Over the past 50 years, the increased ability to undertake increasingly complex surgical procedures has resulted in the inevitable increase in the possibility for infection, resulting in numerous studies and recommendations regarding perioperative infection control.

A surgical site infection (SSI) is one which occurs in the surgical site within 30 days of surgery (or one year if an implant is present). All surgical wounds are contaminated (i.e. bacteria are found over the surface of the wound), but whether they become infected (i.e. bacteria are actively multiplying within the deeper tissues) depends on several factors, including the virulence of the organism and the ability of the host to mount an immune response. Generally, there is increased risk of SSI when the bacterial count in wounds is $10^5$ bacteria/g tissue.

### Surgical wound classification

<table>
<thead>
<tr>
<th>Wound classification</th>
<th>SSI rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clean</td>
<td>2-4.8%</td>
</tr>
<tr>
<td>Non-traumatic elective operative wounds</td>
<td></td>
</tr>
<tr>
<td>No entry into respiratory, gastrointestinal or urogenital tract</td>
<td></td>
</tr>
<tr>
<td>Clean-contaminated</td>
<td>3.5-5%</td>
</tr>
<tr>
<td>Clean procedure with placement of drain</td>
<td></td>
</tr>
<tr>
<td>Entry into respiratory, gastrointestinal or urogenital tract</td>
<td></td>
</tr>
<tr>
<td>Contaminated</td>
<td>4.6-12%</td>
</tr>
<tr>
<td>Major break in asepsis</td>
<td></td>
</tr>
<tr>
<td>Dirty</td>
<td>6.7-18.1%</td>
</tr>
<tr>
<td>Purulent discharge, foreign bodies, devitalised tissue</td>
<td></td>
</tr>
<tr>
<td>Major spillage from a viscus</td>
<td></td>
</tr>
</tbody>
</table>
Patient considerations

- **Surgical site preparation.**
  Removal of hair should be performed with well-oiled and regularly serviced clippers (razors damage the skin) and the clip should be significantly larger than the proposed surgical site. Ideally, preparation should be performed in a separate room (i.e. not in theatre) and hair should be collected immediately with a vacuum cleaner. Clipping should be performed after anaesthetic induction, not before, in order to reduce postoperative infection.

  Techniques for aseptic preparation of the skin vary widely between clinics, but generally include a chlorhexidine or povidone-iodine based preparation. At the authors’ institution, Chloroprep (2% Chlorhexidine Gluconate/70% Isopropyl Alcohol formulation) is utilised on clean swabs to perform a circular scrub, starting at the proposed surgical site and extending outwards towards the hairline. When cleaning the skin, gloves should be worn. When using chlorhexidine, the site should be cleaned for three minutes after the skin appears grossly clean and if the animal is being moved from a preparation room into a theatre, a final additional cleaning of the skin should be performed before draping. *Importantly, solutions of diluted chlorhexidine can harbour bacterial organisms, particularly pseudomonas, and so each batch of scrub solution should be made up as required and not stored before or after use.*

  Where mucous membranes or eyes are involved, povidone iodine is preferable, diluted 1:50 in sterile saline.

  **Anaesthetic induction agent**
  Propofol is associated with increased SSI in some studies, so aseptic technique must be used and unused propofol is stored according to manufacturer’s instructions.
**Anaesthetic and surgical duration**

Increasing duration of anaesthesia and surgery is associated with increased SSI, with infection rate doubling for every additional hour of surgery. Efforts should be made to reduce anaesthetic time where safe to do so (e.g. during diagnostic procedures, waiting time, preparation time).

- **Patient specific factors**
  There is an increased risk of SSI in cats and dogs with diabetes mellitus, hypothyroidism and hyperadrenocorticism.

- **Drapes**
  Drapes are used to prevent microorganisms and debris from the unprepared and unclipped region of the animal entering the surgical site or contaminating surgical staff. The drape should be impermeable to moisture and debris, and should remain secured (either using adhesive strips or towel clamps). Currently, there is no evidence for the superiority of adhesive incise drapes.

**Staff considerations**

- **Theatre clothing**
  Currently, there is little statistically significant evidence documenting the necessity of headcovers or surgical footwear, but there is some evidence that masks may be beneficial. It is recommended that masks should be disposable, changed between procedures (or sooner if damp) and should not be hung around the neck (which increases contamination) when not in use. Gloves should be worn to reduce wound contamination from the surgeon’s hands. Glove perforation is more likely to occur with the primary surgeon, the nondominant hand and during orthopaedic procedures. Despite the 1.5% industry standard for preoperative glove perforation, up to 4.1% of vinyl and 2.7% of latex gloves (unused) leak when filled with water
- **Hand preparation**
  A substantial amount of literature exists regarding hand preparation of the surgeon and many preparations are available commercially. Traditionally, surgeons have used soft scrubbing brushes and sponges to scrub the hands and forearms using chlorhexidine (total of three minutes scrub times) or povidone iodine (5 minutes), but the World Health Organization (WHO) currently recommends the use of alcohol based hand rubs (Pittet 2009).

**Facility considerations**

- **Theatres**
  In order to minimise contamination, the theatre list for the day should be planned such that clean procedures occur early in the day and dirty procedures are scheduled to follow. Theatre should be cleaned between each procedure and at the end of each day.

  A simple detergent in water combined with a microfiber cleaning system is effective at removing dirt and microbial contamination. The electrostatically charged microfibers physically attract the particles and contain them until the cloth/mop is laundered at high temperature. Disinfectants diluted to the manufacturer’s recommendations are suitable for use on semi-critical devices or non-critical devices in close proximity to the patient that are subjected to heavy contamination. Period deep cleaning at locally determined intervals may be used to target specific areas and ensure high standards are maintained.

- **Instrumentation**
  Appropriate instrument cleaning, sterilisation and maintenance are imperative. Following use, instruments should be rinsed and cleaned manually or mechanically using a commercial cleaner according to the manufacturer’s instructions.

  Sterilisation of the packaged instruments may then occur by:
• Steam, which is usually 121°C for 30 minutes in a gravity displacement autoclave or 132°C for 15 minutes in a prevacuum steriliser.

• Ethylene oxide. Precautions should be taken because ethylene oxide is toxic and sterilisation of certain components (eg polyvinyl chloride) may release toxic compounds. Adequate aeration time should be utilised following sterilisation and contact with the skin/eyes/respiratory tract should be avoided.

• Plasma sterilisation.

• Radiation (gamma)

• Cold sterilisation (e.g. gluteraldehyde), which is particularly useful for lensed instruments.

It is imperative that indicators are used to demonstrate that the method of sterilisation has been effective.

**Tissue**

SSI can be minimised by adhering to Halstead’s surgical principles, including minimising dead space, traumatic tissue handling and foreign material (i.e. reduce the gauge and amount of suture material utilised where possible).

**Antibiotic use**

Antibiotics should not be used to compensate for poor preparation of the patient, surgeon or facilities. As a general rule, antibiotics should only be continued beyond 24 hours post surgery if there was a major break in asepsis or if infection would be catastrophic (e.g. following total hip replacement). At the authors’ institution, 20mg/kg intravenous clavulanic acid potentiated amoxycillin (many institutions prefer cefazolin) is administered at the time of anaesthetic induction so that adequate concentration is achieved at surgical site before surgery begins. The dose is repeated every 2 hours intraoperatively. Where the procedure is classified as ‘clean’ and no implants
are used (e.g. an ovariohysterectomy), no intraoperative antibiotics are administered.

Where postoperative antibiotics may be appropriate:

- Oesophageal resection and anastomosis
- Intestinal resection of nonviable bowel
- Hernia repair using non absorbable mesh
- Dental procedures
- Infected biliary procedures
- Perineal hernias
- Total hip replacement
- Extensive internal fixation
- Colonic surgery
- Pacemaker
- >2h with extensive tissue manipulation
- Open fracture
- Extensive neurological procedures

**Active infection surveillance**

Where possible, regular infection control group meetings within the hospital are beneficial. Wound infections rates (and other complications) should be prospectively recorded and reviewed monthly to determine rates between procedures, surgeons, theatres, days of the week etc. In this way, the adequacy of current protocols can be assessed and any alterations required can be implemented.

Infection surveillance should be carried out routinely, but is of particular importance during an infection outbreak. Swabbing of different regions of the hospital (e.g. door handles, mop heads, computer screens, and cages) may be useful in close consultation with a microbiologist, who ideally should also be on the infection control board.