SELECTING AND USING NO-TOUCH ROOM DISINFECTION:

HOW ULTRAVIOLET AND HYDROGEN PEROXIDE VAPOR TECHNOLOGIES ARE CHANGING HOSPITAL HOUSEKEEPING

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Executive Summary

As the world's leading hospital environmental services provider, Sodexo takes hospital cleaning and disinfection very seriously. About three years ago, we began looking into no-touch room disinfection as a means to improve our already industry-leading patient focused infection prevention service model. Our goals are to provide patients with healthy healing environments while improving operational efficiency. In investigating and implementing various no-touch disinfection systems, we have learned a great deal. The purpose of this white paper is to share the lessons that we have learned with healthcare and environmental services professionals so that, working together, we may provide patients the safest possible environment for healing. We will:

- Review the case for no-touch methods
- Provide an overview of current technologies
- Present a list of considerations in selecting a no-touch disinfection technology
- Outline Sodexo's experience in selecting our no-touch room disinfection system.
- In conclusion, we will discuss Sodexo's choice of pulsed-xenon technology as the best option for infection control and hospital operations.

What is a No-Touch Disinfection System?

No-touch disinfection, also called “area disinfection," is a means of disinfecting an enclosed space. This can be achieved using either ultraviolet light (UV) or hydrogen peroxide vapor (HPV). In both cases, a device is placed into a patient room, operating room or other area while the room is unoccupied and the device is run for specified time (disinfection cycle). Depending on the technology, the duration of the disinfection cycle can be between 8 and 240 minutes. There are a variety of companies producing devices for each technology (which we will review later).

Does My Facility Need No-Touch Disinfection?

In short, yes. Significant evidence in the medical and scientific literature has shown that traditional cleaning methods were more often than not inconsistent. In several studies by Philip Carling and others, the industry average room cleaning process achieved just below a 50 percent effectiveness rate on high-touch surfaces. Sodexo, in partnership with industry thought leaders, researchers and manufacturers has been focused on improving the cleaning efficacy for years. After educational, training and process improvement interventions, we have been able to improve those percentages significantly, but *C.difficile* spores and the potential for human error remains a constant threat.

We find this potential risk remains unacceptable, especially when there are no-touch technologies available that can greatly diminish the potential for human error and add a critical layer of extra protection for patient safety.

But Does the Environment Really Matter?

A number of studies have shown that when a patient is admitted into a room in which the prior occupant had an infection, the entering patient has a significantly higher chance of coming down with that same infection. This "prior occupant risk" has been linked to a four-fold increase in infection risk. In other words, a person's risk for a hospital acquired infection (HAI) is partially determined by room into which they are admitted. This is unacceptable, as it represents a differential standard of care and demonstrates that the environment is a significant contributor to HAIs. To make matters worse, the stakes seem to be higher every day with new resistant organisms like New Delhi virus, *Acinetobacter baumanni* and others joining the list of already troubling organisms like MRSA, VRE, Norovirus and *C. diff*.

To put this question into perspective, ask yourself if you would prefer to have a loved one admitted into an ICU room where the previous patient was infected with *Acinetobacter* or in which the previous patient was not on isolation? In effect, would you stake your life or the life of a loved one on manual cleaning and chemicals or would you prefer a no-touch, systematic solution to have been used as well?

Can't We Just Improve Hand Hygiene?

Achieving and maintaining a high percentage of hand hygiene compliance is a need of every facility. However, hand hygiene alone is not enough. Not only is it difficult to maintain a high compliance rate (typical compliance rate

seems to hover between 40 percent and 60 percent), but it is also hard to keep those hands clean. Studies show that hands become contaminated as quickly from surfaces and objects in the environment as they do from touching patients. Hands are only as clean as the surfaces they come in contact with. There is a direct link between the prior occupant and infection risk, which is independent of hand hygiene compliance. In other words, the contaminated environment – regardless of hand hygiene – is the cause of infections.

Targeting Zero

Recently, APIC began a "Targeting Zero" initiative focused on eliminating healthcare-associated infections. While some improvements have been made in infection control in recent years, the environment remains a significant problem. With the exception of changing which chemicals are used, we are cleaning the environment now in the same manner as we were decades ago. We will not achieve zero HAIs until new technologies are used in the environmental cleaning sector as well. In fact, the more successful your facility is at achieving high standards of hand hygiene and procedural compliance, the more impact a no-touch disinfection system can have on your goal of zero infections.

CONSIDERATIONS FOR SELECTING A NO-TOUCH DISINFECTION SYSTEM FOR YOUR FACILITY

First, you need to familiarize yourself with the different technologies and concepts around no-touch disinfection. As with any new technology, there is a vocabulary used in describing how the technologies work and what is different about each one.

Ultraviolet Disinfection

Ultraviolet disinfection is common in everything from laboratories to vacuum cleaners. Using a variety of methods, high-energy ultraviolet light in the area of the spectrum known as UV-C is produced by either mercury or xenon gas lamps. This UV-C energy passes through the cell walls of bacteria, viruses and bacterial spores. Once the UV-C energy is inside the microorganism, it is absorbed by the DNA, RNA and proteins. One of the primary mechanisms of damage created by UV-C is the fusing of the strands of DNA creating what is known as "thymine dimers." Once the DNA is fused, the organism can no longer replicate and is, therefore, no longer infectious. The technical term for this is "deactivation."

Optimal wavelengths vary for UV-C disinfection of different organisms. On average, wavelengths of 260-265 nm are where peak DNA absorption occurs. For E. *c*oli, 265 nm is about 15% more germicidally effective than 253.7 nm. For B. subtilis, 270 nm is about 40% more germicidally effective than 253.7 nm. In addition, UV-A and UV-B wavelengths also play a role in disinfection.

Mercury Ultraviolet

Perhaps the most familiar form of UV is that which is produced by mercury vapor lamps. In these lamps, the mercury vapor is excited to create UV-C. Specifically, mercury vapor lamps create UV at 253.7 nm. This is close to the average peak DNA absorbed at 260-265 nm. Mercury lamps produce a continuous UV light.

Pulsed Xenon Ultraviolet (PX-UV)

UV-C can also be produced by pulsing a xenon lamp. This method, which has been in use since the mid-1970s, produces a flash of light containing a broad spectrum (from 200 nm to 320 nm) covering the entire germicidal UV band, delivered in millisecond pulses. The broad spectrum nature (meaning that more UV-C wavelengths are produced) combined with the high intensity of the millisecond pulses gives PX-UV disinfection efficacy several times faster than mercury UV.

Hydrogen Peroxide Vapor (HPV)

Hydrogen peroxide vapor systems use chemical reactions to produce a vapor of hydrogen peroxide that is then dispersed throughout the area to be disinfected. The oxygen in the hydrogen peroxide vapor reacts with the cell walls of microorganisms, leading to cell lysis and death. HPV systems have been used as instrument sterilizers for some time. The basic concept is to fill the room with a mist containing (depending on the formulation) a percentage of hydrogen peroxide that coats the surfaces in the room.

Each manufacturer emphasizes different aspects of no-touch disinfection and it is crucial to understand the features of each product in order to fit a system into your facility's operations. Below is a list of considerations we looked at when Sodexo was selecting a no-touch disinfection partner:

Consideration: Decontamination Effectiveness

Of course, one primary factor to consider is the effectiveness of the technology in an operational setting. Both UV and HPV have reams of historical data backing their effectiveness in achieving disinfection. Unfortunately, determining the decontamination effectiveness is not simply a matter of choosing which system gives the highest level of disinfection. HPV systems, for example, take multiple hours to achieve their disinfection level. Not only is the high level of disinfection not needed in the patient environment, the long treatment cycle is not practical for routine use. When considering no-touch disinfection, keep in mind that removing 99.9% of organisms from the high-touch surfaces in a room is sufficient to protect the subsequent patient. In selecting a no-touch disinfection system, look for one with proven disinfection effectiveness achievable throughout a facility and on a routine basis.

Selection criteria: A demonstrated, statistically significant reduction of the bacterial load in a "real-life" hospital setting – where the maximum number of square feet can be disinfected.

Consideration: Cost per Room

When no-touch disinfection technologies are deployed effectively, the cost-benefit of implementing a system is a "no brainer." However, the cost of each system is not the same. Prices on legitimate systems (those with proven efficacy in less than five hours) generally range between $50,000 and $120,000 with varied monthly licensing or service fees.

More important to consider than the raw, upfront cost is the cost per room for each machine. Many factors go into calculating this cost, but it can be estimated fairly easily. HPV systems require a chemical canister for each use, whereas UV systems require bulb replacement. In addition, there is the labor cost per use to consider.

Selection criteria: Lowest possible cost per room, factoring in labor skill level, consumables, room "down time," and daily number of rooms treated.

Consideration: Cycle Time

From the environmental services perspective, the cycle time of the no-touch device is a critical consideration. In most facilities, room turnover time is an essential performance indicator for environmental services. Adding on to the room turnover time will reduce the overall capacity of the facility, leading to lost revenues and longer patient wait-times.

Selection criteria: The shortest possible cycle time, while still remaining effective.

Consideration: Operators

Of course, these devices do not operate themselves. Someone is going to have to move the devices around the hospital and operate them. Who that person is will be a very important consideration in choosing a no-touch disinfection system. Some of the no-touch disinfection systems can be operated by a housekeeper and others require a more in-depth technical training. As the skill level for the operator increases, the cost of operating the device increases as well.

Selection criteria: Device must be able to be operated by housekeepers.

Consideration: Access to Rooms

While a device is in use, the room must be unoccupied. For intensive care units, emergency departments, operating rooms and other critical areas there may be situations in which a disinfection cycle must be interrupted to access the room. It is therefore essential that the operation of no-touch disinfection system can be stopped remotely from outside the room and the room is safe to enter and use immediately.

Selection criteria: External, remote stop, and immediate reentry.

Consideration: Safety

Safety is, of course, a paramount concern. Each device must be safe for operators, patients, healthcare workers and visitors. An automated safety system for immediate device shut-off is essential.

Selection criteria: Automated shut-off system.

Consideration: Environmental Friendliness

As Sodexo uses products on a large scale, it is important to be as environmentally conscious as possible. To that end, we are working to reduce our use of caustic chemicals and be certain that new products do not represent an environmental concern. We are also focused on reducing waste.

Selection criteria: Minimal or no use of waste, chemicals or toxins.

Consideration: Infection Rate Impact

Last and most importantly, one should consider the demonstrated impact the no-touch disinfection systems have on infection rates. As these new technologies are deployed in real-world settings, the hospitals that deploy them may or may not report on the resulting infection rate changes. For devices that have been deployed for years without any reported infection rate impact, there may be cause for concern. PX-UV, the newest of the technologies, already has demonstrated several in-hospital infection rate reductions.

Selection criteria: Objective evidence and in-hospital case studies that demonstrate a reduction in infection rates.

COMPARISON OF NO-TOUCH DISINFECTION SYSTEMS

	Hydrogen Peroxide Vapor	Mercury Ultraviolet	Xenon-Pulse Ultraviolet
Decontamination effectiveness	Studies showed 95% reductions[1]	Low-end models (less than 20 bulbs) unproven. High-end models studied showed 99% reductions[2]	Studies showed 99% reductions[3]
Cost per room* (leading vendor in category)	$110.27	$15.75	$2.80
Cycle time	3-4 hours per room[1]	1 hour, 12 min to 2 hours, 6 min[4]	6 min/position, 2 positions = 12 min for typical room[3]
Operators	Specialized Technician	Housekeeper	Housekeeper
Access to room during operation	No	Remote Stop; Immediate Re-entry	Remote Stop; Immediate Re-entry
Safety	Vapor is dangerous until cycle is complete, rooms must be sealed with tape	UV light can irritate the retina, so staff must exit during treatment	UV light can irritate the retina, so staff must exit during treatment

Environmental friendliness	Hydrogen peroxide degrades into H_2O	World Health Organization supports a ban on mercury in healthcare settings	Certified "green" by Practice Greenhealth[3]
Infection Rate Impact	Unconfirmed	Unconfirmed	82% reduction in C. diff[5], MRSA reduced to zero in 2 quarters of use[6]

1. (Manian et al., 2011)
2. (Rutala, Gergen, & Weber, 2010)
3. (Stibich et al., 2011)
4. (Boyce, Havill, & B. a Moore, 2011)
5. Cooley-Dickinson Hospital Press Release, 2010
6. Cone Health Study, 2011

*Calculated using annual cost of equipment + consumables (chemicals, bulbs, etc.) divided by the capacity (number of rooms) allowed by cycle times. Does not include labor or other costs to facilities.

FACTORS IN IMPLEMENTING NO-TOUCH DISINFECTION

Dispatch

One of the biggest considerations in implementing any no-touch disinfection system is dispatch. To get the most out of your no-touch system, give thought to who is operating the device, how notification would be given for the device to move to the room to be disinfected, and other steps in using the system.

Changes in Room Cleaning Protocol

Additional optimization can be obtained by changing the room cleaning protocol to work the specific system into the process. This, of course, would have to be done on a facility-by-facility basis. However, anytime a new process is added, there is an opportunity to integrate it efficiently by considering the workflow of the operators and the workers conducting the terminal clean of the rooms.

Public Relations, both Internal and External

When implementing any new system, communication (both internally and externally) is important to smooth transitioning. Internal communication includes involving medical staff, infection control, and environmental services

in communications that explain the purpose of the no-touch disinfection system and make sure any concerns, questions and comments are addressed formally. External communications are also important. Patients, family and the community should be advised concerning the reasons for implementing a no-touch disinfection system and assurance should be given that the system is not being used because of a "problem" at the facility, but rather is an indicator of the facility's continued commitment to using the best available means to protect patients.

CONCLUSIONS: HOW SODEXO DECIDED ON PULSED XENON UNLTRAVIOLET (PX-UV)

It cannot be stated strongly enough that hospitals have a duty to protect their patients from HAIs. Given the results of recent studies, no-touch disinfection systems that decontaminate the hospital environment play an important role in achieving the goal of zero infections.

Hospital facilities and environmental service companies that decide to add a no-touch disinfection system to their cleaning arsenal must consider several factors to determine the system that is the best fit for them. After careful consideration, Sodexo decided to partner with Xenex Healthcare Services. Xenex manufactures a pulsed-xenon UV system that meets our strict criteria of real-world efficacy and operational efficiency.

The effectiveness of other no-touch disinfection systems was acceptable in terms of their laboratory-proven ability to kill organisms. However, in order for any of these systems to protect patients and reduce infection rates, it must be possible to integrate the system into real-world situations without excessive costs or disruption of patient flow. Sodexo understands that in a busy hospital setting, a system that is too slow, very complex to use, or is costly will not be used often enough to have a meaningful impact on HAI rates.

The Xenex PX426 system met all of our consideration factors. The cost per room is low, due to the short cycle time and the fact that no chemicals are consumed. Each device has the capacity to treat the highest number of rooms in a day. This factor increases cost effectiveness as the number of rooms disinfected facility-wide is very high. Labor costs to a facility are decreased versus other no-touch systems, as personnel time is short and much needed beds are made available quickly, rather than being unoccupied for the hours required for the operation of other systems.

Sodexo considered the safety of operating the different systems, including the safety of the patients and hospital staff. When operated correctly, all no-touch systems are safe. Rooms must be unoccupied with neither patients nor system operators in the room while no-touch disinfection systems are in use. The Xenex PX426 stood out because of a motion detection system and remote stop

features that allow the operator immediate access to the room, while HPV systems do not permit immediate access. Sodexo operators can be easily trained to use the system without concerns for personal safety. Lastly, there are no environmental concerns in using the Xenex system, as xenon is an inert gas that does not harm the environment, unlike mercury.

The proven outcome data from Xenex showing a decrease in actual infection rates reiterates our decision on a system that is cost-effective, easy to use, and faster than all other available technologies. We are able to train and certify Sodexo operators quickly, and integrate the device into our routine cleaning. Easy implementation means we can immediately begin adding the extra level of patient safety to our hospital facilities.

At Sodexo, we are so convinced of the added benefits provided by the use of a no-touch disinfection system that we have taken steps to make it part of our standard cleaning process.

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