Exploring Links Between

CLEANLINESS & INFECTION CONTROL

Efforts in the United States and Abroad

An Interview on Infection Control With Roger Ulrich, PhD, EDAC

INSIDE YOU WILL LEARN ABOUT:

The relationship between visible cleanliness and the risk of contracting a serious infection in the healthcare setting.

The spread of pathogens in healthcare settings.

The risk of infection in U.S. healthcare settings compared with other countries.

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How did you become involved in cleanliness and infection control efforts?

More than a decade ago, I started writing about design and infection in research literature reviews. Later I gained valuable knowledge during a 2-year stint in the United Kingdom as an adviser on evidence-based design to the National Health Services (NHS). It was a time when drug-resistant hospital infections were rising sharply and “killer bugs” were the number one political issue in Britain. Later on I was an adjunct scientist with the Ontario Agency for Health Protection and Promotion and there examined the role played by hospital design factors in specific outbreaks. Along the way, I became familiar with research on the link between room cleanliness and infection prevention. This work focuses mostly on pathogen contamination that’s invisible to the eye but detectable by swab samples or cultures taken from environmental surfaces, bed rails, computer keyboards, and so on.

What is the relationship between visible cleanliness and the risk of contracting a serious infection in the healthcare setting?

There can be some link between visible soiling and increased infection risk, but my impression is the link is not strong or consistent across different types of units and acuity levels. Most environmental contamination is invisible. How much contamination can there be? Studies using swab sampling in North American and European hospitals have found that in patient rooms housing a person with a serious resistant infection, for example, MRSA, VRE, or *C. difficile*, anywhere from 25% to more than 60% of environmental surfaces yield these pathogens prior to cleaning. Environmental features near infected patients rapidly become extensively contaminated, creating reservoirs that transfer pathogens to staff and other patients. When an outbreak of infection occurs, such as multiple cases of MRSA or *C. difficile*, transmission risk rises if there is poor cleaning of environmental surfaces and equipment.
Can you give me an example of how these pathogens spread in a hospital?

Imagine a hypothetical scenario where there is a perfectly clean patient room. Suppose that at 8:00 in the morning a patient is admitted, and lab results received a couple days later show the person had MRSA. The room starts out 100% clean on the first or admission day, but within a few hours—possibly by afternoon—several surfaces in the room and features around the bed will be contaminated with MRSA. Like several other infections, MRSA is spread mainly by contact and viable for long periods on environmental surfaces. It is not visible to the naked eye.

Researchers have studied clinicians who enter rooms of MRSA patients with initially clean hands and do not touch patients, but while in the rooms touch surfaces and equipment. For example, a study by John Boyce and colleagues at Yale showed that despite staff adhering to hand hygiene, at least 40% of the clinicians had MRSA on their hands or gloves by the time they left a patient’s room. Staff touches other surfaces and equipment with their contaminated hands and clothing, creating more pathogen reservoirs that further increase risk for transfer to uninfected patients. The pathogen can be inadvertently conveyed to spaces outside patient rooms and transferred to staff work surfaces and portable equipment such as medication carts.

The hypothetical patient room is cleaned later that same day. After cleaning, is it thoroughly clean at the bacterial level? Not really. Research has shown that conventional cleaning—as in using prescribed cleaners and the usual protocols—eliminates some pathogen contamination and can lessen risk. But even when it is done carefully, contamination remains. It’s disappointing that several studies have found that even after room cleaning by trained staff according to prescribed protocols using conventional detergents and disinfectant agents, more than 20% of sampled surfaces still tested positive for infectious pathogens. I think that much of the evidence supports a rather disturbing conclusion: The notion that conventional manual cleaning is highly effective and thorough is illusory.

Would adopting a more stringent cleaning protocol address this problem?
Most infectious pathogens are bacteria spread primarily by contact. MRSA and VRE (vancomycin-resistant enterococci) are examples. These can be cleaned using conventional detergents, disinfectant agents, or alcohol hand rub. An important exception is *Clostridium difficile*, a toxin-producing bacterium that forms spores that survive for months on environmental surfaces and equipment. Conventional cleaning or disinfectant agents are not sporicidal and therefore not effective for cleaning spaces occupied by patients with *C. difficile*. Alcohol hand rub is not effective for cleaning *C. difficile* from hands or surfaces. The risk to patient safety posed by *C. difficile* is increasingly serious given that highly toxic resistant strains have appeared in recent years, causing many outbreaks in North America and Europe. How toxic are the newer strains? The published case fatality rate for patients 30 days after diagnosis has ranged from 24–28%.

What cleaning agent works for *C. difficile*? Bleach is sporicidal and more effective than traditional detergents or disinfectants. Nonetheless, studies have shown that considerable *C. difficile* contamination persists on room surfaces and equipment after manual cleaning with bleach. And a drawback of bleach is that it is a harsh chemical that causes deterioration of surfaces and furnishings, and negatively impacts the environment outside the hospital.

My view is that there clearly needs to be a rethinking of cleaning methods and hospital design around the goal of achieving much better room decontamination using methods that are more environmentally sustainable and kinder to interior furnishings. Hydrogen peroxide vapor (HPV) is a promising unconventional cleaning process that is very effective, including for eliminating spore-transmitted pathogens such as *C. difficile*. HPV works on electronics, textiles, and even carpet, as well as hard environmental surfaces. Importantly, compared to conventional manual cleaning processes, I think there is more evidence that HPV cleaning not only eliminates environmental contamination, but also reduces infection incidence for both *C. difficile* and MRSA. However, patient rooms and nursing units currently are designed in ways that work directly against using HPV, increasing turnaround time and cost. Rethinking room design and aspects of the ventilation system could eliminate some of the major hindrances.

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Why are healthcare-associated infections more of an issue in the United States than in Sweden and other European countries?

Resistant infections in hospitals are a serious and growing threat in Europe as well as the United States. However, generally speaking, the burden of antibiotic-resistant infection is higher for U.S. patients and hospitals than in most European countries. Imagine a patient who acquires a *Staphylococcus aureus* infection while in the hospital. If the patient acquires the infection in Sweden or Norway, the risk that it will be resistant (MRSA) currently is 1% or less. By contrast, according to CDC data, the risk in the U.S. that a comparable patient’s *Staph* infection could be resistant and therefore very serious would be about 50%—in other words, roughly 50 times higher than in Sweden and Norway.

But looking south from Scandinavia to countries in central and southern Europe, the burden or prevalence of resistance shows a pattern of increase. The risk that a healthcare-associated *Staph* infection will be drug-resistant increases to the range of approximately 15–25% in Britain, Germany, and France. Farther south, in Greece, Italy, and Spain, MRSA prevalence rises markedly to about 30–45%. Prevalence of MRSA in Portugal is roughly comparable to the U.S., approximately 50%.

Data for other resistant infections, such as VRE and *C. difficile*, tends to show similar patterns of geographical differences, with resistance prevalence usually higher in the U.S. than in most European Union countries. A small group of “safe” countries in northern Europe stands out internationally as having impressively low burdens of resistance across different classes or types of bacterial infections. These comparatively safe outliers include Sweden, Norway, Denmark, and, to a lesser extent, the Netherlands.

Why is antibiotic resistance more prevalent in the United States than in Sweden and other northern European countries?

Does the higher burden of resistance facing U.S. patients and hospitals stem from poor quality of personnel and protocols, inferior cleaning, or lack of awareness? I don’t think so at all. Protocols and personnel in American facilities can be excellent by international standards. Hand washing compliance rates in good American hospitals are more or less similar to those in European university hospitals. Levels of pathogen contamination left after room cleaning...
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in European hospitals seem roughly as high as those reported in the U.S. A plus for American hospitals is that they have led the way internationally in adopting important architectural measures for reducing infection, such as single rooms with private toilets. And the U.S. has been a leader in developing clinical safety bundles that have sharply reduced infections linked, for instance, to catheters and surgery.

Then why is the burden of infection resistance much higher in the U.S. compared to countries like Sweden and Norway? Part of the explanation comes down to the fragmentation of the American healthcare system. I think another very important factor is that Sweden and other safer countries, but not the U.S., have implemented policies and practices at the societal and healthcare system levels that lessen the prevalence of antibiotic resistance. First, all the countries I’m familiar with that have low resistance prevalence (Sweden, Norway, Denmark, the Netherlands) have for many years restricted giving antibiotics to livestock and poultry unless animals are sick. By comparison, very large amounts of antibiotics in the U.S. are used for farm animals that are not sick. Only recently has the government begun to take steps to reduce this.

Unlike the U.S. healthcare system, Sweden and other “safe” countries have for years had system-level clinical practice guidelines for reducing unnecessary prescriptions of antibiotics for people. Recently Sweden has doubled down on its national efforts to restrict giving antibiotics to infected patients unless there is evidence an infection is bacterial and an antibiotic will be effective.

Is there anything else that the United States can learn from other countries that might help their efforts to reduce or prevent healthcare-associated infections?

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but is very effective for reducing resistance prevalence and lowering costs long-term in the healthcare systems of the safer countries.

The U.S. does not routinely practice search-and-destroy, but uses it in certain public health emergencies such as the recent Ebola cases in Dallas and New York. If we suppose that somehow history could be different, and imagine that the U.S. had been practicing search-and-destroy for the past 20–25 years for MRSA and other resistant infections, the burden of resistance would certainly be lower today for the nation’s hospitals, nursing homes, and communities.

What are some of the implications for healthcare designers of the high prevalence of infection resistance in the United States?

- The U.S., like other countries, has entered the post-antibiotic era, and it is here to stay.
- Healthcare providers and clients will place ever-increasing priority on evidence-based design to reduce infection. It is imperative for designers to keep up to date with the latest EBD research and best practices.
- Be informed and realistic about the actual effectiveness of conventional cleaning methods and agents, including green agents. These methods do not thoroughly remove contamination and do not necessarily reduce the incidence of resistant infections. Along with cleaning, it is important for designers to be knowledgeable about other factors that influence infection risk, such as hand washing and single rooms.
- An unfortunate corollary of the high burden of infection resistance in U.S. hospitals is that resistant infections are increasingly widespread and endemic in communities. In the case of MRSA, for example, CDC data suggests that less than 30% of infections are hospital-onset, while upwards of 60% are community-onset. Community-onset cases are treated in hospitals, but after discharge patients return to nursing facilities or their own homes where the problem of cleaning pathogen-contaminated spaces can be even more challenging than in hospitals. This underscores the need for healthcare designers to play a proactive role in fostering a much more widespread implementation of EBD measures for reducing infection and facilitating cleaning in community clinics, long-term care facilities, and patient homes.