Designing Cleaner Spaces

How can we create spaces that are easy and intuitive to clean? How can material selection enhance feelings of safety and control?

Designing Cleaner Spaces

How can we create spaces that are easy and intuitive to clean? How can material selection enhance feelings of safety and control?

COVID-19 has changed the way people think about the cleanliness of the spaces we inhabit. As cleaning and disinfecting protocols are re-evaluated or enhanced in hospitals, universities, workplaces, and social spaces, it is imperative designers and end-users understand the cleanability of the surfaces and material types within their facilities.

Since the end of March, those outside of healthcare have become hyperaware of surface to person contamination. With the spread of the coronavirus, people have had to learn to social distance and self-quarantine. Wearing a mask in public has become commonplace, and we know now, more than ever, the importance of washing our hands often. BSA's article on "Bringing People Back to the Built Environment" forecasts considerations in design as people start reentering spaces outside of their homes. As the article states, we must recognize public health practices that will contribute to feelings of safety and control over the environment. One such practice is cleaning and disinfecting.

Infection prevention has always been a driving factor in healthcare facilities BSA designs. While COVID-19 is at the forefront of conversations right now, it is important to recognize that there are, and have been, other threats to consider. In a report issued by the CDC in 2019 Robert R. Redfield, M.D., director of the US Centers for Disease Control and Prevention, urges our nation to recognize that we are in a post-antibiotic era now and we need to start doing something before it gets worse. The report claims that "More than 2.8 million antibiotic-resistant infections occur in the United States each year, and more than 35,000 people die as a result." The report lists 18 bacteria and fungi that are resistant to antibiotics and categorized them into urgent, serious,

and concerning. There needs to be more dedicated efforts toward preventing infections, slowing their development, and stopping the spread (CDC) within healthcare facilities and beyond.

So what does this have to do with design? Research shows, “it has been well established that contaminated environmental surfaces play an important role in the transmission of infectious diseases in the healthcare setting” (Weber et al., 2013) Today, we are seeing this concern spread beyond healthcare settings. “Cleaning surfaces is a critical part of infection control. However, the quality and standard of cleaning in a given environment may be compromised due to factors such as the choice of products, manufacturer specifications, [and] inaccessibility” (Joshi and Taylor). If we are going to interrupt the transmission chain of infections, we need to be informed about surfaces that are easy to clean, which ones won’t harbor the growth of microbes and what will not degrade due to stringent cleaning and disinfecting protocols.

To understand which materials are most suitable for specific environments, it is important to have a basic understanding of how they should be cleaned. The EPA and CDC have guidelines for cleaning and disinfecting recommendations. As they describe, cleaning of visibly dirty surfaces followed by disinfection is a best practice

measure for prevention of COVID-19 and other viral respiratory illnesses in households and community settings. They go on to explain the key differences between cleaning and disinfecting.

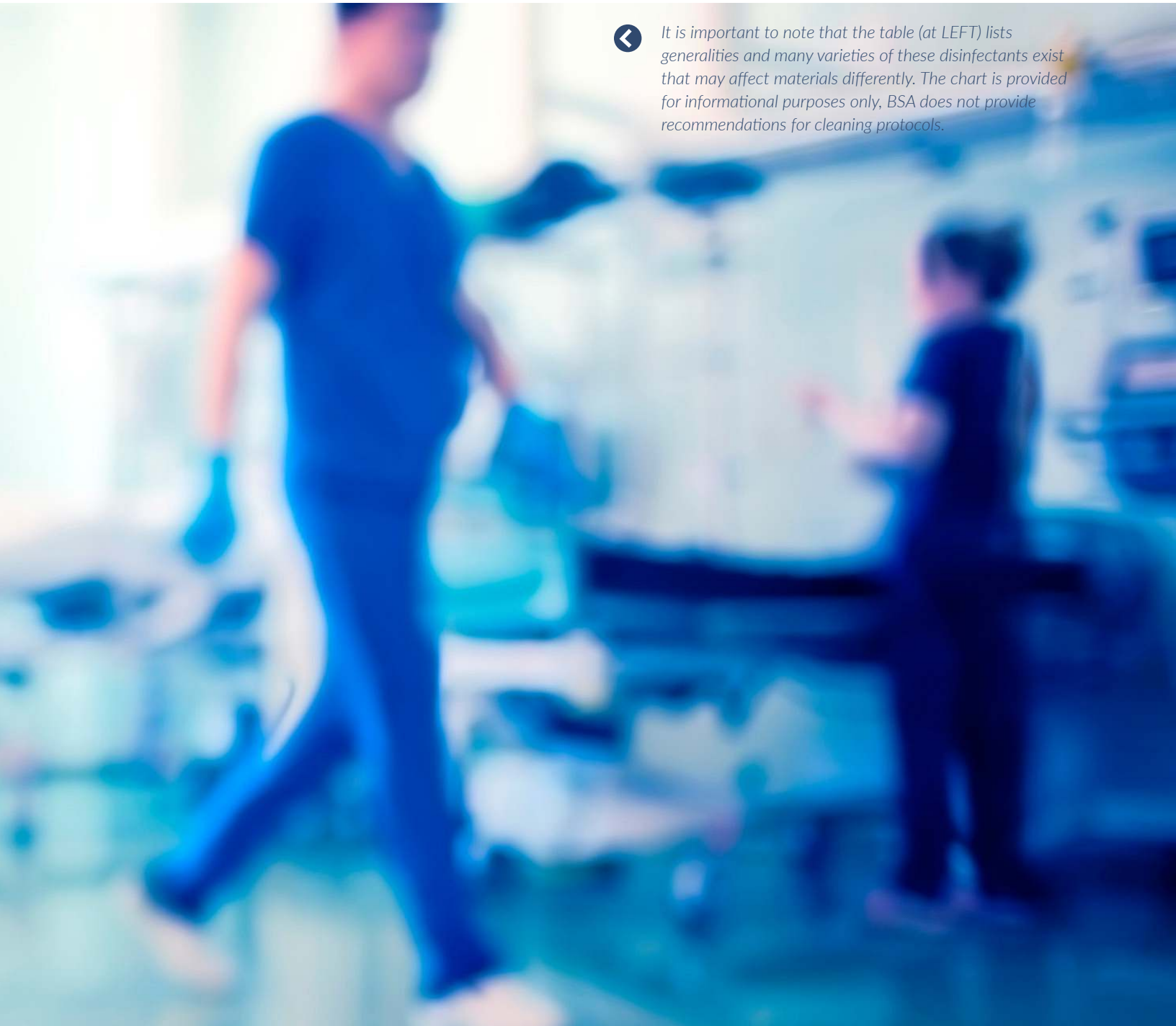
> *Cleaning refers to the removal of germs, dirt, and impurities from surfaces. It does not kill germs, but by removing them, it lowers their numbers and the risk of spreading infection. Disinfecting refers to using chemicals, for example, EPA-registered disinfectants, to kill germs on surfaces. This process does not necessarily clean dirty surfaces or remove germs, but by killing germs on a surface after cleaning, it can further lower the risk of spreading infection. (CDC).*

Among others, three common types of disinfectants that are listed in the EPA's registered "N" list for use against COVID-19 are sodium hypochlorite (bleach), improved hydrogen peroxide, and quaternary ammonium compounds (QACs or "quats"). A full list can be viewed here:. The table below provides a high-level comparison of the disinfectant types and their effects.

DISINFECTANT	Sodium Hypochlorite (bleach)	Improved/Accelerated Hydrogen Peroxide	Quaternary Ammonium Compounds (QACs)
CHARACTERISTICS	• Sodium hypochlorite solutions are considered high-level disinfectants according to the CDC and are effective against a large variety of pathogens, making them a "broad-spectrum antimicrobial". They are widely used because they preform quickly, are easy to use and are inexpensive. (11). • The effectiveness of hypochlorites are reduced by organic matter (ie blood) so it is important to preclean surfaces before disinfecting. (9) Typical contact time is 5-10 mins (3) • The use of hypochlorites is not appropriate on all surfaces. **They can be corrosive to metals and they may cause damage to finishes and fibers on soft surfaces if used in higher concentrations.** They can also cause skin and eye irritation (3)	• Improved or accelerated hydrogen peroxide solutions are EPA registered disinfectants that are bactericidal, virucidal, fungicidal, sporicidal, and mycobactericidal. Different concentrations can allow for low to high disinfection depending on the application. (9) • According to a research study, "the improved HP products have an EPA-registered contact time that is substantially less than most EPA registered low-level disinfectants." (14) They do not typically require pre-cleaning (16) • "These compounds are commonly used, considered safe for EVS staff (i.e., lowest EPA toxicity category IV), surface compatible, noncorrosive, and unaffected by organic material." (9) • Improved/Accelerated Hydrogen Peroxide liquid disinfectants are more expensive than other disinfectants. **Discoloration has been observed when used on certain upholsteries (3).**	• QACs are considered low-level disinfectants. They are widely used in consumer products due to their surface compatibility and effectiveness. (9) However, they typically need to be left undisturbed on a surface to be the most effective. (16) **It is important to consider this before using QACs to disinfect surfaces that are porous or have seams.** • Some QACs require pre-cleaning surfaces, others are considered one-step disinfectants (3) • QACs are generally thought to be safe for human use but have been known to cause occupational asthma (9) • "High water hardness and materials such as cotton towels and cloths can diminish microbicidal activity" (9)

In addition to disinfecting cleaning agents, there is an emergence of devices that claim to destroy, repel, trap or mitigate any pests, including viruses (ozone generators, UV lights etc) (EPA). These products must be reviewed with precaution. In the BSA article, "UV Lighting for Contamination," we go into more detail of the considerations of using UV lights for contamination. This technology should be considered a supplemental decontamination measure and should not replace routine cleaning and disinfecting. It should also be noted that the EPA does not review the safety or efficacy of these devices. As a newer technology, there is little data available from finish manufacturers on how these technologies will affect the surfaces. If they become more prevalent, we expect the industry will need to add proper testing and reporting for material compatibility.

In addition to heightened cleaning and disinfecting protocols, there has also been a surge of product introductions with anti-microbial properties or coatings. As noted by Healthcare Design Magazine, "since surface contamination can occur quickly after cleaning, the use of antimicrobial surfaces—those exhibiting prolonged biocidal activity—is seen as a supplemental



It is important to note that the table (at LEFT) lists generalities and many varieties of these disinfectants exist that may affect materials differently. The chart is provided for informational purposes only, BSA does not provide recommendations for cleaning protocols.

The burning question now, what surface finishes, flooring materials, and furniture finishes are the best post-COVID-19 pandemic?

strategy for controlling contamination through surface treatments" (Joshi and Taylor). These include coatings containing silver, titanium, copper, zinc, chitosan and quaternary ammonium compounds. While there could be benefits to these types of surfaces, they should be reviewed with precaution. There is concern that they could have negative environmental or human health effects that outweigh their proven efficacy. Industry experts recommend "the broad use of AMCs in other applications like medicine, food packaging and textiles should be postponed until reaching evidences on the (i) profound efficiency of these materials in controlling the spread of pathogenic microbes and (ii) safety of AMCs for the human and ecosystems" (Rosenberg et. al). BSA can provide recommendations with regards to specific products or coatings in question.

As we've seen the shift in recent years to healthier, more sustainability finishes, we've also seen a shift to greener cleaning products. However, as one article notes, "the concept of green cleaning actually can complicate the disinfection aspect of infection control, according to Welch. Disinfection is the destruction of a microorganism; therefore, disinfection by nature is not a green process. Disinfectants are EPA-registered [antimicrobial] pesticides and have strict data requirements" (Lorenzi). As we evolve toward WELL Building Standard inspired projects, we will have to find a balance between providing the best product for infection prevention and providing the best products for human health in the indoor environment. At BSA, we have designers with WELL Building Certification as well as Evidence-Based Design Accreditation to help us navigate these complex conversations.

The burning question now, what surface finishes, flooring materials, and furniture finishes are the best post-COVID-19 pandemic? We know disinfectants may cause alterations to surfaces and their cleanability over time. With the quantity of different chemistries of disinfectants and thousands of different surface materials and coatings, it is a complex and evolving question and more research will need to be done. BSA is continuously collecting available data to be able to provide recommendations and resources as it relates to different finish types. We understand the importance of intuitive cleaning protocols when making finish selections. Not all cleaners and disinfectants react the same to finishes, but it's very likely the same solutions will be used on all finishes in the room. In present state, the best recommendation for all market types is to select materials that are smooth, non-porous, and resistant to damage, scratches, and pitting. Designs should strive to minimize the number of joints and seams. Research has shown these are the areas with the highest probability to harbor and grow bacteria. Materials in high touch areas such as classrooms, waiting areas, conference/collaboration rooms, and cafes should be able to withstand regular cleaning, disinfecting, and rinsing to minimize the spread of infection.

At BSA, we will continue to use our years of experience in the healthcare market with infection prevention strategies to inform all our designs. We understand which materials have the highest level of durability and are easiest to clean and which ones are more susceptible to damage and a potential infection control risk. Our research will continue to inform our inspired solutions while maintaining safe environments for those who inhabit them.

Bibliography:

1. CDC. “Antibiotic Resistance Threats in the United States, 2019” U.S. Department of Health and Human Services, CDC; November 2019, https://www.cdc.gov/drugresistance/pdf/threats-report/2019-ar-threats-report-508.pdf
2. CDC. “Cleaning and Disinfecting for Households,” U.S. Department of Health and Human Services, CDC May 2019, https://www.cdc.gov/coronavirus/2019-ncov/prevent-getting-sick/cleaning-disinfection.html
3. Center for Health Design “Cleaning Methods & Materials Characteristics Tool” Healthdesign.org, June 2019 https://www.healthdesign.org/insights-solutions/cleaning-methods-materials-characteristics-tool
4. EPA. “What You Need to Know Regarding Products Making Claims to Kill the Coronavirus1 Causing COVID-19” EPA.gov, May 2020, https://www.epa.gov/sites/production/files/2020-05/documents/cornavirus-compliance-advisory.pdf
5. EPA. “List N: Disinfectants for Use Against SARS-CoV-2 (COVID-19)” EPA.gov, 17 June 2020, https://www.epa.gov/pesticide-registration/list-n-disinfectants-use-against-sars-cov-2-covid-19
6. Joshi, Rutali; Taylor, Ellen. “Contact Transmission, Part 1: The Role of Surfaces in Healthcare-Associated Infections” HealthDesign.org, June 2019, https://www.healthdesign.org/insights-solutions/contact-transmission-part-1-role-surfaces-healthcare-associated-infections
7. Joshi, Rutali; Taylor, Ellen. “Contact Transmission, Part 2: Materials, Design and Cleaning” HealthDesign.org, June 2019, https://www.healthdesign.org/insights-solutions/contact-transmission-part-2-materials-design-and-cleaning
8. Jürgen Gebel, Martin Exner, Gary French, Yves Chartier, Bärbel Christiansen, Stefanie Gemein, Peter Goroncy-Bermes, Philippe Hartemann, Ursel Heudorf, Axel Kramer, Jean-Yves Maillard, Peter Oltmanns, Manfred Rotter, Hans-Günther Sonntag. “The role of surface disinfection in infection prevention” NCBI. NLM.NIH.gov, GMS Hyg Infect Control, 29 April 2013, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3746601/
9. Leas, Brian F., Sullivan, Nancy., Han, Jennifer H., Pegues, David A., Kaxzmarek, Janice L., Umscheid, Craig A. “Environmental Cleaning for the Prevention of Healthcare-Associated Infections“ NCBI.NLM.NIH.gov, Agency for Healthcare Research and Quality (US), Aug 2015, https://www.ncbi.nlm.nih.gov/books/NBK316174/
10. Lorenzi, Neal. “Latest advances in health care cleaning and disinfection chemicals” Health Facilitates Management Magazine, 2 August 2017 https://www.hfmmagazine.com/articles/3025-cleaning-and-disinfection-chemicals-for-health-care
11. Merilin Rosenberg, Krunoslav Ilić, Katre Juganson, Angela Ivask, Merja Ahonen, Ivana Vinković Vrček, Anne Kahru, “Potential ecotoxicological effects of antimicrobial surface coatings: a literature survey backed up by analysis of market reports” NCBI.NLM.NIH.gov, PeerJ, 11 Feb 2019, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6375256/
12. Thompson, Kirsten M. “The Science of Disinfectants “ CMM Cleaning & Maintenance Management, 25 April 2012, https://www.cmmonline.com/articles/the-science-of-disinfectants
13. Weber D. J., Anderson D., Rutala W. A.. “Uses of Inorganic Hypochlorite (Bleach) in Health-Care Facilities” Clinical Microbiology Reviews, American Society for Microbiology, Oct. 1997, p. 597–610, https://cmr.asm.org/content/cmr/10/4/597.full.pdf
14. Weber D. J., Anderson D., Rutala W. A. “The role of the surface environment in healthcare-associated infections” PubMed.Gov, 26 Aug 2013, https://pubmed.ncbi.nlm.nih.gov/23743816/
15. Weber D. J., Anderson D., Rutala W. A “Efficacy of Improved Hydrogen Peroxide against Important Healthcare Associated Pathogens” Infection Control and Hospital Epidemiology, November 2012 http://pdfs.semanticscholar.org/8f39/b12b391ba05487525df4c80e264b0bccc37b.pdf

Authors:

Karen Tobin NCIDQ, LEED GA
Director, Interior Design, Raleigh
Email: ktobin@bsalifestructures.com

ARCHITECTURE
ENGINEERING
PLANNING
INTERIORS

BSA

bsalifestructures.com
800.565.4855