AQUACEL® Ag+ Extra™ Dressing made easy

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Introduction

AQUACEL® Ag+ Extra™ dressing is designed to address three key barriers to wound healing – exudate, infection and biofilm. Winners of the Most Innovative Dressing, World Union of Wound Healing Societies (WUWHS) Award, AQUACEL® Ag+ Extra™ dressing combines two technologies that work synergistically to combat these barriers:

- Hydrofiber® Technology absorbs and retains excess exudate to help create an ideal healing environment*[1-5]
- Ag+ Technology disrupts biofilm, kills infection-causing bacteria† and prevents biofilm reformation*[6-8].

This *Made Easy* outlines how these factors delay healing, with a summary of evidence demonstrating how AQUACEL Ag+ Extra dressing combats these barriers.

Why are some wounds static?

Given the complex nature of wound healing, wounds can become static for many reasons – related to the individual patient, their wound, various biophysical factors and healthcare professional knowledge[9].

Patient – Healing may be impaired by chronic illnesses, comorbidities and pathologies. Patients with vascular insufficiency, coronary artery disease or diabetes mellitus often exhibit poor wound healing. Patients receiving treatments that affect the immune system, blood clot formation or platelet function may have disturbed healing, while nutrition, alcohol consumption, age and body type can also affect healing[10,11].

Wound – Factors in the local wound environment can impact wound healing progress, such as wound size, depth and duration[12–14], presence of infection or biofilm[7], or necrosis, pressure, oedema and maceration. There is a need to balance moisture, remove devitalised tissue, reduce pressure ulcer risk and sustain blood flow to support healing[9].

Physiological – Static wounds are characterised by prolonged inflammation, which results in a hostile wound healing environment. This hostile environment is perpetuated in chronic wounds[11].

*as demonstrated in vitro; †including MRSA, VRE and EBSL bacteria

Professional knowledge – Healthcare professional knowledge, quality of assessment, ability to control a patient's symptoms and management of comorbidities all contribute to a patient achieving complete wound healing[14].

The costs of delayed wound healing

Some wounds do not heal in an orderly manner with standard therapy. Slow-healing, static or deteriorating wounds pose a high burden both to patients themselves and the healthcare systems that support these patients. This burden affects many facets of patients' wellbeing, as well as incurring substantial economic costs (Table 1)[9].

Table 1: Financial and patient challenges of static wounds[15,16]

Economic challenges	Patient challenges
Hospitalisation Inpatient stays or outpatient clinic visits	**Physical** Pain, impaired mobility, decreased functioning, poor nutrition or sleep
Specialist care or treatments Surgical procedures, e.g. amputation	**Mental** Depression, anxiety, low self–esteem
Healthcare professional time Dressing changes, community care visits	**Psychosocial** Social isolation, difficulty with social interaction
Materials and equipment Dressings, devices, medicines (i.e. antibiotics), disposables, orthotics	**Spiritual/cultural** Difficulty connecting with others
Assessment Diagnostic tools, laboratory testing	**Out-of-pocket/productivity** Travel costs, lost work time

Key barriers to wound healing

Table 2 outlines three key barriers that must be addressed in order to optimise wound management.

Table 2: Three key barriers to wound healing

Barrier	Details
Exudate	While a moist wound healing environment is necessary for wound healing, poorly managed exudate can delay wound healing, preventing cell proliferation, decreasing growth factor availability or damaging the host's extracellular matrix (ECM)[17].
Infection	It is inevitable that wounds will contain microorganisms, often with no detrimental effects. However, in some instances these microorganisms can multiply, invade and damage host tissues, delay healing and, eventually, cause systemic illness[18].
Biofilm	Biofilm is formed when microorganisms attach to a surface, or to each other, and secrete protective extracellular polymeric substances[19].

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What is biofilm?

Microorganisms are invariably found in wounds, with effects ranging from contamination with no negative outcomes to spreading or systemic infection. These microorganisms can be divided into two distinct behavioural forms[9]:

- **Single, planktonic cells**
- **Communities of microorganisms – known as biofilm.**

Planktonic microorganisms are solitary and free-floating. However, at least 78% of static, slow-healing or deteriorating wounds have been found to contain biofilm[20], which are aggregated communities of microorganisms that reside within self-secreted extracellular polymeric substances[9].

The role of biofilm in delayed wound healing

Biofilm is an increasingly important focus in wound care, because communities of biofilm[21]:

- Produce a chronic inflammatory response
- Are able to evade the host's defences
- Can often tolerate antibiotics/antiseptics and other antimicrobial agents (i.e. silver, iodine, PHMB).

The chronic inflammatory response is not always successful at removing the biofilm and often damages healing tissues. It is suggested that this inflammatory reaction actually increases exudate, so perpetuating the biofilm[22].

Management of wounds containing biofilm

Anti-biofilm wound management is challenging for a number of reasons (Figure 1):

- Identification of biofilms can be difficult. Currently only specialised microscopy can definitively detect biofilm[19] and clinicians are often limited to managing areas that show suggestive or secondary signs of biofilm[27]. The presence of biofilm may be recognised based on persistence of slough-like material, stalled healing, recurring infection, ineffectiveness of antibiotics, and increasing or excessive wound fluid[23,24]
- Standard clinical microbiology may not be able to fully characterise biofilm given its complex nature, making it difficult to utilise standard microbiological culture
- Most microorganisms in biofilm communities are metabolically down-regulated and so are often tolerant to standard antibiotics, antiseptics and other antimicrobial treatments[19]
- Biofilm can be difficult to completely remove with debridement and reforms quickly[25,26].

As such, an anti-biofilm approach should be utilised that:

- Reduces the amount of biofilm present, but also prevents its reformation
- Addresses factors that may be contributing to the chronicity of the wound, including wound infection and moisture imbalance
- Incorporates cleansing and/or debridement within the protocol of care
- Includes an appropriate antimicrobial dressing with anti-biofilm agents, such as AQUACEL Ag+ Extra dressing.

ASSESS

Evaluate both the patient and the wound:

- Carry out a holistic patient assessment (e.g. medication, comorbidities, lifestyle issues)
- Assess the wound:
  - Wound type and length of time wound has been present
  - Wound bed appearance (tissue type and percentage of: slough, necrosis, granulation, suspected biofilm)
  - Size (length, width, depth)
  - Exudate (colour, consistency, level)
  - Associated pain and/or odour
  - Periwound skin condition (swelling, discolouration, maceration)
  - Signs and symptoms of infection (pain, odour, heat, redness, swelling, purulence)

MANAGE

Cleanse and debride:

- Cleanse and debride the wound where necessary to remove barriers to healing (e.g. slough, necrosis, biofilm) – use a clinical algorithm for biofilm identification[27]
- Dress the wound:
  - Apply an appropriate dressing that can disrupt biofilm, kill bacteria and prevent biofilm reformation, while managing exudate and infection (e.g. AQUACEL Ag+ Extra dressing or AQUACEL Ag+ Ribbon dressing)[28]

MONITOR

Reassess and document the wound at each dressing change:

- If the wound remains infected or at risk of infection, continue to use a suitable dressing such as AQUACEL Ag+ Extra dressing or AQUACEL Ag+ Ribbon dressing covered with a secondary dressing, such as AQUACEL Foam dressing

Figure 1: Managing biofilm in slow-healing, static or deteriorating wounds: a 3-step protocol of care

An introduction to AQUACEL Ag+ Extra dressing

Winner of the WUWHS Most Innovative Dressing Award 2016 (Figure 2), AQUACEL Ag+ Extra dressing, contains two technologies that work together to manage key local barriers to wound healing: excess exudate, infection, and biofilm.

Figure 2: AQUACEL Ag+ Extra dressing for chronic wounds and acute wounds that are infected or at risk of infection

How does AQUACEL Ag+ Extra dressing work?

The synergistic effect of Ag+ Technology and Hydrofiber Technology is explained in Figure 3.

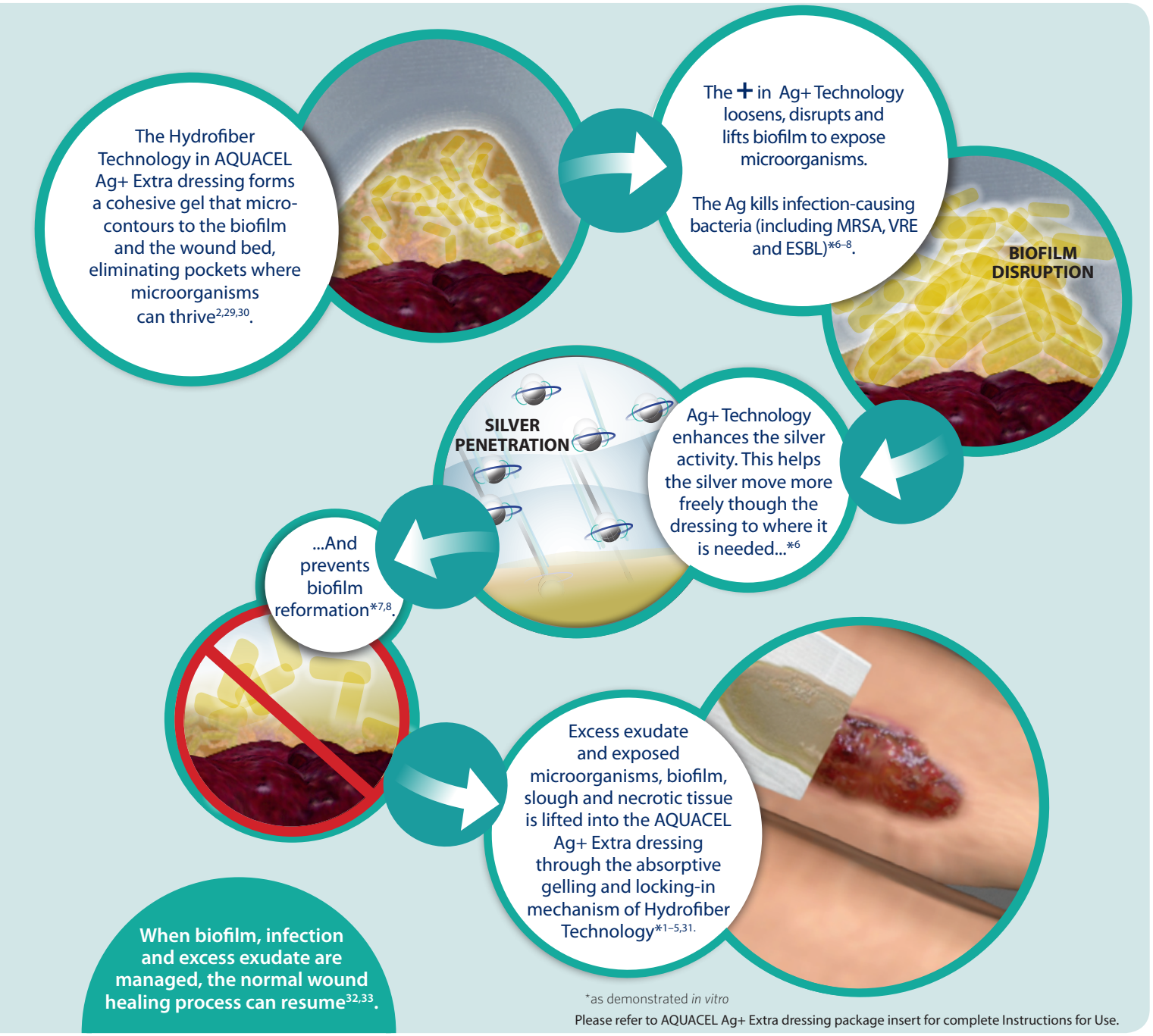
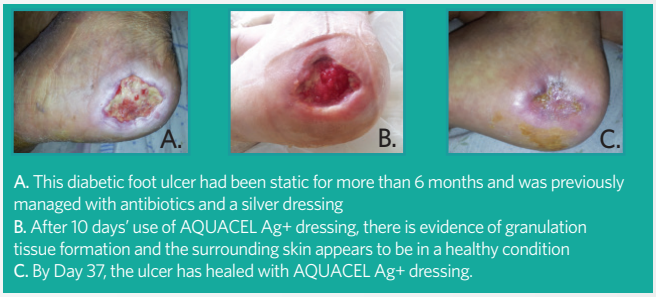


Figure 3: The unique mode of action of AQUACEL Ag+ Extra dressing

Evidence for AQUACEL Ag+ Extra dressing

A combination of two powerful technologies – Ag+ Technology and Hydrofiber Technology – has facilitated wound healing in a number of real-life clinical evaluations, clinical studies and *in vivo* studies (Table 3).

Figure 4 provides an example of a clinical case study using AQUACEL Ag+ dressing for a 6-month-old diabetic foot ulcer.



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A. This diabetic foot ulcer had been static for more than 6 months and was previously managed with antibiotics and a silver dressing
B. After 10 days' use of AQUACEL Ag+ dressing, there is evidence of granulation tissue formation and the surrounding skin appears to be in a healthy condition
C. By Day 37, the ulcer has healed with AQUACEL Ag+ dressing.

Figure 4: Example clinical case study[34]

Title	Background/patient information	Clinical outcomes
Clinical safety and effectiveness evaluation of a new antimicrobial wound dressing designed to manage exudate, infection and biofilm[31]	112 mixed wounds (111 patients) from 60 healthcare facilities (acute and community) across the UK. Silver dressings were the most frequently used dressings beforehand, while iodine, honey, PHMB-containing products and systemic antibiotics were also used. Local standard protocols of care were followed except for replacement of the current primary dressing with AQUACEL Ag+ Extra dressing	■ Median (mean) wound duration was 12 months (32 months) ■ Average management period of 3.9 weeks ■ 78% of wounds progressed to healing or went on to heal (65% improved, of which 13% healed)
Management of diabetic foot ulcers: evaluation of case studies[34]	Case series of 4 patients with diabetic foot ulcers with slow-healing, static or deteriorating wounds and additional comorbidities (see example in Figure 4). Local standard protocols of care were followed except for replacement of the current primary dressing with AQUACEL Ag+ dressing	■ Wounds progressed to healing in 28 and 37 days for 2 patients ■ A reduction in wound size and improvement in wound health was seen in the other 2 patients
A next-generation antimicrobial wound dressing: a real-life clinical evaluation[35]	29 static, deteriorating wounds (28 patients). Local standard protocols of care were followed except for the replacement of the current primary dressing with AQUACEL Ag+ Extra dressing	■ Median (mean) wound duration of 10 months (34 months) ■ 90% of wounds had reduced in size at final assessment ■ 34% of wounds healed completely after a mean management period of 5.4 weeks
Safety and performance evaluation of a next-generation antimicrobial dressing in patients with chronic venous leg ulcers[36]	42 patients with chronic venous leg ulcers with at-risk or infected wounds where biofilm was highly likely. Ten wounds were judged to be clinically infected (where biofilm was a likely factor)	■ At 8 weeks, 5 patients had healed ulcers (11.9%) and 32 patients showed improvement (76.2%) ■ Mean ulcer size reduction of 54.5%
A real-life clinical evaluation of a next-generation antimicrobial dressing on acute and chronic wounds[37]	113 cases of challenging, at-risk or infected wounds; 74% had suspected biofilm. Local standard protocols of care were followed except for the replacement of the current primary dressing with AQUACEL Ag+ dressing	■ Average management period of 4.1 weeks ■ 95% of wounds either healed or improved ■ 17% wounds healed ■ Average wound area reduction of 73%
AQUACEL™ Ag+ dressings: In Practice. In: Next-generation antimicrobial dressings: AQUACEL™ Ag+ Extra™ and Ribbon[38]	17 patients with 18 mixed wounds	■ Management period was 4 weeks ■ Average wound area reduction of 66% ■ Improved healing in 17 of 18 wounds
Impact of a novel, antimicrobial wound dressing on *in vivo, Pseudomonas aeruginosa* wound biofilm: quantitative comparative analysis using a rabbit ear model[39]	Rabbit ear model; n=6-7	■ 99% greater reduction in *Pseudomonas aeruginosa* biofilm after 4 and 6 days compared with PHMB gauze dressings and AQUACEL dressings ($p<0.05$) ■ Reduction in biofilm with significantly improved granulation tissue formation and epithelialisation ($p<0.05$)

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Summary

While there are a number of barriers to wound healing, addressing exudate, infection and biofilm is particularly important when managing slow-healing, static or deteriorating wounds. These barriers combine to increase the chronicity of a wound and must be tackled with innovative technologies that manage the microbial load and ensure an optimum moist wound healing environment.

By combining the clinical heritage and unique properties of Hydrofiber Technology with Ag+ Technology, AQUACEL Ag+ Extra dressing works to manage exudate and reduce the risk of wound infection; the dressing disrupts and kills biofilm, helping host defences to regain control, thereby preventing biofilm reformation. The unique design concept of AQUACEL Ag+ Extra dressing is WUWHS-award-winning and supported by clinical evidence.