

## Surgical Antibiotic Prophylaxis at St. Louis Children's Hospital

### I. General Concepts and Guidance

- Overview of guidance:
  - i. [Table 1](#) lists recommended and alternative antibiotic agents for select procedure types
  - ii. [Table 2](#) summarizes recommended dosing and redosing for antibiotic agents
  - iii. [Appendix A](#) outlines indications and antibiotic agents for prophylaxis against endocarditis
- For at-risk procedures, data suggest **anti-MRSA therapy** is warranted preoperatively in patients with **active** MRSA colonization. In patients without a recent MRSA nasal swab, it is reasonable to review culture data in Epic from the preceding few months (up to six months), acknowledging that colonization waxes and wanes overtime. Note: Data suggests vancomycin is less effective than ceftazidime for preventing surgical site infections caused by MSSA and other non-MRSA pathogens.
- Depending on the procedure, culture results should also be reviewed for VRE and/or resistant gram-negative organisms. Patients with a history of colonization or infection with an organism not covered by recommendations in Table 1 may require targeted prophylaxis. Consult ASP/ID for recommendations.
- Patients with **penicillin allergies** can safely receive a cephalosporin for surgical prophylaxis. Cefazolin, specifically, does not share a similar R1 sidechain with any other beta-lactam antibiotic.
- Patients with **cephalosporin allergies** that are not cefazolin can still be considered candidates for cefazolin prophylaxis due to its dissimilar R1 sidechain. Alternative antibiotic(s) recommended for allergies are listed in Table 1 below.
- **Timing of preoperative antibiotics** is crucial to ensuring effective tissue concentrations at the time of initial surgical incision, and administration of antimicrobials after this initial surgical incision increases risk of surgical site infection. The recommended administration window of antibiotics preoperatively varies based on drug and infusion duration, as well as the timing of the last dose of antibiotics a patient may have received. **If receiving antibiotics currently, refer to [Page 7, Item #2](#) for further considerations.**

Antibiotics	Administration Window (from the START of the antibiotic infusion)	OR Infusion Time
Cephalosporins, ampicillin/sulbactam, piperacillin/tazobactam, aztreonam, carbapenems, clindamycin, gentamicin, metronidazole, and linezolid	0-60 minutes prior to initial surgical incision, but no earlier than 60 minutes	<ul style="list-style-type: none"> <li>• Cefazolin, cefepime, ceftazidime, carbapenems: <b>5-10 minutes</b></li> <li>• Ceftriaxone, ampicillin-sulbactam, aztreonam, gentamicin: <b>15 minutes</b></li> <li>• Clindamycin, metronidazole, linezolid, piperacillin/tazobactam: <b>30 minutes</b></li> </ul>
Vancomycin and ciprofloxacin	30-120 minutes prior to initial surgical incision, but no earlier than 120 minutes	IV infusion over <b>60 minutes at least</b>

These recommendations do not establish a standard of care to be followed in every case. Each case is different and the individuals providing health care are expected to use their judgement in determining what is in the best interests of the patient based on the circumstances at the time.

**Table 1. Antibiotic Prophylaxis for Surgical Procedures**

SURGERY	PREFERRED ANTIBIOTIC	PREFERRED CEPHALOSPORIN ALLERGY	MRSA COLONIZATION / INFECTION*	VRE COLONIZATION / INFECTION	POST-OP PROPHYLAXIS DURATION
<b>CARDIAC SURGERY</b>					
All cardiac procedures	Cefazolin	Vancomycin or Clindamycin	Vancomycin or Clindamycin	Linezolid	≤ 24 - 48 h
<b>GENERAL SURGERY / GASTROINTESTINAL</b>					
Appendectomy	Cefoxitin or Ceftriaxone and Metronidazole	Ciprofloxacin and Metronidazole	—	—	Non-perforated ≤ 24 h
Clean with risk (e.g. implant); clean contaminated/proximal GI (esophageal, stomach, proximal small bowel)	Cefazolin	Vancomycin or Clindamycin	Vancomycin or Clindamycin	Linezolid	≤ 24 h
Contaminated or high risk for Gram-negative colonization (biliary, distal small bowel, appendix, colon)	Cefoxitin	Ciprofloxacin and Metronidazole	—	—	≤ 24 h
G-tube placement	Cefazolin	Vancomycin or Clindamycin	Vancomycin or Clindamycin	—	none
G-tube placement in patient with VP shunt	Cefazolin	Vancomycin or Clindamycin	Vancomycin or Clindamycin	—	≤ 24 h
<b>GYNECOLOGY</b>					
Hysterectomy	Cefazolin	Clindamycin and Gentamicin	Vancomycin or Clindamycin and Gentamicin	Linezolid and Gentamicin	None
Laparotomy/laparoscopy with entry into bowel/vagina	Cefazolin	Clindamycin and Gentamicin	Vancomycin or Clindamycin and Gentamicin	Linezolid and Gentamicin	None
Other laparotomy/laparoscopy (without entry into bowel/vagina)	None required				

\*In patients colonized with MRSA, clindamycin susceptibility should be confirmed prior to using clindamycin as pre-operative prophylaxis. Please call the microbiology lab within seven days of the positive result to request susceptibility testing.

Table 1. Antibiotic Prophylaxis for Surgical Procedures (continued)

SURGERY	PREFERRED ANTIBIOTIC	PREFERRED CEPHALOSPORIN ALLERGY	MRSA COLONIZATION / INFECTION*	VRE COLONIZATION / INFECTION	POST-OP PROPHYLAXIS DURATION
<b>GYNECOLOGY (CONTINUED)</b>					
Colporrhaphy or procedure with complete transection of vagina	Cefazolin	Clindamycin and Gentamicin	Vancomycin or Clindamycin and Gentamicin	Linezolid and Gentamicin	None
Other common gynecologic procedures (exam under anesthesia, vaginoscopy, hymenectomy, cervical tissue excision, cystoscopy, endometrial biopsy, hysteroscopy (operative and diagnostic), IUD insertion, gynecologic D&C): <b>NO ANTIBIOTIC PROPHYLAXIS RECOMMENDED</b>					
<b>ENT / OTOLARYNGOLOGY</b>					
Tonsillectomy, adenoidectomy, tympanostomy tubes	None	None	None	None	None
Clean-contaminated or with placement of prosthesis	Cefazolin	Vancomycin or Clindamycin	Vancomycin or Clindamycin	Linezolid	≤ 24 h
<b>NEUROSURGERY</b>					
All neurologic surgical procedures	Cefazolin	Vancomycin or Clindamycin	Vancomycin or Clindamycin	Linezolid	≤ 24 h
Lumbar spine (incision near rectum)	Cefazolin or Cefepime	Ciprofloxacin	Vancomycin and Cefepime	Linezolid and Cefepime	≤ 24 h
<b>OPHTHAMOLOGY</b>					
All endophthalmic procedures	Intravitreal Ceftazidime and Intravitreal vancomycin	N/A	N/A	N/A	N/A
Intraocular surgical procedures	Intracameral cefuroxime	N/A	N/A	N/A	N/A
Perioperative global perforation	None or Cefazolin IV x1 dose	N/A	N/A	N/A	N/A

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Table 1. Antibiotic Prophylaxis for Surgical Procedures (continued)

SURGERY	PREFERRED ANTIBIOTIC	PREFERRED CEPHALOSPORIN ALLERGY	MRSA COLONIZATION / INFECTION*	VRE COLONIZATION / INFECTION	POST-OP PROPHYLAXIS DURATION
<b>ORTHOPEDIC</b>					
Spinal fusion (idiopathic)	Cefazolin	Vancomycin or Clindamycin	Vancomycin	Linezolid	≤ 24 h
Spinal fusion (neuromuscular)	Cefepime +/- Vancomycin	Vancomycin and Ciprofloxacin	Vancomycin and Cefepime	Linezolid and Cefepime	≤ 24 h
Lumbar spine (including myelo repair, detethering, discectomy, fusion, baclofen pump)	Cefazolin or Cefepime	Ciprofloxacin	Vancomycin and Cefepime	Linezolid and Cefepime	≤ 24 h
All others	Cefazolin	Vancomycin or Clindamycin	Vancomycin or Clindamycin	Linezolid	≤ 24 h
<b>PLASTIC/RECONSTRUCTIVE</b>					
Clean wounds (craniosynostosis, breast reconstruction/reduction, tissue expanders, peripheral nerve/facial animation, congenital nevus > 1.5 hours)	Cefazolin	Vancomycin or Clindamycin	Vancomycin or Clindamycin	Linezolid	≤ 24 h
Cleft lip	Cefazolin	Vancomycin or Clindamycin	Vancomycin or Clindamycin	Linezolid	≤ 24 h
Intraoral/maxillofacial (cleft palate, Le fort fracture, mandible fracture, orbital fracture, alveolar bone graft, rhinoplasty)	Ampicillin / sulbactam	Clindamycin and Ciprofloxacin	Vancomycin and Ampicillin / Sulbactam	Ampicillin / Sulbactam	≤ 24 h

\*In patients colonized with MRSA, clindamycin susceptibility should be confirmed prior to using clindamycin as pre-operative prophylaxis. Please call the microbiology lab within seven days of the positive result to request susceptibility testing.

Table 1. Antibiotic Prophylaxis for Surgical Procedures (continued)

SURGERY	PREFERRED ANTIBIOTIC	PREFERRED CEPHALOSPORIN ALLERGY	MRSA COLONIZATION / INFECTION*	VRE COLONIZATION / INFECTION	POST-OP PROPHYLAXIS DURATION
<b>TRANSPLANT (SOLID ORGAN)</b>					
Heart	Cefazolin	Vancomycin or Clindamycin	Vancomycin or Clindamycin	Linezolid	Open chest: Cefazolin After closure: ≤ 24 h
Kidney	Cefazolin	Vancomycin or Clindamycin and Aztreonam	—	—	≤ 24 h
Liver	Piperacillin/tazobactam	Vancomycin or Clindamycin and Gentamicin	Vancomycin or Clindamycin and Gentamicin	Linezolid and Ceftriaxone	≤ 48 h
Lung	Predetermined by Transplant ID and pharmacy prior to listing. See recommendations in transplant folder.				CF: 2 weeks Non-CF: 7-10 days
<b>UROLOGIC</b>					
Clean with entry into urinary tract	Cefazolin	Gentamicin +/- Clindamycin	Gentamicin +/- Clindamycin	Linezolid and Gentamicin	≤ 24 h
Clean contaminated	Cefoxitin	Clindamycin and Gentamicin	Clindamycin and Gentamicin	Linezolid and Gentamicin	≤ 24 h
Implanted prosthesis	Cefazolin +/- Gentamicin	Vancomycin or Clindamycin +/- Gentamicin	Vancomycin or Clindamycin +/- Gentamicin	Linezolid and Gentamicin	≤ 24 h
Lower tract instrumentation with risk factors for infection (includes transrectal prostate biopsy)	Cefazolin	Gentamicin +/- Clindamycin	Gentamicin +/- Clindamycin	Linezolid and Gentamicin	≤ 24 h

\*In patients colonized with MRSA, clindamycin susceptibility should be confirmed prior to using clindamycin as pre-operative prophylaxis. Please call the microbiology lab within seven days of the positive result to request susceptibility testing.

**II. Dosing and Redosing for Perioperative Antibiotic Prophylaxis**

- For cases exceeding six hours, after three prophylactic antibiotic doses are given at this increased frequency based on renal function (one preoperative and two intraoperative), use standard renally adjusted dosing intervals.
- Additional consideration for redosing can be discussed when there is excessive blood loss.
- **See next page of this document for further information regarding redosing in certain situations.**

**Table 2. Dosing and Redosing Intervals Based on Antibiotic and Renal Function for Perioperative Antibiotic Prophylaxis**

ANTIBIOTIC	DOSE	MAX DOSE	REDOSING INTERVAL IN OR ONLY (in hours) FOR 2 DOSES AFTER PRE-OP DOSE			
			CrCl ≥50	CrCl 30-49	CrCl 10-29	CrCl <10 or iHD
<b>Ampicillin-Sulbactam</b>	50 mg/kg ampicillin	2,000 mg of ampicillin component	4	4	8	12
<b>Aztreonam</b>	30 mg/kg	2,000 mg	4	4	8	12
<b>Cefazolin</b>	30 mg/kg	<120kg: 2,000 mg ≥120 kg: 3,000 mg <sup>^^</sup>	4	4	12	24
<b>Cefepime</b>	50 mg/kg	2,000 mg	4	6	8	12
<b>Cefoxitin</b>	40 mg/kg	2,000 mg	2	4	8	12
<b>Ceftriaxone</b>	50 mg/kg	2000 mg	12	12	24	24
<b>Ciprofloxacin</b>	10 mg/kg	400 mg	8	8	12	12
<b>Clindamycin</b>	10 mg/kg	900 mg	6	6	6	6
<b>Gentamicin</b>	4 mg/kg (AdjBW if obese)	—	For surgical procedures >12 hours duration, contact pharmacy for patient specific redosing recommendations.			
<b>Linezolid</b>	10 mg/kg	600 mg	8	8	8	8
<b>Metronidazole</b>	15 mg/kg or 30 mg/kg for appendectomy  Neonates <1,200 gm: 7.5 mg/kg	500 mg  1,500 mg for appendectomy	8  N/A if using 30 mg/kg	8  N/A if using 30 mg/kg	8  N/A if using 30 mg/kg	8  N/A if using 30 mg/kg
<b>Piperacillin-tazobactam</b>	75 mg/kg piperacillin	3000 mg of piperacillin component	2	2	4	6
<b>Vancomycin</b>	15 mg/kg	1500 mg	For surgical procedures >five hours duration, contact pharmacy for patient specific redosing recommendations.			

<sup>^^</sup>Cefazolin dosing postoperative for patients ≥120 kg should be standard dosing, maxing at 2,000 mg per dose. The 3,000 mg max applies to pre/intraoperative doses.

AdjBW, adjusted body weight  
iHD, intermittent hemodialysis  
CrCl, creatinine clearance

**Important Considerations and Special Populations for Dosing and Redosing Perioperative Antibiotics:**

**1. For cases exceeding six hours**

- It is suggested to redose at the indicated interval for up to three consecutive doses (including pre-operative dose) then proceed with manufacturer recommended dosing intervals.
- The redosing interval should be measured from the time of preoperative dose administration.
- Redosing may need to occur earlier if there has been extensive blood loss during the procedure.
- See Table 2 for redosing intervals based on renal function.

**2. Surgical prophylaxis for patients already receiving therapeutic antibiotics preoperatively for the treatment of an infection**

- If the antibiotic the patient is receiving is the SAME as the preferred drug for surgical prophylaxis, redose the antibiotic prior to incision if the time since last dose is greater than the intraoperative redosing interval listed in Table 2 above.
- If the antibiotic is DIFFERENT than the preferred agent for surgical prophylaxis (e.g., patient receiving cefepime, but cefazolin is the preferred agent for surgical prophylaxis for the given procedure), still administer standard pre-operative antibiotic(s) for surgical prophylaxis timed appropriately based on the OR infusion time listed in Table 2 above.
- For patients already receiving therapeutic vancomycin or an aminoglycoside who also need them as surgical prophylaxis, contact pharmacy for patient-specific recommendations regarding timing of pre-operative dose or rescheduling of current regimen.
- For patients with **appendicitis** who are started on therapeutic ceftriaxone and metronidazole, and later undergo an appendectomy:
  - If >12 hours since the last ceftriaxone dose and CrCl  $\geq 30$  ml/min (based on intraoperative redosing intervals in Table 2), redose with either ceftiofloxacin OR ceftriaxone.
  - If using ceftriaxone for surgical prophylaxis (instead of ceftiofloxacin), anaerobic coverage with metronidazole should be added prior to incision if >24 hours from last 30 mg/kg dose.
  - If patient received alternative antibiotics (e.g., piperacillin/tazobactam) prior to appendectomy, administer ceftiofloxacin OR ceftriaxone and metronidazole prior to incision if the time since the last dose is greater than the intraoperative redosing interval listed in Table 2 above.

**3. For patients with renal insufficiency**

- Redosing intra-operatively in patients with renal insufficiency may require less frequent dosing. See Table 2 appropriate redosing intervals recommended based on dialysis modality and CrCl. For situations not encompassed within this guidance or if you have any questions regarding this, please contact the clinical pharmacist or pharmacy department for redose interval selection.

**4. Surgical prophylaxis that unintentionally has been administered too early due to unanticipated surgery delays**

- Cefazolin may be redosed 5-10 minutes prior to incision due to its large therapeutic index.
- All other antibiotics should be redosed based on the intraoperative redosing interval listed in Table 2 on the previous page.

Appendix A: Subacute Bacterial Endocarditis Prophylaxis

PATIENT POPULATION/RISK FACTORS	ORAL ANTIBIOTIC (PREFERRED)	IM/IV ANTIBIOTIC (UNABLE TO TAKE ORAL)	TIMING
<b>DENTAL PROCEDURES INVOLVING MANIPULATION OF GINGIVAL TISSUE OR PERIAPICAL REGION OF TEETH OR PERFORATION OF ORAL MUCOSA</b>			
<ol style="list-style-type: none"> <li>1. Previous infective endocarditis</li> <li>2. Prosthetic valve or material <ul style="list-style-type: none"> <li>• Includes left ventricular assist devices and valve repair with devices (e.g., annuloplasty, rings, clips)</li> </ul> </li> <li>3. Heart transplant recipients with valvopathy</li> <li>4. Congenital heart disease (CHD) <ul style="list-style-type: none"> <li>• Unrepaired cyanotic CHD including palliative shunts/conduits</li> <li>• Completely repaired CHD with prosthetic material/ device within six months of procedure</li> <li>• Repaired CHD with residual defects at site or adjacent to site of prosthetic material/device</li> <li>• Pulmonary artery valve or conduit placement (e.g., Melody valve, Contegra conduit)</li> </ul> </li> </ol>	<p>Amoxicillin 50 mg/kg (max 2 g) or Cephalexin 50 mg/kg (max 2 g)</p> <p><i>Penicillin/cephalosporin allergy:</i> Azithromycin 15 mg/kg (max 500 mg) or Doxycycline 2.2 mg/kg (max 100 mg)</p>	<p>Ampicillin 50 mg/kg (max 2 g)</p> <p><i>Penicillin allergy:</i> Cefazolin 50 mg/kg (max 1 g)</p>	<p>Single dose 30-60 min before procedure</p> <p>No post-op doses</p>
	<p><i>Note:</i> Clindamycin is NOT recommended as an alternative. Please contact ID/ASP if unable to use a listed preferred or alternative option.</p>		
<ul style="list-style-type: none"> <li>• Implantable cardiac devices (e.g., pacemaker)</li> <li>• Septal defect closure devices with full closure</li> <li>• Peripheral vascular grafts/patches (e.g., HD graft)</li> <li>• Coronary artery or other vascular stents</li> <li>• CNS ventriculoatrial shunts</li> <li>• Vena cava filters</li> <li>• Pledgets</li> </ul>	<p>No antibiotic prophylaxis recommended</p> <p><i>No data has proven benefit for preventing SBE for other non-cardiac indications (e.g., prosthetic joint, asplenia)</i></p>		
<b>DENTAL PROCEDURE INVOLVING ANESTHETIC INJECTIONS INTO NON-INFECTED TISSUE, RADIOGRAPHS, PLACEMENT OR ADJUSTMENT OF PROSTHODONTIC OR ORTHODONTIC APPLIANCES OR BRACKETS, SHEDDING OF PRIMARY TEETH, BLEEDING FROM TRAUMA TO LIPS OR ORAL MUCOSA</b>			
All patients	No antibiotic prophylaxis recommended		