-term care[36]—a fear that became newsworthy in the course of the pandemic. Legally, a person's designated health care power of attorney or surrogate decision-maker may be allowed to consent on the person's behalf, but what counts as legal consent is not always ethical. As a self-regarding notion, informed consent is justified by two things. First, the first-person epistemic knowledge of the person's own wishes, values, and goals is unavailable to others; they are the authority on themselves. Second, the person will live with the decision in a way no one else will. So, while the first observation is to conclude that if a building or design element demonstrates the ability to control behavior, then it should be treated as a medical intervention, closely following that is a second question—whether a medical-like consent process is sufficient for strategies that make use of the science of control.

Issues with surrogate decision-making. We should keep the limits of surrogate decision-making in mind when thinking about design interventions in long-term care facilities. Neither of the foundational justifications of informed consent exist with surrogates, and thus, while we use surrogates in the medical setting as the best means of approximating what a person would want, deciding for others is fundamentally different from deciding for oneself. This concern is particularly acute when the line between surrogate decision-making and outright conservatorship becomes blurred.

In the cases above, the design interventions in long-term care facilities seem more akin to lifelong, mind-altering medications than to procedures or lines of therapy of the kind typically decided by surrogate decision-makers. Interventions that affect the perception of spaces, particularly those that may induce fear, may affect the entire lived experience of the person, not just those aspects related to medical care. Moreover, these interventions are applied in situ, such that the resident generally may not leave. Thus, the problems with surrogate decision-making in medicine are exacerbated by the scope of the effect on the patient when their built environment becomes a medical intervention.

These decisions can remold a person's world; some designers are contemplating ideas such as making all mirrors in a facility computer monitors that instantly de-age the residents so that when they look in the mirror, they see a younger version of themselves. The potential benefits of such interventions come alongside ethical uncertainty, all without the protections afforded patients receiving medical care or subject to research. At some point, quantity becomes its own quality. A singular intervention may have a given effect, as when a trompe l'oeil obscures a door; the door remains hidden from the residents, but their lived experience remains otherwise intact and unaltered. This type of intervention can be justified by the harm that could result were the resident able to get into the medication room or another space where safety or harm might be an issue. Daniel Sokol has proposed a "deception flowchart" that physicians could use to determine the appropriateness of a particular deception.[37] However, Sokol and others have viewed deception as consisting of a discrete intervention. Total and immersive environments from which residents likely cannot leave should meet high levels of scrutiny, and surrogate consent alone may not be sufficient.

Most hospital leaders underestimate the ability of their facilities' physical design to both harm their patients and improve outcomes. No one can know what effect the built environment has on patient outcomes if those effects are not studied and measured.

The problems with surrogate consent for these interventions are suggested by the constraints widely accepted for surrogate decision-making. A surrogate may not appropriately subject a person to just anything they choose; there must be demonstrable benefits that outweigh the anticipated harms. The proposed treatment must be standard of care, not experimental. And short of legal or magisterial oversight and approval, a surrogate may not force nonemergency medical treatment on an unwilling person simply because the person lacks capacity. U.S. society places freedom of choice over beneficence in all but the most extreme circumstances. If a temporary medical detention order is granted, most states strictly limit its effect to a matter of hours. Acknowledging the medical treatment-like effects of the science of control engenders the obligation to meet the standards the society has established for, at a minimum, the rights people hold to refuse similar interference with their persons and lives.

Admittedly, the ethical dynamics of nudging patients who have cognitive impairments are complex, involving trade-offs between very dissimilar benefits and harms, and often without being able to include in the decision-making the person most affected by the decision. Moreover, the poor correspondence between surrogate decision-makers' views about decisions and patients' own wishes is well documented. Given the heterogeneity of dementia and of personal preferences about the dignity of risk, there are unlikely to be generalizable answers. It may be that advance care planning in the future will need to include questions about the nudging measures to which the patient is comfortable being exposed. It seems likely that some portion of patients would prefer the risks and confrontations of a non-nudging environment to an orchestrated reality. Ultimately, what is required is a reimagining of how we care for older people and people who have impairments in our society. It may turn out that research into the science of control, and ethics of its use, could yield insights that render benign some or all of the concerns raised here. For example, research might show that a subset of persons would prefer the artificial world building if it would make their lived experiences easier or better and that they would consent to it in advance.

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Research, reporting, and population-level concerns. Health care organizations regularly conduct institutional surveillance to optimize various behaviors and policies known to affect outcomes, such as using checklists to minimize surgical-site infections, moving high-risk procedures to specialized services, and promoting cultures of safety that incentivize reporting of adverse events, which must be reported to regulators and are subject to scrutiny. Institutions less commonly perform design-based interventions to optimize outcomes.

Appeals to individual behavior—such as initiatives to encourage handwashing regardless of sink proximity—are common and certainly have a role to play in improving outcomes, but physical design is often overlooked as one of the most powerful motivators of behavior. The ICU study of patient outcomes when patients are placed in rooms that cannot be seen well by clinicians is a case in point; no one can know what effect the built environment has on patient outcomes if those effects are not studied and measured. Most hospital leaders underestimate the ability of their facilities' physical design to both harm their patients and improve outcomes.

While it is an ethical maxim that people cannot be responsible for something over which they have no control, one liability of the discovery of new knowledge is the emergence of new responsibilities. Now that we in the medical, bioethical, and public health professions know that the built environment has profound effects on those within a space, we have an obligation to think more carefully about how we or others design those spaces. If evidence suggests that patients in less-visible ICU rooms tend to have poorer outcomes, then we have a duty to address that possible problem seriously. That the cause of the disparity or harm to patients is the building itself, rather than a treatment or therapy undertaken by a medical care team, does not alter the obligation to address it.

A partnership between the professions of architecture, medicine, and bioethics could be fruitful for thinking through these population-level concerns. Such a partnership would rely on insight, good data, and a willingness to work together. Architects are uniquely positioned to educate and lead improvements in design policies, but deciding who ultimately should bear responsibility for addressing these issues is more complicated. And given the vast sums involved in any sort of renovation after construction, hospital leaders will be understandably hesitant to investigate these matters too rigorously once a building is built; the disincentives simply outweigh the potential benefits from an administrative perspective.

The effects of design on patient outcomes will likely require something along the lines of Centers for Medicare and Medicaid Services-mandated reporting, such as is the case with falls and infections. As with any other interventions, whether interventions through the built environment are successful will not be known if their effects are not measured.[38] It may be appropriate to consider a U.S. Food and Drug Administration-like approval process that involves some sort of consensus standards and oversight for interventions that leverage cognitive impairments or induce psychological states. Perhaps a parallel to the Americans with Disabilities Act could be useful in conceptualizing the implementation; much will depend on further research into understanding these effects and attention to the proliferation of their use.

At a minimum, the interventions described here, and the expansion of their use, merit evidence-based investigation. Consider that when a new substance that has medicine-like effects appears on the market, the FDA is authorized to examine and potentially regulate it. We are witnessing the development of new interventions that appear to have powerful effects on some of the most vulnerable members of society. The obligation to study the potential benefits and harms should not be excused merely due to the form these interventions take.

A Path Forward

The health care built environment should, in many cases, be considered analogous to a medical intervention and should therefore be subject to similar ethical scrutiny. This is especially true when design elements use knowledge of cognitive impairments to influence behavior or are associated with relevant medical outcomes. While work remains to be done to understand the full scope, impact, and ethics of the built environment as a medical intervention, we offer several basic recommendations:

- Architectural interventions intended or known to have effects on patients comparable to the effects of medical interventions should be subject to similar scrutiny, oversight, and transparency.

- The informed consent process should disclose any design interventions aimed at modifying behavior, whether as part of a hospital admission process or when a patient is moving to a long-term care facility.

- Surrogate consent to a long-term care facility that employs deception or illusion, particularly when against the patient's wishes, should be subject to additional oversight and scrutiny.

- Hospital quality-improvement departments should monitor the effects of their institution's built environment on relevant patient outcomes and examine more architectural interventions to improve outcomes.

- Institutions responsible for oversight (for example, the Centers for Medicare and Medicaid Services, state departments of health, and hospital associations) should mandate the reporting of built-environment elements proven to affect patient outcomes in health care facilities' outcome reports.

- Funding is needed to create a robust health-environments research infrastructure that can demonstrate the cause-and-effect relationships between the built environment and health, just as such funding is needed to promote the high-quality research on medicine and other treatment that ensures ethical conduct and patient safety.

The issues raised here are distinctly medical and bioethical, and the profession of architecture lacks the significant machinery that medicine or bioethics can call upon for longer-term, project-spanning research enterprises. Evidence-based design, therefore, requires a multidisciplinary approach involving changes at each of the levels cited above: at the bedside, at the drawing table, in the patient-safety department, and in the government. Such a foundation would allow for investigation of broader improvements in health care delivery: design that improves or enhances spaces for psychosocial support[39] or even enhances one's capacity to better cope with the stress of being or having a loved one be in need of hospital care.[40]

Notes

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