Regional Wounds Victoria

# Is this chronic wound infected?

## …and what to do about it

RWV receives funding from the CHSP and the HACC PYP.
e CHSP is funded by the Australian Government Department of Health. The HACC PYP is funded by the Victorian

# Acute Vs Chronic Wound

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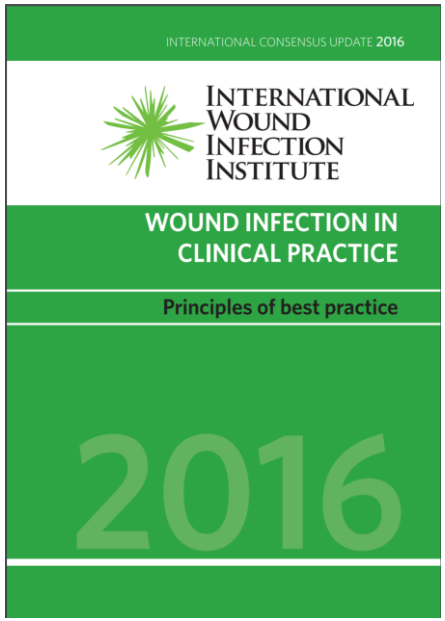


- Acute wound:
  - a wound with an aetiology that occurs suddenly, either with or without intention, but then heals in a timely manner.
- Chronic wound:
  - a wound that has a slow progression through the healing phases, or shows delayed, interrupted or stalled healing due to intrinsic and extrinsic factors that impact on the individual and their wound. A chronic, non-healing wound could be suggestive of a biofilm, providing holistic evaluation has excluded or corrected underlying pathologies such as ischaemia.
  - https://www.woundinfection-institute.com/wp-content/uploads/2017/03/IWII-Wound-infection-in-clinical-practice.pdf

# Hard-to-Heal Wound

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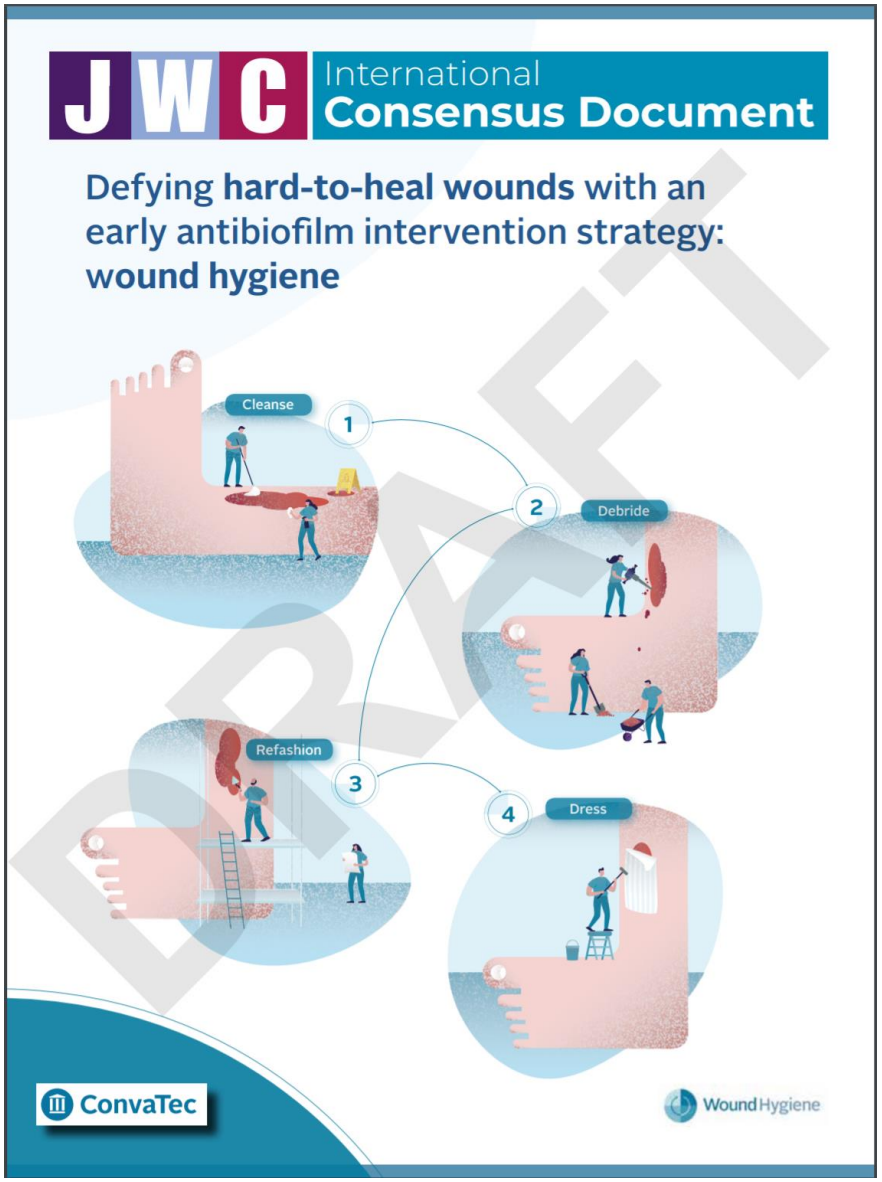
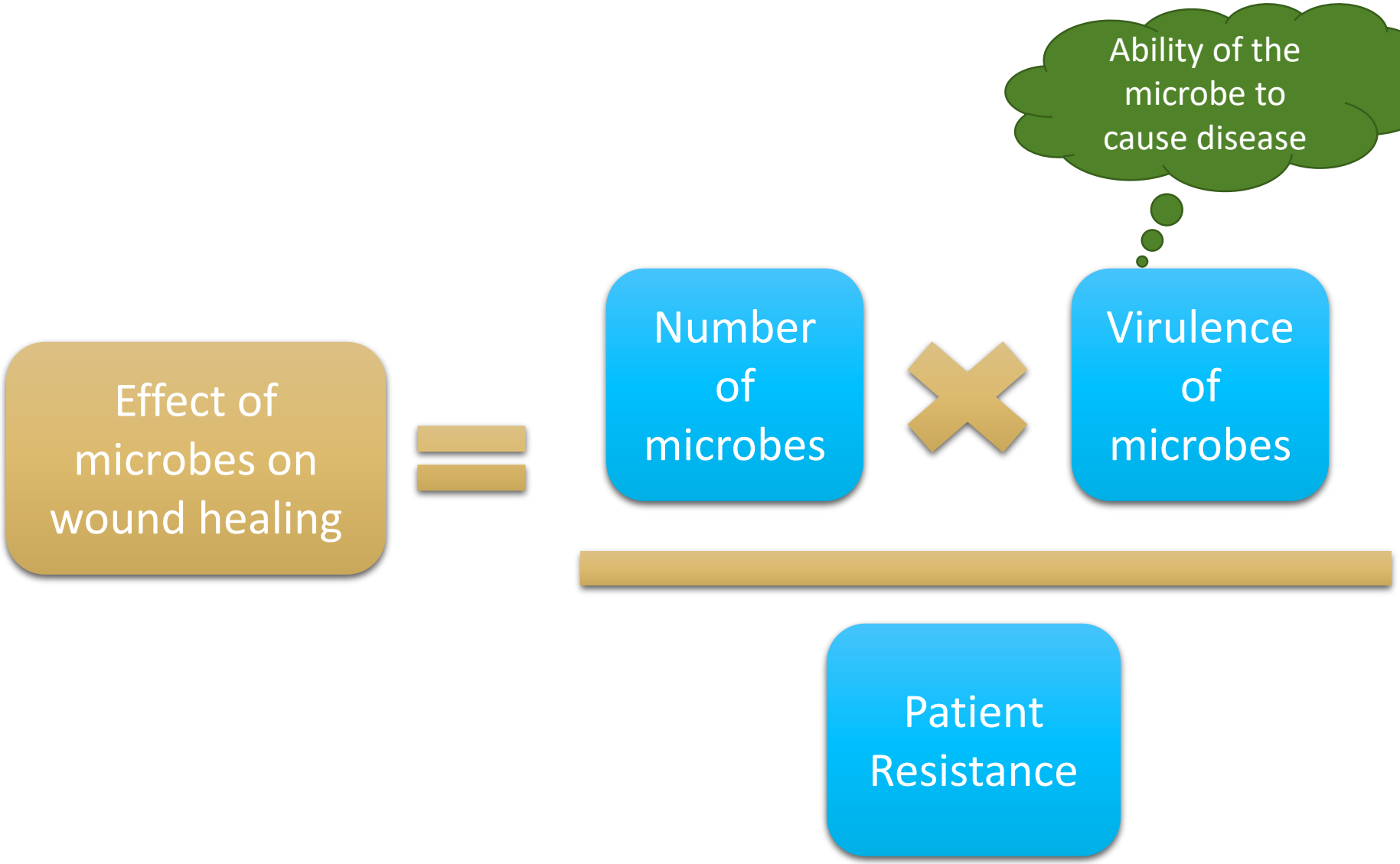



- A wound that has failed to respond to evidence-based standard of care.
- The concept of wound hygiene is based on the premise that all hard-to-heal wounds contain biofilm.
- Because of the speed with which wound biofilm forms, a wound that exhibits exudate, slough and an increase in size by the third day of its occurrence may already be defined as hard-to-heal.
- http://woundhygiene.com/media/arofxqpv/jwc_convatec_wound-hygiene-28pp-consensus-print.pdf


Ability of the microbe to cause disease
Effect of microbes on wound healing
=
Number of microbes
×
Virulence of microbes
Patient Resistance

# Healthy Wound

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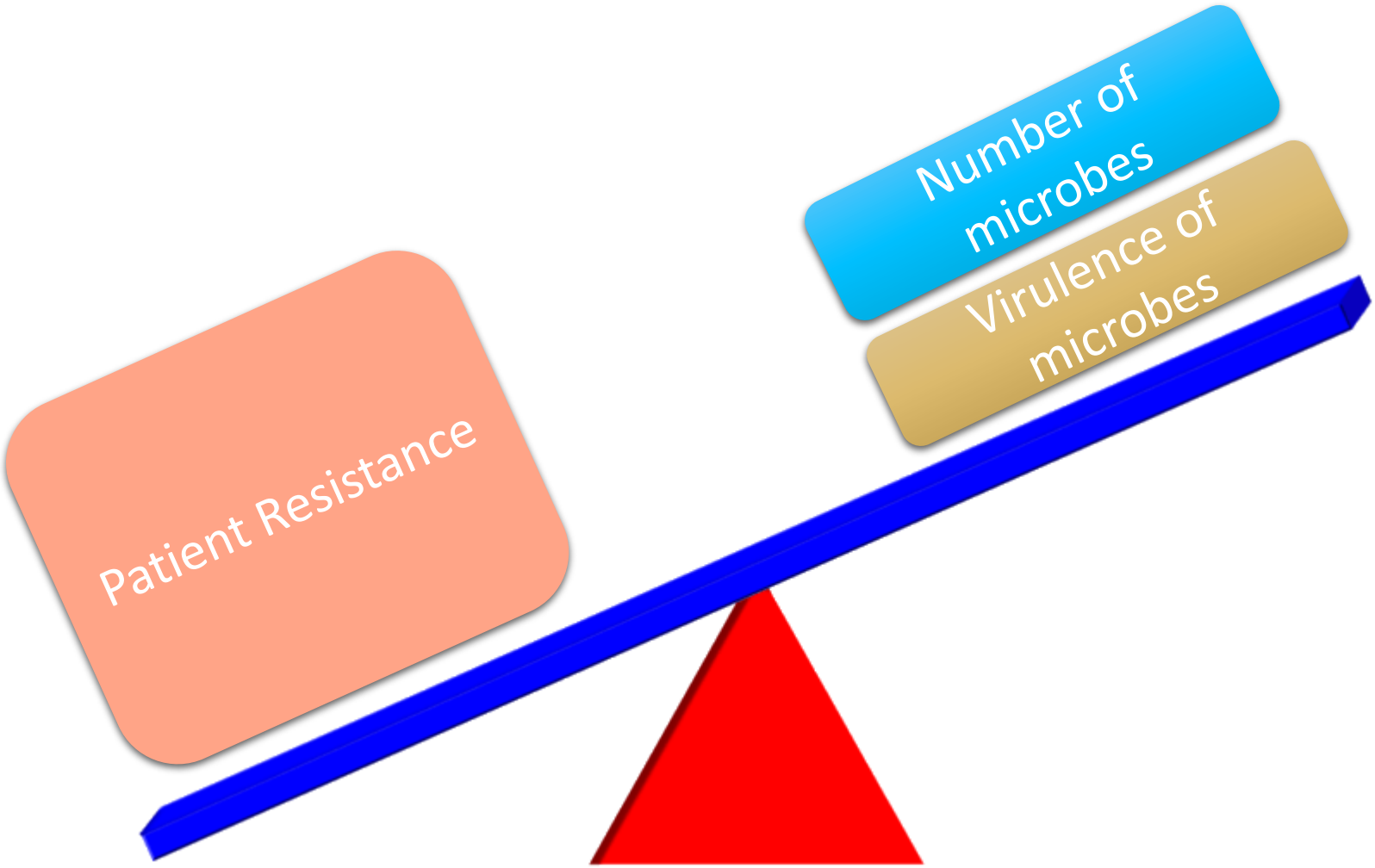
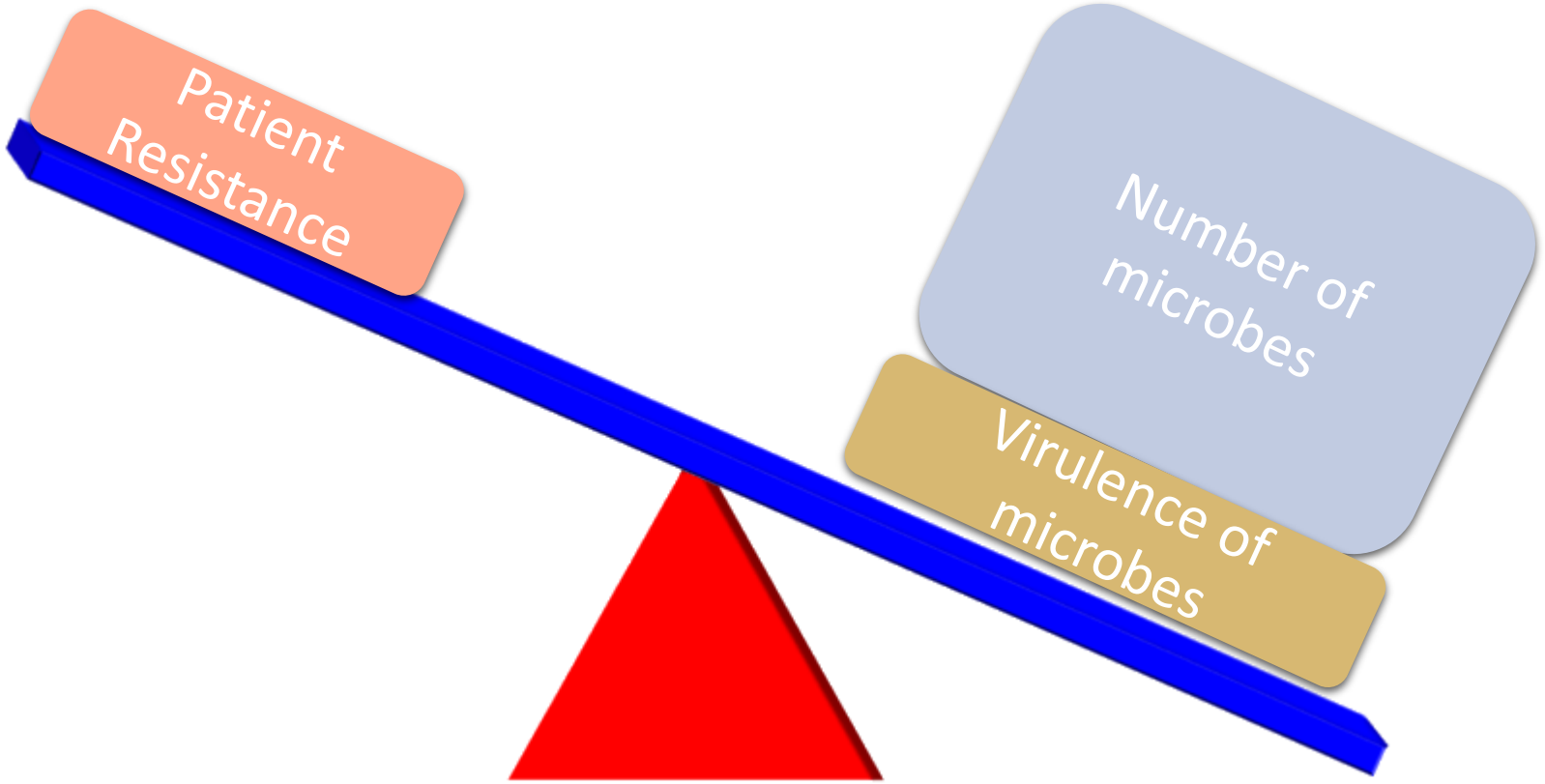


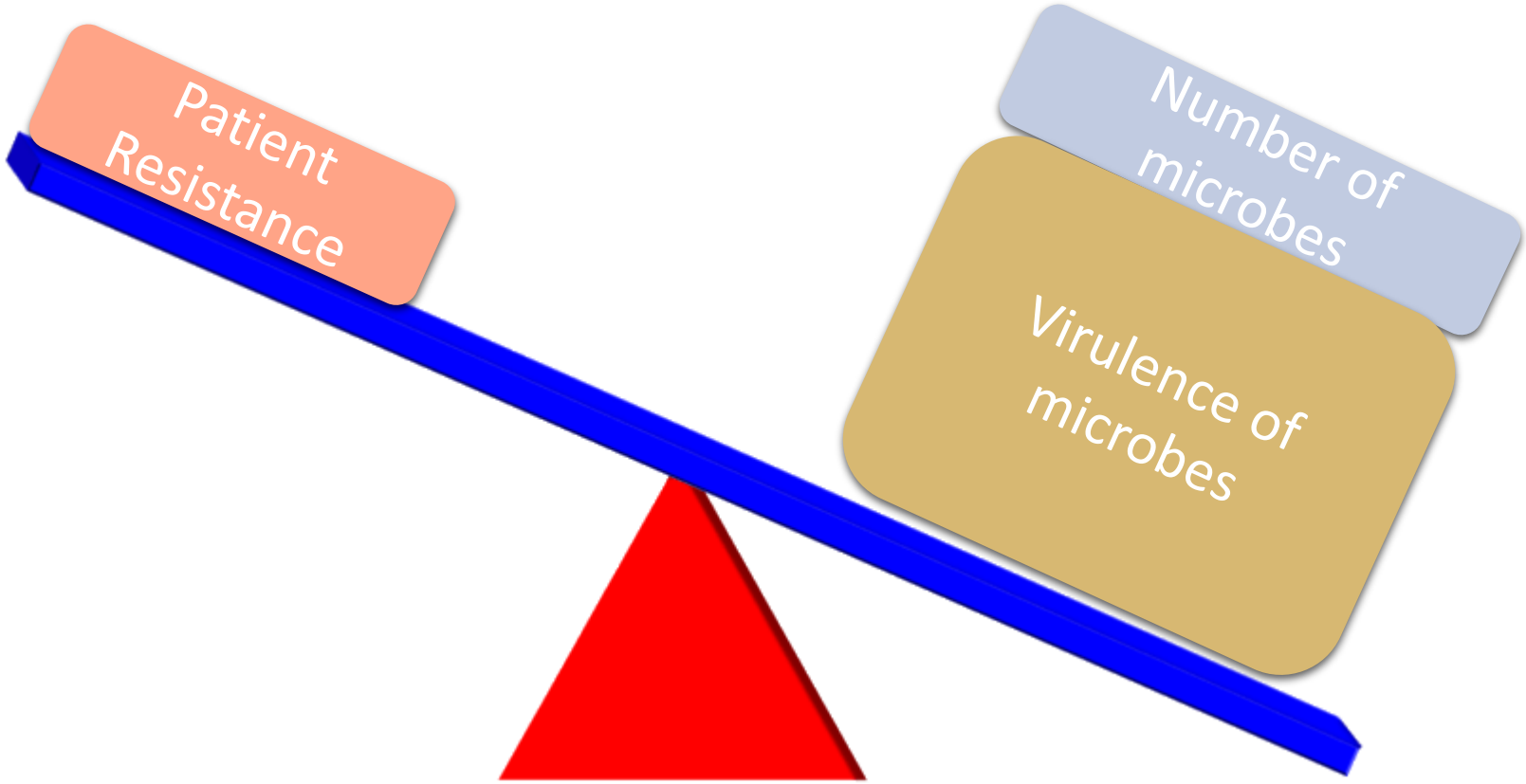
# Infected Wound

Regional Wounds Victoria



# Infected Wound

Regional Wounds Victoria



# Microbial Balance Continuum

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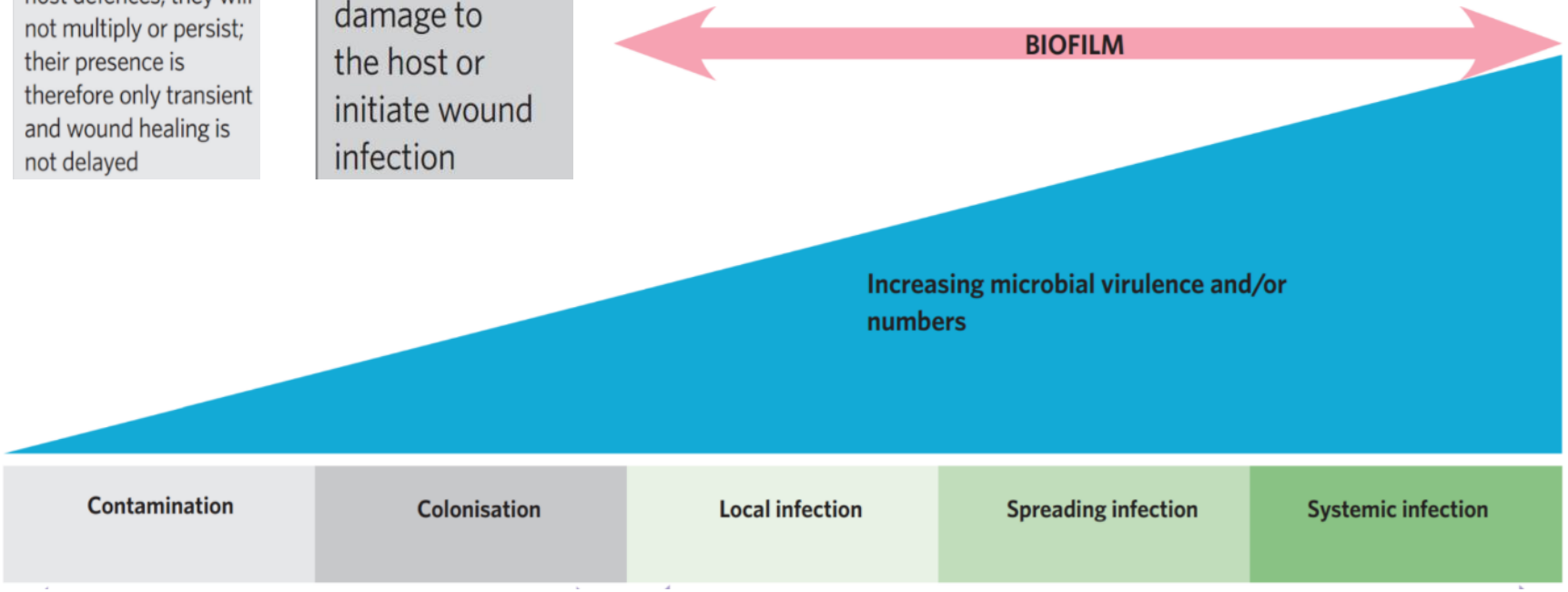
**Contamination**[26]

All wounds may acquire micro-organisms. If suitable nutritive and physical conditions are not available for each microbial species, or they are not able to successfully evade host defences, they will not multiply or persist; their presence is therefore only transient and wound healing is not delayed

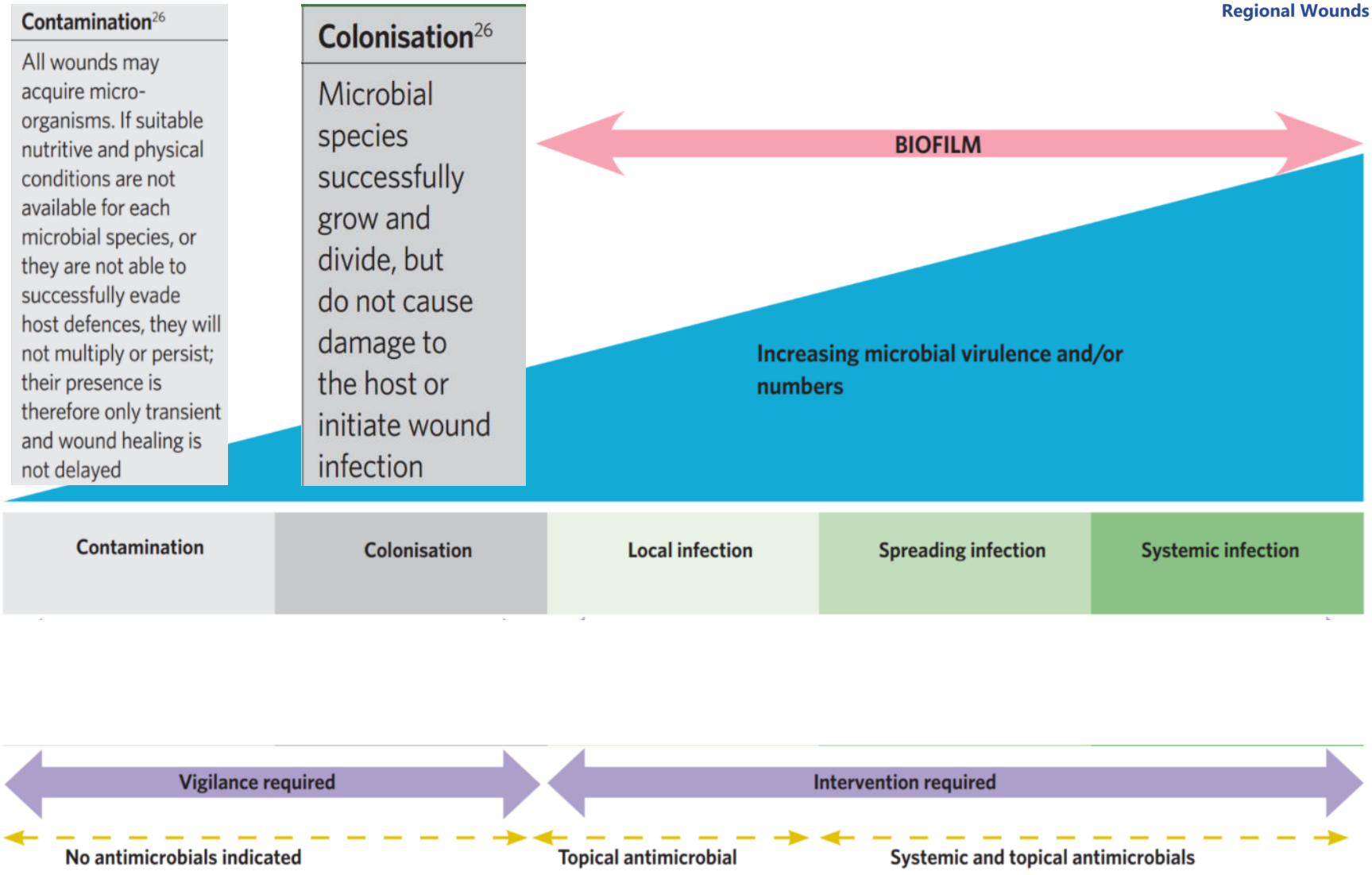
**Colonisation**[26]

Microbial species successfully grow and divide, but do not cause damage to the host or initiate wound infection



# Microbial Balance Continuum

Regional Wounds Victoria



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| Local infection | | Spreading infection[22, 23] | Systemic infection[22, 23] |
|---|---|---|---|
| Covert (subtle) signs of local infection:[2, 27-36]<br>■ Hypergranulation (excessive 'vascular' tissue)<br>■ Bleeding, friable granulation<br>■ Epithelial bridging and pocketing in granulation tissue<br>■ Wound breakdown and enlargement<br>■ Delayed wound healing beyond expectations<br>■ New or increasing pain<br>■ Increasing malodour | Overt (classic) signs of local infection:[2, 27, 28, 35, 36]<br>■ Erythema<br>■ Local warmth<br>■ Swelling<br>■ Purulent discharge<br>■ Delayed wound healing beyond expectations<br>■ New or increasing pain<br>■ Increasing malodour | ■ Extending in duration +/- erythema<br>■ Lymphangitis<br>■ Crepitus<br>■ Wound breakdown/ dehiscence with or without satellite lesions<br>■ Malaise/ lethargy or non-specific general deterioration<br>■ Loss of appetite<br>■ Inflammation, swelling of lymph glands | ■ Severe sepsis<br>■ Septic shock<br>■ Organ failure<br>■ Death |

# Pocketing

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Smooth, non-granulating areas in the base of a wound surrounded by granulation tissue.

**Photo From: Principles of best practice: Wound Infection In Clinical Practice. An International Consensus. London: MEP Ltd, 2008**

# Bridging

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Smooth, non-granulating areas in the base of a wound surrounded by granulation tissue.

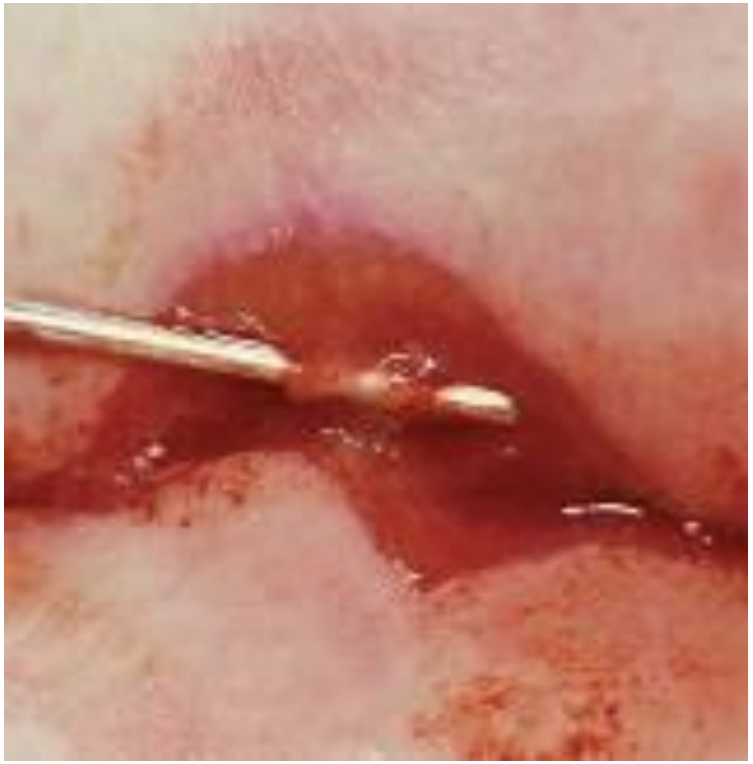

**Photo From: Principles of best practice: Wound Infection In Clinical Practice. An International Consensus. London: MEP Ltd, 2008**

# Biofilm

How it complicates how we identify and treat wound infections

# Biofilm Cycle

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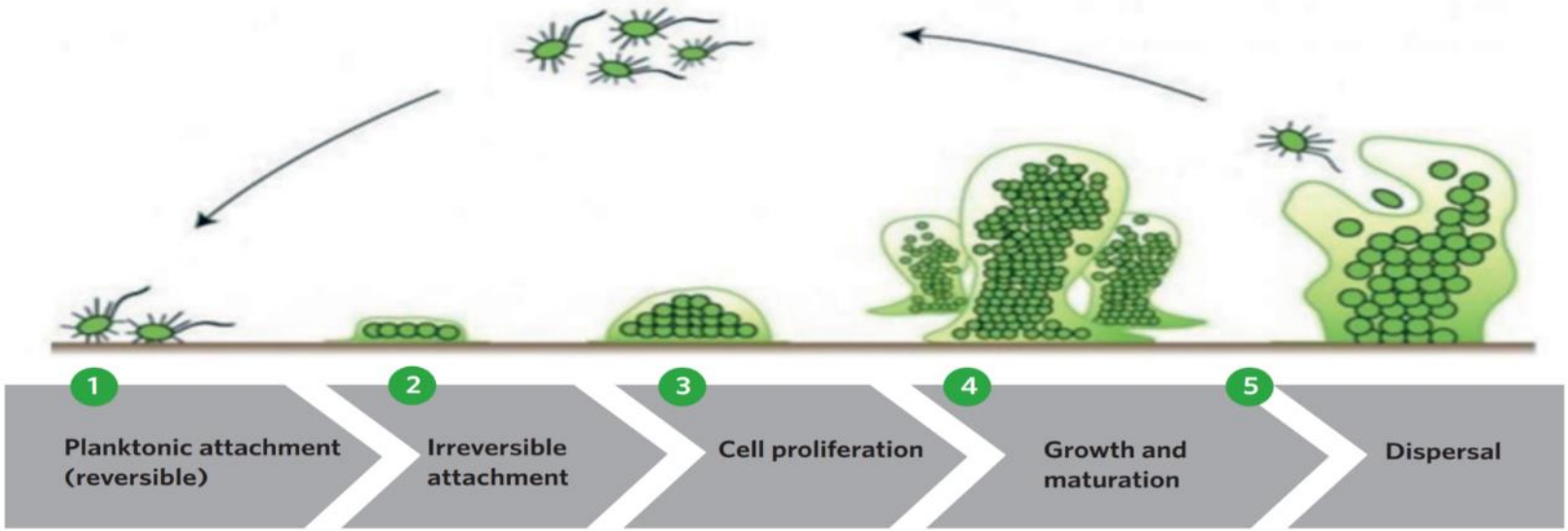



- Free floating
- Single

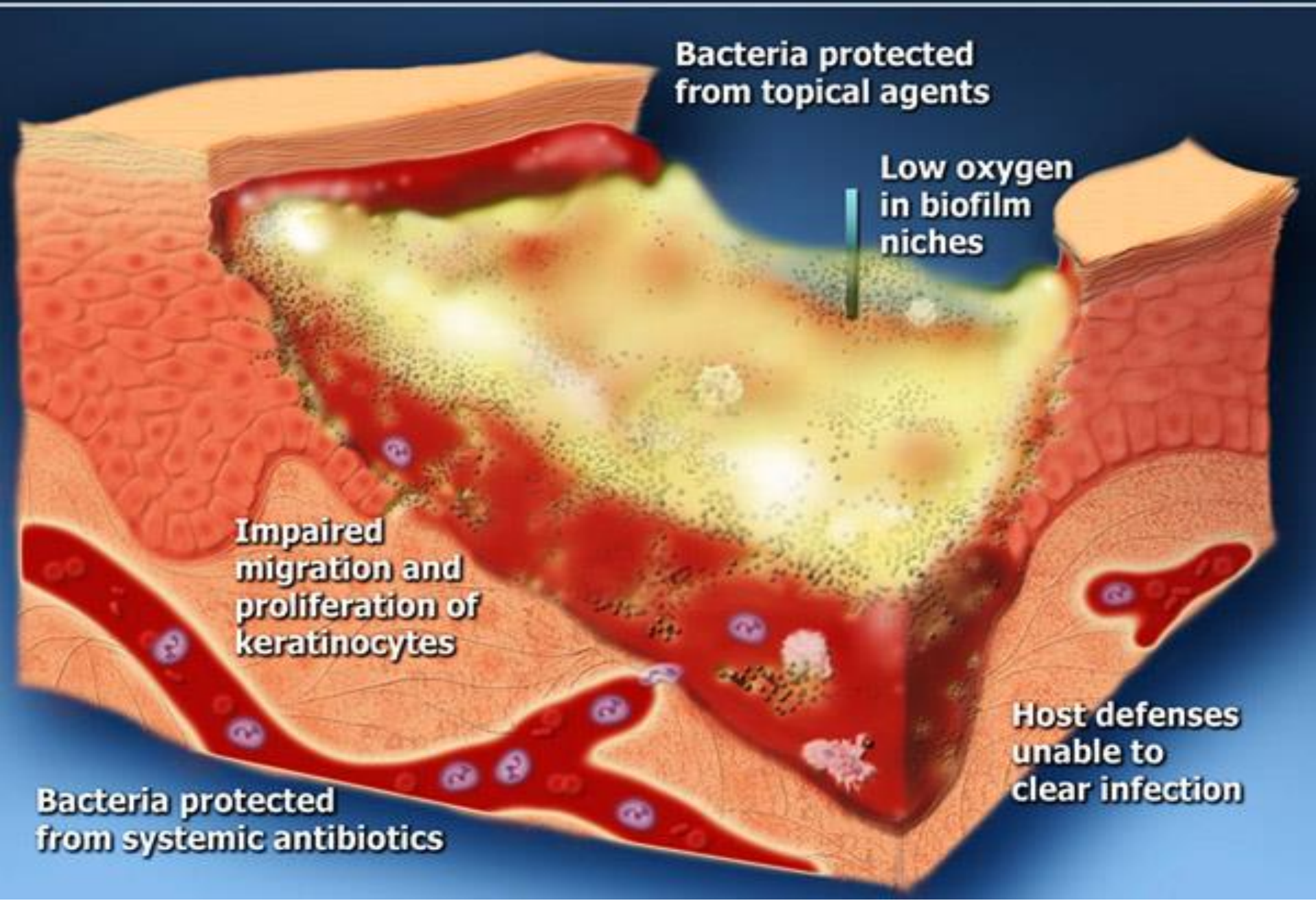
- Secretion of CPS

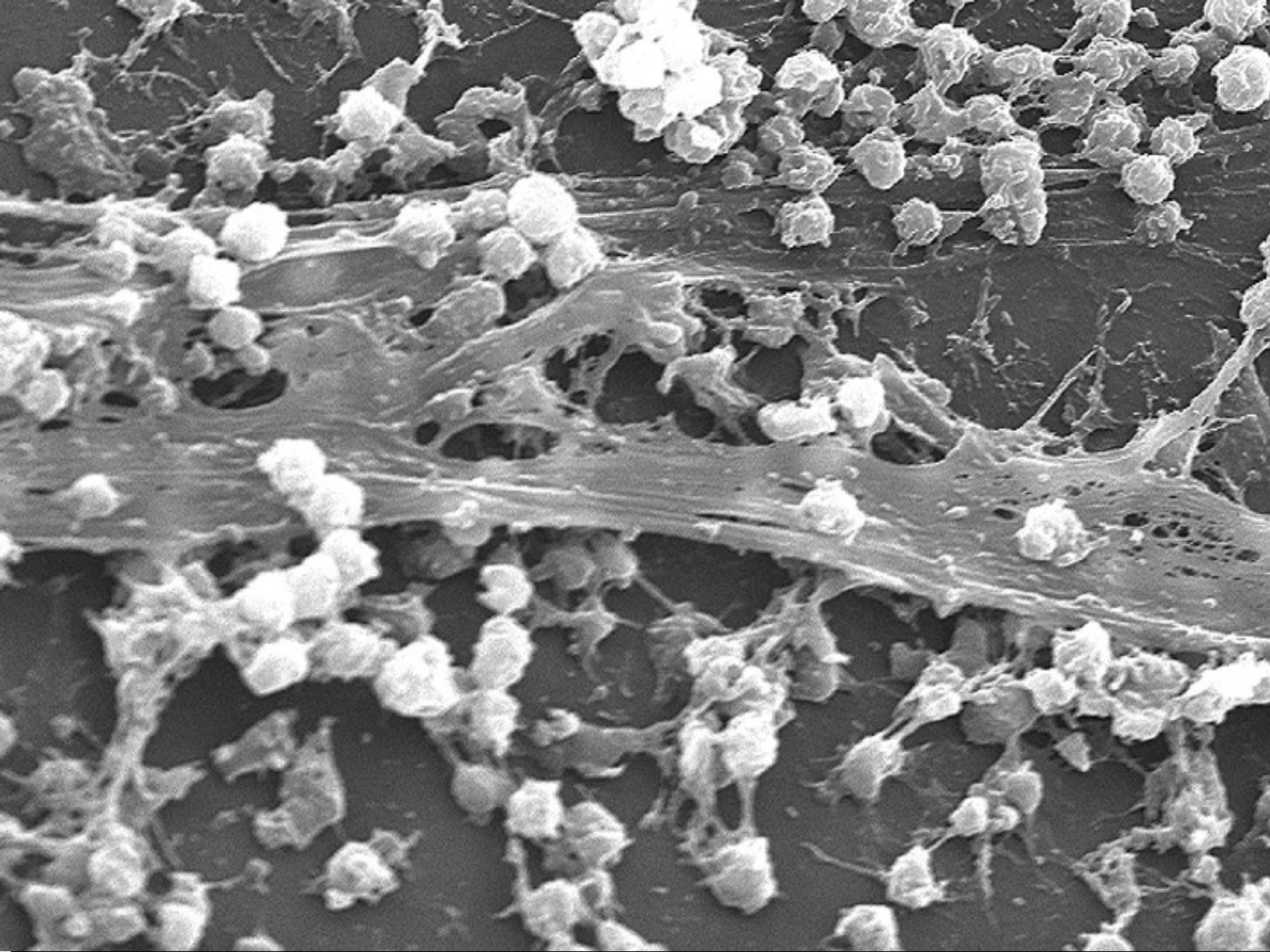
- Quorum sensing
- Attracts other microbes to join biofilm colony

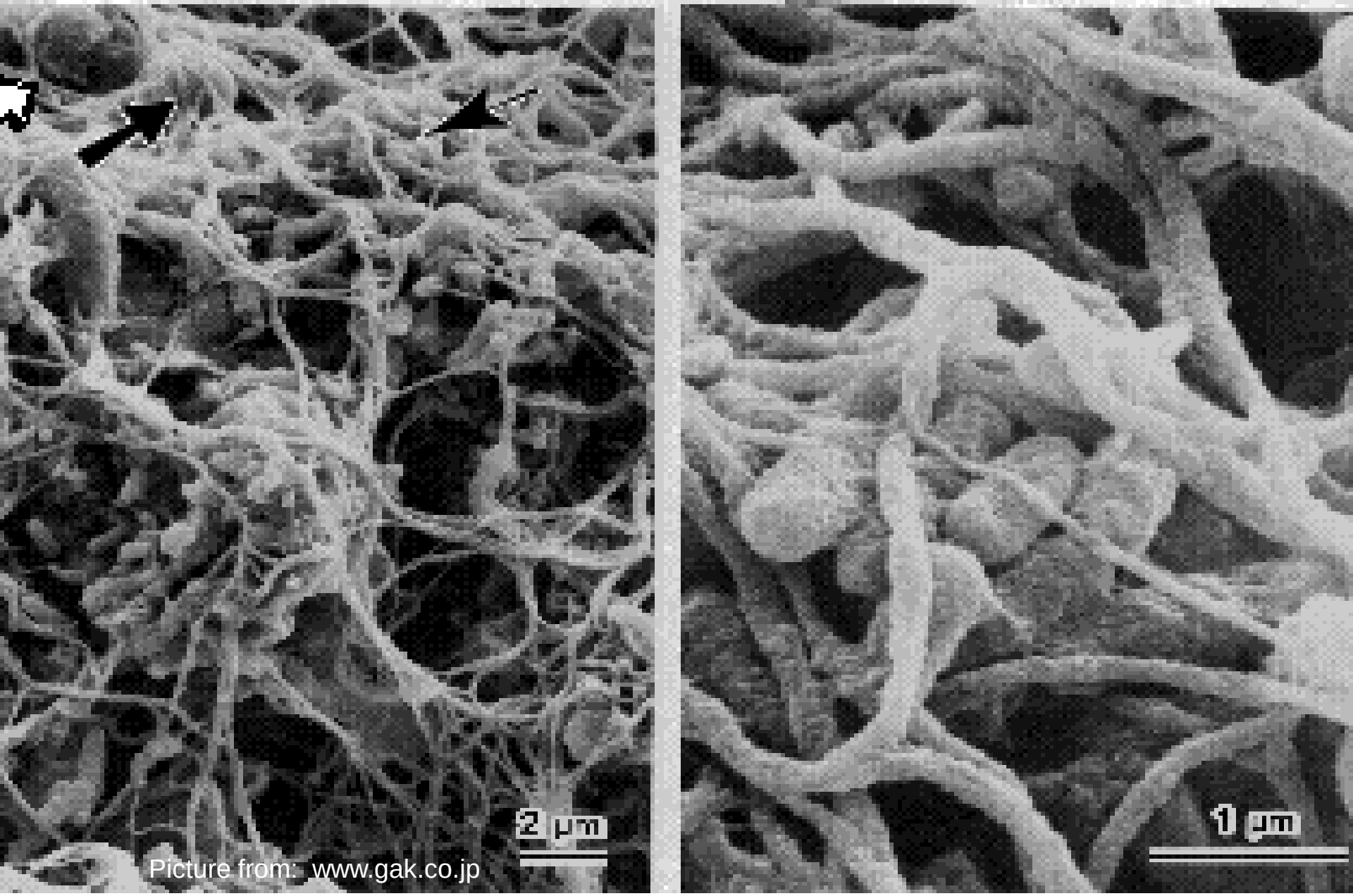
- Grows and differentiates
- Structural features developed
- Promotes chronic inflammation = ‘food’

- Passive or active

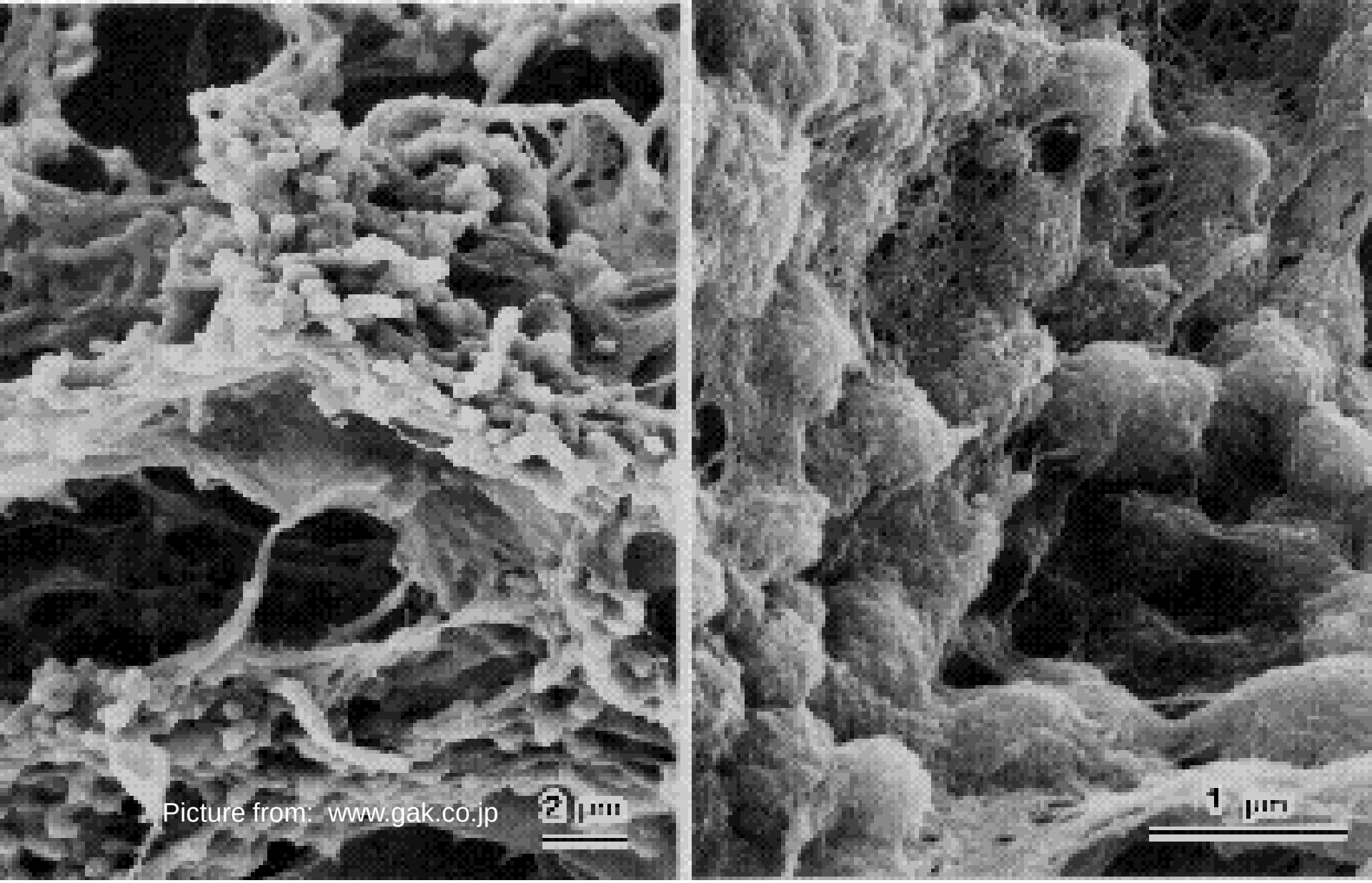
# Bacterial biofilm is a major barrier to wound healing








**Pseudomonas day 1 after infection**
**(S/C tissue in rat)**




**Pseudomonas day 2 after infection showing biofilm (S/C tissue in rat)**


Parasite

# Can you see biofilm?

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Bacterial – Associated Slough ?

- No
- May account for slimy / ‘foreign’ / non-viable / fibrinous / material on some wounds
- But NOT a conclusive indicator
- Lab investigations shows biofilm:
  - Is present in some ‘healthy’ looking wounds that have stalled healing
  - Can form deep in wounds where it can’t be visually identified

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# Criteria indicative of potential biofilm

- Failure of appropriate antibiotic treatment
- Recalcitrance to appropriate antimicrobial treatment
- Recurrence of delayed healing on cessation of antibiotic treatment
- Delayed healing despite optimal wound management and health support
- Increased exudate / moisture
- Low-level chronic inflammation
- Low-level erythema
- Poor granulation / friable hypergranulation
- Secondary signs of infection

Will a wound swab tell me if a wound is infected?

A wound swab

**Does NOT**

Tell us if a chronic wound is infected

# Why not?

All chronic wounds are likely to be colonised

So how do we know if wound is infected?

Clinical Assessment !!

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| Local infection | | Spreading infection[22, 23] | Systemic infection[22, 23] |
|---|---|---|---|
| Covert (subtle) signs of local infection:[2, 27-36]<br>■ Hypergranulation (excessive 'vascular' tissue)<br>■ Bleeding, friable granulation<br>■ Epithelial bridging and pocketing in granulation tissue<br>■ Wound breakdown and enlargement<br>■ Delayed wound healing beyond expectations<br>■ New or increasing pain<br>■ Increasing malodour | Overt (classic) signs of local infection:[2, 27, 28, 35, 36]<br>■ Erythema<br>■ Local warmth<br>■ Swelling<br>■ Purulent discharge<br>■ Delayed wound healing beyond expectations<br>■ New or increasing pain<br>■ Increasing malodour | ■ Extending in duration +/- erythema<br>■ Lymphangitis<br>■ Crepitus<br>■ Wound breakdown/ dehiscence with or without satellite lesions<br>■ Malaise/ lethargy or non-specific general deterioration<br>■ Loss of appetite<br>■ Inflammation, swelling of lymph glands | ■ Severe sepsis<br>■ Septic shock<br>■ Organ failure<br>■ Death |

A wound swab will **NOT** tell you **ALL** of the organisms infecting the wound

# Why not?

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Wound swabs may culture some microbes on the wound, but only those that:

- survive in the culture medium until plated
- are able to be cultured easily
- are on the surface of the wound
- are not protected within the EPS of biofilm

# When should a wound swab be done?

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- Not routinely or without cause
  - Acute wounds with classic signs and symptoms of infection
  - Chronic wounds with spreading or systemic infection
  - Infected wounds that have failed to respond to antimicrobial intervention, or are deteriorating despite appropriate antimicrobial treatment
  - In compliance with local protocols for the surveillance of drug-resistant microbial species
  - Wounds where the presence of certain species wound negate a surgical procedure (e.g. beta haemolytic strep in wounds prior to skin grafting)

**Table 3: Levine technique**

| Step | Action | Further information |
|---|---|---|
| 1 | Cleanse and debride wound prior to wound culture | ■ Inform and seek permission from patient to obtain specimen<br>■ Cleanse wound using warm normal saline<br>■ Debride non-viable tissue as required<br>■ Cleanse wound again |
| 2 | Moisten culture tip | ■ Moisten culture tip with sterile normal saline, especially with dry wounds |
| 3 | Where to obtain specimen | ■ Obtain specimen from cleanest area in the wound<br>■ Where possible, do not obtain from slough or necrotic tissue |
| 4 | Technique | ■ Inform the patient that procedure may cause discomfort<br>■ Place wound culture into wound<br>■ Firmly press swab into wound and rotate<br>■ Using a sterile technique, place swab into culture container |
| 5 | Label appropriately | ■ Patient label on culture container and pathology slip<br>■ Provide site, time and initials of who obtained specimen (e.g. left medial distal malleolus wound)<br>■ Provide as much relevant history as appropriate:<br>■ Current antibiotic or medication (steroid)<br>■ Comorbidity (DM)<br>■ Specific microbe suspected (*Pseudomonas aeruginosa*)<br>■ Provisional diagnosis of wound<br>■ Duration of wound |
| 6 | Apply dressing as appropriate | ■ Medicated dressings may be appropriate<br>■ Moisture management and wound bed preparation principles should be adhered to |

# Treatment of Infection

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- Optimise Host Response
  - Nutrition, Oxygenation & tissue perfusion
  - Management of comorbidities & other infection sites (UTI, CI)
  - Psychosocial support & education
- Good Aseptic Technique
- Thorough Wound Cleansing at each dressing change
- Keep Periwound healthy
- Facilitate wound drainage
- Debridement
  - Remove foreign bodies, necrotic tissue, wound dressing remnants and slough, disrupt biofilm
- Antimicrobial dressings
- Antibiotics (usually only for spreading or systemic infections)

# Antimicrobial Therapy ?

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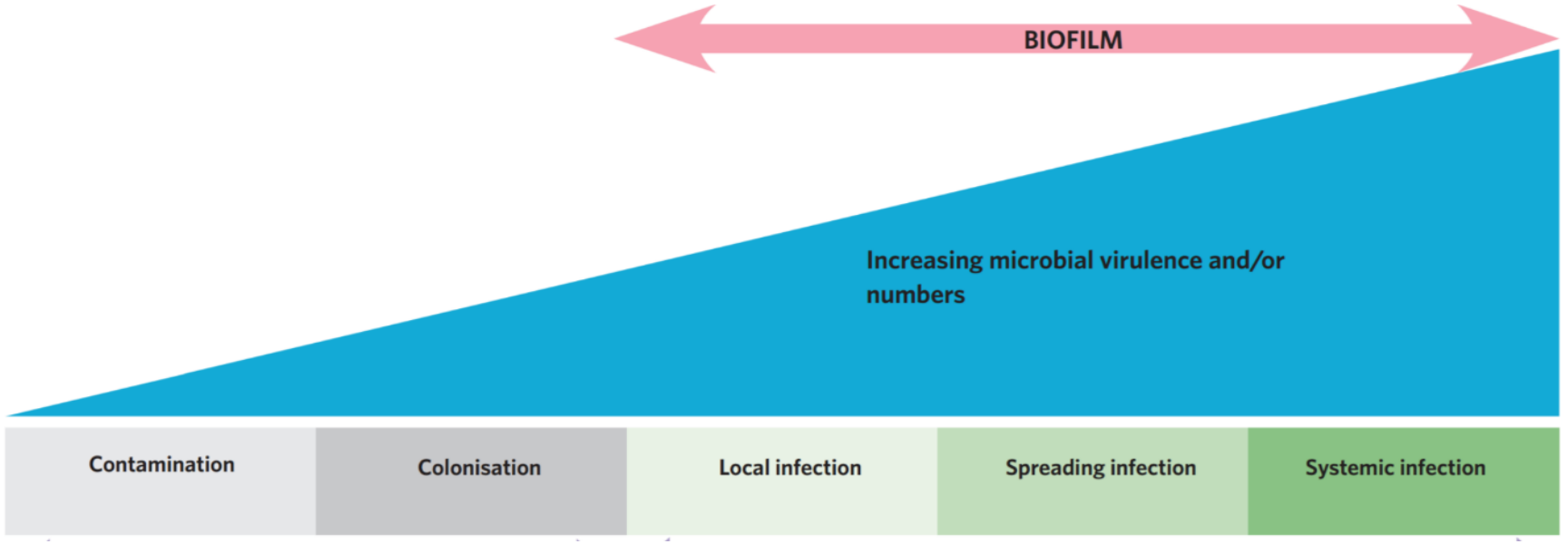


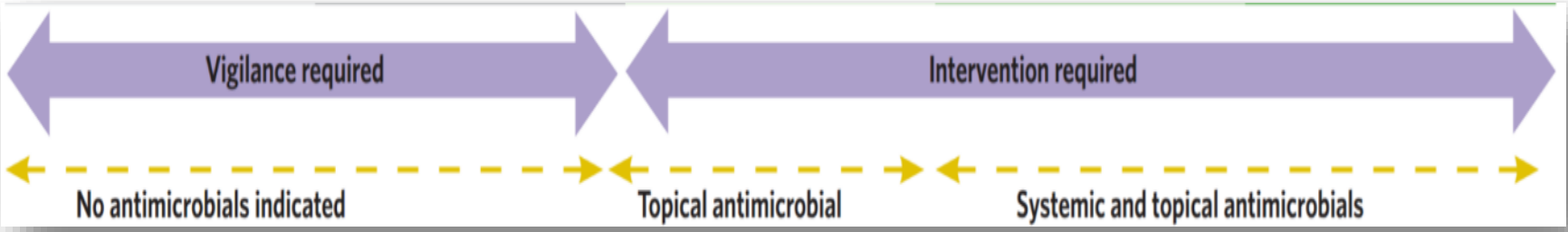

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# Cleansing Solutions and Gels

| solutions and gels | | | | |
|---|---|---|---|---|
| **Solution** | **Type** | **Cytotoxicity** | **Effect on biofilm** | **Comments** |
| Sterile normal saline | Isotonic[105] | None | None | ■ Sterile, non-antiseptic solution[103] |
| Sterile water | Hypotonic | None | None | ■ Sterile, non-antiseptic solution[103] |
| Potable tap water | Varies in content | Unknown/variable | None | ■ Not sterile[103] |
| Polyhexa-methylene biguanide (PHMB) | Surfactant antimicrobial | Low to none[23] | Surfactant qualities disrupt biofilm attachments[23,106] | ■ Available in gel and irrigation preparations that can be used together or separately<br>■ Lowers liquid surface tension, allowing greater spread and facilitating separation of non-viable tissue[23]<br>■ Does not promote bacterial resistance[23] |
| Octenidine dihydrochloride (OCT) | Surfactant antimicrobial | ■ *In vitro* tests show high toxicity[107]<br>■ Lack of absorption suggests no systemic effects[107]<br>■ Not shown to disrupt healing | ■ Prevents formation of new biofilm for at least 3 hours[108]<br>■ Inhibits planktonic and bacterial biofilm growth for up to 72 hours[108] | ■ Available in gel and irrigation preparations that can be used together or separately[107]<br>■ Lowers liquid surface tension allowing greater spread and facilitating separation of non-viable tissue[108] |
| Super-oxidised with hypochlorous acid (HOCL) and sodium hypochlorite (NaOCL) | Antiseptic | May vary depending on concentrations | ■ Penetrates biofilm rapidly, killing formations from within[103]<br>■ Does not promote resistant bacteria strains[103] | ■ Purported to provide desloughing and antimicrobial activity<br>■ Available in gel and irrigation preparations that can be used together or separately |
| Povidone iodine | Antiseptic | Varies depending on concetrations[108] | ■ Inhibits development of new biofilm[110]<br>■ Eradicates young biofilm colonies[110]<br>■ Significantly reduces mature biofilm colonies[110] | ■ Modulates redox potentials and enhances angiogenesis, thereby promoting healing[111]<br>■ May inhibit excess protease levels in chronic wounds[111] |

# Topical Wound Infection Therapies

**Table 7: Topical wound infection therapies**

| Antimicrobial agent | Type | Biofilm efficacy | Guidance for use |
|---|---|---|---|
| Enzyme alginogel | Alginate gel with two enzymes:<br>■ Lactoperoxidase<br>■ Glucose oxidase | ■ Prevents formation of biofilms at concentration M0.5% (w/v)[112,113]<br>■ Inhibits growth of established biofilms at higher concentrations<br>■ Does not disrupt biofilm biomass[112,113] | ■ Concentrations of alginate of 3% and 5% depending on level of exudate[112,113] |
| Iodine (povidone and cadexomer) | ■ Solution<br>■ Impregnated wound dressings<br>■ Powder and paste | ■ Inhibits development of new biofilm[110, 114]<br>■ Eradicates young biofilm colonies[110, 115]<br>■ Significantly reduces mature biofilm colonies[110, 114] | ■ Contraindicated in individuals sensitive to iodine or with thyroid or renal disorders[110]<br>■ Contraindicated in those with extensive burns[110] |
| Honey | ■ Medical grade<br>■ Honey impregnated dressings | ■ Inhibits biofilm growth[116-118]<br>■ Reduces biofilm colony formation[119]<br>■ Inhibits quorum sensing of biofilm, thereby reducing ability to proliferate[120] | ■ Select products that have been gamma irradiated[119]<br>■ Leptospermum species is more effective than other types[119] |
| Silver | ■ Salts (e.g. silver sulphadiazine, silver nitrate, silver, sulphate, silver CMC)<br>■ Metallic, e.g. nanocrystalline, silver-coated nylon fibres<br>■ Impregnated wound dressings | ■ Denatures existing bacterial biofilm in concentrations over 5 $\mu g$/ml120 | ■ Change more frequently in wounds with heavy exudate<br>■ Avoid in individuals with silver sensitivities[121] |
| Ionic silver combined ethylenediamine-tetraacetate (EDTA) and benzethonium chloride (BEC) (antibiofilm agents) | ■ Carboxymethylcellulose gelling dressing impregnated with ionic silver enhanced with EDTA and BEC | ■ Combines antibiofilm and antimicrobial components that work in synergy to disrupt biofilm and expose associated microorganisms to the broad-spectrum antimicrobial action of ionic silver[122]<br>■ Eradicates mature biofilm within 5 days[124]<br>■ Prevents biofilm formation[124]<br>■ Associated improvement in healing rates[125] | ■ Change more frequently in wounds with heavy exudate<br>■ Avoid in individuals with sensitivities to silver, EDTA or BEC[123] |
| Surfactant | ■ Concentrated surfactant gels with antimicrobial preservatives | ■ Prevents biofilm formation[126]<br>■ Increases antibiotic efficacy<br>■ Eradicates mature biofilm | ■ Can be used between and post-debridement to prevent re-establishment of biofilm<br>■ May require daily application for the first few days |

# http://woundhygiene.com/

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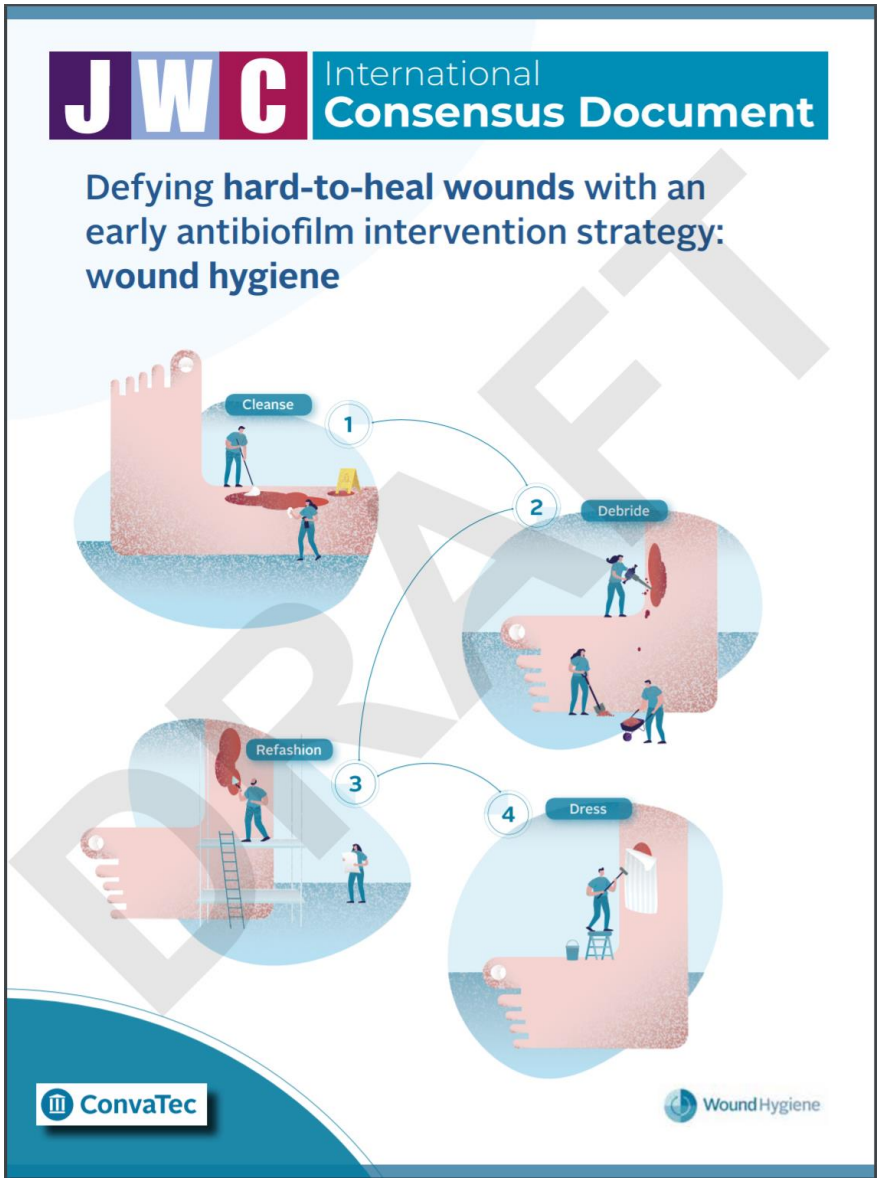


1. Skin & Wound Cleansing
2. Wound Debridement
3. Refashioning the Wound Edge
4. Dress the Wound

# Evaluate Against Regular Reassessment

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- Size
- Tissue
- Exudate
- Malodour
- Periwound
- Consider referral to specialist wound service