

# A Clean Wound Bed is a Healing Wound Bed



**Dr. Julia Overstreet, DPM, FAPWCA**  
Podiatric Physician & Surgeon  
Wound Care Specialist  
High Risk Foot Specialist

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## Wound Cleansing

- Removes debris, inflammatory contaminants and bacteria, devitalized tissue and excess exudates that support bacterial growth and delays healing
- Effective cleansing removes harmful materials from the wound bed without causing trauma to healthy living cells/tissue



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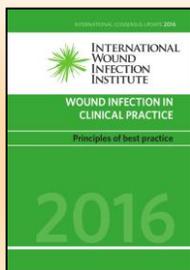
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<http://www.woundinfection-institute.com>



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### The Significance of Biofilms in Wound Infections

[www.woundinfection-institute.com](http://www.woundinfection-institute.com)

- Single-celled organisms generally exhibit 2 distinct modes of behavior:
  - **planktonic** - free floating, form in which single cells float or swim independently in some liquid medium.
  - **sessile**- an attached state in which cells are closely packed and firmly attached to each other and usually a solid surface.
- Biofilms are characterized by surface attachment, genetic diversity, complex community interactions, and an extracellular matrix of polymeric substances.

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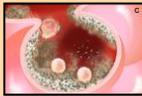
<http://bacterially.com/2008/05/biofilm/>



Biofilm on lettuce



Dental Plaque



*Pseudomonas aeruginosa* biofilms colonize the alveoli



Otitis media, or inflammation of the inner ear, is caused by biofilm.



Biofilm on Ship's Hull



Biofilm in acidic pools at Yellowstone National Park.

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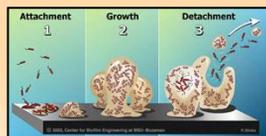
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### The Significance of Biofilms in Wound Infections

[www.woundinfection-institute.com](http://www.woundinfection-institute.com)

Bacteria in biofilms are protected from systemic and topical agents, from endogenous antibodies and phagocytic cells, and thus are relatively free to cause extensive tissue damage and delay healing.



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The microorganisms within biofilms are microscopic structures, rendering them impossible to see with the naked eye.

When the wound is not responding to 'optimal care', the best indicator of the presence of a biofilm is non-healing.

Sandez H (UK), Swanson T (Australia), Weir D (USA), Schutz G (USA) - Biofilm-based wound care with cadexomer iodine. Wounds International, November 2017

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Biofilm detection, diagnosis and treatment

- Stalled Healing
- Failure of a wound to respond to appropriate systemic antibiotics or antiseptics. Biofilm bacteria are inherently tolerant to both.
- Recurring inflammation/infection in the wound and an increased level of exudate related to this inflammation.
- Presence of gelatinous material and/or slough on the wound that reforms after its removal, a result of the biofilm induced inflammation.

Sandez H (UK), Swanson T (Australia), Weir D (USA), Schutz G (USA) - Biofilm-based wound care with cadexomer iodine. Wounds International, November 2017

(Blanchi et al. 2016; Schutz et al. 2017)

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The Significance of Biofilms in Wound Infections

[www.woundinfection-institute.com](http://www.woundinfection-institute.com)

Biofilms are persistent and prone to reformation because:

- The biofilm extra-cellular matrix protects bacteria within it against systemic antibiotics or topical antiseptics.
- Many of the bacteria in biofilms are metabolically dormant, which may result in tolerance to antibiotics.
- Many antimicrobial agents can be neutralized by the biofilm's extra-cellular matrix components, even if they penetrate the matrix.

Sandez H (UK), Swanson T (Australia), Weir D (USA), Schutz G (USA) - Biofilm-based wound care with cadexomer iodine. Wounds International, November 2017

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**The Significance of Biofilms in Wound Infections**

[www.woundinfection-institute.com](http://www.woundinfection-institute.com)

- Biofilms are highly inflammatory, shed bacteria into the wound, exciting an immunological response, tissue damage and chronic inflammation.
- Currently, the only sure method of treating biofilm is physical removal through thorough debridement, followed by the application of effective antimicrobials, antibiotics or antiseptics to prevent re-formation of the Biofilm.

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**Biofilm detection, diagnosis and treatment**

Biofilm-based wound care was coined by Wolcott et al in 2010 and emphasizes the following principles:

- Cleansing, debridement and **cleansing again** with antiseptics.
- Debridement that is aggressive treating with one or multiple types of cleansing and debridement.
- Application of topical antimicrobials with proven antibiofilm efficacy post-debridement.

Sandhu H (UK), Swanson T (Australia), Weil D (USA), Schutz G (USA)- Biofilm-based wound care with cadexomer iodine. Wounds International, November 2017.

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**Biofilm detection, diagnosis and treatment**

Debridement that is aggressive treating with one or multiple types of cleansing and debridement.

- Larval debridement
- Non-contact ultrasound debridement (MIST)
- Sharp debridement
- Hydrosurgery debridement
- Negative pressure wound therapy with instillation
- Concentrated surfactant gel

Sandhu H (UK), Swanson T (Australia), Weil D (USA), Schutz G (USA)- Biofilm-based wound care with cadexomer iodine. Wounds International, November 2017.

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International Wound Infection Institute (IWII)  
**Wound Infection in Clinical Practice.**  
Wounds International 2016

**The characteristics of surfactants has been capitalized on in the development of several surfactants that are combined with antimicrobials**

e.g. polyhexamethylene biguanide [PHMB] and undecylenamidopropyl betaine (Protosan-bbraunusa.com); octenidine dihydrochloride and phenoxyethanol (Europe); and octenidine and ethylhexylglycerin (Europe).

**The use of these surfactant-containing antimicrobial cleansers or antimicrobial preservative containing cleansers is useful for disrupting biofilm in the wound.**

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**Surfactant Based  
Cleansers & Dressings**



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**Surfactant Based Cleaning**

Yang, et al, 2017 International Wound Journal

- The wounds were dressed with a surfactant-based gel directly on the wound or with moistened gauze. The wounds were then wiped daily with moistened gauze, and the gel or gauze was re-applied.
- Each day, an explant from each group was harvested and tested for total viable bacteria counts and viable biofilm-protected bacteria counts.
- The results show that daily wiping with moistened gauze led to an initial decrease of bacteria, but by day 3, the biofilm had been fully re-established to the same level prior to the beginning of treatment.

Yang, Q., Leman, C., Della Porta, A. C., Schatz, G. S. and Gibson, D. J. (2017), A surfactant-based wound dressing can reduce bacterial biofilm in a porcine skin explant model. *Int Wound J*, 14: 408-413. doi:10.1002/wic.1242

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**Review**

- **Planktonic** (moving) microbes
  - ✓ Topical Antimicrobials: Mupirocin, Metronidazole
  - ✓ Topical Antiseptics: PHMB, Povidone Iodine (SupraSorb, Kendall AMD)
  - Wound Cleansers: Any surfactant-based cleanser (Sure-Cleanse, Skintegrity)
- **Sessile** microbes - **Biofilm**
  - ✓ Hypochlorous Acid – HOCL (BrioTech)
  - ✓ Iodosorb (some studies show efficacy with Honey, Silver)
  - ✓ Multiple Debridement Forms: Sharp, Negative Pressure w Instillation, Noncontact Ultrasound (MIST)
  - ✓ Surfactants – Cleansers & Dressings: (PolyMem, Protosan, Plurogel, Sure-Cleans, Skintegrity Spray)
- **New Protocols**
  1. Application of different topical antiseptics in a 2- or 4-week rotation
  2. A 3-day regimen of dressing the wound with a surfactant gel followed by gentle removal of the gel by wiping with a moistened gauze. A simple approach to removing a bacterial biofilm infection.

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International Wound Infection Institute (IWII)  
**Wound Infection in Clinical Practice.**  
Wounds International 2016

**There are also newer cleansing agents that are super-oxidized and/or have lower concentrations of hypochlorous acid and sodium hypochlorite.**

**These newer solutions are purported to disrupt biofilm and kill planktonic bacteria and other organisms while being safe for the wound and the individual.**

Edwards-Jones V, Faragun M, and Wilson R. Technological advancements in the fight against antimicrobial resistance. Wounds Int 2015; 6(2):47-61.  
 Sakarya S, Gray N, Karalikal M, Citrak R, et al. Hypochlorous acid: An ideal wound care agent with powerful microbicidal, antibioid, and wound healing potency. Wounds 2014; 26(12):342-50.

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**HYPOCHLOROUS ACID (HOCl)**

**WHAT IS HOCl?**

- HOCl is an **organic, naturally-occurring part of our internal defense system, and is produced in our white blood cells** (neutrophils & macrophages).
- HOCl is a **highly effective biocidal agent.** (Electrochemically activated solutions: evidence for antimicrobial efficacy and applications in healthcare environments. Thorn RM1, Lee SW, Robinson GM, Greenman J, Reynolds DM. Eur J Clin Microbiol Infect Dis. 2012 May;31(5):641-53.)
- HOCl innately works to:
  - Fight infection
  - Reduce inflammation & pain
  - Increase local immune responses
  - Stimulate epithelial growth & movement
  - Stimulate re-org of local fibroblasts (reduction in scarring)

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## HOCl - A KNOWN ANTI-INFLAMMATORY

- Once an antigen is inactivated, HOCl quickly breaks down into saline and taurine chloramine (TauCl), a primary inflammation modulator.
- HOCl modulates inflammation through the effects on Nuclear Factor - kB to reduce epidermal pathology.
- Furthermore, HOCl neutralizes various proinflammatory cytokines and chemokines (chemotactic factors, leukotrienes, TNF- $\alpha$ , IL-1 $\beta$ , IL-2, and IL-6), regulates metalloproteinases, and releases activated growth factors.

Hewitson A, Neupane B, Gumbin A, Dostal A, Chappin G. Hypochlorous acid and taurine-N-chlorotaurine in psoriatic disease. J Clin Invest. 2006;116:27-33

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## HOCl & ANTIMICROBIAL ACTIVITY

- HOCl is a well-known antimicrobial & biocidal that inactivates pathogens: Bacteria, Viruses, Spores, Fungi...
- When applied topically, there is no bubbling or tingling, unlike other solutions that sting, irritate & aggravate tissue, causing further damage to the wound.

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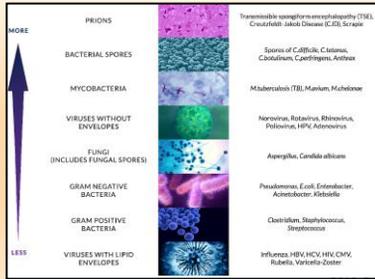
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### THE HIERARCHY OF RESISTANCE




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### HOCl & ANTIMICROBIAL ACTIVITY

**HOCl EVEN INACTIVATES PRIONS!**

\*\*\* In 2016, Dr. Eric Rasmussen published an article in *PLOS Pathogens* that details a consistent 1-millionfold (8-Log Kill) of all PRION species by BRIOHOCl, per Rocky Mountain Lab's, the lab that the National Institute of Health (NIH) uses for their testing measures.  
(PLOS Pathogens, 2016: Inactivation of Prions and Amyloid seeds with Hypochlorous Acid.)

\*\*\*This is significant, as **nothing has been proven to inactivate prions**, including all widely accepted methods of disinfection (NaOH, UV, low-level incineration, autoclaving, boiling in bleach, etc.)

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- Prions appears to cause a number of degenerative brain diseases including but not limited to;
  - Scrapie in sheep
  - Mad cow disease in cows
  - Creutzfeldt-Jakob disease in humans

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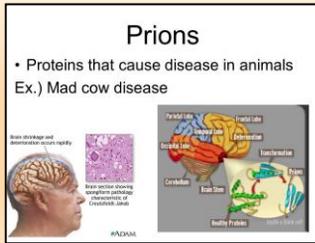
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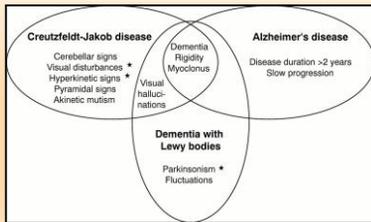
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**HOCL WOUND CARE SPECIFIC STUDIES**

- **Stabilized HOCl's Effect on Bioburden & Infection in Wound Healing** (Journal of Burns & Wounds, 2007; 6: 46, Hypochlorous Acid as a Potential Wound Care Agent Part 1: Stabilized Hypochlorous Acid - Its Role in Decreasing Tissue Bacterial Bioburden and Overcoming the Inhibition of Infection on Wound Healing Martin C. Robson, MD, et al.)
- **HOCl Speeds Healing of Venous Leg Ulcers** (The Symposium on Advanced Wound Care, DAIHC, Dallas, TX, April 2011) Hypochlorous Acid Speeds Soft Tissue Wound Healing of Refractory Venous Leg Ulcers - simplicity, low cost and patient comfort are advantages. Martin Weiskopf, MD, FACS)
- **Stabilized HOCl is a Speedy, Ideal Wound Care Agent** (Journal of Wounds, 2014 Dec;26(12):342-50, Hypochlorous Acid: an ideal wound care agent with powerful microbicidal, antibiologic, and wound healing potency. Sakarya S

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### Stabilized HOCL

- **Unstable** HOCl IMMEDIATELY begins to degrade.
- **Stabilized** HOCL needs to be formulated at a **pH 4.1**, which is neutral for the HOCl molecule.
- Many HOCl products are at a “neutral” pH of 7. But 4.1pH should be the neutral pH of HOCl.
- 7.0 – 7.4 pH products are closer to being bleach!

Journal of Burns & Wounds, 2007, 6, 44. Hypochlorous Acid as a Potential Wound Care Agent Part II: Stabilized Hypochlorous Acid in Bulk in Dissolving Tissue Barriers: Evaluation and Documenting the Inhibition of Infection on Wound Healing. Maria C. Wilson, MD, et al.

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### HOCL Based Cleansers




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### HOCL & BIOFILM ELIMINATION

- HOCL can annihilate biofilm.
- **Stable** HOCL products small molecules that readily penetrate deeply into the biofilm extra-cellular matrix (ECM) coating.
- This action degrades the adherent microbial populations, freeing the surface of ECM and colonizing masses.



Briotech Technology Brief on Applications - Briotech HOCl and Biofilm, Dr. Jeffrey F. Williams

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## HOCl - PROMOTES HEALING

- **HOCl induces the production of many cellular growth factors**, (insulin-like growth factor, epidermal growth factor, keratinocyte growth factor (also called KGF-7), FGF-1, FGF-2, TGF- $\beta$ , PDGF, vascular endothelium growth factor, connective tissue growth factor, and/or cementum-derived growth factor) - *Grzesik WJ, Narayanan AS. Cementum and periodontal wound healing and regeneration. Crit Rev Oral Biol Med 2002;13:474-84.*
- **HOCl Modulates tissue collagenase enzymes, reorganizing scar fibers and softening existing fibrous tissue.**
- **HOCl Stimulates the Migration of Keratinocytes to the wound bed, promoting re-epithelialization.**
- **The Necrotizing Fasciitis Foundation recognizes HOCl as the best agent on the market to stop NF dead in its tracks!**

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## Hypochlorous Acid: An Ideal Wound Care Agent With Powerful Microbicidal, Antibiofilm, and Wound Healing Potency

Serhan Sabatini, MD, Nicola Garay, MS, Mehmet Karakusak, MS, Baron Ozurk, MD, Bulent Ersoylu, MD  
Wounds. 2014;26(12):342-350.

### Conclusion:

- ✓ These findings support **stabilized HOCl** solution as an ideal wound care solution with a powerful and rapid killing effect on different types of microorganisms, antibiofilms, and microbicidal effect within the biofilm.
- ✓ Foremost, it has dose-dependent favorable effects on fibroblast and keratinocyte migration.
- ✓ These features lead to a stabilized HOCl solution as an ideal wound care agent. Randomized, prospective clinical trials are required to determine in vivo relevance of these findings.

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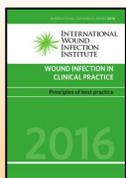
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International Wound Infection Institute (IWII)  
Wound Infection in Clinical Practice.  
Wounds International 2016

<http://www.woundinfection-institute.com>

- ✓ **Application of a cleansing solution that has potential to disrupt biofilm and kill planktonic bacteria and other organisms.**
- ✓ **Cleanse – Debride – Cleanse again.**  
Stabilized HOCl Cleaners – Use at each dressing change
- ✓ **Alternate topical wound therapies in 2 – 4 week rotations. Suppresses a range of microbes and prevents resistance.**  
Topical antimicrobials, Antimicrobial dressings – with signs of infx.
- ✓ **Remove biofilm using surfactant-based cleansers. A 3-day regimen of using a surfactant gel followed by the gentle removal by wiping with a moistened gauze.**  
Surfactant Gels, Surfactant Cleaners – with slow/stalled healing
- ✓ **Hypochlorous Acid HOCl - Stabilized formulations are organic, highly effective biocidal agents. Also reduces pain, stimulates epithelial growth and migration and stimulates fibroblasts. Also degrades the ECM of biofilm.**  
Stabilized HOCl Cleaners – with slow/stalled healing

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