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Research Report

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CaviWipes1 Cleaning and Surface Disinfection Investigation

Purpose – *The study was undertaken to evaluate **CaviWipes1** using three parameters:*

1. Ability to clean environmental surfaces coated with dried organic debris,
2. Cleaning capability compared to that observed for surface disinfectants containing high concentrations of alcohol, and
3. Ability to clean contaminated surfaces and kill vegetative bacteria using a single-step application procedure.

Numerous environmental surfaces become contaminated with biological debris via splashes, spatter, and touch during provision of patient care. While there have not been any reports to date of cross-infection from these surfaces to dental professionals or their patients, certain bacteria, including methicillin-resistant Methicillin Resistant *Staphylococcus aureus* (MRSA), viruses, and fungi can remain viable for extended periods on inanimate surfaces. Hepatitis B Virus (HBV) and influenza viruses are among the more hardy viruses also capable of remaining infectious on these items for hours or even days. Unfortunately, numerous cases of hospital-acquired infections caused by bacteria such as MRSA and *Enterococcus sp.* can be traced back to contaminated environmental surfaces. Current infection control guidelines address this by requiring that these surfaces be cleaned and disinfected or covered between patient appointments.

When considering the large number of surfaces that may accumulate saliva, blood, and exudate, it becomes apparent that environmental surface disinfection comprises a major portion of an effective infection control program. According the most recent modification of the Spaulding Classification System for chemical sterilants and disinfectants (Table 1), environmental surfaces are included as non-critical items, and sub-divided as either clinical contact or housekeeping surfaces. These surface types require different infection control attention based on the potential for direct patient contact, frequency of contact with hands, and likelihood of surface contamination with body fluids or microorganisms. Clinical contact surfaces (i.e. light handles, switches, operatory computers, countertops, drawer handles, bracket trays, etc.) are defined as contaminated surfaces from patient secretions either by direct spray or spatter generated during dental procedures or by contact with healthcare personnel's gloved hands. These surfaces can act as reservoirs for microbial accumulation with the potential for cross-infection, and should be covered with a disposable single-use barrier or cleaned and disinfected with a low to intermediate-level disinfectant. In contrast, housekeeping surfaces (i.e. floors, sinks, walls) are not involved in direct delivery of patient care and have a very low risk of disease transmission. They can be decontaminated with less rigorous procedures, such as cleaning only.

Table 1. Summary of Methods for Decontamination in the Dental Office

Item Category	Item Definition	Is Item Used in the Mouth?	Potential Risk of Disease Transmission*	Potential Risk of Disease Transmission*
Critical	Penetrate soft tissue, contact bone, enter into or contact the bloodstream, or other normally sterile tissue.	Yes	Very high to high	Sterilization
Semicritical	Contact mucous membranes or non-intact skin, but will not penetrate soft tissue, contact bone, enter into or contact the bloodstream, or other normally sterile tissue.	Yes	Moderate	Sterilization or high-level disinfection†
Noncritical items §	Contact with intact skin	No	Low to none	Intermediate- to low-level disinfection or simple cleaning¶

* *Depends on the nature and amount of contamination and how the item or surface is used.*

† *Depends on whether the instruments are damaged by heat. The majority of semicritical items in dentistry are heat-tolerant and therefore should be sterilized with heat.*

§ *Includes environmental surfaces, which carry an even lower risk of disease transmission than medical instruments.*

¶ *Depends on whether the items are contaminated visibly by blood. If an item is visibly contaminated with blood use an intermediate-level disinfectant.*

(from: Molinari JA and Harte JA. Environmental surface infection control: disposable barriers and chemical disinfection. In: Cottone's Practical Infection Control in Dentistry. 3rd ed. Philadelphia. Lippincott Williams & Wilkins Pub; 2010:171-184)

As mentioned above, when disinfecting clinical contact surfaces the current Centers for Disease Control and Prevention (CDC) dental infection control guidelines recommend use of an intermediate-level disinfectant. This category includes liquid chemical germicides registered by the EPA for use in a hospital environment with an additional tuberculocidal claim. *Mycobacterium tuberculosis* presents a strong challenge to chemical disinfectants because of its outer cellular wax and lipid layers, thereby placing it among the more resistant microbial forms. Intermediate-level disinfection inactivates most vegetative bacteria, most fungi, and some viruses, but cannot be relied on to inactivate very resistant microorganisms such as bacterial spores. The recently marketed disinfectant ***CaviWipes1*** meets this criterion, as it has received EPA approval for tuberculocidal disinfection in 1 minute exposure. This is one of the fastest kill times against mycobacteria, making this agent highly effective.

While much discussion of a disinfectant's efficacy focuses on its antimicrobial spectrum, the importance of surface cleaning as a first step cannot be overemphasized. Cleaning is defined as the physical removal of debris. This procedure is an essential step for removing organic matter, such as blood and tissue, and other debris that might otherwise interfere with the subsequent sterilization and disinfection of devices, materials, and environmental surfaces. Thus, initial cleaning of contaminated surfaces is a pre-requisite, as together they minimize the potential for cross-infection. Although separate products can be used for cleaning and disinfection, products that are able to accomplish both functions provide efficient alternatives. This dual capability should be fundamental consideration when selecting an environmental surface disinfectant.

CaviWipes1 has recently been introduced by TotalCare. This low alcohol intermediate level disinfectant has an EPA approved label claim of killing TB in 1 minute and is both a cleaner and disinfectant in one. In an effort to evaluate the ability of ***CaviWipes1*** to pre-clean surfaces and disinfect them, the following investigation was undertaken.

Materials and Methods:

Test Specimen Preparation:

Bacterial suspensions of stock *Staphylococcus aureus ATCC #25923, Escherichia coli ATCC #25922,* and *Pseudomonas aeruginosa ATCC #27853* were prepared by aerobically culturing bacteria in 10 mL of trypticase soy broth at 37C for 48 hours. Individual bacteria/blood suspensions were subsequently prepared by adding 0.5 mL of each of the bacterial cultures to a separate vile of freshly collected heparinized human blood (5 mL). These were used to coat experimental environmental surfaces by adding 0.2 mL of the bacteria/blood suspension onto 2x2 laminated countertop tiles. The suspension was spread over the entire surface using a sterile cotton swab and allowed 2-3 hours to dry at room temperature (Figure 1).

Figure 1: Representative untreated tile surface coated with 0.2 mL bacteria/blood suspension

Replica Plating Procedure:

Detection of remaining viable bacteria on the surface of experimental tiles was determined by replica plating treated countertop squares on trypticase soy agar plates containing 5% sheep blood. After aerobic incubation at 37C, bacterial growth was noted, counted, and recorded as colony-forming units (cfu).

PHASE 1

Positive control blood tiles (no cleaning or disinfection procedures) were replica plated onto trypticase soy agar plates containing 5% sheep blood, in order to obtain baseline bacterial presence. Other blood tiles were treated with one of five test disinfectants

1. ***CaviWipes1*** *(TotalCare)* (contains 22.5% alcohol)
2. ***Super Sani-Cloth Wipes*** *(Professional Disposables International)* (contains 55% alcohol)
3. ***Defend Plus Wipes*** *(Mydent International, Inc.)* (contains 41.58% alcohol)
4. ***Discide Ultra Wipes*** *(Palmero Health Care)* (contains 63.25% alcohol)
5. ***Lysol I.C. III Disinfectant Spray*** *(Reckitt Benckiser)* (contains 58% alcohol)

All disinfectant wipes were consciously applied onto the tiles with normal mechanical force and wiped 3-5 times. ***Lysol I.C. III Disinfectant Spray*** was sprayed 2-3 times onto experimental tiles before wiping 3-5 times with sterile 4x4 in. gauze. The test tiles were replica plated after treatment with the assigned disinfectant onto trypticase soy agar containing 5% sheep blood and incubated at 37C for 24 hours.

PHASE 2

As described for phase 1, positive control blood tiles were replica plated onto trypticase soy agar containing 5% sheep blood. Other contaminated blood tiles were then treated with one of the test disinfectants. In this experiment, however, exposed tiles were allowed to remain moist with the applied disinfectant for the recommended contact time required for intermediate-level disinfection, as per manufacturer's instructions. These times were: a) ***CaviWipes1*** (1 minute); b) ***Discide Ultra Wipes*** (1 minute); c) ***Super Sani-Cloth Wipes*** (2 minutes); d) ***Defend Plus Wipes*** (5 minutes); and e) ***Lysol I.C. III Disinfectant Spray*** (10 minutes). Disinfectant wipes were consciously applied to the tile with normal mechanical force and wiped 3-5 times. ***Lysol I.C. III Disinfectant Spray*** was sprayed 2-3 times onto the test tile before wiping 3-5 with sterile 4x4 in gauze. In a similar manner as above, disinfectant-treated contaminated tiles were replica plated onto trypticase soy agar containing 5% sheep blood and incubated at 37C for 24-hours.

Results:

PHASE 1

Microbial growth from untreated bacteria/blood-coated tiles using each of the three test bacteria was found to be confluent after a 24-hour incubation interval. This reinforced the premise that sufficiently high concentrations of test bacteria were being applied to contaminate surfaces for later experiments (Figure 2). When the cleaning capabilities of the commercial disinfectant preparations were evaluated, the remaining levels of bacteria varied greatly. Of special significance was the observation that wiping of contaminated tile surfaces with ***CaviWipes1*** resulted in removal of virtually all visible blood from the tiles (Figure 3) and detectable bacteria (Figure 4). In contrast, all of the other disinfectants used to "clean" the bacteria/blood suspensions off coated tiles left much of the material on the surface after treatment (Figures 5a-d). Replica plate cultures from these treated tiles also yielded cfu levels that were significantly higher than those recorded using ***CaviWipes1*** (Table 2). It must be noted that in addition to finding numerous colonies on the *Pseudomonas* cultures, they were coalesced in a manner that made cfu determinations unobtainable. Thus, the designation TNTC was assigned to that data section.

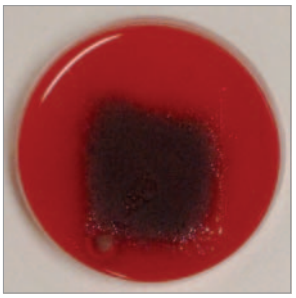


Figure 2: Representative replica plate culture of *P. auruginosa* from untreated bacteria/blood tile

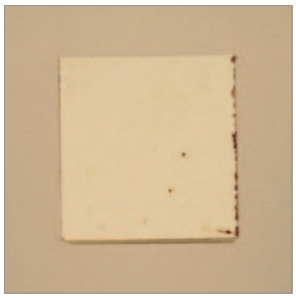


Figure 3: Removal of contaminant bacteria/blood suspension from tile surface by ***CaviWipes1***

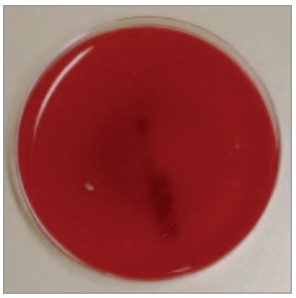
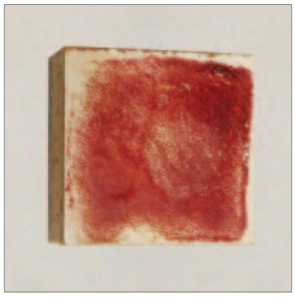


Figure 4: Replica plate culture showing few remaining *S. aureus* colonies after tile surface treatment with ***CaviWipes1***

Figure 5. Remaining surface bioburden contamination after procedure with:
a) ***Lysol I.C. III Disinfectant Spray;*** b) ***Discide Ultra Wipes;*** c) ***Super Sani-Cloth Wipes;*** and d) ***Defend Plus Wipes***.



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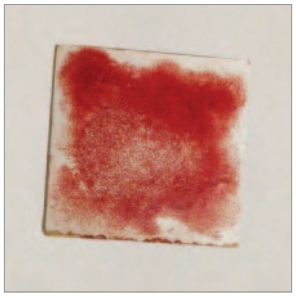

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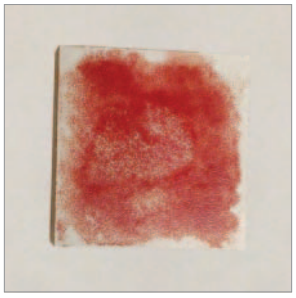

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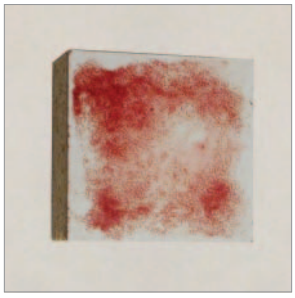


d

Table 2. Bacterial colony-forming units (cfu) remaining on disinfectant-treated tiles coated with bacteria/blood suspensions.

Disinfectant	*S. aureus*	*E. coli*	*P. aeruginosa*
CaviWipes1	0.8 (0-2)	0	1(0-3)
Defend Plus Wipes	1,454 (358-1,896)	977 (204-1,512)	TNTC*
Discide Ultra Wipes	1,560 (942-1,902)	1,349 (720-1,847)	TNTC
Lysol I.C. III Disinfectant Spray	1,329 (624-1,)824	1,441 (938-1,974)	TNTC
Super Sani-Cloth Wipes	478 (197-990)	643 (124-864)	TNTC

**TNTC = too numerous to count (>2,000 cfu/plate)*

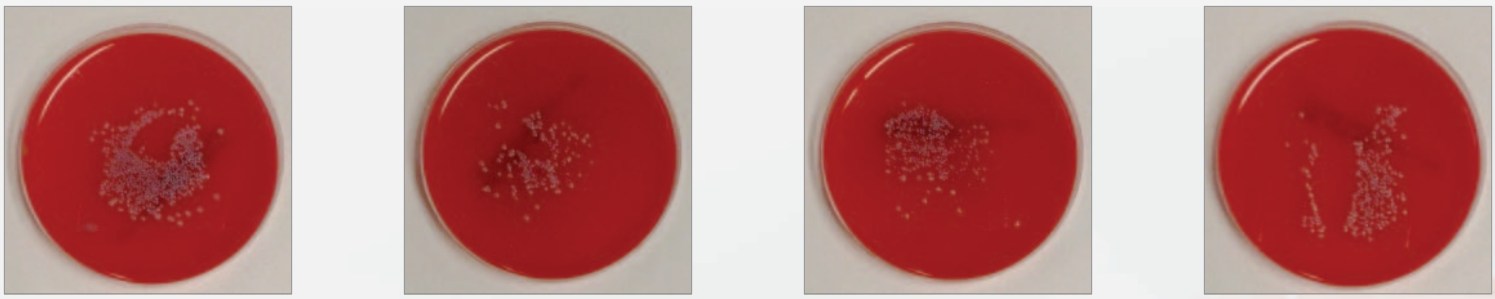
PHASE 2

Surface tiles previously coated with bacteria/blood suspensions were treated with the disinfectants and then allowed to remain wet for the recommended time to accomplish intermediate-level disinfection. The findings from replica plate cultures re-enforced the importance of cleaning surfaces prior to any disinfection procedures. As shown in Table 3, only ***CaviWipes1*** was found to effectively lower test bacterial levels, both by removal of bioburden and subsequent antimicrobial activity. Treatment with each of the other disinfectants resulted in substantially higher bacterial counts following replica plating. Figures 6a-d show representative experimental replica plate cultures where *S. aureus* was used as the test organism.

Table 3. Detectable bacteria on treated surfaces allowed to remain wet for intermediate-level disinfection intervals.

Disinfectant Time(min)	*S. aureus*	*E. coli*	*P. aeruginosa*
CaviWipes1 (1)	0	0	0.2 (0-3)
Defend Plus Wipes (5)	354 (266-561)	410 (160-939)	TNTC*
Discide Ultra Wipes (1)	181 (86-468)	954 (391-1,907)	TNTC
Lysol I.C. III Disinfectant Spray (10)	331 (130-621)	903 (280-1,540)	TNTC
Super Sani-Cloth Wipes (2)	201 (132-282)	514 (308-764)	TNTC

Figure 6. *S. aureus* colonies remaining after treatment and recommended exposure interval to:
a) ***Lysol I.C. III Disinfectant Spray;*** b) ***Discide Ultra Wipes;*** c) ***Super Sani-Cloth Wipes;*** and d) ***Defend Plus Wipes.***



a b c d

Discussion:

Cleaning is the basic premise of environmental surface disinfection. It is the physical removal of debris and initially results in a reduction of the number of microorganisms present. Cleaning also removes organic debris that can interfere with appropriate disinfection. The chemical composition of a disinfectant can greatly affect the ability of the active agent to accomplish cleaning. In particular, products that contain high concentrations of alcohol may not readily remove bioburden. Exposure of organic debris to alcohol denatures and dehydrates proteins making them insoluble and adherent to most surfaces. The denatured material can thus protect contaminant micoorganisms from the agent's antimicrobial effects for prolonged intervals.

In the present investigation, intermediate-level disinfectants containing different concentrations of isopropyl and/or ethyl alcohol were evaluated for their cleaning and disinfection capabilities.

The findings indicated that ***CaviWipes1*** (22.5% alcohol) was able to accomplish cleaning and disinfection of bacteria/blood-contaminated surfaces to a much greater extent than other surface disinfectants that contain higher concentrations of alcohol (41.58-63.25%). Even though ***CaviWipes1*** contains alcohol, the majority of its composition is water (>70%), which is responsible for mechanical cleaning of organic debris.

Conclusion:

A single application of the ***CaviWipes1*** was highly effective in removal of virtually all organic debris from contaminated tiles. This product was also able to accomplish effective disinfection against three test bacteria. As a result of these findings, ***CaviWipes1*** demonstrated the ability to both clean and disinfectant contaminated environmental surfaces in one step.