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Evaluating Oxivir® Tb Versus Criteria For the Ideal Disinfectant

Recent studies have demonstrated that the environment plays a role in the transmission of healthcare-associated infections (HAIs).

Environmental surfaces and patient care equipment are important reservoirs for pathogens. Contaminated surfaces increase the risk of transmission to patients either through their direct contact with contaminated surfaces or by contaminating the hands of healthcare workers who then transfer these pathogens to patients or other surfaces. This evidence supports the need to improve cleaning and disinfection of environmental surfaces and patient care equipment.

The selection of the right disinfectant is one of the two essential components for effective disinfection. The other component, the practice, relates to the proper application of disinfectant onto surfaces, the proper training of users and the adherence to manufacturer's label instructions. The combination of product and practice results in effective surface disinfection, which reduces patient risk and improves patient outcomes.

Since healthcare facilities prefer to use evidence on which to base their decisions and practices, it is important to outline key decision criteria that can be used to select the optimal disinfectant for a facility. Recently, Drs. Rutala and Weber published guidance considerations in the *Infection Control and Hospital Epidemiology (Vol. 35, No. 7 (July 2014), pp. 855-865)*, for healthcare facilities to use when selecting a disinfectant.

1. Kill claims for the most prevalent healthcare pathogens
2. Fast kill times and acceptable wet-contact time to ensure proper disinfection of noncritical surfaces and patient care equipment
3. Safety
4. Ease of Use
5. Other Factors such as training and support provided by manufacturers and total cost

AHP® Patented

This paper will evaluate how Accelerated Hydrogen Peroxide (AHP®), specifically Oxivir® Tb, performs against these key criteria and will highlight how it differs from other disinfectant technologies.

Accelerated Hydrogen Peroxide is a synergistic blend of commonly used, safe ingredients that when combined with low levels of hydrogen peroxide, produce dramatically increased germicidal potency and superior cleaning performance. AHP was designed to be tough on pathogens, in short contact times, while being gentle on staff, patients and facility assets.

The benefits of AHP have been validated by third party clinical studies conducted by scientific organizations and third party researchers that are recognized by government regulatory agencies in Europe, Canada and the United States. AHP has received approvals from the European Union, Health Canada and the United States Environmental Protection Agency (EPA). Several peer reviewed studies have been published on AHP-based formulas and many of these are referenced in the index.

1. Kill claims for the most prevalent healthcare pathogens

Oxivir Tb is effective against key healthcare-associated pathogens, including viruses and bacteria, in just 60 seconds. The one-minute efficacy claims include hard-to-kill, small non-enveloped viruses such as norovirus and poliovirus as well as blood borne pathogens (e.g. HIV, HBV and HCV). The chemistry has also proven to be effective in the presence of soil and hard water.

Oxivir Tb demonstrates the same effectiveness with just 0.5% active ingredients, as compared to other hydrogen peroxide-based disinfectants containing almost three times the level of actives to perform at the same level (see Table 1 on next page, Rutala et al, ICHE 2012;33(11):1159-61). The testing was improved hydrogen peroxide at 1.4%, .5%, compared to regular 3%. Higher levels of actives have been known to increase safety risks and can increase the residue left on surfaces which may cause increased streaking or leave a film.

A recently published study demonstrated AHP's ability to reduce HAI rates across a broad range of pathogens, including MRSA, VRE and *Clostridium difficile* (Alfa MJ, et al. Am J Infect Control 2015; 43:141-6). The only changes made at intervention hospital (St. Boniface Hospital, Winnipeg, Manitoba, Canada) throughout the study's 52-week duration, was the adoption of the AHP wipe vs a daily cleaner. During the time of the study, infection rates dropped by greater than 20%, avoiding an estimated 180 healthcare associated infections and related healthcare costs of more than $650,000. A similar study (Boyce JM, et al. AJIC 2016;44(6)Suppl:S16) was just completed at a major U.S. teaching hospital, and the early analysis demonstrates similar results.

2. Fast kill times and acceptable wet-contact time to ensure proper disinfection of noncritical surfaces and patient care equipment

Ideally contact times should be greater or equal to the kill time listed on the EPA label to achieve disinfection. Wet contact time is a critical component of the disinfectant evaluation because if a product evaporates too quickly, it will not remain in contact with the microorganism for the necessary kill/contact time. Fast kill times are important because they provide confidence that pathogens are killed before the disinfecting solution can dry or be removed. A study by Omidbakhsh published in the *Journal of AOAC International* (2010;93(6): 1-8), investigated the impact of dry time on product efficacy (see Table 2 on next page). Of the six (6) disinfectant products tested, Oxivir Tb (0.5% AHP) was the only chemistry that was able to achieve disinfection using the drying time regardless of contact time, highlighting the fact that facilities that do not achieve the appropriate contact time in accordance to the approved product label may not be achieving the level of kill needed to minimize the risk of transmitting HAIs.

Ensuring that staff are compliant with cleaning and disinfection protocols can reduce the risk of HAIs and readmissions. One of the key benefits realized with Oxivir Tb is faster and more consistent contact times for a broad spectrum of pathogens. Unlike many disinfectants, Oxivir Tb actually stays wet longer than the label's contact time of 60 seconds, ensuring that disinfection can occur with just one application.

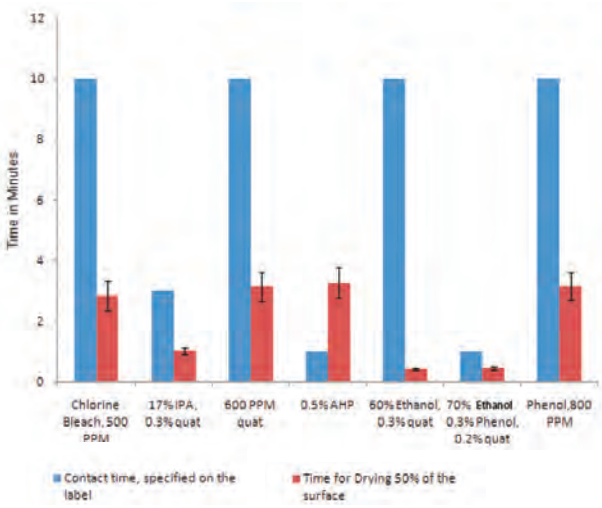
Table 1

TABLE 1. Bactericidal Activity of Disinfectants (log_{10} Reduction) with a Contact Time of 30 Seconds or 1 Minute at 20°C with and without Fetal Calf Serum (FCS)

Organism	Oxivir TB (0.5% H_2O_2)	0.5% H_2O_2	CHHPCD (1.4% H_2O_2)	1.4% H_2O_2	3.0% H_2O_2	A456-II (QUAT)
~10^6 inoculum, contact time = 1 minute, no 5% FCS						
MRSA	>6.62	≤4.04	>6.54	≤4.04	≤4.04	5.55
VRE	>6.34	≤3.61	>6.13	≤3.61	≤3.61	4.58
MDR *A. baumannii*	>6.76	≤4.28	>6.76	≤4.28	≤4.28	>6.76
~10^6 inoculum, contact time = 30 seconds, no 5% FCS						
MRSA	>6.64	NT	>6.64	NT	≤4.16	≤4.16
VRE	>6.28	NT	>6.28	NT	≤3.80	≤3.80
MDR *A. baumannii*	>6.76	NT	>6.76	NT	≤4.28	6.11
~10^5 inoculum, contact time = 1 minute, no 5% FCS						
MRSA	>3.71	≤1.23	>3.71	≤1.23	≤1.23	>3.71
VRE	>3.26	1.45	>3.26	NT	1.40	>3.26
MDR *A. baumannii*	>3.53	≤1.05	>3.53	1.75	>3.53	>3.53
~10^6 inoculum, contact time = 1 minute, 5% FCS present						
MRSA	>6.72	NT	>6.72	NT	≤4.24	≤4.24
VRE	>6.26	NT	>6.26	NT	≤3.78	≤3.78
MDR *A. baumannii*	>6.56	NT	>6.56	NT	≤4.08	>6.56

NOTE. Individual mean values may have the same result because the same inoculums on the same day may have been run against multiple disinfectants. If complete killing occurred, the minimum inactivation would equal the initial inoculum. Some results reported as "greater than X" because complete killing of the inoculums occurred. *A. baumannii*, *Acinetobacter baumannii*; CHHPCD, Clorox Healthcare Hydrogen Peroxide Cleaner Disinfectant; MDR, multidrug-resistant; MRSA, methicillin-resistant *Staphylococcus aureus*; NT, not tested; VRE, vancomycin-resistant *Enterococcus*.

Table 2



3. Safety

A 2010 multi-state report by the CDC[1] highlighted the magnitude of acute antimicrobial pesticide illness among workers in healthcare facilities, including the nature and frequency of these exposures. Below is a recap of the report:

- Identified 401 cases of work-related illness associated with antimicrobial pesticide exposures in healthcare facilities
- The chemicals responsible for most healthcare facility cases were quaternary ammonium compounds (quats), glutaraldehyde and sodium hypochlorite (bleach) which can cause irritant symptoms involving eyes, skin and respiratory tract
- Environmental services staff (24%), nursing (16%) and technicians (15%) were the most frequent occupations reported
- Ocular symptoms (eye irritation/pain) were the most commonly experienced adverse health effect – 55%; neurologic (headaches, dizziness) - 32%; respiratory irritation – 30%; dermal (skin irritation, rash) – 24%
- Most ocular symptoms were frequently associated from splashes while not wearing eye protection (only 15% reported using eye protection)

It is estimated that the average cost per claim[2] for eye injuries is $118,000, for neurological injuries is $85,000 and for respiratory injuries is $64,000. If these cost estimates are applied to the report noted above, the cost for these claims for only these 4 states is estimated at $45 million.

The report highlighted the need to implement less hazardous antimicrobial pesticide products and, where required, to ensure that the appropriate personal protective equipment (PPE) is conveniently-located and used.

While highly effective against key pathogens, Oxivir Tb was formulated with the comfort, safety and well-being of staff and patients in mind. In all six EPA toxicity categories, Oxivir Tb falls into Category IV, the lowest level of hazard (practically non-toxic, not an irritant) and requires no safety warnings or PPE. This means that staff will not have to compromise safety for efficacy. By enabling the use of the product with lower risk, staff may be more willing to use it, which facilitates more consistent use, while reducing the risk of worker related injuries and the cost of PPE. Ensuring that staff is compliant with cleaning and disinfection protocol reduces your risk of HAIs and readmissions.

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1. Acute Antimicrobial Pesticide-Related Illnesses Among Workers in Health-Care Facilities – California, Louisiana, Michigan and Texas 2002-2007, CDC Weekly Morbidity and Mortality Report, May 14, 2010

2. OSHA Safety Pays Program website Acute Antimicrobial Pesticide-Related Illnesses Among Workers in Health-Care Facilities --- California, Louisiana, Michigan, and Texas, 2002—2007, MMWR May 14, 2010 / 59(18);551-556; Arif et al Occupational exposures and asthma among nursing professionals Occup Environ Med. doi:10.1136/oem.2008.042382

4. Ease of Use

The easier a product is to use, the more likely the achievement of usage compliance. To facilitate use, disinfectants should be available in multiple and convenient forms and should be composed of a durable substrate that will not easily tear, fall apart or dry out quickly.

Oxivir Tb is available in:

- RTU (ready-to-use) liquid format
- 6" x 7"size wipes
- 7" x 8" size wipes
- 11" x 12" size wipes

A variety of brackets and stands are available to ensure that the wipes are easily accessible when and where they are needed.

5. Other Factors such as training and support provided by manufacturers and total cost

When selecting a disinfectant, it is important to look at the overall cost vs. just the cost of the disinfectant solution. This calculation should include a variety of factors including labor time to set up and use the product, laundering costs (if applicable), the cost of non-compliance (i.e. not disinfecting due to safety concerns, inaccessibility or lack of time) and the risks and costs associated with increased HAIs.

Oxivir Tb offers you a simple and compliant solution with broad efficacy along with fast and realistic contact times, an improved safety profile and easy-to-use formats. Facilities value the reduction in labor, employee concern and infection rates.

In summary, Oxivir Tb offers many of the benefits referenced in the ideal disinfectant criteria. These hydrogen peroxide-based disinfectants, powered by AHP technology, can disinfect against most common and emerging, healthcare-associated pathogens, including multi-drug-resistant organisms, in just 60 seconds.

Oxivir Tb offers fast disinfection and superior cleaning ability while remaining gentle for staff, patients and surfaces. It is available in an RTU format, along with 3 sizes of wipes and have accessories available to enable convenience for staff.

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The following is a brief summary of the peer reviewed articles and abstracts relevant to environmental surface disinfectants, high level disinfectants and chemosterilants based the AHP technology:

Peer Reviewed Studies:

1. Sattar et al. (1999) A product based on accelerated hydrogen peroxide: Evidence for broad-spectrum activity, *CJIC*, Winter 1998, pg. 123-130. This study summarizes the efficacy of a 0.5% Accelerated Hydrogen Peroxide surface cleaner-disinfectant.

2. Rochon et al. (1999) Products based on accelerated and stabilized hydrogen peroxide: Evidence for cleaning and sanitizing efficiency, environmental and human safety and non-corrosiveness, CJIC. Summer 1999, pg.51-55. This article summarizes the Health and Safety and Environmental Responsibility benefits of the Accelerated Hydrogen Peroxide.

3. B. Thompson and S. Budgell (2000) Hydrotherapy Tub Usage: Infection Risks – Cleaning and Disinfection, Nursing Home Vol 11 No 4, pg 4 – 10. Hydrotherapy Tubs have the potential to act as reservoirs for nosocomial transmission of pathogens such as *Pseudomonas aeruginosa*. The study reviewed several products and protocols in order to develop guidelines for cleaning and disinfection of hydrotherapy tubs in their region.

4. Sattar et al. (2002) Combined application of simulated reuse and quantitative carrier tests to assess high-level disinfection: experiments with an accelerated hydrogen peroxide-based formulation, *AJIC*, Vol. 30, No. 8, pg. 449-457. This article summarizes the efficacy and safety of a 7% AHP High Level Disinfectant and Chemosterilant.

5. Sattar et al. (2005) Activity of selected oxidizing microbicides against the spores of *Clostridium difficile*: Relevance to environmental control, AJIC Vol 33 No 6, pg. 320 – 325. This article summarizes the efficacy of several commonly used disinfectant chemistries and their relative effectiveness against the spores of *Clostridium difficile*. AHP-based technology has been gaining acceptance as a means of formulating safer and environmentally benign microbicides with activity against major classes of nosocomial pathogens. Virox STF (Accel CS 20) could inactivate *C. difficile* spores on hard environmental surfaces in approximately 10-15 minutes under ambient conditions.

6. Omidbakhsh et al. (2006) Broad-spectrum microbicidal activity, toxicologic assessment, and materials compatibility of a new generation of accelerated hydrogen peroxide-based environmental surface disinfectant, AJIC Vol 34 No 5, pg 251 – 257. This article summarizes the efficacy and safety of the EPA registered Intermediate Level disinfectant that is sold as Oxivir Tb in North America by JohnsonDiversey.

7. Tomiczek et al. (2006) Enhancing Patient Safety through the Management of *Clostridium difficile* at Toronto East General Hospital, Healthcare Quarterly 9(Sp) 2006: 50 – 53. A retrospective study of a *Clostridium difficile* outbreak and the interventions implemented that lead to a 50% decrease in the rates of *C. difficile* and corresponding decrease in MRSA rates.

8. Omidbakhsh et al. (2006) A new peroxide-based flexible endoscope-compatible high-level disinfectant, AJIC Vol 34 No 9, pg 571 – 577. This article summarizes the efficacy, safety and materials compatibility of a 2% AHP-based high level disinfectant that is compatible with flexible endoscopes.

9. Grascha et al. (2007) Is skin irritancy of the hand wash products solely related to their pH?, CJIC Vol 22 No 1, pg 10 – 14. The study was designed to dispel the long-held notion that pH levels were directly related to skin irritancy through a scientific examination of the effects of pH on skin of five formulations.

10. N. Omidbakhsh and N. Kenny (2008) An Accelerated Hydrogen Peroxide (AHP)-based Fast-Acting and Reusable Microbicide for Manual Disinfection of Heat Sensitive Semi-Critical Medical Devices, CJIC Vol 23 No 1, pg 81 – 88. The focus of this study was to assess the antimicrobial activity, stability and materials compatibility of a newly-developed AHP-based high level disinfectant in simulated reuse conditions.

11. Bernard et al. (2008) Identification by Quantitative Carrier Test of Surrogate Spore-Forming Bacteria to Assess Sporicidal Chemicals for Use against *Bacillus anthracis*, Applied and Environmental Microbiology, Vol 74 No 3, p. 676-681. In this study, the spores of six strains of *Bacillus anthracis* (four virulent and two avirulent) were compared with those of four other types of spore-forming bacteria for their resistance to for liquid chemical sporicides (sodium hypochlorite, accelerated hydrogen peroxide, chlorine dioxide and peracetic acid).

12. Alfa, M.J, and Howie, R. (2009) Modeling microbial survival in buildup biofilm for complex medical devices, BMC Infectious Diseases 2009, 9;56. This study compares the disinfectant efficacy and microbial eradication of oxidizing-based disinfectant chemistries such as Accelerated Hydrogen Peroxide and cross-linking agents such as Gluteraldehyde against both traditional and build-up biofilms.

13. Alfa, M.J. et al. (2010) Improved eradication of *Clostridium difficile* spores from toilets of hospitalized patients using an accelerated hydrogen peroxide as the cleaning agent, BMC Infectious Diseases 2010, 10:268. The objective was to select a cleaning agent that had microbial killing ability that did not require an additional rinse step after application and had some *C. difficile* sporicidal activity within a short period of time. The evidence from this study shows that the Oxivir Tb formulation is a useful alternative to bleach for surface killing of *C. difficile* spores.

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Peer Reviewed Studies (cont.):

14. Weber, DJ et al. (2010) Role of hospital surfaces in the transmission of emerging health care associated pathogens: Norovirus, *Clostridium difficile* and *Acinetobacter species*. AJIC 2010;38(Suppl 1):S25-S33. This article focuses on the role of surface contamination in the transmission of 3 emerging nosocomial pathogens: norovirus, *C difficile*, and Acinetobacter spp and literature supporting the use of EPA registered disinfectants for helping to control environmental transmission.

15. Omidbakhsh, N. (2010) Evaluation of sporicidal activities of selected environmental surface disinfectants: Carrier tests with the spores of *Clostridium difficile* and its surrogates, AJIC Vol 38, No 9, p. 718-722. Available and fast-acting sporicides are generally corrosive and unsafe for both humans and the environment. The objective of the study was to compare a newly developed AHP-based Surface Sporicidal Agent that carries superior occupational health and compatibility profiles with to differing concentrations of Chlorine bleach.

16. Omidbakhsh, N. (2010) Theoretical and Experimental Aspects of Microbicidal Activities of Hard Surface Disinfectants: Are Their Label Claims Based on Testing Under Field Conditions?, J AOAC International, Vol 93 No 6, p. 1-8. The objective of the study was to assess the bactericidal activity of selected environmental surface disinfectants using conditions reflective of their label claims and field use.

17. Rutala et al (2012) Efficacy of Improved Hydrogen Peroxide against Important Healthcare-Associated Pathogens, ICHE, Nov 2012, 33:1159-61. The objective of the study was to assess the effectiveness of improved hydrogen peroxide-based disinfectants vs. hydrogen peroxide and quats.

Abstracts and Research Posters:

1. Omidbakhsh, N. (2006) Broad-Spectrum Microbial Activity, Toxicological assessment and Materials Compatibility of a New Generation of Accelerated Hydrogen Peroxide (AHP)-Based Environmental Surface Disinfectant, CJIC Vol 21 No 1, pg 33. This article summarizes the efficacy and safety of the EPA registered Intermediate Level disinfectant that is sold as Oxivir Tb in North America by JohnsonDiversey.

2. Omidbakhsh, N. (2006) A New Peroxide-Based Flexible Endoscope-Compatible High-Level Disinfectant, CJIC Vol 21 No 1, pg. 38. The focus of this study was to assess the antimicrobial activity, stability and materials compatibility of a newly-developed AHP-based high level disinfectant in simulated reuse conditions.

3. R. Smith, R. Dufault et al. (2007) Effects of an Environmental Services Professional Training Course and Cleaning Products on the Rates of Infection Seen at Suburban Hospital, CJIC Vol 22 No 1, pg 50. This overall purpose of this study was to review how a comprehensive training program, in conjunction with a product with realistic contact times could decrease HAIs. Over the 12-month study, the conclusion of the study showed that with the use of Oxivir Tb in conjunction with the training program produced a 10.1% decrease in the facilities HAI rates.

4. Alfa et al. (2007) The Oxivir Tb Formulation of Accelerated Hydrogen Peroxide (AHP) is Effective for Killing *Clostridium difficile* spores on Toilet Seat Surfaces, CJIC Vol 22 No 1, pg 49. The purpose of the study was to investigate safer alternative disinfectant chemistries to bleach for managing *Clostridium difficile*.

5. N. Omidbakhsh (2007) A Novel Hydrogen Peroxide-Based Antimicrobial Handwash, CJIC Vol 22 No 1, pg 49. The objective of this study was to introduce a new handwash antimicrobial solution based on accelerated hydrogen peroxide (AHP) technology as an alternative to alcohol, PCMX, chlorohexidine and Triclosan.

6. N. Omidbakhsh (2007) A New Peroxide-based Fast Acting Surface Sporicide, CJIC Vol 22 No 1, pg 49. The objective of this study was to introduce a practical surface sporicidal solution based on accelerated hydrogen peroxide (AHP) technology as an alternative to bleach for managing *Clostridium difficile*.

7. D. Price and B. Morris (2007) Assessment of Accelerated Hydrogen Peroxide for Sanitizing Carpet, Poster Presentation, SIM Annual Meeting & Exhibition July 2007, Denver, CO. The study investigated accelerated hydrogen peroxide's ability to remove and inactivate accumulated biocontaminants from carpet fibers.

8. N. Omidbakhsh (2008) Surface Disinfectants and Label Claims: Realistically can Contact Times be met to Achieve Antimicrobial Efficacy? CJIC Vol 23 No 1, pg 49. The objective of the study was the determine the efficacy of several different disinfectant chemistries against common pathogens using a realistic contact time for each chemistry based on its evaporation rate and compare the results to the efficacy claims listed on the product's label.

9. N. Omidbakhsh (2009) The Assessment of the Sporicidal Activity of Selected Environmental Surface Disinfectants Using Spores of *Clostridium difficile*, AJIC Vol 37 No 5, pg E28-E29. The objective of this study was aimed at evaluating the sporicidal activity of selected disinfectant formulations with proven sporicidal activity at their drying time.

Webinars:

1. R. Smith, R. Dufault et al. (2007) Effects of an Environmental Services Professional Training Course and Cleaning Products on the Rates of Infection Seen at Suburban Hospital, CJIC Vol 22 No 1, pg 50. The study was also presented through an Infection Control Today Webinar and can be reviewed at any time.

The well-being of people everywhere depends on a sustainable world. Sealed Air's Diversey Care Division offers solutions for infection prevention, kitchen hygiene, fabric care, building care and consulting. Our solutions protect brands, deliver efficiency, improve performance for our partners in health care, food service, retail, hospitality and facility services. Our leading expertise integrates product systems, equipment, tools and services into innovative solutions that reduce water and energy usage and increase productivity. By delivering superior results, we help create profitable sustainable enterprises for a cleaner, healthier future.

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