
Infection Reduction

Dr. Ashrafghanjoei
Associate Prof.
Shahid Beheshti University of Medical Sciences
ERAS

• Enhanced recovery after surgery (ERAS) is a standardized, perioperative care program.
• The recovery process is complex and encompasses the multiple dimensions of physical, emotional, economic, and social health.
• ERAS has been shown to result in both clinical benefits (reductions in length of stay, complications, and readmissions) and health system benefits (reduction in cost).
Overview of control measures for prevention of surgical site infection in adults

- Among surgical patients, SSIs are the most common nosocomial infection, accounting for 38 percent of nosocomial infections. It is estimated that SSIs develop in 2 to 5 percent of the more than 30 million patients undergoing surgical procedures each year.
RISK FACTORS FOR SSI

- **Timing of surgery** — including emergency surgery, cancer therapy, remote infection, and malnutrition.

- **Emergency surgery** — Patients undergoing emergency or urgent surgical procedures have higher risk of adverse outcomes, including SSI. As an example, for the treatment of colonic obstruction, stenting can be used in the interim.

- **Cancer therapy** — Chemotherapy and radiation therapy increase the risk of subsequent SSI.

- **Remote infection** — Prior to elective surgery, patients with evidence of active infection at a remote site should complete treatment for the infection prior to surgery, particularly in circumstances when placement of prosthetic material is anticipated.

- **Malnutrition** — Hypoalbuminemia increases the risk of SSI six fold compared with normal albumin.

- **Medication management** — Immunosuppressive therapies impair wound healing but are not generally thought to be directly related to the development of SSI.

- **Minimally invasive versus open approach** — Minimally invasive and laparoscopic-assisted procedures are generally associated with lower rates of SSI compared with open procedures.
PATIENT PREPARATION

• **Smoking cessation** — Smoking is associated with an increased risk for SSI and other complications. Smoking cessation four to six weeks is recommended prior to elective surgery to reduce the risk of pulmonary complications; smoking cessation also reduces wound complications including SSI.

• **Bowel preparation** — Bowel preparation prior to colon surgery reduces SSI rates.
A number of perioperative infection control interventions have been used to reduce the risk of SSIs, including hand hygiene, use of gloves and other barrier devices by operating room personnel, patient decolonization, skin antisepsis, and method hair removal.

These interventions reduce patient contact with flora from the hands, hair, scalp, nares, and oropharynx of hospital personnel, which can be potential sources of microorganisms causing SSIs.

**Antimicrobial prophylaxis** — Antimicrobial prophylaxis is an important intervention for prevention of SSI.
Hand hygiene

• **Hand hygiene** — Surgical hand hygiene consists of preoperative cleansing of hands (including under the nails) and forearms with an antiseptic agent. Cleansing with aqueous alcoholic solution may be as effective as traditional hand scrubbing with antiseptic soap for prevention of SSIs.

• Either antimicrobial soap or an alcohol-based hand rub may be used. The recommended duration of scrubbing with alcohol-based hand rubs is shorter than with antimicrobial soap, and **scrub brushes** are not required for preoperative hand cleaning by surgical staff.
Hand hygiene

• Removal of false nails, clipping nail length, and removal of watches and finger rings prior to surgical scrubbing is a common-sense practice; failure to so do may result increased bacterial counts.

• Artificial nails remain heavily colonized even after surgical scrubbing. However, data evaluating the effect of these interventions on preventing SSI are limited.

• All members of the surgical team must practice hand hygiene. As an example, contaminated hands of anesthesiologists can serve as a significant source of patient environmental and stopcock set contamination in the operating room.

• The mouth, nose, and hair should be covered during all invasive procedures. Jewelry worn on the head and neck should be removed or covered.

• Double gloving does reduce the risk of holes to the inner glove, and, as such, routine double gloving is recommended by the American College of Surgeons primarily to protect the surgeon.
INFECTION CONTROL

• **Skin antisepsis** — Routine application of antiseptics to the skin should be performed prior to surgery to reduce the burden of skin flora.

• However, topical antiseptic agents cannot fully eradicate skin bacteria since organisms also reside in hair follicles and sebaceous glands.

• Based upon systematic reviews, for clean and clean-contaminated surgery, preoperative skin cleansing with chlorhexidine-based preparations are superior to povidone-based preparations (risk ratio 0.70; 95% CI, 0.60-0.83). Chlorhexidine may be superior to iodine because chlorhexidine is not inactivated by blood or serum.

• **Hair removal** — Shaving hair with razors at the planned operative site should be avoided; if hair removal is absolutely necessary, it may be performed with clippers or depilatory agents.

• Preoperative hair removal has been associated with an increased risk for SSI. The lowest rates of SSI have been observed when hair was removed just prior to the surgical incision.
INFECTION CONTROL

- Other perioperative measures such as maintaining normothermia, oxygenation, controlling glucose, minimizing red blood cell transfusion, limiting traffic through the operating room, and possibly the use of laminar flow in selected circumstances may reduce SSI.

- **Maintain normothermia**: perioperative hypothermia may increase risk for SSI by triggering vasoconstriction and reducing subcutaneous oxygen tension.

- **Supplemental oxygen** — The use of high-inspired (supplemental) oxygen perioperatively may also be associated with decreased rates of SSI, but robust evidence is lacking.

- **Minimize red cell transfusion** — Red cell transfusions are associated with increased SSI rates among hospitalized patients. Compared with more liberal transfusion strategies, restrictive transfusion (i.e., at a lower hemoglobin level) reduces the risk of SSI.

- **Glucose control** — Perioperative hyperglycemia has been associated with an increased risk of infection.
SURGICAL TECHNIQUE

• Such practices include:
  • gentle traction,
  • effective hemostasis,
  • removal of devitalized tissues,
  • minimization of electrocautery to avoid thermal spread,
  • obliteration of dead space,
  • irrigation of tissues with saline to avoid excessive drying,
  • wound closure without tension to avoid ischemia,
  • and judicious use of closed-suction drains.
• Preintervention steps to reduce SSI included
• patient education,
• 4% chlorhexidine gluconate shower before surgery,
• antibiotic administration,
• preoperative skin preparation with 2% chlorhexidine gluconate and 70% isopropyl alcohol,
• and cefazolin re-dosing three to four hours after incision.
• The bundled intervention consisted of dressing removal at 24 to 48 hours postoperatively, patient shower with 4% chlorhexidine gluconate after dressing removal, and a follow-up nursing phone call. Of note, approximately 40 percent of women undergoing surgery for ovarian cancer required bowel resection.
Antibiotic prophylaxis — Antibiotics should be given to prevent SSI prior to gynecologic surgery or procedures that enter the reproductive tract (eg, hysterectomy) or are likely to contaminate the peritoneal cavity from the vagina (eg, surgical abortion).

The efficacy of the preferred beta-lactam antimicrobial regimens (eg, cefazolin, cefoxitin or cefotetan) was supported by a retrospective cohort study of over 21,000 women undergoing hysterectomy (abdominal, vaginal, laparoscopic, and robotic). The women who received either alternative antibiotic regimens (clindamycin with gentamicin or quinolone) or nonstandard regimens had a higher risk of SSI compared with women who received preferred preoperative antibiotics (SSI odds ratio of 1.7 for alternative beta-lactam regimens and 2.0 for nonstandard antibiotic regimens).

In contrast, a subsequent retrospective cohort study of over 18,000 women undergoing hysterectomy (all types) reported an increased risk of surgical site infection in women receiving either cefazolin or second-generation cephalosporin agents compared with women receiving cefazolin plus metronidazole (adjusted odds ratio 2.3 for both). However, the authors will continue to use preoperative beta-lactam antibiotics (eg, cefazolin) unless prospective comparative trial data become available that compel a change in guidelines because of concerns that more broad-spectrum antibiotic coverage could contribute to increased antibiotic resistance.
Surgical Site Infection Reduction bundles

• Surgical site infections are defined as infections of the surgical incision or organ space that develop within 30 days of surgery.
• Surgical site infections are associated with increased patient morbidity, mortality, and healthcare expenditures and occur in up to 20–30% of gynecologic oncology patients undergoing a laparotomy.
• Surgical site infection reduction bundles have been demonstrated to decrease the risk of developing a surgical site infection in an additive fashion.
• Surgical site infection bundle elements include antimicrobial prophylaxis, skin preparation, avoiding hypothermia, avoiding surgical drains, and reducing perioperative hyperglycemia.
Antimicrobial Prophylaxis

• Appropriate antibiotic prophylaxis includes administration of a first generation cephalosporin to cover skin flora.

• **Cephalosporins** have relatively broad coverage, are low cost, have a low allergenic potential, and are the recommended prophylaxis for simple hysterectomy.

• **Additional anaerobic coverage is recommended if the bowel is entered during pelvic surgery for cancer.**

• Dosage may need to be adjusted based on **patient weight**.
Antimicrobial Prophylaxis

• Most antibiotics should be administered within 1 hour of incision in order to obtain the highest drug serum levels at incision.
• Antibiotic redosing should be monitored for compliance based on operative time and blood loss.
• Several surgical site infection reduction bundles include an emphasis on antibiotic dosing and timing of administration.
Antimicrobial prophylaxis and skin preparation

- Most surgical interventions for gynecologic malignancies include total hysterectomy which is classified as a clean contaminated, or type II incision.
- Surgical site infections (SSI) in gynecology involve skin flora, vaginal flora, or enteric bacteria when the colon is entered.
- Many studies and meta-analyses have demonstrated the benefits of antibiotic prophylaxis in reducing surgical site infection after vaginal or abdominal hysterectomy.
- Cephalosporins are the most commonly recommended antibiotic class given their broad spectrum, low cost, and low allergenic potential.
- Cefazolin is generally recommended for gynecologic interventions where antibiotic prophylaxis is mandatory. Amoxicillin–clavulanic acid has been shown to be equivalent to cefazolin and can also be used.
- Antibiotics are administered intravenously within 1h before skin incision (usually at the time of anesthesia induction).
Preoperative antimicrobial prophylaxis and skin preparation

• A cesarean delivery performed before rupture of the membranes and without chorioamnionitis usually will be considered a clean (class I) incision.

• However, a cesarean delivery in the setting of ruptured membranes, particularly in active phase of labor or second stage of labor or with chorioamnionitis, usually is classified as a clean contaminated (class II) incision.
Preoperative antimicrobial prophylaxis and skin preparation

• There could be an argument made that, at least, some of these latter incisions are contaminated (class III) incisions.

• Regardless, all are at an increased risk of postoperative infection and have demonstrated benefit from prophylactic antibiotics and other interventions.

• Although the class I incisions will be predominantly at-risk from abdominal skin flora, the class II or class III incisions both carry the risk of skin flora plus the risk of exposure from vaginal flora.

• These microbial risks are the primary issues when considering prophylactic antibiotics, wound preparation, and vaginal preparation.
Skin Preparation

• Skin preparation is intended to decrease the amount of bacterial flora present on the skin before incision. This can be accomplished through pre-operative bathing at home as well as use of a skin preparation in the operating room before incision.

• There is level I evidence demonstrating a 40% lower surgical site infection rate associated with chlorhexidine-alcohol skin preparation compared with povidone-iodine and the CDC has endorsed alcohol-based skin preparation as a category 1A recommendation.

• Most surgical site infection reduction bundles have incorporated pre-operative bathing with a chlorhexidine-based antimicrobial soap and chlorohexidine-alcohol skin preparation before surgery.
Skin Preparation

• Summary and Recommendation: Patients should shower before surgery with a chlorhexidine-based antimicrobial soap and undergo a chlorohexidine-alcohol skin preparation in the operating room before surgery.

• Evidence level: high

• Recommendation grade: strong
Prevention of Hypothermia

- **Intra-operative hypothermia** has been linked to an increased risk of surgical site infections and cardiac events.

- Various methods to avoid intraoperative hypothermia have been evaluated including forced air blanket devices, underbody warming mattresses, and warmed intravenous fluid administration.

- In a randomized clinical trial comparing intraoperative warming only (control group) versus additional warming 2 hours before and after surgery (warming group) among patients undergoing major abdominal surgery, the rate of surgical site infections was decreased by half among those who were normothermic.

- The CDC endorses perioperative normothermia as a category 1A recommendation.

**Summary and Recommendation:**
- Maintenance of normothermia should be incorporated into all ERAS programs.
- Evidence level: high
- Recommendation grade: strong
Avoidance of drains/Tubes

• High quality evidence is lacking to address the role of subcutaneous or peritoneal drains in decreasing surgical site infections and evidence exists that drain biofilm colonization can be detected as early as 2 hours after placement.

• One surgical site infection reduction bundle implemented among gynecologic oncology patients included use of subcutaneous drains in obese patients. However, this surgical site infection reduction bundle also included other interventions with stronger surgical site infection reduction evidence.

• At this point, there is insufficient evidence to recommend inclusion of a subcutaneous drain or peritoneal drain as part of a surgical site infection reduction bundle and there may be harm by introducing a foreign body conduit for bacteria to travel into a surgical wound. Nasogastric intubation increases the risk of post-operative pneumonia after elective abdominal surgery and does not reduce the risk of wound dehiscence or intestinal leaks.

• As such, the use of drains should be tailored according to the surgical procedure and rationale for individualized drain placement.

Summary and Recommendation:

• The use of peritoneal drains, subcutaneous drains, and nasogastric tubes should be avoided after abdominal surgery.

• Evidence level: high
• Recommendation grade: strong
Control of Perioperative Hyperglycemia

• The prevalence of diabetes is 22% among the US population older than 65 years.

• The high prevalence suggests the need not only to implement interventions to obtain perioperative glycemic control but also to improve pre-operative screening.

• Perioperative hyperglycemia has been associated with increased risk of developing surgical site infections, in both diabetic and non-diabetic patients undergoing surgery, and the CDC recommends (category 1A) blood glucose levels be maintained at <200 mg/dL regardless of whether a patient is diabetic or not.

• A recent study among gynecologic oncology patients found that implementing an intensive post-operative glycemic control initiative using a continuous insulin infusion resulted in a 35% reduction in the rate of surgical site infections among patients with diabetes.

• Similarly, authors of another study decreased the surgical site infection rate by 55% through implementation of an initiative standardizing post-operative management of diabetic and pre-diabetic patients using a multidisciplinary team.

• Importantly, glucose management must avoid hypoglycemia as well as hyperglycemia as both extremes have been associated with higher mortality risk.

• It should be noted that other interventions that decrease insulin resistance are part of the ERAS protocol, including oral carbohydrate loading, minimally invasive surgery, early feeding, and thoracic epidural analgesia.
Control of Perioperative Hyperglycemia

• Summary and Recommendation:
• Perioperative glucose levels should be maintained under 200 mg/dL in diabetics and non-diabetics.
• All surgical patients should be screened for diabetes. Measures to optimize perioperative glycemic control should be included in surgical site infection reduction bundles.
• Evidence level: high
• Recommendation grade: strong
Antimicrobial prophylaxis and skin preparation

• The dose should be increased in obese patients (BMI>35 or >100 kg) and repeated after 1–2 times the half-life of the chosen medication in prolonged operations (eg. 3 h for cefazolin, half-life: 1.8 h) and in case of blood loss>1500 ml.

• For patients allergic to penicillin/cephalosporin, a combination of clindamycin and gentamycin IV or a quinolone (eg. ciprofloxacin) can be used.

• Laparoscopic operations not contaminated by the genitourinary or digestive tracts do not require antimicrobial prophylaxis.
Antimicrobial prophylaxis and skin preparation

Summary and recommendation:
• IV antibiotics should be administered routinely within 60 min before skin incision. The dose should be repeated in case of prolonged operations or severe blood loss and increased in obese patients.
• Hair clipping is preferred if hair removal is mandatory.
• Chlorhexidine–alcohol is preferred to aqueous povidone-iodine solution for skin cleansing.

Evidence level:
• Antibiotic prophylaxis: High.
• Hair clipping: High.
• Chlorhexidine–alcohol: High.

Recommendation grade:
• Antibiotic prophylaxis: Strong.
• Hair clipping: Strong.
• Chlorhexidine–alcohol: Strong.
Antimicrobial Prophylaxis in Gynecologic Surgery

• In the United States, it is customary to give antimicrobial prophylaxis shortly before or during the induction of anesthesia.
• Data revealed that a delay of 3 hours or more between the time of bacterial inoculation (i.e., skin incision) and administration of antibiotics may result in ineffective prophylaxis.
• Cefazolin (1 g) appears to be widely used in the United States by gynecologic surgeons because of its relatively low cost and long half-life (1.8 hours).
• Other cephalosporins such as cefoxitin, cefotaxime, and cefotetan are commonly used for prophylaxis. These agents appear to have a broader spectrum of activity against anaerobic bacteria and are appropriate selections when colorectal resections are possible, such as during a debulking surgery for ovarian cancer.
• For the majority of gynecologic procedures, there is little evidence that a clinically relevant distinction exists between cefazolin and the other agents. Obese patients, defined as having a BMI greater than 35 or weight greater than 100 kg, should receive 2 g of cefazolin to achieve appropriate blood and tissue antibiotic concentrations.

• There are no data to support the continuation of prophylactic antimicrobial agents into the postoperative period for routine gynecologic procedures.
Preoperative antimicrobial prophylaxis and skin preparation

• For cesarean delivery performed before rupture of the membranes, the standard of care has been to use a relatively narrow-spectrum first-generation cephalosporin directed against skin flora for infectious prophylaxis, although similar benefits have been seen with other antibiotic regimens.

• Historically, because of concerns of fetal exposure, these antibiotics were often given after cord clamping. However, because of the benefit of a decrease in subsequent wound infections reported in several studies, it is now recommended to give the antibiotics 30-60 minutes before the cesarean delivery when possible.
Skin preparation

• Skin preparation before surgery traditionally includes a shower, hair removal and the use of skin antiseptic solution.
• Showering using plain soap is as effective as chlorhexidine in reducing surgical site infection.
• Compared to shaving, hair clipping in the operating room immediately prior to surgery is associated with lower rates of SSI. However, there is no clear evidence that hair removal reduces SSI, irrespective of the method chosen (shaving, hair clipping or depilatory cream).
• Therefore, hair removal should be avoided and if deemed necessary hair clipping is preferred.
Skin preparation

• Skin antiseptic is highly recommended. A RCT showed a 40% reduction in SSI when using chlorhexidine gluconate and isopropyl alcohol 70% compared to an aqueous solution of 10% povidone-iodine for skin cleansing in different clean-contaminated interventions.

• Chlorhexidine–alcohol therefore is preferred over aqueous povidone-iodine solution although care must be taken to avoid ignition when electrocautery is used.
Perioperative Fluid Management/Goal-directed Fluid

• Therapy Intravenous fluid excess has been associated with a delayed return of bowel function, post-operative ileus, post-operative nausea and vomiting, and increased length of stay.

• Conversely, hypovolemia, if undetected, may lead to post-operative complications, including acute kidney injury, surgical site infections, sepsis, and delirium, as well as prolonged hospital stay.
<table>
<thead>
<tr>
<th>Item</th>
<th>Recommendation</th>
<th>Evidence level</th>
<th>Recommendation grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preoperative information education and counseling</td>
<td>Patients should routinely receive dedicated preoperative counseling</td>
<td>Low</td>
<td>Strong</td>
</tr>
<tr>
<td>Preoperative optimization</td>
<td>Smoking and alcohol consumption (alcohol abusers) should be stopped four weeks before surgery</td>
<td>Smoking: High</td>
<td>Strong</td>
</tr>
<tr>
<td></td>
<td>Alcohol: Moderate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Preoperative bowel preparation</td>
<td>Anaemia should be actively identified, investigated, and corrected preoperatively</td>
<td>High</td>
<td>Strong</td>
</tr>
<tr>
<td></td>
<td>Mechanical bowel preparation should not be used routinely even when bowel resection is planned</td>
<td>Moderate</td>
<td>Strong</td>
</tr>
<tr>
<td>Preoperative fasting and carbohydrate treatment</td>
<td>Clear fluids should be allowed up to 2 h and solids up to 6 h prior to induction of anaesthesia</td>
<td>Solids/fluids: High</td>
<td>Strong</td>
</tr>
<tr>
<td></td>
<td>Carbohydrate loading reduces postoperative insulin resistance and should be used routinely</td>
<td>Carb loading: Mod (outcome insulin resistance)</td>
<td>Strong</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Carb loading: Mod (other outcomes)</td>
<td></td>
</tr>
<tr>
<td>Preanaesthetic medication</td>
<td>Routine administration of sedatives to reduce anxiety preoperatively should be avoided</td>
<td>Low</td>
<td>Strong</td>
</tr>
<tr>
<td>Thromboembolism prophylaxis</td>
<td>Patients at risk of VTE should receive prophylaxis with either LMWH or heparin, commenced preoperatively, combined with mechanical methods</td>
<td>High (Prep admin: Mod)</td>
<td>Strong</td>
</tr>
<tr>
<td></td>
<td>Patients should be advised to consider stopping HRT or consider alternative preparations before surgery</td>
<td></td>
<td>Weak</td>
</tr>
<tr>
<td></td>
<td>Patients should discontinue oral contraception prior to surgery and switch to another form</td>
<td></td>
<td>Strong</td>
</tr>
<tr>
<td>Antimicrobial prophylaxis and skin preparation</td>
<td>IV antibiotics (1st generation cephalosporin or amoxicillin) should be administered routinely within 60 min before skin incision. Additional doses should be given during prolonged operations, severe blood loss and obese patients</td>
<td>High</td>
<td>Strong</td>
</tr>
<tr>
<td></td>
<td>Hair clipping is preferred if hair removal is mandatory</td>
<td>High</td>
<td>Strong</td>
</tr>
<tr>
<td></td>
<td>Chlorhexidine-alcohol is preferred to aqueous povidone-iodine solution for skin cleaning</td>
<td>High</td>
<td>Strong</td>
</tr>
<tr>
<td>Standard anesthetic protocol</td>
<td>Short acting anesthetic agents should be used to allow rapid awakening</td>
<td>Low</td>
<td>Strong</td>
</tr>
<tr>
<td></td>
<td>A ventilation strategy using tidal volumes of 5-7 ml/kg with a PEEP of 4-6 cm H2O should be employed to reduce postoperative pulmonary complications</td>
<td>Moderate</td>
<td></td>
</tr>
<tr>
<td>Postoperative nausea and vomiting</td>
<td>A multimodal approach to PONV with &gt; 2 antemetic agents should be used for patients undergoing gynecologic procedures</td>
<td>Moderate</td>
<td></td>
</tr>
<tr>
<td>Minimally invasive surgery (MIS)</td>
<td>MIS is recommended for appropriate patients when expertise and resources are available</td>
<td>Morbidity: Low Recovery: High</td>
<td>Strong</td>
</tr>
<tr>
<td>Nasogastric intubation</td>
<td>Routine nasogastric intubation should be avoided</td>
<td>High</td>
<td>Strong</td>
</tr>
<tr>
<td></td>
<td>Nasogastric tubes inserted during surgery should be removed before reversal of anesthesia</td>
<td>High</td>
<td>Strong</td>
</tr>
<tr>
<td>Preventing intraoperative hypothermia</td>
<td>Maintenance of normothermia with suitable active warming devices should be used routinely</td>
<td>High</td>
<td>Strong</td>
</tr>
<tr>
<td>Perioperative fluid management</td>
<td>Very restrictive or liberal fluid regimes should be avoided in favor of euvelema</td>
<td>High</td>
<td>Strong</td>
</tr>
<tr>
<td></td>
<td>In major open surgery and for high risk patients where there is large blood loss (&gt;7 ml/kg) or a SIRS response the use of advanced hemodynamic monitoring to facilitate individualized fluid therapy and optimize oxygen delivery during the perioperative period is recommended</td>
<td>Moderate</td>
<td></td>
</tr>
<tr>
<td>Procedure</td>
<td>Antibiotic</td>
<td>Dosage</td>
<td>Level</td>
</tr>
<tr>
<td>------------------------------------------------</td>
<td>---------------------------------</td>
<td>-----------------------------------------------------</td>
<td>-------</td>
</tr>
<tr>
<td>Vaginal hysterectomy</td>
<td>First- or second-generation cephalosporin</td>
<td>Single dose, IV</td>
<td>I-A</td>
</tr>
<tr>
<td>Abdominal hysterectomy</td>
<td>First- or second-generation cephalosporin</td>
<td>Single dose, IV</td>
<td>I-A</td>
</tr>
<tr>
<td>Laparoscopic hysterectomy</td>
<td>First- or second-generation cephalosporin</td>
<td>Single dose, IV</td>
<td>III-B</td>
</tr>
<tr>
<td>Laparoscopy (uterus and/or vagina not entered)</td>
<td>None recommended</td>
<td></td>
<td>I-E</td>
</tr>
<tr>
<td>Pelvic organ prolapse and/or stress urinary incontinence surgery</td>
<td>First-generation cephalosporin</td>
<td>Single dose, IV</td>
<td>III-B</td>
</tr>
<tr>
<td>Hysteroscopy</td>
<td>None recommended</td>
<td></td>
<td>II-2D</td>
</tr>
<tr>
<td>Therapeutic abortion</td>
<td>doxycycline</td>
<td>100 mg po pre-procedure and 200 mg po post-procedure</td>
<td>I-A</td>
</tr>
<tr>
<td>Missed/incomplete abortion</td>
<td>None recommended</td>
<td></td>
<td>I-E</td>
</tr>
<tr>
<td>IUD insertion</td>
<td>None recommended*</td>
<td></td>
<td>I-E</td>
</tr>
<tr>
<td>Endometrial biopsy</td>
<td>None recommended</td>
<td></td>
<td>III-L</td>
</tr>
<tr>
<td>Hystersalpingogram</td>
<td>1. Consider screening for STIs†</td>
<td>1. Rx as per STI guidelines‡</td>
<td>III-B</td>
</tr>
<tr>
<td></td>
<td>2. Antibiotics if dilated tubes</td>
<td>2. e.g., doxycycline</td>
<td>II-3B</td>
</tr>
<tr>
<td>Urodynamic testing</td>
<td>None recommended§</td>
<td></td>
<td>I-E</td>
</tr>
</tbody>
</table>

IV: intravenous  
*Considering screening for sexually transmitted infections in high risk populations  
†Evidence for/against screening unknown  
‡Canadian guidelines on sexually transmitted infections—2006 edition  
§In patients at low risk with a background risk of UTI < 10% after urodynamics
transfusion

• with a Cochrane review showing an increase in cancer recurrence following perioperative transfusion.

• Where transfusion is considered to be unavoidable there is no evidence to suggest advantages of pre- over intraoperative transfusion. If possible, the focus should be on preventing further blood loss intraoperatively.

• Iron therapy is the preferred first line treatment for the correction of iron deficiency anemia.
Preventing intraoperative hypothermia

• Hypothermia has been shown to impair drug metabolism, adversely affect coagulation, and increase bleeding, cardiac morbidity, and wound infection.

• Postoperative shivering also increases oxygen consumption at a critical time and can worsen pain.

• It is important to maintain normothermia by active methods throughout the perioperative period, including prewarming patients to avoid an initial drop in body temperature.

• Wound infections are significantly less common with the use of active warming compared to conventional methods, with an absolute risk reduction of 13%.
Preventing intraoperative hypothermia

- During surgery, warming using forced air blanket devices are effective and widely used. Underbody warming mattresses are also effective and avoid the use of a blanket that may interfere with surgical access, particularly in robotic surgery.

- Intravenous fluids should be warmed using a suitable device to avoid lowering body temperature. Temperature monitoring should be used to guide therapy and to avoid hyperthermia, which also has deleterious effects on homeostasis.

- Patients who have prolonged surgery with a likelihood of a Systemic Inflammatory Response (SIRS), such as open debulking procedures, are at a higher risk of developing hyperpyrexia as surgery progresses if warming is not monitored.

- The most convenient site to measure core temperature during gynecological surgery is the nasopharynx.

- Warming should be continued into the postoperative period to ensure the patient leaves the post anesthetic care unit with a temperature > 36.0 °C.
Peritoneal drainage

Recommendations

• **Peritoneal drainage is not recommended routinely in gynecologic/oncology surgery including for patients undergoing lymphadenectomy or bowel surgery.**

• Evidence level: Moderate.

• Recommendation grade: Strong
Urinary drainage

recommendation

- Urinary catheters should be used for postoperative bladder drainage for a short period preferably 24 h postoperatively.
- Evidence level: Low.
- Recommendation grade: Strong.
Surgical incision

• The subcutaneous tissue, when it is <2 cm in thickness is often not reapproximated. However, in women whose subcutaneous tissue is ≥2 cm in thickness, reapproximation with catgut or Vicryl suture has been demonstrated to reduce wound complications.

• Placement of a subcutaneous drain even with wounds >4 cm in thickness has not been demonstrated to improve outcomes and has been associated with worse wound outcomes.

• The skin can be closed with staples or subcuticular/intracutaneous techniques with Vicryl or Monocryl. The most recent Cochrane metaanalysis found no difference between the 2 approaches with regards to wound infections or complications overall.

• However, there was a large trial published in 2014 that demonstrated a significant reduction in wound complications; in a subsequent metaanalysis of skin closure that incorporated this trial, subcuticular closure with suture was supported for the reduction in wound complications.

• Additionally, women also have improved preference and experience scores with suture closure.

• One caveat is that the only difference is in wound separation; in many trials, staples were removed <4 days after surgery. Similarly, in a recent trial of obese women only, although there were no clinical differences, more women would choose suture for a future surgery.

• Once the wound is closed, there is increasing evidence that prophylactic negative-pressure wound therapy may be useful, particularly in obese women.
surgical incision

• Postoperative surgical incision – Postoperative surgical incisions (clean, clean-contaminated) are typically covered with a dry dressing that is held in place with an adhesive (eg, tape).

• The initial postoperative dressing can be removed within 48 hours, provided the wound has remained dry.
<table>
<thead>
<tr>
<th>Item</th>
<th>Recommendation</th>
<th>Evidence level</th>
<th>Recommendation grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preoperative information education and counseling</td>
<td>Patients should routinely receive dedicated preoperative counseling</td>
<td>Low</td>
<td>Strong</td>
</tr>
<tr>
<td>Preoperative optimization</td>
<td>Smoking and alcohol consumption (alcohol abusers) should be stopped four weeks before surgery</td>
<td>Smoking: High</td>
<td>Strong</td>
</tr>
<tr>
<td>Preoperative anemia</td>
<td>Anemia should be actively identified, investigated, and corrected preoperatively</td>
<td>Alcohointake: Moderate</td>
<td>Strong</td>
</tr>
<tr>
<td>Preoperative bowel preparation</td>
<td>Mechanical bowel preparation should not be used routinely even when bowel resection is planned</td>
<td>Moderate</td>
<td>Strong</td>
</tr>
<tr>
<td>Preoperative fasting and carbohydrate treatment</td>
<td>Clear fluids should be allowed up to 2 h and solids up to 6 h hours prior to induction of anesthesia</td>
<td>Solidsfluids: High</td>
<td>Strong</td>
</tr>
<tr>
<td></td>
<td>Carbohydrate loading reduces postoperative insulin resistance and should be used routinely</td>
<td>Carb loading: Mod (outcome insulin resistance)</td>
<td>Strong</td>
</tr>
<tr>
<td></td>
<td>Carbohydrate loading: Mod (other outcomes)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Preanesthetic medication</td>
<td>Routine administration of sedatives to reduce anxiety preoperatively should be avoided</td>
<td>Low</td>
<td>Strong</td>
</tr>
<tr>
<td>Thromboembolism prophylaxis</td>
<td>Patients at risk of VTE should receive prophylaxis with either LMWH or heparin, combined with mechanical methods</td>
<td>High (Preop admin: Mod)</td>
<td>Strong</td>
</tr>
<tr>
<td></td>
<td>Patients should be advised to consider stopping HRT or consider alternative preparations before surgery</td>
<td>Low</td>
<td>Weak</td>
</tr>
<tr>
<td></td>
<td>Patients should discontinue oral contraception prior to surgery and switch to another form</td>
<td>High</td>
<td>Strong</td>
</tr>
<tr>
<td>Antimicrobial prophylaxis and skin preparation</td>
<td>IV antibiotics (1st generation cephalexin or amoxi–clav) should be administered routinely within 1 h before skin incision; additional doses should be given during prolonged operations, severe blood loss and obese patients</td>
<td>High</td>
<td>Strong</td>
</tr>
<tr>
<td></td>
<td>Hair clipping is preferred if hair removal is mandatory</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Chlorhexidine-alcohol is preferred to aqueous povidone-iodine solution for skin cleansing</td>
<td>High</td>
<td>Strong</td>
</tr>
<tr>
<td>Standard anesthetic protocol</td>
<td>Short acting anesthetic agents should be used to allow rapid awakening</td>
<td>Low</td>
<td>Strong</td>
</tr>
<tr>
<td></td>
<td>A ventilation strategy using tidal volumes of 5-7 ml/kg with a PEEP of 4-6 cm H2O should be employed to reduce postoperative pulmonary complications</td>
<td>Moderate</td>
<td></td>
</tr>
<tr>
<td>Postoperative nausea and vomiting</td>
<td>A multimodal approach to PONV with &gt; 2 antiemetic agents should be used for patients undergoing gynecologic procedures</td>
<td>Moderate</td>
<td>Strong</td>
</tr>
<tr>
<td>Minimally invasive surgery (MIS)</td>
<td>MIS is recommended for appropriate patients when expertise and resources are available</td>
<td>Morbidity: Low</td>
<td>Strong</td>
</tr>
<tr>
<td>Nasogastric intubation</td>
<td>Routine nasogastric intubation should be avoided</td>
<td>Recovery: High</td>
<td>High</td>
</tr>
<tr>
<td></td>
<td>Nasogastric tubes inserted during surgery should be removed before reversal of anesthesia</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Preparing intraoperative hypothermia</td>
<td>Maintenance of normothermia with suitable active warming devices should be used routinely</td>
<td>High</td>
<td>Strong</td>
</tr>
<tr>
<td>Perioperative fluid management</td>
<td>Very restrictive or liberal fluid regimes should be avoided in favor of euvoemaia</td>
<td>High</td>
<td>Strong</td>
</tr>
<tr>
<td></td>
<td>In major open surgery and for high risk patients where there is large blood loss (&gt;7 ml/kg) or a SIRS response the use of advanced hemodynamic monitoring to facilitate individualized fluid therapy and optimize oxygen delivery during the perioperative period is recommended</td>
<td>Moderate</td>
<td>Strong</td>
</tr>
</tbody>
</table>
Vaginal preparation

- Either povidone-iodine (PVP-I) or chlorhexidine gluconate with a low (4%) concentration of isopropyl alcohol is acceptable for vaginal preparation. While PVP-I is commonly used in the United States for vaginal preparation, chlorhexidine is commonly used elsewhere because it may provide a greater reduction in skin flora than PVP-I and is not inactivated in the presence of blood.

- It appears that bacterial counts return to near baseline levels within 30 minutes after vaginal painting with PVP-I solution; however, vaginal PVP-I gel lowers bacterial counts for at least three hours.

- When the patient is allergic to PVP-I and the vaginal use of chlorhexidine is prohibited, vaginal preparation can be performed with sterile saline or baby shampoo.
Surgical site infection

• The CDC defines an SSI as an infection related to a surgical procedure that occurs near the surgical site within 30 days following surgery (or up to 90 days following surgery where an implant is involved).

• Incisional SSIs are further divided into those involving only skin and subcutaneous tissues (superficial incisional SSI) and those involving deeper softer tissues of the incision (deep incisional SSI).

• Organ/space infections include abscess, anastomotic leak for intra-abdominal operations, and implant-associated infections.
Surgical wound classification

• Surgical site infection (SSI) occurs in approximately 4 percent of clean wounds and 35 percent of grossly contaminated wounds.

• **Clean** – An uninfected operative wound in which no inflammation is encountered and the respiratory, alimentary, genital, or uninfected urinary tracts are not entered. In addition, clean wounds are primarily closed and, if necessary, drained with closed drainage.

• **Clean-Contaminated** – Operative wounds in which the respiratory, alimentary, genital, or urinary tracts are entered under controlled conditions and without unusual contamination.
**Surgical wound classification**

- **Contaminated** – 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, nonpurulent inflammation is encountered, including necrotic tissue without evidence of purulent drainage (e.g., dry gangrene), are included in this category.

- **Dirty or Infected** – Includes old traumatic wounds with retained devitalized 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.
• **Superficial SSI** can be fully evaluated through direct observation of the wound. Serial patient-generated wound images and symptom reports transmitted via telemedicine may document the emergence of infection. If there is concern for involvement of underlying tissues or the organ space, imaging can provide valuable diagnostic information.

• **Imaging** — In the presence of signs or symptoms concerning for a systemic infection, clinicians should have a low threshold for obtaining cross-sectional imaging to evaluate for an undrained abscess requiring source control.

• **Ultrasound** is a widely available imaging technique and can identify the presence of fluid in the subcutaneous tissues. However, in the setting of deep or organ space SSIs, **computed tomography or magnetic resonance imaging** provide a more detailed evaluation of the underlying soft tissue and organ space. In the setting of prior gastrointestinal resection with the possibility of an underlying anastomotic leak or intra-abdominal infection, oral contrast aids in diagnosis. The presence of extraluminal contrast and/or air on imaging is concerning for an underlying perforation requiring surgical intervention.
• **Diagnosis and treatment** – The diagnosis of SSI is predominantly clinical. Full evaluation of the wound includes examination of the skin surrounding the surgical site with documentation of the presence and extent of erythema, edema or induration, and any drainage.

• **Superficial SSI** – For patients with clinical signs of superficial SSI (e.g., localized swelling, warmth, drainage) and active drainage or surgical wound separation, additional imaging is generally unnecessary. Treatment of superficial SSI involves wound exploration and debridement. Antibiotics are administered only if there is associated cellulitis.

• **Deep incisional SSI** – For patients with clinical signs of deep SSI, which are like those of superficial SSI, imaging (e.g., ultrasound, computed tomography) may be helpful to estimate the depth and extent of infection to guide the approach to source control. **Treatment of deep SSI requires antibiotic administration and wound exploration/debridement.**

• **Organ/space SSI** – For patients with clinical signs of organ/space infection (e.g., malaise, fever, and pain/tenderness), imaging is necessary to identify any fluid collections or abscess in operated region. The diagnosis is confirmed through positive cultures of fluid obtained during a drainage procedure (percutaneous, surgical), which guides antimicrobial therapy.
Cultures — Treatment of SSI can be initiated based on Gram stain results, which provide the earliest information to guide empiric therapy. However, specific therapy is based on subsequent culture results. Culture of purulent drainage obtained from an indwelling or radiographically placed drain can be also used to tailor antibiotic therapy.

Negative cultures in an obviously infected wound can be a sign of an underlying atypical infection (eg, acid-fast bacillus [AFB]) or fungal infection. In the setting of immunosuppressive therapies (eg, chemotherapy, post-transplant antirejection therapies), consideration should be given to obtaining AFB and fungal cultures.

If systemic signs of infection are present, concomitant blood cultures should be obtained. Resulting culture specificities and sensitivities may be used to narrow empiric antibiotics.
Role of antibiotics

• **Role of antibiotics** — All wounds are expected to be colonized with microbes; however, not all wounds with microbes are infected. Thus, antibiotic therapy is not indicated for all wounds and should be reserved for wounds that appear clinically infected.

• Clinical signs of wound infection that might warrant antibiotic therapy include local (cellulitis, lymphangitic streaking, purulence, malodor) and systemic (fever, chills, nausea, hypotension, hyperglycemia, leukocytosis, change in mental status) symptoms.
Wound infection

• **Irrigation**
  
  • Warm, isotonic (normal) saline is typically used; however, systematic reviews have found no significant differences in rates of infection for tap water compared with saline for wound cleansing.
  
  • The addition of dilute iodine or other antiseptic solutions (eg, chlorhexidine, hydrogen peroxide, sodium hypochlorite) is generally unnecessary. Such additives have minimal action against bacteria, and some, but not all, may impede wound healing.
Wound exploration and debridement

• Treatment of suspected/confirmed superficial/deep incisional SSI involves opening the wound; drainage of infected fluid, which should be cultured; and debridement of necrotic and devitalized tissue, which are imperative for adequate treatment. In the setting of an undrained fluid collection in communication with an abdominal fascial closure, or in cases when the risk of SSI is high, opening the wound is favored over percutaneous drainage. Antibiotics are required in the setting of surrounding skin erythema, evidence of deeper soft tissue infection, or in the presence of systemic signs and symptoms of infection.
WOUND DEBRIDEMENT

- **Surgical debridement** is the most appropriate choice for removing large areas of necrotic tissue and is indicated whenever there is any evidence of infection (cellulitis, sepsis).

- In patients with active infection, antibiotic therapy should be targeted and determined by wound culture and sensitivity to decrease the development of bacterial resistance.

- Wounds that have devitalized tissue, contamination, or residual suture material require debridement prior to further wound management.

- Surgical wounds that have dehisced may have an infected exudate, bowel contamination, or necrotic muscle or fascia. These materials impede the body's attempt to heal by stimulating the production of abnormal metalloproteases and consuming the local resources necessary for healing.

- **Honey** — Honey has been used since ancient times for the management of wounds. Honey has broad-spectrum antimicrobial activity due to its high osmolarity and high concentration of hydrogen peroxide [81]. Medical-grade honey products are now available as a gel, paste, and impregnated into adhesive, alginate, and colloid dressings.

- For specific wound types, such as burns, may benefit, whereas others, such as chronic venous ulcers, may not.
Diagnosis and treatment

• Empiric antimicrobial therapy is directed at the most likely organisms for a given wound site, Gram stain, wound class, prior antibiotics, and antibiotic resistance patterns.

• Definitive antimicrobial treatment is guided by results of wound culture, and sensitivity. The duration of treatment is guided by the clinical response.

• **Wound care and closure** – Wounds that have been opened due to SSI are managed with serial debridement and dressing changes and often left to heal by secondary intention; however, delayed primary closure may be an option. The approach used generally depends on location of the surgical incision, severity of infection, extent of required debridement and amount of tissue loss, and the handling of any implanted materials. NPWT with or without instillation can be used as an adjunctive technique to facilitate closure.
Antimicrobial therapy

• The need for antimicrobial therapy is determined by the extent of the infection, presence of systemic manifestations, and patient comorbidities (eg, chronic glucocorticoids, diabetes). Antibiotics are required in the setting of surrounding cellulitis or in the presence of systemic signs and symptoms of infection. While antibiotics are not always necessary to treat superficial SSI, antibiotics are nearly always required to treat deep and organ/space SSI.

• Definitive antimicrobial treatment is guided by the clinical response of the patient and, when available, results of wound culture and sensitivities.

• In the absence of retained foreign material, antibiotics should be stopped with resolution of cellulitis and/or normalization of physiologic parameters such as leukocytosis. Guidelines suggest a short course of antibiotics (24 to 48 hours) for cellulitis that has not improved with opening the wound.

• In the case of intra-abdominal organ/space infection, antimicrobial treatment may be discontinued four days after source control has been achieved.

• Delayed primary closure and reconstruction — Wounds that are opened due to SSI are often left to heal by secondary intention; however, delayed primary closure may be an option.
SSI

• **Risk factors** – Risk factors for SSI are similar with those associated with impaired wound healing and include cigarette smoking, older age, vascular disease, obesity, malnutrition, diabetes, and immunosuppressive therapy. Other risk factors for SSI include higher wound classification, proximity to other wounds, and possibly transfusion.

• **Preventive measures** – Surgeons can reduce rates of SSI using control measures and good surgical techniques. Leaving the wound open at the primary operation for delayed primary closure is a strategy that is often used but is unproven to reduce the risk for SSI.
Thank you for your attention