Bacterial Burden in the Wound

Content Creators:
Members of the South West Regional Wound Care Program’s Clinical Practice and Knowledge Translation Learning Collaborative
Learning Objectives

1. Identify the differences between wound contamination, colonization, critical colonization and infection

2. Develop an understanding of the significance of infection

3. Differentiate between infection and inflammation

4. Describe how to diagnose wound infection

5. Describe the possible treatments for the various degrees of bacterial burden

6. Understand the potential role of biofilms
Photographs and Illustrations

Images/illustrations obtained via Google Images unless otherwise indicated
Levels of Bacterial Burden
Significance of Infection
Infection vs. Inflammation

BACTERIAL BURDEN IN WOUNDS
Significance of Infection

• “Bacteria are present in all chronic wounds and do not in themselves constitute an infection”

• Rather, it is the relationship between the amount of the bacteria present, the virulence of that bacteria, and the host’s ability to defend itself, that contribute to wound infection.

Infection = Bacterial Load x Virulence

Host Resistance
Pathogen Virulence

• In chronic wounds, **pathogen species** may be more important than number of organisms. The following require treatment regardless of their quantity:
  • Beta-hemolytic strep
  • Mycobacteria
  • Bacillus anthracis
  • Yersinia pestis
  • Corynebacterium diptheriae
  • Erysipelothrix species
  • Leptospira species
  • Treponema species
  • Brucella species
  • Herpes zoster or simplex
  • Invasive dimorphic fungi
  • Parasitic organisms
Host Resistance

- Host resistance is the single most important determinant of wound infection and should be closely assessed whenever a chronic wound fails to heal. Systemic and local factors can increase the risk of infection:

<table>
<thead>
<tr>
<th>Systemic Factors</th>
<th>Local Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Malnutrition</td>
<td>Large wound area and/or depth</td>
</tr>
<tr>
<td>Edema</td>
<td>High degree of wound chronicity</td>
</tr>
<tr>
<td>Vascular disease and/or diabetes mellitus</td>
<td>Anatomatic location, i.e. near anus</td>
</tr>
<tr>
<td>Use of corticosteroids and other immunosuppressant</td>
<td>Presence of foreign bodies and/or necrotic tissue</td>
</tr>
<tr>
<td>medications</td>
<td>in the wound</td>
</tr>
<tr>
<td>Inherited neutrophil deficits and/or immune deficient</td>
<td>Mechanism of injury, i.e. trauma or perforated</td>
</tr>
<tr>
<td>conditions</td>
<td>viscous</td>
</tr>
<tr>
<td>Prior surgery or radiotherapy</td>
<td>High degree of contamination</td>
</tr>
<tr>
<td>Alcoholism</td>
<td>Reduced tissue perfusion</td>
</tr>
<tr>
<td>Rheumatoid arthritis</td>
<td>Long or contaminated surgery</td>
</tr>
</tbody>
</table>
Bacterial Burden

- Bacteria present in a wound originate from the person's normal skin flora and from the environment.

- The level of bacterial burden can be described as one of the following four conditions:
  - Contamination
  - Colonization
  - Critical colonization
  - Infection:
    - Spreading infection
    - Systemic infection
Wound Contamination\textsuperscript{1}

- Presence of non-proliferating bacteria on the wound surface

- No injury to host

- No visible signs of immune response
Wound Colonization\(^1\)

- Presence of proliferating bacteria that adhere to the wound. Bacteria are starting to form colonies

- No injury to host

- No immune response from host

- Some studies suggest that the presence of staph epidermidis and corynebacterium species increases the rate of wound healing:
  - Produce proteolytic enzymes which contribute to wound debridement
  - Stimulate neutrophils to release proteases
Critical Colonization\textsuperscript{1}

- Presence of proliferating bacteria on the wound surface and in the wound bed

- Cause a delay in wound healing by:
  - Releasing MMPs and other pro-inflammatory mediators that impair healing
  - Stimulating angiogenesis, resulting in a product of corrupt matrix

- No visible signs of immune response

- **Subtle** clinical signs of infection may be present:
  - Non-healing: wound margins fail to reduce in size
  - Exudative: increased or altered exudate
  - Red and bleeding: friable bright red granulation
  - Debris: new areas of necrosis
  - Smell: unpleasant odor or change in odor

- Increased pain or edema
Wound Infection (Spreading)\textsuperscript{1}

- Presence of replicating microorganisms on and within the wound and in the surrounding tissues
  - The presence of four or more bacterial groups in a wound = delayed healing\textsuperscript{2}

- Host injury

- In addition to the \textit{subtle} signs of critical colonization, may have \textit{classical signs}/symptoms of infection:
  - Increased peri-wound temperature
  - Wound breakdown with satellite lesions
  - Induration and redness extending beyond the wound borders
  - Lymphangitis
  - General malaise
Wound Infection Continued

- Classical clinical signs of wound infection:
  - **Size**: Increased wound size +/- satellite areas
  - **Temperature**: warmth
  - **Os**: probes to bone
  - **New areas of breakdown**
  - **Exudate**: increased
  - **Erythema**
  - **Edema**
  - **Smell** (new or changed)

- Localized pain (new, increased, or altered)
- **Induration**
- **Pocketing/bridging**
Pocketing and Bridging Photos

Figure 2. Pocketing. Smooth, non-granulating areas in the base of a wound surrounded by granulation tissue.

Figure 3. Bridging. Infection may result in incomplete wound epithelialization with strands or patches of tissue forming ‘bridges’ across the wound. Bridging can occur in acute or chronic wounds healing by secondary intention.
Wound Infection (Systemic)

• Proliferating bacteria are present on the wound surface, in the wound bed, in the surrounding tissues, and has spread systemically

• Injury to host, eliciting an immune response

• Subtle and classic signs and symptoms of infection PLUS:
  • Pyrexia or hypothermia
  • Tachycardia
  • Tachypnea
  • Elevated or depressed white cell counts
  • Multi-organ system failure
How To Determine the Level of Bacterial Burden: Bioburden Assessment Tool

<table>
<thead>
<tr>
<th>Group</th>
<th>Signs and Symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Stalled healing</td>
</tr>
<tr>
<td></td>
<td>Friable and bright red granulation tissue</td>
</tr>
<tr>
<td></td>
<td>Increased or altered exudate</td>
</tr>
<tr>
<td></td>
<td>Increasing or new odor</td>
</tr>
<tr>
<td></td>
<td>Localized edema</td>
</tr>
<tr>
<td></td>
<td>Increased or new pain</td>
</tr>
<tr>
<td>B</td>
<td>Increasing periwound induration PLUS erythema extending well beyond the wound borders</td>
</tr>
<tr>
<td></td>
<td>Wound breakdown and/or satellite areas of breakdown</td>
</tr>
<tr>
<td></td>
<td>Lymphangitis</td>
</tr>
<tr>
<td></td>
<td>General malaise</td>
</tr>
<tr>
<td>C</td>
<td>Fever</td>
</tr>
<tr>
<td></td>
<td>Rigors</td>
</tr>
<tr>
<td></td>
<td>Chills</td>
</tr>
<tr>
<td></td>
<td>Hypotension</td>
</tr>
<tr>
<td></td>
<td>Organ failure</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Level of Risk</th>
<th>Category</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colonized: at risk</td>
<td>I</td>
<td>• No signs or symptoms from any group</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Clinical decision based on location of wound and co-morbid conditions</td>
</tr>
<tr>
<td>Critically Colonized (a.k.a. localized infection)</td>
<td>II</td>
<td>Presence of two or more signs of symptoms from Group A</td>
</tr>
<tr>
<td>Spreading Infection</td>
<td>III</td>
<td>Presence of two or more signs of symptoms from Group A PLUS one or more from Group B</td>
</tr>
<tr>
<td>Systemic Infection</td>
<td>IV</td>
<td>Presence of any signs or symptom from Group A and B PLUS one or more from Group C</td>
</tr>
</tbody>
</table>
Significance of Infection$^{1,3}$

- Extends the inflammatory response
- Delays collagen synthesis as there is a reduction in fibroblasts
- Retards epithelialization
- Causes more injury to the tissues
- Compete with fibroblasts for oxygen and nutrients
- Produce deleterious chemicals into wound environment
- Results in friable granulation tissue
Is it Inflamed or Infected\(^1\)?

- Must assess the following to differentiate between an inflamed or infected wound:
  - The person’s overall condition
  - The wound and the peri-wound

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Inflammation</th>
<th>Infection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Erythema</td>
<td>Well-defined borders, not as intense</td>
<td>Edges or discoloration diffuse and indistinct. May be intense. Red stripes/streaking indicates infection</td>
</tr>
<tr>
<td>Elevated temp</td>
<td>Palpable increase at peri-wound</td>
<td>Systemic fever</td>
</tr>
<tr>
<td>Exudate: Odor</td>
<td>Odor may be present due to necrotic tissue and/or type of dressing in use</td>
<td>Specific odors are related to some bacteria, i.e. sweet smell of pseudomonas or ammonia odor of Proteus</td>
</tr>
<tr>
<td>Exudate: Amount</td>
<td>Usually minimal and gradually decreases over 3-5 days post injury</td>
<td>Usually moderate- large. Exudate does not decrease, rather may increase</td>
</tr>
<tr>
<td>Exudate: Character</td>
<td>Serous $\rightarrow$ Sang</td>
<td>Serous $\rightarrow$ Purulent</td>
</tr>
<tr>
<td>Pain</td>
<td>Variable – may be tender post injury</td>
<td>Pain is persistent, continues</td>
</tr>
<tr>
<td>Edema/Induration</td>
<td>Slight swelling and firmness at peri-wound post injury is normal</td>
<td>May indicate infection if edema and induration are localized and accompanied by warmth</td>
</tr>
</tbody>
</table>
Review: Levels of Bacterial Burden

<table>
<thead>
<tr>
<th></th>
<th>Bacterial Presence</th>
<th>Evidence of Host Injury</th>
<th>Visible Host Response</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Contamination</strong></td>
<td>Non-proliferating bacteria on surface only</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td><strong>Colonization</strong></td>
<td>Proliferating bacteria on surface only</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td><strong>Critical Colonization</strong></td>
<td>Proliferating bacteria on surface and in wound bed</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td><strong>Spreading Infection</strong></td>
<td>Proliferating bacteria on and in the wound and in</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>surrounding tissues</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Systemic Infection</strong></td>
<td>Proliferating bacteria on and in the wound and in</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>surrounding tissues, and have spread systemically</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
DIAGNOSIS OF WOUND INFECTION
Diagnosis of Wound Infection

- Diagnosis difficult – **based on signs/symptoms observed**

- Must distinguish between:
  - Contamination
  - Colonization
  - Critical colonization
  - Wound infection

- Immunocompromised peoples can fail to demonstrate any signs of infection, or the signs may be significantly diminished

- They may also exhibit signs of infection when the bacterial burden is less
Colony Counts\textsuperscript{1}

- Most common method of \textbf{confirming} clinical infection is by colony count

- Diagnose infection based on clinical signs/symptoms. Wound culture results only aide in determining the most appropriate antibiotic therapy and themselves \textbf{DO NOT} diagnose infection

- Colony counts higher than $10^5$ organisms/mL confirm clinical infection

- Heavy bacterial colonization of the wound or compromised host resistance can result in higher counts
Colony Counts Continued$^1$

- Wounds colonized with B-Hemolytic Strep can exhibit impaired healing with colony counts less than $10^5$ organisms/mL$^3$

- Although wound healing is delayed or impaired when the bacterial burden in a wound is over $10^5$ organisms/mL, some wounds may heal uneventfully$^{3-4}$
Methods of Determining Bacterial Types

- Tissue biopsy
- Needle aspiration
- Wound swab

Coccus, Coccobacillus, Vibrio, Bacillus, Spirillum, Spirochete
Tissue Biopsy$^{1,3,10}$

- Removal of a piece of tissue with scalpel or punch biopsy – GOLD STANDARD

- Weighed, flamed to kills surface contaminants, ground and homogenized, and plated

- Disadvantages:
  - Require local anesthetic
  - Painful
  - Costly
  - Time consuming
  - Further trauma to patient
  - Require knowledge, skill, equipment
Needle Aspiration

- Insertion of needle into tissue to aspirate fluid
- Needle moved back and forth at different angles for two to four explorations
- Needle capped and sent to lab
Wound Swabs

- As traditionally performed, wound swabs detect only the bacteria on the surface of the wound, which may not correlate with the bacteria within the wound causing the infection\(^5\)

- Often little concordance between the surface bacteria and those present in deeper tissues:
  - Pressure Ulcers\(^6\)
    - 96% of surface swabs positive versus 43% of tissue aspirates and 63% of biopsies
  - Diabetic Foot Ulcers\(^7\)
    - Superficial swabs correlated with deep tissue specimens in only 62% of cases
Quantitative Cultures\textsuperscript{1}

- Quantitative wound cultures are recommended to help reveal organism causing infection\textsuperscript{5}

- Swab results are more accurate if a standardized approach is used\textsuperscript{8}

- “The best technique for swabbing wounds has not been identified and validated. However, if quantitative microbiological analysis is available, the Levine technique may be the most useful”\textsuperscript{9}
The Levine Technique

1. Cleanse the wound (do not use antiseptics)
2. Conservatively sharp debride the wound if appropriate, and if you have the knowledge, skill, judgment to do so
3. Re-cleanse the wound post debridement (do not use antiseptics)
4. Find the healthiest, cleanest looking area of granulation tissue and rotate a swab is over a 1cm² area with sufficient pressure to express fluid from within the wound tissue
5. Swab inserted into a sterile tube with transport medium and sent to lab
When to Take a Swab

1. Acute wounds with signs of infection
2. Infected chronic wounds that are not responding or are deteriorating despite appropriate antimicrobial treatment
3. Chronic wounds with signs of systemic infection
4. As required by local surveillance protocols for drug resistant micro-organisms
MANAGEMENT OF BACTERIAL BURDEN
Management of Bacterial Burden

- Management of bacterial burden includes:
  - Optimizing the host response:
    - Ensure comorbidities properly managed
    - Reduce risk of infection
    - Optimize nutrition/hydration
  - Reducing bacterial load
    - Wound cleansing
    - Debridement of non-viable tissue
    - Management of exudates and odor
  - Use of topical antimicrobials, antiseptics, and antifungals
  - Possible use of systemic antibiotics
- General measures:
  - Managing systemic symptoms
  - Managing person-centered concerns
  - Education
Holistic Management of Wound Infection

**Effective Management of Wound Infection**

**Optimise Host Response**
- Optimise management of comorbidities, e.g. optimise glycaemic control in diabetic patients, enhance tissue perfusion/oxygenation
- Minimise or eliminate risk factors for infection where feasible
- Optimise nutritional status and hydration
- Seek and treat other sites of infection, e.g. urinary tract infection

**Reduce Bacterial Load**
- Prevent further wound contamination or cross-contamination - e.g. infection control procedures and protecting the wound with an appropriate dressing
- Facilitate wound drainage as appropriate
- Optimise wound bed:
  - remove necrotic tissue and slough (debridement)
  - increase frequency of dressing change as appropriate
  - cleanse wound at each dressing change
  - manage excess exudate
  - manage malodour
- Antimicrobial therapy - topical antiseptic +/- systemic antibiotic(s)

**General Measures**
- Manage any systemic symptoms, e.g. pain, pyrexia
- Provide patient and carer education
- Optimise patient cooperation with management plan
- Ensure psychosocial support

**Re-evaluate Regularly**
- Relate frequency of re-evaluation to the severity of the infection and condition of the patient
- Are the wound and patient improving?
- Is the wound starting to heal?
- If not, re-evaluate the patient and wound and adjust management accordingly
- Systematic monitoring and recording of symptoms is helpful in detecting improvement or deterioration. Consider use of an appropriate assessment tool. Serial clinical photographs or tracking changes in markers of inflammation (e.g. erythrocyte sedimentation rate (ESR), C-reactive protein (CRP), white blood cell count) may be useful in registering subtle deterioration or improvement, especially in chronic wounds

*Figure 5.* Effective management of wound infection.
Strategies to Reduce Risk of Infection

• Adhere to hand washing protocols before and after dressing changes

• Remember that dressings supplies are for single person use only, i.e. avoid sharing dressings between people

• Dressings pre-packaged for single use are intended to be used in that manner

• Single use saline or sterile water bottles (110mL) are to be used in their entirety at each dressing change, i.e. they are not re-capped and used for subsequent dressing changes, nor are they to be shared between people
Reducing Infection Risk

• For those accessing larger containers of saline or sterile water, i.e. larger than 115mL, if accessed in a sterile manner, these bottles may be re-used for the same person for a period of 24 hours, before they are required to be discarded.

• Assess and treat acute wounds, i.e. wounds that are less than four weeks old, using sterile (aseptic) technique. Those with neutrophil deficits and/or immune deficiency and who have chronic wounds, may also benefit from aseptic technique.

• Assess and treat chronic wounds, i.e. wounds that are greater than four weeks old, using clean technique.
Reduce Infection Risk

• Take only the supplies needed for the single dressing change to the person’s bedside or into the person’s home, as such supplies cannot be returned to the dressing supply room/shelf/cart, etc. and MUST BE DISCARDED for infection control reasons.

• If supplies are being stored in a person’s home, they must be stored according to manufacturer’s guidelines and in a location that is inaccessible to children and pets.

• Remove non-viable tissue from the wound surface, as appropriate, as it provides an opportunity for microbial growth.
Reducing Risk of Infection

- Optimize the moisture balance of the wound bed (in healable wounds), as dry wound beds may develop microscopic ‘cracks’ that may be portals of entry for bacteria.

- Consider the use of topical antimicrobials in high-risk individuals/wounds to prevent wound infection.
Topical Antimicrobials¹

• Effective in limiting surface colonization

• Some topical agents can damage healthy tissue, exacerbate tissue destruction, and/or damage tissue defenses

• Three main classes of topical antimicrobials:
  • Antibacterials
  • Antiseptics
  • Antifungals
Antibacterials

• “Chemicals that eliminate living organisms that are pathogenic to the host”

• Broad-spectrum antibacterials are useful for mixed infections, i.e. there is more than one pathogen

• You require a smaller dose of topical antibacterial agents versus systemic as the antibacterial is in direct contact with the affected area – less toxic

• Can use systemic antibacterials in addition to topical ones for spreading or systemic infection
Antibacterials Continued¹

- Can be used prophylactically to impede entrance of pathogens

- If used prophylactically, be cautious of resistance

- Topical antibacterials used in a viscous vehicle promote a moist wound healing environment:
  - Lotions or pastes best for wet skin/wounds
  - Ointments better for dry, cracked skin/wounds
  - Creams can be used on both wet and dry wounds/skin
  - Watch for contents of viscous vehicles – some contain lanolin, wood alcohols, or stabilizers which can be sensitizing
Commonly Used Antibacterials

- Antibiotics:
  - **Silver Sulfadiazine**
  - Fusidic Acid
  - Gentamicin Sulphate
  - **Metronidazole** (anaerobes only)
  - **Mupirocin** (nasal colonization of MRSA only)
  - Boric Acid
  - Polymixin B
  - Sulfate/Bacitracin Zinc
  - Polymixin B Sulfate/Bacitracin/Zinc/Neomycin
  - Framycetin
Antiseptics

• Group of different chemical compounds that are either bactericidal (kill bacteria) or bacteriostatic (prevents bacterial multiplication)

• Used to prevent or combat bacterial infection of superficial tissues

• Applied directly to tissue

• Excessive use of antiseptics may result in toxicity, allergy, superinfection, excess cost

• Now are dressings that contain and release antiseptics at the wound surface
Commonly Used Antiseptics

- Peroxide
- Hypochlorite
- Acetic Acid (pseudomonas only)
- Chlorhexidine
- Hexachlorophene
- Povidone-Iodine
- Gentian Violet
- Alcohols
Commonly Used Antiseptic Dressings

- Cadexomer Iodine
- Hypertonic Saline
- Various Silver Dressings
- PMHB
- Honey based products
Antifungals\textsuperscript{1}

- Agents that contain a variety of chemical types with a narrow spectrum

- Either fungicidal or fungistatic

- Broad-spectrum agents are non-selective and as such a toxic irritant. However as many have limited absorption through the skin they can be used in dermatological preparations\textsuperscript{14}

- External factors such as temperature, ambient water vapor pressure, use of drying agents may affect the antifungals ability to penetrate the skin
Commonly Used Antifungals

- Nystatin
- Ketoconazole (Nizoral)
- Miconazole nitrate (Monistat-Derm)
- Metronidazole (MetroGel)

- Topical metronidazole (1% solution or 0.75% gel) applied BID can reduce or eliminate odor in 80-90% of wounds within one week.
Topical Antimicrobials

• When selecting a topical agent, consider **STAR**:
  • Not used systemically
  • Not high in tissue toxicity
  • Not likely to induce allergy
  • Not likely to be associated with bacterial resistance

• Avoid:
  • Gentamicin
  • Tobramycin
  • Neomycin
  • Bacitracin

  Induce resistant organisms

  Allergic sensitivity
Topical Antimicrobial Selection Enablers

- Safest Topical Antimicrobials for Use in Wound Care
- Topical Antimicrobials for Selective Use in Wound Care
- Topical Antimicrobials for Cautionary Use in Wound Care
The ‘Two Week Challenge’

- Antimicrobials should be trialed for a 10-14 day period (a ‘Two Week Challenge’)

- If the wound shows no improvement, the person and the wound should be re-evaluated, a wound swab should be considered, and the person should be assessed by their primary care provider to determine if systemic antibiotic treatment is warranted

- If after two weeks the wound is progressing towards closure yet still exhibits signs of infection, continue the use of the antimicrobial dressing for another two weeks. If the person has had an antimicrobial dressing on for longer than four weeks, review the dressing regimen and consider a referral to Enterostomal Nurse or Wound Care Specialist for further discussion of the management plan
Systemic Antibiotics

- Should be used in all chronic wounds where there is active infection beyond the level that can be managed with local wound therapy

- Indications:
  - Fever
  - Life threatening infection
  - Cellulitis extending 1cm beyond the wound margin
  - Underlying deep structure infections
## Systemic Antibiotics Continued

<table>
<thead>
<tr>
<th>Presentation</th>
<th>Organisms</th>
<th>Antibiotic</th>
<th>Duration</th>
</tr>
</thead>
</table>
| Wound <4 weeks old, mild cellulitis, no systemic infection or bone involvement | S. Aureus Strep | - Cephalexin 500mg PO QID, or  
- Clindamycin 300mg PO TID | 14 days (outpatient) |
| Wound <4 weeks old, extensive cellulitis, systemic response | S. Aureus Strep | - Cloxacillin or Oxacillin 2g q6h IV (step down to oral) | 14 days total (initially inpatient) |
| Wound >4 weeks old, deep tissue infection, no systemic response | S. Aureus Strep Coliforms Anaerobes | - Amoxi-Clav 500/125mg PO TID, or  
- Cephalexin 500mg PO QID + Flagyl 500mg PO BID, or  
- Cotrimoxazole 160/800mg PO BID + Flagyl or Clindamycin, or  
- Clindamycin 300mg PO TID + Levofloxacin 500mg PO OD | 2-12 weeks (outpatient) |
| Wound >4 weeks old, deep infection with systemic response | S. Aureus Strep Coliforms Anaerobes Pseudomonas | - Clindamycin 600mg IV q8h + Cefotaxime 1g IV q8h (or Ceftriaxame 1gm IV q24h), or  
- Piperacillin 3g IV q6h + Gentamicin 5mg/kg IV q24h, or  
- Pip-Taz 4.5g IV q8h, or  
- Clindamycin 600mg IV q8h + Levofloxacin 500mg IV q24h, or  
- Imipenem 500mg IV q6h | 14 days IV (prolonged oral therapy if bone or joint involvement, initially inpatient management) |
Goals of Antimicrobial Therapy

- Topical Antimicrobials:
  - Prevent wound infections
  - Treat localized wound infections
  - Prepare the wound for grafting
  - Reduce wound exudate in maintenance wounds

- Parenteral/Oral Antibiotics:
  - Spreading infection
  - Osteomyelitis
    - Plain x-ray – if negative, repeat in 10-14 days
    - If x-rays negative, however wound continues to fail to improve, MRI
    - 3 months oral antibiotics
  - Bacteremia
  - Decolonization therapy (MRSA)
How to Choose the Best Antimicrobial Therapy Approach\textsuperscript{16}

Determine what bacterial burden level the wound is at using the “Bioburden Assessment Tool” document, and cross reference it with the following:

<table>
<thead>
<tr>
<th>Bacterial Burden Level</th>
<th>Clinical Interventions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contaminated</td>
<td>Monitor and risk reduction*</td>
</tr>
<tr>
<td>Colonized</td>
<td>Monitor and risk reduction*</td>
</tr>
<tr>
<td>Critical Colonization</td>
<td>• Topical antimicrobials</td>
</tr>
<tr>
<td></td>
<td>• Effective debridement</td>
</tr>
<tr>
<td>Spreading Infection</td>
<td>• Topical antimicrobials</td>
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<tr>
<td></td>
<td>• Effective debridement</td>
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<tr>
<td></td>
<td>• Systemic antibiotics</td>
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<td></td>
<td>• Effective debridement</td>
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<tr>
<td></td>
<td>• Systemic antibiotics</td>
</tr>
<tr>
<td></td>
<td>• Rule out other infection sources</td>
</tr>
</tbody>
</table>
Reassess!

• Response to antibiotics can be monitored through ongoing clinical assessment of the signs/symptoms of infection with special attention to:
  • Pain
  • Ulcer size

• In those with less obvious signs/symptoms, monitor:
  • Eosinophil sedimentation rate (higher than 40)
  • C-Reactive protein

Click the image to watch a video on wound infection myths and legends
THE POTENTIAL ROLE OF BIOFILMS
**Biofilms**

- “A complex, structured, interdependent community of microorganisms enclosed in a self-produced polymeric matrix”

- “Adherent to inert and living surfaces that have sufficient moisture and/or nutrients to sustain its survival”

- Can be a single species of bacteria or fungi, or multiple

- Organisms in biofilms don’t always produce infection and are not always harmful
Biofilms Development

- Conditioning film formed on tissues by organic molecules in tissue fluid
- Bacteria in the wound near each other will co-aggregate and attach to conditioning film
- The colony of organisms surrounds itself with matrix
- This process may take a few hours or several weeks
Biofilms and Infection\textsuperscript{12}

- Bacteria in biofilms commonly responsible for recurring infections after repeated trials of antibiotics.

- If integrity of biofilm fails, bacteria no longer in the biofilm will multiply quickly and may cause infection, osteomyelitis, bacteremia.
Biofilm Resistance\textsuperscript{12}

- Antibiotics act on bacteria outside biofilm

- Bacteria in biofilm protected from:
  - Antimicrobials
  - Host’s defense mechanisms

- Bacteria in biofilm may have much higher minimum bactericidal concentration, may require 5,000 times the level of antibiotics to kill

Click on the bacteria to watch a short video on biofilm
Biofilm Treatment\textsuperscript{12}

• Poorly understood

• Under investigation

• Sharp debridement followed immediately by the application of a broad spectrum topical antimicrobial (repeated as necessary) is the only way to successfully remove and prevent biofilm reconstitution
SWRWCP Infection Resources

- Infection/Inflammation
  - Guideline: Assessment and Management of Bacterial Burden in Acute and Chronic Wounds
  - Definitions of Bacterial Burden in Chronic Wounds (poster)
  - Bioburden Assessment Tool
    - Procedure: Bioburden Assessment Tool
  - Topical Antimicrobials Available for Use in Wound Care (posters):
    - Safest Antimicrobials
    - Antimicrobials for Selective Use
    - Antimicrobials to Use With Caution and to Avoid
  - Procedure: Wound Cleansing
  - Wound Cleansing Enabler
  - Procedure: Quantitative Wound Swab Technique

- Moisture Balance and Dressing Selection
- Wound Edge
Review

1. The differences between wound contamination, colonization, critical colonization and infection

2. The significance of infection

3. Difference between infection and inflammation

4. How to diagnose wound infection

5. Management of the various degrees of bacterial burden

6. The potential role of biofilms
For more information visit: swrwoundcareprogram.ca
References