

Integral Debridement: A New Paradigm in Wound Care

How Medical Technology Is Revolutionizing Slough Removal and Supporting Debridement

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Disclosures

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Learning Objectives

- Explore the significance of sharp debridement as a fundamental method for skilled clinicians and how adjunct technologies can enhance or, in some cases, replace sharp debridement in wound care
- Examine the well-established benefits of pure hypochlorous acid (pHA) in removing germs and necrotic debris, including its use in instillation therapy to aid wound healing
- Assess how the combination of pHA exposure followed by the application of highly charged fiber dressings can enhance the removal of necrotic tissue, improving wound healing outcomes
- Recognize the underlying science of synergistic technologies and how they work together to facilitate more efficient desloughing and support the debridement process

Q&A

**Please submit your questions,
at any point, via the question box.**

We want to hear from you!

Wound Bed Preparation And Debridement Modalities

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Polling Question

Integral debridement is a method of debridement that _____.

- A. occurs in a delayed fashion
- B. always utilizes sharp instruments
- C. is tailored to the patient's individual needs
- D. uses cautery

Types of Debridement

Strategy	Description	Examples
Mechanical	Removal of necrotic tissue by mechanical means	Wet-to-dry dressings, hydrotherapy, ultrasound, NPWT
Surgical (excisional/sharp)	Removal by surgical instrument	Scalpel, scissors, hydrosurgery, lasers, curettes
Biosurgical	Sterile larvae selectively digest necrotic tissue and bacteria	Sterile blowfly or horsefly larvae
Autolytic	Uses the body's own enzymes to dissolve necrotic tissue; assisted with moisture-retentive dressings	Films, hydrogels, hydrocolloids, honey, surfactants
Enzymatic	Application of enzymes to liquefy necrotic tissue	Collagenase, bromelain

Types of Debridement



Wound Bed Preparation and **TIME:**

Tissue
Inflammation/Infection
Moisture
Edge

Epithelial Edge



Tissue Debridement



Infection/**I**nflammation



Moisture Balance



21 Years of TIME



Wound bed preparation: a systematic approach to wound management

GREGORY S. SCHULTZ, PhD¹; R. GARY SIBBALD, MD²; VINCENT FALANCA, MD³; CAROLINE SCHWITZ, MD⁴; KEITH HARDING, MB, ChB⁵; MARIO ROMANELLO, MD⁶; LUC TEOT, MD, PhD⁷; WOLFGANG VANSCHIEDT, MD⁸

The healing process in acute wounds has been extensively studied and it has often been extrapolated to the care of chronic wounds, on the assumption that the normal tissue repair process. However, the chronic wound healing process differs in many important respects from the acute sequence of events seen in acute wounds because of the different stages of wound healing. For the normal repair process to return and removed through application of the correct techniques. It is important events that are involved in the wound healing process in order to select the appropriate management of a wound in order to accelerate effectiveness of other therapeutic measures. Experts in wound management are an important concept with significant potential as an educational tool. The article was developed after consulting with wound healing experts overview of the current status, role, and key elements of wound bed preparation. The current status of wound bed preparation, an environment, a "how wound healing can take place in these environments" and the clinical and cultural components of the wound bed preparation components of wound bed preparation. (WOUND REP REG 2003;11:1)

Wound bed preparation and a brief history of TIME

Gregory S Schultz, David J Barillo, David W Mazing, Gloria A Chin, The Wound Bed Advisory Board Members*

Management of chronic wounds has progressed from merely ensuring the status of a wound to understanding the underlying molecular and cellular mechanisms that prevent the wound from healing. The concept of wound bed preparation has increasingly evolved to provide a systematic approach to ensuring these barriers to natural healing and enhancing the effects of advanced therapies. This brief review of wound bed preparation from the development of these concepts and explains how to apply systematic wound management using the TIME acronym—(Time: debridement, moisture balance, infection, and protection)—to ensure optimal preparation of the wound.

THE WORLD BEFORE WOUND BED PREPARATION
Until the 1960s, the aims of wound management were simply to cover and control. Materials used for wound management were adaptations of materials in use for other purposes, such as ointments (blendable resins, petroleum jelly) and gauze. These materials were passive products that did little to encourage the healing process, and no attention was paid either to their functional performance or to the healing environment required for different types of wounds. If a wound healed without problems, it was an ability to be due to chance, not design.

Developments in wound products could only have come about through greater knowledge of the biology of chronic wounds, and it was clear that the whole management of wounds needed to be based on the same understanding. The move from an almost entirely empirical approach, to one based on an analysis of, and response to, the wound environment, is the underlying concept of wound bed preparation.

Wound management starts with wound assessment. Wound assessment methods were an important part of the development of active wound management. Standardized methods were developed that allowed wound care clinicians to monitor the status of the wound and—by implication—the effect of an intervention. Wound assessment methods, including scales, were developed for pressure ulcers, venous ulcers and diabetic foot ulcers, and much work was done into assessing their validity and reliability. A number of different classification systems have been developed to assess pressure

Extending the TIME concept: what have we learned in the past 10 years?*

David J Leaper, Gregory Schultz, Keryn Carville, Jacqueline Fletcher, Theresa Swanson, Rebecca Drake

Leaper DJ, Schultz G, Caville K, Fletcher J, Swanson T, Drake R. Extending the TIME concept: what has been learned in the past 10 years? *Wound J* 2012; 9 (Suppl 2): 1–19

The TIME acronym (tissue, infection/inflammation, moisture balance and edge of wound) was first described 10 years ago, by an international group of wound healing experts, to provide a framework for approach to wound bed preparation, a basis for optimizing the management of open chronic wounds. Secondary prevention. However, it should be recognized that the TIME principles are only a part of the holistic evaluation of each patient at every wound assessment. This review, prepared by the International Wound Bed Advisory Board, examines how new data and evidence generated in the intervening decade affect concepts of TIME, and how it is translated into current best practice. Four developments stand out as the most important: (1) the development of a structured framework for wound bed preparation (1); (2) the development of a structured framework for wound bed preparation (1); (3) the development of a structured framework for wound bed preparation (1); (4) the development of a structured framework for wound bed preparation (1).

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Wound bed preparation: TIME for an update

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¹ Royal College of Surgeons in Wales, Wound Infection Research Facility, Wound Healing Research Unit, School of Medicine, Cardiff, UK

While the overwhelming majority of wounds heal rapidly as a process through the wound-healing process. These wounds are considered to be self-healing. However, it should be recognized that the TIME principles are only a part of the holistic evaluation of each patient at every wound assessment. This review, prepared by the International Wound Bed Advisory Board, examines how new data and evidence generated in the intervening decade affect concepts of TIME, and how it is translated into current best practice. Four developments stand out as the most important: (1) the development of a structured framework for wound bed preparation (1); (2) the development of a structured framework for wound bed preparation (1); (3) the development of a structured framework for wound bed preparation (1); (4) the development of a structured framework for wound bed preparation (1).

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TIME CDST: an updated tool to address the current challenges in wound care

Abstract: Despite the understanding that wounds are a common problem affecting the individual, the health service and society as a whole, there continues to be a lack of a systematic, structured, evidence-based approach to wound management. The TIME principle was first published in 2003, and has since been integrated by many into clinical practice and research. However, the tool has been criticised for its inability to focus mainly on the wound rather than on the wider issues that the patient is presenting with. At an expert meeting held in London in 2010, this concern was addressed and the TIME clinical decision support tool (CDST) was introduced. This article introduces the TIME CDST, explains why it is required and discusses how its use is likely to benefit patients, clinicians and health service organisations. It also explains the framework in detail, and shows why this simple and accessible framework is robust enough to facilitate consistency in the delivery of wound care and better patient outcomes. Finally, it outlines the steps for the rollout, use and evaluation of the impact of the TIME CDST.

Declaration of interest: This article is based on an expert group discussion held in October 2010. Smith & Nephew (SMN) provided MA healthcare financial support to facilitate the group discussion. The authors were paid honoraria for their time in panel engagement. This is an author for SMN. DM is a speaker for SMN. NJ is currently employed by SMN.

Wounds and their associated problems pose an important healthcare challenge, with estimates suggesting a point prevalence range of 2.5–5.5 per 1000 population.¹ Annually, healthcare providers deliver a substantial financial investment in the management of wounds, for example, £3.5 billion in the UK alone.² However, the work of Gurev and colleagues³ explored the current provision of wound care within the UK, and found that many individuals lack an accurate diagnosis and an often managed using an inappropriate treatment plan. This is of particular concern, given the morbidity and often mortality associated with hard-to-heal wounds.⁴ Further, inappropriate management compounds the problem of wounds, with the mean patient care cost of an unhealed wound estimated at 135% more than that of a healed wound.⁵

The TIME principle⁶ has been widely adopted in many in practice.^{7–9} However, the current gaps in practice¹⁰ indicate that there is a need for an expansion of the TIME principle for the assessment and management of chronic wounds, which incorporates the 111 principles. This will serve to help standardise care, both regionally and internationally, and to improve outcomes, while also saving costs.¹¹

The origins of TIME
At an expert meeting, the concept of TIME⁶ was born in an endeavour to enhance the assessment of management of wounds using agreed criteria. The origin of the time, synthesised by the expert group highlighted the key differences between healing of hard-to-heal wounds, with particular emphasis placed on understanding the biological imbalances present which are hard-to-heal. For example, failed hard-to-heal wounds was found to differ substantially from that of healing wounds, displaying an imbalance between the production of proteases and the inhibition of TIMPs.¹² This imbalance causes an excess production of proteases, such as matrix metalloproteinases (MMP) and serine proteases, which impact negatively on the function of TIMPs and extracellular matrix (ECM) proteins. As a result, there is inhibition in TIMP production of the essential cells required for new healing.¹³ Given the distinct difference between healing and hard-to-heal wounds, from a cellular perspective the requirement for a focused approach to correct the imbalance within hard-to-heal wounds was being of distinct importance.

The concept of TIME, which is familiar to most health professionals, incorporates: Tissue; Infection;

Wound Bed Preparation 2024: Delphi Consensus on Diabetic / Other Foot Ulcer Management in Resource-Limited Settings

Abstract: Chronic wound management in low-resource settings deserves special attention. Rural or under-resourced settings (ie, those with limited basic needs/healthcare supplies and inconsistent availability of interprofessional team members) may not be able to apply or duplicate best practices from urban or abundantly resourced settings. Objective: The authors linked world expertise to develop a practical and scientifically sound application of the wound bed preparation model for communities without ideal resources. Methods: A group of 41 wound experts from 15 countries reached a consensus on wound bed preparation in resource-limited settings. Results: Each statement (22 sub-statements) reached more than 88% consensus. Conclusions: The consensus statements and rationales can guide clinical practice and research for practitioners in low-resource settings. These concepts should prompt ongoing innovation to improve patient outcomes and healthcare system efficiency for all persons with foot ulcers, especially persons with diabetes.

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T: Tissue Debridement

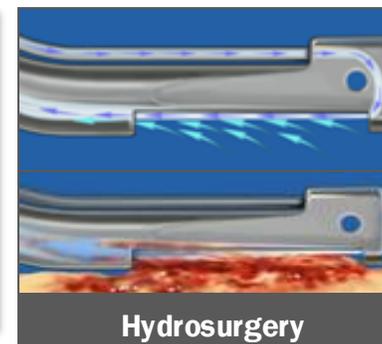
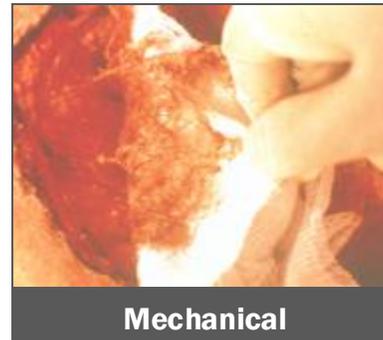
Remove Non-Viable or Deficient Tissue

Goals

- Remove necrotic tissue, micro-debris, and slough
- Reduce microbial bioburden

Types of debridement

- Autolytic
- Surgical/sharp
- Mechanical
- Enzymatic
- Biological
- Hydrosurgery
- Ultrasonic
- Chemical
- Honey



International Consensus Document On Wound Debridement, 2024

DEFINITION

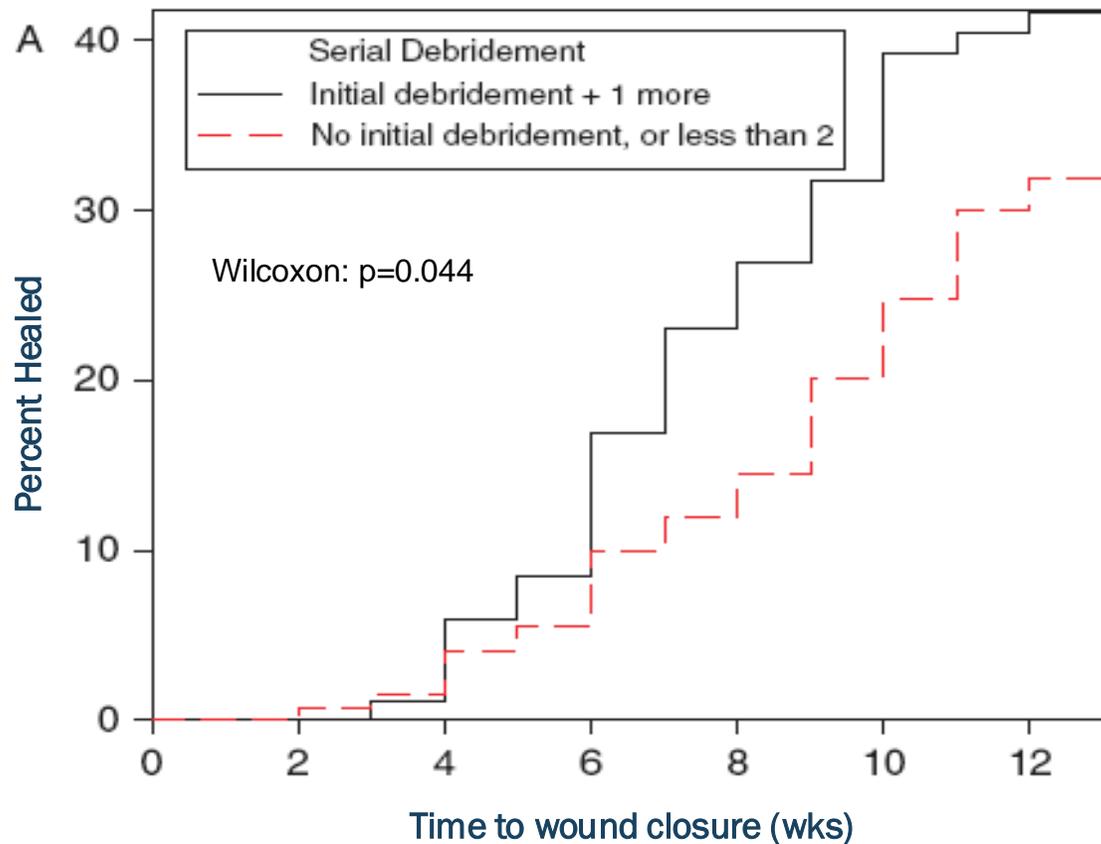
Debridement is the removal of viable and non-viable wound components, including necrotic material, slough, antimicrobial tolerant polymicrobial communities, and foreign materials. The primary goal of debridement is to reduce both microbial and non-microbial biomaterials using the most effective methods with the fewest side effects. These methods should be safely executable at the site of care.

ACTION POINT

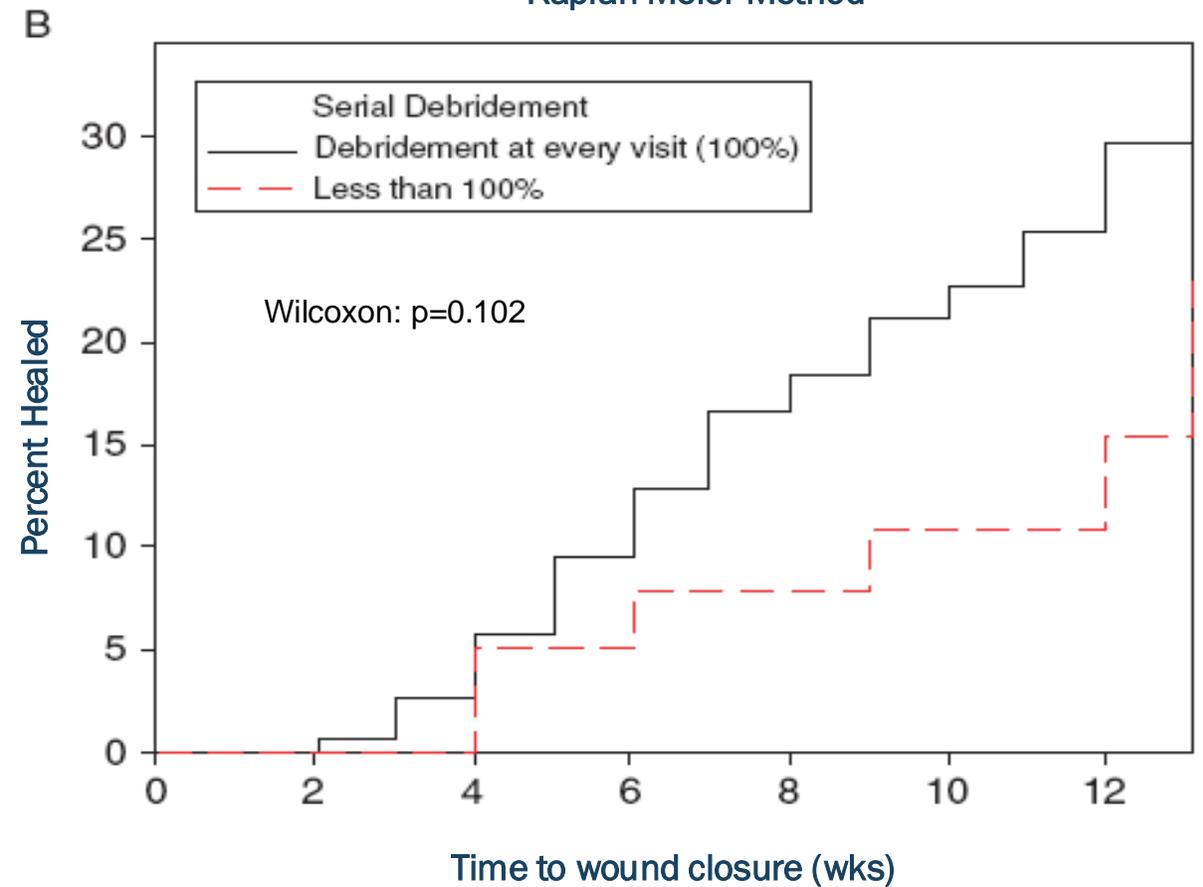
Debridement is a critical component of best practice in wound management due to its significant impact on the healing process. The rationale for debridement lies in the removal of devitalized tissue, microbial and non-microbial biomaterial, and bacterial colonies and debris from wounds. Devitalized tissue, such as necrotic or sloughy tissue, creates a barrier to wound healing. It hinders the migration of healthy cells and the formation of new blood vessels, impeding the wound's ability to progress through the healing phases. By removing this non-viable tissue, debridement promotes the growth of healthy granulation tissue and facilitates wound closure.

Frequent, Sharp Debridement Improves Healing Of Chronic VLUs and DFUs

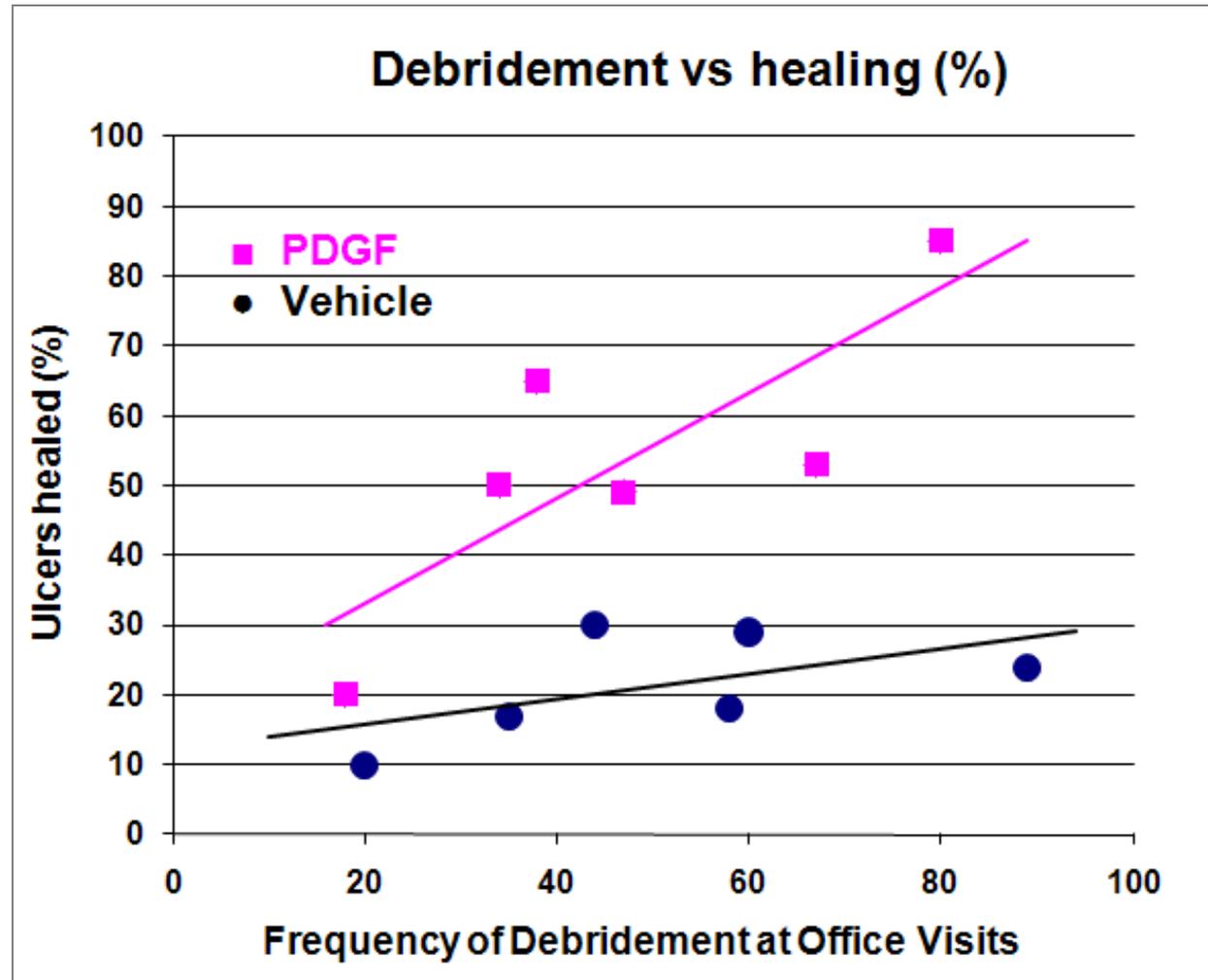
VLU Time to Healing vs Serial Debridement
Kaplan-Meier Method



DFU Time to Healing vs Serial Debridement
Kaplan-Meier Method



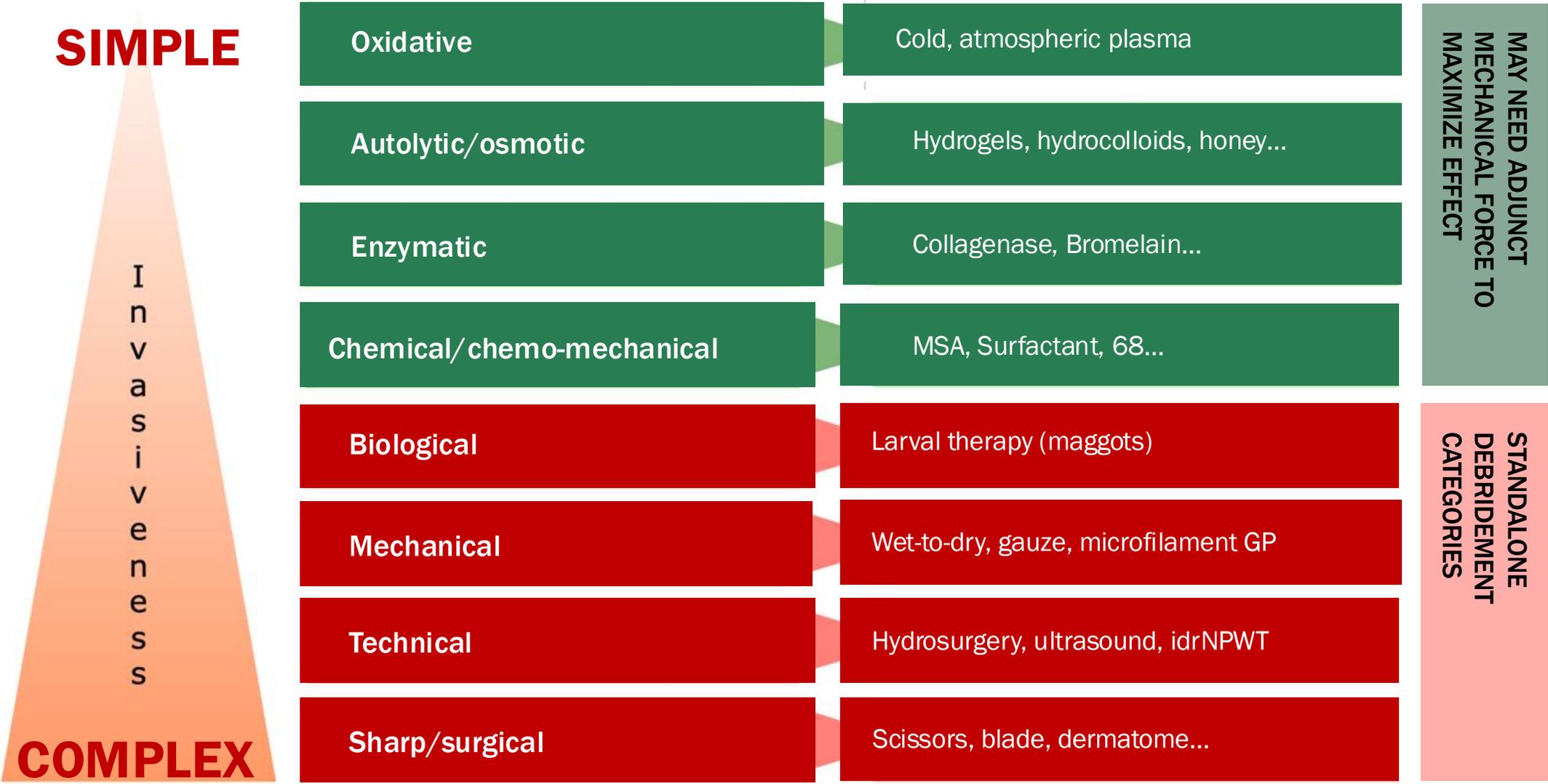
Frequent Sharp Debridement Improves Healing of Chronic DFU, Effect of Advanced Treatments: rhPDGF



Methods of Debridement

- Autolytic: Hydrogel
- Sharp
- Enzymatic: Bromelain, collagenase
- Ultrasonic
- Mechanical
- Highly negative-charged fibers: Device

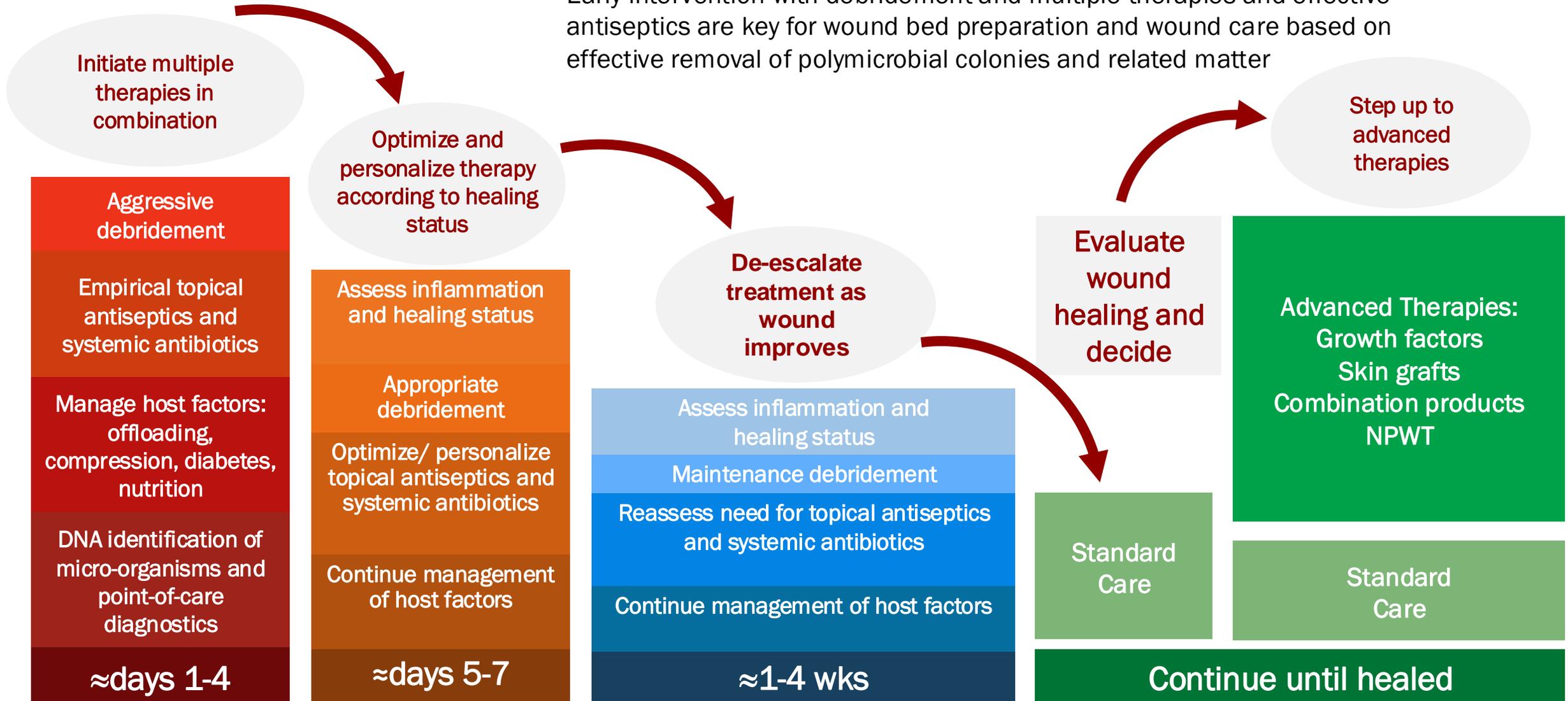
Complexity of Wound Debridement Procedures



Mayer D, et al. *J Wound Care*. In press.

Step-Down, then Step-Up Treatment Strategy

Early intervention with debridement and multiple therapies and effective antiseptics are key for wound bed preparation and wound care based on effective removal of polymicrobial colonies and related matter



Microbial Colonies and Associated Debris Begin to Re-form 24hrs after Debridement

- “Slough or necrotic tissue can promote bacterial growth...[and] prevent the formation of granulation tissue, and subsequent re-epithelialisation, and interfere with wound contraction.” (IWII)
- “More frequent debridement was associated with improved healing. Wounds that were debrided weekly or more frequently were over four times more likely to heal than wounds receiving debridement less often than weekly.” (EPUAP, NPIAP, PPIA)
- “Autolytic debridement... is insufficient to meet the debridement requirements of wound hygiene, as it takes a long time to occur, requires numerous dressing changes, and can increase the risk of infection in hard-to-heal wounds.” (JWC International Consensus Document)



Continuous Debridement of Slough Is Needed

1. Must be effective

Continuously remove slough and wound debris and mitigate re-formation of microbial colonies post-sharp debridement

2. Must be accessible

All caregivers can incorporate sharp debridement throughout the continuum of care

3. Must be easy and comfortable

Easy to use by healthcare providers and well tolerated by patients

Charged fibers support the continuous debridement of slough

- Fibrin, microorganisms, and wound residue attach to negatively-charged fibers to continuously clean the wound bed
- Fibers form a gel to promote moist wound healing



Antimicrobial

- Fast, broad-spectrum, antimicrobial-barrier efficacy
- TLC-Ag healing matrix (antimicrobial layers impregnated with silver) promotes healing and atraumatic, pain-free removal



Case: Pressure Ulcer (Day 1)



Excisional debridement performed. Collagenase applied.

Case: Non-Healing Wound, Abdominal Wall

Day 1



Day 47



Collagenase applied daily for 6 wks

The Need for Debridement Options

Current State

- Feeling stuck in a pigeonhole of 5 ways to prepare a wound bed

Clinician Wants

- To safely clean a wound and “do no harm” to healthy tissue
- Something with wide variety of use cases and safe with other modalities

Market

Evolutionary
vs
Revolutionary

How Charged Fibers Work

Biomaterials behave in predictable ways within complex tissue environments

- Steric exclusion
- Hydrophobic interactions
- Hydrogen bonds



⚡ Electrostatic Interactions

- Negatively-charged fibers have a high attraction to positively charged fibers

Combining Technologies

Highly Charged Fiber (HCF)* dressings to support debridement in conjunction with debridement via clostridial collagenase

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INTRODUCTION

Complex wounds need highly effective debridement to heal optimally, or to be prepared optimally for primary closure via surgery. Debridement can be done via excision, but this acute procedure can be subsequently augmented with the use of enzymatic products such as clostridial collagenase. Additional debridement support may be obtained, via the use of newly available highly charged fiber dressings that can be used synergistically with other modalities such as excisional debridement, or enzymatic debridement. In particular we studied wounds treated with collagenase with conjunctive use of HCF dressings, and we report our results.

METHOD

Five cases of complex wounds are presented, two of these were destined for surgical closure pending appropriate wound bed preparation. Three wounds were planned and destined for secondary closure. Cases 1-5 details and images shows how the wounds progressed via the judicious use of sharp debridement, enzymatic debridement, and debridement support from Highly Charged Fiber (HCF) dressings.

RESULTS

We found that the use of the HCF dressing allows the continuation of slough removal, post excisional debridement and collagenase debridement enzyme, allowing successful surgical closure in two wounds, and stepped down to secondary closure in three others following optimal cleansing/debridement of the wounds.

CASE 1 - RIGHT ISCHIAL PRESSURE ULCER

61 yo male with paraplegia with h/o multiple pressure ulcers including progressive right ischial ulcer with necrotic debris, despite wound management and offloading.

Medical history: Paraplegia

Treatment:

- Clostridial Collagenase utilized following office excisional debridements.
- Negatively Charged Dense fibers added to Clostridial Collagenase to expedite debridement
- Taken to OR for flap closure once wound bed preparation deemed adequate
- Placental allograft placed to optimize healing.
- Incisional V.A.C.® Therapy initiated with a 3M™ Prevena™ Customizable Dressing immediately following closure



CASE 2 - NON HEALING SURGICAL WOUND LOWER BACK

74 yo female s/p spine surgery complicated by PE requiring anticoagulation that resulted in hematoma and secondary dehiscence. | Medical history: DVT, PE (On anticoagulants) | Treatment:

- Clostridial Collagenase utilized following office excisional debridements.
- Negatively Charged Dense fibers added to Clostridial Collagenase to expedite debridement
- Taken to OR for flap closure once wound bed preparation deemed adequate
- Placental allograft placed to optimize healing.
- Incisional V.A.C.® Therapy initiated with a 3M™ Prevena™ Customizable Dressing immediately following closure

CASE 2 - CONT'D



CASE 3 - THIGH WITH FULL THICKNESS NECROSIS

70yo female s/p recurrent ventral hernia repair with postoperative dehiscence and tissue necrosis. Medical history: Obesity, Pace maker

Treatment:

- Clostridial Collagenase utilized following office excisional debridements.
- Negatively Charged Dense fibers added to Clostridial Collagenase to expedite debridement
- Secondary healing without need for surgical intervention



CASE 4 - THIGH WITH FULL THICKNESS NECROSIS

49 yo male with paraplegia with failed flap with extensive full thickness necrosis thigh.

Medical history: Paraplegia | Treatment:

- Excisional debridement in office.
- Clostridial Collagenase utilized following office excisional debridements.
- Negatively Charged Dense fibers added to Clostridial Collagenase to expedite debridement
- NPWT initiated



CASE 5 - THIGH WITH FULL THICKNESS NECROSIS

57 yo male with paraplegia with right ischial pressure ulcer extending to bone (Stage 4). Presents with extensive debris with deep tissue necrosis | Medical history: Paraplegia | Treatment:

- Clostridial Collagenase utilized following office excisional debridements.
- Negatively Charged Dense fibers added to Clostridial Collagenase to expedite debridement
- Taken to OR for flap closure once wound bed preparation deemed adequate
- Placental allograft placed to optimize healing.
- Incisional V.A.C.® Therapy initiated with a 3M™ Prevena™ Customizable Dressing immediately following closure



CONCLUSION

The results show that though more research is indicated in this area, the combination of established debridement methods, such as excisional debridement and enzymatic debridement, can likely be supported by the continuous slough removal properties of the Highly Charged Fiber (HCF) dressings.

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Cases

Case Summary: Right ischial pressure ulcer

61y Male with paraplegia, Hx of multiple pressure ulcers (PUs), including progressive right ischial ulcer with necrotic debris despite wound management and offloading

- Medical Hx: Paraplegia
- Treatment
 - Clostridial collagenase utilized following office excisional debridements
 - Negatively-charged dense fibers added to Clostridial collagenase to expedite debridement
 - Taken to OR for flap closure when wound bed preparation was deemed adequate
 - Placental allograft placed to optimize healing
 - Incisional NPWT (iNPWT) initiated with 3M™ Prevena™ (incision management system) immediately following closure

Necrotic Pressure Ulcer (Day 1)



Debridement supported with negatively-charged fibers applied daily

Necrotic Pressure Ulcer (Days 1, 7)



Necrotic Pressure Ulcer (Day 7)



Necrotic Pressure Ulcer (Day 7)



Necrotic Pressure Ulcer (Day 7)



Debridement supported with negatively-charged fibers applied daily until definitive surgical closure performed

Necrotic Pressure Ulcer (6 Wks)



Case Summary: Non-healing surgical wound, abdomen

70y Female s/p recurrent ventral hernia repair with post-operative dehiscence and tissue necrosis

- Medical Hx: Obesity, pacemaker
- Treatment
 - Clostridial collagenase utilized following office excisional debridements
 - Negatively-charged dense fibers added to Clostridial collagenase to expedite debridement
 - Secondary healing without need for surgical intervention

Non-Healing Wound, Abdomen (Day 1)



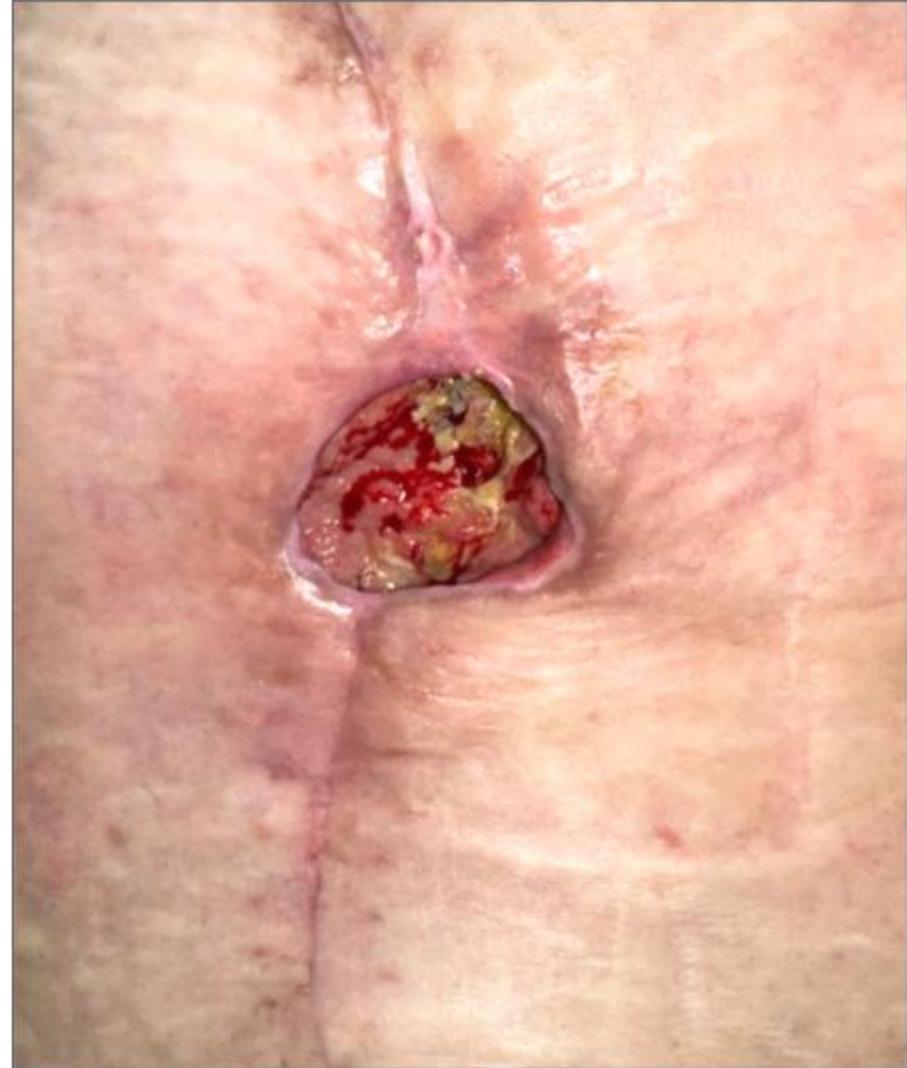
Non-Healing Wound, Abdomen (Day 7)



Non-Healing Wound, Abdomen (Day 7)



Non-Healing Wound, Abdomen (Day 21)



Non-Healing Wound, Abdomen (Day 21)



Non-Healing Wound, Abdomen (Day 21)



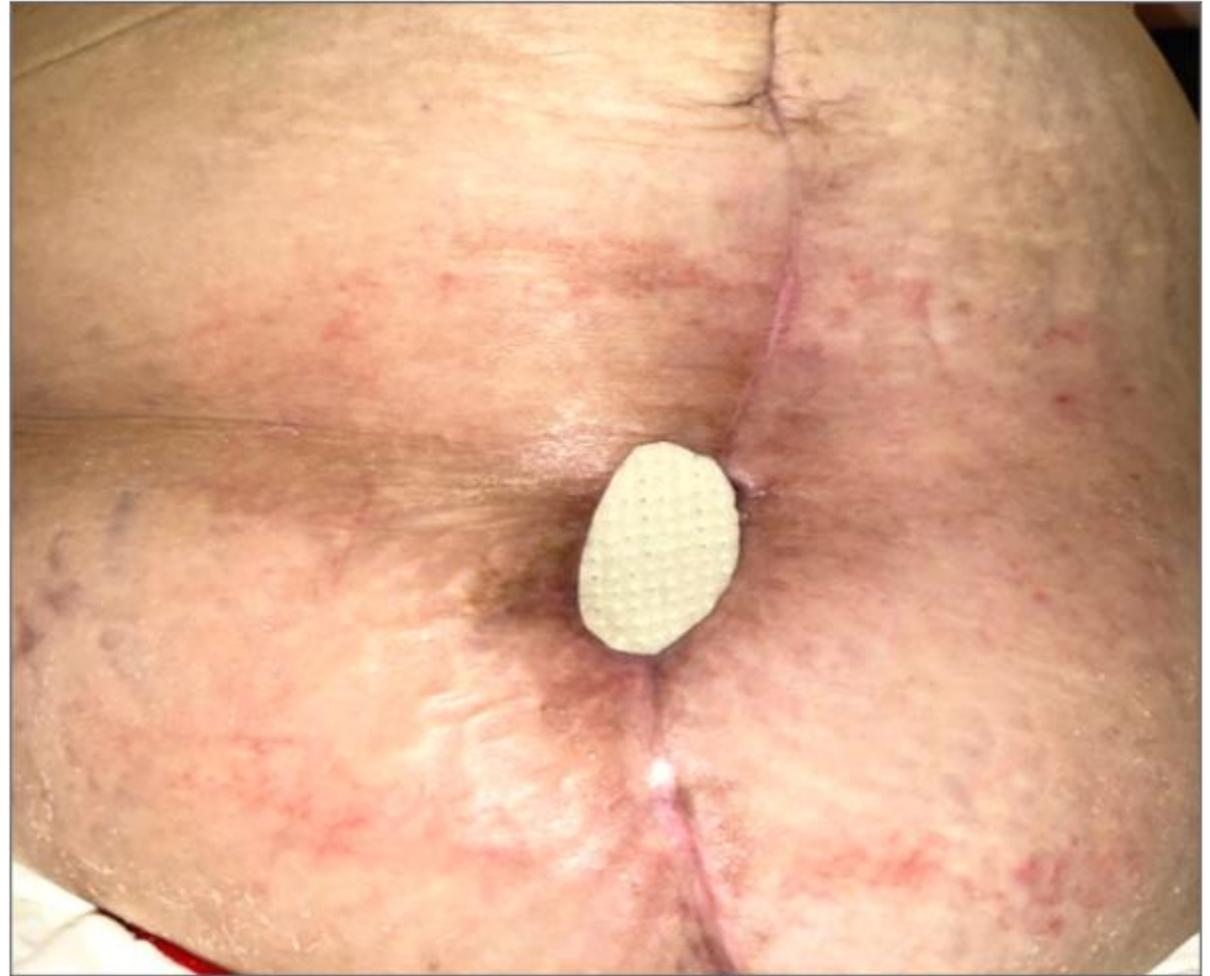
Non-Healing Wound, Abdomen (6 Wks)



Non-Healing Wound, Abdomen (8 Wks)



Non-Healing Wound, Abdomen (8 Wks)



Non-Healing Wound, Abdomen (10 Wks)



Case Summary: Thigh with full-thickness necrosis

- 49y Male with paraplegia; failed flap with extensive full-thickness necrosis, thigh
- Medical Hx: Paraplegia
- Treatment
 - Excisional debridement in office
 - Clostridial collagenase utilized following office excisional debridements
 - Negatively-charged dense fibers added to Clostridial collagenase to expedite debridement
 - NPWT initiated

Necrosis, Left Thigh (Day 1)



**Left thigh with full-thickness
necrosis**



s/p Removal eschar

Necrosis, Left Thigh (Day 1)



Necrosis, Left Thigh (Day 1)



**Collagenase application
followed by non-adherent**



Negatively-charged dense fibers

Necrosis, Left Thigh (Day 7)



Necrosis, Left Thigh (Day 7)

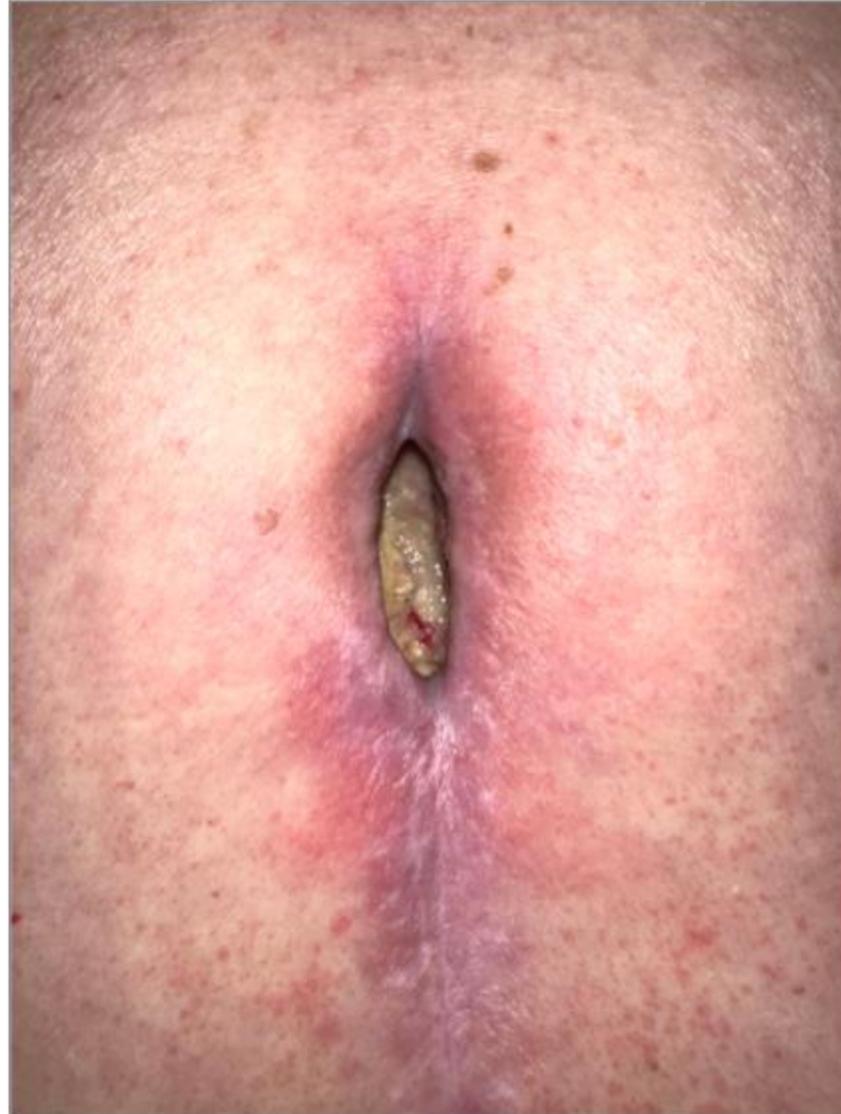


Collagenase application followed by non-adherent and negatively-charged fibers

Case Summary: Non-healing surgical wound, lower back

- 74y Female s/p spine surgery complicated by PE requiring anticoagulation that resulted in hematoma and secondary dehiscence
- Medical Hx: DVT, PE (on anticoagulants)
- Treatment:
 - Clostridial collagenase utilized following office excisional debridements
 - Negatively-charged dense fibers added to Clostridial collagenase to expedite debridement
 - Taken to OR for flap closure once wound bed preparation deemed adequate
 - Placental allograft placed to optimize healing
 - Incisional NPWT (iNPWT) with customizable iNPWT dressing initiated immediately following closure

Non-Healing Wound, Spine (Day 1)



Non-Healing Wound, Spine (Day 1)



Non-Healing Wound, Spine (Day 1)



Non-Healing Wound, Spine (Day 10)



Non-Healing Wound Spine (Day 10)



Case Summary: Right ischial pressure ulcer

57yo Male with paraplegia; right ischial pressure ulcer extending to bone (Stage 4)

- Presents with extensive debris with deep tissue necrosis
- Medical history: Paraplegia
- Treatment:
 - Clostridial collagenase utilized following office excisional debridements
 - Negatively-charged dense fibers added to Clostridial collagenase to expedited debridement
 - Taken to OR for flap closure once wound bed preparation deemed adequate
 - Placental allograft placed to optimize healing
 - iNPWT with iNPWT customizable dressing initiated immediately following closure

Right Ischial Ulcer (Day 1)



Right Ischial Ulcer (Day 1)



Right Ischial Ulcer (6 Wks)



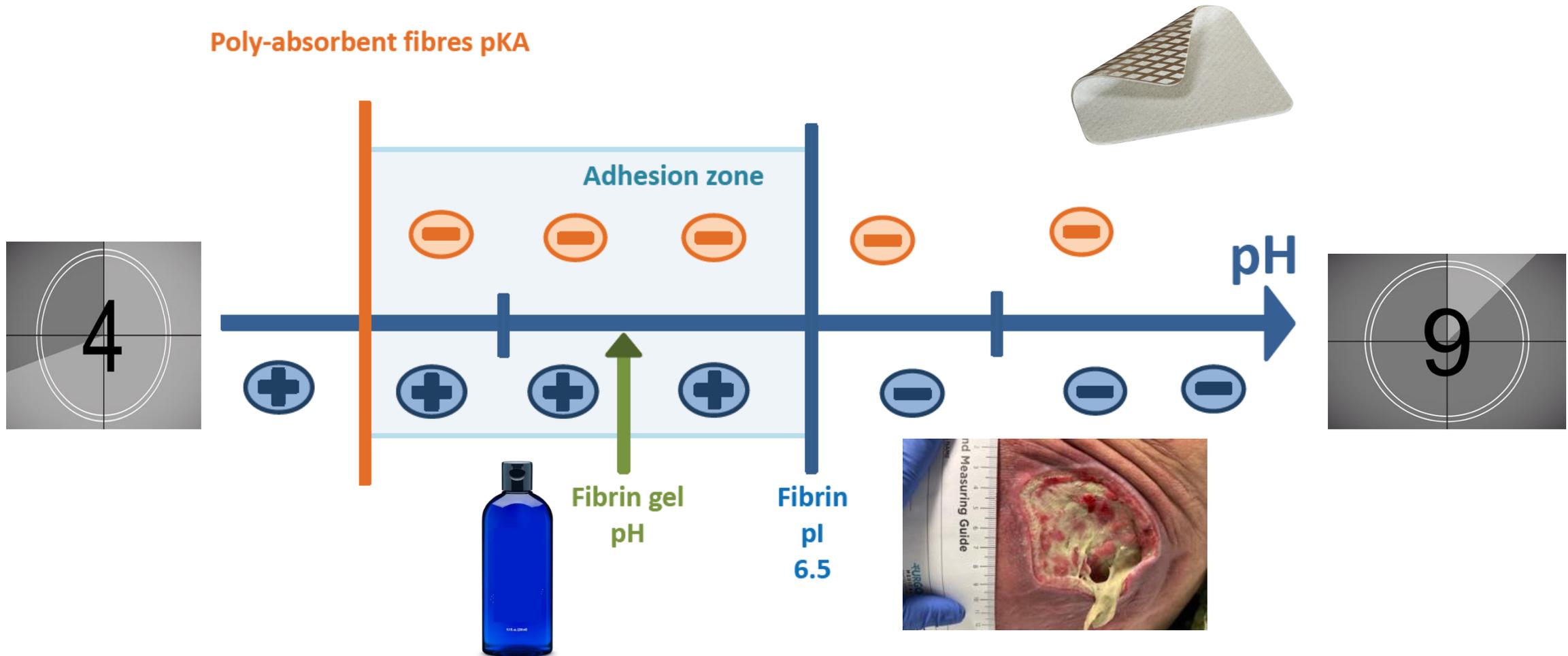
Right Ischial Ulcer (6 Wks)



Right Ischial Ulcer (6 Wks)



Synergy Between HOCl and Negative Fibers



Case Summary: Non-healing surgical wound, lower back

74y Female s/p spine surgery complicated by PE requiring anticoagulation that resulted in hematoma and secondary dehiscence

Medical Hx: DVT, PE (on anticoagulants)

- Treatment:
 - Taken to OR for surgical closure with finding of deep tissue abscess
 - Underwent drainage of abscess, debridements
 - **Intraoperatively, pHA utilized as 10-minute soak**
 - NPWTi-d initiated with pHA
 - Returned to OR 72 hrs for definitive surgical closure
 - **Intraoperatively, pHA utilized as 10-minute soak**
 - Placental allograft placed to optimize healing
 - NPWT initiated for incisional management immediately following closure

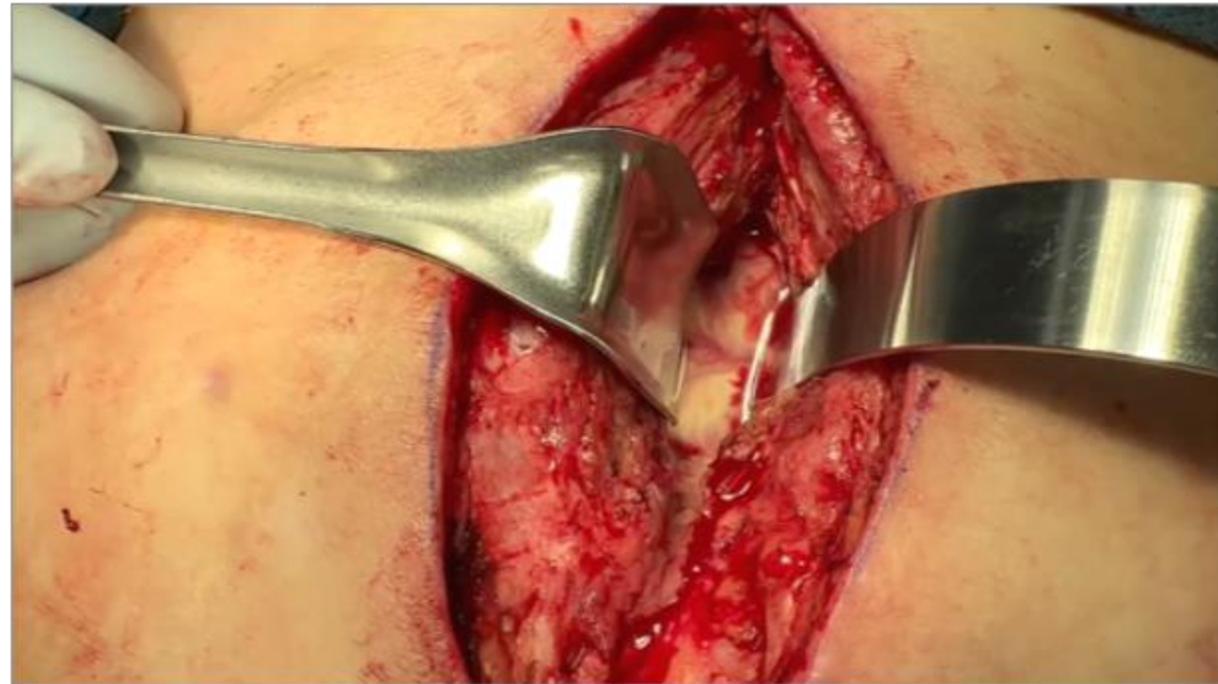
Non-Healing Surgical Wound, Back (Day 1)



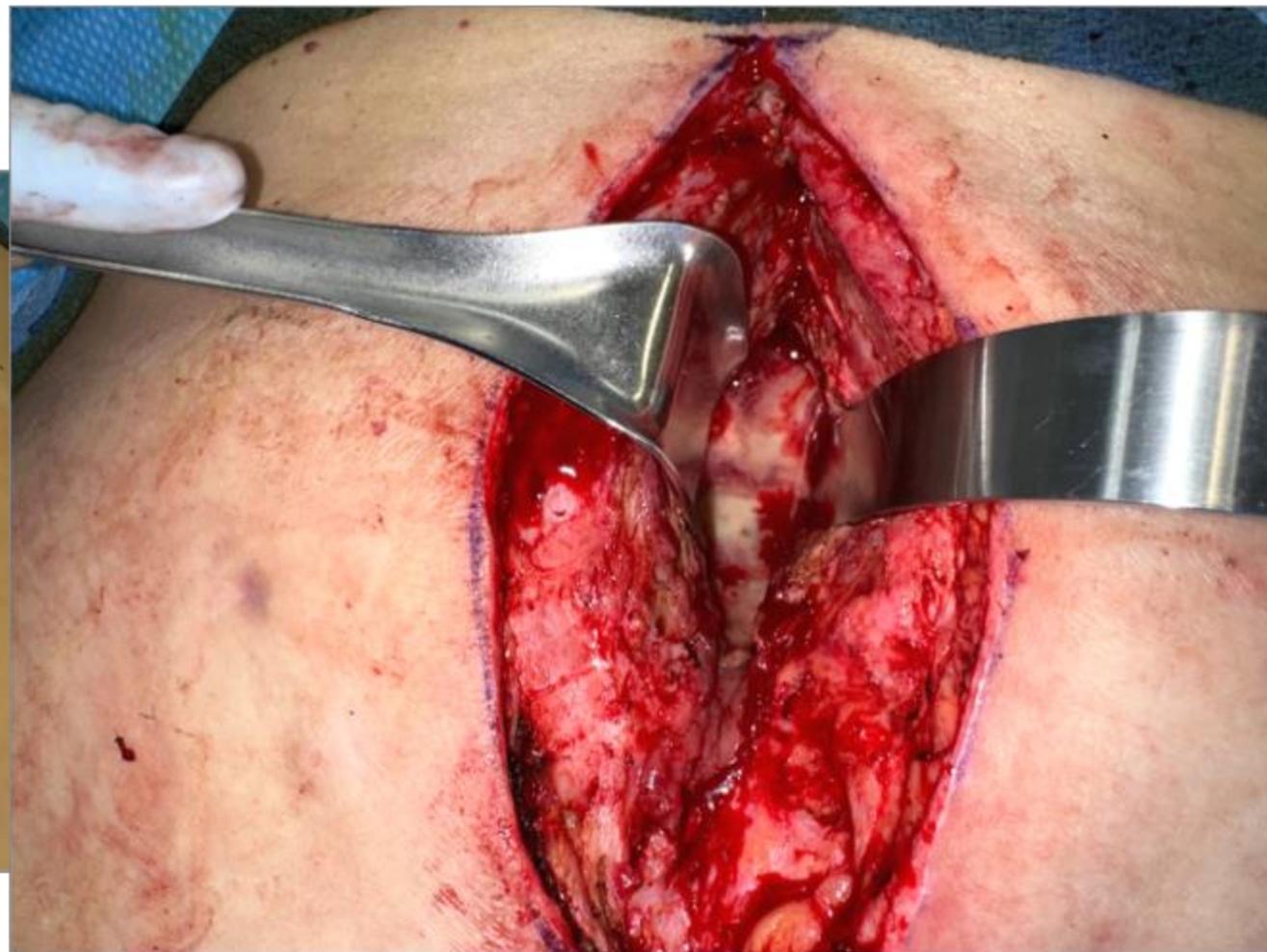
Non-Healing Surgical Wound, Back (Day 1)



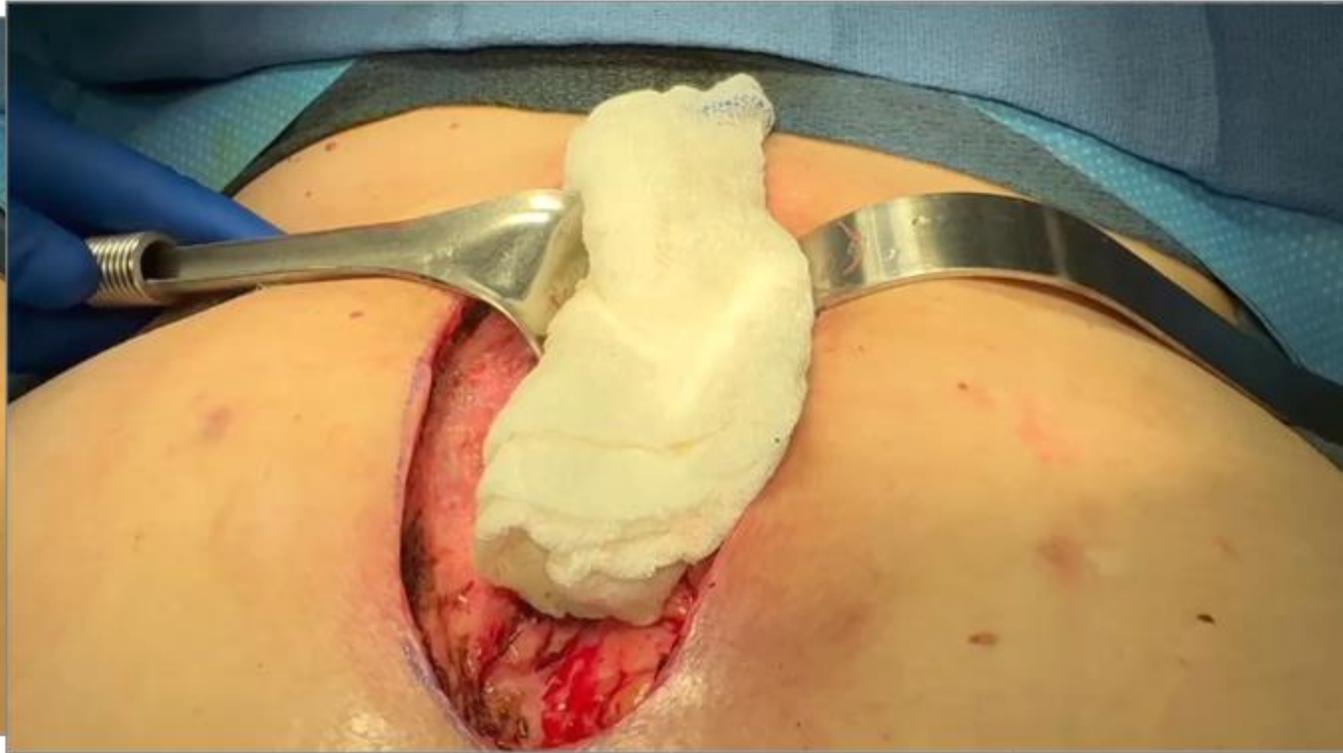
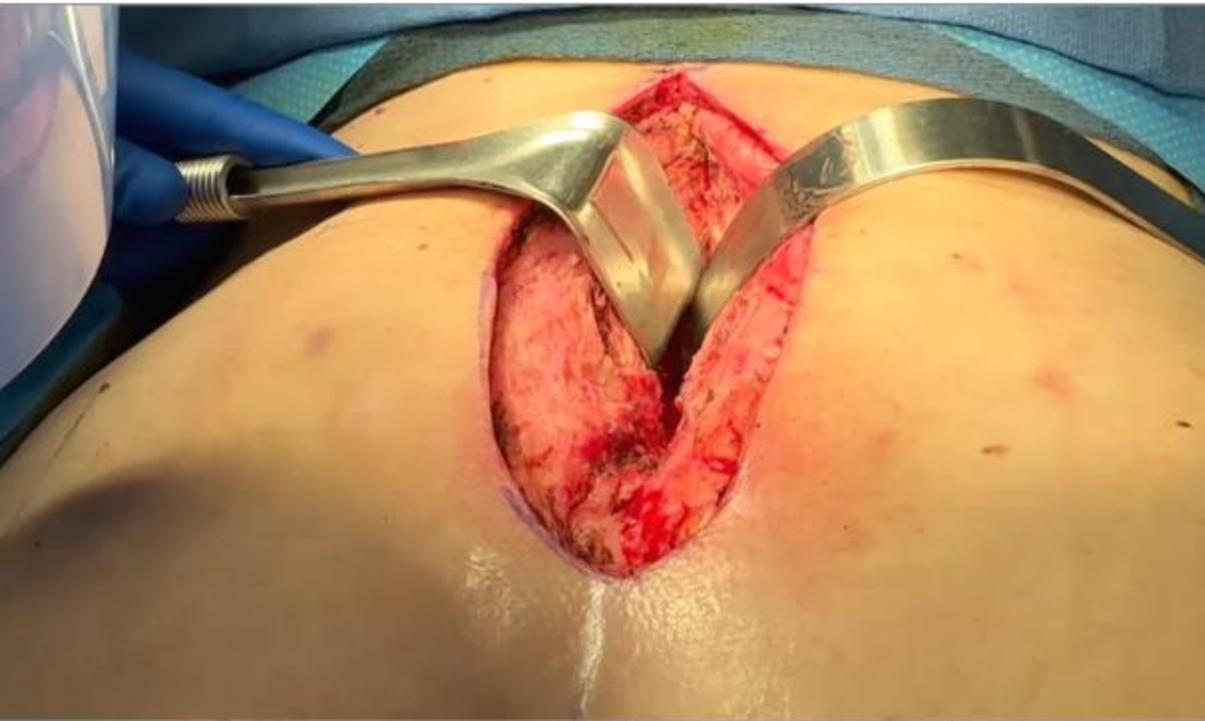
Non-Healing Surgical Wound, Back (Day 1)



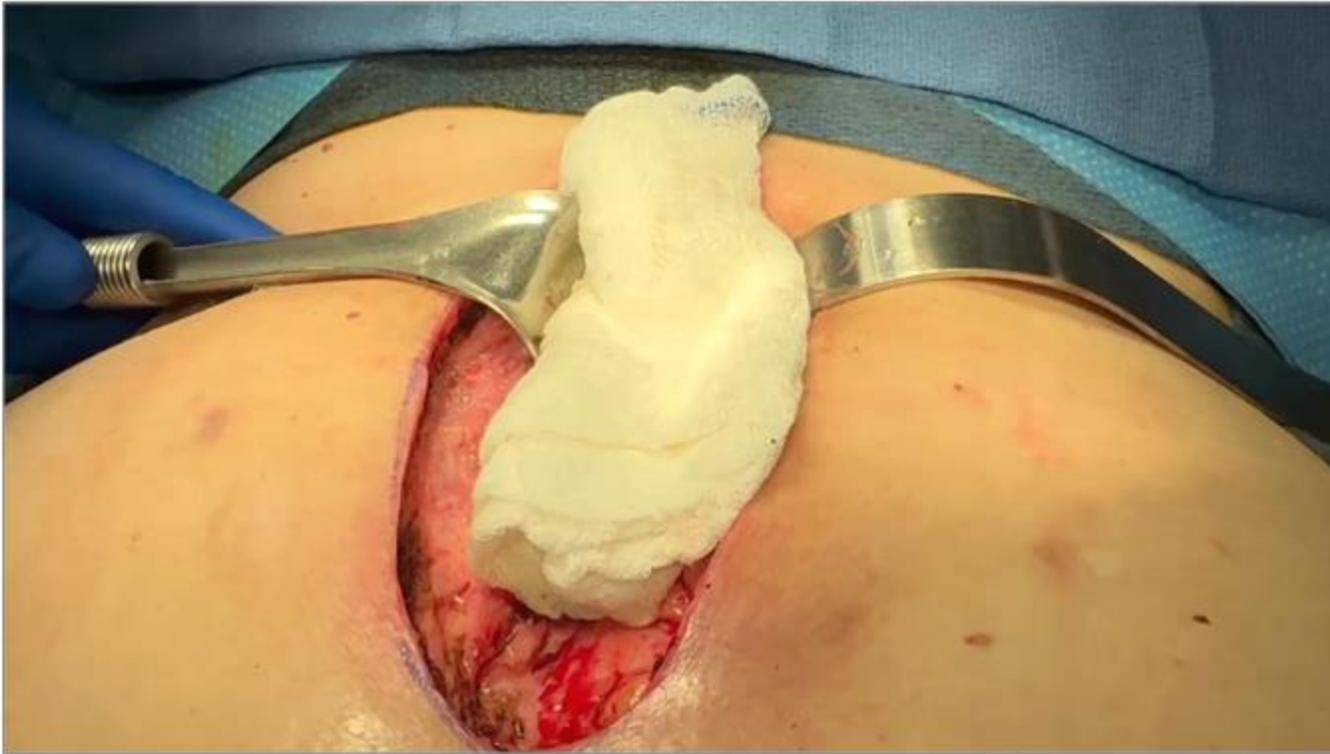
Non-Healing Surgical Wound, Back (Day 1)



Non-Healing Surgical Wound, Back (Day 1)



Non-Healing Surgical Wound, Back (Day 1)



Non-Healing Surgical Wound, Back (Day 3)



Non-Healing Surgical Wound, Back (Day 3)



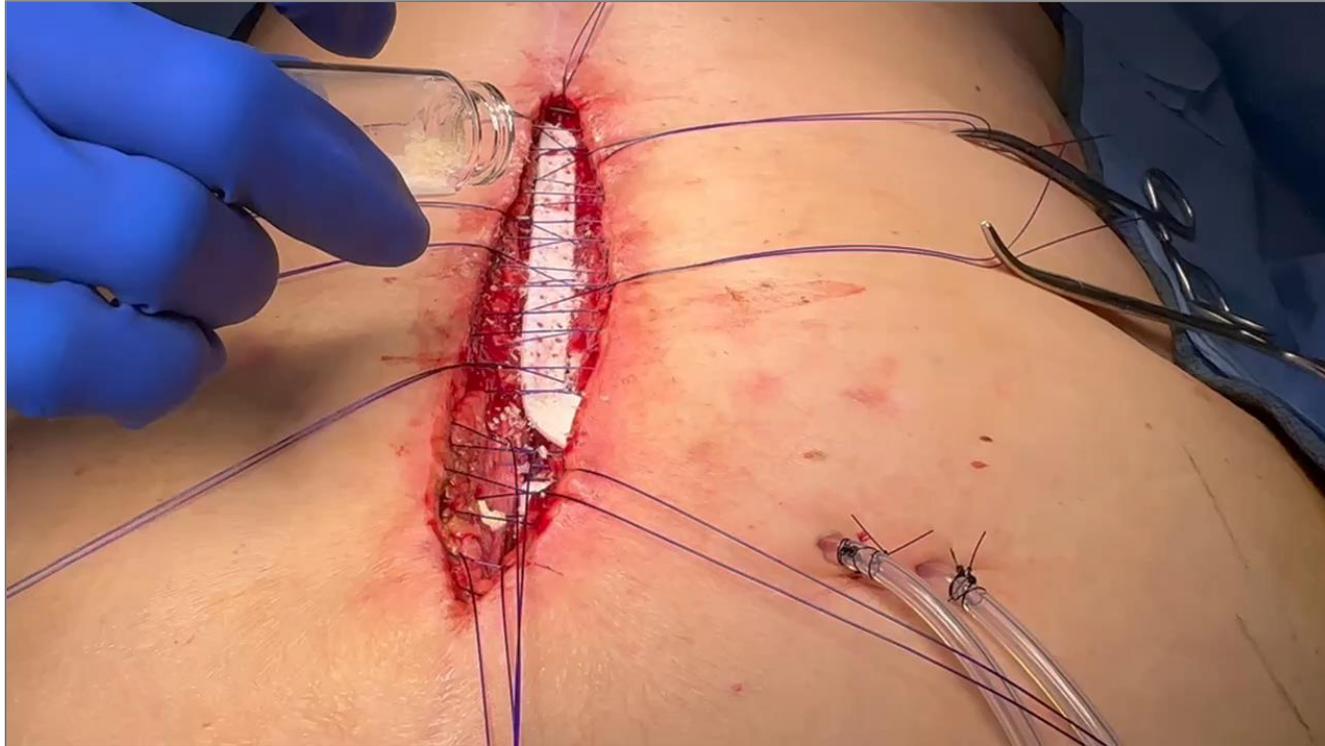
Non-Healing Surgical Wound, Back (Day 3)



Non-Healing Surgical Wound, Back (Day 3)



Non-Healing Surgical Wound, Back (Day 3)



Non-Healing Surgical Wound, Back (Day 3)



Non-Healing Surgical Wound, Back (2 Wks)



Non-Healing Surgical Wound, Back (4 Wks)



Non-Healing Surgical Wound, Back (6 Wks)



Pure Hypochlorous Acid (pHA) in Removing Germs and Necrotic Debris

Mark Suski, MD, FACS

Plastic Surgeon, Medical Director

Center for Advanced Wound Healing

Los Robles Regional Medical Center

Thousand Oaks, CA

Why Is There a Lack of Standardization in Wound Care?

- One of the main reasons is because to **standardize** wound care, the products in protocols need to check all the following



Effective in eradicating pathogens



Suitable pH for both intact and non-intact skin



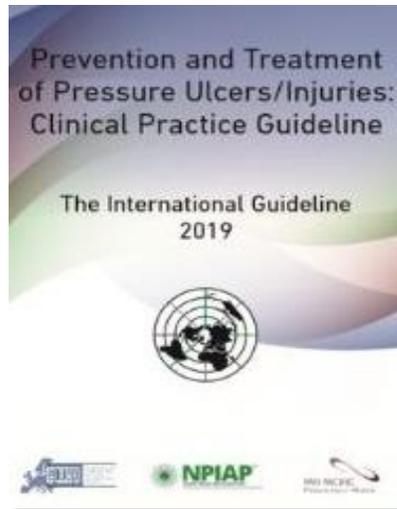
Non-cytotoxic: Safe for key cells



Practical to use in everyday treatment

What Can Be Done?

November 2019



National Pressure Injury
Advisory Panel
International Guidelines

March 2020



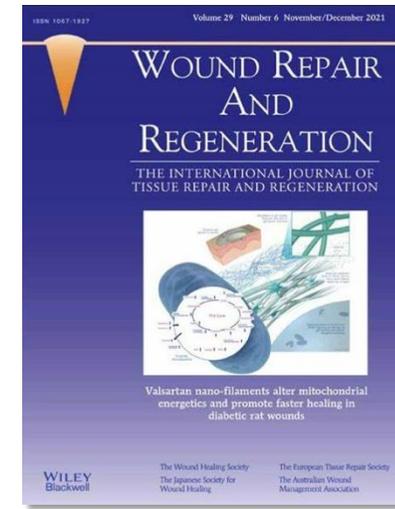
JWC International
Consensus Guidelines:
Hard-to-heal wounds

March 2022



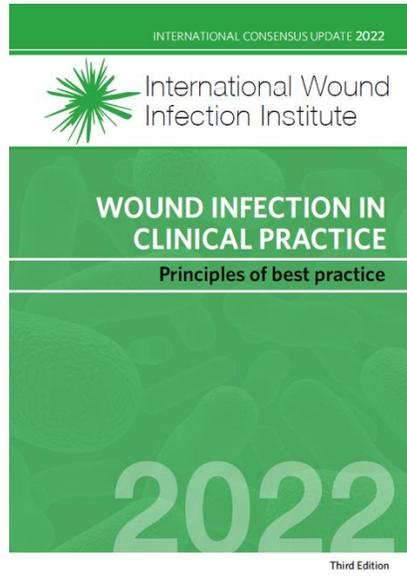
International Wound
Infection Institute:
Wound Infection in
Clinical Practice

April 2022



Wound Repair
and Regeneration:
Treatment Guidelines

Objective Clinical Truth Consensus and Guidelines



Cleanse/
Irrigate Topical Wound Care

<p>Super-oxidised solutions (Hypochlorous acid [HOCl] antimicrobial preservative)</p>	<ul style="list-style-type: none"> ■ Broad-spectrum action against bacteria, virus and fungi, including MRSA^{183,266} ■ Eradicates bacterial and fungal biofilms^{266,281} 	<p>✓</p>	<p>✓</p>	<p>✓</p>	<ul style="list-style-type: none"> ■ Sometimes available as a blend with NaOCl²⁸⁰ ■ Has an anti-inflammatory effect through reducing activity of histamines, matrix metalloproteinases, mast cell and cytokine activity¹⁸³ ■ Dose-dependent cytotoxicity, but non-cytotoxic at concentrations that achieve antimicrobial action²⁸⁰
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pHA Meets All Consensus Guidelines for Wound Cleansing



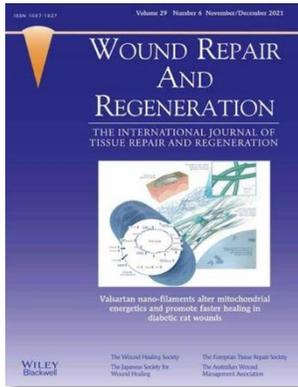
Effective in eradicating pathogens



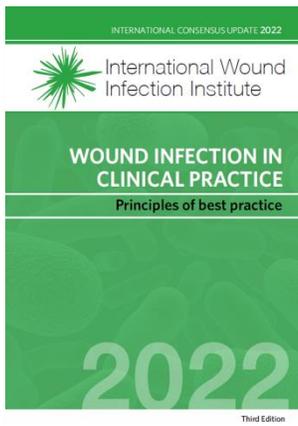
Non-cytotoxic: Safe for key cells



According to Guidelines: Cleansers Should Be Effective in Reducing Bacterial Bioburden



“Using topical antimicrobials to reduce bacterial (and fungal) bioburden in chronic wounds to levels that do not impair healing is based on the principle that the topical antimicrobial treatments can **effectively kill the planktonic and bacteria without killing an unacceptable amount of wound cells** (fibroblasts, keratinocytes, vascular endothelial cells) that are required to actually heal the wound.”



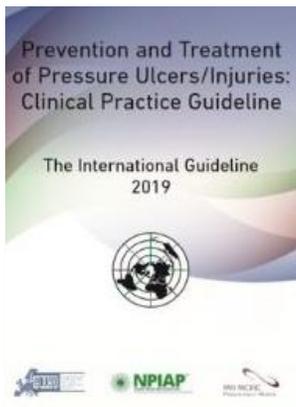
“Topical antiseptics are non-selective and may be **cytotoxic**. This means they **may kill skin and tissue cells involved in wound repair** (eg, neutrophils, macrophages, keratinocytes, and fibroblasts), thereby impairing the healing process.”

According to Guidelines: Cleansers Should Be Effective in Reducing Bacterial Bioburden



“To initiate and support wound healing, the [bacteria] must therefore be disrupted/removed.”

“Saline or water rinses/flushes will not remove bacteria. **Cleansing with intent and appropriate tools/solutions prepares the wound bed for debridement.** It is essential that the periwound skin is cleansed to remove further sources of contamination.”



“Use topical antiseptics in tissue-appropriate strengths to control microbial burden AND to promote healing in pressure injuries.”

Pure Hypochlorous Acid (HOCl)

Effective against various pathogens,* ie,

- Multi-drug-resistant bacteria
- Viruses
- Fungi
- Spores

Demonstrated to eradicate

99.999% in 15 seconds



Meets All Consensus Guidelines for Wound Cleansing



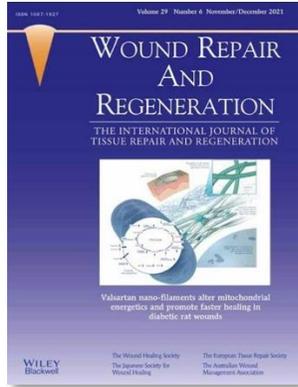
Effective in eradicating pathogens



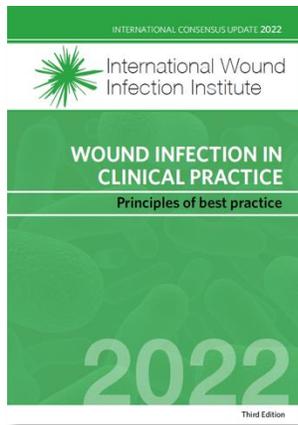
Non-cytotoxic: Safe for key cells



According to Guidelines: Minimize Harm



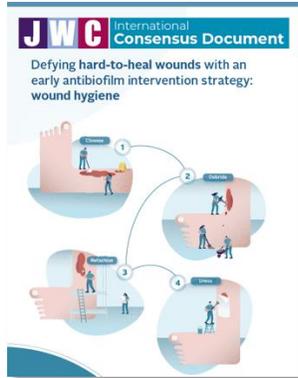
“Microbicidal agents that have a **high therapeutic index (TI)** against typical wound pathogens should be more effective in reducing bacterial bioburden **while not killing wound cells.**”



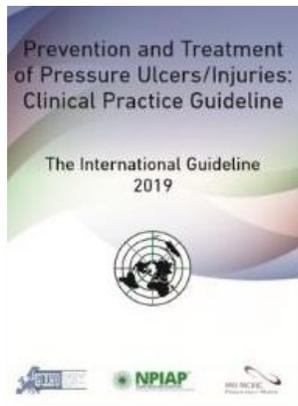
“Topical antiseptics are non-selective and may be **cytotoxic**. This means they **may kill skin and tissue cells involved in wound repair**, thereby impairing the healing process.”

“Many older antiseptics, including **hydrogen peroxide, traditional sodium hypochlorite** (eg, EUSOL and Dakin’s solution), and **chlorhexidine** are **no longer recommended** for use in open wounds due to the risk of tissue damage associated with their use.”

According to Guidelines: Minimize Harm



“Highly cytotoxic solutions, such as those containing povidone-iodine and hydrogen peroxide, are not recommended. Ideally, a skin cleanser designed for daily use should be chosen, to balance the need to disrupt the microbial load while maintaining skin integrity.”



"Newer antiseptics do not have the same cytotoxicity concerns."

“Cytotoxicity is the main concern when applying a topical agent to an open wound. Antiseptics have been found, primarily using *in vitro* models, to be cytotoxic to cells essential to the wound healing process, including fibroblasts, keratinocytes, and leukocytes.”

“Cytotoxicity of cleansing solutions may be concentration dependent.”

Defining “Non-Cytotoxic”

Biocompatibility and toxicity data for pH4

Animal Model	Results
Eye Irritation (Rabbit)	No ocular irritation
Skin Sensitization (Guinea Pig)	No skin sensitization, no delayed- contact hypersensitivity
Primary Dermal Irritation (Rabbit)	No dermal irritation, no erythema or edema
Acute Oral Toxicity (Rat)	No oral toxicity (LD50>5g/kg)
Cell-Based Assay	
Bacterial Mutagenicity	Non-mutagenic
Cytotoxicity	Biocompatible with fibroblasts and keratinocytes

1. Sampson CM, Sampson MN. Hypochlorous acid: A safe and efficacious new wound therapy. Poster presented at: World Union of Wound Healing Societies; 2008; Toronto, Ontario, Canada. 2. Data on file with Uro Medical North America.

Comparative cytotoxicity testing of HOCl and commonly used wound irrigants against human dermal fibroblasts and keratinocytes (n=5 per group, p<0.01)

Wound Irrigant	Results	Grade
Hypochlorous Acid (@ 4 times the normal % of Vashe Wound Solution)	Pass	0
Saline (0.9% NaCl, pH 5.0)	Pass	0
Dakin's Solution (0.25%)	Fail	3
Dakin's Solution (0.5%)	Fail	3
Chlorhexidine gluconate (4%)	Fail	3
Hydrogen peroxide (3%)	Fail	3
Povidone iodine (7.5%)	Fail	3
Povidone iodine (10%)	Fail	3

1. Block SS. Disinfection, sterilization, and preservation. Philadelphia: Lea & Febiger; 2000

How does the definition of non-cytotoxic impact wound progression?

Any pH above 5.5 Could Be Hazardous for Wounds

Table 3. *The optimum growth pH for the most prevalent microorganisms isolated from wounds*

<i>Wound-associated microorganisms</i>	<i>Optimum pH for growth</i>
<i>Staphylococcus aureus</i>	7.0–7.5
<i>Enterococcus faecalis</i>	7.0–9.0
<i>Pseudomonas aeruginosa</i>	6.6–7.0
<i>Coagulase-negative staphylococci</i>	7.0–7.5
<i>Anaerobic bacteria</i>	6.0–7.0
<i>Escherichia coli</i>	6.0–7.0
<i>Klebsiella spp.</i>	5.5–7.0
<i>Candida spp.</i>	7.0–8.0

Take-Home Messages

High pH products are likely harmful to wounds; lower pH wound environment is associated with healing

- The presence of bacteria, proteases, defective extracellular matrices (ECM), and change in pH make chronic wounds very difficult to treat
- pH plays a role in wound healing
- pH could be used as a simple tool to quickly recognize a non-healing wound
- **Targeting pH and making the wound environment acidic could benefit the healing process**

Meets All Consensus Guidelines for Wound Cleansing



Meets all consensus guidelines



Effective in eradicating pathogens

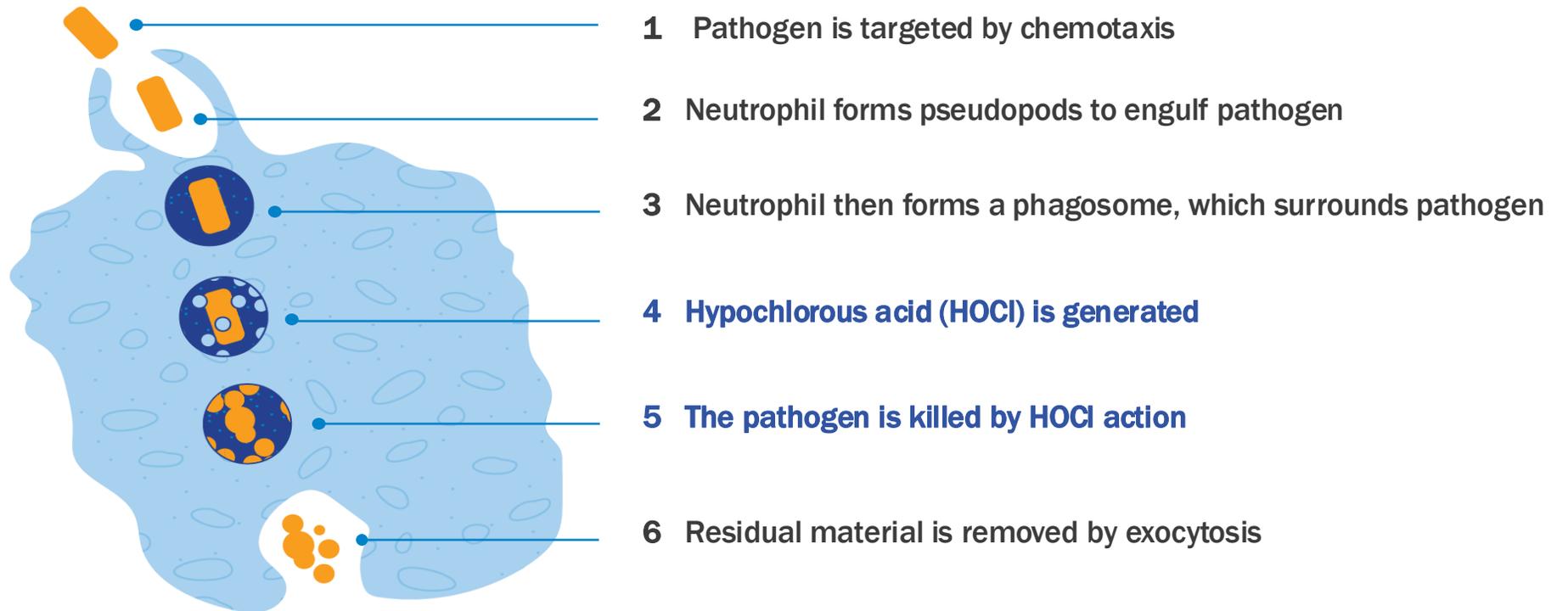


Non-cytotoxic: Safe for key cells



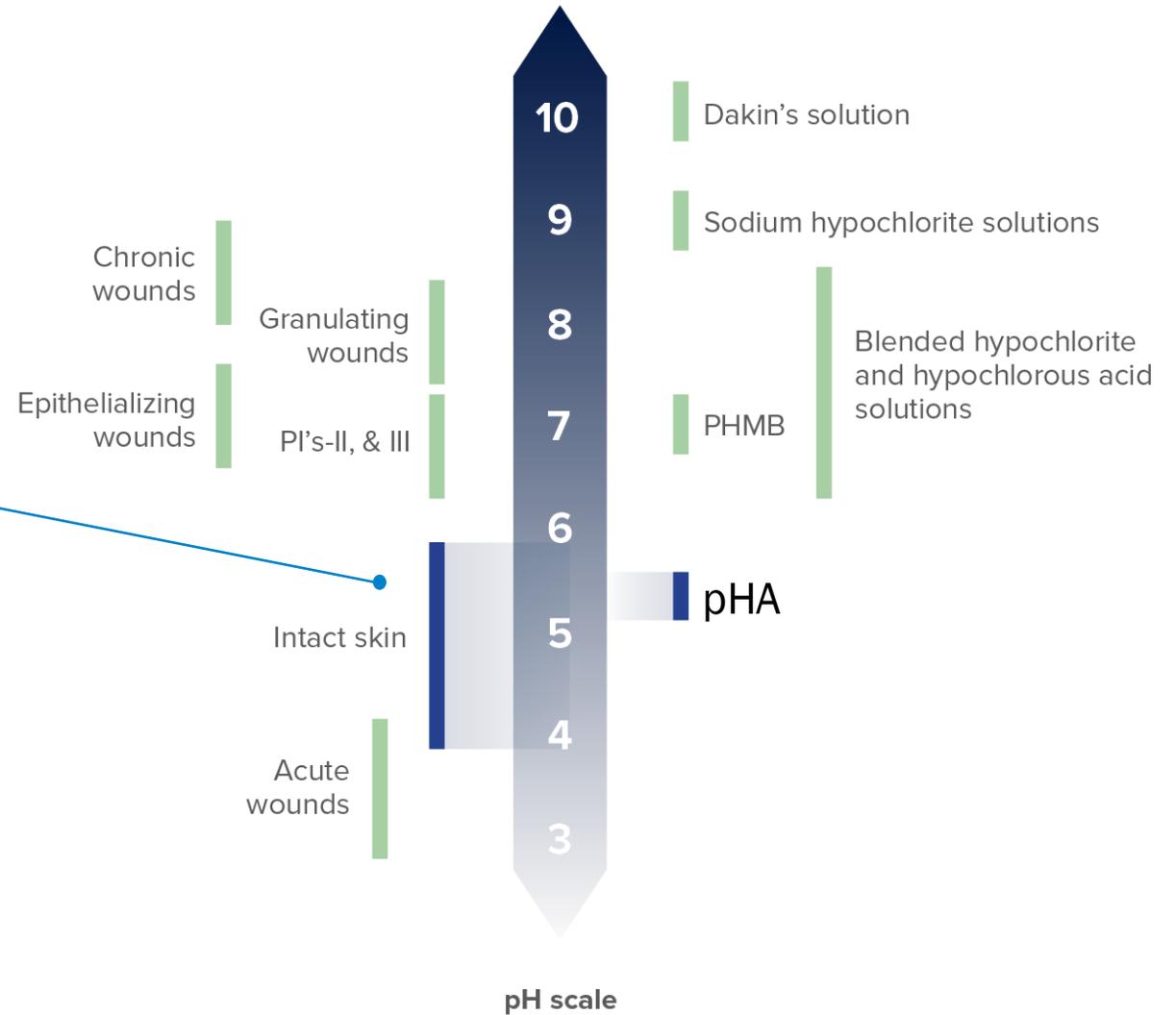
Replicating the Body's Natural Response to Fighting Pathogens

Oxidative Burst Pathway



The Importance of pH

pH promotes effectiveness and safety



pHA cleanser is efficacious, safe, and versatile for streamlined, standardized use in clinical practice



General cleansing



Soaking



Packing



NPWTi-d

pHA Cleanser in Clinical Practice

- Safe for patients 23 wks gestation and up
- Can be used on all wound types



PIs (stage I-IV)



Diabetic ulcers



Burns



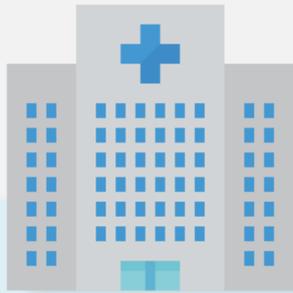
Post-op



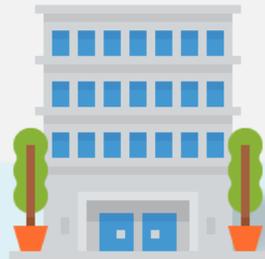
Chronic

pHA Cleanser in Clinical Practice

Available and appropriate for use across all care settings



Inpatient; acute



Outpatient: LTAC, SNF

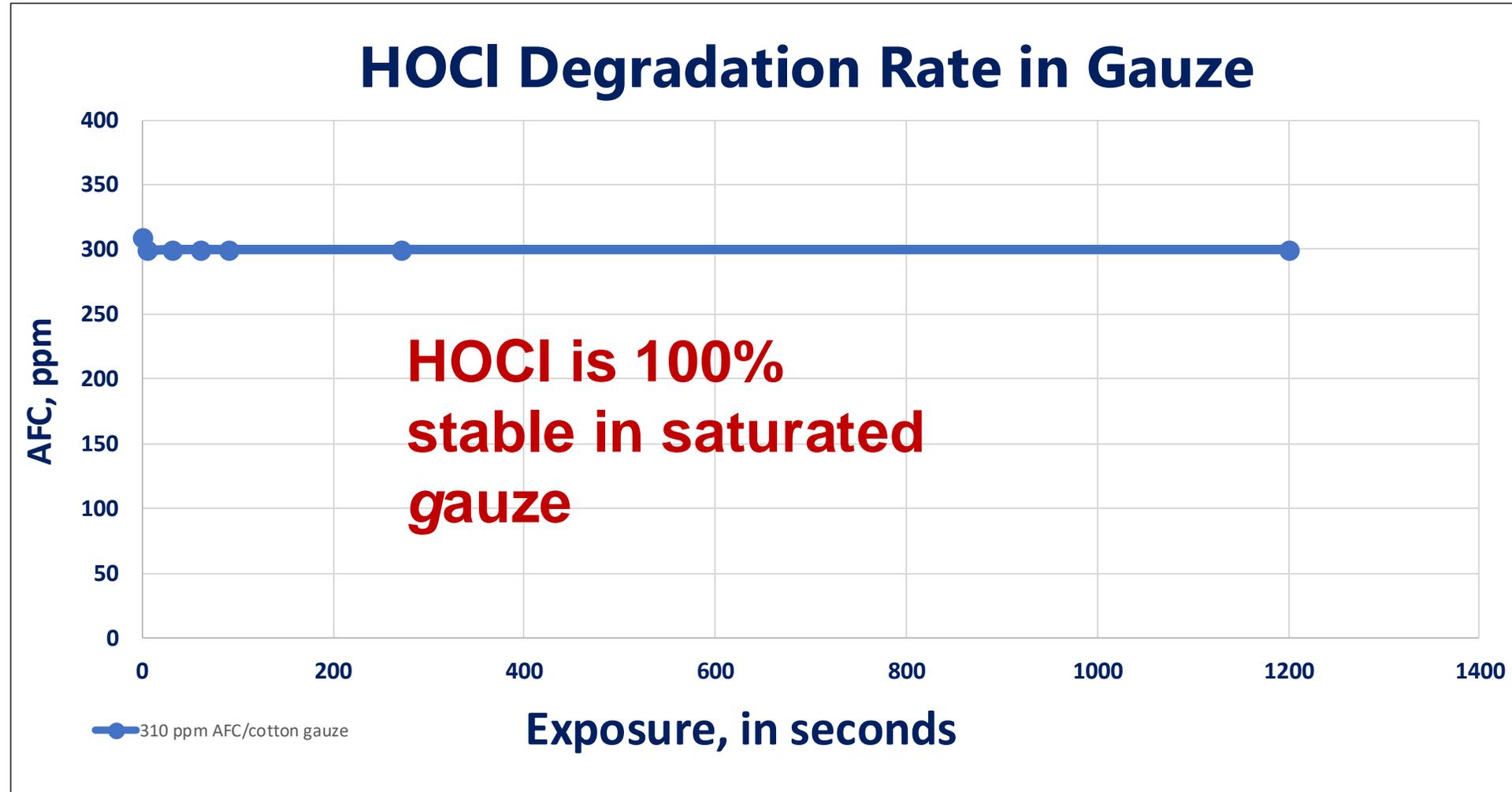


Available OTC

pHA Behavior in Gauze and Tissue

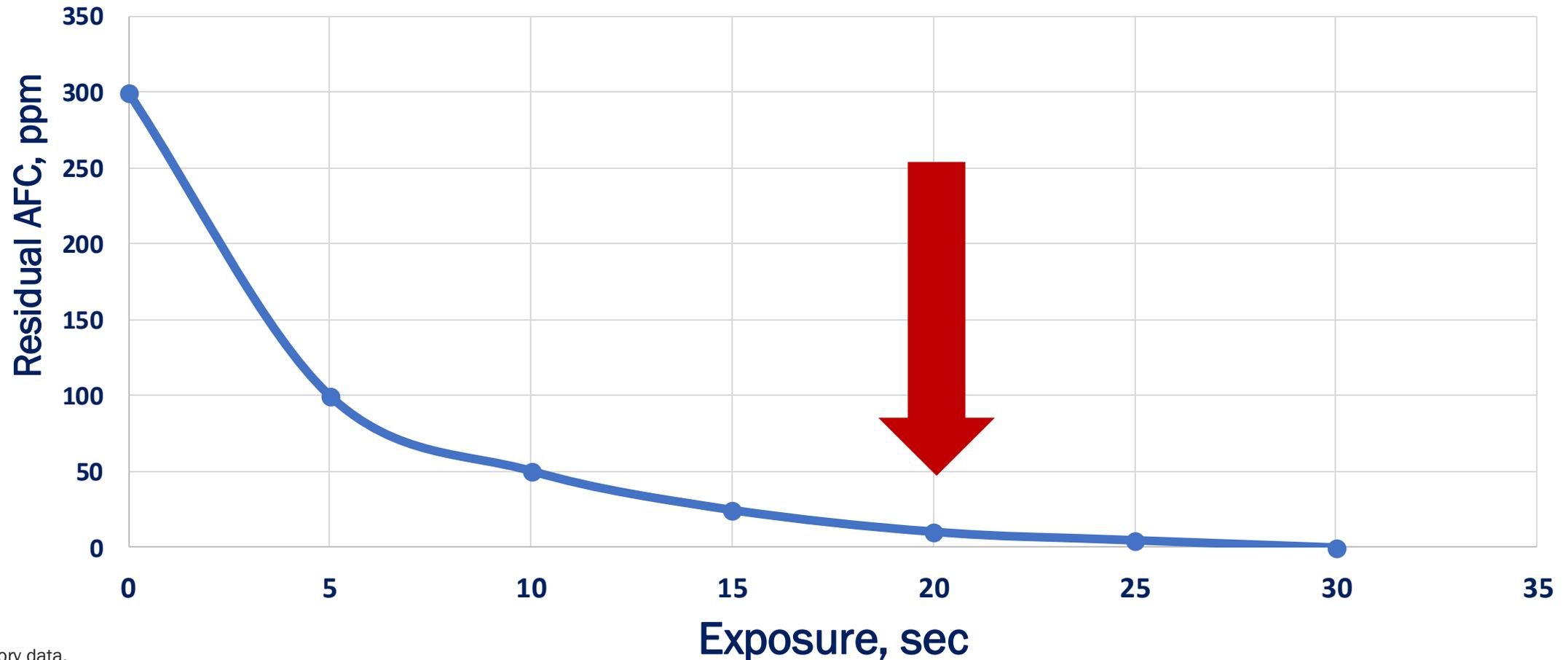
- How much pHA should be poured onto standard 4x4 gauze and packing to achieve maximal effect?

Soaking with Gauze as the Delivery System



HOCl Safety Profile Is Due to Rapid Biodegradation at the Wound/Gauze Interface

HOCl is rapidly consumed
in direct contact with tissue protein



Proven Efficacy

- Bacteria die 3-6 logs — most with 5 logs minimum — within seconds of HOCl exposure

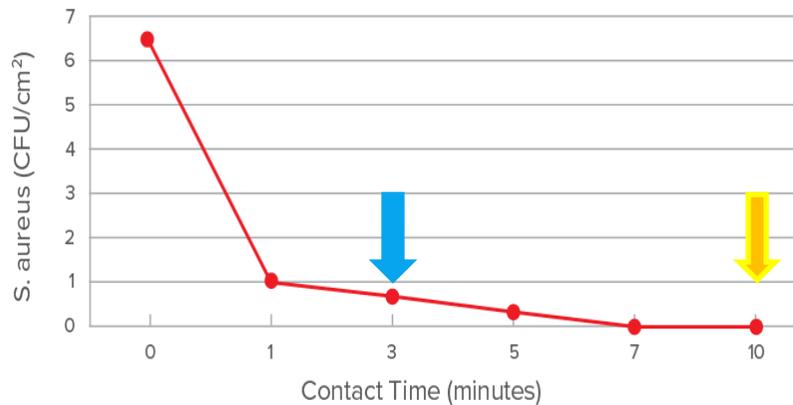
Organism	Time to kill	% Reduction
MRSA	15 seconds	99.999%
VRE	15 seconds	99.999%
<i>Escherichia coli</i>	15 seconds	99.999%
<i>Acinetobacter baumannii</i>	15 seconds	99.999%
<i>Bacteroides fragilis</i>	15 seconds	99.999%
<i>Candida albicans</i>	15 seconds	99.999%
<i>Enterobacter aerogenes</i>	15 seconds	99.999%
<i>Enterococcus faecium</i>	15 seconds	99.999%
<i>Haemophilus influenzae</i>	15 seconds	99.999%
<i>Klebsiella oxytoca</i>	15 seconds	99.999%
<i>Klebsiella pneumoniae</i>	15 seconds	99.999%

Organism	Time to kill	% Reduction
<i>Micrococcus luteus</i>	15 seconds	99.999%
<i>Proteus mirabilis</i>	15 seconds	99.999%
<i>Pseudomonas aeruginosa</i>	15 seconds	99.999%
<i>Serratia marcescens</i>	15 seconds	99.999%
<i>Staphylococcus epidermidis</i>	15 seconds	99.999%
<i>Staphylococcus haemolyticus</i>	15 seconds	99.999%
<i>Staphylococcus hominis</i>	15 seconds	99.999%
<i>Staphylococcus saprophyticus</i>	15 seconds	99.999%
<i>Streptococcus pyogenes</i>	15 seconds	99.999%
<i>Staphylococcus aureus</i>	15 seconds	99.995%
<i>C. difficile</i> endospores	15 seconds	99.93%

If Bacteria Die within Seconds, Why Soak for 5-10 Min?

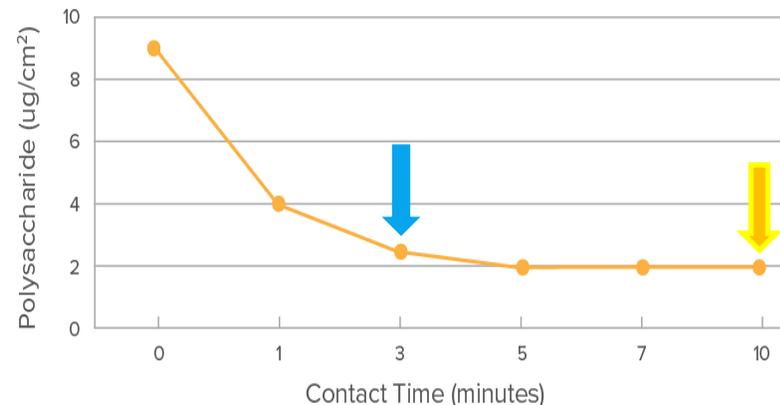
- Soaking for 5-10min allows time to kill adherent bacteria in more realistic 3D conditions — like in a wound — and break down polysaccharides and proteins

Effect of HOCl on adherent colonies of *S. aureus* bacterial numbers



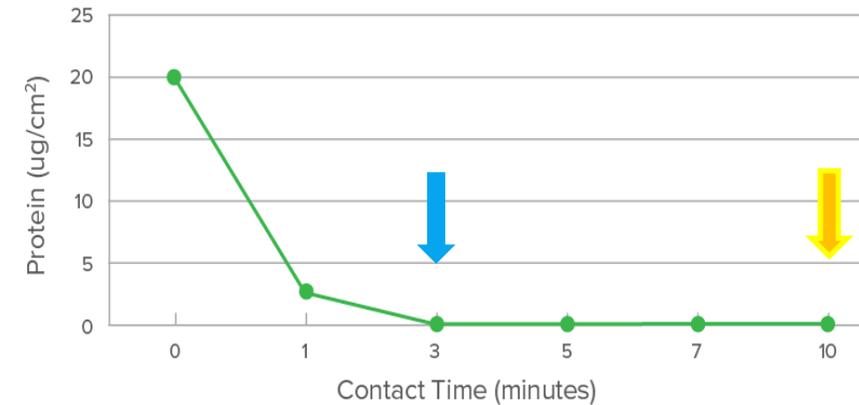
Rapid killing of adherent colonies of *S. aureus*

Effect of HOCl on polysaccharide levels within *S. aureus* slime



Rapid breakdown of polysaccharides in adherent colonies of *S. aureus*

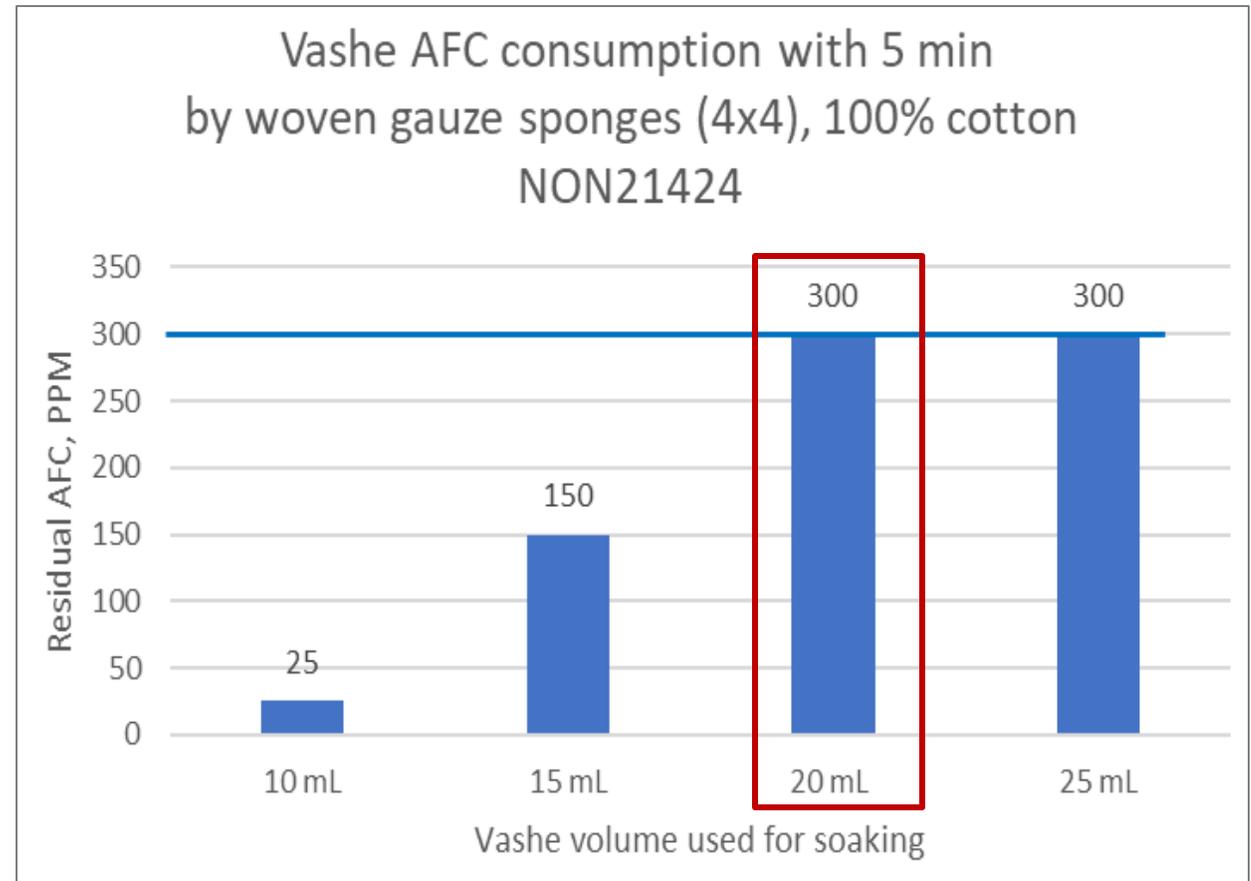
Effect of HOCl on protein levels within *S. aureus* slime



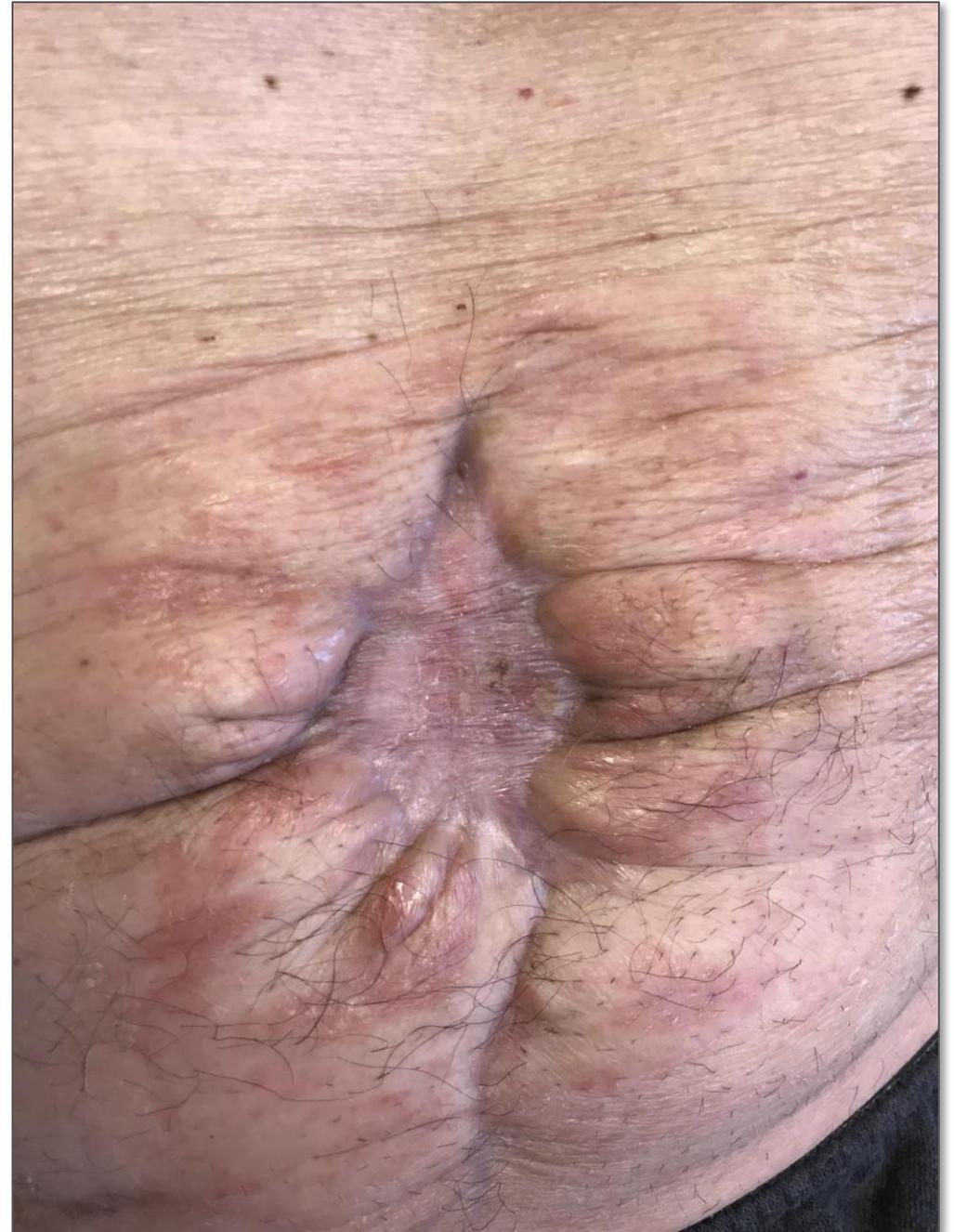
Rapid breakdown of proteins in adherent colonies of *S. aureus*

The Right Amount of HOCl in 4x4 Gauze

- The ideal amount of HOCl in a 4x4-inch gauze is $\approx 30\text{ml}$ (or $\approx 1\text{oz}$)
 - *Less than that means losing HOCl concentration in the gauze in 5min*

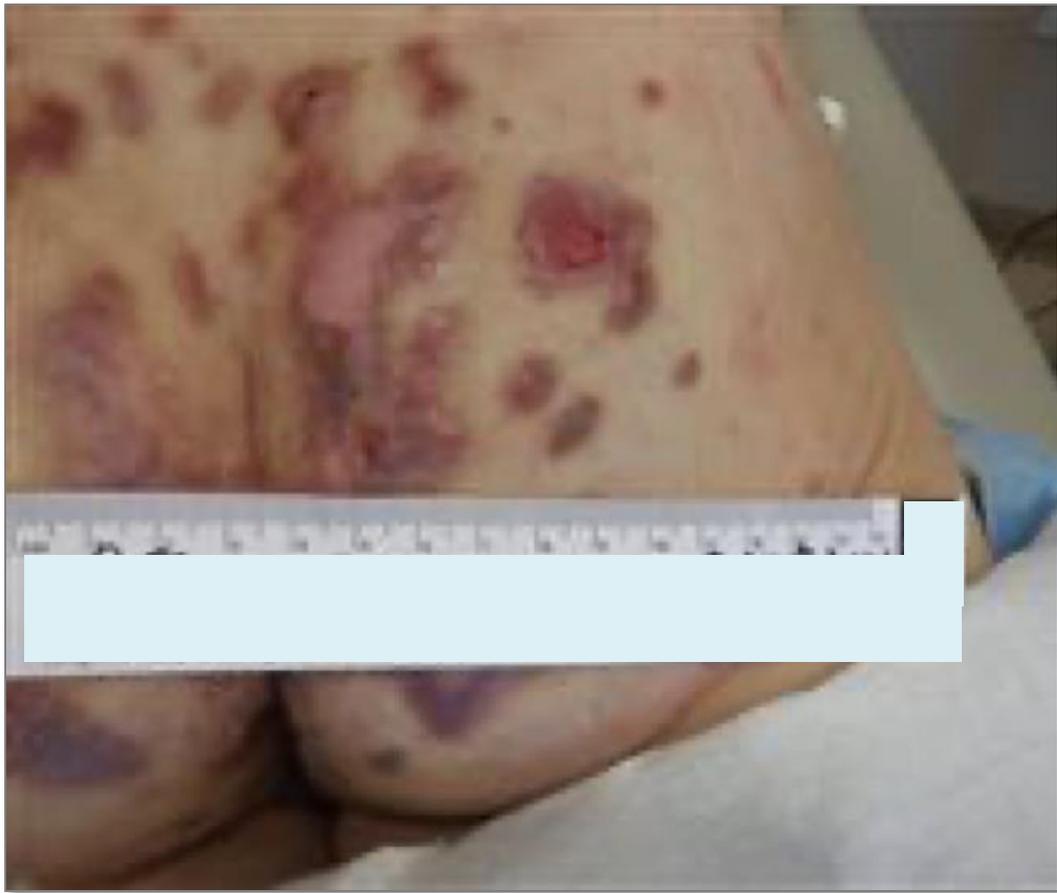


Case Studies















How Synergistic Technologies Work Together for Efficient Desloughing and Debridement

Abigail E. Chaffin, MD, FACS, CWSP, MAPWCA

Professor and Chief, Division of Plastic Surgery

Tulane University

New Orleans, LA

Slough

Complex mixture of

- Exudate proteins
 - Degraded ECM proteins
 - WBC
 - Microorganisms
-
- Common occurrence in hard-to-heal wounds
 - May **impair healing**



Slough

Loose Slough

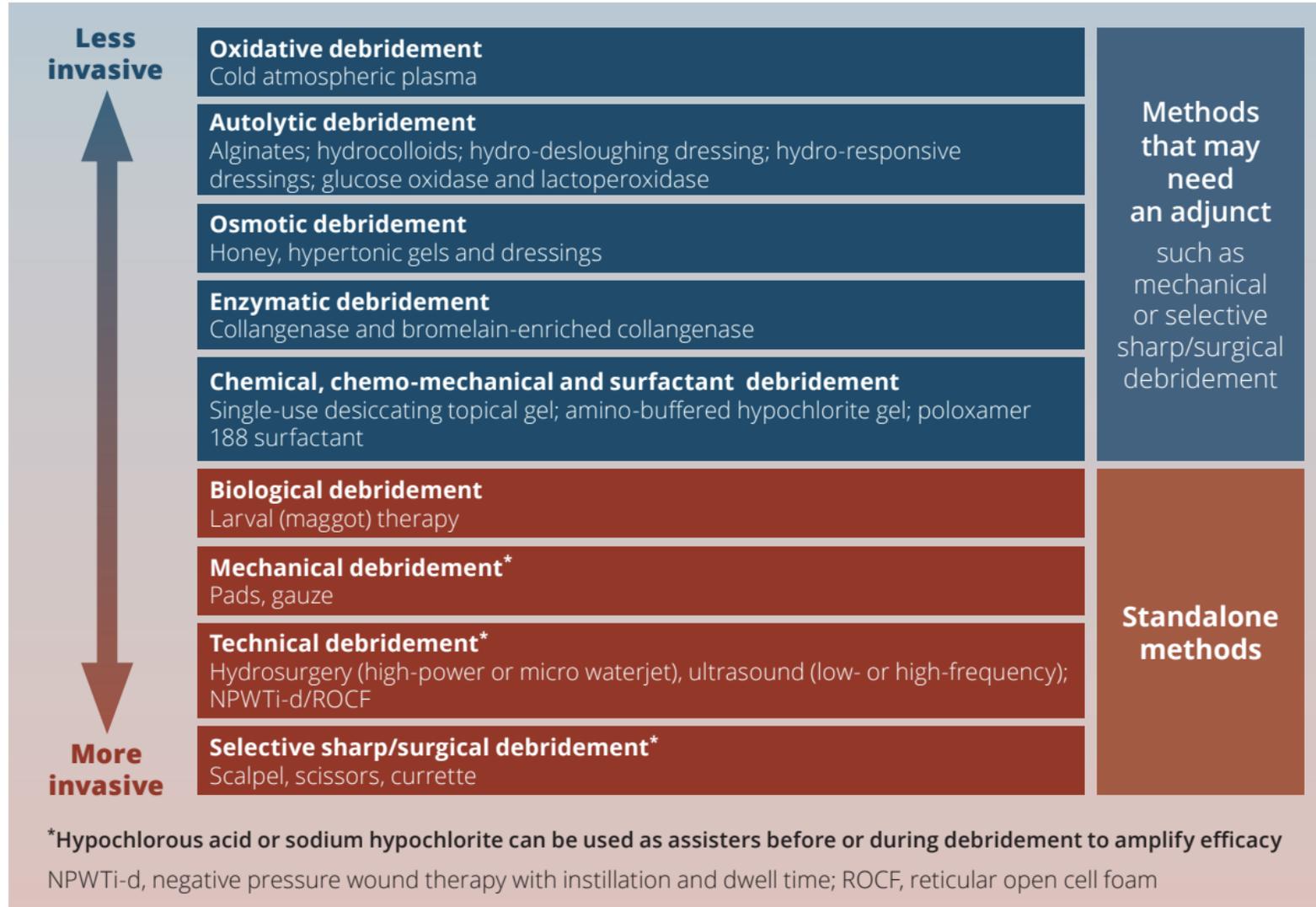
- Lightly adherent to the wound bed
- Yellow or tan
- Usually easily removed from the wound bed
- Dead cells, debris, fibrin

Adherent Slough: **PRO-INFLAMMATORY**

- Layer of devitalized tissue tightly adherent to the wound bed
- More challenging to remove
- Fibers, degraded ECM proteins, exudate, WBC, bacteria



Methods of Debridement

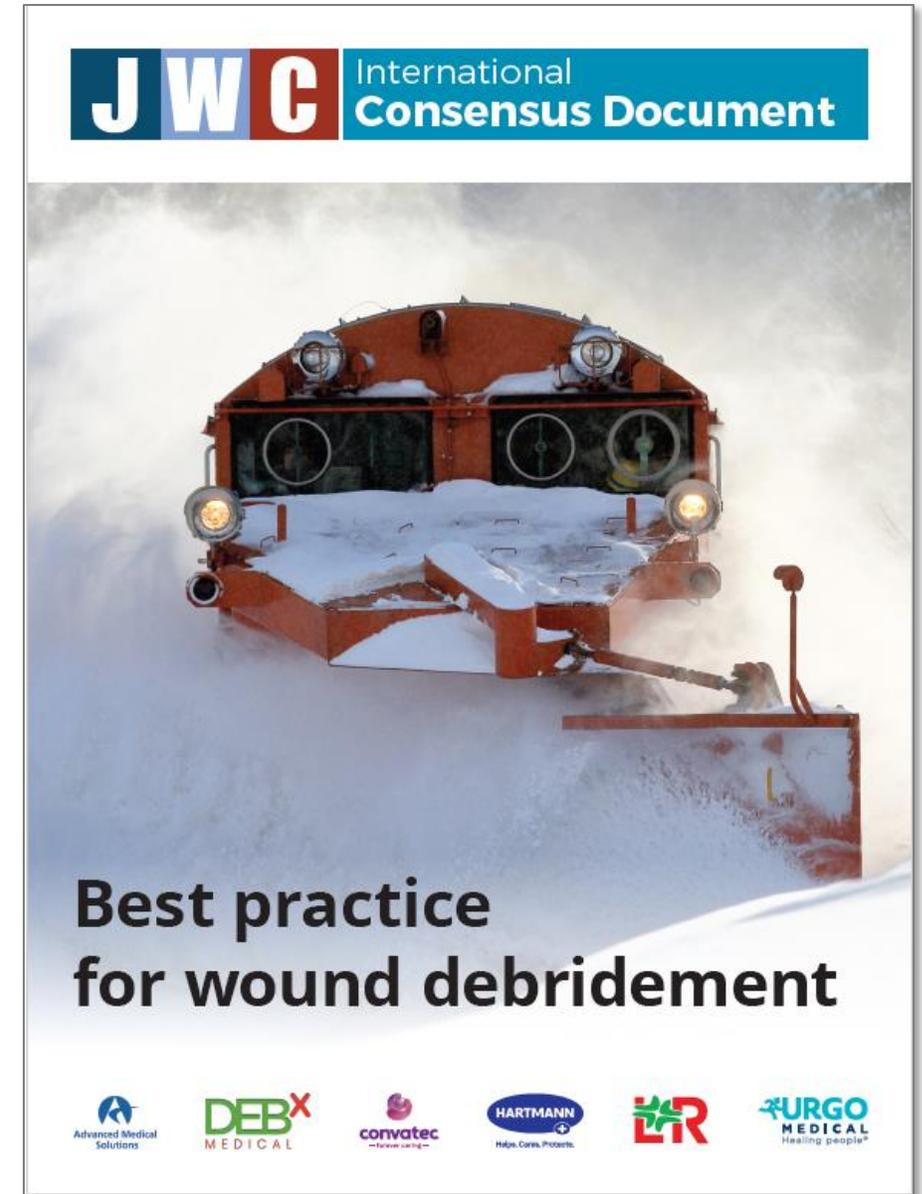


Integral Debridement

- Emphasizes the importance of **tailoring debridement methods to individual patient needs**, preferences and environments, local resources, skill levels of different caregivers/clinicians
- DIFFERENT CARE SETTINGS MAY REQUIRE DIFFERENT APPROACHES
- Health professional's level of training may limit their scope of practice
- CONSIDER clinical context and patient perspectives when selecting the appropriate debridement method
- **Ensures that debridement care is not only effective, but also aligned with the unique needs and goals of each patient**

Recently Published Data

- Dieter Mayer, et al. *Journal of Wound Care*
- HOCl can be used to **assist (amplify)** various standalone debridement methods, such as mechanical debridement, selective sharp/surgical debridement, and technical methods, including NPWTi-d with ROCF
- It has properties that enable the removal of germs and debris in a way that differentiates it from saline
- **SYNERGISTIC technology** with other forms of debridement



JWC International Consensus Document

Best practice for wound debridement

Advanced Medical Solutions | DEBx MEDICAL | convatec | HARTMANN | LIR | URGO MEDICAL

ROCF = reticulated open cell foam.

Mayer DO, et al. *J Wound Care*. 2024;33(Sup6b):S1-S32. *J Wound Care*. 2024;33(6):SUP C. Accessed March 11, 2025. <https://www.journalofwoundcare.com/docs/debridementConsensus.pdf>

HOCl: Assister/Amplifier of Debridement

- Mechanical disruption of devitalized tissue and microbes during irrigation or in conjunction with mechanical debridement

Table 3. Summary of assisters (amplifiers) of various debridement methods

Method	Examples	Mechanism of action	Key indications	WBP	Referral
Hypochlorous acid	Stabilised solutions or gels	Mechanical disturbing of devitalised tissue and microbes during irrigation or in conjunction with mechanical debridement	Assists mechanical debridement in wounds with high bacterial burden	Needed	See note*
Sodium hypochlorite					

Note: *Refer in extensive, deep wounds, exposed tendon or bone, chronic venous insufficiency, clinical signs of deep or systemic infection, worsening wound or no progress after 2–4 weeks of treatment

Polling Question

Integral debridement is a method of debridement that _____.

- A. occurs in a delayed fashion
- B. always utilizes sharp instruments
- C. is tailored to the patient's individual needs
- D. uses cautery

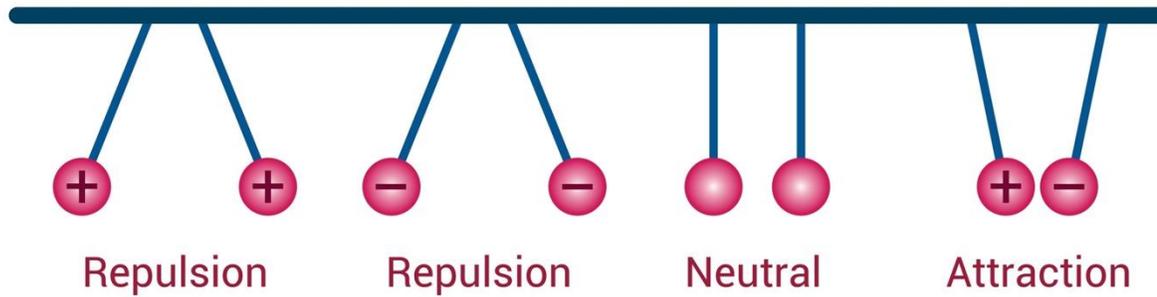
Wounds with Slough

- Novel absorbent fiber dressing with TLC-Ag matrix (lipido-colloid technology with silver salts)
- Provides combined antimicrobial and complete cleaning action to fight against local infection
 - Steric exclusion
 - Hydrophobic interactions
 - Hydrogen bonds
 - Electrostatic interactions



Highly-Charged Fiber Dressing

Laws of attraction and repulsion



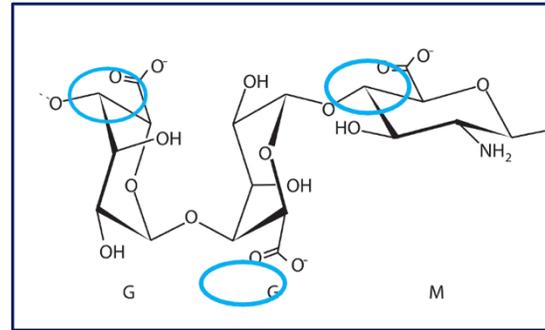
Works via
electrostatic
interactions



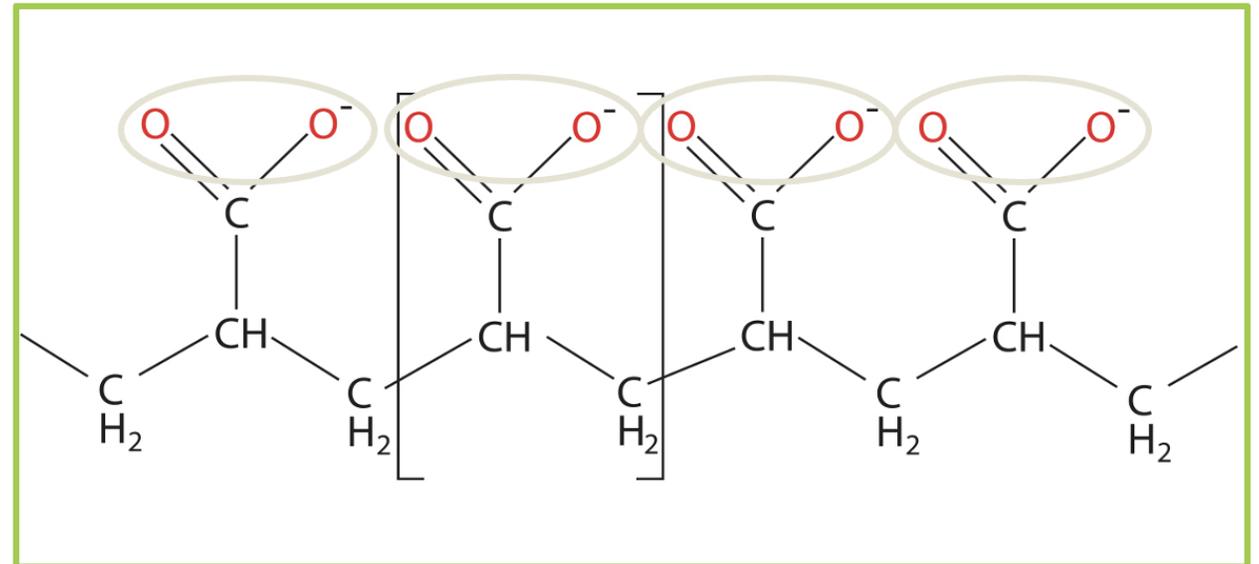
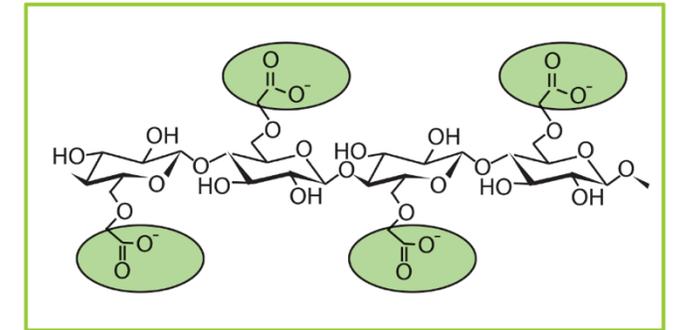
Many Absorbent Dressings Have Negative Charges

- Novel highly-charged fiber dressing has negative charges closer together/densely packed
- More negative charges per square inch of dressing

Alginates

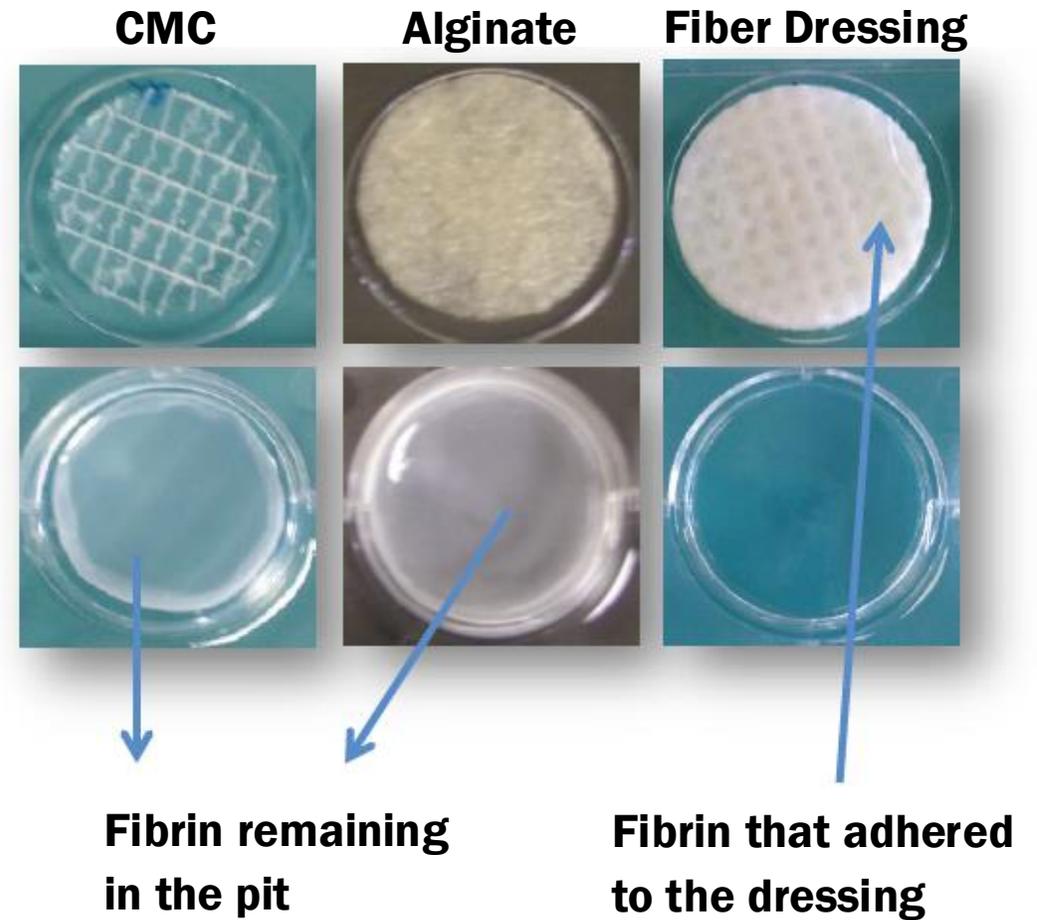


CMC Gelling Fiber

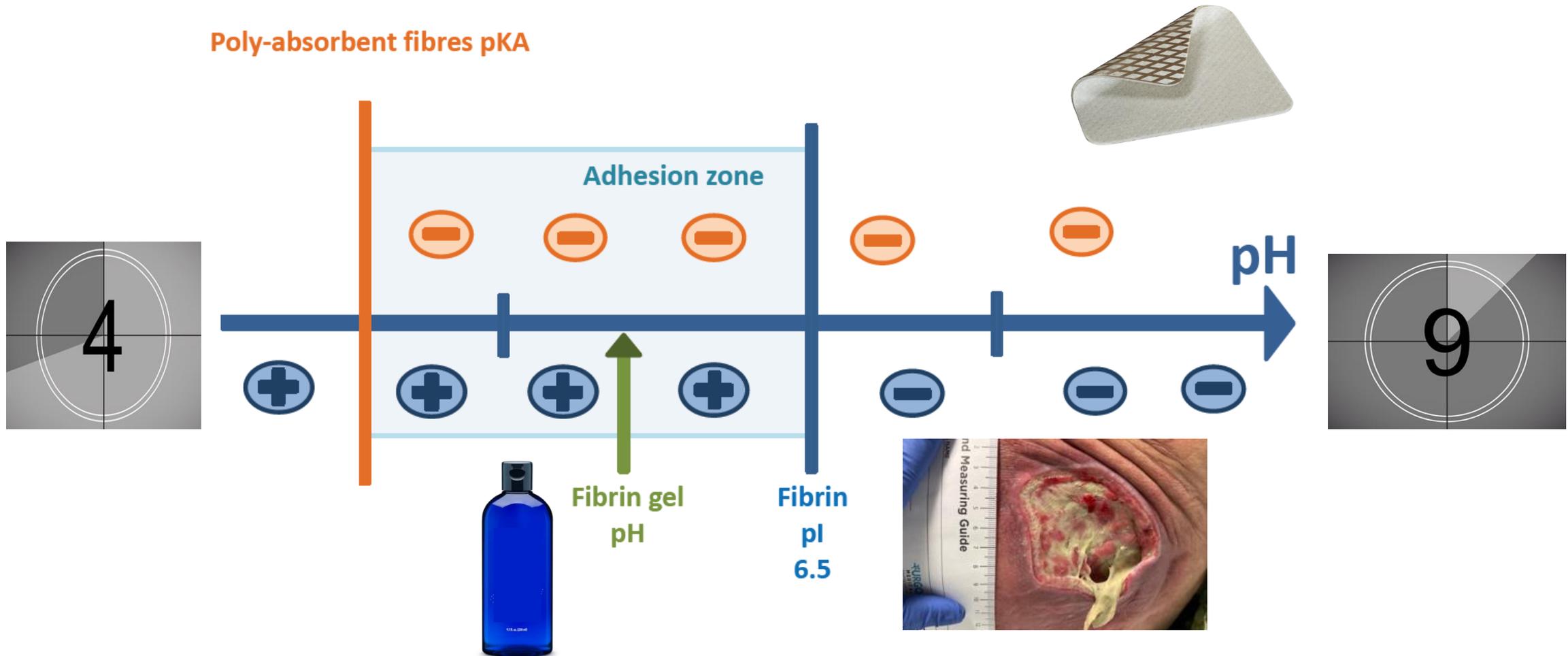


Fibrin Attraction

- Positively charged fibrin gel in petri dish
- Charged fiber technology



Synergy Between HOCl and Negative Fibers



Case Studies

Total Knee Arthroplasty (TKA) Dehiscence Wound

- 70y Female
- DM, peripheral arterial disease (PAD)
- Right TKA performed 6 wks prior
- Early initiation of PT for ROM
- Superficial wound dehiscence
- Threatens prosthetic joint
- Plan operative excision and local flap reconstruction



TKA Dehiscence Wound

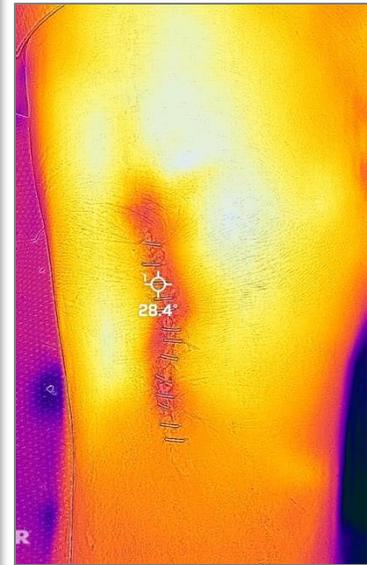
- Day 6
- Novel dressing changed 3 times
- pHA soaks
- **0% reduction in slough**

- Able to start in operating room with a much cleaner operative wound
 - Decreased slough = Decreased wound colonization



TKA Dehiscence Wound

- OR
- Excision of wound
- Irrigation with **pHA**
- Local tissue advancement closure
- Good perfusion of tissue
- Incisional NPWT (iNPWT)/knee immobilizer



TKA Dehiscence Wound

- POD 8
- Incision intact with 4mm superficial open area superiorly
- Reapply novel dressing
- Change q2 days by home health
- No signs of infection
- Continue knee immobilizer



TKA Dehiscence Wound

- Healed at 2 wks



Pyoderma Wound

- 68y Female
- Dermatology biopsied proven pyoderma gangrenosum to LLE
- Adherent slough
- Concern to avoid sharp debridement to not risk pathergy

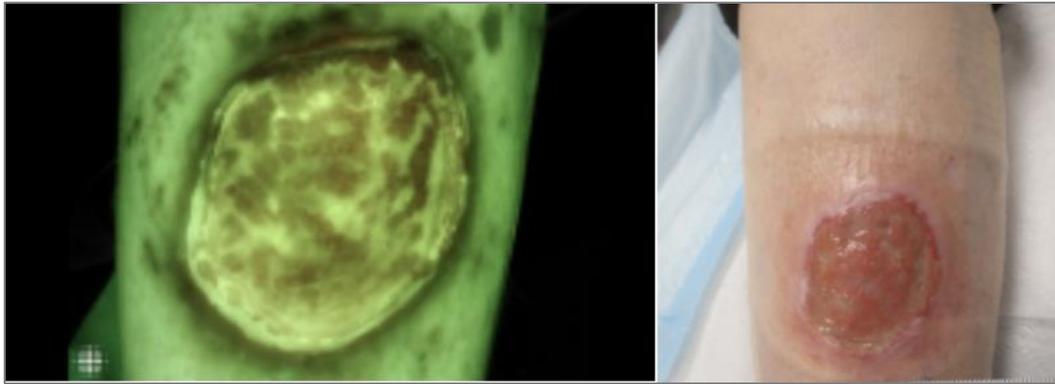


Synergistic Debridement

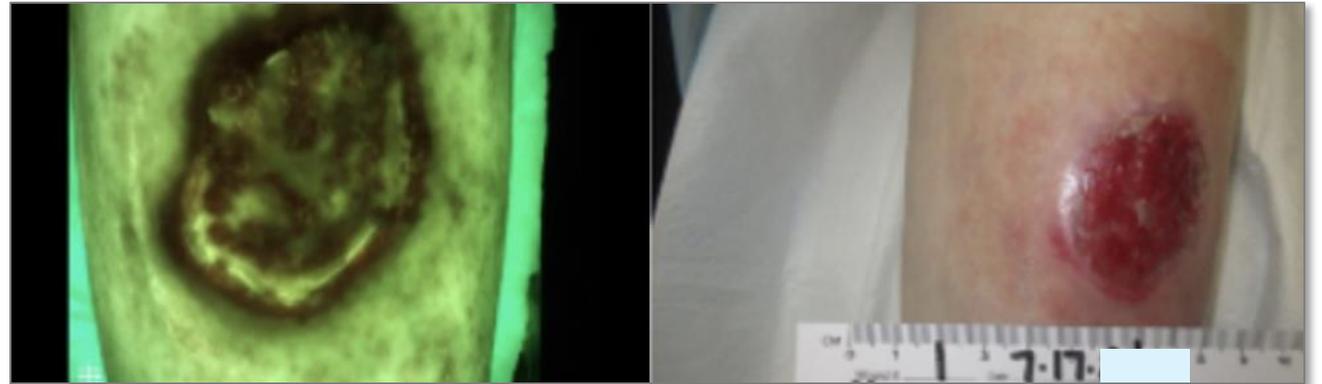
- pHA soaks
- Highly-charged fiber dressing



Reduction in Bacterial Fluorescence



4 wks



7 wks

5 Months: Healed



Infected Calciphylaxis

- 71y Female
- End stage renal disease (ESRD) and spontaneous calciphylaxis



> **SURGICAL CULTURE** Final
Organism 1
QUANTITATION

| ESCHERICHIA COLI
| MODERATE

ANAEROBIC CULTURE Final
Organism 1
QUANTITATION

| BACTEROIDES FRAGILIS
| MODERATE



Infected Calciophylaxis



Infected Calciphylaxis: Staged STSG



Infected Calciphylaxis



Venous Gangrene

- 62y Female
- Morbid obesity: BMI 62
- Diabetes mellitus (DM)
 - HgA1c = 12
- Venous gangrene to LLE



Venous Gangrene

- Wound = 1800cm²



Venous Gangrene

- NPWTi with pHA cleanser
 - Adequate excisional debridement
 - Duo port
 - Fill port proximal/high
 - Suction port distal/low
 - Start on suction before instillation



Venous Gangrene

- Transfer to LTACH 1 month
- Continue NPWTi with pHA cleanser
- IV antibiotics per ID
- 5-layer compression
- Wound now 662cm²
- **STSG 662cm²**
- NPWT/5-layer compression wrap



Venous Gangrene



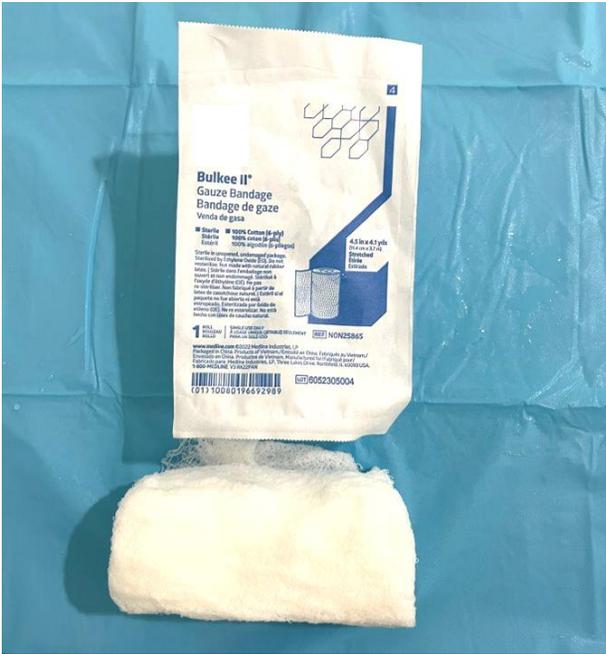
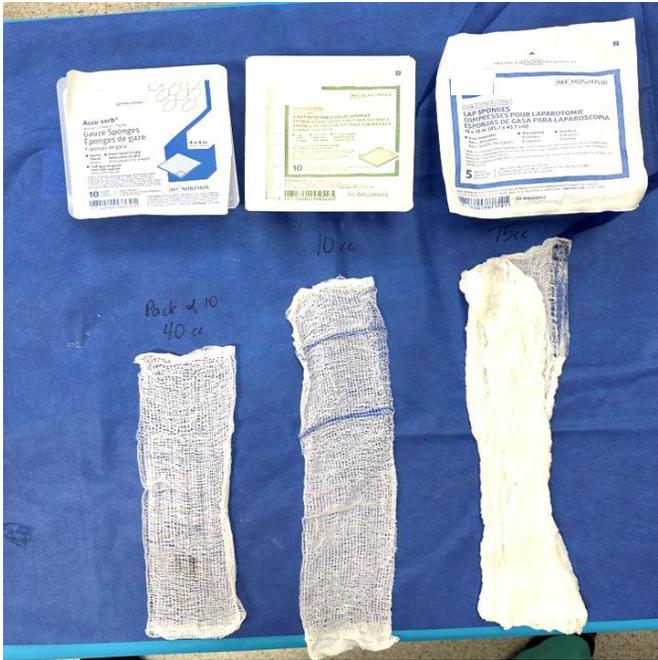
Groin Abscess Wound

- 62y Female
- Diabetes
- Heavy smoker
- **Spontaneous necrotic abscess** at right groin
- Presented to ED
- Thin coverage over pulsatile femoral artery



Groin Abscess Wound

	OR Xray Gauze (1)	OR 4x4 Gauze (10)	OR Lap Sponges (1)	Rolled Gauze Bandage (1)
Amount of <u>pHA</u> to saturate	10cc	40cc	75cc	124cc
Cost	\$0.63	\$2.52	\$4.75	\$7.81

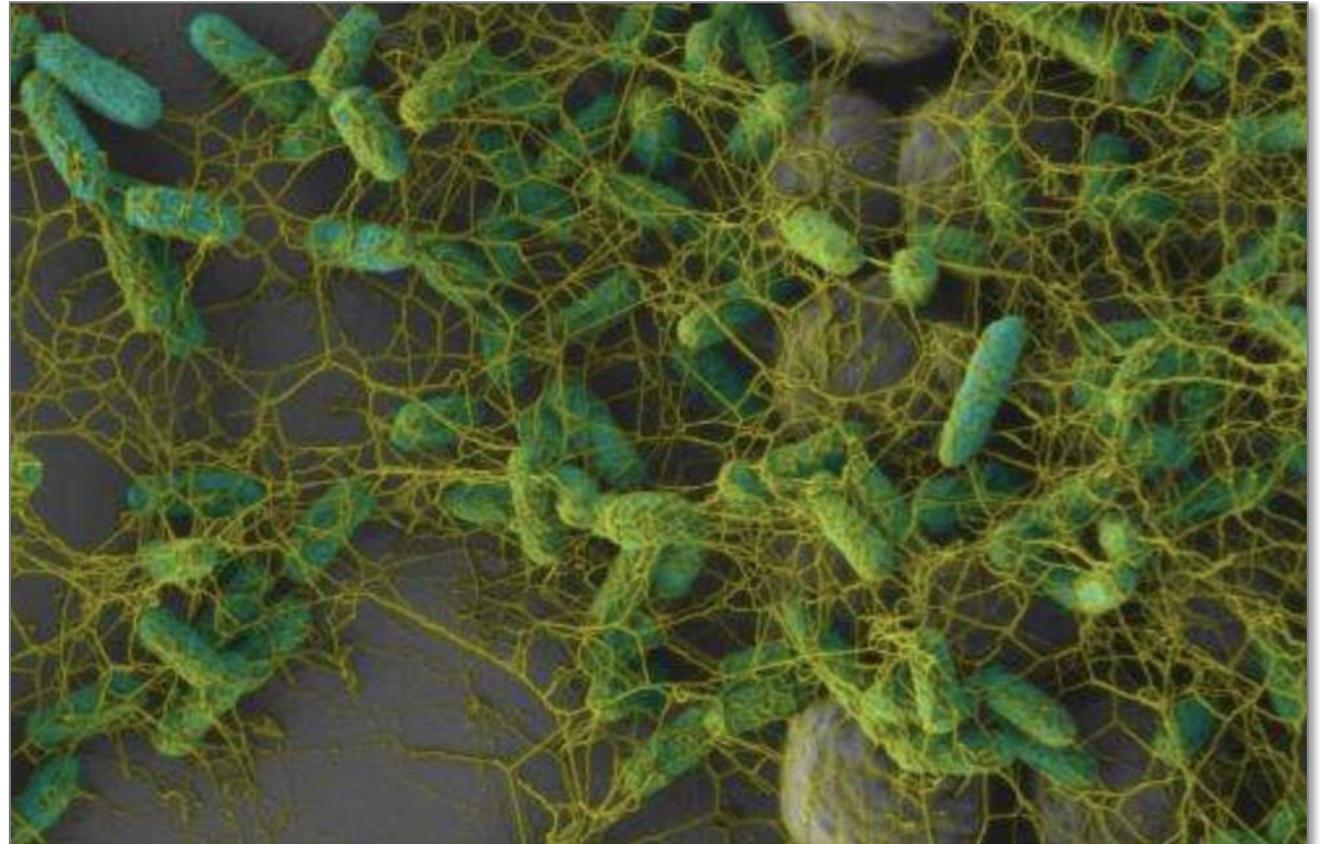


Groin Abscess Wound



Groin Abscess Wound

- OR Cultures
 - *Bacteroides fragilis*
 - Methicillin-resistant *Staphylococcus aureus*
 - *Enterococcus faecalis*
 - *Morganella morganii*
 - *Escherichia co*



Abscess Wound

2 wks post-op



3 months post-op



Thank you!

Please submit your questions via the question box