COMMENTARY

Surface Disinfection: Treatment Time (Wipes and Sprays) Versus Contact Time (Liquids)

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(See the article by Rutala W, Weber DJ, Selection of the ideal disinfectant. *Infect Control Hosp Epidemiol* 2014;35:855–865.)

In 2014, we published a paper on the "Selection of the Ideal Disinfectants."[1] Disinfectant selection (ie, disinfectant product) is 1 of 2 essential components for effective disinfection. The other component, the practice, is the thorough application of the disinfectant such that the disinfectant contacts all contaminated surfaces. This practice should include proper training of hospital staff, especially environmental services and nursing staff, and adherence to the manufacturer's label instructions. The combination of "product" and "practice" results in effective surface disinfection and leads to the reduction of patient risk and improved patient outcomes.[1,2] Among the 5 key considerations in the selection of an ideal disinfectant is a consideration commonly referred to as the "contact time."[1] The purpose of this paper is to provide a better understanding of "contact time" for liquids and "treatment time" for disinfectant wipes and sprays.

Each chemical disinfectant requires a specific length of time it must remain in contact with a microorganism to achieve complete inactivation. This is known as the contact time (or kill time), and kill times for each microorganism will be clearly listed on the label of US Environmental Protection Agency (EPA)–registered liquid disinfectants. Rapid kill times are important because they provide confidence in complete killing of the most common healthcare-associated pathogens before the disinfecting solution dries or is removed, and before patients or staff are likely to retouch the surface. Ideally, the contact time (or "wet" time) for liquid disinfectants should be greater than or equal to the kill time. For example, some disinfectants may have a kill time for vegetative bacteria of 1 minute, which means that the bacteria listed on its label will be inactivated within 1 minute. Other products, often concentrated formulas that require dilution before use, are registered by the EPA for use against bacteria and viruses (eg, hepatitis B virus and human immunodeficiency virus) with a contact time of 10 minutes. Such a long contact time is not practical for disinfection of environmental surfaces in a healthcare setting because most healthcare facilities only apply a water-based disinfectant once and allow it to dry, which normally takes 1–2 minutes.

The EPA position is this: "By law, all applicable label instructions on EPA-registered products must be followed. If the user selects exposure conditions that differ from those on the EPA-registered product label, the user assumes liability from any injuries resulting from off-label use and is potentially subject to enforcement action under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)."[1,3] According to this position, contact or kill times for the organisms listed on the label must be followed. Currently, EPA-registered disinfectants are available with contact times of 1–4 minutes against most pathogens known to cause healthcare-associated infections and outbreaks (see http://www.epa.gov/oppad001/chemregindex.htm). Disinfectant manufacturers are working with the EPA to obtain shortened contact times so that disinfecting products will be used correctly (ie, in compliance with label claims) and effectively in the healthcare environment.

The method that has been used for more than 60 years for EPA registration of liquid and dilutable liquid disinfectants for hard surfaces is the Association of Official Analytical Chemists (AOAC) use-dilution method. In this method, stainless-steel carriers are immersed in bacteria (eg, *Staphylococcus aureus*), treated with the disinfectant for a prescribed time, then placed the carriers in growth media to determine whether any bacteria survived.[4] With this test, all microbes on a carrier (eg, ≥1,000,000 *S. aureus* on a stainless-steel carrier) must be inactivated to result in a negative carrier. If ≥1 organism survives, the carrier is positive, and nearly all carriers must be negative (eg, performance standard for *S. aureus* is 0–3 positive carriers in 60) to support EPA registration. This method is a qualitative test (ie, pass or fail based on any bacterial growth) rather than a quantitative method (eg, determines the $\log_{10}$ reduction, such as 5-$\log_{10}$ reduction in 1 minute). Thus, this use-dilution test measures the ability of the disinfectant to inactivate the test organism (normally ~ 10^6 test organisms per carrier) in the disinfectant in a measured time.

The EPA also has a standardized test for towelettes (ie, wipes).[5] In the past several years, presaturated wipes have been found to be effective and are increasingly used in healthcare facilities.[6] The "towelette" test is a modification of the AOAC

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TABLE 1. Differences Between the Surface Disinfection Methods Based on the Environmental Protection Agency (EPA) Registration Tests

Disinfection Method	EPA Registration Test	Rationale	Test Measures	Comments
Wipe[a]	Disinfectant towelette test	Measures disinfectant inactivation and physical removal	Treatment time (duration of wet time is not relevant)	Wipe should be discarded when the wiped surface is no longer wet. Treatment time includes a wet time plus wiping as well as the undisturbed time.
Spray	Germicidal spray products as disinfectants	Measures disinfectant inactivation	Treatment time (duration of wet time is not relevant)	Spray is applied to a surface usually from a distance of 6–8 inches. The spray would be tested and used per manufacturer's instructions (eg, until thoroughly wet; number of pumps).
Liquid disinfectant	Association of Official Analytical Chemists use-dilution test	Measures disinfectant inactivation	Contact time or wet time	If the product evaporates too quickly it would not remain in contact with the microbe for the necessary kill/contact time. Most aqueous-based products (eg, chlorine) will keep the standard surfaces wet for ~2 minutes, while alcohol-containing solutions will dry faster.

[a]*Clostridium difficile* and *Candida auris* are assessed using different methodology.

germicidal spray products test for disinfectants, but instead of a contaminated surface being sprayed with disinfectant, it is wiped with a disinfectant towelette. The EPA presaturated towelette disinfection test method is used to substantiate efficacy claims for disinfectant towelettes.[5]

The disinfectant towelette test method involves the application of the test organism to a glass surface prior to being treated by the disinfecting wipe in a standardized manner. Following the desired contact (eg, 1 minute, 2 minutes), the carrier (ie, glass slides) is placed in the growth medium for 48 hours to determine whether all test organisms (eg, at least 10^5 *S. aureus* or *Pseudomonas aeruginosa*) have been inactivated. During the contact time, the liquid delivered on the glass surface by the wipe is open to drying. Thus, the reduction of microorganisms is caused not only by the inactivation produced by the disinfectant but also by physical removal of microorganisms by the wipe. The EPA towelette test does not require the test surface to remain wet during the test time, but it must be undisturbed (eg, not touched or abraded).[5,7] Thus, the treatment time for a wipe disinfectant consists of the wet time plus wiping as well as the undisturbed "dry" time. To "pass" a 60-carrier test with *S. aureus*, 59 of 60 surfaces wiped with the towelette must show no detectable growth. The germicidal spray products test for disinfectants is performed similarly and is particularly appropriate for disinfectants, which do not require dilution and are designed to be used with an aerosol or trigger spray.[8,9] That is, the surface is inoculated and sprayed, and after the treatment time has elapsed, the treated test surface is transferred to the growth medium for 48 hours to determine whether the test organisms have been inactivated. Like the towelette test, to pass a 60-carrier test with *S. aureus*, 59 of 60 surfaces sprayed must show no detectable growth of the test bacteria. The treatment time for a disinfectant spray consists of the wet time plus the undisturbed dry time (if any), as no surface wipe is involved.[8,9]

In summary, the issue of "contact time" and "treatment time" is complex because it is based on different EPA test methods used for liquid disinfectants versus a disinfectant towelette or spray, respectively. The registration test for liquid disinfectants is the AOAC use-dilution test, and the contact time should be the wet time.[4] This practice simulates the contact time in the test tube with the inoculated carrier. The registration test for a disinfectant wipe and the spray are the EPA disinfectant towelette test and germicidal spray test, respectively, and the label should be interpreted as the treatment time.[5] For the wipe, the treatment time is the kill time and is equal to the combination of the physical removal and inactivation caused by the disinfectant regardless of the surface appearance (eg, wet vs dry). For the spray, the treatment time is the kill time or the time for complete inactivation of the test bacteria caused by the disinfectant regardless of the surface appearance (eg, wet or dry). Thus, if a product is a liquid disinfectant (eg, dilutable quaternary ammonium compound) and the label indicates an EPA registration label based on the use-dilution test of 2 minutes, then the treated surface should remain wet for 2 minutes. In contrast, if a disinfectant wipe or a spray has an EPA registration time of 2 minutes, then the surface (ie, wiped or sprayed) should be allowed to remain undisturbed for the EPA registration time of 2 minutes (ie, duration of wet time is not relevant). (Table 1)

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Infection preventionists, environmental service workers, nurses, regulators (eg, state and federal), and accrediting agencies (eg, The Joint Commission) surveying healthcare facilities should be aware of the different requirements for EPA registration of surface disinfectants registered by the use-dilution method (ie, liquids have a contact time and wet time) and those tested by the towelette and spray test (ie, wipes and sprays have a treatment time and no wet time).

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