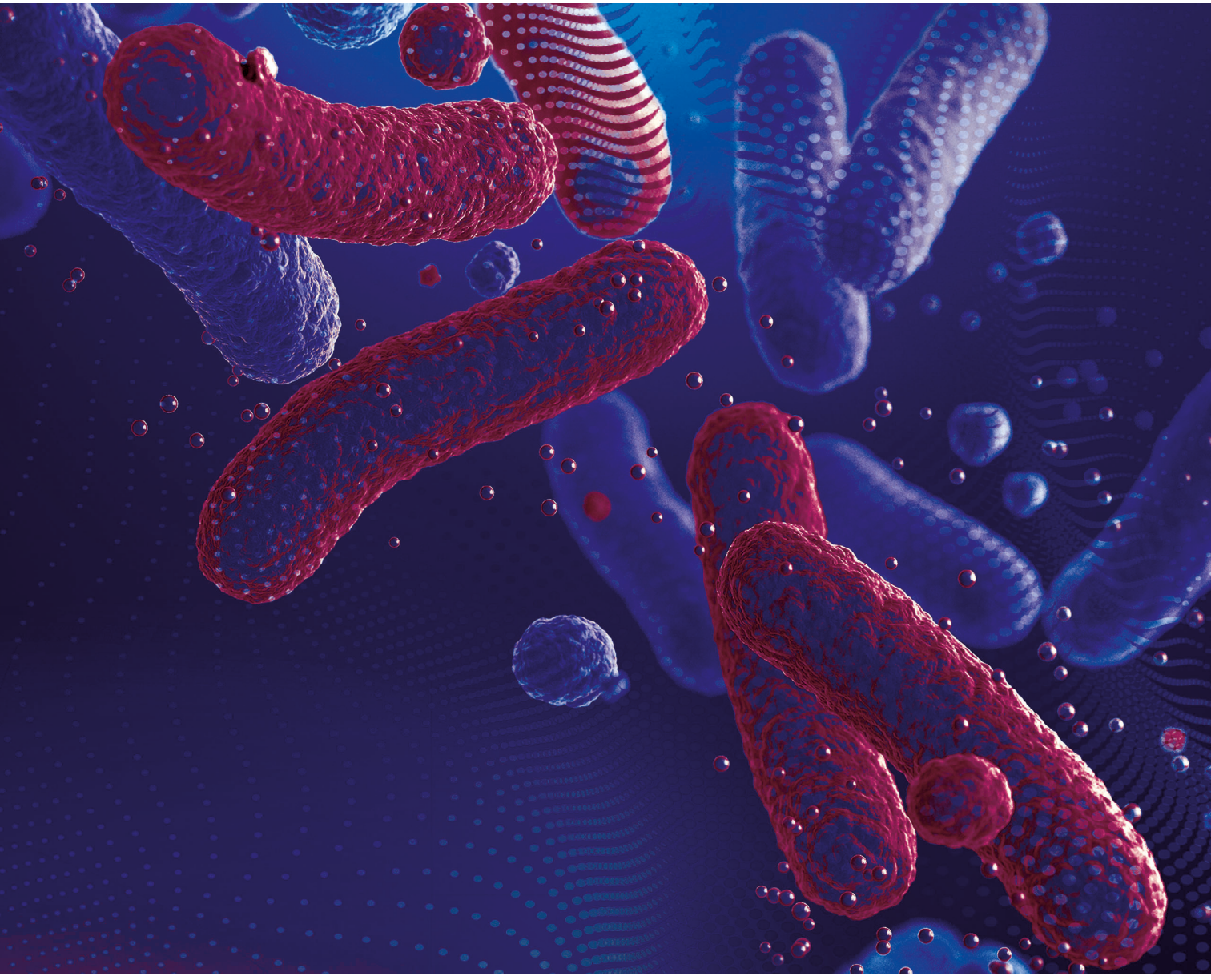
International guideline on antimicrobial stewardship and the role of microbial-binding dressings in wound care 2026:

infection prevention, control, early intervention and treatment



JWC journal of wound care

EXPERT PANEL ANTIMICROBIAL STEWARDSHIP IN WOUND CARE

essity

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MA Healthcare

Contents

Foreword

Antimicrobial stewardship (AMS) is a challenge for all healthcare professionals (HCPs) involved in infection control, prevention of progression and treatment of wound infection. The rising evidence of antimicrobial resistance (AMR) in both surgical and hard-to-heal wounds makes infections harder to treat and jeopardises the healing process, negatively impacting patients' lives and making this a global responsibility.

HCPs managing wounds should be asking 'Is the wound infected?' and, if so, 'How can the infection be responsibly treated?'. However, HCPs often lack the knowledge and confidence to identify infection by its signs and symptoms, differentiate it from inflammation and make a confident assessment and diagnosis. Likewise, wound care in clinical practice is variable and not always in alignment with AMS, with widespread use of antimicrobials in uninfected wounds.

Strengthening AMS and reducing AMR in wound care can preserve the effectiveness of antimicrobials, prevent complications and improve patient outcomes. However, this will require a shift in practice towards safe and early first-line interventions that minimise the microbial burden in a wound, manage local infection and prevent progression, with minimal antimicrobial requirements.

This guideline aims to meet the need for clear, credible and practical guidance on AMS in wound care. Its applications are intended to support clinical decision making and complement clinical judgement in a way that is relevant, accessible and implementable for HCPs across all settings, whether working with surgical incisions or hard-to-heal wounds. The guideline has been carefully developed through a rigorous, evidenced-based interdisciplinary process and is complemented with four standalone clinical pathways. Moreover, it is a living document, intended to evolve alongside the evidence with key updates on this fast-moving area of research.

The guideline builds the evidence for a shift towards early AMS-aligned intervention to control microbial burden before antimicrobials become necessary. All HCPs in wound care are encouraged to collaborate in advancing this evidence-based paradigm shift in infection prevention and control for the benefit of patients and colleagues now and in the future.

Abstract

Background: Wound microbial burden and infection can delay wound healing, increase complications and rapidly progress to spreading or systemic infection, particularly in high-risk patients. Early diagnosis and appropriate treatment are essential for improved outcomes and reduced antimicrobial resistance (AMR). AMR is a growing concern in wound care due to reported inappropriate use of topical antiseptics, as well as systemic antibiotics. A recent survey found 41.8% of healthcare professionals used antimicrobial prophylactically, against recommendations, while 37.2% did not follow antimicrobial stewardship (AMS) guidance, indicating a potential gap in best-practice treatment.

Aims: The primary aim of this document was to provide evidence-based guidance on the role of microbial-binding dressings (MBDs) in managing microbial burden, preventing infection and reducing the need for antimicrobial intervention in both surgical incisions and hard-to-heal wounds. The secondary aim was to summarise key findings in four clinical pathways.

Methods: This guideline was developed according to AGREE II with a pragmatic literature review with GRADE assessments and a modified Delphi process for developing evidence-based statements. The literature search asked: 'In adults with a wound or surgical incision, do MBDs, compared with standard care, reduce surgical site infections, microbial burden, signs of infection, antibiotic use, antiseptic dressing use, time to healing or complication rates?'. For the statements, a 10-member expert panel scored agreement from 1 to 5, over three rounds (two remote and one in person), with acceptance at a mean score of ≥4.00 (SD ≤1.00).

Results: The literature review returned 12 studies on surgical incisions and 17 on hard-to-heal wounds, varying in evidence level and certainty. From 13 original statements, strong agreement was reached for 14; nine in round one, two in round two and three in round three (in-person meeting), with one statement split into two prior to agreement. The statements fit three themes: challenges of wound infection and AMR; benefits of MBDs for infection prevention and control (IPC); and early IPC in future AMS strategies. The guideline presents each statement with supporting evidence and detailed guidance for implementation in practice. This is followed by four easy-to-use AMS clinical pathways to support practical implementation, decision-making and consistency in care, currently under evaluation, with further validation studies expected.

Conclusion: This guideline identifies and aims to meet a clear need for evidence-based best practice to enhance AMS in wound care. A paradigm shift towards infection prevention, early intervention and first-line treatment using MBDs should be considered an opportunity in everyday practice to minimise progression of infection, limit antimicrobial requirements and thus tackle the global threat of AMR.

Keywords: Antimicrobial stewardship, wound care, infection prevention and control, wound infection prevention and management, surgical and hard-to-heal wounds, early intervention, microbial-binding dressings

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Consent and approvals

No informed consent or institutional review board approvals were required for this research.

Contributions

Chair: Evidence review, statements, validation, writing of original draft preparation, review and editing
Co-chair: Conceptualisation, searches, evidence review, statement drafting, formal analysis, visualisation, writing original draft preparation, review and editing
Other authors: Validation, writing and review

Conflicts of interest

All panel members declared any direct and indirect conflicts of interest, which were not a barrier to participation. All panel members received a fee for their contribution to this guideline from the *Journal of Wound Care*. Febe Bruwer, Patricia Idensohn, Astrid Probst, George Smith, Zhavandre van der Merwe, Kevin Woo and Emma Woodmansey had received speaker and/or consultancy fees from Essity prior to this publication. Windy Cole, Bodo Günther, Klarida Hoxha, Vivek Lakshmanan and Paulo Ramos had no conflict of interest to declare.

Abbreviations

AGREE	Appraisal of Guidelines Research and Evaluation
AMR	Antimicrobial resistance
AMS	Antimicrobial stewardship
CDC	Centers for Disease Control and Prevention
CEAP	Clinical, Etiological, Anatomical Pathophysiological classification of venous disease
DRFU	Diabetes-related foot ulcer
GRADE	Grading of Recommendations Assessment, Development and Evaluation
HCP	Healthcare professional
IPC	Infection prevention and control
IWII	International Wound Infection Institute
MBD	Microbial-binding dressing
MDRO	Multi-drug-resistant organism
PI/PU	Pressure injury/pressure ulcer
PICO	Problem, Intervention, Comparison, Outcome
SINBAD	Site, Ischaemia, Neuropathy, Bacterial infection and Depth
SSI	Surgical site infection
VLU	Venous leg ulcer
WHO	World Health Organization
WIC	Wound Infection Continuum
WIFI	Wound Ischaemia Foot Infection

International guideline on antimicrobial stewardship and the role of microbial-binding dressings in wound care 2026: infection prevention, control, early intervention and treatment

Wound infection is a major burden for patients, delaying healing and impacting quality of life,[1–5] making it a major concern for the majority of healthcare professionals (HCPs).[6] Progression can lead to serious complications, including spreading infection, systemic involvement and even amputation or death,[1,7–9] requiring significant resources to treat.[10–12]

These challenges are amplified in infections caused by microbes that are resistant to antimicrobial treatment.[13,14] Infections with antimicrobial resistance (AMR) are more difficult to treat and increase risk of death, being associated with over 4.7 million deaths from 1990 to 2021, including an 80% increase in deaths in patients older than 70 years.[14] AMR, the process by which microbes (bacteria, fungi, parasites, viruses) evolve mechanisms to reduce the effectiveness of antimicrobials, develops in response to selective pressure from antimicrobial challenge and natural selection, particularly if antimicrobials are used inappropriately, increasing antimicrobial treatment failure and making infections more difficult to treat.[15] The global burden of AMR-related infection is predicted to rise by 2050,[14] placing it among the World Health Organization's top 10 threats to global health.[16]

These trends are mirrored in wound care, where both hard-to-heal[17–20] and surgical wounds[21–23] increasingly demonstrate complications driven by antimicrobial-resistant organisms. This burden is further exacerbated in clinical practice by the inappropriate use of antimicrobials, including topical antiseptics and systemic antibiotics, particularly when they are applied in the absence of infection.[24–28] Collectively, these challenges underscore the need for greater awareness of AMR-related issues in wound management.

Wound care has a widely identified need for greater antimicrobial stewardship (AMS).[29–33] AMS can be defined as a systematic, healthcare-wide approach to promoting the judicious, responsible use of antimicrobials as part of infection prevention and control (IPC) strategies,[34] to preserve their future effectiveness.[29,35,36] However, in a recent observational study only 33% of surgeons complied with AMS guidelines,[37] and a recent survey found 37.2% of HCPs did not follow AMS guidance in everyday practice.[28] These findings pave the way for new guidance on AMS in wound care.

This guideline is intended to overcome identified challenges posed by wound infection and AMR, including limitations of current practice and inappropriate use of antimicrobials, particularly where no local infection is observed.[28] Surveyed HCPs identified the need for support for making evidence-based decisions on antiseptic dressings, including clinical evidence demonstrating efficacy of new technologies (77.9%), guidance documents (71.6%) and pathways to support appropriate treatment (71.6%).[28] This document is intended to provide that evidence-led support for preventing and treating infection in closed surgical incisions and hard-to-heal wounds by presenting clinical evidence, guidance and pathways (*Figure 1*), thus supporting AMS.

Aims

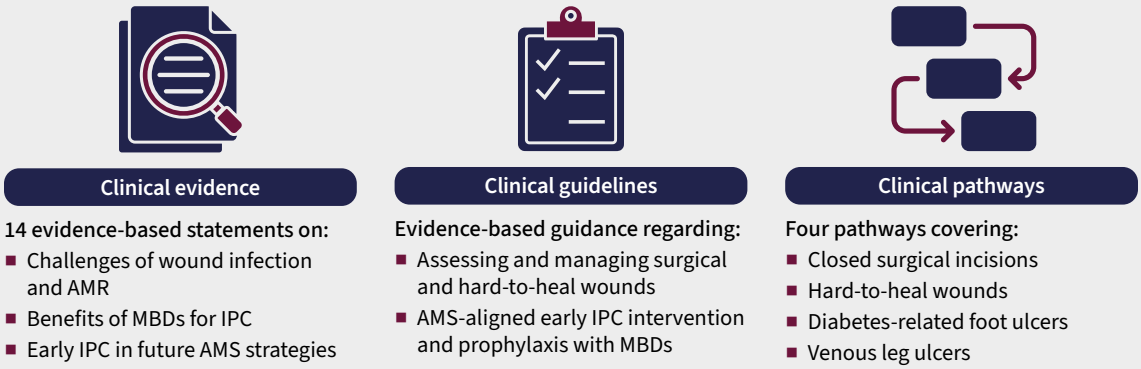
The primary aim of this document was to provide evidence-based guidance on the role of microbial-binding dressings (MBDs) in managing microbial burden, preventing infection and reducing the need for antimicrobial intervention in both surgical incisions and hard-to-heal wounds. The secondary aim was to summarise key findings in easy-to-use AMS clinical pathways to aid decision making and implementation in practice.

As a target population, this guideline is intended for all HCPs involved in wound care, including specialist and general nurses, general practitioners, surgeons, pharmacists, podiatrists, dermatologists, endocrinologists, geriatricians, infectious disease specialists, managers of wound care facilities and healthcare institutions, healthcare funders and those involved in IPC with a vested interest in reducing AMR and promoting AMS at regional, national and international levels.

Methods

The guideline was developed according to the Appraisal of Guidelines Research and Evaluation (AGREE II) instrument, which provided a rigorous, transparent and globally relevant methodological structure for reporting of objectives, panel membership, pragmatic literature searches and development of evidence-based statements and recommendations.[38,39] The development of this guideline was prompted by a global survey to identify the gaps and needs in AMR in clinical practice.[28]

Figure 1. Document components



Key: AMR=antimicrobial resistance; AMS=antimicrobial stewardship; IPC=infection prevention and control; MBD=microbial-binding dressing

Panel selection

To complete the 12-member panel, the chair and co-chair selected 10 voting members through a structured mapping process with the following criteria:

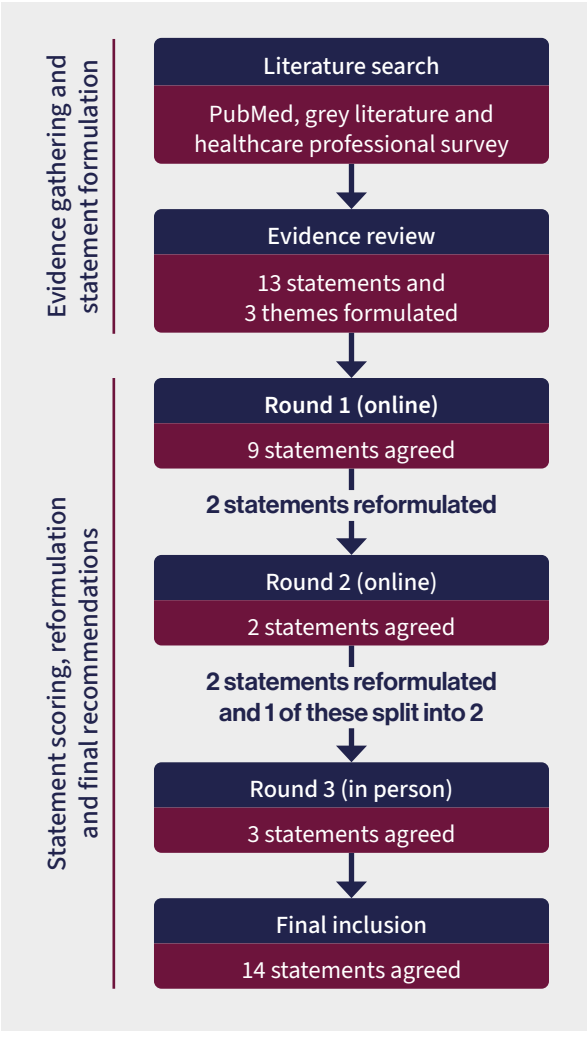
- **Clinical expertise:** demonstrated by publications, presentations and best-practice involvement covering hard-to-heal or surgical wounds
- **Deep knowledge:** including experience in guideline development, initiatives and professional education relevant to AMS in wound care
- **International representation:** covering five continents to ensure recommendations are applicable across diverse healthcare systems and cultural contexts
- **Multidisciplinary representation:** including specialist nurses, orthopaedic surgeons, a vascular surgeon, a podiatrist, a microbiologist, researchers and policy makers
- **Scientific weight:** recognised by academic contributions, research leadership and advocacy of IPC and AMS principles.

Literature review

The guideline development process (*Figure 2*) began with a pragmatic scoping literature review to inform statement development. The literature search was conducted via PubMed on 1 August 2025, and more recent literature was prioritised in the review (*Table 1*). A single reviewer was sufficient for a pragmatic review. It excluded paediatric patients, preclinical data, wound types other than those in the pathway, non-English language text and publications before 1990. The following PICO (Problem, Intervention, Comparison, Outcome) selection criteria were used to identify studies directly or indirectly aligned to the topic of AMS:

- **Population:** Adults with a wound or surgical incision
- **Intervention:** Dialkylcarbamoyl chloride (DACC) dressings (i.e. MBDs)
- **Comparator:** Standard care (various)
- **Outcomes:** Surgical site infection (SSI) prevention, microbial burden, signs and symptoms of infection,

Figure 2. Process for development and agreement of evidence-based statements



antibiotic use, antiseptic dressing use, wound healing, complications.

This resulted in the clinical question: 'In adults with a wound or surgical incision, do DACC dressings, compared with standard care, reduce SSIs, microbial burden, signs of infection, antibiotic use, antiseptic dressing use, time to healing or complication rates?'.

Studies were reported by evidence level (Oxford Centre for Evidence-Based Medicine),[40] and the certainty of evidence was assessed using the GRADE (Grading of Recommendations Assessment, Development and Evaluation) tool.[41]

Statement formulation

The initial statements were drafted by the chair and co-chair, based on published evidence. The statement themes encompassed core issues related to wound infection and AMR, particularly the inappropriate use of antimicrobials in wound care, and they explored how earlier intervention with MBDs could help align clinical practice with AMS principles.

A modified Delphi process[42] was used to develop and gain agreement on statements. The minimally acceptable response rate was 70% and all statements were scored using the Likert scale of 1–5 (1 strongly disagree to 5 strongly agree).[43] Consensus agreement for statements was defined as mean score of ≥4.00 and standard deviation of ≤1.00. Responses from round 1 were calculated by the co-chair and methodologist (EW). Quantifiable scoring was supported by capturing anonymous qualitative comments, including additional research. The chair (PI) and co-chair/methodologist (EW) did not participate in the scoring due to their involvement in statement development; all other panellists anonymously scored statements in each round. Agreed statements were removed from subsequent rounds. For rounds 1 and 2, statements were distributed to panel members and responses received using an electronic survey tool (Microsoft Forms). In round 2, statements for which consensus was not achieved were reformulated and circulated as described for round 1. The statements not agreed in round 2 were brought to the in-person meeting (round 3) for voting. At round 3, remaining areas lacking consensus were discussed and re-formulated statements finalised in a face-to-face meeting, with anonymous paper responses collated by the co-chair. The evidence base used to inform and support agreed statements was then linked and summarised, reflecting each of the subsections of the guideline. Traceability of modifications between rounds for each statement is shown in *Appendix 1*.

Table 1. Search terms

#	Search terms	Results
#1	((DACC)) OR (dialkylcarbamoyl chloride)	1433
#2	((((((((((((“Complex wound”) OR (“Chronic wound”)) OR (“Hard-to-heal wound”)) OR (“Non-healing wounds”)) OR (“Closed incision”)) OR (“Incision*”)) OR (“Surgical site*”)) OR (“Diabetic foot*”)) OR (“Venous ulcer”)) OR (“Venous leg ulcer”)) OR (“Pressure ulcer”)) OR (“Pressure injury”)) OR (“Dehisced surgical wound”)) OR (“Surgical wound”)	179558
#3	Combining searches #1 and #2 plus grey literature and company data/literature on any terms above	29

Note: The term 'microbial-binding dressing' was not included in the search as it had not yet been established

Guideline and pathway development and review

Following statement formulation, the full guideline document was drafted by the chair and co-chair, describing the guideline development process and exploring the evidence and recommendations in detail.

Building on the current guidance for infection prevention and management and to aid implementation in everyday clinical practice, the evidence-based recommendations were summarised in four clinical pathways for treating IPC and AMS in closed surgical incisions and hard-to-heal wounds, including specific pathways for diabetes-related foot ulcers (DRFUs) and venous leg ulcers (VLUs). The pathways are intended as easy-to-use quick reference guides and practical clinical decision-making algorithms to be used in combination with clinical judgement and best-practice guidelines.

The manuscript and pathways underwent several rounds of feedback from both the author panel and a panel of five external blinded reviewers until a final draft was approved by all stakeholders. Reviewers were selected by the journal based on suggestions from the sponsor and using the same criteria as the author panel. Review took the form of open-ended comments and questions, seeking to improve quality, gather feedback on draft recommendations, assess applicability and feasibility and disseminate evidence, which the panel considered in forming final recommendations and structuring the published document. The manuscript was approved by all stakeholders.

Results

Literature review

The literature review returned 12 studies on surgical incisions (*Table 2*) and 17 studies on hard-to-heal wounds, with levels of evidence ranging from 5 to 1a (*Table 3*). The study outcomes underwent GRADE assessment of certainty, with certainty levels ranging from very low to high (*Table 4* and *Appendix 2*).

Evidence-based statements

Of the 13 statements initially assessed by the panel, strong agreement was reached for nine in round 1, two in round 2 and three in round 3, with one statement split into two separate statements prior to agreement (for a total of 14). Overall, strong agreement was reached for 14 statements (*Table 5*). Statement iterations and modifications are shown in *Appendix 1*. The key points of each theme can be summarised as follows:

Table 2. Key evidence for use of microbial-binding dressings to control infection in surgical incisions

Author (date)	Title	Wound	Study type	Level of evidence	Controlled microbial burden	Cost saving	Improved healing	Infection prevention	Reduced antibiotic use	Reduced readmission
Magro and Ashfield (2025)[44]	Reducing surgical site infections and antibiotic prescribing after Caesarean section with the use of dialkylcarbamoyl chloride coated (DACC) dressings	Surgical (C-section)	Ambispective	2b		✓		✓	✓	✓
Rippon et al (2025)[45]	Use of DACC-coated wound dressings in the reduction of surgical site infection: a systematic review and meta-analysis	Surgical	SLR-MA	1a				✓		
Mulpur et al (2024)[46]	Dialkyl carbamoyl chloride (DACC)-impregnated dressings for the prevention of surgical site infection: experience from a multi-disciplinary study in India	Surgical	Non-comparative observational	3b				✓		
Magro (2023)[47]	Reducing surgical site infections post-caesarean section	Surgical (C-section)	Ambispective	2b		✓		✓	✓	✓
Wijetunge et al (2021)[48]	Advanced dressings for the prevention of surgical site infection in women post-caesarean section: a systematic review and meta-analysis	Surgical (C-section)	SLR-MA	1a				✓		✓
Jiang et al (2020)[49]	Evaluation of different surgical dressings in reducing postoperative surgical site infection of a closed wound: a network meta-analysis	Surgical (SSI)	SLR-MA	1a				✓		
Taylor et al (2020)[50]	Reducing SSI rates for women birthing by caesarean section	Surgical (C-section)	Ambispective	3b		✓		✓		
Totty et al (2019)[51]	A pilot feasibility randomised clinical trial comparing dialkylcarbamoyl chloride-coated dressings versus standard care for the primary prevention of surgical site infection	Surgical (vascular)	Pilot RCT	2b			✓	✓		
Bua et al (2018)[52]	Dialkylcarbamoyl chloride dressings in the prevention of surgical site infections after nonimplant vascular surgery	Surgical (vascular)	Non-concurrent comparative cohort	2b				✓		
Stanirowski et al (2016a)[53]	Dialkylcarbamoyl chloride-impregnated dressing for the prevention of surgical site infection in women undergoing cesarean section: a pilot study	Surgical (C-section)	Pilot RCT	2b				✓	✓	
Stanirowski et al (2016b)[54]	Randomised controlled trial evaluating dialkylcarbamoyl chloride impregnated dressings for the prevention of surgical site infections in adult women undergoing cesarean section	Surgical (C-section)	RCT	1b		✓		✓	✓	✓
Bullough (2012)[55]	The use of DACC-coated dressings for the treatment of infected, complex abdominal wounds	Surgical (open)	Case series	4	✓		✓		✓	

Key: RCT=randomised controlled trial; SLR-MA=systematic literature review and metaanalysis; level of evidence: 1=highest, 2=high, 3=medium, 4=low, 5=lowest

- **Challenges of wound infection and AMR:** SSI and infected hard-to-heal wounds remain a challenge for HCPs. Current guidance supports appropriate use of antiseptics and systemic antibiotics. However, fear of infection consequences leads many HCPs to use these antimicrobials when not indicated. Inappropriate use of antimicrobials can increase the risk of AMR.
- **Benefits of MBDs for IPC:** MBDs can support both infection prevention and management strategies by reducing microbial contamination and consequently risk of infection. Effective management of microbial burden with MBDs can reduce the requirement for antimicrobial use. These clinical impacts align with AMS principles and should support cost-savings.

Table 3. Key evidence for use of microbial-binding dressings to control infection in hard-to-heal wounds

Author (date)	Title	Wound	Study type	Level of evidence	Controlled microbial burden	Improved healing	Infection prevention	Reduced antibiotic use	Reduced signs and symptoms of infection
Nakamura et al (2025)[56]	Effect on bacterial load of a DACC-coated dressing as a wound contact layer in negative pressure wound therapy	HtHW, STSG	Prospective inpatient comparative	3b	✓				
Manas et al (2025)[57]	Treating diabetic foot ulcers with antimicrobial wound dressing impregnated with dialkylcarbamoyl chloride	DRFU	Prospective observational	3b	✓	✓		✓	
Lev-Tov (2024)[58]	Dialkylcarbomoyl chloride compared to silver dressing in treatment venous leg ulcers	VLU	Pilot RCT	2b		✓			
Sebayang (2024)[59]	Comparison of effectiveness of hydropobic Cutimed Sorbact versus cadexomer iodine 0.9% on healing of diabetic foot ulcer: a randomized control trial	DRFU	RCT	2b		✓			✓
Dissemond et al (2023)[60]	Aquacel Ag Advantage/ Ag+ Extra and Cutimed Sorbact in the management of hard-to-heal wounds: a cohort study	VLU, DRFU, PI	Retrospective audit/chart review	3b		✓		✓	✓
Malone et al (2023)[61]	In vivo observations of biofilm adhering to a dialkylcarbamoyl chloride-coated mesh dressing when applied to diabetes-related foot ulcers: a proof of concept study	DRFU	Prospective case series	3b	✓				
Williams (2022)[62]	The Leeds Wound Infection Framework: development and implementation of a new pathway to improve care	HtHW	Quality improvement	4				✓	
Seckam (2021)[63]	Clinical performance and quality of life impact of an absorbent bacteria-binding foam dressing	VLU/ DRFU	Multicentre observational	3b					✓
Mosti et al (2015)[64]	Comparative study of two antiseptic dressings in infected leg ulcers: a pilot study	Leg ulcers	RCT (pilot)	2b	✓			✓	
Gentili et al (2012)[65]	Panbacterial real-time PCR to evaluate bacterial burden in chronic wounds treated with Cutimed™ Sorbact™	AU/VLU	NCCS	3b	✓	✓			
Bruce (2012)[66]	Using Cutimed® Sorbact® Hydroactive on chronic infected wounds	HtHW	Multicentre case series	4		✓			✓
Skinner et al (2010)[67]	The diabetic foot: managing infection using Cutimed® Sorbact® dressings	DRFU	Case series	5			✓		
Johansson et al (2009)[68]	Open study on the topical treatment of interdigital fungal infections in diabetic patients	DRFU	NCCS	3b	✓				
Kammerlander et al. (2008)[69]	An investigation of Cutimed Sorbact as an antimicrobial alternative in wound management	HtHW	Observational	3b		✓			✓
Pirie (2009)[70]	Cutimed® Sorbact® gel: a new infection management dressing	Various LLU	Case series	5		✓			✓
Hampton (2007)[71]	An evaluation of the efficacy of Cutimed® Sorbact® in different types of non-healing wounds	HtHW	Case series	4		✓			✓
Mussi (2004)[72]	Clinical evaluation of Sorbact (bacteria adsorbing dressing) in the treatment of infected pressure sores	PI	Case-controlled comparative	3b		✓			✓

Key: AU=arterial ulcer; DRFU=diabetes-related foot ulcer; HtHW=hard-to-heal wound; LLU=lower leg ulcer; NCCS=non-comparative cohort study; PI=pressure injury; RCT=randomised controlled trial; VLU=venous leg ulcer; level of evidence: 1=highest, 2=high, 3= medium, 4=low, 5=lowest

- **Early IPC in future AMS strategies:** Inappropriate use of antimicrobials exists in some non-infected wounds, despite clear guidance on appropriate use. Using MBDs as the first choice of dressing in management of microbial contamination and local infection helps to minimise antiseptic and antibiotic use when not needed, thus reducing the risk of AMR and reserving antimicrobial use for when appropriate.

Discussion

The following discussion summarises the relevant published evidence supporting the guideline statements by theme.

Table 4. GRADE assessments of the certainty of literature review outcomes

Wound type	Studies	Certainty
Surgical incisions		
Controlled microbial burden	1	Low
Cost saving	3	Low/high
Improved healing	2	Low/high
Infection prevention	6	Moderate/high
Reduced antibiotic use	4	Low/high
Reduced readmission	2	Moderate/high
Hard-to-heal wounds		
Controlled microbial burden	6	Low/high
Improved healing	9	Low/high
Infection prevention	1	Very low
Reduced antibiotic use	4	Low/high
Reduced signs and symptoms of infection	8	Low/moderate

Key: GRADE=Grading of Recommendations Assessment, Development and Evaluation

Challenges of wound infection and antimicrobial resistance

Statements 1–6

1. Wound infection continues to be one of the biggest challenges facing HCPs in wound care[6,9,31,73–76]
2. The number of wound infections attributable to antimicrobial-resistant organisms could be underestimated[74,77]
3. AMR in wound care is a growing challenge[17–20,22,29,78–89]
4. Prevention of infection is one of the key focus areas for global AMR strategy[13,14,36,90–96]
5. Inappropriate use of antimicrobials has been reported in non-infected wounds not requiring intervention[24–28,97]
6. Inappropriate use of antimicrobials may increase the risk of AMR development[98–109]

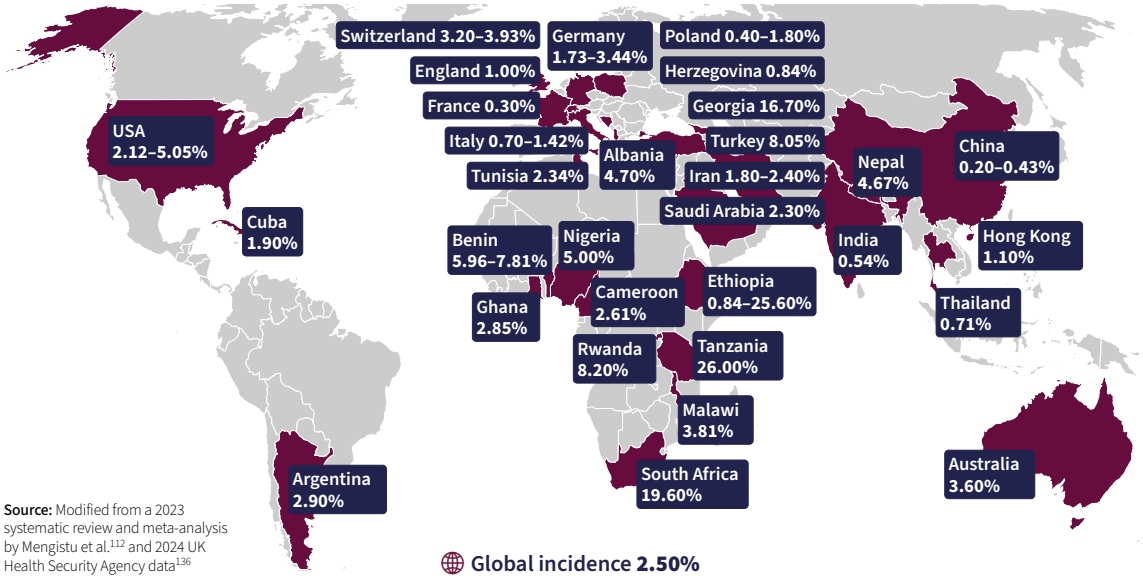
Wound infection is a challenge to healthcare globally, contributing substantially to delayed wound healing, increased wound care costs, negative impact on patient quality of life, morbidity and mortality.[1–5,7–12,110] Limited evidence on host–microbe interactions and infection progression challenges HCPs in identifying, diagnosing and managing wound infections.[24,111] There is a need for careful balancing of infection progression risk and appropriate management, with due consideration of the global impact of AMR.[24,111] The focus for this current guideline is surgical and hard-to-heal wounds given the increasing burden of both globally.

Table 5. Evidence-based statements by theme, Delphi round and agreement scores (mean±SD)

#	Statement	Round	Mean	SD
Theme: Challenges of wound infection and AMR				
1	Wound infection continues to be one of the biggest challenges facing HCPs in wound care	1	4.30	0.90
2	The number of wound infections attributable to antimicrobial-resistant organisms could be underestimated	2	4.10	0.94
3	AMR in wound care is a growing challenge	1	4.40	0.80
4	Prevention of infection is one of the key focus areas for global AMR strategy	1	4.50	0.67
5	Inappropriate use of antimicrobials has been reported in non-infected wounds not requiring intervention	1	4.60	0.49
6	Inappropriate use of antimicrobials may increase the risk of AMR development	2	4.60	0.49
Theme: Benefits of MBDs for IPC				
7	Microbial burden of a wound may be reduced using MBDs	1	4.60	0.49
8	Early intervention with MBDs decreases microbial burden, minimising risk of progression on the wound infection continuum	1	4.40	0.49
9	Incorporating MBDs into postoperative care bundles can significantly reduce the risk of (superficial) SSIs	1	4.40	0.49
10	Prevention of SSI using MBDs can result in reduced re-admission, treatment and hospital-stay costs	1	4.30	0.66
Theme: Early IPC in future AMS strategies				
11	Considering comprehensive wound care, reserving use of antiseptic dressings for covert and overt infection, combined with antibiotics for spreading and systemic infection, supports AMS	3	4.70	0.46
12a	Prophylactic prevention and control of microbial burden with MBDs may reduce the need for antibiotic therapy, supporting AMS	3	4.50	0.50
12b	Management of local infection with MBDs may reduce the need for antibiotic therapy, supporting AMS	3	4.50	0.50
13	MBDs should be considered a key part of IPC and AMS in wound care	1	4.70	0.46

Key: AMS=antimicrobial stewardship; AMR=antimicrobial resistance; HCPs=healthcare professionals; IPC=infection prevention and control; MBD=microbial-binding dressing; SD=standard deviation; SSI=surgical site infection

Figure 3. Global and national rates of surgical site infection (published 1996–2021)



Source: Modified from a 2023 systematic review and meta-analysis by Mengistu et al.[112] and 2024 UK Health Security Agency data[136]

Burden of surgical site infection

SSI has a global incidence of 2.5% (95% CI 1.6–3.7), varying by country (*Figure 3*).[112] Rates are highest in Sub-Saharan Africa, due to overcrowding of hospitals, inadequate IPC, understaffing and inappropriate use of restricted resources.[112–114]

SSI incidence can be much higher depending on patient risk factors, surgical location and procedure type (*Figure 4*).[112,115–126] Surveillance for SSI can also be variable, which may lead to an underestimate of actual rates.[128] They are the leading cause of postoperative readmissions[129,130] prolonged hospitalisation,[129–131] delayed wound healing[132] and increased wound dehiscence and scarring.[133,134] The number of deaths among people with an SSI directly attributable to the infection has been reported at around 30%.[129,130]

SSI is the most expensive hospital-acquired infection, with costs ranging from over $20 000 to $68 101 per person[129,135] and from $3.3 billion to $10 billion for the whole US healthcare system annually.[131] The long-term post-discharge impacts of SSIs on clinical outcomes and system costs are inadequately recognised,[129,130] and there are known environmental impacts that correlate with SSI severity.[12] Many SSIs are caused by AMR organisms.[21–23,113,122]

Prevention of surgical site infection

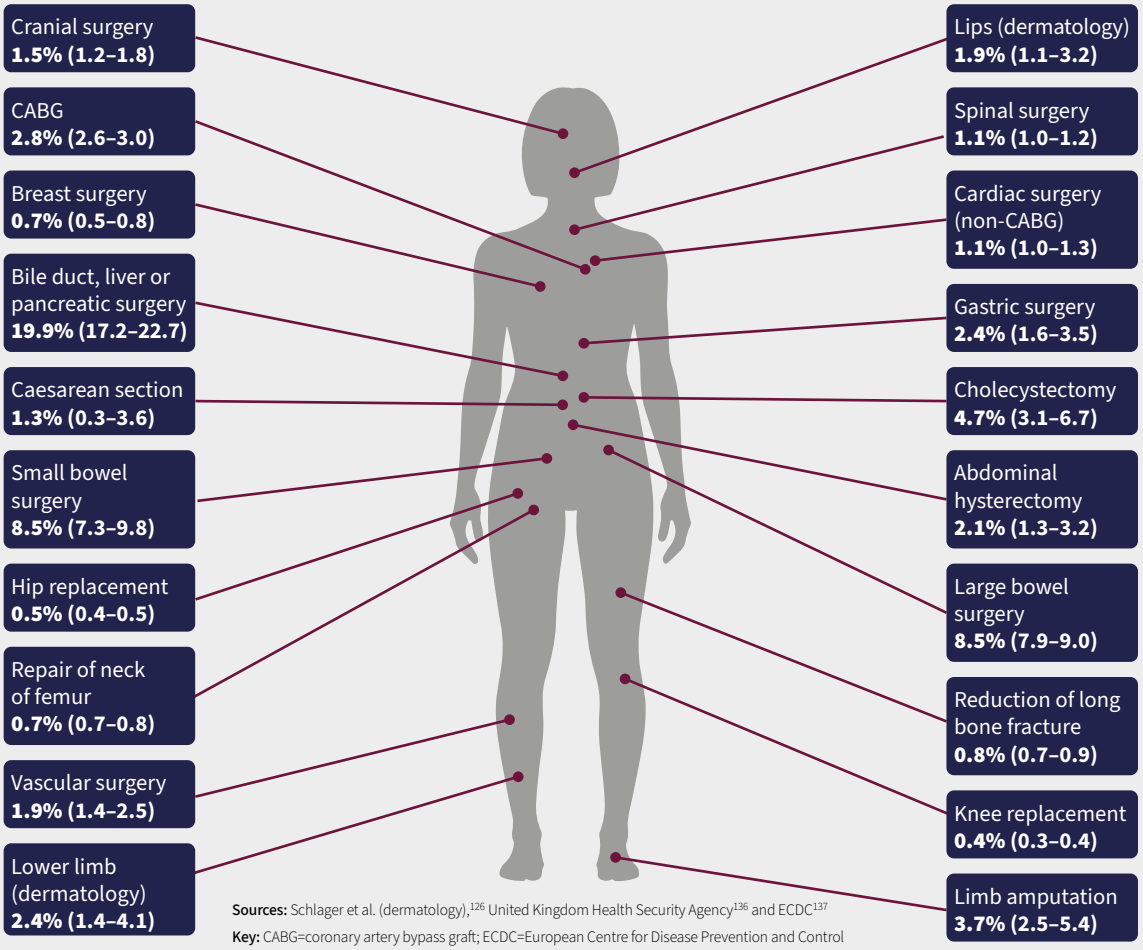
SSIs are mostly preventable,[138] and evidence-based interventions may prevent up to 50% of SSIs.[121] This makes infection prevention the priority of AMS.[31,34,95,122,139] To optimise patient safety and reduce unnecessary costs, clinicians should implement standardised evidence-based SSI prevention interventions, pre-, intra- and postoperatively, according to international guidelines.[121,122,138]

Reducing SSI risk begins pre-operatively by identifying risk factors using a structured risk assessment tool,[112,115–125] such as the American College of Surgeons online risk calculator.[140] However, existing risk-assessment tools tend to focus on cardiac procedures and morbidity and mortality outcomes, and there is a need for validated tools for assessing risk of SSI and dehiscence in most surgical populations.[141] Documenting details of the patient and procedure, including the wound contamination class (*Box 1*), provides prognostic indicators of complications and informs targeted risk-modification strategies.[119,122,142] Stratification into low, medium and high-risk groups may support treatment pathways.[123,124]

Risk stratification supports AMR by allowing prophylactic antibiotics to be restricted to appropriate high-risk patients or procedures,[121–123,143] avoiding unjustified use, including in the presence of surgical drains.[122,138] SSI risk can be lowered by optimising nutrition, maintaining wound and hand hygiene and applying sterile dressings,[31] with operative and postoperative aseptic technique being key to minimising the risk of SSI.[121,122,138]

Postoperatively, wound dressings can be applied to manage microbial colonisation locally before it progresses to local infection.[144] The limited guidelines on local wound management recommend a sterile interactive dressing (i.e. designed to protect against contamination and absorb exudate to maintain a moist healing environment),[138] which should be selected according to the wound characteristics, applied aseptically and left in place for a period determined by continuous assessment.[121,122,138] Most scenarios do not require advanced dressings, such as hydrocolloids and hydrogels. Limited evidence suggests that high-risk patients may benefit from gentle cleansing

Figure 4. Risk of surgical site infection by procedure (%)[126,136,137]



Sources: Schlager et al. (dermatology),[126] United Kingdom Health Security Agency[136] and ECDC[137]

Key: CABG=coronary artery bypass graft; ECDC=European Centre for Disease Prevention and Control

with antiseptic solutions and use of antiseptic dressings, but this must be balanced against the potential risk of AMR.[74,145] Postoperative dressings should be worn for 2–14 days, balancing the benefits of undisturbed healing with the need to remove sutures or manage presenting patient and wound factors (such as signs and symptoms of infection), including replacing exudate-saturated dressings.[146,147] In closed surgical incisions, systemic antibiotics should be reserved for where the patient or surgery presents a high risk of contamination.[121–123,143]

Assessment of surgical site infection

Effectively assessing and managing infected surgical incisions requires a structured approach to facilitate early recognition, appropriate treatment and prompt escalation of SSIs, which is imperative to avoid progression, readmission and sepsis.[8,122,138,148–150] For epidemiology, surveillance and diagnosis, SSIs are defined as an infection at a surgical site occurring within 30 days postoperatively (or 90 days if an implant is present).[119,147,148] Accurate definition, diagnosis and documentation of SSI are challenging and require expertise, time and resources.[122,138,148] Visual indicators of SSI may be less reliable with dark skin tones, which may delay diagnosis.[147,151] Differentiating between inflammation and SSI is also a challenge and may lead to unnecessary antimicrobial use and delayed healing.[31,147]

A comprehensive assessment of the incision, the patient and their preferences is necessary to align plans for IPC.[74] SSIs are classified by the US Centers for Disease Control and Prevention (CDC) criteria based on location and depth as superficial incisional, deep incisional or organ/space SSIs (*Box 2*).[119,148]

SSIs should be differentiated from other surgical wound complications, including surgical wound dehiscence (SWD), seroma, haematoma, incisional hernia, periwound maceration, medical adhesive-related skin injury and poor-quality scarring, as these vary in cause and management.[152,153] SWD is the separation of the margins of a closed surgical incision.[152] SWD increases SSI risk, and

SSI can cause SWD. However, SWD is not always caused by infection[152] and it may result from closure issues or mechanical stress in uninfected wounds. Inaccurately differentiating the cause of SWD can result in unnecessary antimicrobial use and AMR,[31,152] highlighting the need for AMS-aligned IPC in these open wounds.[152]

SSIs require swabs or tissue sampling for microbiological culture to guide the selection of targeted antibiotics or antifungals.[74,148] Semi-quantitative wound swabs following wound cleansing and debridement remain the mainstay of sampling due to their simplicity and routine availability[154] and should be performed with the Levine technique and as described by the International Wound Infection Institute (IWII).[74] Microbiological samples should be submitted with full clinical information to enable accurate analysis and ensure that laboratory results support clinically relevant decision making.[155]

If not managed appropriately, SSIs can progress rapidly to sepsis, a life-threatening condition in which the body's response to infection causes organ dysfunction, multiple organ failure and death.[8,149] Signs and symptoms of sepsis require urgent escalation, as sepsis is a medical emergency requiring immediate specialist assessment and management, including optimal antibiotics.[110,149,150,156] So care can be escalated, sepsis may be recognised early by looking for the subtle signs of fever (or hypothermia), tachycardia, tachypnoea, malaise/fatigue or local infection signs worsening. The following red-flag features indicate severe illness and require emergency intervention including urgent escalation:

S. Slurred speech/confusion
E. Extreme shivering or pain
P. Passing of low or no urine in 24 hours
S. Severe breathlessness
I. It feels like you are going to die
S. Skin that is mottled or discoloured.[149]

Management of surgical site infection

With limited guidance specific to surgical wounds,[157] management can follow the Tissue, Infection, Moisture balance and Edge TIME framework to support consistency and guide best practice.[158–160] SSI management should aim to readjust the interaction between the host and infecting pathogen and treat the cause of infection, while controlling pain and inflammation and remaining cognisant of AMS.[74,147] Deep or organ/space SSIs require systemic antibiotics, targeted to the causative organism according to resistance patterns and microbiology results, supporting the clinical judgment of the multidisciplinary team (MDT).[138]

With increased risk of infection in SWD, prevention and management aligned with AMS is necessary.[152]

The surgical-wound MDT may comprise surgeons and wound care specialists, supported by community nurses, GPs, podiatrists, microbiologists and dietitians.

Box 1. Wound contamination classes[119]

Clean (Class I): An uninfected operative wound in which no inflammation is encountered and the respiratory, alimentary, genital, or uninfected urinary tract is not entered. In addition, clean wounds are primarily closed and, if necessary, drained with closed drainage. Operative incisional wounds that follow nonpenetrating (blunt) trauma should be included in this category if they meet the criteria.

Clean-contaminated (Class II): An operative wound in which the respiratory, alimentary, genital, or urinary tracts are entered under controlled conditions and without unusual contamination. Specifically, operations involving the biliary tract, appendix, vagina, and oropharynx are included in this category, provided no evidence of infection or major break in technique is encountered.

Contaminated (Class III): Open, fresh, accidental wounds. In addition, operations with major breaks in sterile technique (e.g. open cardiac massage) or gross spillage from the gastrointestinal tract, and incisions in which acute, non-purulent inflammation is encountered are included in this category.

Dirty/infected (Class IV): Old traumatic wounds with retained devitalised tissue and those that involve existing clinical infection or perforated viscera. This definition suggests that the organisms causing postoperative infection were present in the operative field before the operation.

Box 2. Centres for Disease Control and Prevention (CDC) classification of surgical site infections (SSIs)[119,14]

Superficial incisional SSI: Involves only skin and subcutaneous tissue of the incision

Deep incisional SSI: Involves deep soft tissues of the incision (for example, fascial and muscle layers)

Organ/space SSI: Involves the organ/space tissues (deeper than the fascia/muscle)

Coordinating the MDT requires clear documentation and communication between centres, including verbal and written clinician referral and patient education at discharge.[125,157]

Burden of infected hard-to-heal wounds

Hard-to-heal wounds are wounds that fail to heal within an expected timeframe, and wounds that do

not reduce in size by at least 40%–50% in 4 weeks are less likely to heal by 12 weeks.[161–163] Hard-to-heal wounds, largely comprising VLUs, arterial leg ulcers, DRFUs and pressure ulcers/injuries, are an increasing global healthcare burden, affecting approximately 2% of the developed global population.[164] Hard-to-heal wounds are associated with increased mortality and reduced patient satisfaction among other negative impacts.[4,76,165–168] Patients may require hospital stays and ongoing management with specialist resources and interventions, such as wound dressings, antibiotics and surgeries.[162,169] This has significant implications for patient outcomes and healthcare resource use.[4,7,11,162,165,170] This cost is increased by complications such as infection and amputation, with an uninfected VLU costing at least 69% less than an infected wound, and amputations costing up to £16 900.[171] In the US, hard-to-heal wounds cost around $22.5 billion annually.[11]

Wound infection is a key cause of delayed healing in over 40% of hard-to-heal wounds.[172] A large cohort study showed healing in 59% of uninfected wounds compared with 45% of infected wounds.[170] More than half of DRFUs develop infection, which can progress rapidly without timely intervention; approximately 17% of infected DRFUs may require amputation;[76,171] and 80% of DRFU-related hospital admissions are due to infection.[171] Between 30% and 65% of VLUs may be infected on initial presentation,[173] and up to 38.1% develop a systemic infection.[174] Furthermore, hard-to-heal wounds are associated with increased bacterial counts, C-reactive protein levels, inflammatory cytokines and wound diameter.[73]

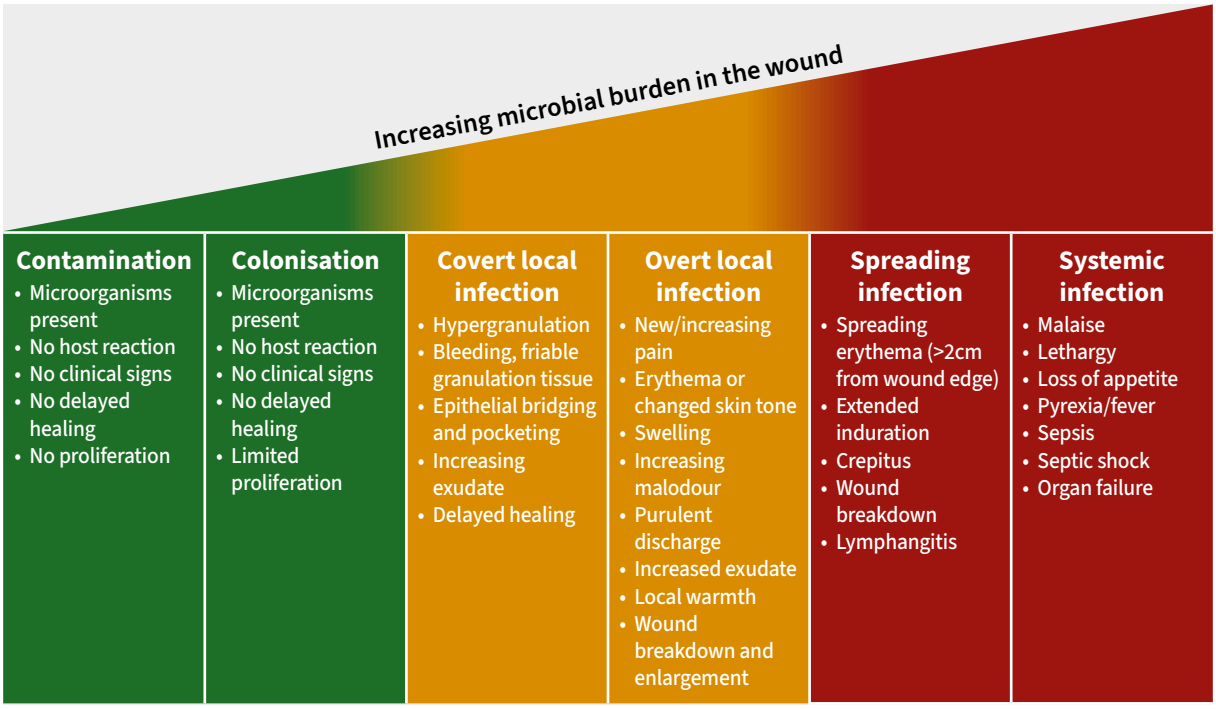
Assessment and diagnosis of infected hard-to-heal wounds

Hard-to-heal wounds, with or without infection, require regular assessment. This is imperative to accurately identify and manage the wound's underlying aetiology and increase the probability of wound healing.[74,158,175–177] Assessment should be holistic and multifactorial, taking an interdisciplinary approach and covering not just the wound but the whole patient, their vascular status and any contributing local, systemic, social and environmental factors.[74]

The IWII Wound Infection Continuum (WIC) is an educational tool that aims to standardise approaches to diagnosing infection in hard-to-heal wounds (*Figure 5*). This structured model divides the microbiological progression of wound infection into different stages according to severity and increasing microbial burden, from contamination to colonisation and local (covert and overt) infection to spreading and systemic infection. Observable clinical signs and symptoms are provided to help differentiate between these stages.[74]

Infection in hard-to-heal wounds can be a challenge to identify.[24,31,74] As there are limited routine diagnostic tests that accurately indicate infection,[178] diagnosis relies on the identification of multiple clinical signs and symptoms.[74,179,180] However, signs of infection such as redness (erythema) may be less visible in patients with darkly pigmented skin tones and therefore requires touch assessment for skin temperature, tissue consistency changes and swelling.[74,181,182] Differentiation between

Figure 5. International Wound Infection Institute Wound Infection Continuum[74]



uninfected and infected wounds is a challenge in patients with comorbidities, compromised immune systems, peripheral neuropathy or poor vascular perfusion, where covert local signs and symptoms of infection may be masked or muted.[74,183]

Diagnostic accuracy can be inconsistent in practice. In a retrospective multicentre audit, HCPs were unsure of the wound infection diagnosis, and they used antimicrobials in 35% of non-infected wounds and did not use them in 41% of infected wounds where indicated, despite gaining confidence in identification as the number of signs of infection increased.[24] Uncertainty in identification and diagnosis of infection led to the inappropriate use of antiseptic dressings.[24]

Infection in DRFUs is diagnosed by more than two clinical signs of infection and staged as low, mild, moderate and severe, according to the International Working Group for the Diabetic Foot (IWGDF) and the Infectious Disease Society of America (IDSA).[184] Infection is a key criterion in many DRFU scoring systems, including Wound Ischaemia foot Infection (WIfI)[185] and Site, Ischaemia, Neuropathy, Bacterial infection and Depth (SINBAD).[185–187] Severely infected DRFUs require additional tests, such as magnetic resonance imaging or x-ray, for progression of infection into deeper tissues and bone (osteomyelitis).[184] Equivocal clinical diagnosis may require measurement of serum inflammatory markers, such as C-reactive protein and erythrocyte sedimentation rate.[73,184] Osteomyelitis should be considered in any hard-to-heal wound with palpable or exposed bone.[188] If osteomyelitis is suspected, bone samples should be taken for culture and sensitivities and for histology.[184]

Spreading or systemic infections in hard-to-heal wounds require swabs or tissue sampling for a microbiological culture to target antibiotic or antifungal treatment.[184,189] Samples are ideally taken with a biopsy, although a swab may be more accessible.[154] Samples should be submitted with full clinical information.[155]

Sepsis requires urgent recognition, escalation and treatment, as described for SSIs.[110,149,150,156]

Managing infection in hard-to-heal wounds

Optimal management of microbial burden in wounds should be multifactorial, including therapeutic cleansing, debridement and dressings, alongside appropriate antimicrobial use.[74]

Hard-to-heal wounds anywhere on the WIC require wound bed preparation using the TIMERS framework.[74,158,160,183,190–193] Vigorous therapeutic cleansing of the wound zones should be performed before and repeated after debridement.[191,193] International guidelines recommend therapeutic cleansing with antiseptic solutions in patients with hard-to-heal wounds with signs and symptoms of local or spreading or systemic infection, as well as those at high risk infection in whom signs and symptoms of infection might be muted.[74,191] Wounds should be cleansed at every dressing change, as well as debrided and re-cleansed as indicated by an individual holistic assessment.[191,193] Debridement of devitalised (dead) tissue, which helps reduce the microbial burden and disrupt biofilm, should follow consensus recommendations on integral debridement.[190,193]

Interventions should be aligned with the WIC.[74] This means avoiding all antimicrobials on contaminated or colonised wounds, using antiseptics in local spreading and systemic infections, and reserving systemic antibiotics and antifungals for spreading and systemic infections.[194] Antibiotic use should follow strict evidence-based guidance, and antibiotics should be targeted to specific pathogen susceptibilities identified by wound culture once available.[74,184,194] Presence of osteomyelitis may require longer antibiotic treatment duration of 6 weeks or more,[184,188] although some studies report similar outcomes with 3 weeks' treatment.[195] Infected wounds may even require surgical intervention.[184]

Treatment effectiveness should be reviewed every 2 weeks, with a comprehensive reassessment of wound size, infection status and other indicators of healing progress to guide continuation, change or escalation of care.[196,197]

Burden of antimicrobial resistance in wound care

AMR due to misuse of antibiotics is reaching a crisis point across healthcare-related infections, with more infections caused by AMR-associated pathogens reported globally.[13,14,80] AMR infections are a major driver of morbidity, poor quality of life and mortality.[13] AMR-related deaths increased by up to 80% in people over 70 years old from 1990 to 2021 and are forecast to rise to 8.2 million by 2050.[14] AMR makes infections much more difficult and resource-intensive to treat,[198] costing up to $74 306[199] and adding 9.2 days of hospital care.[80]

These trends are also reflected in wounds with AMR-related skin infections leading to around 200 000 deaths in 2019.[13] Reported rates of AMR-related SSIs after gastrointestinal surgery include 16.6% in high-income and 35.9% in low-income countries.[85] SSIs caused by multi-drug-resistant organisms (MDROs) are associated with major post-operative complications, re-admissions and re-operations,[22] requiring additional resources that dramatically exacerbate management costs.[86] Despite the increasingly obvious implications of AMR in the surgical arena, AMS principles are inconsistently applied.[23,82] Antibiotics are given during or after 55% of surgical procedures, compared with 45% in medical practice.[200] This frequency increases further if a patient develops an SSI.[201] In a major UK hospital, antibiotics were prescribed more frequently, for longer and with less compliance to local policy in surgery than general medicine.[200]

In hard-to-heal wounds, up to 88% of isolates show resistance to an antibiotic and nearly 30% show resistance

to more than six antibiotics.[17] Hard-to-heal wounds are an independent risk factor for developing MDROs.[84] MDROs, such as methicillin-resistant *Staphylococcus aureus*, carbapenem-resistant *Pseudomonas aeruginosa* and extended-spectrum beta-lactamase-producing *Enterobacterales*, have been shown to be common in pressure ulcers/injuries.[87] AMR is common in DRFUs,[18,19,89] where MDROs prevalence is as high as 63%[88] and polymicrobial infections are common.[18,19] A recent meta-analysis in DRFUs found the highest frequency of AMR to a single antibiotic in *S. aureus*, closely followed by the Gram-negative *Pseudomonas* species, and to multiple antibiotics in *Acinetobacter* isolates.[89] VLU infections are common, and they are often caused by *P. aeruginosa*, which can be resistant to many antibiotics,[20] including carbapenems, the last-line treatment for many *P. aeruginosa* infections.[79] An Indian study of chronic leg ulcers observed *S. aureus* was the most common organism isolated (27%), followed by *P. aeruginosa* (17%). Among *S. aureus* isolates, 53% were methicillin-resistant. Among the Gram-negative isolates, extended spectrum beta lactamase (36%) and metallo-beta-lactamase (46%) production was highest among *Escherichia coli*.[83] AMR was detected against ciprofloxacin, gentamicin, ceftazidime and meropenem.[83] The true burden of AMR in wounds is likely to be underestimated, as wound sampling is not recommended for local infection, and is only indicated if a spreading or systemic infection is suspected.

Causes of antimicrobial resistance in wound care (limitations of current practice)

AMR results from widespread use of antibiotics, and the risk of AMR is greater in settings with high antibiotic use, such as intensive care, burn units and long-term care.[84,202,203] In wound care, high frequencies of antibiotic use have been reported across traumatic and postoperative wounds (78.3%), VLUs (66%) and pressure ulcers/injuries (36.4%).[25] Antibiotics are also often used, in many cases empirically, in DRFUs, where infection can progress rapidly.[88,184] A registry study found over 70% of hard-to-heal wounds were treated with antibiotics, although this was dramatically reduced to around 20–30% following initiation of a wound registry.[26] Moreover, hard-to-heal wounds often require repeated rounds of antibiotics due to recurrent infections.[25] The efficacy of antibiotics in hard-to-heal wounds is limited by the high prevalence of biofilms, which are inherently tolerant to antimicrobials.[204–208]

One factor that can increase the risk of AMR is prescribing the incorrect antibiotic for the infection, which has been reported in 41.8% of skin and soft-tissue infections.[27] Another factor is insufficient bioavailability of the antibiotic in the wound and surrounding tissue, giving microbes the opportunity to survive sub-therapeutic levels and develop resistance mechanisms. Bioavailability may be limited by comorbidities that limit perfusion, particularly in the peripheries, such as diabetes, vascular disease and oedema.[209] Bioavailability is also affected by patient weight, and dosage should be adjusted accordingly to maintain therapeutic levels.

The risk of AMR is also increased by inappropriate use of antiseptics. Using antiseptic dressings with insufficient concentrations of active agents can lead to selection for resistance.[109] Antiseptic dressings are often used where they are not indicated, with studies showing use rates of 35% in non-infected wounds[24] and 41.8% of all wounds on a just-in-case basis.[28] Microbes have been shown to develop resistance to antiseptics commonly used in wound care, including chlorhexidine gluconate and silver nitrate, mainly following laboratory exposure at below-therapeutic levels.[106,107,210] Triclosan may have a dual impact on AMR, with resistance to the antiseptic and augmentation of acquisition of resistance to antibiotics, based on limited in vitro data.[102] In addition, a recent review of resistance to some silver dressings in clinical scenarios reinforces the need for appropriate antiseptic use.[104] These studies highlight that antiseptics are not exempt from AMS principles, and their use should be guided by clear clinical indications, appropriate concentrations and defined treatment durations.

Benefits of microbial-binding dressings for infection prevention and control

Statements 7–10

7. **Microbial burden of a wound may be reduced using MBDs[55–57,61,64,65,68]**
8. **Early intervention with MBDs decreases microbial burden, minimising the risk of progression on the wound infection continuum[44–54,56,57,59,60,63–72]**
9. **Incorporating MBDs into postoperative care bundles can significantly reduce the risk of (superficial) SSIs[44–54]**
10. **Prevention of SSI using MBDs can result in reduced re-admission, treatment and hospital-stay costs[44,47,48,50,54,211,212]**

MBDs are wound dressings that support IPC and align with AMS principles, with a microbial-binding mode of action distinct from the microbicidal action of antiseptic dressings, by definition placing MBDs in its own unique category of dressings with an antimicrobial effect (*Box 3* and *Figure 6*).[213] MBDs irreversibly bind microbes to the dressing through interactions with a coating of the hydrophobic agent dialkylcarbamoyl chloride (DACC). The microbes are then removed from the wound.[214] This controls microbial burden, shifting the balance in favour of the host's immune response, minimising risk of progression and allowing healing to progress.[58,59,65,69,215,216] This is in contrast to absorbent dressings that are not indicated and have no clinical evidence for the management of wound infection.

Efficacy of microbial-binding dressings

The effectiveness of MBDs in IPC has been demonstrated in clinical evidence on both surgical incisions (*Table 2*) and hard-to-heal wounds (*Table 3*). Several studies on the use of MBDs show reduced microbial counts:

- Significantly reduced microbial count compared with silicone gauze (1.2 $\log_{10}$CFU reduction, p=0.0175) in hard-to-heal wounds requiring a split-thickness skin

graft over 7 days (MBD used under negative pressure wound therapy)[56]
- Significantly reduced microbial count of 73.1%, compared with 41.6% with a silver hydrofiber dressing ($p<0.00001$), in highly colonised leg ulcers (i.e. covert local infection) over 4 days, in a pilot randomised controlled trial (RCT)[64]
- Reduced bacterial load of 2.4 $\log_{10}$CFU/mg from biopsy samples of arterial and venous ulcers over 4 weeks (non-comparative)[65]
- Reduced fungal levels and no fungal growth in 45% of interdigital toe lesions (areas of damaged or abnormal tissue between the toes) in patients with diabetes by day 10.[68]

Another study showed bacterial load remaining stable where it might be expected to increase in infected DRFUs over 2 weeks.[61]

Observational studies have linked MBDs to improvements in clinical signs and symptoms of infection, including exudate,[55,63,66,71] odour,[55,66,71] slough,[66,67,70,71] necrotic tissue,[71] erythema/heat,[67,72,219] pain,[55,66,67,69,216] wound tissue[66,70,71] and peri-wound skin.[63,66] Such improvements can be useful indirect measures of efficacy, even if individual responses are influenced by comorbidities, immune response and medications.[220]

Early interventions for infection control

Studies also show that MBDs can help prevent infection from occurring by controlling microbial burden before it becomes an issue. RCTs have shown significant reductions in SSI rates when MBDs are used instead of standard care following C-sections[54] and vascular surgery.[51] Real-world evidence on incorporating MBDs into IPC care bundles has demonstrated similar SSI reductions in C-sections[44,47,50] and vascular,[52] orthopaedic and gastrointestinal surgeries.[46]

Box 3. Definitions of antimicrobial agents used in wound care

Antibiotics: Agents (traditionally organic, obtained from fungi or bacteria) used to inhibit or kill specific bacteria (based on target sites within bacterial cells). Examples include beta-lactams (penicillin, cephalosporin, carbapenem), aminoglycosides (gentamicin) and macrolides (erythromycin).

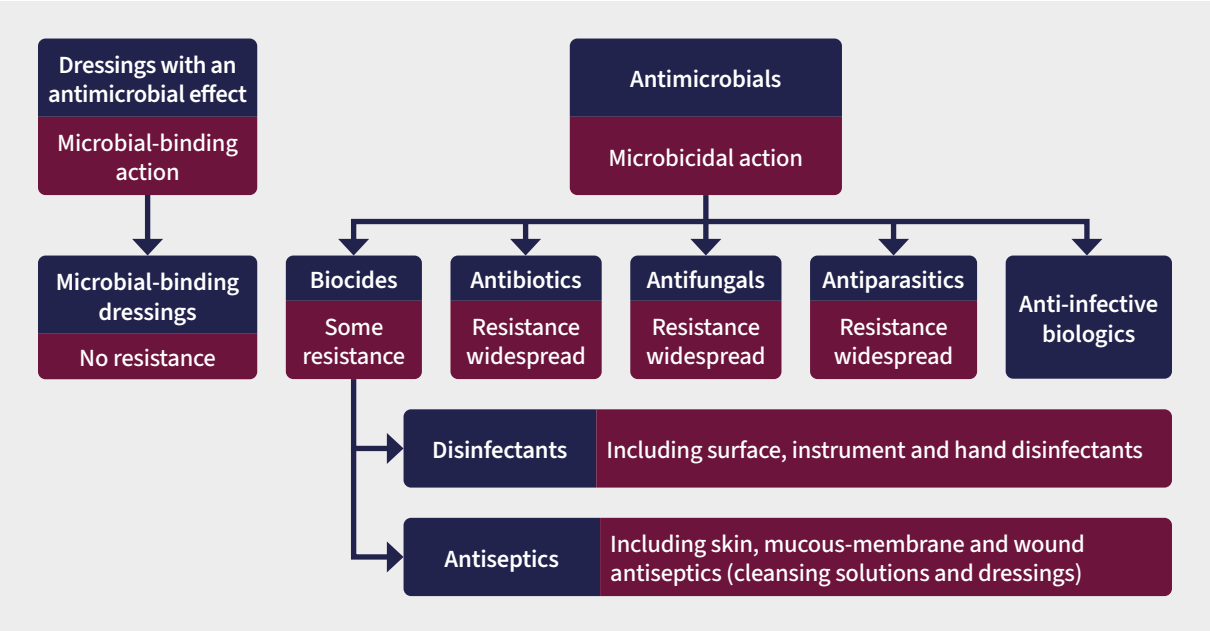
Antifungals: Agents (chemical) used to inhibit or kill fungal infections. Examples include azole compounds for superficial mycoses, amphotericin B for aspergillosis and flucytosine for systemic fungal infection.

Antiseptics: Biocides used topically on living tissue, such as skin. Examples include silver, iodine, polyhexamethylene biguanide, chlorhexidine gluconate, sodium hypochlorite and honey.

Biocides: Agents (chemical or organic) used to inhibit or kill a broad spectrum of microbes. Biocides include antiseptics and disinfectants, both of which typically have a effect on most microbes (including some spores).

Disinfectants: Biocides used on inert surfaces. Disinfectants are usually toxic to living tissue, such as skin.

Figure 6. Antimicrobial classification[217,218]



These data on SSI prevention have been systematically reviewed in three meta-analyses:

- One found that using MBDs instead of standard dressings almost halved SSI rates after C-section or vascular surgery (58.5%, OR 0.585, 95% CI 0.462–0.741)[45]
- Another found that using MBDs significantly reduced SSI rates following C-section in a sub-analysis comparing six advanced wound dressings (RR 1.20, 95% CI 0.77–1.88, p=0.41)[48]
- A wider network meta-analysis of nine dressings across 22 studies incorporating different surgery types further substantiated the impact of MBDs on reducing SSI risk compared with conventional dressings (OR=1.047, 95% CI 1.012–1.083, p=0.008)[49]

Prevention studies are more difficult in hard-to-heal wounds, which are often already colonised with microbes.[221,222] However, MBDs have been shown to prevent infection in DRFUs.[67]

Antimicrobial stewardship

As MBDs do not release any antimicrobial chemicals into the wound, genetic resistance development is not expected. This makes MBDs an AMS-appropriate option for routine early prophylactic use without contributing to AMR.

Moreover, the ability of MBDs to prevent the occurrence or progression of infection has been shown to reduce the subsequent need for antibiotics and the resulting selective pressure for AMR development, a key goal of AMS.[29,95] Use of MBDs after C-section has been shown to reduce antibiotic use compared with standard care,[44,47,53,54] including a 30% reduction in an ambispective study,[47] a significant decrease (0 vs 7%, p=0.03) in a pilot RCT[53] and a non-significant decrease (0% vs 1.5%) in a larger RCT by the same group.[54] Likewise, a pilot RCT found use of MBDs after vascular surgery reduced SSI rates and corresponding antibiotic use, compared with standard dressings.[51]

Similar reductions in antibiotic use have been reported in hard-to-heal wounds. A prospective observational trial in DRFU antibiotic use was reduced by 54% post MBDs compared to baseline.[57] These data reinforce the findings of a retrospective audit in DRFUs, VLUs and PUs who highlighted a marked reduction in antibiotic use for wounds managed with MBDs compared to silver hydrofiber dressings in both Germany and the USA (20% and 16% respectively).[60] Reductions in antibiotic prescribing following the introduction of MBDs as part of a framework for infected wounds within a NHS trust in the UK further substantiates this trend, with a concurrent reduction in spend across antiseptic dressings also, both supporting AMS initiatives.[62]

Cost benefits

Infection prevention reduces healthcare resource costs, such as re-admission to manage infectious complications. A hospital using MBDs after C-section reduced readmissions by 31% and saved £234 784 over the same 12 months.[47]

Other reports show annual savings of £21 548[212] and £163 816.[50] An economic analysis of an RCT found using MBDs after C-section reduced costs by 46.6%, driven by reductions in SSI cases, outpatient attendances and inpatient length of stay.[211] Adopting MBDs could generate annual NHS savings of £5.3 million in C-section and £1.2 million in vascular surgery, according to guidance from the National Institute for Health and Care Excellence (NICE).[223] MBD use can also save on antimicrobial product spend, with an infection wound pathway incorporating MBDs at a UK healthcare trust reducing spend on silver dressings alone by 47.7% (£124,894.54) within 1 year.[62]

Early infection prevention and control in future antimicrobial stewardship strategies

Statements 11–13

11. Considering comprehensive wound care, reserving use of antiseptic dressings for covert and overt infection, combined with antibiotics for spreading and systemic infection, supports AMS[31,74,183,194,197,224,225]

12A. Prophylactic prevention and control of microbial burden with MBDs may reduce the need for antibiotic therapy, supporting AMS[44,47,48,54]

12B. Management of local infection with MBDs may reduce the need for antibiotic therapy, supporting AMS[57,60,62,64]

13. MBDs should be considered a key part of IPC and AMS in wound care[31,218,224]

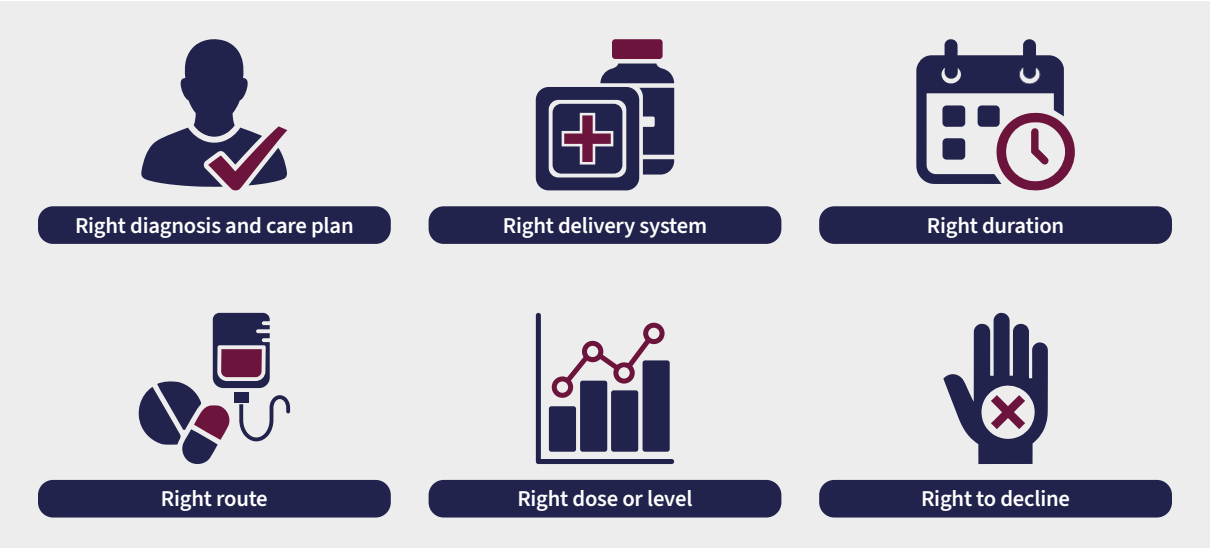
AMS is a systematic, healthcare-wide approach to promoting the judicious, responsible use of antimicrobials as part of IPC strategies, to preserve their future effectiveness.[29,35,36] AMS aims to minimise unnecessary antimicrobial use as the main driver of AMR.[30,74,224] To support AMS, HCPs must be able to distinguish between antimicrobial classifications, including antiseptics and antibiotics, and precise terminology in communication and documentation is essential to avoid errors in prescribing, use or reporting.[74,217] Moreover, all antimicrobials, including antiseptics and antibiotics, should be prescribed according to the 'Right Principles': the right diagnosis and care plan, right delivery system, right dose or level, right route, right duration and right to decline (*Figure 7*).[139,226–228]

Infection prevention

The most effective way to minimise the spread and impact of AMR in wound care is to negate the need for antimicrobials by preventing infections from occurring in the first place.[29] Infection prevention is supported by a recent European Wound Management Association (EWMA) AMS toolkit.[139] Minimising the risk of wound infection requires the implementation of globally recommended IPC principles,[34,95,122] including standard and transmission based precautions.[34] Infection risk is also minimised by optimal management of wounds to minimise microbial burden, disrupt biofilm and facilitate healing.[74,158,183,190,191]

Infection can be prevented by intervening prophylactically to reduce microbial burden in the early stages of the WIC.

Figure 7. 'Right' principles of antimicrobial use[139,226–228]



Early first-line prophylactic interventions should ideally comprise therapeutic cleansing, debridement and dressings that manage exudate and microbial burden, aligned with AMS. These interventions help manage moisture levels (avoiding desiccation or maceration), as well as control and remove microbes before they can overcome the body's defences, reducing microbial burden and tipping the balance in favour of the host.[222] This should prevent progression from contamination and colonisation to local, spreading and systemic infection, consequently minimising the need for antiseptics and antibiotics, both of which can contribute to AMR.[44,47,51,53,54,57,60,62,229] Prophylactic cleansing should be performed with inert solutions to avoid contributing to AMR.[191] The importance of early prophylactic intervention with MBDs is becoming increasingly recognised across surgery and wound care.[74,218]

Infection management

Managing infection in hard-to-heal wounds requires early multifactorial intervention to prevent progression, reduce microbial burden and facilitate healing. This includes standard wound care, such as the application of aseptic technique; therapeutic cleansing of the wound, periwound and surrounding skin; debriding devitalised tissue; managing inflammation and controlling infection; and maintaining a moist healing environment conducive to wound-edge advancement. Healing may be supported by patient optimisation, such as improving blood supply, offloading pressure or reducing oedema, as well as addressing local, systemic and social factors.[74,147,191,230] There is insufficient evidence to support the use of topical antibiotics in the management of hard-to-heal wounds.[183,184,231]

If local infection does occur, effective early intervention can prevent progression to a spreading or systemic infection that would require antibiotic therapy.[74,194] This includes the use of MBDs, which have been shown to markedly reduce signs and symptoms of local infection while avoiding AMR.[55,63,66,67,69–72,219] However, in infected wounds, selective use of effective antiseptic cleansing solutions and (second-line) antiseptic dressings may be necessary to reduce the microbial burden, thus supporting AMS by preventing progression and limiting unnecessary systemic antibiotics.[197,217,225,231] Conversely, inappropriate or prolonged use of these antiseptics may contribute to AMR and adverse effects.[104,197,225] Recent guidance for infected DRFUs recommends against using antiseptics to improve infection outcomes.[184]

When selecting dressings for IPC in wounds with local infection, MBDs should generally be used as the first-line option and exchanged for a second-line antiseptic dressing if first-line treatment fails (*Box 4* and *Table 6*). This would align with the routine practice of dividing some medications, especially antibiotics, into access and watch groups, based on an empirical balance between safety and effectiveness. The access group is prioritised for first-line use based on a balance between safety and effectiveness, and the watch group is reserved as a second-line alternatives if the first line fails. This approach, based on expert recommendations, would minimise antimicrobial overuse and integrate wound care into wider AMS practices across infectious disease and pharmacy specialists.[232]

Changing mindsets

Wound care needs a shift in mindset away from both inappropriate just-in-case antimicrobial use[28] and intervening only once infection has occurred. There is scope for further expansion of HCPs guidance on managing microbial burden in contaminated wounds before an infection fully develops. HCPs can be reassured that evidence shows early AMS-aligned prophylactic interventions, including MBDs, have a key and increasing role in IPC and AMS in surgical and hard-to-heal wounds.[31,144,224]

Table 6. Intervention recommendations based on the Wound Infection Continuum

Intervention	Contamination or colonisation	Covert or overt local infection	Spreading or systemic infection
Therapeutic cleansing[191]	Inert cleansing solutions*	Inert cleansing solutions or antiseptic cleansing solutions	Inert cleansing solutions or antiseptic cleansing solutions
Dressings	Microbial-binding dressings	Microbial-binding dressings (first line) or antiseptic dressings (second line)	Microbial-binding dressings (first line) or antiseptic dressings (second line)
Antibiotics[74]	No antibiotics	No antibiotics	Targeted antibiotics

Note: *Antiseptic cleansing solutions may be used in wounds at high risk of infection

Box 4. First- and second-line interventions for treating wound infection

Established use in antibiotics

- **First-line therapy:** Access-group antibiotics
- **Second-line therapy:** Watch-group antibiotics

Expanded use across wound care

- **First-line therapy:** Microbial-binding dressings
- **Second-line therapy:** Skin and wound antiseptics, with antibiotics or antifungals as appropriate in spreading or systemic infection

This indication-based approach requires regular review to optimise outcomes while conserving antimicrobial efficacy.[74,197] In practice, this approach needs to achieve a fine balance between the risk of AMR, the risk of infection development/progression and limitations on resources.

Clinical pathways

This guideline led to the development of four clinical pathways for AMS.

Rationale

Clinical pathways are interdisciplinary care frameworks aimed to translate evidence into practical guidance to improve clinical outcomes[234] by improving quality of care, reducing risks and improving how resources are allocated.[235] AMS pathways provide a structured approach to IPC for appropriate antimicrobial initiation optimisation and de-escalation, which supports targeted antimicrobial use and minimises the risk of AMR.[236] Evidence suggests that standalone, evidence-based, clinical pathway interventions support reduction of length of stay in hospitals and in-hospital complications and can increase clinical compliance with guidelines.[234]

The pathways presented are intended as simple, easy-to-apply, evidence-based tools to support and guide clinical decisions in the prevention and management of infection in surgical and hard-to-heal wounds. They emphasise application of AMS principles and strategies in daily IPC practice, including a shift to early intervention with MBDs to manage microbial burden and prevent development or progression of infection.

Box 5. Rationale for implementing clinical pathways for antimicrobial stewardship

Prevents development of infection: Early risk-factor identification and prophylactic intervention may prevent progression from colonisation to local infection and consequent complications

Reduces antimicrobial use: Preventive intervention to control microbial burden can reduce the use of antimicrobials

Reduces antimicrobial resistance: Minimising unnecessary antimicrobial exposure reduces selective pressure and emergence of resistant organisms

Improves patient outcomes: Early intervention and prevention can accelerate healing and reduce complications

Supports proactive care: Embedding early intervention shifts practice from reactive treatment to prevention

Reduces healthcare burden: Preventing infection decreases hospital admissions, resource use, complications and antimicrobial resistance

Adoption of these pathways should support clinicians to make decisions, provide consistent care and improve patient outcomes, among other key benefits (*Box 5*).[35] These pathways should serve as a guide to be used in combination with clinical judgement and best-practice guidelines. The pathways are intended to undergo clinical evaluation and validation.

The four clinical pathways cover the following areas:

- Closed surgical incisions
- Hard-to-heal wounds
- DRFUs
- VLUs.

Implementation

Successful implementation of these clinical pathways for AMS-aligned IPC requires consistent adoption, adaptation and integration into local organisational contexts for routine clinical practice.[35,237,238]

Table 7. Facilitators and barriers to implementation of clinical guidelines and pathways for antimicrobial stewardship in wound care

Domain	Facilitators	Barriers
Antimicrobial stewardship (AMS) education	**AMS alignment:** microbial-binding dressings (MBDs) can reduce microbial burden, avoiding unnecessary antimicrobial use, without contributing to AMR	**Knowledge gaps:** limited clinician awareness of AMS principles and MBD mechanisms can hinder appropriate use
Infection prevention and control (IPC) pathways	**Integration into existing pathways:** easy integration of MBDs into structured wound IPC pathways can ensure convenient, consistent and timely care	**Established prescribing habits:** reliance on antiseptics and systemic antibiotics can limit adoption of AMS-aligned interventions
Diagnosis	**Diagnostic education:** training can develop clinician competency and confidence to identify, assess and diagnose infection early	**Diagnostic uncertainty:** difficulty in identifying high risk or presence of wound infection can delay intervention
Patient factors	**Patient engagement:** Involving patients in their care and educating them to recognise infection signs can enhance adherence to effective preventive measures	**Variability adherence and engagement:** social, economic or health-related barriers can limit patient participation in preventive and curative care
Resources	**Resource availability:** local access to adequate staffing, equipment, microbiological support and MBDs facilitates consistent implementation	**Resource constraints:** limited access to MBDs, specialist services, staffing or microbiological support may hinder timely implementation
Monitoring and feedback	**Audit mechanisms:** tracking and feedback of antimicrobial use and AMR outcomes can encourage implementation and adherence, as well as support continuous quality improvement	**Workload pressures:** Adherence to sufficient accurate assessment, documentation and monitoring can be difficult under high clinical workloads
Multidisciplinary team	**Collaboration:** engagement of the team members and other stakeholders can ensure alignment, shared goals and coordinated care	**Communication gaps:** poor coordination, documentation and communication across teams can compromise continuity and effective pathway use
Institutional culture	**Institutional support:** a culture that values early intervention, infection prevention treatment and AMS as continuous improvement can encourage consistent adoption	**Resistance to change:** clinicians accustomed to reactive management may be slow to adopt early intervention and AMS-driven preventive approaches
Organisational leadership	**Organisational support:** inclusion of MBDs in local guidelines, formularies and AMS governance frameworks can promote sustained uptake	**Organisational variability:** system-level differences in policies, infrastructure and staffing may limit consistent implementation

This requires coordination across an MDT of surgeons, clinicians, nurses, clinical nurse specialists,[239] IPC practitioners, pharmacists, microbiologists, podiatrists and dermatologists, often alongside collaboration with other stakeholders, such as quality improvement teams, organisational leaders, policymakers, payers, healthcare funders and patients.[240,241] With so many stakeholders, clear communication is essential to ensure alignment, shared understanding and knowledge.[238,242] Wound care specialists are best placed to lead this collaboration, education and active engagement.[239] Decision-makers should be guided by the various facilitators and barriers that can influence the successful implementation of AMS pathways (*Table 7*).[35,144,236] Antimicrobial stewardship initiatives within wound infection should be addressed at government, organisational and clinical level to facilitate successful implementation (*Figure 8*).[197,218,225,243,255]

Applying these recommendations may initially increase resource use in the short term, particularly in staff time, training, dressing costs and local policy making. However, these investments are likely to be offset by longer-term cost-savings from reduced rates of infection, complications and antimicrobial use, leading to improved wound healing and other patient outcomes, as well as reduction in AMR.[47]

Box 6. Areas for monitoring and audit criteria

- Adherence to early intervention and prevention protocols
- Timely and appropriate use of microbial-binding dressings
- Adherence to infection control, such as septic technique and swabs only taken for targeted prescribing in spreading and systemic infection
- Documentation accuracy
- Patient and wound outcomes, including infection rates, extent of infection, dehiscence and time to infection resolution or wound healing
- Use of antiseptics, antibiotics and antifungals
- Surveillance for AMR organisms from wound isolates (if needed)
- Additional resource use, such as hospitalisations, readmissions, length of stay, visits, additional procedures, re-operations and nursing time

Figure 8. Antimicrobial stewardship initiatives

Government-level AMS initiatives

- Promote global regulation of prescription and supply of antimicrobials.
- Support global initiatives focused on reducing AMR.
- Promote awareness of AMR in the health and animal sectors and the general public.
- Support and stimulate ongoing research on AMR and development of new antimicrobial agents and innovative technologies shown not to induce AMR.

Organisational-level AMS initiatives

- Provide adequate funding and resources to support antimicrobial stewardship.
- Convene an AMS committee responsible for guiding and monitoring the use of antimicrobial agents in the facility.
- Develop institutional policies and procedures on the use of antimicrobial agents based on global guidance.
- Adopt, adapt and implement international AMS guidelines in wound management pathways, for best clinical practice.
- Facilitate accurate diagnosis of wound infection with appropriate policies, resources and care pathways.
- Monitor trends in microbial sensitivities in the facility.
- Audit antimicrobial prescribing and patterns of use.
- Monitor and publish incidence of wound infection, types of wounds being managed with antimicrobial agents and their effectiveness.
- Provide regular education to all stakeholders on AMR and AMS.

Clinical-level AMS initiatives

- Educate patients, their families and HCPs regarding AMR and responsible use of antimicrobials.
- Use MBDs to prevent wound infection and the progression of wound infection.
- Use MBDs as first-line management of wound infection.
- Avoid the use of skin and wound antiseptics as a prophylactic therapy, except for wounds identified at high risk of infection.
- Sample wounds for microbiological culture and sensitivities only when an antibiotic/antifungal is indicated (i.e. spreading or systemic infections).
- Only use antibiotics when a wound has been clinically identified as spreading or systemic infection.
- Base antibiotic selection on identification of the infecting organisms.
- Select an antibiotic agent with narrow-spectrum activity where possible.
- Reserve broad-spectrum agents for more-resistant bacterial infections where possible.
- Continue use of antibiotic therapy for an appropriate duration to prevent development of AMR.
- Monitor clinical response to guide ongoing selection and use of antimicrobials.
- Implement international AMS guidelines in wound management pathways into clinical practice.

Key: AMR=antimicrobial resistance; AMS=antimicrobial stewardship; HCP=healthcare professional; MBD= microbial-binding dressing

Source: Adapted with permission from the International Wound Infection Institute 2022 guidelines on wound infection in clinical practice[74]

Monitoring

Regular feedback and review of the application of these pathways in individualised wound care can identify gaps in the criteria, reinforce consistent adoption and support continuous improvement (*Box 6*).

Limitations

A systematic review process would have greater authority than the rigorous pragmatic literature review conducted. The generalisability of the recommendations is limited by the variable strength of evidence and heterogeneity of wound types covered, as well as the focus on English-language literature. The scope is limited to adults and is specific to MBDs only, with little detail on other dressing types. The pathways would be strengthened by prospective validation and inclusion of specific pathways for additional wound aetiologies, to be addressed in future updates. This guideline and its recommendations could influence future research, such as further comparative, implementation and validation studies.

Conclusions

Early intervention against wound microbial burden, including prophylactic use of MBDs, has been shown to minimise development and progression of infection, along with consequent requirements for antibiotic and antiseptic use. This supports a paradigm shift towards an IPC approach to reinforce AMS in wound care.

This guideline, based on a pragmatic literature review and evidence-based statements, advocates best-practice AMS principles and detailed guidance. The practical application of these principles is supported by four clinical pathways, intended as simple tools to guide clinical decisions, in combination with clinician judgement and best-practice guidelines (*Appendix 3*), in everyday IPC across closed surgical incisions and hard-to-heal wounds.

IPC in accordance with AMS principles is a professional responsibility for everyone working in wound care, fulfilled through diligent, evidence-based practice. HCPs should work with wound care teams and the wider MDT, including IPC, pharmacy and infectious disease specialists, to demonstrate how implementing this guideline and the pathways can support AMS and ultimately improve patient outcomes.

Glossary

Advanced wound dressing: Dressings that actively modify the local wound environment to support healing through, for example, moisture management, facilitating gas exchange and/or antimicrobial effects

Antimicrobial: Agent that kills (microbicidal) or stops the growth of (microbiostatic) microorganisms

Antimicrobial effect: Reduction in the microbial burden and/or reduction in the clinical signs and symptoms of infection by removal of microorganisms

Antimicrobial resistance: Evolution by microorganisms of mechanisms to reduce antimicrobial effectiveness, in response to selective pressure from antimicrobial challenge and natural selection, particularly in inappropriate antimicrobial use, increasing antimicrobial treatment failure and making infections harder to treat

Antimicrobial stewardship: Systematic, healthcare-wide approach to promoting the judicious, responsible use of antimicrobials as part of infection prevention and control strategies, to preserve their future effectiveness

Clinical, Etiological, Anatomical, Pathophysiological classification of venous disease (CEAP): International assessment tool for chronic venous disorders, with 12 categories from C0 to C6r

Hard-to-heal wound: Wound that fails to progress through normal stages of healing within an expected timeframe as a result of multiple local and systemic factors

Infection prevention and control: Evidence-based, practical approach to prevent the development and spread of harmful, often healthcare-associated, infections among patients, staff and visitors

Infection: The presence of multiplying organisms which overwhelm the body's immune system resulting in a host response evident in clinical signs and symptoms

Infectious Disease Society of America: Organisation that provides globally relevant evidence-based guidelines, resources and insights on the prevention and treatment of infectious diseases (www.idsociety.org)

Integral debridement: Approach to debridement recognising that some methods are sufficient alone and others require an adjunct to be effective, as well as that methods should be matched to need and availability

Interactive wound dressing: Wound dressings designed to interact with the wound by maintaining a local moist environment at the wound surface, with selection and duration of use guided by ongoing clinical assessment

International Working Group for the Diabetic Foot: Global, multidisciplinary expert group that has developed guidelines for preventing, managing and reducing the burden of diabetes-related foot diseases through structured, evidence-based care (https://iwgdfguidelines.org)

International Wound Infection Institute: A group for healthcare professionals with an interest in wound infection supporting education and tools to support appropriate infection management in wound care (https://woundinfection-institute.com)

Microbial-binding dressing: Non-medicated, hydrophobic wound dressings that physically bind and remove bacteria and fungi, reducing wound microbial burden without releasing active agents

Sepsis: Life-threatening condition in which the body's response to infection causes organ dysfunction, multiple organ failure and death

Site, Ischaemia, Neuropathy, Bacterial infection and Depth (SINBAD): Validated international assessment tool for diabetes-related foot ulcers, with scores ≥3/6 indicating a more severe/complicated ulcer

Surgical site infection: Infection occurring at or near a surgical incision within 30 days of the procedure (or within 90 days if prosthetic material was implanted)

Surgical wound dehiscence: Separation of the margins of a closed surgical incision, with or without exposure or protrusion of underlying tissue, organs or implants

Therapeutic wound cleansing: Cleansing of the wound bed, wound edge, periwound and surrounding skin, before and after debridement, performed diligently, at times vigorously and considering individual holistic needs, using appropriate techniques, solutions and sequencing

Wound Ischaemia foot Infection (WIfI): Risk-assessment tool for diabetes-related foot ulcers, comprising three factors (wound severity, perfusion and infection) and four stages (0–3), predicting 1-year major amputation risk and potential revascularisation benefit

ANTIMICROBIAL STEWARDSHIP PATHWAY: CLOSED SURGICAL INCISIONS

Assess risk

Assess patient and procedure complication risk factors (see over)[1–12]
Initiate pre- and intra-operative SSI prevention measures per local protocol[9–11]

0–1 risk factors → low risk	2 risk factors → medium risk	≥3 risk factors → high risk
		Prophylactic antibiotics if indicated[10–13]

Prevent

Dress wound immediately after closure to minimise microbial burden and infection risk[14–22]
Change dressings as required prior to wound progress check-up, per instructions for use

Standard dressings or microbial-binding dressings[15–21*] in low-risk patients	Microbial-binding dressings[15–21*] in medium-risk patients	Microbial-binding dressings[15–21*] and antibiotics per local guidance in high-risk patients

Assess

Assess for infection according to CDC classification[8,10,22,23]
Are there one or more of the criteria below within 30 days of surgery (90 days with prosthetics/implants)?

Superficial SSI Involving only skin and subcutaneous tissue of the incision	Deep SSI Involving deep soft tissue	Organ/space SSI Involving anatomy other than the incision
• Positive culture • Increased pain and tenderness • Localised swelling and induration • Localised heat and redness of the incision • Purulent drainage • Cellulitis not beyond 2 cm of incision margin • Evident superficial wound abscess • Superficial dehiscence • No evidence of deep or organ/space SSI	• Positive culture • Increased pain, erythema and heat • Spreading induration and swelling • Purulent drainage • Cellulitis spreading ≥2 cm beyond margin • Evident deep abscess or fasciitis • Deep dehiscence • Postoperative fever • Raised blood CRP, WBC, ESR or PCT • No evidence of organ/space SSI	• Positive culture • Purulent drainage from a drain placed through skin into the organ or body space • Organ or body-space abscess diagnosed by radiology or histopathology • Evidence of infection involving organ or body space observed during surgery • Postoperative fever • Raised blood CRP, WBC, ESR or PCT

Consider signs of sepsis (see over)[24]

Treat

Treat SSI and/or surgical wound dehiscence, including appropriate dressings[15–21,25–28]
Including wound bed preparation (therapeutic cleansing, debridement and repeat cleansing)[22,28]

Control microbial burden in surgical wound dehiscence without infection	Treat superficial SSI	Treat deep or organ/space SSI
• **First-line:** Microbial-binding dressings[15–21*]	• **Referral:** Surgical referral • **First-line:** Microbial-binding dressings[15–21*] • **Second-line:** Antiseptic dressings[28]	• **Referral:** Urgent surgical referral • **Culture:** Swab or tissue/fluid sample[23] • **Antibiotics:** Targeted systemic antibiotics used with dressings[26,28] • **First-line:** Microbial-binding dressings[15–21*] • **Second-line:** Antiseptic dressings[28]

Review

Assess patient and wound with TIME at every visit and re-evaluate treatment after 2 weeks[2,3,15–21]
Is the infection resolved or wound improving?

Notes: *Microbial-binding dressings have a DACC coating that can control microbial burden to prevent or manage infection in a way that is not expected to contribute to antimicrobial resistance. All treatments should be used per local policy and where clinically appropriate. This pathway applies to closed surgical incisions healing by primary intention. See over for supplementary tables, abbreviations and references.

Risk factors for SSIs[5–13]

Patient risk factors

- Advanced age
- Chronic liver or kidney disease
- Diabetes
- Immunosuppression (drug induced or genetic)
- Malnutrition
- Obesity
- Pre-operative nasal colonisation with *Staphylococcus aureus*
- Respiratory conditions
- Smoker/nicotine use
- Steroid use
- Drug/alcohol abuse/addiction

Surgical procedure risk factors

- Anatomical location of surgery (consult guidance for specifics)
- Classification of surgery as clean, clean/contaminated, contaminated or dirty
- Complexity of surgical procedure
- Emergency procedure
- Interruption of asepsis during surgery
- Introduction of a prosthetic implant
- Prolonged duration of surgery

Signs of sepsis[24]

Sepsis is a life-threatening condition in which the body's response to infection causes injury to its tissues and organs. Organ dysfunction is a key component in any diagnosis of sepsis.

Act on any of the following red flags:

- **S.** Slurred speech or confusion
- **E.** Extreme shivering or muscle pain
- **P.** Passing no urine (in a day)
- **S.** Severe breathlessness
- **I.** It feels like you are going to die
- **S.** Skin mottled or discoloured

Abbreviations: CDC=Centers for Disease Control and Prevention; CRP=C-reactive protein; DACC=dialkylcarbamoyl chloride ESR=erythrocyte sedimentation rates; PCT=pro-calcitonin; SSI=surgical site Infection; TIME=Tissue, Infection/inflammation, Moisture balance, Edge/epithelialisation; WBC=white blood cell.

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Guidance

Centers for Disease Control and Prevention (2025)
Surgical site infection

International Surgical Wound Complications Advisory Panel (2025)
Guideline for post-operative incision care

International Wound Infection Institute (2022)
Wound infection in clinical practice

World Health Organization (2018)
Global guidelines for the prevention of surgical site infection

World Union of Wound Healing Societies (2018)
Surgical wound dehiscence: improving prevention and outcomes

DACC™-coated dressings instructions for use

ANTIMICROBIAL STEWARDSHIP PATHWAY: HARD-TO-HEAL WOUNDS

Assess

Perform holistic patient and wound assessment with TIMERS (see over)[1–7]
Is the wound infected? Do you observe two or more clinical signs and symptoms?

Contamination	Colonisation	Covert local infection	Overt local infection	Spreading infection	Systemic infection
• Microorganisms present • No host reaction • No clinical signs • No delayed healing • No proliferation	• Microorganisms present • No host reaction • No clinical signs • No delayed healing • Limited proliferation	• Hypergranulation • Bleeding, friable granulation tissue • Epithelial bridging and pocketing • Increasing exudate • Delayed healing	• New/increasing pain • Erythema or changed skin tone • Swelling • Increasing malodour • Purulent discharge • Increased exudate • Local warmth • Wound breakdown and enlargement	• Spreading erythema (>2cm from wound edge) • Extended induration • Crepitus • Wound breakdown • Lymphangitis	• Malaise • Lethargy • Loss of appetite • Pyrexia/fever • Sepsis • Septic shock • Organ failure

Increasing microbial burden in wound

Consider signs and symptoms of biofilm: covert infection, recurrent infections, low-level chronic inflammation/erythema or antimicrobial treatment failure[6]

Consider signs of sepsis (see over)[7]

Treat

Perform wound bed preparation (therapeutic cleansing, debridement and repeat cleansing)[8,9]
Is there a need for a dressing for infection control or treatment?

Control microbial burden in wound contamination or colonisation	Treat covert or overt local wound infection	Treat spreading or systemic wound infection
• **First-line:** Microbial-binding dressings[10–14*]	• **Referral:** Consider specialist referral • **First-line:** Microbial-binding dressings[10–14*] • **Second-line:** Antiseptic dressings[1]	• **Culture:** Swab or biopsy[1] • **Referral:** Specialist referral • **Antibiotics:** Targeted systemic antibiotics used with dressings[1,15] • **First-line:** Microbial-binding dressings[10–14*] • **Second-line:** Antiseptic dressings[1]

Review

Assess patient and wound with TIMERS at every visit and re-evaluate treatment after 2 weeks[1–7]
Is the infection resolved or wound improving?

Notes: *Microbial-binding dressings have a DACC coating that can control microbial burden to prevent or manage infection in a way that is not expected to contribute to antimicrobial resistance. All treatments should be used per local policy and where clinically appropriate. See over for supplementary tables and references. Aetiology-specific varients of this pathway are available for diabetes-related foot ulcers and venous leg ulcers.

Abbreviations: DACC=dialkylcarbamoyl chloride; TIMERS=Tissue, Infection/Inflammation, Moisture balance, Edge/epithelialisation, Regeneration and repair, Social factors

DACC™-coated dressing[s] instructions for use

Aspects of a holistic patient assessment in hard-to-heal wounds – adapted from TIMERS[1–6]

Patient assessment
- Comorbidities
- Current medication
- Functionality and mobility
- Nutritional assessment
- Skin assessment (including skin tone)
- Social factors
- Surgical and medical history

Local assessment
- Ankle brachial index, toe brachial index and toe systolic pressure (lower leg)
- Oedema
- Skin perfusion
- Skin temperature
- Surrounding skin condition
- Transcutaneous oxygen pressure
- Vitals

Wound assessment
- Aetiology and classification
- Imaging as appropriate
- Location, duration, size and depth
- Odour
- Pain (see guidance)
- Periwound condition
- Previous investigations and treatments
- Tissue biopsy (if appropriate in ≥3 months duration or atypical presentation)
- Tissue types on wound bed (necrotic, sloughy, granulation or epithelial)

Risk factors for wound infection – adapted from the International Wound Infection Institute[1,15,16]

Patient risk factors
- Alcohol, smoking or illicit drug use
- Conditions associated with hypoxia or poor perfusion (e.g. anaemia, cardiac disease, respiratory disease, peripheral arterial disease, renal impairment or rheumatoid arthritis)
- Connective tissue disorders (e.g. Ehlers-Danlos syndrome)
- Corticosteroid use
- Immune disorders (e.g. acquired immune deficiency syndrome)
- Lymphoedema
- Malnutrition or obesity
- Neuroarthropathy
- Peripheral arterial disease (including ischaemia)
- Peripheral neuropathy (sensory, motor and autonomic)
- Poor adherence to treatment plan
- Poorly controlled diabetes
- Radiation therapy or chemotherapy

Wound risk factors
- Atypical aetiology[18]
- Duration of wound
- Foreign body presence (e.g. drains, sutures or wound dressing fragments)
- Haematoma
- Impaired tissue perfusion
- Increased exudate and oedema that is not adequately managed
- Involvement of tissue deeper than skin and subcutaneous tissues (e.g. tendon, muscle, joint or bone)
- Necrotic or sloughy wound tissue
- Probing to bone
- Wounds over bony prominences

Environmental risk factors
- Hospitalisation (due to increased risk of exposure to antimicrobial-resistant microorganisms)
- Inadequate hand hygiene and aseptic technique
- Inadequate management of moisture (e.g. due to exudate, incontinence or perspiration)
- Unhygienic environment (e.g. dust, unclean surfaces, or presence of mould/mildew)

Signs of sepsis[7]

Sepsis is a life-threatening condition in which the body's response to infection causes injury to its tissues and organs. Organ dysfunction is a key component in any diagnosis of sepsis.

Act on any of the following red flags:

S. Slurred speech or confusion
E. Extreme shivering or muscle pain
P. Passing no urine (in a day)
S. Severe breathlessness
I. It feels like you are going to die
S. Skin mottled or discoloured

Guidance

European Wound Management Association (2024)
Holistic management of wound-related pain

International Wound Infection Institute (2022)
Wound infection in clinical practice

1. International Wound Infection Institute. Wound infection in clinical practice: principles of best practice – Wounds International. 2022. **2.** Atkin L et al. J Wound Care. 2019;28:S1–50. **3.** Fletcher J et al. Wounds UK. 2018;1–24. **4.** Conte MS et al. Eur J Vasc Endovasc Surg. 2019;58:S1–S109. **5.** Isoherranen K et al. J Wound Care. 2019;28:S1–92. **6.** Schultz GS et al. Wound Rep Regen. 2017;25:744–757. **7.** UK Sepsis Trust. Spotting the signs of sepsis. 2025. **8.** Haesler E et al. Wounds Int. 2025;1–52. **9.** Schultz GS et al. Wound Rep Regen. 2003;11:S1–28. **10.** Bjarnsholt T et al. Wounds Int. 2020;1–32. **11.** Blackburn J et al. Int Wound J. 2025;22:e70684. **12.** Cole W et al. Wounds. 2025;37:S1–S24. **13.** Mosti G et al. J Wound Care. 2015;24:121–127. **14.** Rippon MG et al. J Wound Care. 2021;30:284–296. **15.** Assadian O et al. J Wound Care. 2023;32:3–4. **16.** García Nores GD et al. J Invest Dermatol. 2018;138:325–335

ANTIMICROBIAL STEWARDSHIP PATHWAY: DIABETES-RELATED FOOT ULCERS

Assess

Perform holistic patient and wound assessment with TIMERS (see over)[1–12]
Is the wound infected? Do you observe two or more clinical signs and symptoms?

Urgently consult vascular team and IDT in exposed bone/tendon, osteomyelitis (MRI/x-ray) or CLTI (TBPI <0.4)

Contamination	Colonisation	Covert local infection	Overt local infection	Spreading infection	Systemic infection
• Microorganisms present • No host reaction • No clinical signs • No delayed healing • No proliferation	• Microorganisms present • No host reaction • No clinical signs • No delayed healing • Limited proliferation	• Hypergranulation • Bleeding, friable granulation tissue • Epithelial bridging and pocketing • Increasing exudate • Delayed healing	• New/increasing pain • Erythema or changed skin tone • Swelling • Increasing malodour • Purulent discharge • Increased exudate • Local warmth • Wound breakdown and enlargement	• Spreading erythema (>2cm from wound edge) • Extended induration • Crepitus • Wound breakdown • Lymphangitis	• Malaise • Lethargy • Loss of appetite • Pyrexia/fever • Sepsis • Septic shock • Organ failure

Increasing microbial burden in wound

Consider signs and symptoms of biofilm: covert infection, recurrent infections, low-level chronic inflammation/erythema or antimicrobial treatment failure[5]

Consider signs of sepsis (see over)[6]

IDSA/IWGDF uninfected[12]	IDSA/IWGDF mild–moderate[12]	IDSA/IWGDF severe[12]

Treat

Perform wound bed preparation (therapeutic cleansing, debridement and repeat cleansing)[10–16]
Is there a need for a dressing for infection control or treatment?

Control microbial burden in wound contamination or colonisation	Treat covert or overt local wound infection	Treat spreading or systemic wound infection
• **First-line:** Microbial-binding dressings[17–24*]	• **Referral:** Consider specialist referral • **First-line:** Microbial-binding dressings[17–24*] • **Second-line:** Antiseptic dressings[1]	• **Referral:** Surgical referral • **Culture:** Swab or tissue/bone sample[1,12] • **Antibiotics:** Targeted systemic antibiotics (longer and stronger in osteomyelitis) used with dressings[1,12,25] • **First-line:** Microbial-binding dressings[17–24*] • **Second-line:** Antiseptic dressings[1]

Review

Assess patient and wound with TIMERS at every visit and re-evaluate treatment after 2 weeks[1–12]
Is the infection resolved or wound improving?

Notes: *Microbial-binding dressings have a DACC coating that can control microbial burden to prevent or manage infection in a way that is not expected to contribute to antimicrobial resistance. All treatments should be used per local policy and where clinically appropriate. See over for supplementary tables and references.

Abbreviations: CLTI=critical limb-threatening Ischaemia; CRP=C-reactive protein; DACC=dialkylcarbamoyl chloride; ESR=erythrocyte sedimentation rates; IDSA=Infectious Diseases Society of America; IDT=interdisciplinary team; IWGDF=International Working Group on the Diabetic Foot; TBPI=toe brachial pressure index; TIMERS=Tissue, Infection/Inflammation, Moisture balance, Edge/epithelialisation, Regeneration and repair, Social factors

DACC™-coated dressings instructions for use

Aspects of a holistic patient assessment in diabetes-related foot ulceration – adapted from TIMERS[1–5,7–12]

Patient assessment
- Comorbidities
- Current medication
- Functionality and mobility
- Nutritional assessment
- Skin assessment (including skin tone)
- Social factors
- Surgical and medical history

Foot assessment
- Neuropathic assessment
- Oedema
- Pallor
- Pulses
- Skin perfusion
- Skin temperature
- TBPI/toe systolic pressure
- Transcutaneous oxygen pressure
- Vitals

Wound assessment
- Charcot foot
- DFU stage (Wagner, Texas, SINBAD or WIfI)
- Imaging as appropriate (CT, MRA, duplex)
- Location, duration, size and depth
- Odour
- Pain (nociceptive or neuropathic)
- Periwound condition
- Previous investigations and treatments
- Tissue types on wound bed (necrotic, sloughy, granulation or epithelial)

Risk factors for wound infection – adapted from the International Wound Infection Institute[1,25–47]

Patient risk factors
- Acute kidney injury/disease
- Alcohol, smoking or illicit drug use
- Conditions associated with hypoxia or poor perfusion
- Connective tissue disorders (e.g. Ehlers-Danlos syndrome)
- Corticosteroid use
- Immune disorders (e.g. acquired immune deficiency syndrome)
- Lymphoedema
- Malnutrition or obesity
- Neuroarthropathy
- New/worsening azotaemia and electrolyte abnormalities
- Peripheral arterial disease (inc. ischaemia)
- Peripheral neuropathy (sensory, motor and autonomic)
- Poor adherence to treatment plan
- Poorly controlled diabetes
- Radiation therapy or chemotherapy
- Severe/worsening hyperglycemia or acidosis

Wound risk factors
- Duration of wound
- Foreign body presence (e.g. drains, sutures or wound dressing fragments)
- Haematoma
- Impaired tissue perfusion
- Increased exudate and oedema that is not adequately managed
- Large or deep wounds
- Necrotic or sloughy wound tissue
- Penetration to subcutaneous tissues (fascia, tendon, muscle, joint or bone)
- Previous ulceration or amputation
- Probing to bone
- Traumatic aetiology
- Wounds over bony prominences

Environmental risk factors
- Hospitalisation (due to increased risk of exposure to antimicrobial-resistant microorganisms)
- Inadequate hand hygiene and aseptic technique
- Inadequate management of moisture (e.g. due to exudate, incontinence or perspiration)
- Interface pressure that is inadequately offloaded
- Unhygienic environment (e.g. dust, unclean surfaces, or presence of mould/mildew)

Signs of sepsis[6]

Sepsis is a life-threatening condition in which the body's response to infection causes injury to its tissues and organs. Organ dysfunction is a key component in any diagnosis of sepsis.

Act on any of the following red flags:

S. Slurred speech or confusion
E. Extreme shivering or muscle pain
P. Passing no urine (in a day)
S. Severe breathlessness
I. It feels like you are going to die
S. Skin mottled or discoloured

1. International Wound Infection Institute. Wound infection in clinical practice: principles of best practice – Wounds International. 2022. **2.** Atkin L et al. J Wound Care. 2019;28:S1–50. **3.** Fletcher J et al. Wounds UK. 2018;1–24. **4.** Conte MS et al. Eur J Vasc Endovasc Surg. 2019;58:S1–S109. **5.** Schultz GS et al. Wound Rep Regen. 2017;25:744–757. **6.** UK Sepsis Trust. Spotting the signs of sepsis. 2025. **7.** Wagner FW. Foot Ankle. 1981;2:64–122. **8.** Mills JL et al. J Vasc Surg. 2014;59:220–234. **9.** Treece KA. Diabet Med. 2004;21:987–991. **10.** ElSayed NA et al. Diabetes Care. 2025;48:S252–S265. **11.** Fitridge R et al. Diabetes Metab Res Rev. 2024;40:e3686. **12.** Senneville É et al. Diabetes Metab Res Rev. 2024;40:e3687. **13.** Bus SA et al. Diabetes Metab Res Rev. 2024;40:e3647. **14.** Chen P et al. Diabetes Metab Res Rev. 2024;40:e3644. **15.** Haesler E et al. Wounds Int. 2025;1–52. **16.** Schultz GS et al. Wound Rep Regen. 2003;11:S1–28. **17.** Johansson A et al. J Wound Care. 2009;18:470–473. **18.** Mañas CR et al. J Wound Care. 2025;34:278–284 . **19.** Sebayang et al. J Wound Res Technol. 2024;1:28–37. **21.** Bjarnsholt T et al. Wounds Int. 2020;1–32. **22.** Blackburn J et al. Int Wound J. 2025;22:e70684. **23.** Cole W et al. Wounds. 2025;37:S1–S24. **24.** Rippon MG et al. J Wound Care. 2021;30:284–296. **25.** Assadian O et al. J Wound Care. 2023;32:3–4. **26.** García Nores GD et al. J Invest Dermatol. 2018;138:325–335. **27.** Brocklehurst JD et al. Adv Skin Wound Care. 2023;36:1–5

Classification and guidance

Treece et al (2023)
SINBAD classification

Bus et al (2024)
IWGDF guidelines on offloading foot ulcers in persons with diabetes

Chen (2024)
IWGDF guidelines on interventions to enhance healing of foot ulcers in people with diabetes

El-Sayed et al (2025)
American Diabetes Association standards of care in diabetes

Fitridge et al (2024)
Intersocietal guidelines on peripheral artery disease in people with diabetes and a foot ulcer

International Wound Infection Institute (2022)
Wound infection in clinical practice

Mills et al (2014)
WIfI classification

Monterro-Soares et al (2024)
IWGDF guidelines on the classification of foot ulcers in people with diabetes

ANTIMICROBIAL STEWARDSHIP PATHWAY: VENOUS LEG ULCERS

Assess

Perform holistic patient and wound assessment with TIMERS (see over)[1–12]
Is the wound infected? Do you observe two or more clinical signs and symptoms?

Urgently consult vascular team in CLTI, DVT, severe PAD, severe calcification or severe cardiac insufficiency

Contamination	Colonisation	Covert local infection	Overt local infection	Spreading infection	Systemic infection
• Microorganisms present • No host reaction • No clinical signs • No delayed healing • No proliferation	• Microorganisms present • No host reaction • No clinical signs • No delayed healing • Limited proliferation	• Hypergranulation • Bleeding, friable granulation tissue • Epithelial bridging and pocketing • Increasing exudate • Delayed healing	• New/increasing pain • Erythema or changed skin tone • Swelling • Increasing malodour • Purulent discharge • Increased exudate • Local warmth • Wound breakdown and enlargement	• Spreading erythema (>2cm from wound edge) • Extended induration • Crepitus • Wound breakdown • Lymphangitis	• Malaise • Lethargy • Loss of appetite • Pyrexia/fever • Sepsis • Septic shock • Organ failure

Increasing microbial burden in wound

Consider signs and symptoms of biofilm: covert infection, recurrent infections, low-level chronic inflammation/erythema or antimicrobial treatment failure[6]

Consider signs of sepsis (see over)[7]

Treat

Perform wound bed preparation (therapeutic cleansing, debridement and repeat cleansing)[10–14]
Is there a need for a dressing for infection control or treatment?

Control microbial burden in wound contamination or colonisation	Treat covert or overt local wound infection	Treat spreading or systemic wound infection
• **First-line:** Microbial-binding dressings[15–19*]	• **Referral:** Consider specialist referral • **First-line:** Microbial-binding dressings[15–19*] • **Second-line:** Antiseptic dressings[1]	• **Referral:** Surgical referral • **Culture:** Swab or biopsy[1] • **Antibiotics:** Targeted systemic antibiotics used with dressings[1,20] • **First-line:** Microbial-binding dressings[15–19*] • **Second-line:** Antiseptic dressings[1]

Review

Assess patient and wound with TIMERS at every visit and re-evaluate treatment after 2 weeks[1–12]
Is the infection resolved or wound improving?

Notes: *Microbial-binding dressings have a DACC coating that can control microbial burden to prevent or manage infection in a way that is not expected to contribute to antimicrobial resistance. All treatments should be used per local policy and where clinically appropriate. See over for supplementary tables and references.

Abbreviations: CEAP=Clinical, Etiological, Anatomical Pathophysiological Classification of Venous Disease; CLTI=critical limb-threatening ischaemia; DACC=dialkylcarbamoyl chloride; DVT=deep vein thrombosis; PAD=peripheral arterial disease; TIMERS=Tissue, Infection/Inflammation, Moisture balance, Edge/epithelialisation, Regeneration and repair, Social factors

DACC™-coated dressings instructions for use

Aspects of a holistic patient assessment in venous leg ulceration – adapted from TIMERS[1–6,8–12]

Patient assessment
- Comorbidities
- Current medication
- Functionality and mobility
- Nutritional assessment
- Skin assessment (including skin tone)
- Social factors
- Surgical and medical history

Lower-leg assessment
- Ankle or toe brachial pressure index
- CEAP classification
- Doppler/vascular ultrasound
- Leg and foot pulses
- Oedema
- Skin perfusion
- Skin temperature
- Surrounding skin condition
- Transcutaneous oxygen pressure
- Vitals

Wound assessment
- Classification
- Imaging as appropriate
- Location, duration, size and depth
- Odour
- Pain
- Periwound condition
- Previous investigations and treatments
- Tissue biopsy (if appropriate in ≥3 months duration or atypical wound presentation)
- Tissue types on wound bed (necrotic, sloughy, granulation or epithelial

Risk factors for wound infection – adapted from the International Wound Infection Institute[1,20,21]

Patient risk factors
- Alcohol, smoking or illicit drug use
- Conditions associated with hypoxia or poor perfusion (e.g. anaemia, cardiac disease, respiratory disease, peripheral arterial disease, renal impairment or rheumatoid arthritis)
- Connective tissue disorders (e.g. Ehlers-Danlos syndrome)
- Corticosteroid use
- Immune disorders (e.g. acquired immune deficiency syndrome)
- Lymphoedema
- Malnutrition or obesity
- Neuroarthropathy
- Peripheral arterial disease (inc. ischaemia)
- Peripheral neuropathy (sensory, motor and autonomic)
- Poor adherence to treatment plan
- Poorly controlled diabetes
- Radiation therapy or chemotherapy

Wound risk factors
- Atypical wounds
- Duration of wound
- Foreign body presence (e.g. drains, sutures or wound dressing fragments)
- Haematoma
- Impaired tissue perfusion
- Increased exudate and oedema that is not adequately managed
- Involvement of tissue deeper than skin and subcutaneous tissues (e.g. tendon, muscle, joint or bone)
- Necrotic or sloughy wound tissue

Environmental risk factors
- Hospitalisation (due to increased risk of exposure to antimicrobial-resistant microorganisms)
- Inadequate hand hygiene and aseptic technique
- Inadequate management of moisture (e.g. due to exudate, incontinence or perspiration)
- Unhygienic environment (e.g. dust, unclean surfaces, or presence of mould/mildew)

Signs of sepsis[7]

Sepsis is a life-threatening condition in which the body's response to infection causes injury to its tissues and organs. Organ dysfunction is a key component in any diagnosis of sepsis.

Act on any of the following red flags:

S. Slurred speech or confusion
E. Extreme shivering or muscle pain
P. Passing no urine (in a day)
S. Severe breathlessness
I. It feels like you are going to die
S. Skin mottled or discoloured

1. International Wound Infection Institute. Wound infection in clinical practice: principles of best practice – Wounds International. 2022. **2.** Atkin L et al. J Wound Care. 2019;28:S1–50. **3.** Fletcher J et al. Wounds UK. 2018;1–24. **4.** Conte MS et al. Eur J Vasc Endovasc Surg. 2019;58:S1–S109. **5.** Isoherranen K et al. J Wound Care. 2019;28:S1–92. **6.** Schultz GS et al. Wound Rep Regen. 2017;25:744–757. **7.** UK Sepsis Trust. Spotting the signs of sepsis. 2025. **8.** Fletcher J et al. Best practice statements: effectively assessing ABPI in leg ulcer patients. 2024. **9.** Lurie F et al. J Vasc Surg Venous Lymphat Disord. 2020;8:342–352. **10.** Atkin L & Tickle J. Wounds UK. 2016;12:32–36. **11.** Isoherranen K et al. J Wound Manag. 2023;24:S1–S76. **12.** Nair HK et al. J Wound Care. 2024;33:S1–S31. **13.** Haesler E et al. Wounds Int. 2025;1–52. **14.** Schultz GS et al. Wound Rep Regen. 2003;11:S1–28. **15.** Bjarnsholt T et al. Wounds Int. 2020;1–32. **16.** Blackburn J et al. Int Wound J. 2025;22:e70684. **17.** Cole W et al. Wounds. 2025;37:S1–S24. **18.** Mosti G et al. J Wound Care. 2015;24:121–127. **19.** Rippon MG et al. J Wound Care. 2021;30:284–296. **20.** Assadian O et al. J Wound Care. 2023;32:3–4. **21.** García Nores GD et al. J Invest Dermatol. 2018;138:325–335

Classification and guidance

Conte et al (2019)
Global vascular guidelines on the management of chronic limb-threatening ischemia

European Wound Management Association (2023)
Lower leg ulcer diagnosis & treatment

European Wound Management Association (2024)
Holistic management of wound-related pain

International Wound Infection Institute (2022)
Wound infection in clinical practice

Lurie et al (2020)
Update of the CEAP classification

Nair et al (2024)
Leg ulceration in venous and arteriovenous insufficiency: assessment and management

Appendices

Appendix 1. Evidence-based statements and revisions by Delphi round and score

S	R	Statement	M	SD
1	1	Wound infection continues to be one of the biggest challenges facing HCPs in wound care	4.3	0.90
2	1	The number of wound infections attributable to antimicrobial-resistant organisms is underestimated	3.8	0.75
	2	The number of wound infections attributable to antimicrobial-resistant organisms could be underestimated	4.1	0.94
3	1	AMR in wound care is a growing challenge	4.4	0.80
4	1	Prevention of infection is one of the key focus areas for global AMR strategy	4.5	0.67
5	1	Inappropriate use of antimicrobials has been reported in non-infected wounds not requiring intervention	4.6	0.49
6	1	Inappropriate overuse of antimicrobials with active agents may increase the risk of AMR development	4.2	0.87
	2	Inappropriate use of antimicrobials may increase the risk of AMR development	4.6	0.49
7	1	Microbial burden of a wound may be reduced using BBDs	4.6	0.49
	2	Microbial burden of a wound may be reduced using MBDs	4.8	0.40
8	1	Early intervention with BBDs decreases microbial burden, minimising risk of progression on the wound infection continuum	4.4	0.49
	2	Early intervention with MBDs decreases microbial burden, minimising risk of progression on the wound infection continuum	4.8	0.40
9	1	Incorporating BBDs into post-operative care bundles can significantly reduce the risk of (superficial) SSIs	4.4	0.49
	2	Incorporating MBDs into postoperative care bundles can significantly reduce the risk of (superficial) SSIs	4.8	0.40
10	1	Prevention of SSI using BBDs can result in reduced re-admission, treatment and hospital-stay costs	4.3	0.66
	2	Prevention of SSI using MBDs can result in reduced re-admission, treatment and hospital-stay costs	4.8	0.40
11	1	Reserving antimicrobial dressings for covert and overt local infection, combined with antibiotics for spreading and systemic infections, supports the appropriate use of antimicrobials	4.1	0.54
	2	Following comprehensive wound bed preparation, reserving the use of antimicrobial dressings for covert and overt local infection, combined with antibiotics for spreading and systemic infection, supports the appropriate use of antimicrobials	4.2	0.40
	3	Considering comprehensive wound care, reserving use of antiseptic dressings for covert and overt infection, combined with antibiotics for spreading and systemic infection, supports AMS	4.76	0.46
12	1	Management of local bioburden/wound infection with BBDs reduces the need for antibiotic therapy, supporting AMS	4.0	0.77
	2	Early, proactive management of local bioburden/wound infection with BBDs may reduce the need for antibiotic therapy, supporting AMS	4.0	0.77
	3	12A. Prophylactic prevention and control of microbial burden with MBDs may reduce the need for antibiotic therapy, supporting AMS	4.5	0.50
		12B. Management of local infection with MBDs may reduce the need for antibiotic therapy, supporting AMS	4.5	0.50
13	1	BBDs should be considered a key part of IPC and AMS in wound care	4.7	0.46
	2	MBDs should be considered a key part of IPC and AMS in wound care	4.8	0.40

Key: 1 Statement number; 1 Round (not accepted or requiring redraft); 1 Round (accepted)

Notes: Some accepted statements were revised and rescored to enhance clarity; 'bacteria-binding dressings' was replaced with 'microbial-binding dressings' at round 3 (M 4.80, SD 0.40) ; AMR=antimicrobial resistance; AMS=antimicrobial stewardship; BBD=bacteria-binding dressing; HCP=healthcare professional; IPC=infection prevention and control; MBD=microbial-binding dressing; M=mean (approval score); R=round; S=statement; SD=standard deviation (approval score); SSI=surgical site infection

Appendix 2. Detailed GRADE assessments of the certainty of literature review outcomes

Outcome (study type)	Studies	Design	Certainty	Importance	Details
Surgical incisions					
Controlled microbial burden	1	Non-randomised	2. Low		
Cost saving	1	Randomised	4. High		
Cost saving (non-RCT)	2	Non-randomised	2. Low		SA, SRB
Improved healing	1	Randomised	4. High		
Improved healing (case series)	1	Non-randomised	2. Low		APRC, CS, SRB
Infection prevention	3	Randomised	4. High	Critical	
Infection prevention (non-RCT)	3	Non-randomised	3. Moderate	Critical	SA
Reduced antibiotic use	2	Randomised	4. High	Important	
Reduced antibiotic use (case series)	1	Non-randomised	2. Low		APRC, CS, SRB
Reduced antibiotic use (non-RCT)	1	Non-randomised	4. High	Important	APRC, SA
Reduced readmission	1	Randomised	4. High	Important	
Reduced readmission (non-RCT)	1	Non-randomised	3. Moderate		SA
Hard-to-heal wounds					
Controlled microbial burden	1	Randomised	4. High	Critical	
Controlled microbial burden (3b observational studies)	5	Non-randomised	2. Low	Critical	
Improved healing	2	Randomised	4. High		
Improved healing (L3b)	5	Non-randomised	2. Low		
Improved healing (L4/5 case series/studies)	3	Non-randomised	2. Low		
Infection prevention	1	Non-randomised	1. Very low	Important	CS, PBSS
Reduced antibiotic use	1	Randomised	4. High		
Reduced antibiotic use (L3b observational studies)	3	Non-randomised	2. Low		
Reduced signs and symptoms of infection	1	Randomised	3. Moderate		IRI, PBSS
Reduced signs and symptoms of infection (L3b observational studies)	4	Non-randomised	2. Low		
Reduced signs and symptoms (L4 case series)	2	Non-randomised	2. Low		
Reduced signs and symptoms (L5 case report)	1	Non-randomised	2. Low		

Abbreviations: CS=company sponsorship; PBSS=publication bias strongly suspected; APRC=all plausible residual confounding would reduce the demonstrated effect; IRI=infection resolution inferred by wound progress and healing but not reported specifically; SA=strong association; SRB=serious risk of bias

Appendix 3. Guidelines

American College of Surgeons (2025)
Online risk calculator

Centres for Disease Control and Prevention (2025)
National Healthcare Safety Network: surgical site infection

International Surgical Wound Complications Advisory Panel (2025)
Guideline for post-operative incision care

International Wound Infection Institute (2022)
Wound infection in clinical practice

International Wound Infection Institute (2025)
Therapeutic wound and skin cleansing: clinical evidence and recommendations

Mayer et al. (2024)
Best practice for wound debridement

UK Sepsis Trust (2025)
Spotting the signs of sepsis

World Health Organization (2018)
Global guidelines for the prevention of surgical site infection

World Union of Wound Healing Societies (2018)
Surgical wound dehiscence: improving prevention and outcomes

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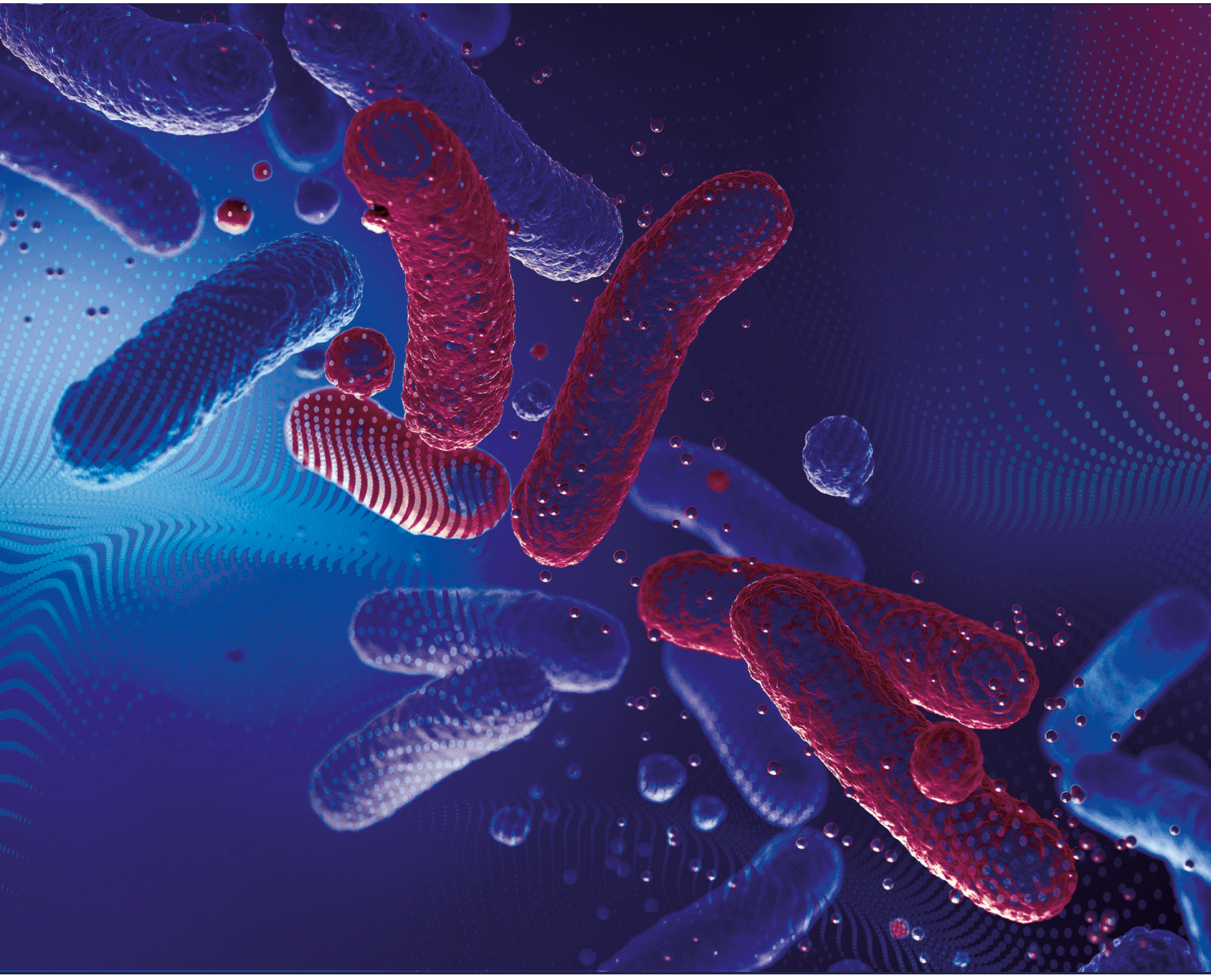

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