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Facing the Upcoming Crisis Now: All Hands On Deck!

Selecting the Right Disinfectant When It's Needed Most

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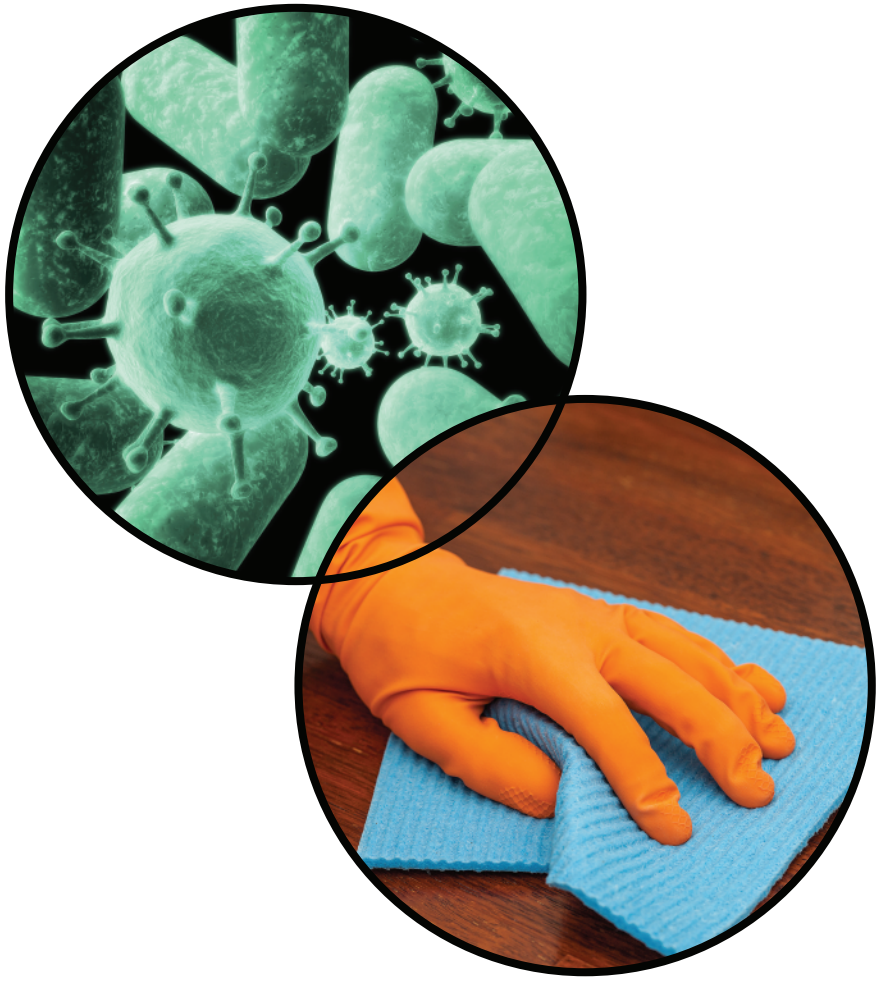

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Selecting the Right Disinfectant When It's Needed Most

Introduction: About two million patients acquire at least one healthcare-associated infection (HAI) in the United States (US) each year. Approximately 90,000 of these patients will die (Stone). It has been estimated that as much as 70% of HAIs are preventable, and thus should not occur (Pronovost). Most healthcare facilities have been increasing efforts to reduce HAIs over the last two to three decades, but we are not even close to where we need to be.

Significant amounts of time and money have been funneled into HAI reduction efforts by healthcare facilities and government agencies. With the direct cost of HAIs to US hospitals estimated to be between $28 billion and $45 billion a year, it is also worth the effort and cost of successfully implemented enhanced preventative measures (Stone). More importantly we are trying to save the lives of someone's parent, spouse, child, friend, or colleague, and prevent the long term suffering and reduced quality of life endured by a large percentage of HAI survivors. It is worth the personal daily effort it takes for HAI prevention perfection.

A Critical Time: A challenging time is about to hit healthcare as multiple circumstances converge to exert increasing pressure on healthcare infection prevention efforts over the next 10-20 years. Each topic below needs an in depth discussion to really understand how impactful this convergence will be, but here we can only list them.

1) Between 2010 - 2030 the US population will increase by 42%; 1 in 5 residents will be age 65 or older; and as is the case for all elderly, they will be more vulnerable to infection, but their demands for heart, hip, knee, eye, shoulder, and spine surgeries will increase from two [hip] to six [knees] times the current number
2) Escalating numbers of patients with obesity and/or diabetes that increasing their vulnerability to infection
3) Accelerating frequency of emerging new pathogens against which we will have no immunity. According to the World Health Organization (WHO), "new infectious disease pathogens are emerging at a rate never before seen with 40 new pathogens in the last 40 years!"
4) Increasing number of natural disasters, urban crowding, resource depletion, climate changes
5) Growing number of individuals and families refusing vaccinations
6) Failing infectious disease treatment and cure capability due to:
   - the need for new diagnostic techniques to identify & treatment methods for infections caused by biofilms, small colony variants (SCV), persister cells, and anaerobic infections as they are prominent and need to be addressed differently than acute infections
   - resistance of pathogens to treatment antibiotics and drugs
   - plummeting research and development efforts into new antibiotics and drug treatments

   Emphasizing the seriousness of these converging pressures, experts have said:

   - "Many common infections will no longer have a cure and, once again, could kill unabated" (WHO)
   - "A simple cut to your finger could leave you fighting for your life." (BBC)
   - "The most basic operations - getting an appendix removed or a hip replacement - could become deadly." (BBC)

- "Cancer treatments and organ transplants could kill you. Childbirth could once again become a deadly moment in a woman's life." (BBC)
- "Opportunistic infections - those that often hit the elderly when they are already ill and vulnerable in hospital - are one of the main concerns." (BBC)

Although this may seem a harsh introduction to an article on cleaning and disinfection, it is used to personalize the importance of whatever we can do to prevent infections initially, and the spread of the pathogens from those who acquire an infection. Because, from the pathogens' point of view, they will find any means they can to transfer from an infected patient to another vulnerable patient in order to sustain their own existence and disperse their species. But how to get to that next patient? Depending on the infectious pathogen type and the disease symptoms caused, they may be propelled in droplets or aerosols when the patient coughs, is speaking, vomiting, or has diarrhea. Alternatively, after touching the patient or contaminated surfaces around the patient, a healthcare provider (HCP) may unknowingly "pick-up" some of those hitchhiking pathogens and transport them to the nurses' station, a surface or device in another room, or directly to another patient. For the pathogen, it's their instinct to survive, their prime directive - whatever it takes!

Environmental Services (EVS): Over the last two decades, the environment around patients has been more highly scrutinized as a possible source of infectious pathogens. It has been confirmed that both non-porous and porous items can be highly contaminated with pathogenic microorganisms. When devices, objects, gloved hands, bare hands, etc., contact these surfaces they themselves become contaminated and can transport the clinging pathogens to vulnerable patient. Studies have revealed that bacteria, viruses, fungi, and spores remain infectious on dry inanimate surfaces for hours, days, weeks, months, and even years (Kramer, Ledwoch, Casanova, Bonilla). Their longevity tremendously increases the opportunities for them to be carried to another host --- unless those surfaces have just been cleaned and disinfected. Given that EVS processes each room once in 24 hours, it is highly improbable that the surface has been disinfected just prior to any given contact event.

Studies have determined that after a patient infected with *Acinetobacter baumannii,* vancomycin resistant enterococcus (VRE), methicillin resistant *Staphylococcus aureus* (MRSA) or *Clostridium difficle,* is discharged, and the room terminally cleaned and disinfected, the next patient assigned to that room will be at significantly increased risk for an HAI caused by that specific pathogen. Similar levels of risk were calculated to apply to patients who share a room with a patient infected with any of these same pathogens. (Cohen, Vickery)

Authors of a 4 country study identified still infectious bacteria including their antibiotic-resistant forms in biofilms on hospital patient room surfaces. Their conclusion: "More frequent and better cleaning [is] needed to remove biofilms and MDROs [multi-drug related organisms] from hospital surfaces and the environment." (Anwar)

So, how can we remove contamination from surfaces in a timely manner? We could have EVS hire more staff that keep rotating through the rooms each and every day, but that would be cost prohibitive, cause excessive foot traffic, and still end up with surfaces not being cleaned and disinfected just before someone touches it.

There may be antimicrobial surfaces that reduce the number of microorganisms in extensive testing, but it is unlikely that their surface-bound antimicrobials will be able to reach the microbes present within or atop organic substances dispersed from the patient, from meal remnants, etc.

There must be a more effective and timely solution!

First, EVS must have:

- enough well trained staff, to perform daily and terminal cleaning/disinfection well
- enough time allotted to EVS staff to perform their tasks correctly and completely
- the most appropriate disinfectants for the targeted pathogens and are also compatible with the surfaces being disinfected
- a monitoring system to provide them with immediate feedback on the effectiveness of their cleaning and disinfecting tasks
- positive association and frequent communication with their own leadership and with the Infection Preventionist team
- the partnership and assistance of nursing, dietary, and all other staff who work in clinical areas of the facility. I have said this for years, and even penned a slogan:

"Grab a Wipe and Swipe! It Takes Seconds, It Saves Lives!"

But, that's all I did --- talk for years.
Separately, others have figured it out and, with the entire facility staff, performed the work!

United States: A True Multiple Facility-Wise Success Story and Example: Now retired Nancy Metternich was the EVS manager of Cedar Community, who oversaw a staff of 31. They were responsible for the laundry and cleaning of a 229 bed healthcare center and 155 apartments at two assisted living centers at Cedar Community in West Bend, Wisconsin. That in itself was a huge accomplishment.

However, she and her team knew, that not long after EVS has cleaned the patient's room, surfaces around the patient would again become contaminated. They knew, it would not be long before a tray, a chart, a glucose monitor, a TV remote, or some other item was placed on one of the contaminated surfaces. After it became contaminated, someone would pick it up, contaminating their hands and attire before they transported the clinging microorganisms to the next patient, touch screen, nurses' station, etc. When a patient down the hall becomes infected with the same pathogen as the patient in the room our "transporter" had been in a few days before, he or she could confidently make the relieved statement, "It couldn't have been me; I never touched either one of those patients!" Ignorance is bliss.

Metternich's staff could not be in each room 24/7, so how did she address this type of serious everyday problem? She had appropriate disinfectant canisters placed at every bedside. Nurses were trained to use them for spills, on equipment after use, on surfaces before and after procedures. They understood why it really must be those that need to be in the room that make certain they do not carry pathogens out with them.

Metternich also knew that different disinfectants can damage different materials. This was a hard-earned lesson when, early on in their efforts, nurses grabbed the bleach canisters and used the wipes on the readout screens, severely damaging the equipment. Additional in-service training was conducted and more obvious differences made in the dispensers to better identify material incompatibility. Different canisters were placed on the computer carts, in the nursing stations, in offices, in rehabilitation rooms, etc. They focused on making it easy for staff to do it right…and hard to do it wrong!

England: Addressing MRSA infections by attacking contamination near the patient: Garvey also used an "all-hands-on-deck" cleaning and disinfection approach. Initially, between 2013 and 2016, staff used a two canister system: first a wipe with a detergent solution, followed with an alcohol wipe. The two canister system took time, was somewhat messy, and was not always performed. In 2016, they switched to a one-

wipe cleaner-disinfectant system. In the year following the change, the number of MRSA acquisitions across the University Hospitals Birmingham system in England fell from 20.7 to 9.4 per 100,000 patient bed days.

Garvey noted that moving from a two-wipe to a one-wipe system simplified the process for very busy staff making the task simpler and more convenient. “The combination wipes fit well with a human factors approach, being available at the point of use and maximizing the opportunity for correct practice.”

What are some of the most important things to remember when selecting a disinfectant?

1) Cleaning:
Whether as a separate process or as a cleaner/disinfectant one-wipe system, cleaning is extremely important.
Surfaces soiled with organic substances such as mucus, saliva, blood, feces, urine, pus, or food will deactivate many disinfectants preventing them from being effective against the pathogens they are expected to destroy. Additionally, some disinfectants will literally “fix” organic substances to surfaces. For example, high concentrations of alcohol are known to fix blood onto surfaces much like glue. This makes it extremely difficult for future cleaning procedures to completely remove the stuck-on organics, while providing bacteria a protected food supply where they can multiply, initiate biofilm formation, and share resistance capability with co-inhabitants under the stuck-on blood/organics. To prevent this sealed in microbial habitat, clean before using a disinfectant, or use an Environmental Protection Agency (EPA) registered cleaner/disinfectant approved for hospital use with strict compliance to the manufacturer’s instructions for use (IFU). The cleaner/disinfectants can save time and eliminate the risk of carrying potentially pathogen-contaminated detergent wipes, cleaning rags and open detergent buckets into multiple rooms.

Exception: Large volume pooled blood, spills, solid waste all need to be removed before normal cleaning/disinfection can continue (e.g., spill kits, “sop-up” forceps).

2) Disinfectant capability:
Hospital disinfectants: Disinfectants used in hospital environments, must be EPA registered and approved for hospital use. Hospitals using other disinfectants will receive an infraction if noted during surveys. The EPA looks at many different requirements when assessing an application both for registration of a disinfectant and for its safe use in hospital environments. Their requirements for microbial “kill” are listed in the “EPA Product Performance Test Guidelines, OCSPP 810.2200: Disinfectants for Use on Environmental Surfaces, Guidance for Efficacy Testing”. It surprises many to learn that a disinfectant only has to kill *two microorganisms* to pass the EPA efficacy testing to quality for that portion hospital-use approval. Those microorganisms are: *Staphylococcus aureus* (ATCC 6538) and *Pseudomonas aeruginosa* (ATCC 15442). No more bacteria required. No viruses. No fungus. No Mycobacterium (e.g. *M. tuberculosis -TB*). Just two specific bacteria!

Hospitals must determine what they need: EPA expects that hospitals will review and list those pathogens that have caused infections in their facility and add those identified by the Centers for Disease Control and Prevention (CDC) as significant threats.

CDC and WHO have developed a list of infectious bacteria referred to as ESKAPE pathogens. These bacteria are responsible for the majority of HAIs throughout the world. The CDC states that over 2/3rds of HAIs in the United States are caused by these ESKAPE pathogens. Each pathogen is aggressively virulent in both its antibiotic sensitive and resistant forms. However, because they are capable of surviving attempts to treat

the patient, antibiotic-resistant forms are selectively becoming a higher percentage of each of the ESKAPE pathogens. (Indrawattana) These are extremely important to include on your list.

ESKAPE Pathogens	
E	• *Enterococcus faecium*
S	• *Staphylococcus aureus*
K	• *Klebsiella Pneumoniae*
A	• *Acinetobacter baumannii*
P	• *Pseudomonas aeruginosa*
E	• *Enterobacter aerogenes*

Hospitals also need to consider threats that appear to be affecting some geographical locations more than others. For example, due to the growing number of individuals and families refusing vaccinations against historically devastating infections, we expect to face serious school, city and regional outbreaks of infectious viral and bacterial diseases we are not used to treating. These diseases include:

- **Viral:** chickenpox, measles, mumps, rubella, polio, rotavirus, hepatitis A, hepatitis B, and influenza (includes both enveloped and non-enveloped viruses)
- **Bacterial:** diphtheria, whooping cough, and several causes of meningitis, pneumonia, and bloodstream infections

Specialty focus hospitals caring for cancer, AIDS, burn, and transplant patients, must also make certain they include several fungal species, as these severely immune-compromised patients are extremely vulnerable. For more generalized hospital facilities, the primary fungal pathogens are Candida spp.

Disinfectant efficacy: Once a facility has compiled the list of pathogens they want to be prepared for, they can select the EPA registered disinfectants approved for hospitals that also list efficacy against those bacteria, fungi and viruses. (Note: in a number of cases, the pathogens are so virulent that testing facilities are required to use surrogates that have the similar disinfectant susceptibility levels. The EPA must approve of the surrogates selected)

To enable disinfectant manufacturers to list the microorganisms against which they have been tested, the EPA has specific test methods and efficacy requirements. These are described in the same EPA document noted earlier: OCSPP 810.220. There is a section for each of the following:

- **Bactericidal** (in addition to the required *S. aureus* and *P. aeruginosa*)
- **Virucidal** (recommend both enveloped and non-enveloped)
- **Fungicidal**
- **Tuberculocidal**

Tuberculocidal: As noted, EPA registered disinfectants approved for use in hospitals are not required to have a tuberculocidal claim. The Occupational Safety and Health Administration (OSHA) historically required a tuberculocidal disinfectant (or bleach) for all blood spills and contaminated surfaces under initial Bloodborne Pathogens ruling in 1991 after it was determined that HIV and HBV were transmitted via infected blood. That ruling was revised in 2001 [OSHA: 1910.1030(d)(4)(ii)(A)]. The revision allows the use of diluted bleach and disinfectants proven effective against HIV and HBV to be used on equipment and surfaces contaminated with blood and other potentially infectious materials (OPIM) “provided that such

surfaces have not become contaminated with agent(s) or volumes of or concentrations of, agent(s) for which higher level disinfection is recommended"(OSHA).

HOWEVER, because tuberculocidal disinfectants have a "higher level of kill", many facilities use them for most disinfection tasks in hospitals. Used in compliance with their IFU, EPA registered, hospital approved tuberculocidal disinfectants will destroy not only HIV and HBV, but most other pathogens as well, except spores and, as is the case with some formulations, a few fungi and non-enveloped viruses. Selecting a tuberculocidal disinfectant just takes a lot of the worry and disinfectant "shopping" off the table. Check the approved claims to make certain they are not missing the fungi and non-enveloped viruses of concern for your facility. Make certain the disinfectant's IFU is followed perfectly from concentration and pH requirements, to the length of time it stays in wet contact with the surface being disinfected.

3) Disinfectant material compatibility

A disinfectant that only requires a short contact time and is effective over the broad spectrum of pathogens outlined above appears to be the perfect choice. But if it is incompatible with the material on which it is used, a whole spectrum of damages can occur.

Discoloration: The damage may be "just" discoloration such as bleaching out bright colors, dulling of shiny or painted surfaces, yellowing of white fixtures. These may be deemed acceptable as long as the items are still usable or just look too awful. However, there are many items that can functionally be impaired by discoloration. For example, permanent hazing of monitor screens or of clear plastic window panels where viewing is impaired after incompatible disinfectants are used making them useless.

Swelling, hardening, cracking: Disinfection of surfaces with incompatible disinfectants can cause plastics to develop fine invisible cracks referred to as crazing. Repeated disinfection further deepens and enlarges the cracks until they are visible. At this stage the material becomes weaker. If load-bearing, it may break. If still functioning, the cracks provide places into which blood and other body fluids can seep and pathogens can find protection with a food supply triggering biofilm formation. Whether the material incompatibility mars aesthetics, ruins functionality, or creates places for pathogens to multiply becoming pathogen reservoirs, they can be expensive damaged items to replace.

Electronics Repeated disinfection of items such as monitoring leads, wiring, cell phones, data entry devices, scanners, and remotes, can "fry" delicate circuitry if they have not been shown to be compatible to these material. When in question about the compatibility disinfectants with electrical components being disinfected, call the device manufacturer's technical support department and document their response.

Metal corrosion: Some disinfectants corrode galvanized steel, stainless steel, aluminum, brass, and/or chrome fixtures. Confirm compatibility.

Altered hard surface texture: In addition to discoloration, dulling, electrical damage, and corrosion, disinfectants may alter the surface texture of nonporous materials such as plastics, acrylics, wood, and hard vinyl, from smooth and shiny to rough textured with cracks and pitting. Laminate adhesives can degrade with the use of incompatible disinfectants causing areas of separation and buckling. This type of damage is usually unacceptable as far as comfort, appearance and usability. It also provides the perfect opportunity for organic debris to fall into, moisture to persist, and bacteria to establish biofilms within the damage-created cracks and material separations.

Confirm disinfectant compatibility. For the most extensive list of compatibility and incompatibility, download EPA documentation on the EPA registered disinfectant.

Damage to flexible and porous materials: By far, the majority of EPA registered disinfectants approved for hospital use have been formulated for use on nonporous surfaces. Most are not compatible for use on porous, thin-film or soft supple type materials such as vinyl, polyurethane, natural rubber, plastic films, or nylon used, for example in hospital furniture, curtains, mattresses, and protective mattress covers. Disinfection with incompatible disinfectants can harden these materials, create fine cracks, peeling, flaking and tears providing access points for blood, other bodily fluids, and pathogens to seep into enabling future sources of infection to survive and multiply within the material.

Alert on Mattresses:
Bed - The FDA has received over 700 reports of stained, peeling and cracked bed mattresses. Yet, the FDA stated that this is an industry-wide problem and for the most part, hospitals are not reporting the damages. In fact inspections have revealed that over one third of bed mattresses fail.

Surgical table mattress – Between 2011 and 2013, the FDA received 458 FDA reports of contaminated operating room mattresses. The mattresses were reported to be worn and cracked obviously capable of letting blood & body fluids leak inside to support microbial growth and biofilm formation within the surgical table mattresses. If saline or water seeps into the mattress before or during surgery, the fluids provide an easy exit from the mattress to the patient during the procedure.

Disinfectants safe for porous materials: Check to make certain that the disinfectant is not only EPA registered and approved for hospital use, but that the manufacturer also lists it as **compatible with the porous materials you will be disinfecting**. Most often, these will be quaternary ammonium based disinfectants (Quats). Historically, Quats have been compatible with non-porous and porous materials in healthcare, but were typically slower and had a narrower microbial kill range than aggressive disinfectants used primarily on non-porous materials.

However, quat formulation adjustments over the years have decreased kill times dramatically while increasing the spectrum of pathogens killed in many of the newer formulations. Some are now approved for the full range of bactericidal (ESKAPE pathogens), fungicidal, viricidal (both enveloped and non-enveloped viruses) as well as tuberculocidal. These are the quaternary ammonium/alcohol-based formulations (also known as alcohol quats). As a cautionary general rule, for cleaning/disinfectant combinations, a level of alcohol of about 20% is needed for the faster, expanded kill and dry times. However, *higher than 20% alcohol concentrations can "fix" blood and other organic substances onto the surfaces* being cleaned, and with repeated use tend to "dry-out" plastics and porous materials on mattresses and furniture causing them to harden and crack.

Survey infractions: Visibly noted damage that creates opportunities for pathogen reservoirs are being sighted as infractions by surveyors. More importantly, they place current and future patients at risk for infection.

Fluid-barrier mattress protectors have been shown to make a big difference in preserving the quality and safety of the mattress and thus the future patients. A total mattress cover that is impermeable to fluids, can be surface disinfected at any time as well washed as laundry without special delicate requirements is best. Of course, confirm the disinfectant addresses the target pathogens and is compatible with the barrier material.

In Summary:
Hospitals are soon to be pressured with increasing numbers of patients, most of whom will be the more vulnerable to infections, including the elderly, obese, and diabetic patients. The increase in vulnerable

patients will occur at the same time we are confronted with failing treatment options for those who acquire infections. The best way to avert this crisis is to prevent infections before they occur.

We now know that enhanced disinfection methods can be one of our most effective efforts of preventing healthcare-associated infections.

Enhanced disinfection starts with selection of highly effective disinfectants effective against all ESKAPE pathogens specified by CDC, as well as being viricidal (enveloped and non-enveloped viruses), fungicidal, tuberculocidal or sporicidal as needed. Each disinfectant must be compatibility with each of the items to be disinfected whether they are porous or non-porous. Nurses, and other staff who attend to the patient should clean and disinfect the surfaces they will contact both before and after they accomplish their task. The most convenient method with the highest compliance and, it appears, the greatest reduction in targeted infections, has become the use of cleaner-disinfectant canisters at point of use.

Make it easy to do the right thing!

We really do need to do this! Rally all hospital staff to participate in preventing pathogen transmission by being part of the disinfection brigade:

Grab a Wipe and Swipe! It Takes Seconds, It Saves Lives!

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