

# Modifiable Risk Factors in Orthopaedic Infections

AAOS Patient Safety Committee

## Surgical Site Infections (SSI) by the Numbers

### Burden – US

- ~300,000 SSIs/yr (17% of all HAI; second to UTI)
- 2%-5% of patients undergoing inpatient surgery

### Mortality

- 3 % mortality
- 2-11 times higher risk of death
- 75% of deaths among patients with SSI are directly attributable to SSI

### Morbidity

- Long-term disabilities

### Length of Hospital Stay

- ~7-10 additional postoperative hospital days

### Cost

- \$3000-\$29,000/SSI depending on procedure & pathogen
- Up to \$10 billion annually
- Most estimates are based on inpatient costs at time of index operation and do not account for the additional costs of rehospitalization, post-discharge outpatient expenses, and long term disabilities



# Factors for Preoperative Modification

## Smoking

- Evaluate patient's smoking status
- Recommend smoking intervention programs at least 4-6 weeks preoperatively

## Obesity

- Counsel patients regarding body mass reduction
- Screen for hyperglycemia
- Refer to primary care physicians to improve preoperative glycemic control as appropriate
- Refer to dietician for nutritional recommendations and supplementation, where appropriate
- It is not advisable to recommend weight loss in the short period prior to surgery
- Collaborate with anesthesia team preoperatively to optimize dosing of prophylactic antibiotics

## Malnutrition

- Evaluate in patients at risk for malnutrition (elderly, history of GI disease, renal failure, alcoholism, cancer, other chronic disease)
- Assess malnutrition markers associated with increased wound complications (e.g., serum albumin)

## Oral Health

- Consider preoperative dental screenings for patients with a history of poor oral health
- Encourage patients to complete anticipated dental treatment prior to elective orthopaedic surgery

## Rheumatoid Arthritis

- Discontinue NSAIDs
- Review corticosteroid use
- Be aware of methotrexate use
- Consult with a rheumatologist regarding other disease-modifying antirheumatic drugs (DMARDs)
- Consider a conservative approach to biologics such as TNF antagonists and IL-1 antagonists

## Diabetes

- Work with patient's primary care physician toward tight glucose control prior to surgery
- Non-emergent cases should be delayed until optimal nutritional status and glucose control are achieved, whenever possible

## MRSA/*S. aureus* colonization

- Screen preoperatively
- Decolonize patients
- Consult w/ ID staff to select appropriate antibiotic prophylaxis agent

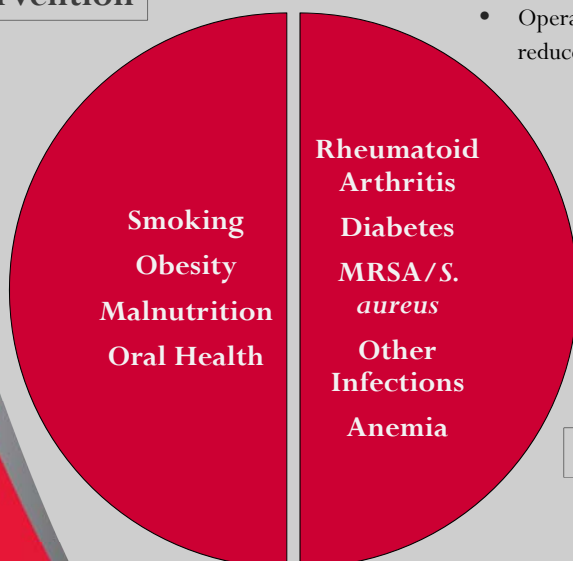
## Other Infections

- Evaluate leukocyte count w/ differential, ESR, and CRP
- If any of these values are elevated, perform additional preoperative/intraoperative testing (frozen sections, cell counts, aspiration, bone marrow-WBC scan)
- If necessary, postpone elective surgery until underlying sources of infection have been resolved

## Anemia

- Preoperatively screen
- Treat with erythropoietin, if appropriate
- Operatively, employ blood conservation regimens to reduce the need for post-op transfusion

Lifestyle Modifications  
+ Medical Intervention



Medical Intervention

# Factors in the OR

## Antibiotic Prophylaxis

- **Selection** – Choose appropriate agents on basis of surgical procedure
  - Most common SSI pathogens for the procedure
  - Published recommendations
- **Dose** – Adjust dose for obese patients (body mass index >30)
- **Timing** – Administer in accordance with evidence based standards and guidelines
  - Administer within 1 hour prior to incision (2 hours for vancomycin and fluoroquinolones)
- **Re-dosing** – Re-dose at the 3 hour interval or within drug half-life in procedures with duration >3 hours
- **Duration** – Discontinue within 24 hours of surgery end time

## Skin Preparation

- **Hair Removal** – Clip only if necessary, do not shave
  - Shaving the surgical site with a razor induces small skin lacerations which are potential sites for infection
- **Use appropriate antiseptic agent**

### Alcohol

- Readily available, inexpensive, and remains the most effective and rapid-acting skin antiseptic
- Highly flammable

**Chlorhexidine gluconate and iodophors** – have broad spectra of antimicrobial activity

### *Chlorhexidine gluconate*

- Studies suggest it achieved greater reductions in skin microflora than did povidone-iodine and also had greater residual activity after a single application
- Not inactivated by blood or serum proteins
- Not as rapid-acting as alcohol

### *Iodophors*

- Exert a bacteriostatic effect as long as they are present on the skin
- May be inactivated by blood or serum proteins

## Surgical Care Improvement Project (SCIP) Protocols

- **Hypothermia Control** – Control hypothermia with multiple modalities
- **Glucose Control** – Control blood glucose level during the immediate post-operative period
- **Antibiotic** – Appropriate selection, timing, and discontinuance

## OR traffic

- **Keep OR doors closed during surgery except as needed for passage of essential equipment, personnel, and the patient**



# Case Study I – MRSA Screening & Total Knee Arthroplasty

## Patient A

- Age: Mid 50s
- Colonized w/ MRSA
- Screened for MRSA
- Decolonized preoperatively
- Cefazolin prophylaxis

### Outcome

- Successful TKA
- No SSI



## Patient B

- Age: Mid 50s
- Colonized w/ MRSA
- No MRSA screening performed
- No preoperative decolonization
- Cefazolin prophylaxis

### Outcome

- MRSA SSI
- Amputation



## MRSA Screening and Decolonization

- Approximately 30% of people carry *Staphylococcus aureus* in their nose
- *S. aureus* carriers are 200 – 900% more likely to develop *S. aureus* SSIs than noncarriers
- In patients with *S. aureus* surgical site infections, paired *S. aureus* isolates from the wound match those from the nares 80-85% of the time
- Literature suggests preoperative screening and topical decolonization can decrease the risk of SSIs
- Decolonization protocols include mupirocin to the nares, chlorhexidine showers/baths preoperatively



# Case Study II – Impact of Smoking and Drug Use on Wound Healing

## Patient A

- Age: Late 30s
- Smoker and illicit drug user
- Did not participate in smoking cessation or substance abuse program
- Continued smoking and illicit drug use postoperatively

### Outcome

- Poor wound healing
- MRSA SSI
- Required two-stage hip reconstruction



## Patient B

- Age: Early 40s
- Smoker
- Participated in a smoking cessation program
- Quit smoking prior to surgery

### Outcome

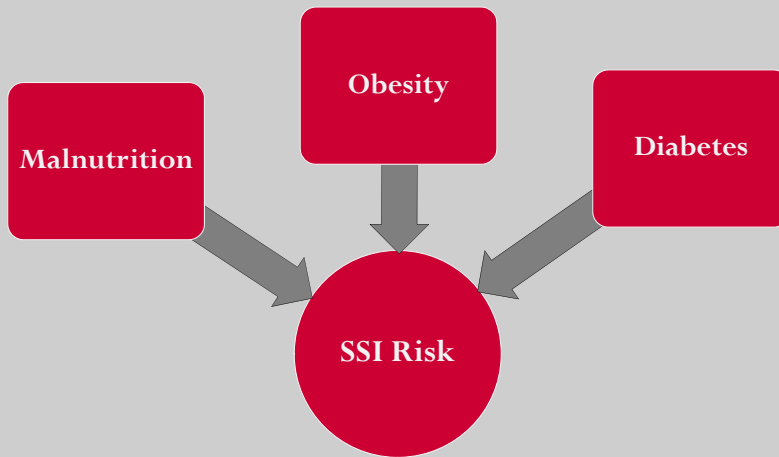
- No SSI or postoperative complications



## Smoking and Wound Healing

- Numerous publications cite smoking as the single most important modifiable risk factor in the development of serious postoperative complications
- Smokers have 300% more healing complications than non-smokers
- Nicotine delays primary wound healing and may contribute to SSIs
- Spine surgeons report smokers experience 300 – 400% higher non-union or delayed union following bony fusions resulting from delayed revascularization in the graft
- Smoking cessation 6-8 weeks prior to surgery and during recovery significantly reduces these risks

# Nutritional and Metabolic Factors



- Retrospective case-control study of patients who had an orthopaedic spinal operation and SSI outcome
- 50% of the factors related to nutritional or metabolic status

Multivariate Logistic Regression Model for the Development of Spinal Surgical Site Infection*		
Risk Factor	Adjusted Odds Ratios (95% Confidence Interval)	P Value
<b>Diabetes</b>	<b>3.5 (1.2, 10.0)</b>	<b>0.020</b>
Suboptimal timing of prophylactic antibiotic therapy	3.4 (1.5, 7.9)	0.005
<b>Elevated serum glucose level postoperatively</b>	<b>3.3 (1.4, 7.5)</b>	<b>0.005</b>
<b>Obesity (body mass index &gt; 30.0 kg/m<sup>2</sup>)</b>	<b>2.2 (1.1, 4.7)</b>	<b>0.034</b>
≥ 2 resident surgeons	2.2 (1.0, 4.7)	0.048
Operation involving cervical levels	0.3 (0.1, 0.6)	0.002

\*The c-statistic for the model = 0.807. The Hosmer and Lemeshow goodness-of-fit chi-square p = 0.734 (7 degrees of freedom), and the Nagelkerke R<sup>2</sup> = 0.305

## Considerations in the Treatment of Obese Patients

- Surgical duration is often longer
- Antibiotic prophylaxis dosage should be adjusted to weight and re-dosed as indicated
- Patients should be screened preoperatively for hyperglycemia and referred to their PCP for improvement of glycemic control
- Counsel patients well in advance of elective procedures about methods of body mass reduction and postpone surgery, as necessary, to address these options