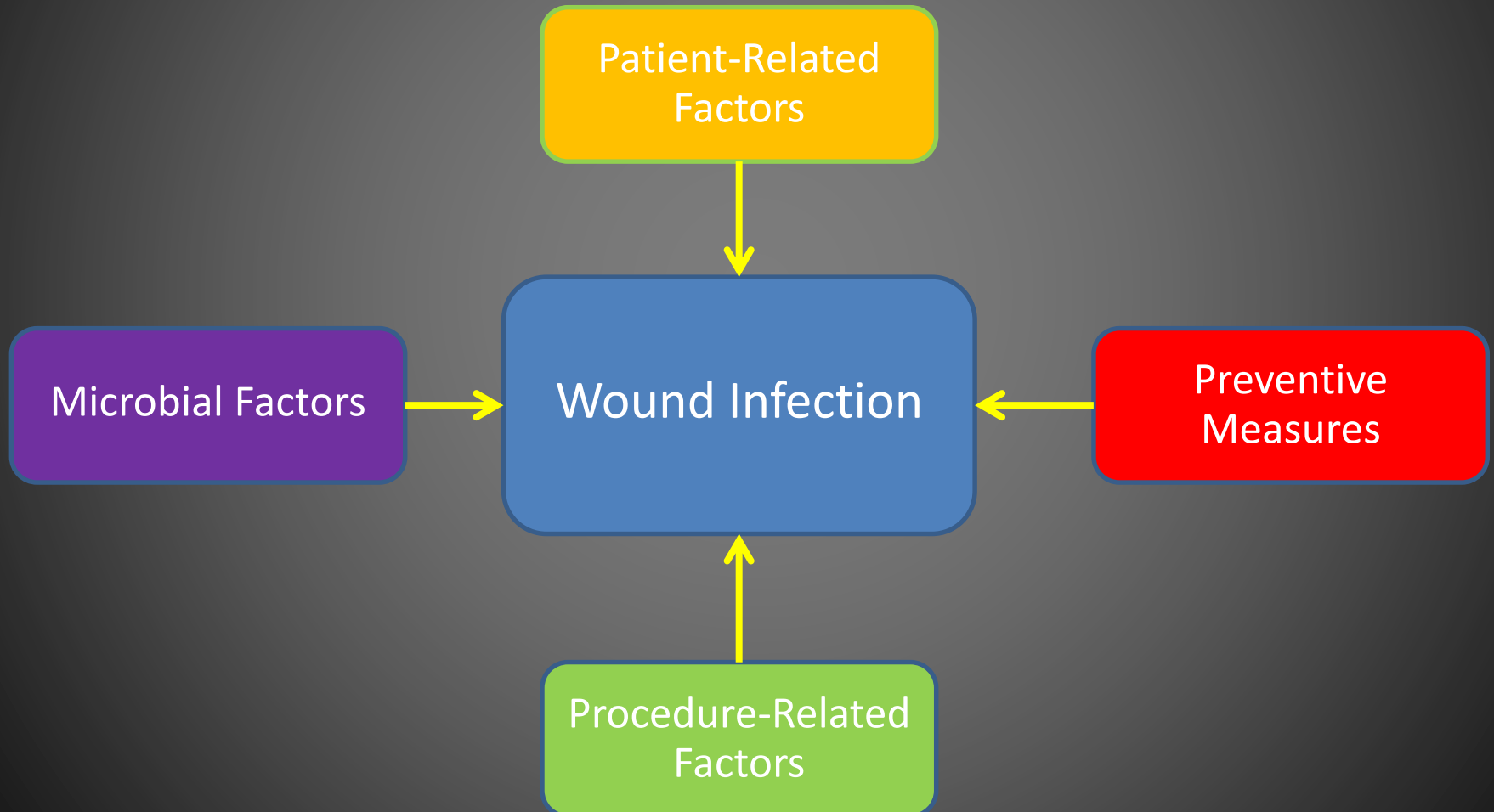




# Complication Concerning in Wound Care: Infection

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# Determinants and Pathophysiology of Wound Infection



# Source of Wound Bacteria

## Classification of Operative Wounds by Level of Bacterial Contamination

Class I : Clean wound

Class II: Clean-Contaminated wound

Class III: Contaminated wound

Class IV: Dirty-Infected wound

# Classification of Operative Wounds by Level of Bacterial Contamination

## Clean wound

แผลผ่าตัดที่ไม่ผ่านเนื้อเยื่อที่มีการอักเสบ และไม่เข้าสู่ระบบทางเดินหายใจ ทางเดินอาหาร ทางเดินปัสสาวะ ระบบสืบพันธุ์ มีการเย็บปิดแผลหรือใส่ท่อระบายในระบบปิด

## Clean-Contaminated wound

แผลผ่าตัดที่เข้าสู่ระบบทางเดินหายใจ ทางเดินอาหาร ทางเดินปัสสาวะ ระบบสืบพันธุ์ ภายใต้สภาวะที่ควบคุมได้และไม่มีหลักฐานของการติดเชื้อ

# Classification of Operative Wounds by Level of Bacterial Contamination

## Contaminated wound

แผลสด แผลเปิด แผลจากอุบัติเหตุ การผ่าตัดที่เทคนิคปลอดเชื้อไม่ถูกต้อง การผ่าตัดที่มีสารในลำไส้ออกมา การผ่าตัดผ่านเนื้อเยื่ออักเสบไม่มีหนอง

## Dirty-Infected wound

แผลจากอุบัติเหตุที่เก่าแล้ว มีการติดเชื้ออยู่เดิม หรือมีการแตกรั่วของอวัยวะภายใน

# Factors Associated with an Increased Risk for Surgical Site Infection

- DM/hyperglycemia
- Current Tobacco Use
- Remote infection
- Obesity
- Malnutrition
- Concurrent Steroid
- Prolonged Preop stay
- Prior site irradiation
- Colonization with S.aureus

Patient

- shaving of site the night before procedure
- improper preop skin prep
- improper antimicrobial prophylaxis
- failure to redose ATB
- inadequate ventilation
- increase OR traffic
- hypothermia
- hypoxia

Procedure

- surgical technique
- sterile technique
- glove micropenetration
- behavioral factors

Procedurist

# Surgical Site Infection: Epidemiology and Outcomes

- 2-5% of patients undergoing surgery in US
- 160,000 – 300,000 SSIs each year
- *S.aureus* is the most common cause
- SSI leads to increased length of stay, cost, and mortality

# Common Surgical Pathogens

**Table 1**

**Ten most common pathogens in surgical site infections among hospitals that report to the Centers for Disease Control and Prevention**

<b>Pathogen</b>	<b>Percent of Infections</b>
<i>Staphylococcus aureus</i>	23
Coagulase-negative staphylococci	17
Enterococci	7
<i>Pseudomonas aeruginosa</i>	5
<i>Escherichia coli</i>	5
Streptococci	4
<i>Enterobacter</i> species	3
<i>Proteus</i> species	3
<i>Klebsiella pneumoniae</i> / <i>Klebsiella oxytoca</i>	3
<i>Serratia</i> species	3

Data from Berrios-Torres SI, Yi SH, Bratzler DW, et al. Activity of commonly used antimicrobial prophylaxis regimens against pathogens causing coronary artery bypass graft and arthroplasty surgical site infections in the United States, 2006-2009. *Infect Control Hosp Epidemiol* 2014;35(3):231-9.



# Common Surgical Pathogens

## Clean wound

S.aureus

Coagulase-negative Staphylococci

## Clean-Contaminated wound

Skin flora

gram negative pathogen

## Contaminated wound

Skin flora

gram negative pathogen

Anaerobes

# Diagnosis of Infected Wound

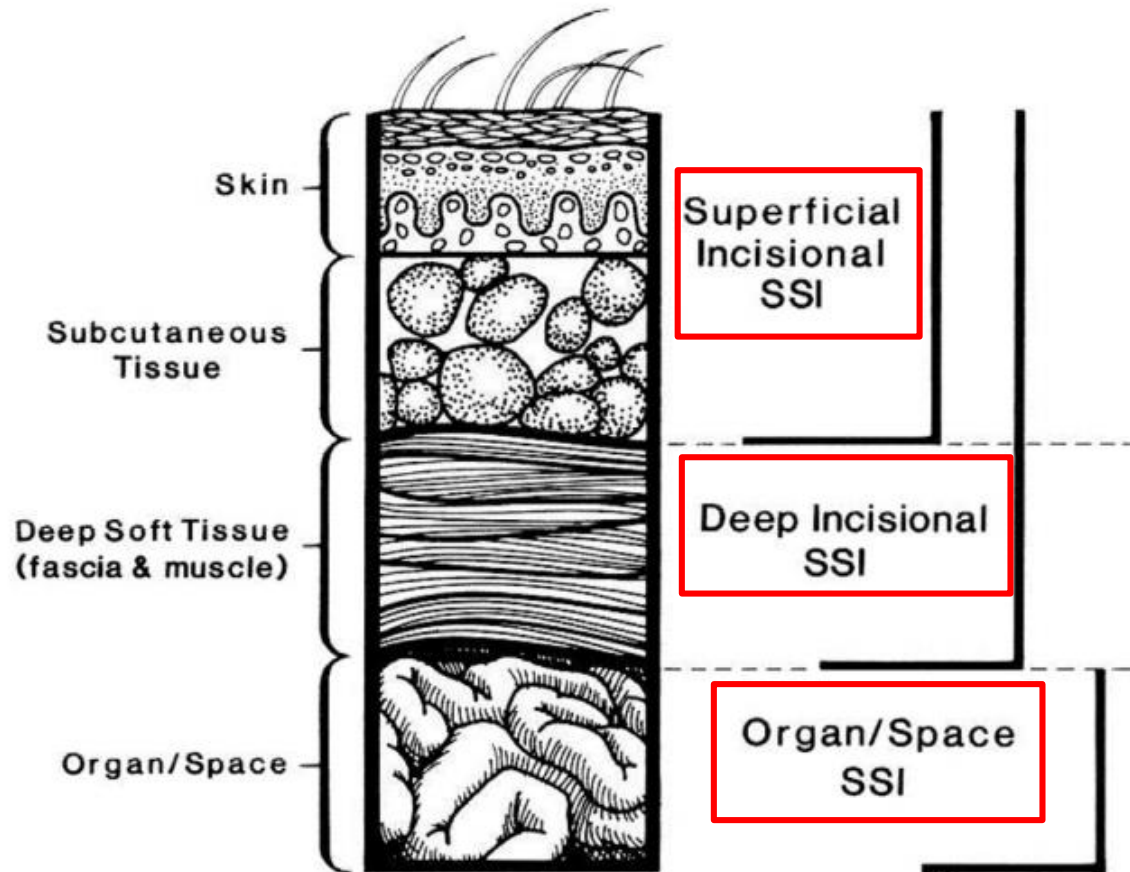
## Classification of SSI

### 1. Incisional SSI (การติดเชื้อบริเวณที่ลงมีด)

- superficial incisional SSI
- deep incisional SSI

### 2. Organ/Space SSI (การติดเชื้อในอวัยวะหรือช่องต่างๆ)

# Classification of SSI



**Fig. 1.** CDC classification of SSI (public domain). (From Horan TC, Gaynes RP, Martone WJ, et al. CDC definitions of nosocomial surgical site infections, 1992: a modification of CDC definitions of surgical wound infections. *Infect Control Hosp Epidemiol* 1992;13(10):606–8.)

# Diagnosis of Infected Wound

## Box 1

### Criteria for defining a surgical site infection

#### *Incisional SSI*

*Superficial:* infection involves skin or subcutaneous tissue of the incision *and* at least one of the following:

1. Purulent drainage, with or without laboratory confirmation, from the superficial incision
2. Organisms isolated from an aseptically obtained culture from the superficial incision
3. At least one of the following signs or symptoms: pain, localized swelling, erythema, or heat and superficial incision, is deliberately opened by surgeon, unless incision is culture-negative.
4. Diagnosis of superficial incisional SSI by surgeon

*Deep:* infection involves deep soft tissues (eg, fascial and muscle layers) of the incision *and* at least one of the following:

1. Purulent drainage from the deep incision, excluding organ/space<sup>a</sup>
2. A deep incision that spontaneously dehisces or is deliberately opened by a surgeon when a patient has one or more of the following signs/symptoms: fever (>38°C), localized pain, unless site is culture-negative
3. An abscess or other evidence of infection is found on direct examination, during repeat surgery, or by histopathologic or radiologic examination<sup>b</sup>
4. Diagnosis of a deep incisional SSI by surgeon

# Diagnosis of Infected Wound

## Box 1

### Criteria for defining a surgical site infection

Organ/space SSI: infection involves any part of the anatomy (eg, organs or organ spaces), which was opened or manipulated during an operation and at least one of the following:

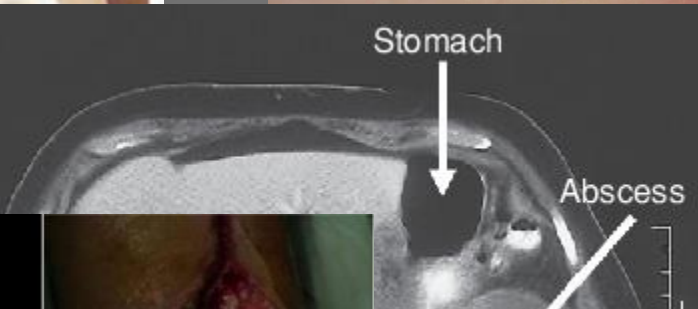
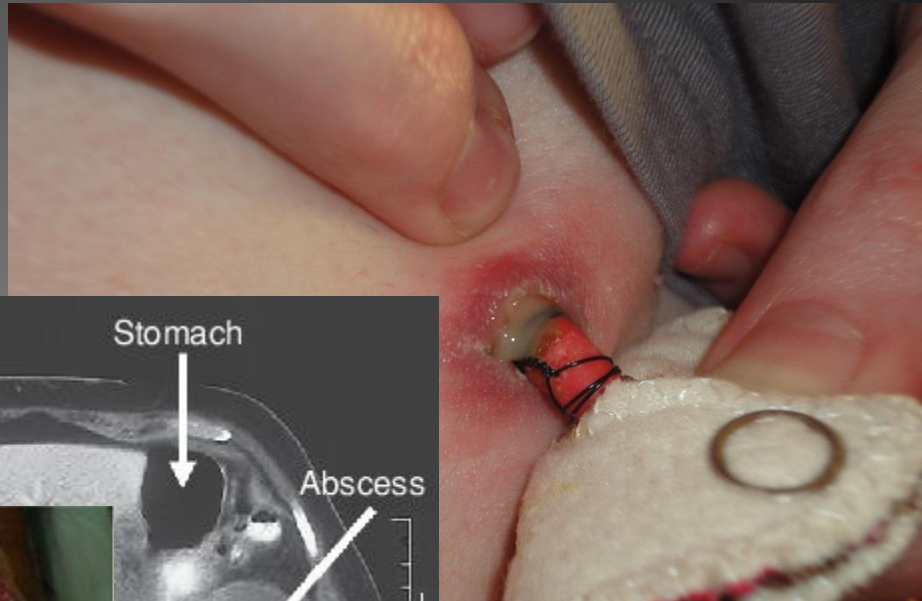
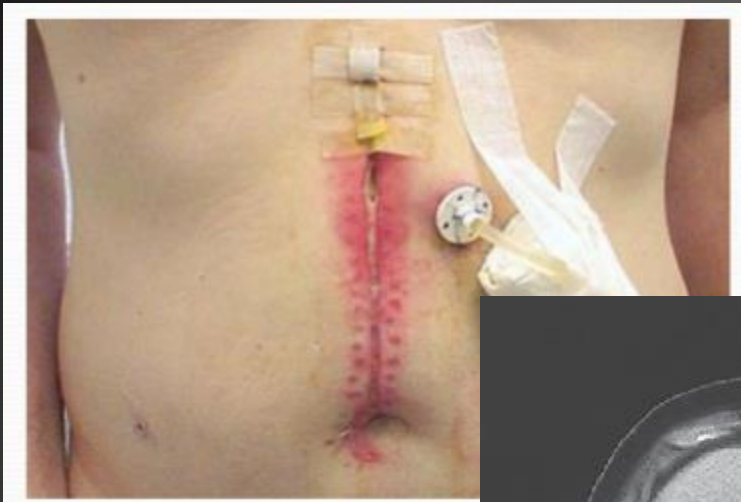
1. Purulent drainage from a drain that is placed through the stab wound into the organ/space
2. Organisms isolated from an aseptically obtained culture from the organ/space
3. An abscess or other evidence of infection involving organ/space that is found on examination (physical, histopathologic, or radiologic) or during repeat surgery
4. Diagnosis of an organ/space SSI by surgeon

For all classifications, infection is defined as occurring within 30 days after the operation if no implant is placed or within 90 days if an implant is in place and the infection is related to the incision.

<sup>a</sup> Report infection that involves both superficial and deep incision sites as a deep incisional SSI.

<sup>b</sup> Report an organ/space SSI that drains through the incision as a deep incisional SSI.

*Adapted from* Horan TC, Gaynes RP, Martone WJ, et al. CDC definitions of nosocomial surgical site infections, 1992: a modification of CDC definitions of surgical wound infections. *Infect Control Hosp Epidemiol* 1992;13(10):606–8.



### Deep Incisional



### Superficial Incisional



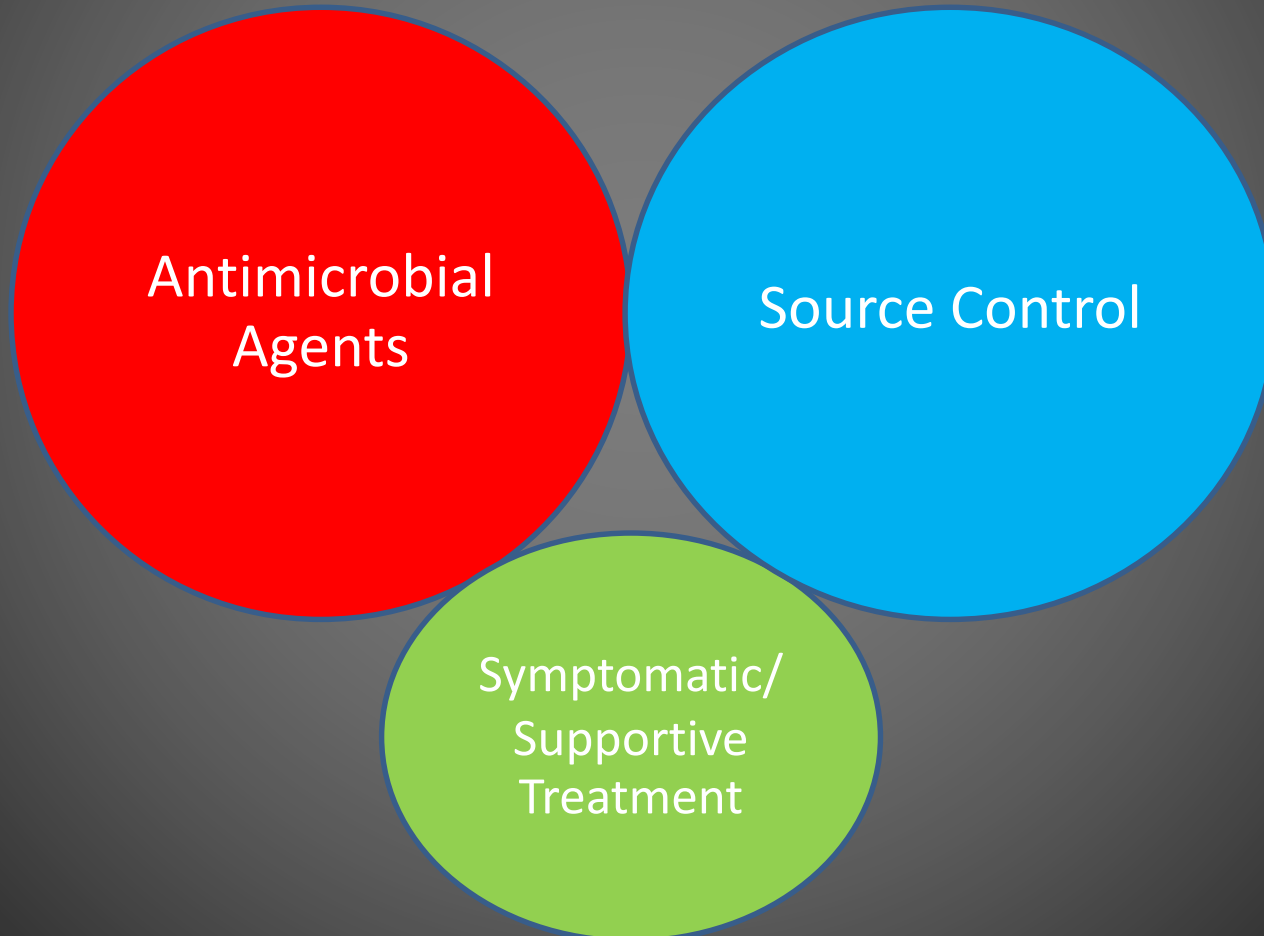
Wound Gapping  
Fever  
Pain  
Discharge



Redness  
Pain  
Swelling  
Heat  
Discharging pus

# Treatment of Infected Wound

# Treatment of Infectious Diseases





# Treatment of Infected Wound

- Surgical debridement\*\*\*
- Antibiotics
  - empirical
  - specific
- Nutritional support/ Other supportive treatment

# Prevention of Surgical Site Infection

## Reduce Bacterial Inoculation

- avoid Preop ATB
- minimize Preop hospitalization
- treat remote infection
- avoid shaving or razor use
- delay hair removal
- timely administration of preop ATB
- consider *S.aureus* decolonization
- Use standardized checklist

- carefully prepare patients' skin
- adhere to aseptic technique
- isolate clean from contaminated site
- high flow filtered air
- redose of ATB if necessary
- minimize traffic
- minimize use of drain

## Improving Host Containment

- resolve malnutrition/obesity
- discontinue tobacco use
- Blood sugar control

- minimal dead space, devitalized tissue, hematomas
- consider oxygen supplement
- maintain normothermia
- maintain adequate hydration and nutrition
- identify and minimize hyperglycemia

# Preoperative Antimicrobial Prophylaxis

**TABLE 318-5 Typical Microbiologic Flora and Recommended Antimicrobial Drugs for Surgical Prophylaxis for Commonly Performed Surgical Procedures in Adults**

PROCEDURE	TYPICAL MICROBIOLOGIC FLORA*	RECOMMENDED ANTIMICROBIALS
Cardiac	<i>Staphylococcus aureus</i> , CoNS, (GMR less common)	Cefazolin, cefuroxime
Coronary artery bypass		Cefazolin, cefuroxime
Cardiac device insertion (e.g., pacemaker)		Cefazolin, cefuroxime
Ventricular assist device placement		Cefazolin, cefuroxime
Thoracic	<i>S. aureus</i> , CoNS	Cefazolin, ampicillin-sulbactam
Gastroduodenal (involving entry into lumen of gastrointestinal tract or without entry into lumen in high-risk patients)	Coliform GMR, streptococci, staphylococci	Cefazolin
Biliary	GMR (less commonly, anaerobes and enterococci)	Cefazolin, ceftiofloxacin, cefotetan, ceftriaxone, ampicillin-sulbactam
Open		Cefazolin, ceftiofloxacin, cefotetan, ceftriaxone, ampicillin-sulbactam
Laparoscopic, high risk		Cefazolin, ceftiofloxacin, cefotetan, ceftriaxone, ampicillin-sulbactam
Appendectomy	GMR, anaerobes	Ceftiofloxacin, cefotetan, cefazolin + metronidazole
Colorectal	GMR, anaerobes (especially <i>Bacteroides fragilis</i> and <i>Escherichia coli</i> )	Cefazolin + metronidazole, ceftiofloxacin, cefotetan, ampicillin-sulbactam, ceftriaxone + metronidazole, ertapenem; IV agent used along with mechanical bowel preparation and oral antimicrobial (neomycin sulfate + erythromycin base or neomycin sulfate + metronidazole)
Neurosurgery (craniotomy, CSF shunting, intrathecal pump implantation)	<i>S. aureus</i> , CoNS	Cefazolin
Cesarean section	<i>S. aureus</i> , streptococci, enterococci, vaginal anaerobes	Cefazolin
Hysterectomy (vaginal or abdominal)	<i>S. aureus</i> , streptococci, enterococci, vaginal anaerobes	Cefazolin, ceftiofloxacin, cefotetan, ampicillin-sulbactam
Orthopedic	<i>S. aureus</i> , CoNS, streptococci, GMR ( <i>Propionibacterium</i> spp. in shoulder procedures)	None
Clean procedure of hand, knee, foot without implantation of foreign materials		
Spinal procedures, hip fracture repair, internal fixation procedure, total joint arthroplasty		Cefazolin
Urologic	GMR ( <i>E. coli</i> ), rarely enterococci	Fluoroquinolone, trimethoprim-sulfamethoxazole, cefazolin
Lower tract instrumentation (includes transrectal prostate biopsy)		Cefazolin (single-dose aminoglycoside may be added for placement of prosthetic material)
Clean procedure (with or without entry into urinary tract)		Cefazolin + metronidazole, ceftiofloxacin
Clean contaminated		Cefazolin
Vascular	<i>S. aureus</i> , CoNS	Cefazolin

# Preoperative Antimicrobial Prophylaxis

- Dosing
- Timing of administration
- Redosing

# Dosing of Preop Antimicrobial Prophylaxis

**TABLE 318-6 Recommended Doses and Redosing Intervals for Adults for Commonly Used Antimicrobials for Surgical Prophylaxis**

ANTIMICROBIAL	RECOMMENDED DOSE FOR ADULTS	RECOMMENDED REDOSING INTERVAL (FROM INITIATION OF PREOPERATIVE DOSE) (hr)
<b>Intravenous Agents</b>		
Ampicillin-sulbactam	3 g (ampicillin 2 g/ sulbactam 1 g)	2
Ampicillin	2 g	2
Aztreonam	2 g	4
Cefazolin	2 g; 3 g for persons with weight $\geq 120$ kg	4
Cefotaxime	1 g	3
Cefoxitin	2 g	2
Cefotetan	2 g	6
Ceftriaxone	2 g	NA
Ciprofloxacin	400 mg	NA
Clindamycin	900 mg	6
Ertapenem	1 g	NA
Fluconazole	400 mg	NA
Gentamicin	5 mg/kg	NA
Levofloxacin	500 mg	NA
Metronidazole	500 mg	NA
Moxifloxacin	400 mg	NA
Piperacillin-tazobactam	3.375 g	2
Vancomycin	15 mg/kg	NA
<b>Oral Agents for Colorectal Procedures (in Conjunction with Mechanical Bowel Preparation)</b>		
Erythromycin base	1 g	NA
Metronidazole	1 g	NA
Neomycin	1 g	NA

NA, not applicable.

Modified from Bratzler DW, Dellinger EP, Olsen KM, et al. Clinical practice guidelines for antimicrobial prophylaxis in surgery. Am J Health Syst Pharm. 2013;70:195-283.

# Preoperative Antimicrobial Prophylaxis

- Timing of administration

within 1 hour of incision except vancomycin and fluoroquinolones

# Hair Removal

- Shaving increase rate of SSI by causing microscopic abrasion
- Hair should not be removed, or if necessary, remove with clipper or depilatory agent



# Preoperative Bathing

- It's a good clinical practice for patients to bathe or shower before surgery
- Either a plain or antimicrobial soap may be used



# Glycemic Control

- Blood sugar should be controlled to less than 180 mg/dL at least 48 hours postoperatively

# Postoperative Measures

- Suggest not using any types of advanced dressing over a standard dressing practice

# Antimicrobial Prophylaxis in the Presence of a Drain

- Antimicrobial Prophylaxis should not be continue in the presence of a drain
- Drain should be removed if clinically indicated

# Take Home Message

- Wound infection is one of concern in wound care
- Wound Infection in surgery is from surgical site infection (SSI)
- SSI is preventable
- Risk identification and modifying risk are the key of prevention of SSI

Thank You