YOU HAVE THE POWER TO
DISRUPT AND DESTROY BIOFILM
TO ADVANCE HEALING
Chronic wounds are a battle worth fighting

Estimated to affect 1% of the general population in the developed world, chronic wounds are expected to increase due to ageing populations and obesity.

- **£7,600 and £7,800**
  - The estimated respective mean NHS costs per annum to manage a venous leg ulcer and a diabetic foot ulcer. For those unhealed wounds, these estimates increase to £13,500 and £8,800 respectively (rising to £16,900 for diabetic foot amputations).

- **Antibiotic overuse**
  - High rates of antibiotic prescribing (60%-75%) are reported in patients with chronic, non-healing wounds, and there are concerns regarding overuse.

- **Cost of infected wounds**
  - The cost per patient of a diabetic foot ulcer was 4x higher in those that were infected, with costs largely attributed to antibiotics, amputations and hospitalisation.

BIOFILM IS PRESENT IN AT LEAST 78% OF CHRONIC WOUNDS

75% OF NON-HEALING WOUNDS HAD CONFIRMED BIOFILM

Biofilm is an enemy worth targeting

In the battle to heal chronic wounds, there is an invisible enemy. Biofilm is a primary cause of chronic infection, blocking the effective action of antibiotic and antiseptic agents.

- **Biofilm is everywhere**
  - In healthcare, biofilm accounts for more than 80% of all microbial infections. In nature, 99% of bacteria exist in biofilm.

- **Difficult to eradicate**
  - Biofilm is difficult to completely remove, even with debridement. It reforms quickly and is a precursor to infection. It is tolerant to antiseptics and antibiotics and able to evade the body's immune response.

- **Delays wound healing**
  - Biofilm creates a sustained but ineffective inflammatory response. It also impairs granulation, tissue formation and epithelialisation.

A real-life evaluation of stalled wounds confirmed the meta-analysis results of biofilm prevalence:

- 16 stalled wounds were selected where a primary cause of non-healing was attributed to the presence of biofilm.
- Biopsy and subsequent microscopic analysis confirmed the presence of biofilm in 75% of the wounds.
Know your enemy

Biofilm can be defined as microbial cells adherent to a living or non-living surface, which are embedded within a self-produced matrix of extra-cellular polymeric substances (EPS). Biofilm provides tolerance to antimicrobial agents and can result in persistent inflammation and infection.\textsuperscript{20, 21}

How biofilm operates within the wound

EPS shields micro-organisms from antibiotics, antiseptics and the host’s immune response.\textsuperscript{22}

This biofilm-specific defence and the inability to breach the EPS matrix contributes to a chronic inflammatory state in the wound environment.\textsuperscript{21}

Extra-cellular polymeric substance (EPS)
This is the self-produced protective matrix that surrounds bacteria. Largely water, plus sugars, proteins, glycolipids and bacterial DNA, it is one of the defence mechanisms of mature biofilm.\textsuperscript{21}

DEFENCE MODE
EPS shields micro-organisms from antibiotics, antiseptics and the host’s immune response.\textsuperscript{22}

This biofilm-specific defence and the inability to breach the EPS matrix contributes to a chronic inflammatory state in the wound environment.\textsuperscript{21}

RECOVERY MODE
Biofilm is difficult to remove completely as it is attached to the wound bed. Biofilm can reform in as little as 24h, even following aggressive debridement.\textsuperscript{16}

To prevent biofilm reformation, effective long-lasting antimicrobial protection is needed.\textsuperscript{16}

ATTACK MODE
Biofilm can spread and form new colonies by constantly releasing micro-organisms from the mature biofilm structure.\textsuperscript{22}

This can increase the risk of cross-infection both within the wound and in the surrounding environment.\textsuperscript{23}
MORE THAN SILVER™

Disrupt and destroy biofilm with our breakthrough technology

Specifically developed to win the battle against biofilm, MORE THAN SILVER™ technology contains three components; ionic silver together with a surfactant and metal chelating agent, which work together to deliver superior* anti-biofilm performance.

In their 2014 guidelines on the diagnosis and management of biofilm infections, the European Society for Clinical Microbiology and Infectious Diseases recognised biofilm as a principle cause of chronic wound infection. Additionally the society expressed an urgent need for research to improve prevention and treatment of biofilm infections, including research into chelator agents and their ability to make the biofilm more amenable to management.

The result of years of research
Developing MORE THAN SILVER™ technology involved researching a wide range of biofilm-disrupting agents and surfactants in combination with antimicrobials.*

250,000 POTENTIAL COMBINATIONS WERE IDENTIFIED
60,000 WERE TESTED

United in the battle against biofilm

Biofilm is more likely to develop if exudate management is poor. Hydrofiber® technology works together with MORE THAN SILVER™ technology to absorb and remove wound exudate and disrupted EPS and bacteria, helping to manage wound moisture and support healing.*

* When compared to AQUACEL® Ag+ Extra™ dressing and other silver-only competitor dressings: ACTICOAT™ 7 and SILVERCEL™ Non-Adherent dressings.
1. BEC: A SURFACTANT

A broad-spectrum antimicrobial, BEC is a safe, broad-spectrum antimicrobial that is only effective in its ionic form. Attracted to sites on bacterial cell walls, it accumulates and then enters the cell, where it damages the DNA, denatures proteins and enzymes, and interferes with protein synthesis. The cell wall becomes porous and the contents leak out, leading to cell death. 33,34

2. EDTA: METAL CHELATING AGENT

Chelating agents are compounds that strongly attract and bind certain metal ions, boosting the action of surfactants and certain metal ions. EDTA helps disrupt biofilm by removing metal ions that hold the biofilm together, enhancing the effects of the ionic silver. 33,34

3. IONIC SILVER

A broad-spectrum antimicrobial, silver is only effective in its ionic form. Attracted to sites on bacterial cell walls, it accumulates and then enters the cell, where it damages the DNA, denatures proteins and enzymes, and interferes with protein synthesis. The cell wall becomes porous and the contents leak out, leading to cell death. 33,34

MORE THAN SILVER™ technology incorporates BEC (Benzethonium chloride) and EDTA (ethylenediaminetetraacetic acid disodium salt). BEC and EDTA synergistically work together to disrupt biofilm, enhance the ability of EDTA to remove metal ions, and expose biofilm to the antimicrobial effects of the ionic silver. 28-32
Winning the battle to **disrupt, destroy** and prevent reformation of **biofilm**

MORE THAN SILVER™ technology in AQUACEL® Ag+ dressings enables superior and sustained anti-biofilm activity against antibiotic-resistant biofilm and prevents reformation of biofilm

**Test**
Community-acquired Methicillin-Resistant Staphylococcus aureus (CA-MRSA) *in vitro* wound biofilm model.35

**Objective**
To establish the antimicrobial activity of AQUACEL® Ag+ Extra™ and other silver-based dressings against antibiotic-resistant micro-organisms in terms of:
- Ability to disrupt the biofilm and kill the micro-organisms.
- Prevent biofilm re-growth following re-inoculation.

**Results**
AQUACEL® Ag+ Extra™ demonstrated:
- Faster kill-rate against CA-MRSA.
- Reduced biofilm levels within 6 hours of dressing application.
- Sustained activity after re-inoculation at day 5 to prevent biofilm regrowth.

MORE THAN SILVER™ technology in AQUACEL® Ag+ dressings delivers superior anti-biofilm activity compared to other silver dressings

**Test**
To mimic wound conditions, a challenging, multi-species *in vitro* biofilm model was developed based on an UKAS-accredited CDC (Centres for Disease Control and Prevention) reactor model. The CDC reactor was incubated for 72 hours using a suspension containing Staphylococcus aureus, Pseudomonas aeruginosa and Candida albicans. Dressings were applied for 24 hours.36

**Objective**
To compare the anti-biofilm activity of AQUACEL® Ag+ Extra™ dressing with a range of silver-only gelling fibre dressings.

**Results**
Only AQUACEL® Ag+ Extra™ dressing reduced viable micro-organisms to undetectable levels after 24 hours of exposure.

Quantity of total viable micro-organisms recovered following 24-hour dressing exposure to a 72-hour pre-formed multi-species biofilm.

Dressing: **A** = AQUACEL® Ag+ Extra™, **B** = UrgoClean™ Ag, **C** = Exufiber™ Ag+ **D** = Kerracel™ Ag
Winning the battle to *advance healing*

AQUACEL® Ag+ dressings advance healing in stalled, deteriorating chronic wounds

**Test**
111 patients, with challenging and stalled wounds from 60 centres across the UK and Ireland.

**Objective**
To demonstrate the ability of AQUACEL® Ag+ dressings to promote healing in chronic wounds that were stalled or deteriorating at baseline.

**Results**

- 78% of wounds progressed towards healing, 13% healed completely during an average evaluation period of 3.9 weeks.
- 83% of the wounds progressed in key wound healing parameters (exudate, suspected biofilm and wound healing status).
- Biofilm was suspected more frequently (54%) than any other clinical sign of infection at baseline. This reduced to 27% at the final evaluation.

Wound status at baseline (light blue) and after evaluation (dark blue).

**Case studies: Advancing healing in chronic wounds**

**Example 1 - the wound:**
Diabetic foot ulcer (6+ months) with the following clinical signs: Odour, exudate, slough, suspected biofilm.

**Results**
AQUACEL® Ag+ dressings: peri-wound skin improved, wound bed improved, healed in 5 weeks.

**Example 2 - the wound:**
Stalled foot ulcer (3 months) with the following clinical signs: antibiotics, and standard silver dressing had failed.

**Results**
AQUACEL® Ag+ dressings: change from sloughy to granulation tissue. Ulcer healed in less than 7 weeks.

Images kindly provided by Vitor Santos, Centro de Tratamento de Feridas São Peregrino – Med Caldas.
Don't delay: make biofilm your target with AQUACEL® Ag+dressings

**Why wait for a wound to get worse?**
If you're faced with delayed healing, it's time to target the enemy. With AQUACEL® Ag+ dressings, you have the power to disrupt and destroy biofilm to advance healing.

**Perfect allies**
AQUACEL® Ag+ dressings can be used on a wide range of acute and chronic wound types and partner perfectly with AQUACEL® Foam dressings.

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### AQUACEL® Ag+ Dressings

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**To learn more about AQUACEL® Ag+ or to arrange a visit from your ConvaTec representative, please call 0800 289 738 (UK) or 1800 946 938 (ROI)**

www.convatec.co.uk

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### AQUACEL® Foam

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