B.7. SIGNS AND SYMPTOMS OF WOUND INFECTION

The information appearing in these tables\textsuperscript{1 ii iii iv v vi} (pages 1-3) has been derived from a variety of sources, including the validation of signs and symptoms through bacterial assays, expert opinion via a Delphi technique and overview articles. They have been collated in order to provide one source for the multitude of signs and symptoms of localized and spreading infection in acute and chronic wounds. Documentation of the signs and symptoms should be done using the charting system for wound assessment identified by each agency, institution or organization.

B.7.2 Differentiating Between Local and Spreading Infection in Acute and Chronic Wounds

<table>
<thead>
<tr>
<th>i) Acute Wounds</th>
<th>Acute Localized Infection</th>
<th>Acute Spreading Infection</th>
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</thead>
<tbody>
<tr>
<td>E.g. traumatic wounds, surgical wounds healing by primary intention including stitches, sutures, drains, and toenail resection/extraction\textsuperscript{vi}.</td>
<td><strong>Cellulitis</strong></td>
<td>As for localized infection PLUS:</td>
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<tr>
<td></td>
<td>• Heat</td>
<td>• Further extension of erythema</td>
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<td></td>
<td>• Pyrexia – in surgical wounds, typically five to seven days post-surgery</td>
<td>• Lymphangitis (see definition in chronic wounds)</td>
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<td></td>
<td>• Delayed (or stalled) healing</td>
<td>• Crepitus in soft tissues</td>
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<td></td>
<td>• Abscess (under eschar in burns)</td>
<td><strong>Specific signs of deep incision SSI</strong>, affecting the fascia and muscle layers, or organ or space SSI, related to the procedure, which involves any part of the anatomy other than the incision that is opened or manipulated during the surgical procedure which may occur within 30 days or within one year if implant in place, and have at least one of the following criteria:*</td>
</tr>
<tr>
<td></td>
<td>• Malodour</td>
<td>• Purulent drainage from the incision but not from the organ/space of the surgical site *</td>
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<td></td>
<td>• Wound breakdown</td>
<td>• a deep incision spontaneously dehisces or is deliberately opened by a surgeon when the patient has at least one of the following signs or symptoms - fever (&gt;38°C), localised pain or tenderness - unless the culture is negative*</td>
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<tr>
<td></td>
<td>• Serous exudates with erythema</td>
<td>• an abscess or other evidence of infection involving the incision is found on direct examination or by histopathologic or radiological examination*</td>
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<tr>
<td>Specific signs of superficial SSI - Involves only skin and subcutaneous tissue around the incision, occurring within 30 days of the procedure, and have at least one of the following criteria.*</td>
<td></td>
<td>• diagnosis of a deep incisional SSI by a surgeon or attending physician*</td>
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<td></td>
<td>• New or increasing pain*</td>
<td>The following are NOT considered superficial SSIs:</td>
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<tr>
<td></td>
<td>• Erythema + induration (erythema purplish in colour in burns)*</td>
<td>• Stitch abscesses (minimal inflammation and discharge confined to the points of suture penetration)</td>
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<tr>
<td></td>
<td>• Local warmth*</td>
<td></td>
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<tr>
<td></td>
<td>• Localized swelling + increased exudates*</td>
<td>• Infection of an episiotomy or neonatal circumcision site</td>
</tr>
<tr>
<td></td>
<td>• Purulent (under eschar in burns)/hemopurulent discharge*</td>
<td><strong>Validation:</strong> S&amp;S of SSI have been validated for those items indicated with an asterisk*</td>
</tr>
<tr>
<td></td>
<td>• Organisms isolated from an aseptically obtained culture of fluid or tissue from the incision*</td>
<td><strong>Action:</strong> Contact surgeon; obtain a swab for c&amp;s using the Levine method (see C) for aerobic and anaerobic\textsuperscript{vii} cultures and sensitivity (obtain health practitioner orders) to determine species of bacteria and sensitivities to antibiotic therapy.</td>
</tr>
<tr>
<td></td>
<td>• The incision is deliberately opened by a surgeon, unless the culture is negative*</td>
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<tr>
<td>The following are NOT considered superficial SSIs:</td>
<td></td>
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<tr>
<td></td>
<td>• Stitch abscesses (minimal inflammation and discharge confined to the points of suture penetration)</td>
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<tr>
<td></td>
<td>• Infection of an episiotomy or neonatal circumcision site</td>
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</tr>
</tbody>
</table>

**ii) Acute Wounds: Partial thickness and Full Thickness Burns**

**Burns** – As above in italics plus:

- Increased fragility of skin graft
- Skin graft/ skin substitute rejection with involvement of viable tissue
- Black/dark brown focal areas of discolouration in burn
- Friable granulation tissue that bleeds
- Green discolouration of the subcutaneous fat
- Hemorrhagic lesions in subcutaneous tissue of burn wound or

**Burns: As for localized infection PLUS:**

- *Ecthyma gangrenosum* (infected of the skin typically caused by *Pseudomonas aeruginosa*. It presents as a round or oval lesion, 1 cm to 15 cm in diameter, with a halo of erythema. A necrotic center is usually present)
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**Chronic tissue necrosis**
- Increase in size or depth of wound
- Secondary loss of keratinized areas
- Necrotizing infection/ fasciitis

**Validation in Burns:** Any signs and symptoms need to be assessed by a health care practitioner as quickly as possible to determine if systemic antibiotics are warranted.

**Notes:** *Pain is not always a feature of infection in full thickness burns*
- Deep wounds – induration, extension of the wound, unexplained increased white cell count or signs of sepsis may be signs of deep wound (i.e. subfascial) infection
- Immunocompromised patients – signs and symptoms may be modified and less obvious

<table>
<thead>
<tr>
<th>SYSTEMIC INFECTION</th>
<th>Sepsis – documented infection with pyrexia &gt;39°C or hypothermia &lt;36.5°C, tachycardia &gt;110 beats per minute, raised or depressed white blood cell count</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Severe sepsis – sepsis and multiple organ dysfunction</td>
</tr>
<tr>
<td></td>
<td>Septic shock – sepsis and hypotension despite adequate volume resuscitation</td>
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<tr>
<td></td>
<td>Death</td>
</tr>
</tbody>
</table>

**NB:** Other sites of infection should be excluded before assuming that systemic infection is related to wound infection

**Chronic Wounds** e.g. diabetic foot ulcers, venous leg ulcers, arterial leg/foot ulcers or pressure ulcers, open surgical wounds including dehisced, infected, healing by secondary intention, wound closing by contraction and deposition of tissue.

Both chronic localized and chronic spreading infections involve signs and symptoms beyond the classic signs and symptoms of infection, pain, swelling and heat.

**Chronic Wound Infected with Biofilm**

Delayed (or stalled) healing (wound not 20 to 30% smaller in 4 weeks according to patient history or existing documentation* (in spite of compression Rx with venous ulcers) occurring alone without other signs & symptoms is indicative of biofilm infection.

**Chronic Localized Infection**
- New, increased or altered pain*
- Delayed (or stalled) healing (wound not 20 to 30% smaller in 4 weeks according to patient history or existing documentation* (in spite of compression Rx with venous ulcers)
- Bleeding or friable (easily damaged) granulation tissue*
- Distinctive malodour or sweet, sickening odor*/ change in odour
- Wound bed debris or discoloration (dark, dull red or grey/green, raw, red or salmon discolouration with gelatinous texture) or slough and necrotic/ nonviable tissue*
- Increased or altered/purulent exudates*
- Induration
- Pocking of granulation/ bridging of epithelium (seen in chronic surgical wounds healing by secondary intent such as pilonidal sinus wounds)
- Periwound oedema

**Additional signs specific to:**
- **Arterial leg ulcers:** Change in viscosity of exudates, necrosis new or spreading, erythema in periwound tissue that persists with elevation of limb

**Chronic Spreading Infection**
- As for localised infection PLUS:
  - Wound breakdown/ increased size (length/ width or depth)*
  - Increase in temperature in surrounding skin (if thermoscan is available, increased periwound margin temperature of more than 3°F or 1.1°C*)
  - Erythema/ edema extending from wound edge*
  - Increased exudate (serous/ Purulent / sango-purulent)*
  - Wounds with exposed bone or probes to bone*
  - New areas of satellite breakdown beyond the original wound and/or recurrence of wounds shortly after healing*
  - Unpleasant or sweet, sickening odor*
  - Increased pain in an insensate diabetic foot
  - Cellulitis
  - Crepitus, warmth, induration or discoloration spreading into periwound area
  - Malaise or other non-specific deterioration in patient’s general condition

**Additional signs specific to:**
- **Venous ulcers:** newly formed ulcers within the inflamed margins of existing ulcer
- **Diabetic Foot ulcers:** Phlegmon (a spreading diffuse inflammatory process with formation of suppurative/purulent exudate or pus), fluctuation of tissues, blue-black discoloration and hemorrhage (halo), bone or tendon becomes exposed at base of ulcer, sinuses develop, spreading necrosis or...
Venous leg ulcers: Sudden appearance or increase in amount of slough, sudden appearance of necrotic black spots
Pressure ulcers: Viable tissue becomes sloughy
Diabetic foot ulcers: Ulcer base changes from healthy pink to gray

***gangrene***

Arterial leg and diabetic foot ulcers: Lymphangitis (inflammation of the lymphatic channels that occurs as a result of infection at a site distal to the channel. Thin red lines observed running along the course of the lymphatic vessels in the affected area, accompanied by painful enlargement of the nearby lymph nodes- known as “blood poisoning in layman’s terms”

Validation of signs and symptoms in chronic wounds: Infection has been validated in the presence of three or more of the other signs designated with an asterisk.

Action: Assume that if three or more validated s&s are present, the wound is infected and obtain a swab for c&s using the Levine method (see C) for aerobic and anaerobic cultures and sensitivity (obtain physician orders) to determine species of bacteria and sensitivities to antibiotic therapy.

Notes

In patients who are immunocompromised and/or who have motor or sensory neuropathies, symptoms may be modified and less obvious. For example, in a diabetic patient with an infected foot ulcer and peripheral neuropathy, pain may not be a prominent feature

- Arterial ulcers – previously dry ulcers may become wet when infected
  
  Clinicians should also be aware that in the diabetic foot, inflammation is not necessarily indicative of infection. For example, inflammation may be associated with Charcot’s arthropathy.

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vii Hamilton Niagara Haldimand Norfolk CCAC CASE MANAGEMENT PROCESS: ASSESSMENT & MANAGEMENT OF CHRONIC SURGICAL WOUNDS. (Sept 30, 2009), and CASE MANAGEMENT PROCESS ASSESSMENT & MANAGEMENT OF CLOSED (ACUTE) SURGICAL WOUNDS. (Nov 20, 2009). Used with permission.