

Antimicrobial prophylaxis

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Definition

The United States Centers for Disease Control and Prevention (CDC) has developed criteria that define surgical site infection (SSI) as infection related to an operative procedure that occurs at or near the surgical incision (incisional or organ/space) within 30 days of the procedure or within 90 days if prosthetic material is implanted at surgery.

Wound Classification

- Clean wounds are uninfected operative wounds in which no inflammation is encountered and the wound is closed primarily. By definition, a viscus (respiratory, alimentary, genital, or urinary tract) is not entered during a clean procedure
- Clean-contaminated wounds are operative wounds in which a viscus is entered under controlled conditions and without unusual contamination

Wound Classification

- Contaminated wounds are open, fresh accidental wounds, operations with major breaks in sterile technique, or gross spillage from a viscus. Wounds in which acute, nonpurulent inflammation was encountered also were included in this category.
- Dirty wounds are old traumatic wounds with retained devitalized tissue, foreign bodies, or fecal contamination or wounds that involve existing clinical infection or perforated viscus

Antimicrobial prophylaxis is justified for most clean-contaminated procedures. The use of antimicrobial agents for dirty procedures or established infection is classified as treatment of presumed infection, not prophylaxis

Microbiology

- The predominant organisms causing surgical site infections (SSIs) after clean procedures are skin flora, including **streptococcal species**, ***Staphylococcus aureus***, and **coagulase-negative staphylococci**
- The percentage of SSIs caused by antibiotic-resistant pathogens has increased (eg, MRSA, methicillin-resistant *Staphylococcus epidermidis* [MRSE], vancomycin-resistant enterococci [VRE])

Antibiotic selection

- Cefazolin is a drug of choice for many procedures; it is the most widely studied antimicrobial agent with proven efficacy for antimicrobial prophylaxis. It has a desirable duration of action, spectrum of activity against organisms commonly encountered in surgery, reasonable safety, and low cost.
- Second-generation cephalosporins (such as Cefuroxim) have broader coverage against gram-negative organisms than Cefazolin. Cefoxitin and Cefotetan also have some anaerobic activity.

Antimicrobial prophylaxis for cardiac surgery in adults

Nature of operation	Common pathogens	Recommended antimicrobials	Usual adult dose*	Redose interval [¶]
Cardiac procedures: coronary artery bypass, cardiac device insertion procedures (eg, pacemaker implantation), placement of ventricular assist devices	<i>Staphylococcus aureus</i> , <i>S. epidermidis</i>	Cefazolin	<120 kg: 2 g IV ≥120 kg: 3 g IV	4 hours
		OR cefuroxime	1.5 g IV	4 hours ^Δ
		OR vancomycin [◊]	15 mg/kg IV (max 2 g)	N/A
		OR clindamycin	900 mg IV	6 hours

IV: intravenous.

* Parenteral prophylactic antimicrobials can be given as a single IV dose begun within 60 minutes before the procedure. If vancomycin is used, the infusion should be started within 60 to 120 minutes before the initial incision to have adequate tissue levels at the time of incision and to minimize the possibility of an infusion reaction close to the time of induction of anesthesia.

¶ For prolonged procedures (>3 hours) or those with major blood loss or in patients with extensive burns, additional intraoperative doses should be given at intervals one to two times the half-life of the drug for the duration of the procedure in patients with normal renal function.

Δ Some experts recommend an additional dose when patients are removed from bypass during open-heart surgery.

◊ Use of vancomycin is appropriate in hospitals in which methicillin-resistant *S. aureus* (MRSA) and *S. epidermidis* are a frequent cause of postoperative wound infection, in patients previously colonized with MRSA or for those who are allergic to penicillins or cephalosporins. Rapid IV administration may cause hypotension, which could be especially dangerous during induction of anesthesia. Even when the drug is given over 60 minutes, hypotension may occur; treatment with diphenhydramine and further slowing of the infusion rate may be helpful. For procedures in which enteric gram-negative bacilli are common pathogens, many experts would add another drug such as an aminoglycoside (gentamicin 5 mg/kg IV), aztreonam (2 g IV), or a fluoroquinolone (ciprofloxacin 400 mg IV or levofloxacin 500 mg IV).

Adapted from:

1. Antimicrobial prophylaxis for surgery. *Med Lett Drugs Ther* 2016; 58:63.
2. Bratzler DW, Dellinger EP, Olsen KM, et al. Clinical practice guidelines for antimicrobial prophylaxis in surgery. *Surg Infect (Larchmt)* 2013; 14:73.

Antimicrobial prophylaxis for gastrointestinal surgery in adults

Nature of operation	Common pathogens	Recommended antimicrobials	Usual adult dose*	Redose interval [†]
Gastrointestinal surgery				
Procedures involving entry into lumen of gastrointestinal tract	Enteric gram-negative bacilli, gram-positive cocci	Cefazolin [‡]	<120 kg: 2 g IV ≥120 kg: 3 g IV	Four hours
Procedures not involving entry into lumen of gastrointestinal tract (selective vagotomy, antireflux)	Enteric gram-negative bacilli, gram-positive cocci	High risk [§] only: cefazolin [‡]	<120 kg: 2 g IV ≥120 kg: 3 g IV	Four hours
Biliary tract surgery (including pancreatic procedures)				
Open procedure or laparoscopic procedure (high risk) [¶]	Enteric gram-negative bacilli, enterococci, clostridia	Cefazolin ^{‡,¶}	<120 kg: 2 g IV ≥120 kg: 3 g IV	Four hours
		OR cefotetan	2 g IV	Six hours
		OR cefoxitin	2 g IV	Two hours
		OR ampicillin-sulbactam	3 g IV	Two hours
Laparoscopic procedure (low risk)	N/A	None	None	None
Appendectomy[†]				
	Enteric gram-negative bacilli, anaerobes, enterococci	Cefoxitin [‡]	2 g IV	Two hours
		OR cefotetan [‡]	2 g IV	Six hours
		OR cefazolin [‡]	<120 kg: 2 g IV ≥120 kg: 3 g IV	Four hours
		PLUS metronidazole	500 mg IV	N/A
Small intestine surgery				
Nonobstructed	Enteric gram-negative bacilli, gram-positive cocci	Cefazolin [‡]	<120 kg: 2 g IV ≥120 kg: 3 g IV	Four hours
Obstructed	Enteric gram-negative bacilli, anaerobes, enterococci	Cefoxitin [‡]	2 g IV	Two hours
		OR cefotetan [‡]	2 g IV	Six hours
		OR cefazolin [‡]	<120 kg: 2 g IV ≥120 kg: 3 g IV	Four hours
		PLUS metronidazole	500 mg IV	N/A
Hernia repair				
	Aerobic gram-positive organisms	Cefazolin [‡]	<120 kg: 2 g IV ≥120 kg: 3 g IV	Four hours
Colorectal surgery[†]				
Enteric gram-negative bacilli, anaerobes, enterococci		Parenteral:		
		Cefoxitin [‡]	2 g IV	Two hours
		OR cefotetan [‡]	2 g IV	Six hours
		OR cefazolin [‡]	<120 kg: 2 g IV ≥120 kg: 3 g IV	Four hours
		PLUS metronidazole	500 mg IV	N/A
		OR ampicillin-sulbactam ^{‡,¶¶}	3 g IV (based on combination)	Two hours
		Oral (used in conjunction with mechanical bowel preparation):		
Neomycin PLUS erythromycin base or metronidazole	¶¶	¶¶		

IV: intravenous.

* Parenteral prophylactic antimicrobials can be given as a single IV dose begun within 60 minutes before the procedure. If vancomycin or a fluoroquinolone is used, the infusion should be started within 60 to 120 minutes before the initial incision to have adequate tissue levels at the time of incision and to minimize the possibility of an infusion reaction close to the time of induction of anesthesia.

† For prolonged procedures (>3 hours) or those with major blood loss or in patients with extensive burns, additional intraoperative doses should be given at intervals one to two times the half-life of the drug.

‡ For patients allergic to penicillins and cephalosporins, clindamycin (900 mg) or vancomycin (15 mg/kg IV; not to exceed 2 g) with either gentamicin (5 mg/kg IV), ciprofloxacin (400 mg IV), levofloxacin (500 mg IV), or aztreonam (2 g IV) is a reasonable alternative. Metronidazole (500 mg IV) plus an aminoglycoside or fluoroquinolone are also acceptable alternative regimens, although metronidazole plus aztreonam should not be used, since this regimen does not have aerobic gram-positive activity.

§ Morbid obesity, gastrointestinal (GI) obstruction, decreased gastric acidity or GI motility, gastric bleeding, malignancy or perforation, or immunosuppression.

¶ Factors that indicate high risk may include age >70 years, pregnancy, acute cholecystitis, nonfunctioning gall bladder, obstructive jaundice, common bile duct stones, immunosuppression.

¶ Cefotetan, cefoxitin, and ampicillin-sulbactam are reasonable alternatives.

¶ For a ruptured viscus, therapy is often continued for approximately five days.

† Use of ertapenem or other carbapenems not recommended due to concerns of resistance.

¶¶ Due to increasing resistance of *Escherichia coli* to fluoroquinolones and ampicillin-sulbactam, local sensitivity profiles should be reviewed prior to use.

¶¶ In addition to mechanical bowel preparation, the following oral antibiotic regimen is administered. 1 g of neomycin plus 1 g of erythromycin base at 1 PM, 2 PM, and 11 PM, or 2 g of neomycin plus 2 g of metronidazole at 7 PM and 11 PM the day before an 8 AM operation. Issues related to mechanical bowel preparation are discussed further separately. Refer to UpToDate topic on overview of colon resection.

Data from:

1. Antimicrobial prophylaxis for surgery. *Med Lett Drugs Ther* 2016; 58:63.
2. Bratzler DW, Dellinger EP, Olsen KM, et al. Clinical practice guidelines for antimicrobial prophylaxis in surgery. *Surg Infect (Larchmt)* 2013; 14:73.

Antimicrobial prophylaxis for head and neck surgery in adults

Nature of operation	Common pathogens	Recommended antimicrobials	Usual adult dose*	Redose interval [¶]
Clean	–	None	–	–
Clean with placement of prosthesis (excludes tympanostomy tube placement)	<i>Staphylococcus aureus</i> , <i>S. epidermidis</i> , streptococci	Cefazolin*	<120 kg: 2 g IV ≥120 kg: 3 g IV	4 hours
		OR cefuroxime	1.5 g IV	4 hours
		OR vancomycin ^Δ	15 mg/kg (max 2 g)	N/A
		OR clindamycin	600 to 900 mg IV	N/A
Clean-contaminated	Anaerobes, enteric gram-negative bacilli, <i>S. aureus</i>	Cefazolin	<120 kg: 2 g IV ≥120 kg: 3 g IV	4 hours
		PLUS metronidazole	500 mg IV	N/A
		OR cefuroxime	1.5 g IV	4 hours
		PLUS metronidazole	500 mg IV	N/A
		OR ampicillin-sulbactam [◇]	3 g IV	2 hours
		OR clindamycin	900 mg IV	6 hours

IV: intravenous.

* Parenteral prophylactic antimicrobials can be given as a single IV dose begun within 60 minutes before the procedure. If vancomycin is used, the infusion should be started within 60 to 120 minutes before the initial incision to have adequate tissue levels at the time of incision and to minimize the possibility of an infusion reaction close to the time of induction of anesthesia.

¶ For prolonged procedures (>3 hours) or those with major blood loss, or in patients with extensive burns, additional intraoperative doses should be given at intervals one to two times the half-life of the drug for the duration of the procedure in patients with normal renal function.

Δ Use of vancomycin is appropriate in hospitals in which methicillin-resistant *S. aureus* (MRSA) or *S. epidermidis* are frequent causes of postoperative wound infection, in patients previously colonized with MRSA, or for those who are allergic to penicillins or cephalosporins. Rapid IV administration may cause hypotension, which could be especially dangerous during induction of anesthesia. Even when the drug is given over 60 minutes, hypotension may occur; treatment with diphenhydramine and further slowing of the infusion rate may be helpful. For procedures in which enteric gram-negative bacilli are common pathogens, many experts would add another drug such as an aminoglycoside (such as gentamicin 5 mg/kg IV), aztreonam (2 g IV), or a fluoroquinolone (such as levofloxacin 500 mg IV or ciprofloxacin 400 mg IV).

◇ Some experts recommend an additional dose when patients are removed from bypass during open-heart surgery.

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1. Antimicrobial prophylaxis for surgery. *Med Lett Drugs Ther* 2016; 58:63.
2. Bratzler DW, Dellinger EP, Olsen KM, et al. Clinical practice guidelines for antimicrobial prophylaxis in surgery. *Surg Infect (Larchmt)* 2013; 14:73.

Antimicrobial prophylaxis for neurosurgery in adults

Nature of operation	Common pathogens	Recommended antimicrobials	Usual adult dose*	Redose interval [¶]
Elective craniotomy	<i>Staphylococcus aureus</i> , <i>S. epidermidis</i>	Cefazolin	<120 kg: 2 g	4 hours
Cerebrospinal fluid shunting procedures			≥120 kg: 3 g	
Implantation of intrathecal pumps		OR vancomycin ^Δ	15 mg/kg IV (max 2 g)	12 hours
		OR clindamycin	900 mg IV	6 hours

IV: intravenous.

* Parenteral prophylactic antimicrobials can be given as a single IV dose begun within 60 minutes before the procedure. If vancomycin is used, the infusion should be started within 60 to 120 minutes before the initial incision to have adequate tissue levels at the time of incision and to minimize the possibility of an infusion reaction close to the time of induction of anesthesia.

¶ For prolonged procedures (>3 hours) or those with major blood loss, or in patients with extensive burns, additional intraoperative doses should be given at intervals one to two times the half-life of the drug (cefazolin every four hours, clindamycin every six hours, vancomycin every 12 hours) for the duration of the procedure in patients with normal renal function.

Δ Use of vancomycin is appropriate in hospitals in which methicillin-resistant *S. aureus* (MRSA) and *S. epidermidis* are a frequent cause of postoperative wound infection, in patients previously colonized with MRSA, or for those who are allergic to penicillins or cephalosporins. Rapid IV administration may cause hypotension, which could be especially dangerous during induction of anesthesia. Even when the drug is given over 60 minutes, hypotension may occur; treatment with diphenhydramine and further slowing of the infusion rate may be helpful. For procedures in which enteric gram-negative bacilli are common pathogens, many experts would add another drug such as an aminoglycoside (such as gentamicin 5 mg/kg IV), aztreonam (2 g IV), or a fluoroquinolone (such as ciprofloxacin 400 mg IV or levofloxacin 500 mg IV).

Adapted from:

1. Antimicrobial prophylaxis for surgery. *Med Lett Drugs Ther* 2016; 58:63.
2. Bratzler DW, et al. *Clinical practice guidelines for antimicrobial prophylaxis in surgery. Surg Infect (Larchmt)* 2013; 14:73.

Antimicrobial prophylaxis for orthopedic surgery in adults

Nature of operation	Common pathogens	Recommended antimicrobials	Usual adult dose*	Redose interval ¶
Clean operation involving hand, knee, or foot with no implantation of foreign material	–	None	–	–
Spinal procedures Hip fracture Internal fixation Total joint replacement	<i>Staphylococcus aureus</i> , <i>Staphylococcus epidermidis</i>	Cefazolin ^Δ OR vancomycin ^{Δ◊} OR clindamycin	<120 kg: 2 g IV ≥120 kg: 3 g IV 15 mg/kg IV (max 2 g) 900 mg IV	Four hours N/A Six hours

IV: intravenous; N/A: not applicable.

* Parenteral prophylactic antimicrobials can be given as a single IV dose begun within 60 minutes before the procedure. If vancomycin is used, the infusion should be started within 60 to 120 minutes before the initial incision to have adequate tissue levels at the time of incision and to minimize the possibility of an infusion reaction close to the time of induction of anesthesia.

¶ For prolonged procedures (>3 hours) or those with major blood loss or in patients with extensive burns, additional intraoperative doses should be given at intervals one to two times the half-life of the drug for the duration of the procedure in patients with normal renal function.

Δ If a tourniquet is to be used in the procedure, the entire dose of antibiotic must be infused prior to its inflation.

◊ Use of vancomycin is appropriate in hospitals in which methicillin-resistant *Staphylococcus aureus* (MRSA) and *Staphylococcus epidermidis* are a frequent cause of postoperative wound infection, in patients previously colonized with MRSA, or for those who are allergic to penicillins or cephalosporins. Rapid IV administration may cause hypotension, which could be especially dangerous during induction of anesthesia. Even when the drug is given over 60 minutes, hypotension may occur; treatment with diphenhydramine and further slowing of the infusion rate may be helpful. Some experts would give 15 mg/kg of vancomycin to patients weighing more than 75 kg, up to a maximum of 1.5 g, with a slower infusion rate (90 minutes for 1.5 g).

Adapted from:

1. Antimicrobial prophylaxis for surgery. *Med Lett Drugs Ther* 2016; 58:63.
2. Bratzler DW, et al. *Clinical practice guidelines for antimicrobial prophylaxis in surgery. Surg Infect (Larchmt)* 2013; 14:73.

Antimicrobial prophylaxis for thoracic (noncardiac) surgery in adults

Nature of operation	Common pathogens	Recommended antimicrobials	Usual adult dose*	Redose interval [¶]
Thoracic (noncardiac) procedures: lobectomy, pneumonectomy, lung resection, thoractomy	<i>Staphylococcus aureus</i> , <i>S. epidermidis</i> , streptococci, enteric gram-negative bacilli	Cefazolin	<120 kg: 2 g IV ≥120 kg: 3 g IV	4 hours
		OR ampicillin-sulbactam ^Δ	3 g IV	2 hours
		OR vancomycin [◇]	15 mg/kg IV (max 2 g)	N/A
		OR clindamycin	900 mg IV	6 hours

IV: intravenous.

* Parenteral prophylactic antimicrobials can be given as a single IV dose begun within 60 minutes before the procedure. If vancomycin is used, the infusion should be started within 60 to 120 minutes before the initial incision to have adequate tissue levels at the time of incision and to minimize the possibility of an infusion reaction close to the time of induction of anesthesia.

¶ For prolonged procedures (>3 hours) or those with major blood loss, or in patients with extensive burns, additional intraoperative doses should be given at intervals one to two times the half-life of the drug for the duration of the procedure in patients with normal renal function.

Δ Due to increasing resistance of *Escherichia coli* to fluoroquinolones and ampicillin-sulbactam, local sensitivity profiles should be reviewed prior to use.

◇ Use of vancomycin is appropriate in hospitals in which methicillin-resistant *S. aureus* (MRSA) and *S. epidermidis* are a frequent cause of postoperative wound infection, in patients previously colonized with MRSA, or for those who are allergic to penicillins or cephalosporins. Rapid IV administration may cause hypotension, which could be especially dangerous during induction of anesthesia. Even when the drug is given over 60 minutes, hypotension may occur; treatment with diphenhydramine and further slowing of the infusion rate may be helpful. For procedures in which enteric gram-negative bacilli are common pathogens, many experts would add another drug such as an aminoglycoside (gentamicin 5 mg/kg IV), aztreonam (2 g IV), or a fluoroquinolone (ciprofloxacin 400 mg IV or levofloxacin 500 mg IV).

Adapted from:

1. Antimicrobial prophylaxis for surgery. *Med Lett Drugs Ther* 2016; 58:63.
2. Bratzler DW, Dellinger EP, Olsen KM, et al. Clinical practice guidelines for antimicrobial prophylaxis in surgery. *Surg Infect (Larchmt)* 2013; 14:73.

Timing

- Antimicrobial therapy should be initiated within the 60-120 minutes prior to surgical incision to optimize adequate drug tissue levels at the time of initial incision

Evidence base 1

- **BACKGROUND:** Randomized, controlled trials have shown that prophylactic antibiotics are effective in preventing surgical-wound infections. However, it is uncertain how the timing of antibiotic administration affects the risk of surgical-wound infection in actual clinical practice.
- **METHODS:** We prospectively monitored the timing of antibiotic prophylaxis and studied the occurrence of surgical-wound infections in 2847 patients undergoing elective clean or "clean-contaminated" surgical procedures at a large community hospital. The administration of antibiotics 2 to 24 hours before the surgical incision was defined as early; that during the 2 hours before the incision, as preoperative; that during the 3 hours after the incision, as perioperative; and that more than 3 but less than 24 hours after the incision, as postoperative.

Evidence base 1

- **RESULTS:** Of the 1708 patients who received the prophylactic antibiotics preoperatively, 10 (0.6 percent) subsequently had surgical-wound infections. Of the 282 patients who received the antibiotics perioperatively, 4 (1.4 percent) had such infections (P = 0.12; relative risk as compared with the preoperatively treated group, 2.4; 95 percent confidence interval, 0.9 to 7.9). Of 488 patients who received the antibiotics postoperatively, 16 (3.3 percent) had wound infections (P less than 0.0001; relative risk, 5.8; 95 percent confidence interval, 2.6 to 12.3). Finally, of 369 patients who had antibiotics administered early, 14 (3.8 percent) had wound infections (P less than 0.0001; relative risk, 6.7; 95 percent confidence interval, 2.9 to 14.7). Stepwise logistic-regression analysis confirmed that the administration of antibiotics in the preoperative period was associated with the lowest risk of surgical-wound infection.
- **CONCLUSIONS:** We conclude that in surgical practice there is considerable variation in the timing of prophylactic administration of antibiotics and that administration in the two hours before surgery reduces the risk of wound infection.

Evidence base 1

Timing of prophylactic antibiotic administration and subsequent rates of SSIs

Time of administration*	Percent with SSI	Odds ratio †	95 percent CI
Early	3.8	4.3	1.8-10.4
Preoperative	0.6	1	-
Perioperative	1.4	2.1	0.6-7.4
Postoperative	3.3	5.8	2.4-13.8

SSI: surgical site infection.

* "Early" denotes 2 to 24 hours before incision, "preoperative" 0 to 2 hours before incision, "perioperative" within 3 hours after incision, and "postoperative" more than 3 hours after incision.

† Odds ratio determined by logistic-regression analysis.

Adapted from: Classen DC, Evans RS, Pestotnik SL, et al, N Engl J Med 1992; 326:281.

Evidence base 2

- **TI** Timing of surgical antimicrobial prophylaxis: a phase 3 randomised controlled trial.
- **AU** Weber WP, Mujagic E, Zwahlen M, Bundi M, Hoffmann H, Soysal SD, Kraljević M, Delko T, von Strauss M, Iselin L, Da Silva RXS, Zeindler J, Rosenthal R, Misteli H, Kindler C, Müller P, Saccilotto R, Lugli AK, Kaufmann M, Gürke L, von Holzen U, Oertli D, Bucheli-Laffer E, Landin J, Widmer AF, Fux CA, Marti WR
- **SO** Lancet Infect Dis. 2017;17(6):605. Epub 2017 Apr 3

Evidence base 2

- BACKGROUND Based on observational studies, administration of surgical antimicrobial prophylaxis (SAP) for the prevention of surgical site infection (SSI) is recommended within 60 min before incision. However, the precise optimum timing is unknown. This trial compared early versus late administration of SAP before surgery.

Evidence base 2

- **METHODS** In this phase 3 randomised controlled superiority trial, we included general surgery adult inpatients (age \geq 18 years) at two Swiss hospitals in Basel and Aarau. Patients were randomised centrally and stratified by hospital according to a pre-existing computer-generated list in a 1:1 ratio to receive SAP early in the anaesthesia room or late in the operating room. Patients and the outcome assessment team were blinded to group assignment. SAP consisted of single-shot, intravenous infusion of 1.5 g of cefuroxime, a commonly used cephalosporin with a short half-life, over 2-5 min (combined with 500 mg metronidazole in colorectal surgery). The primary endpoint was the occurrence of SSI within 30 days of surgery. The main analyses were by intention to treat. The trial is registered with ClinicalTrials.gov, number NCT01790529

Evidence base 2

- FINDINGS Between Feb 21, 2013, and Aug 3, 2015, 5580 patients were randomly assigned to receive SAP early (2798 patients) or late (2782 patients). 5175 patients (2589 in the early group and 2586 in the late group) were analysed. Median administration time was 42 min before incision in the early group (IQR 30-55) and 16 min before incision in the late group (IQR 10-25). Inpatient follow-up rate was 100% (5175 of 5175 patients); outpatient 30-day follow-up rate was 88·8% (4596 of 5175), with an overall SSI rate of 5·1% (234 of 4596). **Early administration of SAP did not significantly reduce the risk of SSI compared with late administration** (odds ratio 0·93, 95% CI 0·72-1·21, p=0·601).

Evidence base 3

- In one study including more than 4000 patients undergoing cardiac surgery, hysterectomy, or hip or knee arthroplasty, there was no difference in the risk of infection between patients who received antimicrobial prophylaxis within 30 minutes prior to incision and patients who received antimicrobial prophylaxis 31 to 60 minutes prior to incision (1.6 and 2.4 percent, respectively)

Evidence base 3

- TI Timing of antimicrobial prophylaxis and the risk of surgical site infections: results from the Trial to Reduce Antimicrobial Prophylaxis Errors.
- AU Steinberg JP, Braun BI, Hellinger WC, Kusek L, Bozikis MR, Bush AJ, Dellinger EP, Burke JP, Simmons B, Kritchevsky SB, Trial to Reduce Antimicrobial Prophylaxis Errors (TRAPE) Study Group
- SO Ann Surg. 2009 Jul;250(1):10-6.

Duration

- In a systematic review of randomized trials, there was no difference in the rate of SSI with single dose compared with multiple-dose regimens given for less than or more than 24 hours

Evidence base 4

- TI Single- versus multiple-dose antimicrobial prophylaxis for major surgery: a systematic review.
- AU McDonald M, Grabsch E, Marshall C, Forbes A
- SO Aust N Z J Surg. 1998;68(6):388.

Evidence 4

- **BACKGROUND** Single-dose antimicrobial prophylaxis for major surgery is a widely accepted principle; recommendations have been based on laboratory studies and numerous clinical trials published in the last 25 years. In practice, single-dose prophylaxis has not been universally accepted and multiple-dose regimens are still used in some centres. Moreover, the principle has recently been challenged by the results of an Australian study of vascular surgery. The aim of this current systematic review is to determine the overall efficacy of single versus multiple-dose antimicrobial prophylaxis for major surgery and across surgical disciplines

Evidence base 4

- **RESULTS** Combined OR by both fixed (1.06, 95% CI, 0.89-1.25) and random effects (1.04, 95% CI, 0.86-1.25) models indicated no clear advantage of either single or multiple-dose regimens in preventing SSI. Likewise, subgroup analysis showed no statistically significant differences associated with type of antimicrobial used (beta-lactam vs other), blinded wound assessment, length of the multiple-dose arm (>24 h vs 24 h or less) or type of surgery (obstetric and gynaecological vs other).
- **CONCLUSIONS** Continued use of single-dose antimicrobial prophylaxis for major surgery is recommended. Further studies are required, especially in previously neglected surgical disciplines.

Summary

- Surgical site infection (SSI) is an infection related to an operative procedure that occurs at or near the surgical incision within 30 days of the procedure (or within 90 days if an implant is left in place)
- Wounds may be classified as clean, clean-contaminated, contaminated, or dirty. Antimicrobial prophylaxis is justified for most clean-contaminated procedures.

Summary

- In general, antimicrobial selection for SSI prophylaxis is based on cost, safety, pharmacokinetic profile, and bactericidal activity. Cefazolin is a drug of choice for many procedures
- Antimicrobial therapy should be administered within 60 minutes before surgical incision to ensure adequate drug tissue levels at the time of initial incision.

Summary

- In general, repeat antimicrobial dosing following wound closure is not necessary and may increase antimicrobial resistance. For cases in which prophylaxis beyond the period of surgery is warranted, in general, the duration should be less than 24 hours