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UCSF Benioff Children's Hospitals Surgical and Trauma Antimicrobial Prophylaxis Guidelines

These guidelines aim to promote optimal selection, dose, and timing of administration for antimicrobial agents to prevent surgical site infections (SSI) in patients undergoing surgical procedures at either of the two UCSF Benioff Children's Hospital campuses. Additionally, guidelines are provided for antimicrobial prophylaxis to prevent infection associated with traumatic injuries. Follow links below to navigate between sections:

Additional Online Resources:

BCH Empiric Antimicrobial Therapy Guidelines

Standard Dosing (non-perioperative)
Neonatal Antimicrobial Dosing Guideline
Pediatric Antimicrobial Dosing Guideline

Antimicrobial Prophylaxis Guidelines for Pediatric Cardiothoracic Surgery

Pediatric Appendicitis Clinical Algorithm

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Timing of Antimicrobial Prophylaxis

Situation	Target Time Period for Initial Dose
Perioperative Prophylaxis	
Most antimicrobial agents (e.g., cefazolin)	Within 60 minutes prior to incision
Vancomycin or fluoroquinolone (e.g., levofloxacin) requiring prolonged infusion	Start infusion within 60-120 minutes and complete infusion before incision
Anticipated tourniquet placement	Administer antimicrobial dose before tourniquet goes up
Anticipated microbiologic sampling during procedure	Confirm with surgeon at the time-out or earlier since occasionally antibiotics need to be delayed until after culture
Prophylaxis for traumatic injuries with contamination risk	Refer to Trauma section

Modifying Surgical Antimicrobial Prophylaxis for Patients with Methicillin-Resistant *Staphylococcus aureus* (MRSA) Colonization

Category	Recommendation
Patients with identified MRSA colonization identified by **pre-operative screening** for specific procedures: • Ventricular shunt placement • Spinal fusion surgery • Cardiothoracic surgery designated high risk	Add antimicrobial prophylaxis with MRSA activity per section in antimicrobial selection table(s). This usually involves administration of vancomycin which is recommended to start infusion 60-120 minutes prior to incision. Logistics of vancomycin administration should be coordinated in advance. If there are <60 minutes to incision and Vancomycin has not yet been initiated, Clindamycin should be used as an alternative agent.
Patients with history of documented MRSA carriage or infection within the last 6 months	Addition of antimicrobial prophylaxis with activity against MRSA may be considered

Surgical Wound Classification, Modifying Prophylaxis Based on Existing Infection

Classification	Definition
Class I: Clean	An uninfected operative wound in which no inflammation is encountered and the respiratory, alimentary, genital, or uninfected urinary tract is not entered. In addition, clean wounds are primarily closed and, if necessary, drained with closed drainage. Operative incisional wounds that follow nonpenetrating (blunt) trauma should be included in this category if they meet the criteria.
Class II: Clean-contaminated	An operative wound in which the respiratory, alimentary, genital, or urinary tracts are entered under controlled conditions and without unusual contamination. Specifically, operations involving the biliary tract, appendix and oropharynx are included in this category, provided no evidence of infection or major break in technique is encountered.
Class III: Contaminated	Open, fresh, accidental wounds. In addition, operations with major breaks in sterile technique or gross spillage from the gastrointestinal tract, and incisions in which acute, nonpurulent inflammation is encountered are included in this category.
Class IV: Dirty-Infected[a]	Old traumatic wounds with retained devitalized tissue and those that involve existing clinical infection or perforated viscera.

[a] Patients with pre-existing infection: Treatment for the underlying infection should be chosen on a case-by-case basis, in accordance with BCH Empiric Antimicrobial Therapy Guidelines. Antimicrobial coverage should be continued for the site of infection and duration is based on extent and type of infection. Additional antimicrobials maybe needed perioperatively to cover for potential skin/soft issue infection pathogens and modified dosing including timing and frequency may be needed to provide optimal tissue levels during the procedure. Patient-specific recommendations for antimicrobial prophylaxis may be guided by Antimicrobial Stewardship or Infectious Diseases consultation 24-48 hours prior to the procedure.

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Modifying Surgical Antimicrobial Prophylaxis for Patients with Penicillin or Cephalosporin Allergy

For most surgical procedures, cephalosporins (e.g., cefazolin) are preferred for antimicrobial prophylaxis. There is evidence in the literature suggesting that patients with penicillin or cephalosporin allergies have increased risk for surgical site infection compared to patients without allergy, due to selection of alternative prophylaxis agents that are less effective. It is therefore important to consider whether the patient can safely receive the preferred agent even if an allergy is documented. Many patients with a documented allergy can safely receive the preferred prophylaxis agent if they meet criteria for "Lower risk for allergic reaction" in the table below. Alternative antimicrobials are provided for each procedure with recommendations stratified based on the allergy risk assessment.

When the guidelines refer to patients with . . .	
"Higher risk for allergic reaction"	**"Lower risk for allergic reaction"**
This includes patients who report history of reaction including:	This includes patients who report history of reaction limited to:
• Hives/urticaria • Angioedema (swelling) • Laryngeal edema • Wheezing / Dyspnea • Hypotension • Treatment with epinephrine • Intubation • Patient unable to give any history due to medical condition (or caregiver unavailable to provide information)	• Itching only • Mild, delayed rash (not hives) without internal organ involvement • EMR lists allergy, but patient and/or caregiver do not recall any details about the reaction
*In addition to the above "higher risk" criteria, patients with the following allergy history suggestive of a **Severe Type II-IV Reaction** should generally not receive antibiotics of the same class without further evaluation by an allergy or infectious diseases specialist: • Lesions or ulcers involving the mucous membranes; skin desquamation (suggests Stevens-Johnson Syndrome/Toxic Epidermal Necrolysis) • Rash, fever, and lymph node, liver, and/or kidney involvement (suggests Drug Reaction with Eosinophilia and Systemic Symptoms [DRESS] or Drug induced hypersensitivity syndrome [DIHS]) • Fever, urticarial rash, arthritis (suggests serum sickness)	

- Patients with penicillin allergy who meet above criteria for **"lower risk for allergic reaction"** can safely receive **cefazolin.**
- Patients with cephalosporin allergy or penicillin allergy meeting above criteria for "**higher risk for allergic reaction"** should receive alternative treatment recommended in the antimicrobial selection table(s).

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Intraoperative Antimicrobial Dosing

Antimicrobial	Perioperative Dose Some doses are OR-specific; refer to Neonatal Antimicrobial Dosing Guideline and Pediatric Antimicrobial Dosing Guideline for post-operative dosing if applicable	Infusion time Some may be OR-specific	Intraoperative Re-dosing			
			Pediatric intraoperative re-dosing Interval (hours)[b]	**Neonatal intraoperative re-dosing interval (hours)[b]**	**When to convert to standard frequency** To avoid administration of more than usual 24-hour dose intra-operatively	**Standard frequency**
Ampicillin-sulbactam[a]	50 mg ampicillin/kg/dose (max 2000 mg ampicillin)[a]	15 min	2	Consult pharmacist	After 3 doses	q6h
Aztreonam	30 mg/kg/dose (max 2000 mg)	IV push over 3 to 5 min	4		After 2 doses	q8h
Cefazolin	30 mg/kg/dose (usual max 2000 mg; weight > 120 kg, max 3000 mg)	IV push over 3 to 5 min	4	Age <= 7 days OR Weight <= 2 kg: 6 Age > 7 days OR Weight > 2 kg: 4	After 3 doses	q8h
Cefepime	50 mg/kg/dose (max 2000 mg)	30 min	4	8	After 3 doses	q8h
Cefoxitin	40 mg/kg/dose (max 2000 mg) neonatal dosing: 30 mg/kg/dose	IV push over 3 to 5 min	2	3	After 3 doses	q8h
Ceftriaxone	50 mg/kg/dose (max 2000 mg)	30 min	12	*contraindicated in neonates <14d & <41wksPMA (consider cefoxitin)	After 2 doses	q24h
Clindamycin	10 mg/kg/dose (max 900 mg)	15 min	6	Age <= 7 days OR Weight <= 2 kg: 12 Age > 7 days OR Weight > 2 kg: 6	After 3 doses	q8h
Fluconazole	6 mg/kg/dose	60 to 120 min	24		Already standard	
Gentamicin	5 mg/kg/dose	30 min	24		Already standard	
Levofloxacin	10 mg/kg/dose (max 500 mg)	60 min	Age < 5 years: 12 Age >= 5 years: 24		Already standard	
Metronidazole	15 mg/kg/dose (max 500 mg)	30 min	8		Already standard	
Piperacillin-tazobactam	80 mg piperacillin/kg/dose (max 4000 mg piperacillin)[a]	30 min	2		After 3 doses	q6h
Vancomycin	15 mg/kg/dose (max 1000 mg)	60 min	6	Do not re-dose	Already standard	q6h

[a] Pediatric dosing for combination antimicrobials is based on the core component – e.g., 2000 mg ampicillin-sulbactam = 2000 mg ampicillin component

[b] In addition to the re-dosing intervals suggested in the dosing table, consider immediate re-dosing in patients who have > 1.5 L of blood loss (> 25 mL/kg or > 30% blood volume loss for patients < 40 kg) within a short time frame and those with severe burns. Restart the re-dosing clock for the next re-dose if this is done. Do not re-dose vancomycin or gentamicin for blood loss. All intervals provided assume normal renal function – intervals should be modified if patient has renal impairment, consult pharmacist for guidance.

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Recommended Perioperative Antimicrobial Prophylaxis by Procedure, Grouped by Service/Site

Procedure	First Choice	Alternative Penicillin allergy with lower risk for allergic reaction	Alternative Cephalosporin allergy OR Penicillin allergy with higher risk for allergic reaction	Duration Perioperative only = no further doses after end of procedure
Cardiothoracic For detailed recommendations including post-operative prophylaxis, refer to "Antimicrobial Prophylaxis Guidelines for Pediatric Cardiac Surgery Patients"				
Routine case (without any below special circumstances) Includes pre- and intra-operative prophylaxis for cases that may have different recommendations for post-operative prophylaxis: • open sternum • ECLS cannulation • ventricular assist device placement • rhythm management and monitoring device implantation	Cefazolin ADD Vancomycin* if MRSA screen positive *If < 60 mins to incision use Clindamycin instead of Vancomycin	Cefazolin ADD Vancomycin if MRSA screen positive	Vancomycin	Per above guideline
Special Circumstances:				
Aortic root surgery, defined as aortic root replacement or reconstruction	Cefazolin + Vancomycin	Cefazolin + Vancomycin	Vancomycin	Per above guideline
Presence of tracheostomy	Cefepime ADD Vancomycin if MRSA screen positive *If < 60 mins to incision use Clindamycin instead of Vancomycin	Cefepime + Vancomycin	Consult pharmacist or ASP pre-op	Per above guideline
Slide tracheoplasty	Cefepime + Vancomycin	Cefepime + Vancomycin	Consult pharmacist or ASP pre-op	Per above guideline
General Pediatric Surgery and Abdominal Refer to Trauma section for prophylaxis recommendations in penetrating abdominal trauma				
CLEAN PROCEDURES				
Clean procedure without foreign body (e.g., hernia repair, mass/lymph node excision	None	None	None	n/a

Procedure	First Choice	Alternative Penicillin allergy with lower risk for allergic reaction	Alternative Cephalosporin allergy OR Penicillin allergy with higher risk for allergic reaction	Duration Perioperative only = no further doses after end of procedure
Clean procedure with foreign body placement	Cefazolin	Cefazolin	Clindamycin	Perioperative only
Thoracic procedure without entry into aerodigestive tract	Cefazolin	Cefazolin	Clindamycin	Perioperative only
CLEAN-CONTAMINATED PROCEDURES				
Thoracic procedure with entry into aerodigestive tract (e.g., repair of esophageal atresia, lobectomy)	Ampicillin-sulbactam	Clindamycin	Clindamycin	Perioperative only
Gastroduodenal procedures (e.g., G tube placement [without CAPD catheter placement], pyloroplasty, duodenal atresia repair, gastrocutaneous fistula closure)	Cefazolin	Cefazolin	Clindamycin + Levofloxacin	Perioperative only
G tube + CAPD catheter placement	Cefazolin + Fluconazole	Cefazolin + Fluconazole	Cefazolin + Fluconazole	Perioperative only
Cholecystectomy without active cholecystitis	Cefazolin	Cefazolin	Clindamycin + Levofloxacin	Perioperative only
Colorectal procedures	Cefoxitin	Cefoxitin	Levofloxacin + Metronidazole	Perioperative only
Incidental appendectomy	Cefoxitin	Cefoxitin	Levofloxacin + Metronidazole	Perioperative only
Liver resection	Cefazolin	Cefazolin	Levofloxacin	Perioperative only
CONTAMINATED ABDOMINAL PROCEDURES				
Appendectomy for uncomplicated or complicated infection	Ceftriaxone + Metronidazole OR Cefoxitin if >= 8 hours from prior dose	Ceftriaxone + Metronidazole OR Cefoxitin if > 8 hours from last dose of Ceftriaxone	If receiving Ciprofloxacin + Metronidazole per Pediatric Appendicitis Algorithm, repeat dose of Ciprofloxacin if >= 12 hours from prior dose	Refer to Appendicitis Clinical Algorithm
Other contaminated abdominal procedure (e.g. ostomy closure, obstructed small intestine, cholecystectomy for cholecystitis)	Ceftriaxone + Metronidazole	Ceftriaxone + Metronidazole	Levofloxacin + Metronidazole	Determined by extent of contamination and presence of active infection
Special Circumstances:				

Procedure	First Choice	Alternative Penicillin allergy with lower risk for allergic reaction	Alternative Cephalosporin allergy OR Penicillin allergy with higher risk for allergic reaction	Duration Perioperative only = no further doses after end of procedure
Procedure for active intra-abdominal infection with hospital-onset	Piperacillin-tazobactam	Cefepime + Metronidazole	Levofloxacin + Metronidazole	Per BCH Empiric Antimicrobial Therapy Guidelines
Choledochal cyst resection with preoperative stenting for biliary obstruction	Piperacillin-tazobactam	Cefepime + Metronidazole	Levofloxacin + Metronidazole	Perioperative only
Neonatal cases (e.g., CDH repair, gastroschisis repair, omphalocele repair) – even if already receiving antibiotics	Cefazolin	n/a	n/a	Perioperative only
Otolaryngology, Head and Neck				
Adenotonsillectomy	None	None	None	n/a
Tympanostomy tube insertion	None	None	None	n/a
Laryngoscopy/bronchoscopy	None	None	None	n/a
Sinus surgery	None	None	None	n/a
Major ear surgery, with or without implant	Cefazolin	Cefazolin	Clindamycin	Perioperative only
Open neck surgery, clean, without entry into aerodigestive tract	None	None	None	n/a
Open neck surgery, clean, contaminated with entry into aerodigestive tract	Ampicillin-sulbactam	Clindamycin	Clindamycin	Perioperative only
Major intraoral surgery	Ampicillin-sulbactam	Clindamycin	Clindamycin	Perioperative only
Neurosurgery Refer to Trauma section for prophylaxis recommendations in open skull fractures				
Elective craniotomy	Cefazolin	Cefazolin	Clindamycin	Perioperative only, unless EVD placed
CSF shunting procedure (VP shunt placement)	Cefazolin ADD Vancomycin* if MRSA screen positive *If < 60 mins to incision use Clindamycin instead of Vancomycin	Cefazolin ADD Vancomycin if MRSA screen positive	Clindamycin	Procedure duration <= 6 hours: Perioperative only Procedure duration > 6 hours: 24 hours post-operative

Procedure	First Choice	Alternative Penicillin allergy with lower risk for allergic reaction	Alternative Cephalosporin allergy OR Penicillin allergy with higher risk for allergic reaction	Duration Perioperative only = no further doses after end of procedure
Spinal cord untethering	Cefazolin	Cefazolin	Clindamycin	24 hours post-operative
Myelomeningocele repair	Cefazolin (including neonates already receiving Ampicillin and Gentamicin)	Cefazolin	Clindamycin	48 hours post-operative
EVD Placement	Cefazolin	Cefazolin	Clindamycin	24-hours post-operative
Orthopedic Refer to Trauma section for prophylaxis recommendations in orthopedic trauma				
Percutaneous tenotomy	None	None	None	n/a
Other procedure of extremity, including hip procedures	Cefazolin	Cefazolin	Clindamycin	24 hours post-operative
Spinal fusion - low risk (without complex chronic condition)	Cefazolin ADD Vancomycin* if MRSA screen positive *If < 60 mins to incision use Clindamycin instead of Vancomycin	Cefazolin ADD Vancomycin if MRSA screen positive	Clindamycin	24 hours post-operative
Spinal fusion - high risk (indicated for neuromuscular scoliosis, and/or with comorbidities such as cerebral palsy or other complex chronic condition)	Cefazolin + Gentamicin ADD Vancomycin* if MRSA screen positive *If < 60 mins to incision use Clindamycin instead of Vancomycin	Cefazolin + Gentamicin ADD Vancomycin if MRSA screen positive	Levofloxacin ADD Vancomycin if MRSA screen positive	24 hours post-operative

Procedure	First Choice	Alternative Penicillin allergy with lower risk for allergic reaction	Alternative Cephalosporin allergy OR Penicillin allergy with higher risk for allergic reaction	Duration Perioperative only = no further doses after end of procedure
Plastic Surgery				
Clean procedure, uncomplicated	None	None	None	n/a
Clean procedure, complicated or with risk factors for infection	Cefazolin	Cefazolin	Clindamycin	Perioperative only
Clean-contaminated procedures	Follow recommendations from other categories as applicable to body site			
Contaminated procedures, with active infection	Treat based on clinical judgment, ensure adequate prophylaxis for skin flora and potential pathogen			
Transplantation, Abdominal				
Kidney	Cefazolin	Cefazolin	Clindamycin	Perioperative only
Liver	Piperacillin-tazobactam	Cefepime	Vancomycin + Aztreonam	Perioperative only
Urology				
Lower or upper urinary tract instrumentation,				
Lower urinary tract instrumentation involving: • Cystourethroscopy with minor manipulation, break in mucosal barriers • Transurethral Cases: laser enucleative and ablative procedures, etc. Upper urinary tract instrumentation: • Percutaneous renal surgery • Ureteroscopy, all indications	Cefazolin	Cefazolin	Levofloxacin	Perioperative only
Open, laparoscopic, or robotic surgery				
procedures without entry to urinary tract, e.g., laparoscopic nephrectomy, laparoscopic orchiopexy	Cefazolin	Cefazolin	Levofloxacin	Perioperative only

Procedure	First Choice	Alternative Penicillin allergy with lower risk for allergic reaction	Alternative Cephalosporin allergy OR Penicillin allergy with higher risk for allergic reaction	Duration Perioperative only = no further doses after end of procedure
Uncomplicated elective inguinal or scrotal surgery (e.g., orchiopexy, hernia repair)	None	None	None	N/A
Inguinal or scrotal surgery with devitalized tissue (e.g., testicular torsion)	Cefazolin	Cefazolin	Levofloxacin	Perioperative only
Penile surgery without urethral reconstruction (e.g., circumcision)	None	None	None	N/A
Penile surgery with urethral reconstruction (e.g., hypospadias repair)	Cefazolin	Cefazolin	Levofloxacin	N/A
procedures involving controlled entry into upper or lower urinary tract without bowel involvement	Cefazolin	Cefazolin	Levofloxacin	Perioperative only
Urinary diversion procedures with small or large bowel involved	Ceftriaxone + Metronidazole	Ceftriaxone + Metronidazole	Levofloxacin + Metronidazole	Perioperative only
Implanted prosthetic devices: testicular prosthesis	Cefazolin	Cefazolin	Levofloxacin	Perioperative only

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Recommended Antimicrobial Prophylaxis for Pediatric Major Trauma, by Category

Trauma Category **Duration notes:** The starting point for prophylaxis should be as soon as possible from time of triage and recognizing the injury. If surgical intervention/clean out occurs within the recommended duration interval, the recommended duration should be completed from the time of initiation. If intervention is deferred beyond the recommended interval, the recommended duration should be completed following intervention. Longer durations may be individualized based on extent of injury and contamination, in consultation with surgical service and ID.	First Choice **Refer to Pediatric Antimicrobial Dosing Guideline for pre- and post-operative standard inpatient dosing**	Alternative **Penicillin allergy with lower risk for allergic reaction**	Alternative **Cephalosporin allergy OR Penicillin allergy with higher risk for allergic reaction**	Duration, Usual **See duration notes 1st column**
Penetrating Trauma				
Maxillofacial	Ampicillin-sulbactam	Clindamycin	Clindamycin	24 hours
Thoracic	Cefazolin	Cefazolin	Clindamycin	24 hours
Abdominal, including with spinal cord injury	Ceftriaxone + Metronidazole	Ceftriaxone + Metronidazole	Levofloxacin + Metronidazole	24 hours
Extremity (soft tissue or bone)	Cefazolin	Cefazolin	Clindamycin	24 hours
Animal bite (high-risk bite wound without apparent active infection)	Amoxicillin-clavulanate OR Ampicillin-sulbactam	Trimethoprim-sulfamethoxazole + Clindamycin	Trimethoprim-sulfamethoxazole + Clindamycin	3-5 days for prophylaxis of high risk bite wounds See BCH Empiric Antimicrobial Therapy Guidelines for detail
Open Skull Fracture				
Open skull fracture	Cefazolin	Cefazolin	Clindamycin	Pre- and perioperative only
Open skull fracture with dural involvement	Cefazolin	Cefazolin	Clindamycin	24 hours
Open skull fracture with dural involvement and gross environmental contamination	Ceftriaxone + Metronidazole	Ceftriaxone + Metronidazole	Levofloxacin + Metronidazole	24 hours
Open Fracture, Other Site				
Gustilo Grade I or II	Cefazolin	Cefazolin	Clindamycin	24 hours
Gustilo Grade III	Ceftriaxone + Vancomycin	Ceftriaxone + Vancomycin	Clindamycin	24 hours
Gross environmental contamination including waterborne	Cefepime + Metronidazole	Cefepime + Vancomycin	Levofloxacin + Metronidazole	48 hours

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