Postop Infection Following Abdominal Hysterectomy
Risk Factors and Effective Interventional Strategies

Nasia Safdar, MD, PhD
Professor, Infectious Diseases and Vice Chair for Research, Department of Medicine,
University of Wisconsin School of Medicine and Public Health, Madison, Wisconsin
Objectives

• To examine risk factors for surgical site infection following hysterectomy

• To review current infection prevention strategies for hysterectomy procedures
Why focus on hysterectomy?

• One of the most commonly performed operations, particularly in the United States
• Lifetime risk of a hysterectomy is 45%
• Vast majority are for benign gynecological conditions
• Literature on gyn cancer hysterectomy outcomes is very limited
Reporting of hysterectomy infections

- Inpatient
- Abdominal, not vaginal
- Open or laparoscopic included
- Implications
- Risk adjustment
Epidemiology

Rates of Infection

• Total Abdominal Hysterectomy

• Laparoscopic hysterectomy

• Vaginal hysterectomy

• Robot-assisted hysterectomy
Changes in trends of hysterectomy procedures (benign)

- 40% decline in inpatient settings
- Move to outpatient settings
- Minimally invasive
- Surveillance challenges
Risk factors for SSI

Risk factor

• Obesity
• Blood Transfusion
• Blood loss during surgery


Young H, Bliss R, Carey JC, Price CS.
Pathogenesis of SSI

- Bacteria
- Host
- Procedure
Risk factors for SSI

• Secondary database analysis of the 2005-09 American College of Surgeons National Surgical Quality Improvement Program (ACS NSQIP) participant use data files

• Women undergoing hysterectomies performed by gynecologic services.

• Voluntary and confidential.
  • This information is collected by a formal chart review process in addition to 30-day postoperative follow-up on patients.

Published online 2013 Jun 13. doi: 10.1016/j.ajog.2013.06.018
Surgical site infection after hysterectomy
AeuMuro G. Lake, MD et al.
<table>
<thead>
<tr>
<th>Variable</th>
<th>Adjusted OR</th>
<th>95% CI</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Route of hysterectomy</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TVH (referent)</td>
<td>1</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Laparotomy</td>
<td>3.74</td>
<td>(2.26, 6.22)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Laparoscopic</td>
<td>1.45</td>
<td>(0.83, 2.56)</td>
<td>.20</td>
</tr>
<tr>
<td><strong>Operative time &gt; 75th percentile duration</strong></td>
<td>1.84</td>
<td>(1.40, 2.44)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>ASA Class 3 or higher</td>
<td>1.79</td>
<td>(1.31, 2.43)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td><strong>BMI category</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BMI &lt; 30 kg/m² (referent)</td>
<td>1</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>BMI ≥ 30 and &lt; 40 kg/m²</td>
<td>1.31</td>
<td>(0.94, 1.81)</td>
<td>.11</td>
</tr>
<tr>
<td>BMI ≥ 40 kg/m²</td>
<td>2.65</td>
<td>(1.85, 3.80)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>1.54</td>
<td>(1.06, 2.24)</td>
<td>.02</td>
</tr>
</tbody>
</table>

Laparotomy included total abdominal hysterectomy and supracervical hysterectomy. Laparoscopic included laparoscopic-assisted vaginal hysterectomy, total laparoscopic hysterectomy, and laparoscopic supracervical hysterectomy.

OR = Odds Ratio; CI = Confidence Interval; TVH = total vaginal hysterectomy; ASA = American Society of Anesthesiologists; BMI = body mass index
Box 3. Patient Risk Factors for Surgical Site Infection

- Perioperative hyperglycemia
  - Perioperative serum glucose greater than or equal to 180–200 mg/dL
- Smoking
- Obesity (BMI ≥30 or BMI Prime* ≥1.2)
- Nutritional status
- Depth of subcutaneous tissue ≥3 cm
- Coexistent infection at a remote body site (eg, skin, urinary tract)
- Vaginal colonization with microorganisms (eg, Group B streptococcal infection, bacterial vaginosis)
- American Society of Anesthesiologists Physical Status†

Abbreviations: BMI, body mass index; MRSA, methicillin-resistant *Staphylococcus aureus.*

*Ratio of actual to upper limit BMI (currently defined as healthy BMI=25).
• MRSA status

• Immunodeficiency
Superficial Incisional SSI

Must meet the following criteria:
Infection occurs within 30 days after any NHSN operative procedure (where day 1 = the procedure date)
AND
involves only skin and subcutaneous tissue of the incision
AND
patient has at least one of the following:
a. purulent drainage from the superficial incision.

b. organisms identified from an aseptically-obtained specimen from the superficial incision or subcutaneous tissue by a culture or non-culture based microbiologic testing method which is performed for purposes of clinical diagnosis or treatment (for example, not Active Surveillance Culture/Testing (ASC/AST)).
Superficial Incisional SSI

c. superficial incision that is deliberately opened by a surgeon, attending physician** or other designee and culture or non-culture based testing is not performed

AND

patient has at least one of the following signs or symptoms: pain or tenderness; localized swelling; erythema; or heat.

d. diagnosis of a superficial incisional SSI by the surgeon or attending physician** or other designee.
Organ Space Infection

• Involves any part of the body deeper than the fascial/muscle layers that is opened or manipulated during the operative procedure

• AND at least one of the following:
  • a. purulent drainage from a drain that is placed into the organ/space
  • b. organism(s) identified from fluid or tissue in the organ/space
  • c. an abscess or other evidence of infection involving the organ/space that is detected on gross anatomical or histopathologic exam, or imaging test evidence suggestive of infection.
Purulence

- NHSN does not define purulent drainage as there is no standard, clinically agreed upon definition.

- Generally, thick/viscous, creamy/opaque fluid discharge with or without blood seen at the site or documentation of pus/purulence by a medical professional would be accepted evidence of purulent drainage.

- At this time NHSN does not use any gram stain results such as WBCs or Poly’s to define purulence for the SSI protocol.
Microbiology

• Skin flora

• Anaerobes/Gram-negatives/enterococcus

• MRSA less common

• Bacterial vaginosis important for vaginal hysterectomy
Perioperative Antibiotic Prophylaxis

• National guidelines recommend abx prophylaxis for all types of hysterectomy

• Implementation and choice of antibiotic varies widely

• Single dose recommended

• Important considerations; weight, blood loss, allergies
Limitations of the literature

• Older randomized trials so some agents no longer in use or considered best practice

• Variable duration of abx prophylaxis

• Patient population with largely benign procedures
Cochrane Review of Abx prophylaxis in hysterectomy

• **Types of participants**
• Women of any age **without serious comorbidity (such as cancer)** undergoing an elective total or subtotal abdominal, vaginal, laparoscopic, or laparoscopically assisted hysterectomy, with or without oophorectomy, for a benign gynecological condition such as fibroids, endometriosis, uterovaginal prolapse, or heavy menstrual bleeding.
4. Forest plot of comparison: 1 Any antibiotic versus placebo, outcome: 1.1 Total postoperative infections - early and late.

<table>
<thead>
<tr>
<th>Antibiotic</th>
<th>Recommended Dose</th>
<th>Half-Life (With Normal Renal Function)</th>
<th>Recommended Redosing Interval (From Initiation of Preoperative Dose)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ampicillin</td>
<td>2 g</td>
<td>1–1.9 hrs</td>
<td>2 hrs</td>
</tr>
<tr>
<td>Cefazolin</td>
<td>2 g (3 g for patients weighing &gt; 120 kg)</td>
<td>1.2–2.2 hrs</td>
<td>4 hrs</td>
</tr>
<tr>
<td>Aztreonam</td>
<td>2 g</td>
<td>1.3–2.4 hrs</td>
<td>4 hrs</td>
</tr>
<tr>
<td>Cefuroxime</td>
<td>1.5 g</td>
<td>1–2 hrs</td>
<td>4 hrs</td>
</tr>
<tr>
<td>Cefoxaxime</td>
<td>1 g</td>
<td>0.9–1.7 hrs</td>
<td>3 hrs</td>
</tr>
<tr>
<td>Cefoxitin</td>
<td>2 g</td>
<td>0.7–1.1 hrs</td>
<td>2 hrs</td>
</tr>
<tr>
<td>Cefotetan</td>
<td>2 g</td>
<td>2.8–4.6 hrs</td>
<td>6 hrs</td>
</tr>
<tr>
<td>Ceftriexone</td>
<td>2 g</td>
<td>5.4–10.9 hrs</td>
<td>N/A†</td>
</tr>
<tr>
<td>Ciprofloxacin</td>
<td>400 mg</td>
<td>3–7 hrs</td>
<td>N/A†</td>
</tr>
<tr>
<td>Clindamycin</td>
<td>900 mg</td>
<td>2–4 hrs</td>
<td>6 hrs</td>
</tr>
<tr>
<td>Gentamicin</td>
<td>5 mg/kg based on dosing weight (single dose)</td>
<td>2–3 hrs</td>
<td>N/A†</td>
</tr>
<tr>
<td>Vancomycin</td>
<td>15 mg/kg</td>
<td>4.8 hrs</td>
<td>N/A†</td>
</tr>
</tbody>
</table>
What is the best agent for antibiotic prophylaxis if penicillin allergy?

Table 2. Antibiotic Prophylaxis Regimens in Patients With Immediate Hypersensitivity Reactions* to Penicillin

<table>
<thead>
<tr>
<th>Agent</th>
<th>Dose</th>
<th>Half Life (h)</th>
<th>Interval to Repeat (h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clindamycin</td>
<td>900 mg</td>
<td>2–4</td>
<td>6</td>
</tr>
<tr>
<td>or Metronidazole PLUS†</td>
<td>500 mg</td>
<td>6–8</td>
<td>NA†</td>
</tr>
<tr>
<td>Gentamicin</td>
<td>5 mg/kg§</td>
<td>2–3</td>
<td>NA†</td>
</tr>
<tr>
<td>or Aztreonam</td>
<td>2 g</td>
<td>1.3–2.4</td>
<td>4</td>
</tr>
</tbody>
</table>

*Anaphylaxis, urticaria, or bronchospasm. Patients with exfoliative dermatitis (Stevens–Johnson syndrome, toxic epidermal necrolysis) from β-lactam antibiotics should also not receive cephalosporins.

†No repeat administration is needed.
Allergy to beta-lactam and implications

• Appropriate use of perioperative antibiotics can decrease the incidence of SSIs.
• A beta-lactam antibiotic is the preferred perioperative antibiotic.
• For the 10% of patients who report a prior penicillin allergy, non-beta-lactam antibiotics (eg, clindamycin, vancomycin) are given.
• However, 90%–99% of patients with a reported penicillin allergy are not truly allergic (ie, there is no immediate hypersensitivity) and <3% of patients with an allergy to penicillin will also react to cefazolin.

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PMCID: PMC5850334
PMID: 29361015
The Impact of a Reported Penicillin Allergy on Surgical Site Infection Risk
Kimberly G Blumenthal,1,2,3,4 Erin E Ryan,5,6 Yu Li,1,2 Hang Lee,4,7 James L Kuhlen,8 and Erica S Shenoy2,4
Allergy to beta-lactam and implications
Hypersensitivity Reactions,\textsuperscript{a} n = 718 (68.9%) 

<table>
<thead>
<tr>
<th>Reaction</th>
<th>n</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rash\textsuperscript{b}</td>
<td>346</td>
<td>37.5</td>
</tr>
<tr>
<td>Urticaria\textsuperscript{b}</td>
<td>166</td>
<td>18.0</td>
</tr>
<tr>
<td>Angioedema or swelling\textsuperscript{b}</td>
<td>82</td>
<td>8.9</td>
</tr>
<tr>
<td>Anaphylaxis\textsuperscript{b}</td>
<td>42</td>
<td>4.6</td>
</tr>
<tr>
<td>Itching\textsuperscript{b}</td>
<td>41</td>
<td>4.5</td>
</tr>
<tr>
<td>Shortness of breath\textsuperscript{b}</td>
<td>19</td>
<td>2.1</td>
</tr>
<tr>
<td>Flushing\textsuperscript{b}</td>
<td>12</td>
<td>1.3</td>
</tr>
<tr>
<td>Hypotension\textsuperscript{b}</td>
<td>5</td>
<td>0.5</td>
</tr>
<tr>
<td>Acute interstitial nephritis\textsuperscript{c}</td>
<td>2</td>
<td>0.2</td>
</tr>
<tr>
<td>Blister\textsuperscript{c}</td>
<td>2</td>
<td>0.2</td>
</tr>
<tr>
<td>Stevens-Johnson syndrome or toxic epidermal necrolysis\textsuperscript{c}</td>
<td>1</td>
<td>0.1</td>
</tr>
</tbody>
</table>

Reactions Identified for the 922 Patients Reporting Penicillin Allergy (n = 1042) 

\textsuperscript{a}Twenty-one patients had both hypersensitivity reactions and side effects to penicillin. 

\textsuperscript{b}Reactions amenable to penicillin allergy evaluation (ie, penicillin skin testing and/or test dose challenges). 

\textsuperscript{c}Reactions that are potential contraindications to beta-lactam antibiotic administrations.
Side Effects and Intolerances, n = 89 (8.5%)

- Gastrointestinal symptoms
  - 51 (5.5)
- Renal damage
  - 2 (0.2)
- Headache
  - 4 (0.4)
- Fever
  - 2 (0.2)
- Mental status change
  - 4 (0.4)
- Musculoskeletal symptoms
  - 7 (0.8)
- Other adverse reactions
  - 19 (2.1)
- Unknown Reactions, n = 235 (25.5%)
**Impact of a Reported Penicillin Allergy on Surgical Site Infection**

<table>
<thead>
<tr>
<th>Adjustment</th>
<th>Odds ratio (95% confidence interval)</th>
<th>$P$ value</th>
</tr>
</thead>
<tbody>
<tr>
<td>None (univariable)</td>
<td>1.36 (.94–1.97)</td>
<td>.10</td>
</tr>
<tr>
<td>Surgery type</td>
<td>1.45 (1.00–2.12)</td>
<td>.051</td>
</tr>
<tr>
<td>Surgery type, age, sex, and race</td>
<td>1.49 (1.02–2.18)</td>
<td>.04</td>
</tr>
<tr>
<td>Surgery type, age, sex, race, American Society of Anesthesiologists class, procedure duration, and wound class</td>
<td>1.51 (1.02–2.22)</td>
<td>.04</td>
</tr>
</tbody>
</table>
• Routine pre-operative bowel preparation should not be used before minimally invasive gynecologic surgery.

• Its use is similarly discouraged before open laparotomy in gynecologic surgery/gynecologic oncology, especially within an established ERAS pathway.

• Surgeons who feel bowel preparation is necessary should limit its use to patients in which a colon resection is planned.

• In these cases the use of oral antibiotics alone should be considered or combined with mechanical bowel preparation.

• High quality data from the colorectal literature have shown that mechanical bowel preparation alone does not decrease post-operative morbidity and should thus be abandoned.

• Evidence level: moderate

• Recommendation grade: strong
Chlorhexidine bathing

Review article

Preoperative chlorhexidine shower or bath for prevention of surgical site infection: A meta-analysis

Maciej Piotr Chlebicki MD a, Nasia Safdar MD, PhD b,c,d,*, John Charles O'Horo MD e, Dennis G. Maki MD b,c

a Department of Infectious Diseases, Singapore General Hospital, Singapore
b Section of Infectious Diseases, Department of Medicine, University of Wisconsin Medical School, Madison, WI
c Infection Control Department, University of Wisconsin Hospital and Clinics, Madison, WI
d William S. Middleton Memorial Veterans Hospital, Madison, WI
e Department of Graduate Medical Education, Aurora Healthcare, Milwaukee, WI
Cutaneous antisepsis

Chlorhexidine-Alcohol Compared With Povidone-Iodine for Preoperative Topical Antisepsis for Abdominal Hysterectomy

Shitanshu Uppal, MBBS, Ali Bazzi, MD, R. Kevin Reynolds, MD, John Harris, MD, MS, Mark D. Pearlman, MD, Darrell A. Campbell, MD, and Daniel M. Morgan, MD

Table 3. Surgical Site Infection (Any): Unmatched and Propensity Score-Matched Cohorts

<table>
<thead>
<tr>
<th>Primary Outcome</th>
<th>Unmatched Cohort</th>
<th></th>
<th>Propensity Score-Matched Cohort</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Chlorhexidine-Alcohol (n=3,005)</td>
<td>Povidone-Iodine (n=1,254)</td>
<td>Chlorhexidine-Alcohol (n=808)</td>
<td>Povidone-Iodine (n=845)</td>
</tr>
<tr>
<td>Surgical site infection (any)</td>
<td>2,926 (97.4)</td>
<td>1,209 (96.4)</td>
<td>0.09</td>
<td>796 (98.5)</td>
</tr>
<tr>
<td>No</td>
<td>2,926 (97.4)</td>
<td>1,209 (96.4)</td>
<td>0.09</td>
<td>796 (98.5)</td>
</tr>
<tr>
<td>Yes</td>
<td>79 (2.6)</td>
<td>45 (3.6)</td>
<td>0.09</td>
<td>12 (1.5)</td>
</tr>
</tbody>
</table>

Data are n (%) unless otherwise specified.
Vaginal antisepsis

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Major Article

Safety and tolerability of chlorhexidine gluconate (2%) as a vaginal operative preparation in patients undergoing gynecologic surgery

Ahmed Al-Niaimi MD, Laurel W. Rice MD, Uppal Shitanshu MD, Bonnie Garvens MD, Megan Fitzgerald NP, Sara Zerbel MS, Nasia Safdar MD, PhD

a School and Public Health, University of Wisconsin Medical, Madison, WI
b University of Michigan, Ann Arbor, MI
c William S. Middleton Memorial Veterans Hospital, Madison, WI
### Table 1
Patient characteristics

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Group 1: PI (n = 64)</th>
<th>Group 2: CHG (n = 53)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, mean (y)</td>
<td>53</td>
<td>56</td>
<td>.48</td>
</tr>
<tr>
<td>BMI, mean (kg/m²)</td>
<td>38</td>
<td>36</td>
<td>.53</td>
</tr>
<tr>
<td>Pathology</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Benign</td>
<td>14</td>
<td>12</td>
<td>.37</td>
</tr>
<tr>
<td>Malignant</td>
<td>50</td>
<td>41</td>
<td>.32</td>
</tr>
<tr>
<td>Surgery</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hysterectomy (laparoscopic/abdominal)</td>
<td>47</td>
<td>42</td>
<td>.61</td>
</tr>
<tr>
<td>Hysterectomy (vaginal)</td>
<td>6</td>
<td>5</td>
<td>.51</td>
</tr>
<tr>
<td>No hysterectomy (laparoscopic BSO/USO/others)</td>
<td>9</td>
<td>6</td>
<td>.79</td>
</tr>
<tr>
<td>Preexisting choric vulvar disease</td>
<td>3</td>
<td>2</td>
<td>.43</td>
</tr>
</tbody>
</table>

NOTE. Values are the number of patients or as otherwise indicated.

**BMI**, body mass index; **BSO**, bilateral salpingo-oophorectomy; **CHG**, chlorhexidine gluconate; **PI**, povidone-iodine; **USO**, unilateral salpingo-oophorectomy.

### Table 2
Reports of vaginal irritation

<table>
<thead>
<tr>
<th>Vaginal irritation score</th>
<th>Patient reports on postoperative day 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 = No vaginal itching or burning</td>
<td>60 (93.75%)</td>
</tr>
<tr>
<td>1 = Mild vaginal itching or burning</td>
<td>3 (4.69%)</td>
</tr>
<tr>
<td>2 = Mild to moderate vaginal itching or burning</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>3 = Moderate vaginal itching or burning</td>
<td>1 (1.56%)</td>
</tr>
<tr>
<td>4 = Moderate to severe vaginal itching or burning</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>5 = Severe vaginal itching or burning</td>
<td>0 (0%)</td>
</tr>
</tbody>
</table>

NOTE. Values are n (%).

CHG, chlorhexidine gluconate.
Normothermia

Consensus Bundle on Prevention of Surgical Site Infections After Major Gynecologic Surgery

Joseph E. Pellegrini, Paloma Toledo, David E. Soper, William C. Bradford, Deborah A. Cruz, Barbara S. Levy, and Lauren A. Lemieux

Correspondence
Joseph E. Pellegrini, PhD, CRNA, University of Maryland School of

ABSTRACT
Surgical site infections are the most common complications of surgery in the United States. Of surgeries in women of reproductive age, hysterectomy is one of the most frequently performed, second only to cesarean birth. Therefore,
Normothermia

• Extrapolated from the colorectal surgical literature

• Active rewarming vs not-reduces SSI

• Passive vs active methods of normothermia

• Ambient air temperature issues
Hyperglycemia and Infection

**Background**

- Hyperglycemia is common in hospitalized patients
- 38% of medical and surgical patients had hyperglycemia
  - 26% diabetic
  - 12% nondiabetic
- In cardiac surgery, degree of postoperative hyperglycemia correlates with SSI, adopted as SCIP measures

**Goal**

Glucose <180mg/dl in all hospitalized patients

---

Postoperative hyperglycemia is associated with an increased risk of SSI in general surgery patients.

Slide from AHRQ: Building your SSI bundle
MRSA Status

• Not a common cause of infection post hysterectomy

• Decolonization with mupirocin/chg

• Unclear if routine screening is necessary in all patients but history of MRSA should prompt decolonization

Surgical Technique

• Hemostasis

• Tissue damage

• Training/volume

• Wound closure

• Post operative dressing standardization
Audit and Feedback

Surgical Site Infection Prevention: A Qualitative Analysis of an Individualized Audit and Feedback Model

Carolyn Nessim, MD, FRCSC, Cécile M Bensimon, MA, PhD, Brigette Hales, MSc, Claude Laflamme, MD, MHSc, FRCPC, Darlene Fenech, MD, MSc, FRCSC, Andy Smith, MD, MSc, FRCSC, FACS

BACKGROUND: Surgical site infection (SSI) adversely affects patient outcomes and health care costs, so prevention of SSI has garnered much attention worldwide. Surgical site infection is recognized as an important quality indicator of patient care and safety. The purpose of this study was to use qualitative research methods to evaluate staff perceptions of the utility and impact of individualized audit and feedback (AF) data on SSI-related process metrics for their individual practice, as well as on overall communication and teamwork as they relate to SSI prevention. This study was performed in a tertiary care center, based on patients treated in the colorectal and hepatic-pancreatic-biliary surgical oncology services. Eighteen clinicians were interviewed. Analysis of interviews via comparative analysis techniques and coding strategies were
## Audit and Feedback

<table>
<thead>
<tr>
<th>Theme</th>
<th>Illustrative quote</th>
</tr>
</thead>
</table>
| **Impact on individual practice**          | “[…] a reminder that you have to continually maintain your skills”  
“It’s good to get feedback; it certainly helps to remind you to take care of those little details that sometimes you can forget”  
“We all have a blind spot [and] you like to think you’re doing well, but to have some objective measure of how you’re performing … is valuable because your perception of how you’re doing may not be totally accurate,” thus creating opportunities to “improve what kind of job you do.” |
| **Recognition of the integral role of anesthesia** | “I always looked at [it] as a surgeon’s issue; that’s their domain, it’s something that they do … I am certainly much more aware of it now and look at my responsibility much differently than I used to.”  
“Part of the challenge [was] to be changed in my thinking — it’s a surgical site infection — what’s that got to do with anesthesia, you know? I think to have it reinforced that three of the biggest factors that we can do to prevent this … quite frankly, I do all three of those things … it forced me to accept more ownership of this [because] I can have a significant effect on this.”  
“After the patients leave the recovery room, we don’t know the outcome … It’s good [to] have some kind of feedback as to what the longer term outcome is and [know that] part of what we do actually does affect the outcome.” |
Audit and Feedback

Shared responsibility via interprofessional collaboration and communication

“Once upon a time, things were very clear — that’s your responsibility or it’s yours — but that’s extremely blurred. [If] somebody gets an infection and the anesthesiologist didn’t hang the antibiotics before the skin cut, well, whose fault is that ultimately? Is it the surgeon because he’s the one that deals with wound infections and complications? Was it the anesthesiologist because the surgeon scrubbed and can’t be [the one to] give the antibiotics? It’s not so simple anymore. And that’s why I think we need to constantly be doing things to foster a general culture of team approach.”

“If we have a clear improvement, which I think we do, then that’s one thing that can enhance the practice [by seeing that the team is] obviously making an impact.”

“It has to be a collaborative effort,” which can only be done with “more communication” where “[we are] constantly doing things to foster a sense of free and open communication.”

Surgeon accountability

“I think it’s more the surgeon’s responsibility then, say, the anesthesiologist’s responsibility because [the surgeon is] the one who has the primary relationship with the patient.”

“I tend to think the surgeon is the captain of the ship.”
Tobacco and Perioperative Outcomes

Perioperative Medicine | April 2011
Smoking and Perioperative Outcomes

Alparslan Turan, M.D.  *
Edward J. Mascha, Ph.D.  †
Dmitry Roberman, M.S.  ‡
Patricia L. Turner, M.D.  §
Jing You, M.S.  †
Andrea Kurz, M.D.  #
Daniel I. Sessler, M.D.  **
Leif Saager, M.D.  ††

* Associate Professor, † Medical Student, # Professor and Vice-chair, ** Professor and Chair, †† Assistant Professor, Department of Outcomes Research, The Cleveland Clinic, Cleveland, Ohio; † Staff Biostatistician, Biostatistician, Departments of Quantitative Health Sciences and Outcomes Research, The Cleveland Clinic; § Assistant Professor of Surgery, Department of Surgery, University of Maryland School of Medicine.
<table>
<thead>
<tr>
<th>Major Morbidity</th>
<th>Odds Ratio and 95% CI</th>
<th>OR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Septic Shock</td>
<td>1.40 (1.33, 1.47)</td>
<td></td>
</tr>
<tr>
<td>Sepsis</td>
<td>1.38 (1.11, 1.72)</td>
<td></td>
</tr>
<tr>
<td>Bleeding Transfusions</td>
<td>1.38 (1.20, 1.60)</td>
<td></td>
</tr>
<tr>
<td>Myocardial Infarction</td>
<td>2.09 (1.80, 2.43)</td>
<td></td>
</tr>
<tr>
<td>Cardiac Arrest</td>
<td>1.87 (1.58, 2.21)</td>
<td></td>
</tr>
<tr>
<td>Coma &gt; 24 hours</td>
<td>0.88 (0.64, 1.21)</td>
<td></td>
</tr>
<tr>
<td>Stroke/CVA</td>
<td>1.53 (1.31, 1.79)</td>
<td></td>
</tr>
<tr>
<td>Ventilator &gt; 48 hours</td>
<td>1.73 (1.18, 2.53)</td>
<td></td>
</tr>
<tr>
<td>Pulmonary Embolism</td>
<td>1.37 (0.63, 2.93)</td>
<td></td>
</tr>
<tr>
<td>Unplanned Intubation</td>
<td>1.57 (1.10, 2.25)</td>
<td></td>
</tr>
<tr>
<td>Pneumonia</td>
<td>1.80 (1.11, 2.92)</td>
<td></td>
</tr>
<tr>
<td>Organ Space SSI</td>
<td>1.05 (0.78, 1.42)</td>
<td></td>
</tr>
<tr>
<td>30-day Mortality</td>
<td>1.30 (1.15, 1.46)</td>
<td></td>
</tr>
<tr>
<td>Any Major Morbidity</td>
<td>1.55 (1.29, 1.87)</td>
<td></td>
</tr>
</tbody>
</table>
Teamwork in the Operating Room

Frontline Perspectives among Hospitals and Operating Room Personnel


Background: The Joint Commission on Accreditation of Healthcare Organizations is proposing that hospitals measure culture beginning in 2007. However, a reliable and widely used tool is not available. Conclusions: Rigorous assessment of teamwork climate is possible using this psychometrically sound teamwork climate scale. This tool and initial benchmarks allow others to compare
OR Teamwork Climate by Caregiver Type

% respondents reporting good teamwork

- OR Nurses
- Surgical Technicians
- CRNAs
- Anesthesiologists
- Staff Surgeons
Traffic flow in the operating room: An explorative and descriptive study on air quality during orthopedic trauma implant surgery

Annette Erichsen Andersson RN\textsuperscript{a,b,*}, Ingrid Bergh RN, PhD\textsuperscript{c}, Jón Karlsson MD, PhD\textsuperscript{d,e}, Bengt I. Eriksson MD, PhD\textsuperscript{d,e}, Kerstin Nilsson RN, PhD\textsuperscript{a}

\textsuperscript{a}Institute of Health and Care Sciences, Sahlgrenska Academy, University of Gothenburg, Gothenburg, Sweden
\textsuperscript{b}Department of Anesthesia, Surgery and Intensive Care, Sahlgrenska University Hospital, Gothenburg, Sweden
\textsuperscript{c}School of Life Sciences, University of Skövde, Skövde, Sweden
\textsuperscript{d}Department of Orthopedics, Sahlgrenska University Hospital, Gothenburg, Sweden
\textsuperscript{e}Institute of Clinical Sciences, Sahlgrenska Academy, University of Gothenburg, Gothenburg, Sweden
## OR Traffic

**Table 3**  
Reasons for traffic flow

<table>
<thead>
<tr>
<th>Necessary door openings*</th>
<th>n</th>
<th>Semi-necessary door openings</th>
<th>n</th>
<th>Unnecessary door openings</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expert consultations (eg, help needed from senior surgeons, expert nurses, or anesthesiologists)</td>
<td>40</td>
<td>Surgical team members entering after incision or leaving before closure</td>
<td>76</td>
<td>Logistic reasons planning next or other operation</td>
<td>30</td>
</tr>
<tr>
<td>Instruments or other material needed</td>
<td>137</td>
<td>Lunch and coffee breaks</td>
<td>108</td>
<td>Social visits</td>
<td>45</td>
</tr>
<tr>
<td>Instruments or other material needed</td>
<td>137</td>
<td>Lunch and coffee breaks</td>
<td>108</td>
<td>No detectable reasons</td>
<td>93</td>
</tr>
<tr>
<td>Total</td>
<td>177</td>
<td>Total</td>
<td>184</td>
<td>Total</td>
<td>529</td>
</tr>
</tbody>
</table>

*The need assessed in relation to patient safety and ongoing procedure.*
OR Traffic

- Canadian hospital with high rates of SSI following orthopedic procedures
- Manual counting showed 32 to 72 door openings in a 75 minute case
- Reasons were: chart review, break, instrument and new people
- Interventions: record reason why one is entering the door if not core person, phone rather than in person entry, collect all instruments ahead of time to be ready
- OR openings dropped from 70 to 3 per case; SSI were reduced as well

Don Berwick’s Knee—How to Prevent Complications and Extrapolation to Hysterectomy
Bundles for Reducing SSI Post Hysterectomy

Gynecology: Clinical Practice and Quality

Decreased Surgical Site Infection Rate in Hysterectomy
Effect of a Gynecology-Specific Bundle

Sarah E. Andiman, MD, Xiao Xu, PhD, John M. Boyce, MD, Elizabeth M. Ludwig, BA, Heidi R. W. Rillstone, RN, Vrunda B. Desai, MD, and Linda L. Fan, MD
<table>
<thead>
<tr>
<th>Variable</th>
<th>Unadjusted Analysis</th>
<th>Adjusted Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>OR</td>
</tr>
<tr>
<td>Bundle implementation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Post–full bundle implementation</td>
<td>747</td>
<td>0.97</td>
</tr>
<tr>
<td>Pre–full bundle implementation</td>
<td>1,352</td>
<td>Reference</td>
</tr>
<tr>
<td>Surgical route</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Open</td>
<td>967</td>
<td>Reference</td>
</tr>
<tr>
<td>Traditional laparoscopic</td>
<td>228</td>
<td>0.97</td>
</tr>
<tr>
<td>Robot-assisted laparoscopic</td>
<td>861</td>
<td>0.97</td>
</tr>
<tr>
<td>Laparoscopic-assisted vaginal</td>
<td>43</td>
<td>0.97</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than 24.9</td>
<td>537</td>
<td>Reference</td>
</tr>
<tr>
<td>25–29.9</td>
<td>581</td>
<td>1.01</td>
</tr>
<tr>
<td>30–34.9</td>
<td>430</td>
<td>1.02</td>
</tr>
<tr>
<td>35–39.9</td>
<td>276</td>
<td>1.02</td>
</tr>
<tr>
<td>40 or greater</td>
<td>275</td>
<td>1.05</td>
</tr>
</tbody>
</table>

OR, odds ratio; BMI, body mass index.

The indicator for post–full bundle implementation was forced into the model. The model considered patient age, BMI, surgical route, indicator for bowel involvement, indicator for cancer diagnosis, and indicator for diagnosis of type 2 diabetes mellitus as candidate explanatory variables and used a backward stepwise selection process (cutoff P value=.05) to determine variables retained in the final model. The final model included the indicator for post–full bundle implementation, surgical route, and BMI.


<table>
<thead>
<tr>
<th>Bundle Component</th>
<th>Adjusted OR</th>
<th>95% CI</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Component #7 (direct feedback) vs components #1–6</td>
<td>0.45</td>
<td>0.18–1.15</td>
<td>.097</td>
</tr>
<tr>
<td>Component #6 (antibiotic standardization) vs components #1–5</td>
<td>1.43</td>
<td>0.57–3.63</td>
<td>.45</td>
</tr>
<tr>
<td>Component #5 (maintenance of intraoperative normothermia) vs components #1–4</td>
<td>0.59</td>
<td>0.32–1.09</td>
<td>.09</td>
</tr>
</tbody>
</table>

OR, odds ratio.

This analysis was based on a multivariable logistic regression model adjusting for different bundle component implementation periods (ie, time period when components #1–4 were implemented, time period when component #5 was added, time period when component #6 was added, and time period when component #7 was added) as well as patient body mass index and surgical route. By alternating each of the first three time periods as the reference group in analysis and comparing it with the next adjacent time period, we assessed the incremental effect of the additional bundle component on surgical site infection.

(Obstet Gynecol 2018;131:991–9)
Framework for SSI Reduction

Readiness (Facility)

- Establish standard preoperative care instructions and education for women undergoing major gynecologic surgery

- Establish a system that delineates responsibility for every member of the surgical team

- Establish standards for temperature regulation:
  - Ambient operating room temperature
  - Patient normothermia
Readiness

• Standardize the selection and timing of administration of prophylactic antibiotics

• Standardize the timing of discontinuation of prophylactic antibiotics

• Establish standard on appropriate skin preparation
Recognition and Prevention (Every Patient)

• Assess patient risk preoperatively for surgical site infection:
  • Blood glucose level
  • Body mass index
  • Immunodeficiency
  • Methicillin-resistant Staphylococcus aureus status
  • Nutritional status
  • Smoking status
Response (Every Case)

• Develop intraoperative “Timeouts” to address antibiotic dosage, timing, prophylaxis issues, and patient-specific issues

• Reassess patient risk for surgical site infection based on length of surgery, potential bowel incision, vaginal contamination, and amount of blood loss

• Provide postoperative care instructions and education
Reporting and Systems Learning (Every Facility)

• Establish a culture of huddles for high-risk patients

• Create system to analyze and report surgical site infection data

• Monitor outcomes and process metrics
Reporting and Systems Learning (Every Facility)

- Actively collect and share physician-specific surgical site infection data with all surgeons as part of their ongoing professional practice evaluation

- Standardize a process to actively monitor and collect surgical site infection data with postdischarge follow-up