Architecture as a Cure: Building a Better Defense Against Hospital Infectious Disease Spread

By Chaya Rosenbaum

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Dawn, a child who survived a car accident but left the hospital with a highly contagious condition.[1] Scott, a child who underwent facial surgery after he contracted a dangerous communicable disease from Dawn.[2] Allison, a teenager who experienced a knee reconstruction operation and then fought a near-fatal infection.[3] Amber, a bride-to-be and dedicated nurse who was not protected from her patient's illness.[4] A bridal shop one thousand miles away from Amber's hometown, which closed permanently due to health risks.[5] Edward, a husband and father who succumbed after six years to a disease he caught in an isolation room, after it took away his leg.[6] Theresa and Gina, Edward's distressed family members, who lost their loved one and their lifelong peace of mind about their health.[7] Gwen and Bohmati, two nursing assistants who suffered from skin infections passed on from the convalescent residents they bathed.[8] Walter and Orlin, their husbands, who were not shielded from their wives' work.[9] Albert, a security guard whose day on the job led to a year of worrisome testing.[10] JoAnn, his wife, whose night of sexual activity with him brought her the same fate.[11] These individuals, interrelated through threads of infectious medical conditions, share the same disastrous tie: they endured infectious diseases that originated in hospitals.[12]

Hospitals are meant to shelter, care, and cure.[13] One of the oldest doctrines in medicine is "First, do no harm"—or, in Latin, "*Primum non nocere*"—an aphorism attributed to Hippocrates.[14] It extends beyond refraining from affirmative harm to preventing harm, a component often underplayed in physician practice.[15] While many think of hospitals as sterile and safe environments, it is estimated that the number of patients who die from a hospital-acquired infection (HAI) is more than double the number of annual car crash victims.[16] People enter American health-care institutions for care—but some exit only after being treated for newly acquired conditions, including falls, burns, blood incompatibility, or the presence of foreign objects retained in their bodies after surgery.[17] Specifically, infectious diseases constitute one type of hospital-acquired condition that spreads within a hospital, transmitted by patients and staff through direct contact or unclean surfaces.[18]

While these facts are alarming medically, they present several legal challenges too. Litigation over HAIs is not a clear matter. The cause of action for a victim of an HAI can be indeterminate. State courts have applied tests for whether these cases fall within the area of medical malpractice statutes, common law negligence, or other tort law. These differences affect plaintiffs by implicating procedural requirements and recovery limits. Different causes of action also expose defendants to wide risks of liability. These legal issues surround the lack of a universal cause of action for contracting an infectious disease in a hospital.

However, hospital architecture can inhibit the medical and legal problems of HAIs. Research illustrates the need for improving hospital building and design. Although the building of hospitals is heavily regulated, gaps exist within the regulatory scheme. Incorporating changes into hospital building code policy may reduce hospital disease spread.

HAI spread in the U.S. hospital system has medical and legal gravity, and change in hospital building code regulation can aid in its prevention. This paper addresses the issue of HAIs and proposes the area of hospital architecture as a basis for new policies to counteract them. Part I reveals the severity of HAIs. Part II discusses the litigation issues surrounding HAI claims, for both plaintiffs and defendants, and reviews state court HAI decisions. Part III describes the current hospital building code regulatory structure and provides ideas for preventing disease spread through hospital architecture. This research serves to educate about the anomalous suffering caused by health-care institutions within the area of infectious diseases, and to promote feasible policy changes in health-care architecture to alleviate the consequences of those statistics.

Hospital-Acquired Diseases

A person who enters a hospital is, ironically, at risk for developing a health condition. While the term *hospital-acquired conditions* is broad, the specific focus of this paper is infectious disease spread within hospital buildings. An HAI, also termed a nosocomial infection, is one that is acquired by a patient who enters a hospital for

a reason other than the infection.[19] Examples include blood infections from central lines; urinary tract infections from catheters; surgical site infections; pneumonia from ventilators;[20] and 20 common viral and bacterial infections, such as tuberculosis (TB), hepatitis, staph infections, influenza, and human immunodeficiency virus (HIV).[21] These infections can be transmitted though airborne, waterborne, and foodborne particles; respiratory aerosols; injection sites; and direct contact with patients and staff.[22] The most infections occur in intensive care units and surgical wards, and patients at higher risk are those who are elderly, are undergoing chemotherapy, or have underlying illnesses.[23]

Worldwide, nosocomial infections are prevalent in an average of 8.7 percent of hospital patients; and, at any given time, over 1.4 million people suffer from infectious complications acquired in hospitals.[24] Nationally, nosocomial infections are prevalent in an average of one in every 31 patients.[25] There were about 687,000 nosocomial infections in U.S. hospitals in 2015, and about 72,000 of those patients died during their hospitalizations.[26] The financial burden of nosocomial infection treatment was calculated to be over $4 billion in 2013.[27]

Furthermore, there is a current antibiotics crisis that affects nosocomial infection treatment.[28] Misuse of antibiotics encourages the growth of "superbugs" that are immune to drugs and kill off patients' protective bacteria.[29] When antibiotics are used widely, patient microorganisms sensitive to the given drug are suppressed, while resistant strains persist and may become endemic in a hospital.[30] The threat of antimicrobial resistance is on the rise, with many drug-resistant pathogens associated with infections with higher morbidity.[31] Many of these infections are commonly acquired in hospitals.[32] The pharmaceutical industry cannot keep up with these specialized medication needs.[33] Soon, there may not be medication to control the types of infections transmitted in hospitals.

In these ways, nosocomial infections are a medical, financial, and ethical problem in this country. Unfortunately, for those who suffer from an HAI and for hospitals who need to defend themselves against ensuing litigation, the path toward legal justice is rife with issues.

Causes of Action for Nosocomial Infectious Disease Claims

With so many cases of nosocomial diseases, one may think that hospital infection-control conditions are ripe for litigation. However, the path for recovery for patients who suffer from an HAI is murky. With no universal breach of infection-control standards to create a cause of action, people affected by nosocomial infectious diseases rely on various state tort claims. This causes an unclear basis of litigation for plaintiffs, results in differences in procedure and damage recovery, and creates a risk of a wide range of claims for defendants.

Ambiguities: Medical Malpractice or Common Law Negligence?

The first way to sue a hospital over a health concern is usually via a medical malpractice claim. However, state medical malpractice statutes differ as to whether infectious diseases fall within their scope. Some state legislatures have classified claims against the conduct of a health-care provider that results in an infectious disease as common law negligence and, thus, do not provide a method of relief through the state's medical malpractice statute. This differentiation, which can be difficult to determine, is often not within the knowledge of plaintiffs and leads to differences in damages and procedural requirements.

In one divided West Virginia case, *Riggs v. West Virginia University Hospitals, Inc.*,[34] Allison Riggs underwent knee reconstruction surgery and contracted a serratia bacterial infection in the hospital.[35] She suffered from complications, procedures, and further surgeries over the next five years.[36] Her claim against the hospital, which alleged failure to exercise reasonable care during a serratia bacterial outbreak, was brought under the state medical malpractice statute,[37] the Medical Professional Liability Act (MPLA).[38] The jury awarded a limited amount of noneconomic damages, pursuant to the provisions of the MPLA.[39] However, the plaintiff argued that the MPLA, narrowly interpreted, does not include claims against infection control because such claims are against an "administrative function involving the environmental safety of the hospital" and because Allison was not rendered care by the infection-control department.[40] The plaintiff appealed and redefined the claim as a premises liability issue, which fell outside the MPLA and was not bound by the noneconomic cap.[41]

As a procedural matter, the appellate court rejected the argument, based on the doctrine of judicial estoppel.[42] However, as a matter of law, the concurrence by the chief justice highlighted the difficulties in separating medical malpractice and common law negligence claims.[43] The medical malpractice statute in that jurisdiction covered injuries resulting from health-care services rendered.[44] In Justice Davis's opinion, because Allison was admitted to the hospital for knee surgery, a claim for failure to control an infectious disease outbreak fell outside the medical malpractice statute.[45] The hospital breached a general duty to maintain a safe environment,[46] and, therefore, the plaintiffs could have and should have brought a cause of action under general common law negligence.[47]

This opinion tells us that claims of hospital failure to maintain an environment sterile from infectious disease can fall outside state medical malpractice legislation.[48] In fact, "[t]he distinction between medical malpractice and negligence is a subtle one, for medical malpractice is but a species of negligence and 'no rigid analytical line separates the two.'"[49] This differentiation leads to ambiguity over causes of action.

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whether to allow claims inside the parameters of medical malpractice statutes or to designate them within general negligence.[50] For example, Tennessee bases a medical malpractice determination on "whether the alleged negligent conduct bears a substantial relationship to the rendition of medical treatment by a medical professional."[51] Connecticut adds two more considerations to the substantial relationship test: (1) negligence of a specialized medical nature and (2) a claim within the capacities of medical professionals.[52] Michigan's test is phrased as "(1) whether the claim pertains to an action that occurred within the course of a professional relationship; and (2) whether the claim raises questions of medical judgment beyond the realm of common knowledge and experience."[53] Louisiana's test, with six detailed factors, adds considerations of intent and the necessity of expert medical evidence, among others.[54] These differing state rules show how the right cause of action can be ambiguous in nosocomial infectious disease cases.

Differences in Recovery

Aside from confusion over the cause of action to present, plaintiffs in nosocomial infectious disease cases also are affected by differences in recovery. In *Riggs*, Justice Davis found that the plaintiff's claim for a nosocomial infectious disease clearly fell outside medical malpractice under all of the above tests.[55] The difference meant that the plaintiff may have received a greater reward for noneconomic damages if she had sued under a common law negligence claim at the outset.[56] By contrast, sometimes advancing the wrong claim under a state's rule may bring procedural problems that result in no recovery at all.

A prime example of this type of situation is in Texas's medical malpractice statute. In a 2018 decision, *Texas Health Resources v. Coming Attractions Bridal & Formal, Inc.*,[57] the Texas Court of Appeals considered whether a nosocomial infectious disease should be classified as a medical malpractice or a common law negligence cause of action.[58] In the case, Amber Vinson, a nurse, cared for an Ebola patient until the patient's death.[59] The hospital said that she posed no risk and was free to socialize in public.[60] Amber visited a bridal shop in Ohio in preparation for her upcoming wedding.[61] When she returned home to Texas, she was diagnosed with Ebola.[62] The wedding shop was mandatorily closed for cleaning by Ohio authorities.[63] It never regained community trust and closed permanently due to perceived Ebola risks and stigma.[64] The shop brought a negligence action against the hospital, alleging that it failed to respond and take protective measures[65] after it had been warned by local health organizations and the Centers for Disease Control and Prevention (CDC) about an imminent Ebola outbreak, and after its staff was exposed to this dangerously communicable disease.[66]

Texas's medical malpractice statute, the Texas Medical Liability Act (TMLA),[67] requires that a claimant with a health-care liability claim (HCLC) serve an expert report for each health-care provider against whom a claim is asserted, in a timely fashion, or the claim may be dismissed.[68] The plaintiff argued that as a negligence claim, its claim was not included under the TMLA and therefore was not bound by those restrictions.[69] However, the court ruled that the bridal shop had an HCLC and dismissed the case due to lack of a timely expert report.[70]

The court's reasoning was twofold.[71] Firstly, it applied textual definitions to the term *health care liability claim*.[72] It then determined whether there was a safety standards–based claim presented that fell under the *health care liability claim* definition by employing a "substantive nexus" test,[73] and the use of seven *Ross* factors.[74] The court found that "[t]he safety standards that [the hospital] allegedly violated arise directly from its professional duties as a health care provider. They are not the types of duties that arise in an ordinary negligence case."[75] Thus, it concluded that the bridal shop's claim against the hospital for failure to contain the Ebola outbreak was within the parameters of the state medical malpractice statute.[76]

Here, unlike in *Riggs*, the court held that a nosocomial infectious disease claim fell under medical malpractice legislation and not common law negligence.[77] However, in greater contrast, the plaintiff lost all possible recovery due to bringing the wrong claim.[78] In fact, the expert report provision in the TMLA has caused many plaintiffs to lose all damage recovery because of the statute of limitations in the claim assertion.

For example, in *Southeast Texas Cardiology Associates v. Smith*,[79] Mr. Smith, a patient at a cardiology office, tripped over a weight scale, underwent hip surgery, and died from complications.[80] His widow tried to sue for negligence within a wrongful death claim, in a case unrelated to infectious diseases.[81] However, the court held that she had an HCLC under the TMLA because a substantive nexus existed between the safety standards at issue and the provision of health care and because the *Ross* factors were satisfied.[82] Thus, the court dismissed Mrs. Smith's claim altogether because she missed the 120-day deadline for filing the required expert report as part of a TMLA HCLC.[83]

By contrast, in the earlier *Galvan v. Memorial Hermann Hospital System*,[84] the same court decided that a visitor's slip and fall on water on a hospital floor did not constitute an HCLC[85] specifically because it didn't implicate

infection-control standards,[86] so there was no substantive nexus between safety and care.[87] The case was remanded for further proceedings instead of dismissed because the expert report was no longer required, and the plaintiff had another chance at recovery.[88]

These two distinguishing outcomes illustrate how variations between negligence and medical malpractice actions affect recovery, which holds true specifically with infectious diseases. In particular, the Texas medical liability statute greatly limits plaintiffs' relief because of the Texas courts' inconsistent classification of causes of action within this area.

Many Theories of Liability

The ambiguity in infectious disease causes of action within tort law, which affects plaintiffs' claims and recovery, also results in increased liability for defendants. Nosocomial infectious disease spread can create a wide range of causes of action, in addition to malpractice and common law negligence. The different possibilities for claims implicated by an HAI leaves hospital defendants open to a variety of litigation.

One case that addresses numerous tort claims within a nosocomial infectious disease context is *Padney v. Metro-Health Medical Center*,[89] an Ohio Court of Appeals case in which a hospital employee, Edward Padney, contracted multidrug-resistant TB while assisting with an autopsy of an infected cadaver.[90] Three years later, the disease was active in Edward's body, and he suffered respiratory failure and a leg amputation.[91] He died during a violent coughing fit, after three more years of considerable suffering from unchecked pulmonary TB.[92] Edward's wife and daughter also contracted the disease, and it remained latent within them with a risk of activity in their lifetimes.[93] They advanced several claims against the hospital for failure to adequately control disease transmission within the workspace, including counts of intentional tort, loss of consortium and services, and negligent infliction of emotional distress.

Regarding the nosocomial infectious disease in this case, the facts are extreme and worth noting. The autopsied patient had not been treated until the last two weeks of her life, when the contagiousness was increased.[94] She also suffered from acquired immune deficiency syndrome (AIDS), which resulted in the dispersion of TB throughout her body.[95] The multidrug-resistant nature of the TB strain made it nonresponsive to regular treatment and caused a high mortality rate.[96] The hospital did not order special precautions for handling the patient's cadaver.[97] The ventilation system in the autopsy room was operating with six air changes per hour, half the amount recommended by the CDC guidelines for preventing TB in a health-care setting.[98] The hospital relied on ultraviolet (UV) lights, but an infection risk remained.[99] Although CDC guidelines recommended that personal respirators be worn by personnel performing autopsy procedures,[100] the employees wore regular surgical masks.[101] Despite this, the lower court found for the defendant in a directed verdict decision.[102]

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Regarding the claims in this case, the intentional tort claim elements required a standard exceeding negligence or recklessness and required that the hospital knew about the existence of the dangerous condition, knew that harm was substantially certain to occur, and yet required the employee to perform a dangerous task.[103] The appellate court found that the evidence satisfied the elements and reversed the intentional tort decision, with the associated loss of consortium claims.[104] For the emotional distress claims, the court held that the hospital owed a duty to the family members of employees who worked in risky workplace conditions[105] and that living with a latent condition that had a high mortality rate was a "real danger, not a non-existent peril."[106]

While the ultimate ruling in this case was fair, it shows the multitude of tort claims, such as emotional distress, that can be involved in nosocomial infectious disease actions against hospitals. It also establishes a duty to family members and introduces the first case herein in which the plaintiff was an employee.

These factors were present in similar cases in Alaska and Louisiana. In an Alaska Supreme Court case against a residential health-care facility, in which two nursing assistants and their spouses contracted staph infections, the court decided that the facility owed a duty of care to employees' spouses to control or warn of the danger of infection.[107] The nursing assistants had brought workers' compensation claims, and the spouses had brought personal injury claims.[108] In a similar Louisiana appellate case against a hospital, a security guard, who was not warned of a need for protective equipment, got blood on his hand while restraining a patient with AIDS.[109] That court decided that the security guard's wife had a cause of action for negligent infliction of emotional distress because it took a year of testing to determine if either sexual partner was infected.[110] The workers' compensation and emotional distress elements of these claims show that hospitals have a range of tort liability with nosocomial infectious disease claims.

Moreover, defendants' liability can exceed tort law. For example, in *Derrick v. Ontario Community Hospital*, Dawn, a child, was hospitalized following a car accident.[111] Unbeknownst to her or her guardian, she was

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released from the hospital with an infectious, highly contagious, communicable disease.[112] She came in contact with another child, Scott, who contracted the disease and subsequently suffered from extensive facial surgery, as well as great mental and physical pain.[113] Scott and his guardian brought a negligence action against the hospital for exposing a patient and others to the hazard and for failing to notify both Dawn and Scott about it.[114]

Surprisingly, the California Court of Appeal ruled that the hospital was not liable for breaching any common law duty.[115] First, the court found that a claim for exposing a patient and others to the disease without implementing proper safeguards was a "vague, conclusory allegation."[116] Second, the court found that the hospital owed no duty to Scott to inform him of Dawn's disease because "[i]t would impose an intolerable burden upon [a] [h]ospital to notify all members of the public that one of its patients being released from the hospital is suffering from a contagious, communicable disease."[117] Third, the court found that the hospital had no duty to warn Dawn or her mother that Dawn had contracted a disease because it was the treating physician's duty alone.[118]

However, despite this determination, the court found liability under a state health code violation, which provided for negligence under a statutory duty that did not exist under civil negligence.[119] According to California legislation,[120] the hospital had a duty to report the disease to a local health officer.[121] Thus, the case was remanded to trial to prove that the hospital violated the statute and that the violation proximately caused Scott's injuries.[122]

The case of Dawn and Scott is interesting on two accounts. Firstly, it provides a detailed analysis of a hospital's duties to report the contagiousness of released patients, or lack thereof. Secondly, it finds liability for a defendant in a nosocomial infectious disease case in no area of tort law but rather under state legislation alone. Together, all of these cases show that defendants in nosocomial infectious disease cases face risks through a variety of legal channels, such as workers compensation, personal injury, infliction of emotional distress, and statutory violation.

Summary of Litigation Issues

In sum, litigation for nosocomial infectious diseases is not well-defined. Plaintiffs often face ambiguity over which cause of action to advance, as courts differ in whether they categorize infectious diseases as medical malpractice or common law negligence. The differences in causes of action detrimentally affect procedural requirements and damages. Defendants carry a risk of liability for infectious diseases under numerous areas of law, within both tort law and state legislation. Ultimately, the best way to alleviate these issues is to prevent nosocomial infectious diseases.

Architectural Regulation for Reducing Infectious Diseases in Hospitals

There are many ways to fight the spread of disease within hospitals. Examples include handwashing, respiratory etiquette, other personal hygienic practices, environmental cleanliness, personal protective equipment, and strong administrative leadership.[123] However, one specific means to aid in this endeavor is the architecture and design of hospital buildings. Although the current building code standards are comprehensive, there are gaps in the regulatory scheme and space for practices that aid in infection reduction.

Hospital Building Code Standards and Regulations

Hospital buildings are complex structures, and the regulation over their construction and operations is specific, specialized, and complicated.[124] Due to hospital functions, hospital architects need to address efficiency, cost-effectiveness, expandability, sustainability, cleanliness, aesthetics, accessibility, security, and safety.[125] Therefore, hospital buildings are among the most highly regulated building types.[126]

Broadly, hospital building code standards in the United States are governed by federal and state regulation.[127] State building codes vary, but many jurisdictions have adopted the Facilities Guidelines Institute (FGI) *Guidelines for Design and Construction of Hospitals*[128] and the International Code Council's *International Building Code* (*IBC*)[129] as regulatory bodies.[130] Federal building codes apply to hospitals on federal property and are usually in compliance with parts of the *IBC*.[131] To be accredited, hospitals must meet the standards of the Joint Commission.[132] Federal law also affects architecture as it relates to the Americans with Disabilities Act (ADA), the Occupational Safety and Health Administration (OSHA), Centers of Medicare and Medicaid Services (CMS) standards for participation, accommodations for the Health Insurance Portability and Accessibility Act (HIPAA), requirements for military buildings, and executive orders.[133] This is but a general picture of the administration that covers this issue.

Room for Improvement

Although there is much regulation, or perhaps because of it, there are gaps in the current hospital building code structure. Firstly, the Joint Commission, which gives accreditation to U.S. hospitals under many state licensure and CMS certification conditions, also makes hospitals

self-regulated.[134] The government relies on it to accredit hospitals, but the Joint Commission rarely withdraws approval from facilities.[135] Furthermore, accreditation by the Joint Commission is not associated with better patient outcomes.[136]

Secondly, the CDC, a world leader in public health, functions only as a source of data.[137] As a federal agency, it has some rulemaking power over quarantine, but disease reporting by states is voluntary.[138] The CDC has guidelines for health-care facilities for infectious diseases, but CMS and other accrediting organizations generally do not require the implementation of all CDC-recommended practices.[139] In congressional testimony about health-care-associated infections in hospitals, the U.S. Government Accountability Office reported that there was a lack of department-level prioritization of the CDC's strongly recommended practices, that there was no one responsible for coordinating infection-control activities across the Department of Health and Human Services (HHS), and that more leadership was needed to improve data in HAIs.[140]

Finally, building code regulation only provides a minimum standard for architects. This results in disparities between hospital building design in urban and rural areas, or in public and private sectors. Although health care is not distributed with equitable outcomes in this country, even a less expansive point of view about the right to health care in the United States concedes that there should be equal access to a fundamental level of care.[141] Perhaps some architectural infection-control elements can be considered as part of a decent minimum of care.

These three reasons show that the regulatory structure is not airtight in providing satisfactory hospital building code enforcement.

Ideas to Implement

To fill the gaps in the regulatory policy, a proposal of specific measures is appropriate. There are various areas in which architectural measures can be implemented to reduce nosocomial infectious diseases. Through the study of "evidence-based design"[142] for hospital architecture, experts have found ways to promote better patient outcomes.[143] Ideas include ventilation, water systems, building materials, clinical input, nonprofit advocacy, and learning from health crises.

Ventilation. Regarding ventilation, from an early time, Florence Nightingale was a proponent of proper ventilation in hospitals to reduce airborne infectious transmissions.[144] She considered depriving patients of a properly ventilated environment "nothing but manslaughter under the garb of benevolence."[145]

Modern research has confirmed the connection between indoor environmental conditions and disease spread. A study of environmental and operational parameters was conducted in a brand-new hospital building at the University of Chicago, by collecting air samples every day for a year.[146] It found that variations in the survival of viral and bacterial microbes can be partially attributed to differences in temperature, humidity, and sunlight, which are affected by different occupant preferences, different types of windowpane glass, and hospital floors that use different air-handling units.[147] A related study of blood cultures in U.S. hospitals showed that hospital-associated blood infections were more prevalent when outdoor temperatures were higher.[148] This may be associated with changes in indoor heating, ventilating, and air-conditioning (HVAC) operation.[149]

Current HVAC-related regulations[150] in hospitals include air changes and different configurations in specific types of rooms.[151] However, an aerobiology study in health-care facilities showed that frequent air changing does not radically reduce airborne infectious particles and that particles spread evenly throughout spaces regardless of HVAC configuration.[152] The filtration systems in use were found to be suboptimal and dated, while natural air changes were found to be helpful.[153]

Further studies, inculcating Nightingale's approach, confirmed that natural ventilation achieves higher air change rates than mechanical ventilation.[154] In one study, old English hospital buildings that featured high ceilings and large windows were correlated with greater protection for TB patients than those in modern buildings.[155] In a similar study, patients transferred from these older types of hospitals had significantly fewer staph infections than those in a mechanically ventilated ward.[156] Additional studies in China and Thailand proved that operable windows, cross breezes, and rooms that weren't solely air-conditioned successfully raised air changes to prevent infections.[157] In the United Arab Emirates, a contaminated air conditioner duct caused an infectious serratia outbreak in a hospital baby unit.[158] While natural ventilation poses disadvantages, such as fall and contaminant risks,[159] it is a beneficial means undervalued in hospital buildings.

In sum, these studies indicate ventilation in hospitals can be either detrimental or helpful in preventing infectious disease spread. HVAC conditions and mechanical systems showed harm, while historical perceptions of natural ventilation proved healthier. Presumably, the hospitals in these studies where diseases were spread because of ventilation issues were built according to code. Therefore, a review of ventilation regulation in building codes for U.S. hospitals based on this research is warranted.

Water systems. Regarding water systems, numerous water-based practices in hospitals have been linked to nosocomial infectious diseases, particularly Legionnaires' disease, a type of pneumonia that is spread through water.[160] This disease and similar ones have been attributed to hospital plumbing systems; decorative water fountains; hands-free faucets; humidifiers; birthing pools; therapy tubs; bathing facilities; thawing techniques for frozen blood products; sinks, toilets, and showers with

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splash-back; and tap water used in ice machines and rinsing protocol.[161] Furthermore, as of 2015, there were no widely accepted guidelines for the prevention of Legionnaires' disease, most organizations only addressed water system management on a macro level, and only 10 states had significant prevention guidelines that included routine water testing for this disease.[162] Perhaps hospital building code regulation can give more deference to simple fixture design, in addition to large-scale plumbing maintenance requirements.

Building materials. Regarding building materials, copper alloy has been proven to be a building material upon which bacteria die.[163] In a hospital study in which commonly contaminated surfaces, such as bed rails, intravenous poles, and call buttons, were replaced with copper ones, the results showed a 58 percent reduction rate in nosocomial infections.[164] Additionally, copper holds U.S. Environmental Protection Agency public health registration, which allows its products to be used in hospitals as a safe sterilant.[165] Finally, the cost for copper installation, taking into account savings from prevented nosocomial treatment, can be recouped by a hospital in 37 days.[166] Usage of this material would have a big impact if it was included in hospital building code regulation.

Clinical input and nonprofit advocacy. Regarding clinical input and nonprofit advocacy, building codes within health care are often not based on medicine.[167] Therefore, the inclusion of medical professionals in the hospital design process can effectuate evidence-based design.[168] Infection-control experts should be privy to building plans from early stages, and their consultation should be contractually prescribed for building professionals.[169] Additionally, there are advocacy groups that offer valuable information about safer hospital building design. Examples include MASS Design Group, a nonprofit architecture and civil rights organization that provides access to better-designed hospital buildings in Africa;[170] Clinicians for Design, which aims to close the gap between health-care and design professionals, particularly within the neuroscience and mental health fields;[171] and ASHE Advocacy Highway, a division of a larger health-care builders association that liaises with the government to address building code legislation affecting the health-care environment.[172] These organizations have conducted research within the health-care architecture field that can be enlightening for regulatory reform.

Learning from health crises. Lastly, regarding learning from health crises, many changes within health-care spaces have been made while fighting the COVID-19 pandemic. Examples include increased use of telemedicine, private bedrooms and bathrooms, UV light disinfection of HVAC systems, plexiglass partitions,[173] touch-free controls, elimination of window curtains, and distance between patients—all while the emergency design of makeshift hospital spaces afforded the ability to avoid many mandated compliance protocols.[174] Perhaps some of these changes should be enforced to prevent other types of disease spread in the future.

Summary. In sum, there are numerous studies that promote the implementation of better building code regulation to prevent disease spread in hospitals. Research in areas such as ventilation, water systems, and building materials and knowledge gained through clinical input, nonprofit advocacy, and the current health crisis reveal factual results that alleviate nosocomial disease spread through changes in architecture. Policy changes in building regulation should follow this research. Reform should also address gaps in the current regulatory system stemming from widespread jurisdictional legislation and ineffective accrediting and advising institutions.

Conclusion

In conclusion, the spread of nosocomial infections is a problem in the U.S. hospital system. Litigation for patients who suffer from nosocomial infections, and for hospitals who defend against the lawsuits, is complicated by ambiguous causes of action, differences in recovery, and widespread liability. Hospital architecture prevents nosocomial infections. The current regulatory structure for hospital building codes has gaps due to jurisdictional administration, ineffective regulatory and advising bodies, and minimum standards. Research has discovered ideas in architecture that prevent nosocomial infections. As society looks forward, the COVID-19 pandemic gives more data to evaluate. These studies should be used to reform hospital building code policy.

Upon reflection, would Edward have lived if the hospital had implemented the CDC-required air changes in the autopsy room?[175] Was Allison's serratia infection caused by a contaminated air conditioner unit?[176] Were Gwen and Bohmati infected at work because they bathed residents in contaminated water?[177] Or would the residents have been spared from staph infections if the facility had natural ventilation?[178] Could Dawn's condition have been prevented with sanitary copper materials in her room?[179] Was Albert infected during an altercation with a patient because the hospital operated with only minimum infection-prevention standards due to health-care disparities?[180] Would Amber have caught Ebola if the COVID-19 safeguards in place today were utilized in the hospital where she worked?[181] Let's build a better future.

Chaya Rosenbaum, crosenbaum@weisszarett.com, is an associate in the corporate, transactional, and health-care regulatory practice at Weiss Zarett Brofman Sonnenklar & Levy, P.C. A former architectural drafting and design student, her 2022 J.D. is from St. John's

University School of Law and she won the 2022 ABA Forum on Construction Law's Law Student Writing Competition.

Endnotes

1. Derrick v. Ont. Cmty. Hosp., 120 Cal. Rptr. 566, 568 (Cal. Ct. App. 1975).

2. *Id.*

3. Riggs v. W. Va. U. Hosps., Inc., 656 S.E.2d 91, 93 (W. Va. 2007) (per curiam).

4. Tex. Health Res. v. Coming Attractions Bridal, 552 S.W.3d 335, 337 (Tex. App. 2018).

5. *Id.*

6. Padney v. Metrohealth Med. Ctr., 764 N.E.2d 492, 494–95 (Ohio Ct. App. 2001).

7. *Id.*

8. Bolieu v. Sisters of Providence in Wash., 953 P.2d 1233, 1233–34 (Alaska 1998).

9. *Id.* at 1234.

10. Vallery v. S. Baptist Hosp., 630 So. 2d 861, 862–63 (La. Ct. App. 1993).

11. *Id.*

12. The nursing assistants are exceptions, having contracted skin infections in a residential care facility and not a hospital. *See Bolieu*, 953 P.2d at 1233.

13. Renee Garrick et al., *The Role of the Hospital in the Healthcare System*, *in* The Modern Hospital 47, 47 (Rifat Latifi ed., 2019).

14. Geoffrey Hughes, *First Do No Harm; Then Try to Prevent It*, 24 Emergency Med. J. 314, 314 (2007).

15. *See id.*

16. *How Your Hospital Can Make You Sick*, Consumer Reps., July 29, 2015 https://www.consumerreports.org/cro/health/hospital-acquired-infections/index.htm [hereinafter Consumer Reps.]

17. Hospital-Acquired Conditions, Ctrs. for Medicare & Medicaid Servs. (modified Aug. 12, 2022), https://www.cms.gov/Medicare/Medicare-Fee-for-Service-Payment/HospitalAcqCond/Hospital-Acquired_Conditions.

18. Hughes, *supra* note 14.

19. R. Girard et al., World Health Org, *Prevention of Hospital Acquired Infections: A Practical Guide*, 1, WHO/CDS/CSR/EPH/2002.12(2002) https://apps.who.int/iris/bitstream/handle/10665/67350/WHO_CDS_CSR_EPH_2002.12.pdf [hereinafter WHO].

20. Healthcare-Associated Infections (HAIs): Types of Healthcare-Associated Infections, Ctrs. for Disease Control & Prevention (last reviewed Mar. 26, 2014) [hereinafter CDC], https://www.cdc.gov/hai/infectiontypes.html.

21. Healthcare-Associated Infections (HAIs): Diseases and Organisms in Healthcare Settings, Ctrs. for Disease Control & Prevention (last reviewed Oct. 7, 2019), https://www.cdc.gov/hai/organisms/organisms.html.

22. Hassan Ahmed Khan et al., *Nosocomial Infections: Epidemiology, Prevention, Control and Surveillance*, 7 Asian Pac. J. Tropical Biomedicine. 478, 479–80 (2017).

23. WHO, *supra* note 19.

24. *Id.*

25. Healthcare-Associated Infections—Community Interface (HAIC): HAI and Antibiotic Use Prevalence Survey, Ctrs. for Disease Control & Prevention (last reviewed Feb. 25, 2022), https://www.cdc.gov/hai/eip/antibiotic-use.html.

26. Healthcare-Associated Infections (HAIs): Data Portal, Ctrs. for Disease Control & Prevention (last reviewed Nov. 3, 2022), https://www.cdc.gov/hai/data/portal/index.html. This is the most current study provided by the CDC.

27. Gonzalo Bearman et al., *Hospital Infection Prevention: How Much Can We Prevent and How Hard Should We Try?*, 21 Current Infectious Disease Reps. 1,1 (2019).

28. *See* Margaret Chan, Dir.-Gen., World Health Org., Keynote Address at Copenhagen, Denmark Conference on Combating Antimicrobial Resistance: Antimicrobial Resistance in the European Union and the World (Mar. 14, 2012) available at https://www.who.int/director-general/speeches/detail/antimicrobial-resistance-in-the-european-union-and-the-world.

29. Consumer Reps., *supra* note 16.

30. WHO, *supra* note 19, at 2–3.

31. Chan, *supra* note 28.

32. *See id. Cf.* CDC *supra* note 21 (providing a list of common hospital-acquired infections).

33. *See* Chan, *supra* note 28.

34. Riggs v. W. Va. U. Hosps., Inc., 656 S.E.2d 91, 93 (W. Va. 2007) (per curiam).

35. *Id.* at 648.

36. *Id.*

37. *Id.*

38. W. Va. Code § 55-7B.

39. W. Va. Code § 55-7B-8.

40. *Riggs*, at 98.

41. *Id.* at 99.

42. *Id.* at 101 (holding that "[the] Court will not sanction a change in liability theories post-verdict to avoid application of clear statutory provisions"). The doctrine of judicial estoppel precluded a change in a cause of action after a verdict. *Id.*

43. *Id.* at 111.

44. *Id.* The legislation defined *health care services* as "any act or treatment performed or furnished, or which should have been performed or furnished, by any health care provider for, to or on behalf of a patient during the patient's medical care, treatment or confinement." *Id.* (quoting W. Va. Code § 55-7B-2(e)).

45. *Id.*

46. *Id.*

47. *Id.* 111.

48. *Id.*

49. Draper v. Westerfield, 181 S.W.3d 283, 290 (Tenn. 2005) (quoting Gunter v. Lab. Corp. of Am., 121 S.W.3d 636, 639 (Tenn. 2003) (citations omitted)).

50. *See Riggs* at 111.

51. *Draper*, 181 S.W.3d at 291 (quoting *Gunter*, 121 S.W.3d at 641) (finding that a defendant physician who did not have a physician-patient relationship with a plaintiff's child did have a common law duty to report suspected child abuse once he voluntarily undertook to review the child's medical records).

52. Trimel v. Lawrence & Mem'l Hosp. Rehab. Ctr.,764 A.2d 203, 207 (Conn. App. Ct. 2001) (finding that injuries due to a fall during a physical therapy appointment constituted a medical malpractice claim and not a negligence claim).

53. Bryant v. Oakpointe Villa Nursing Ctr., Inc., 684 N.W.2d 864, 871 (Mich. 2004) (citing Dorris v. Detroit Osteopathic Hosp. Corp., 594 N.W.2d 455, 465 (Mich. 1999)) (finding that a claim against a nursing home that failed to respond to the risk of asphyxiation created by the decedent-plaintiff's bedding arrangements was an ordinary negligence claim).

54. Blevins v. Hamilton Med. Ctr., Inc., 959 So. 2d 440, 445 (La. 2007) (citing Coleman v. Deno,813 So. 2d 303, 316–18 (La. 2002)) (finding that a patient who sustained an injury from a defective hospital bed had a general negligence claim).

55. *Riggs*, 656 S.E.2d at 101.

56. *See id.* at 99.

57. *See* Tex. Health Res. v. Coming Attractions Bridal & Formal, Inc., 552 S.W.3d 335, 337–339 (Tex. Ct. App. 2018)..

58. *Id.*

59. *Id.* at 337.

60. *Id.*

61. *Id.*

62. *Id.*

63. *Id.*

64. *Id.*

65. *Id.* at 338.

66. *Id.* at 337.

67. Tex. Civ. Prac. & Rem. Code § 74.001.

68. *Id.* at § 74.351(b).

69. *Tex. Health*, 552 S.W.3d 335, at 338_.

70. *Id.* at 342.

71. *Id.*

72. *Id.* at 338–39 (The statutory definition from the TMLA is "a cause of action against a health care provider or physician for treatment, lack of treatment, or other claimed departure from accepted standards of medical care, or health care, or safety or professional or administrative services directly related to health care, which proximately results in injury to or death of a claimant, whether the claimant's claim or cause of action sounds in tort or contract."). The court also looked at the Texas Supreme Court's explanation of the statutory definition, which breaks it down into three elements. *Id.* at 339. *See* Tex. W. Oaks Hosp., LP v. Williams, 371 S.W.3d 171, 179 (Tex. 2012). The court then looked at the definition of the word *safety*. *Tex. Health*, 552 S.W.3d at 339. *See Tex. W. Oaks Hosp.*, 371 S.W.3d at 184. *See also Safe*, Black's Law Dictionary (10th ed. 2014).

73. *Tex. Health*, 552 S.W.3d at 339. ("'[F]or a safety standards-based claim to be an HCLC there must be a substantive nexus between the safety standards allegedly violated and the provision of health care.'" (quoting Ross v. St. Luke's Episcopal Hosp., 462 S.W.3d 496, 504 (Tex. 2015))).

74. *See Ross*, 462 S.W.3d at 505.

75. *Tex. Health*, 552 S.W.3d at 340.

76. *Id.* at 342.

77. *Id.*; *cf*. Riggs v. W. Va. U. Hosps., Inc., 656 S.E.2d 91, 99 (W. Va. 2007)

(Davis, J. concurring) (finding that a hospital-acquired infection did not fall under the state medical malpractice statute).

78. *Tex. Health*, 552 S.W.3d at 342.

79. Southeast. Tex. Cardiology Assocs. v. Smith, 593 S.W.3d 743, 745 (Tex. App. 2019).

80. *Id.*

81. *Id.*

82. *Id.* at 749.

83. *Id.*

84. Galvan v. Mem'l Hermann Hosp. Sys., 476 S.W.3d 429, 429(Tex. 2015).

85. *Id.* at 433.

86. *Id.* at 432.

87. *Id.* at 433.

88. *Id.*

89. Padney v. Metrohealth Med. Ctr., 764 N.E.2d 492, 492 (Ohio Ct. App. 2001).

90. *Id.* at 763.

91. *Id.* at 764.

92. *Id.*

93. *Id.*

94. *Id.*

95. *Id.*

96. *Id.*

97. *Id.* at 768.

98. *Id.*

99. *Id.* at 765. Expert testimony advised that the UV light was equivalent to an additional 10 to 20 air changes per hour, but an infection risk of approximately 25 percent to 30 percent remained. *Id.*

100. *Id.* at 764.

101. *Id.*

102. *Id.* at 765.

103. *Id.* at 766.

104. *Id.* at 768. The holding was criticized by the Utah Supreme Court for failing to maintain the distinction between intent and probability when determining the substantial certainty of an injury occurring. Helf v. Chevron U.S.A., Inc., 203 P.3d 962, 974 (Utah 2009) ("Ohio courts determine whether an injury is 'substantially certain to occur' in order to evaluate whether the injury is intentional [,] and they occasionally resort to statistics to determine the likelihood that the injury will occur. We agree with the South Dakota Supreme Court that such an approach 'blur[s] the line between cases involving only negligent or reckless conduct and those involving true intent to injure.'"). The holding was also cited in Davis's concurrence in *Riggs* to illustrate that common law tort claims for breach of general duty may be brought against a hospital when it fails to control the transmission of an infectious disease. Riggs v. W. Va. Univ. Hosps., Inc., 221 W. Va. 646, 656 S.E.2d 91, 666 (2007).

105. *Padney*, 764 N.E.2d at 499.

106. *Id.* The case was remanded for a new trial. *Id.* at 500. The appellate decision in favor of the plaintiffs took place nine years after Edward had contracted the disease. *See id.* at 494. The result of the new trial is unknown by this author.

107. Bolieu v. Sisters of Providence in Wash., 953 P.2d 1233, 1233 (Alaska 1998).

108. *Id.* at 1234.

109. Vallery v. S. Baptist Hosp., 630 So. 2d 861, 869 (La. Ct. App. 1993). The blood was spread due to a dislodged needle. *Id.*

110. *Id.* The husband's personal injury claim was denied because it was barred by the "exclusive remedy" provision contained in Louisiana's workers' compensation statue. *Id.* at 862. The emotional distress claim was decided by the rule requiring a channel for infection. *Id.* at 868. This case is unique because the Louisiana Supreme Court has a general rule for emotional distress claims, limiting them to cases with personal injuries. *See* Moresi v. Dep't of Wildlife & Fisheries, 567 So. 2d 1081, 1095_ (La.1990). Therefore, the emotional distress decision requiring only a channel of infection was criticized by the Louisiana Court of Appeals for the Third Circuit (although it had applied *Vallery* in the past) for unnecessarily analyzing federal law when there was guiding law by the state's highest court. Vallier v. La. Health Sys., Inc., 722 So. 2d 418, 420 (La. Ct. App.1998). Although emotional distress claims from possible HIV infection are not always upheld, the channel of infection rule is used in multiple jurisdictions. *See Vallery*, 630 So. 2d at 866. By contrast, the Missouri Supreme Court criticized the channel of infection rule and requires that a plaintiff be present at the scene of an injury-producing event. Bosch v. St. Louis Healthcare Network, 41 S.W.3d 462, 465 (Mo. 2001).

111. Derrick v. Ont. Cmty. Hosp., 120 Cal. Rptr. 566, 568 (Cal. Ct. App. 1975).

112. *Id.* at 569 The disease is not specified within the case.

113. *Id.* The ages of the minors and their relationship to each other are not specified within the case.

114. *Id.* at 568-69.

115. *Id.* at 571.

116. *Id.*

117. *Id.*

118. *Id.* at 572 ("We do not think it wise to impose upon Hospital the duty to advise a patient or a patient's parents concerning the patient's condition when that duty might substantially interfere with the relationship between the patient and her attending physician.").

119. *Id.* at 570.

120. Cal. Health & Safety Code § 3125. The statute requires that a person living with or visiting a contagious person promptly report that fact. *Id.*

121. *Derrick*, 47 Cal. App. 3d at 569–70. The hospital's argument that it was ridiculous to apply the code to hospitals, which treat communicable diseases, was found to be untenable. *Id.* at 570.

122. *Id.* at 572.

123. Amy S. Collins, Patient Safety and Quality: An Evidence-Based Handbook for Nurses, ch. 41 (Ronda G. Hughes ed., 2008).

124. Robert F. Carr, *Hospital*, WBDG (updated Apr. 6, 2017), https://www.wbdg.org/building-types/health-care-facilities/hospital. The Whole Building Design Guide is a federally funded information database provided by the National Institute of Building Sciences. *See generally id.*

125. *Id.*

126. *Id.*

127. *Id.*

128. The Facility Guidelines Inst., Guidelines for Design and Construction of Hospitals (2018).

129. Int'l Code Council, Inc., 2018 International Building Code (2018). For a list of International Codes adopted by state, see Int'l Code Council, International Codes—Adoption by State (May 2020), https://www.nrmca.org/wp-content/uploads/2020/07/Master-I-Code-Adoption-Chart-May-2020.pdf.

130. Carr, s*upra* note 124. For an example of a court citation of the *FGI Guidelines* in state legislation, see Falls Church Med. Ctr., LLC v. Oliver, 412 F. Supp. 3d 668, 680 (E.D. Va. 2019). For an example of a court citation of the *IBC* in state legislation, see W/S Lebanon v. City of Lebanon, No. 2008-0436, 2009 N.H. LEXIS 162 (N.H. Mar. 10, 2009).

131. Carr, s*upra* note 124.

132. *Id.*

133. *Id.*

134. *See generally* Michelle M. Mello et al., *Fostering Rational Regulation of Patient Safety*, 30 J. Health, Pol., Pol'y & L. 375, 376–77 (2005) (discussing top-down forms of regulation and the role of the Joint Commission).

135. Stephanie Armour, *Hospital Watchdog Gives Seal of Approval, Even After Problems Emerge*, Wall St. J. (Sept. 8, 2017), https://www.wsj.com/articles/watchdog-awards-hospitals-seal-of-approval-even-after-problems-emerge-1504889146.

136. Miranda B. Lam et al., *Association Between Patient Outcomes and Accreditation in US Hospitals: Observational Study*, 337 BMJ 363 (Oct. 18, 2008).

137. *See* Mark A. Hall et al., Health Care Law and Ethics 913–16 (Rachel A. Barkow et al. eds., 9th ed. 2018).

138. *Id.*

139. Marjorie Kanof, U.S. Gov't Accountability Off., GAO-09-516T, Health-Care-Associated Infections in Hospitals: Continuing Leadership Needed from HHS to Prioritize Prevention Practices and Improve Data on These Infections, 9 (2009), https://www.gao.gov/assets/gao-09-516t.pdf [hereinafter GAO].

140. *Id.* at 14.

141. *See generally* Hall et al., *supra* note 137, at 1024–26 (quoting an excerpt from Tom L. Beauchamp & James F. Childress, Principles of Biomedical Ethics (4th ed. 1994) (discussing a decent minimum of care through the egalitarian principle of health-care distribution)).

142. This term was promulgated and subsequently launched the field of design using scientific data through a 1984 study showing that postoperative patients with a view of nature did better than those with a view of a brick wall. Diana C. Anderson, *Bricks and Morals—Hospital Buildings, Do No Harm*, 34 J. Gen. Internal Med. 312, 312–16 (2019).

143. *Id.*

144. Gary A. Noskin & Lance R. Peterson, *Engineering Infection Control Through Facility Design*, 7 Emerging Infectious Diseases 354, 354 (2001).

145. *Id.* (quoting Florence Nightingale, Notes on Hospitals 90–91 (1859)).

146. Tiffanie Ramos et al., *Spatial and Temporal Variations in Indoor Environmental Conditions, Human Occupancy, and Operational Characteristics in a New Hospital Building*, 10 PLOS ONE

1 (2015), https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0118207.

147. *Id.*

148. Michael R. Eber et al., *Seasonal and Temperature-Associated Increases in Gram-Negative Bacterial Bloodstream Infections Among Hospitalized Patients*, 6 PLOS ONE 1, 1 (2011), https://journals.plos.org/plosone/article/file?id=10.1371/journal.pone.0025298&type=printable.

149. Ramos et al., *supra* note 146.

150. Energy-related building code standards are commonly overseen by the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE), whose guidelines are partially integrated by the International Code Council and adopted in building code regulations in many jurisdictions. *See* Building Energy Codes Compliance Toolkit, Building energy Codes Program, ch. 3 (Sept. 2012), https://www.energycodes.gov/sites/default/files/2019-09/ACE_Compliance_Toolkit.pdf (prepared for U.S. Dep't of Energy) (last visited August 25, 2023).

151. Aaron Fernstrom & Michael Goldblatt, *Aerobiology and Its Role in the Transmission of Infectious Diseases*, 2013 J. Pathogens 1, 6 (2013), http://downloads.hindawi.com/journals/jpath/2013/493960.pdf.

152. *Id.*

153. *Id.* at 8.

154. Richard A. Hobday & Stephanie J. Dancer, *Roles of Sunlight and Natural Ventilation for Controlling Infection: Historical and Current Perspectives*, 84 J. Hosp. Infection 271, 275 (2013), https://www.sciencedirect.com/science/article/pii/S0195670113001540

155. *Id.*

156. *Id.*

157. *Id.*

158. *Id.* at 275–76.

159. *Id.* at 275.

160. Brooke K. Decker & Tara N. Palmore, *The Role of Water in Healthcare-Associated Infections*, 26 Current Op. Infectious Diseases 345, 345–51 (2013).

161. *Id.*; *see also* Arthur W. Baker et al., *Two-Phase Hospital-Associated Outbreak of Mycobacterium abscessus: Investigation and Mitigation*, 64 Clinical Infectious Diseases 902, 902–11 (2017) (further research results on patient infection from tap water exposure).

162. *See* Alyssa Parr et al., *Legionellosis on the Rise: A Review of Guidelines for Prevention in the United States*, 21 J. Pub. Health Mgmt. Prac., at E17, E17–E26 (2015).

163. Harold T. Michels et al., *From Laboratory Research to a Clinical Trial: Copper Alloy Surfaces Kill Bacteria and Reduce Hospital-Acquired Infections*, 9 Health Env'ts Rsch. Design J. 64, 64 (2015).

164. *Id.* at 70–74.

165. *Id.* at 70.

166. *Id.* at 75.

167. *See* Jeffrey T. O'Neill & John Williams, *Ensuring Relevance of Building Codes*, Health Facilities Mgmt. Mag. (2019), https://www.hfmmagazine.com/articles/3551-ensuring-relevance-of-building-codes.

168. Anderson, *supra* note 142, at 312.

169. Noskin & Peterson, *supra* note 144.

170. Mass Design Group, https://massdesigngroup.org (last visited July 14, 2020).

171. Clinicians for Design, https://www.cliniciansfordesign.com (last visited July 14, 2020).

172. ASHE, https://www.ashe.org/advocacyhighway (last visited July 14, 2020). The American Society for Health Care Engineering (ASHE) is the largest association for builders of health-care facilities dedicated to optimizing the health-care-built environment. *Id.*

173. Jonathan Lamantia et al., *NY's Nursing Home Crisis: Facilities Chart a Path Forward*, Crain's N.Y. (May 29, 2020), https://www.crainsnewyork.com/health-pulse/nys-nursing-home-crisis-facilities-chart-path-forward.

174. Jeremy Hsu, *How the Covid-19 Pandemic May Reshape U.S. Hospital Design*, Undark (Apr. 16, 2020), https://undark.org/2020/04/16/covid-19-modified-hospital-design.

175. *See* Padney v. Metrohealth Med. Ctr., 764 N.E.2d 492, 492 (Ohio Ct. App. 2001)) (hospital employee contracted TB from an autopsy of an infected cadaver in an isolation room that had fewer air changes per hour than the CDC recommended); *cf.* GAO, *supra* note 139 (weak HHS department leadership allows for CDC guidelines to be incompletely implemented in hospital protocols).

176. *See* Riggs v. W. Va. U. Hosps., Inc., 656 S.E.2d 91, 91 (W. Va. 2007) (per curiam). (patient acquired a serratia infection at her surgical site in a hospital); *cf.* Hobday & Dancer, *supra* note 154, at 271-282 (hospital serratia outbreak was attributed to a contaminated air conditioner).

177. *See* Bolieu v. Sisters of Providence in Wash., 953 P.2d 1233, 1233 (Alaska 1998) (two nursing assistants contracted infections through their work at a health-care facility, which included bathing infected convalescent residents); *cf.* Decker & Palmore, *supra* note 160 (water systems in hospitals shown to spread infectious diseases).

178. *See Bolieu*, 953 P.2d at 1233 (nursing assistants contracted staph infections at their jobs in a health-care facility); *cf.* Hobday & Dancer, *supra* note 154, at 271-282 (patients from hospitals with natural ventilation had significantly fewer staph infections than patients from a mechanically ventilated ward).

179. *See* Derrick v. Ont. Cmty. Hosp., 120 Cal. Rptr. 566, 566 (Cal. Ct. App. 1975) (patient acquired an infectious, highly contagious, communicable condition at a hospital); cf. Michels et al., supra note 163, at 64 (copper materials in hospital rooms were found to reduce the spread of bacteria and reduce hospital infections).

180. *See* Vallery v. S. Baptist Hosp., 630 So. 2d 861, 869 (La. Ct. App. 1993) (hospital security guard was exposed to AIDS while restraining a patient with a dislodged intravenous needle); *cf.* Hall, *supra* note 137, at 1024-1026 (discussing inequitable distribution of health care with the egalitarian principle of a decent standard of health care).

181. *See* Tex. Health Res. v. Coming Attractions Bridal & Formal, Inc., 552 S.W.3d 335 (Tex. App. 2018) (hospital employee caught Ebola from an infected patient); *cf.* Hsu, *supra* note 174 (hospitals implement infection-prevention protocols during COVID-19 outbreak).