Implementing the new Infection Management Pathway to optimise outcomes: real-world case series

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The Infection Management (IM) Pathway is a comprehensive, succinct, expert-endorsed, evidence-based pathway that can assist clinicians in the diagnosis and management of infection (Dowsett et al, 2020). This article describes the real-world experiences of a clinical team who have implemented the IM pathway into daily practice. They have formally evaluated three clinical cases. The IM pathway helped to guide diagnosis of infection, wound bed preparation, treatment and ongoing management of chronic wounds including the clarification of biofilm based wound care and management of local infection. The clinicians involved reported that the IM pathway was easy-to-follow and they felt more confident managing infected wounds with the support of the IM pathway.

Local infection and biofilm management continue to be challenges faced by clinicians caring for people with wounds. A recently published international survey (Dowsett et al, 2020) confirms this, underlining that the three biggest challenges faced by clinicians related to managing infected chronic wounds are:

1. Distinguishing between local infection and biofilm
2. Selecting the right treatment according to diagnosis
3. Fear of rapid deterioration due to systemic and spreading infection.

The survey reported that 67% of wound care clinicians recognise the different presentation of local infection and biofilm, however only 40% (*n*=119/298) manage the wounds differently in practice (Dowsett et al, 2020). Of the 60% of responders who did not follow a biofilm-specific pathway for management (*n*=180), 70% were non-wound care specialists and 56.5% were wound care specialists (*p*=0.041). This highlighted an educational opportunity to support and upskill non-wound care specialists to deliver consistent care, particularly in biofilm management.

Infection Management (IM) pathway

The recently published IM pathway was developed by an international group of experts using published guidelines and clinical evidence *[Figure 1]* to guide differential diagnosis of biofilm and local infection and appropriate early treatment intervention, thereby reducing unnecessary or incorrect antimicrobial use and delays in treatment. This should lead to better patient outcomes, appropriate use of antimicrobials and reduced costs through prompt management of wound complications before they progress, resulting in faster wound healing overall (Dowsett et al, 2020). The IM pathway was also developed as an aid to support non-wound care specialists *[Box 1]*.

Box 1. How the IM pathway can support non-wound care specialists and the wider clinical team.

- Simplifies the complexities of wound assessment, and provide a treatment plan based on the signs and symptoms of biofilm or infection present in the wound and the patient
- Prompts for re-assessment and evaluation of the treatment options if the wound is stalled and not responding to antimicrobial treatments
- Reduces variation in care and improves confidence by providing a consistent means of communication for wound infection terminology

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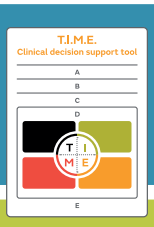
Declaration
This case series has been supported by Smith & Nephew.

A route to more effective infection management

Improve patient outcomes[1] with accurate decision making, a fast response and effective treatment choices



Start with following steps to undertake a comprehensive assessment[2]

- **A** **Assess** patient, wellbeing and wound
- **B** **Bring in** a multi-disciplinary team and informal carers to promote holistic patient assessment
- **C** **Control** and treat the underlying causes and barriers to wound healing
- **D** **Decide** appropriate treatment
- **E** **Evaluate** and reassess the treatment and wound management outcomes

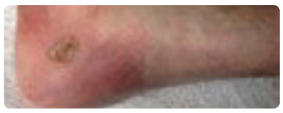
What clinical signs and symptoms of infection are present?

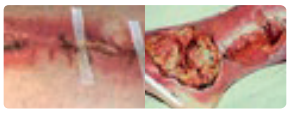
Biofilm[1,3-5]

- Antibiotic/antimicrobial treatment failure
- Recurrence of delayed healing on cessation of antibiotic treatment
- Delayed healing despite optimal wound/patient management
- Low level chronic inflammation
- Low level erythema
- Friable granulation
- Covert (subtle) signs of infection

Covert (subtle)[1,3]

- Delayed wound healing
- Serous drainage with concurrent inflammation
- Hypergranulation
- Bleeding, friable granulation
- Epithelial bridging and pocketing in granulation tissue
- Wound breakdown & enlargement
- New or increasing pain
- Increasing malodour





Overt (classic)[1,3]

- Erythema
- Warmth
- Oedema/swelling
- Purulent discharge
- Pain
- Increasing malodour
- Delayed wound healing

Spreading or systemic infection[1,3]

- Spreading erythema, warmth
- May include cellulitis, crepitus
- Wound breakdown/dehiscence with or without satellite lesions
- Malaise/lethargy
- Loss of appetite
- Systemic inflammatory response
- Sepsis
- Organ dysfunction

Biofilm based wound care[4,5]

1. Repeated aggressive debridement and cleanse† as per local protocol
2. Manage suspected biofilm with **IODOSORB**◊ 0.9% Cadexomer Iodine Ointment / **IODOFLEX**◊ Cadexomer Iodine Dressing[7-9Ω]
3. Reassess at regular intervals as per local protocol and appropriate antimicrobials use. **Two weeks' minimum treatment – may need longer than overt local infection treatment due to persistent nature of biofilms**

Local wound infection management[1,3,6]

1. Debride and cleanse† as per local protocol
2. Manage local bioburden and infection with **ACTICOAT**◊ [10‡] Antimicrobial Barrier Dressing
3. Reassess at regular intervals as per local protocol and following **the two-week challenge principles[6]**

Spreading or systemic infection management

- Refer to appropriate specialist
- Tissue sample for culture and sensitivity
- Systemic antibiotics per local protocol

Have signs and symptoms of biofilm / covert infection resolved?

- Yes
- No

Have signs and symptoms of local infection resolved?

- No
- Yes

Is the wound still stalled?

- Yes – suspect biofilm
- No

Conduct comprehensive reassessment using the A B C D E approach, manage host factors and refer to an appropriate specialist

Use standard wound care (i.e. non-antimicrobial dressings) or advanced therapies until healing (follow local protocol)[5]

TWO-WEEK CHALLENGE[1,6∞]

Antimicrobial dressings are recommended to be used for a minimum of two weeks' duration. After two weeks, re-evaluate and either:

1. discontinue if signs and symptoms of infection have resolved,
2. continue with antimicrobial if wound is progressing but there are still signs and symptoms, or
3. consider an alternative antimicrobial and refer to an appropriate specialist if no improvement.

* No one sign or symptom can reliably confirm the presence of infection, and those with immunosuppression may not exhibit signs and symptoms of clinical infection.
† Cleanse wound and periwound skin thoroughly. Should an antiseptic cleanser be selected, the product's Instructions for Use (IFU) and soak time should be followed.
‡ Consider the use of **DURAFIBER**◊ **Ag Silver Gelling Fibre Dressing** for deep infected wounds.
Ω Unless iodine contraindicated.
∞ For very-high risk patients and wounds (e.g. osteomyelitis), it may be appropriate to use antimicrobial treatment for longer than the two-week challenge.

For detailed product information, including indications for use, contraindications, precautions and warnings, please consult the product's Instructions for Use (IFU).

References 1. International Wound Infection Institute (IWII) Wound infection in clinical practice. Wounds International (2016). **2.** Moore Z, et al. J Wound Care 28(3):154-161 (2019). **3.** Weir D, Schultz G. Assessment and Management of Wound-Related Infections. In Doughty D & McNichol L (Eds.). Wound, Ostomy and Continence Nurses Society Core Curriculum: Wound Management (p. 156-180). 2016. Philadelphia: Wolters-Kluwer. **4.** Wolcott RD, et al. J Wound Care 19(2): 45–53 (2010). **5.** Schultz G, et al. Wound Repair Regen 25(5): 744–757 (2017). **6.** Ayello EA, et al. Wounds Int 1–24 (2012). **7.** Roche ED, et al. Int Wound J 1–10 (2019). **8.** Malone M, et al.. J Antimicrob Chemother 72, 2093–2101 (2017). **9.** Schwarzer S, et al J Infect 80(3):261-270 (2020). **10.** Gago M, Garcia F, Gaztelu V, Verdu J, Lopez P, Nolasco A. A comparison of three silver-containing dressings in the treatment of infected, chronic wounds. Wounds. 2008;20(10):273-278.

Photographs (from left to right) courtesy of Kerlyn Carville, Kevin Woo, and Henri Post.

Figure 1. The Infection Management Pathway (Dowsett et al, 2020).

Using the IM pathway in the real-world

A case series was conducted to evaluate the effectiveness of the IM pathway in supporting clinicians to deliver improved patient outcomes at two chronic care hospitals in Toronto, Canada.

The clinical team involved in this series were an engaged group of eight non-wound care specialists who were selected to participate due to their keenness to make a difference to patients, and to reinforce and validate their own experience in wound care. The non-wound care specialists were introduced to the IM pathway by the wound care specialist (KW), this included detailed discussion of the signs and symptoms associated with wound infection and suspected biofilm.

Prior to implementing the IM pathway into practice, the clinical team discussed what they perceived to be their biggest challenges surrounding the management of wound infection:

- When is a wound infected and what does this mean?
- How is infection diagnosed?
- When to swab a wound?
- How to treat and manage wound infection?

Alongside local protocols and guidelines, the IM pathway was used by the non-wound care specialists at initial patient assessment and at each subsequent review to provide consistent guidance on the following:

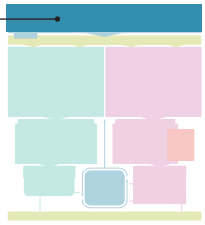
- Infection diagnosis
- Differentiation between local infection and biofilm
- Wound bed preparation
- Dressing selection.

Three patients were monitored and reviewed for at least 1 month. Wound parameters such as wound size, condition of the wound bed, wound progression and the degree to which the wound management goals had been achieved were recorded. Wound pain was measured on the visual analogue scale (VAS; 0=no pain, 10=unbearably pain).

The first patient case (case 1) is reported in detail and illustrates step-by-step each section of the pathway and how it helped the clinical team to identify when management needed to shift from **local infection management** to **biofilm based wound care (BBWC)**. *Table 1* describes the progression of this wound. A summary of the experiences using the IM pathway for two patients with local infection and biofilm are shown in *Table 2* and *Table 3*, respectively.

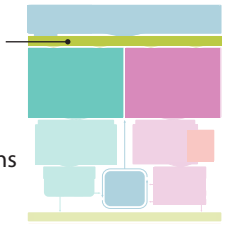
Case 1: Infected haematoma to the lower leg

Holistic assessment



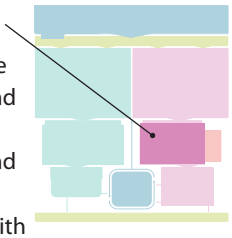
A female patient in her early 60s, presented with a traumatic wound that had begun to blister on the lateral gaiter area of the left leg 5 days post-injury. The patient had diabetes and lymphoedema. She was referred to the acute facility because of concerns with compartment syndrome. The wound initially appeared to be progressing to healing, and was treated with daily enzymatic debridement and topical antimicrobials.

What clinical signs and symptoms are present?



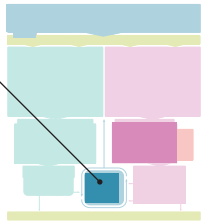
On day 15 post-injury, the wound was formally assessed using the IM pathway. The clinical signs and symptoms of local infection listed in the IM pathway were present, particularly, extensive friable tissue.

Local wound infection management



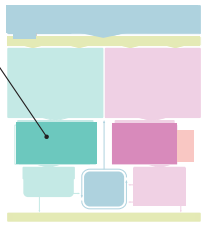
Therefore, following the IM pathway, local wound infection management was initiated. The wound was debrided using a curette and cleansed with saline as per local protocol and ACTICOAT™ FLEX 3 Antimicrobial Barrier Dressing was used to dress the wound along with a secondary dressing.

Reassessment



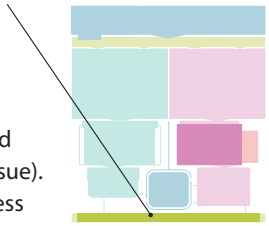
At Day 21 (7 days later), the signs of local infection had resolved, but the wound was not progressing. Following the IM pathway, this triggered a comprehensive reassessment using the 'ABCD and E' approach. The clinical signs and symptoms of biofilm and covert (subtle) were present, and biofilm was suspected. The clinician shifted to the right-side of the IM pathway and commenced BBWC.

Biofilm based wound care



Over 4 weeks, BBWC was conducted with frequent aggressive sharp debridement, cleansing and the use of IODOSORB™ as an effective topical antimicrobial against biofilm (Malone et al, 2017; Schultz et al, 2017; Roche et al, 2019; Schwarzer et al, 2020). IODOSORB™ Powder was changed every 2 days due to a high volume of exudate. A foam dressing (ALLEVYN™ Life) was applied as a secondary dressing, and two-layer short-stretch, inelastic high-level compression was applied to manage the oedema.

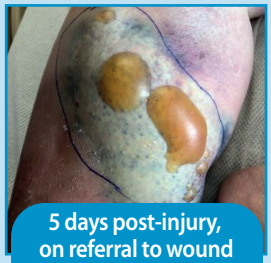
Standard care



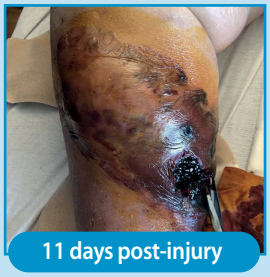
The wound reduced in size over 4 weeks, and the wound bed composition improved (100% granulation tissue). The wound became less painful and the patient was pleased with progress. The clinical signs and symptoms of biofilm had resolved, so on day 43, PICO™14 Single Use Negative Pressure Wound Therapy (sNPWT) System was initiated to facilitate healing, reduce dressing change frequency under compression and accelerate wound closure.

Table 1. Case 1: Infected haematoma to the lower leg.

Before formal assessment with the IM pathway



5 days post-injury, on referral to wound care team



11 days post-injury

Post debridement

During daily enzymatic debridment

Formal assessment with the IM pathway commenced

Wound condition	Clinical indicators	Treatment plan & rationale
Day 15 – initiated local wound infection management  **Size:** 24 cm (length) x 15 cm (width) **Wound bed composition:** 25% granulation tissue 75% slough and no-viable fibrinous tissue	**Overt (classic) infection** • Erythema • Warmth • Oedema/swelling • Purulent discharge • Pain (7 on the VAS) • Increasing malodour • Delayed wound healing.	**Local wound infection management** • Debrided with curette and cleansed with saline as per local protocol. • Managed local bioburden and infection with ACTICOAT FLEX™ 3 (Secondary dressing: ALLEVYN™ Life). • Reassessed regularly as per local protocol and following two-week challenge principles (Ayello et al, 2012).
Day 21 (6 days of ACTICOAT™ treatment)  **Size:** 24 cm (L) x 15 cm (W) **Wound bed composition:** 30% granulation tissue 40% sloughy 30% necrotic tissue	**Biofilm** • Delayed healing despite optimal wound management with ACTICOAT™ FLEX 3 • High exudate levels • Friable hypergranulation • Wound breakdown and enlargement • Low level chronic inflammation. **Overt (classic) infection** • Increasing pain (8 on the VAS) • Malodour.	**BBWC** • Aggressive sharp debridement and cleanse with saline as per local protocol. • Mangaged suspected biofilm with IODOSORB™ Powder (Secondary dressing: ALLEVYN™ Life). • Reassessed regularly as per local protocol and following two-week challenge principles. • High compression was applied with a two-layer, short-stretch, inelastic compression system. • Analgesia was prescribed (hydromorphone hydrochloride).

Table 1 (cont.) Case 1: Infected haematoma to the lower leg.

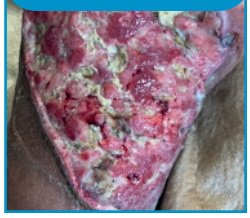
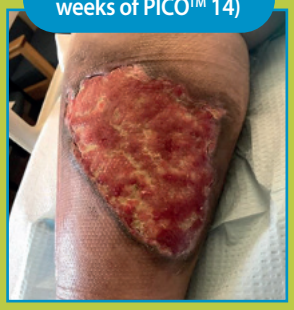
Wound condition	Clinical indicators	Treatment plan & rationale
Day 28 (7 days of IODOSORB™ treatment)  **Size:** 23.5 cm (L) x 14 cm (W) **Wound bed composition:** 60% granulation tissue 40% slough	**Covert (subtle) signs of infection** • High exudate levels • Pain reduced (6 on the VAS).	**BBWC** • There were no treatment changes as there were positive signs of progression to healing. • Antimicrobial therapy was continued for a minimum of 2 weeks, according to the two-week challenge (Ayello et al, 2012).
Day 35  **Size:** 22 cm (L) x 13.5 cm (W) **Increased granulation tissue:** 70% granulation tissue 30% slough	**Covert (subtle) signs of infection** The wound had reduced in size and more granulation tissue had developed.	**BBWC** • There were no treatment changes as there were positive signs of progression to healing. • The aim was to reassess in 7 days with aim to stop antimicrobial treatment.
Day 43  **Size:** 20 cm (L) x 12 cm (W) **Increased granulation tissue:** 80% granulation tissue 20% slough	**The signs and symptoms of biofilm and covert infection had resolved.**	Stepped-up treatment and initiated single-use NPWT with PICO™ 14 Single Use Negative Pressure Wound Therapy System for 2 weeks.
Day 64 (After 2 weeks of PICO™ 14)  **Size:** 20 cm (L) x 12 cm (W) **Increased granulation tissue:** 95% granulation tissue 5% yellow fibrin **Treatment plan & rationale:** Treatment was stepped-down to standard care with foam dressings to support moist wound healing		

Table 2. Case 2: Locally infected pressure ulcer to the trochanter area.

The patient was a 75-year-old male, who had Parkinson's Disease and anemia and had previously received cancer treatment. He was referred from ICU with a stalled Category 4 pressure ulcer on the right trochanter area present for over 6 months. The wound had previously been treated with an antimicrobial ribbon and foam dressing. The presence of osteomyelitis and deep infection involving the bony tissue was confirmed with X-ray and MRI; therefore, systemic antibiotics (pipecillin with tazobactam) were administered.

On Day 0, the clinical signs and symptoms of overt local infection and spreading or systemic infection were present. Therefore, local infection wound management was commenced – sharp debridement and cleansing with sterile water as per local protocol. The bioburden and local infection was managed with ACTICOAT™ FLEX 3 Antimicrobial Barrier Dressing in conjunction with antibiotics to treat the osteomyelitis to prevent sepsis. The wound was offloaded using an air mattress and frequently re-positioning the patient. The patient and wound were reassessed weekly for progress and the signs and symptoms of infection following the two-week challenge principles (Ayello et al, 2012). After the 4-week period when the IM pathway was used, the wound had reduced in size, granulation and epithelial tissue had developed, and the patient was in less pain.

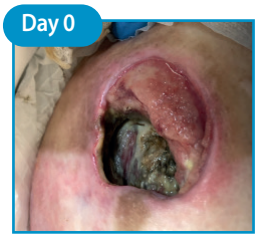
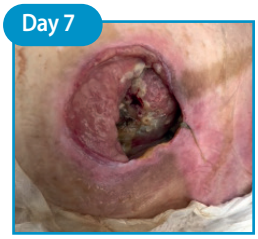
Wound condition	Clinical indicators present	Treatment plan & rationale
Day 0  **Size:** 4.5 cm (length) x 4.5 cm (width) x 2 cm (depth) **Wound bed:** 60% granulation tissue 40% sloughy	**Overt (classic) infection** • Erythema • Warmth • Oedema/swelling • Purulent discharge • Pain (7 on the VAS) • Increasing malodour • Delayed wound healing. **Spreading or systemic infection** • Spreading erythema • Cellulitis • Crepitus • Malaise • Loss of appetite.	**Local infection management** • Sharp debridement and cleansed with sterile water as per local protocol. • Managed local bioburden and infection with ACTICOAT™ FLEX 3 (Secondary dressing: ALLEVYN™ Gentle Border). • Systemic antibiotics commenced (pipecillin with tazobactam). • Offloaded the wound with air mattress and repositioning.
Day 7  **Size:** 5 cm (L) x 4.5 cm (W) x 3 cm (D) **Improved wound bed composition:** 70% granulation tissue 30% sloughy	**Overt (classic) infection** The wound remained highly exuding requiring daily dressing changes, malodourous, but less painful (5 on the VAS) and improved condition of the wound bed. **Spreading or systemic infection** Fewer signs of spreading infection.	• There were no treatment changes as there were positive signs of progression to healing. • Analgesia was prescribed (hydromorohone hydrochloride).
Day 11  **Size:** 4.8 cm (L) x 4.5 cm (W) x 3 cm (D) **Improved wound bed composition:** 90% granulation tissue 10% sloughy	**Overt (classic) infection** The wound was improving, but there were still signs and symptoms of infection. The wound remained highly exuding, malodourous and the patient was in moderate pain (5 on the VAS).	• There were no treatment changes as there were positive signs of progression to healing. • Analgesia continued.
Day 17  **Size:** 3.5 cm (L) x 3.5 cm (W) x 2 cm (D) **Improved wound bed composition:** 100% granulation tissue	**Overt (classic) infection** The wound remained highly exuding and required daily dressing changes, but it was a thinner consistency and lighter in colour. The wound odour had improved and the wound was less painful for the patient (4 on the VAS).	• There were no treatment changes as there were positive signs of progression to healing. • Analgesia continued.

Table 3. Case 3: Chronic, non-healing pressure ulcer with suspected biofilm.

This patient was a 74-year-old man who was referred from ICU with a stalled wound present for 4 months. He had a complex medical history including coronary artery disease, diabetes, hypertension, end-stage renal disease (ESRD), stroke and anaemia. Previous wound treatment included systemic antibiotics for osteomyelitis, local silver wound dressings and foam dressings.

The patient presented with delayed healing despite optimal wound and patient management, so the patient and wound were assessed using the IM pathway. The signs and symptoms of infection were suggestive of biofilm, so biofilm based wound care (BBWC) was commenced. The wound was cleaned of devitalised tissue with frequent, aggressive mechanical debridement with monofilament pads and sharp debridement with curette, followed by saline to cleanse as per local protocol. IODOSORB™ Ointment was selected to manage the suspected biofilm, covered with ALLEVYN™ Gentle Border Dressing. After 1 week, the antimicrobial was changed to IODOSORB™ Powder so as to better absorb moisture from the wound. The wound was reassessed at regular intervals, and IODOSORB™ was continued beyond 2 weeks due to ongoing improvement and the persistent nature of the biofilm. Over a 4-week period when the IM pathway was used, the wound reduced in size and the composition of the wound bed improved from 50% slough and 50% granulation tissue to 95% granulation tissue and 5% epithelialisation tissue. The clinical indicators of biofilm were resolved and treatment was stepped down to standard care.

Wound condition	Clinical indicators present	Treatment plan & rationale
Day 0  **Size:** 7 cm (length) x 6 cm (width) x 0.4 cm (depth) **Wound bed composition:** 50% granulation tissue 50% sloughy	**Biofilm** • Delayed healing despite optimal management. • Recurrence of delayed healing on cessation of antibiotics. **Covert (subtle) signs of infection** • Serous drainage with concurrent inflammation, hypergranulation, bleeding, friable granulation, wound breakdown/enlargement, increasing odour. • High exudate levels. • Pain (4 of the VAS).	**BBWC** • Repeated, aggressive mechanical debridement with monofilament pad and sharp debridement with curette. • Wound was cleansed as per local protocol. • Managed suspected biofilm with IODOSORB™ Ointment (Secondary dressing: ALLEVYN™ Gentle Border). • Reassessed regularly as per local protocol and following two-week challenge principles (Ayello et al, 2012).
Day 7  **Size:** 7 cm (L) x 4 cm (W) x 0.2 cm (D) **Wound bed composition:** 70% granulation tissue 30% sloughy	**Covert (subtle) signs of infection** There remained high exudate levels, but the wound bed comprised of more granulation tissue and the edges were becoming flatter. The wound was less painful (2 on the VAS).	• Debridement and cleansing continued as before. • IODOSORB™ Powder was selected to absorb moisture from the wound. (Secondary dressing: ALLEVYN™ Gentle Border).
Day 13  **Size:** 6 cm (L) x 4 cm (W) x 0.2 cm (D) **Wound bed composition:** 100% granulation tissue	**Covert (subtle) signs of infection** All the slough was removed, and there was still some bleeding friable tissue.	• There were no treatment changes as there were positive signs of progression to healing. • Antimicrobial therapy was continued for a minimum of 2 weeks, according to the two-week challenge (Ayello et al, 2012).
Day 17  **Size:** 6 cm (L) x 4 cm (W) x 0.2 cm (D) **Wound bed composition:** 95% granulation tissue 5% epithelialisation tissue	**Covert (subtle) signs of infection** There were some signs of covert infection present: High exudate, serous drainage with concurrent inflammation, hypergranulation, bleeding friable granulation. The wound was no longer painful and epithelialised tissue was present on the wound bed.	• There were no treatment changes as there were positive signs of progression to healing. • Planned to review in 3 days and step down to a hydrofiber dressing once biofilm resolved.

Box 2. Feedback from the clinical team.

"Very helpful, easy to use and follow"

"Clear, straight forward"

"Precise, to the point, not lengthy"

"Now I understand/ know the signs [of wound infection] to look for"

Feedback on the IM pathway

The group of eight non-wound care specialists who used the IM pathway strongly agreed that the tool enhanced their confidence as a non-specialist caring for patients with underlying co-morbidities and very complex wounds *[Box 2]*. On a practical level, the IM pathway was straight forward, and easy to use and follow; it was "precise, to the point and not lengthy". The non-specialists also reported that the IM pathway helped them to communicate effectively and provide consistent evidence-based care in a setting where patients are often treated by a number of different clinicians.

The IM pathway provided a clear, systematic approach that facilitated differentiation between overt local infection and biofilm, and aided understanding of the different approaches to treatment. In doing so, the IM pathway simplified dressing choice and eased decision making. The group reported that they still occasionally required support and assistance from a wound care specialist for complex patients and hard-to-heal infected wounds, but that they were able to understand the rationale for the care they were providing and seek early help when infection was suspected to avoid delay in treatment.

Learnings from this case series

There are opportunities to produce the IM pathway in different formats to aid accessibility, i.e. digitally and in large posters or pocket-sized reference guides. The non-specialists identified that continued learning, including a glossary of some of the key clinical descriptors referenced in the IM pathway, would be beneficial in the future. In this way, the IM pathway can be used as a support tool for specialists to work alongside non-specialist colleagues to improve confidence and aid learning.

Other centres and teams are now implementing the IM pathway. For further information and support, visit: https://www.smith-nephew.com/key-products/advanced-wound-management/infection-

Conclusion

The need for differential diagnosis of biofilm and local infection and effective and appropriate antimicrobial use is well-known, but it is not always easily applied to practice. An evidence-based pathway can simplify guidelines, provide consistency in practice, support appropriate antimicrobial use and build confidence among non-specialists.

This real-world case series shows that the IM pathway is a one-stop tool that can:

- Improve the confidence of the clinical team when managing and discussing wound infection
- Encourage clinicians to seek help early when infection is suspected
- Help guide clinicians to make an accurate diagnosis
- Provide appropriate and effective solutions for patients with wounds with local infection and suspected biofilm.

WINT

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