SURGICAL GUIDELINE

SURGICAL ANTIBIOTIC PROPHYLAXIS

Age < 25 years of age

Children's MINNESOTA

Aim: To standardize surgical antibiotic prophylaxis.

RECOMMENDATIONS FOR SURGICAL ANTIBIOTIC PROPHYLAXIS

This guideline is intended to provide practitioners with a standardized approach to surgical prophylaxis that is safe and effective. Recommended antibiotics target anticipated organisms. A thorough clinical assessment is required to identify complicating factors that may necessitate alternative/additional therapy.

Timing of Prophylaxis:

- **Pre-Op dosing:** To be initiated within 60 minutes before surgical incision (120 minutes for vancomycin or fluoroquinolones). The goal of this timing is to ensure adequate antimicrobial tissue concentrations at the time of incision.
- **Intra-Op dosing:** To be administered if the duration of the procedure exceeds 2 half-lives of the antimicrobial agent or if there is excessive blood loss (> 20 mL/kg in pediatric patients; > 1,500 mL in adults). The goal is to maintain adequate antimicrobial concentrations throughout the surgical procedure. Intra-op redosing interval should be measured from the time of administration of the pre-op dose, not from the beginning of the procedure.
- **Post-Op dosing:** The duration of prophylaxis should be ≤ 24 hours for most procedures. Use of antibiotics beyond the recommended post-operative duration requires appropriate documentation of infection or suspected infection.

Note: According to the Infectious Diseases Society of America (IDSA), patients receiving therapeutic antimicrobials prior to surgery should also be given antimicrobial prophylaxis before surgery to ensure adequate serum and tissue levels of antimicrobials with activity against likely pathogens for the duration of the operation. For these patients, the surgeon will determine if the scheduled antibiotics are appropriate for surgical prophylaxis and if additional perioperative antibiotics or doses are needed. Administration of perioperative doses of gentamicin or vancomycin **in addition to** scheduled doses increases the risk of toxicity. Administration of perioperative doses of penicillins (e.g., ampicillin-sulbactam) or cephalosporins (e.g., cefazolin**) in addition to** scheduled doses is generally considered safe.

Drains:

According to the CDC Guideline for the Prevention of Surgical Site Infection, in clean and clean-contaminated procedures, additional prophylactic antimicrobial agent doses should not be administered after the surgical incision is closed in the operating room, even in the presence of a drain (strong recommendation; high-quality evidence).

Chest Tubes:

There is no evidence to support continuing antibiotic prophylaxis until chest and mediastinal drainage tubes are removed.

Allergy:

Beta-lactam antibiotics (e.g., cefazolin, ceftriaxone, ampicillin-sulbactam) are the safest and most effective agents for surgical prophylaxis. Use of second line agents (e.g., fluoroquinolones, vancomycin, clindamycin) are associated with inferior patient outcomes and increased risk of toxicity, *C. difficile* infection and drug-resistant organisms. Every effort should be made to thoroughly evaluate reported beta-lactam antibiotic allergies prior to surgery to ensure patients do not receive second-line, inferior agents unnecessarily. Beta-lactam allergies comprise a spectrum of allergic reactions. **See Appendix A (pages 15-18) for antibiotic choices appropriate to the type and severity of beta-lactam allergy. Cefazolin or other cephalosporins may still be indicated.**

MRSA Colonization or history of MRSA Infection:

- Clindamycin can be used instead of vancomycin if the isolate is known to be susceptible to clindamycin.
- The combination of cefazolin plus vancomycin is preferred over vancomycin alone for effective concurrent coverage of MSSA (cefazolin). Surgical prophylaxis with vancomycin alone has been associated with higher rates of MSSA surgical site infections than cefazolin alone.

SURGICAL GUIDELINE

SURGICAL ANTIBIOTIC PROPHYLAXIS

Age < 25 years of age

Children's MINNESOTA

Aim: To standardize surgical antibiotic prophylaxis.

Table of Contents and Quick Links to Procedure Types within Document

TABLE 1. RECOMMENDATIONS FOR PERIOPERATIVE ANTIBIOTIC SELECTION

Type of Procedure	Recommended Agent(s)	Severe ß-lactam Allergy (Link to Appendix A)	MRSA Colonization OR History of MRSA Infection	Postoperative Duration	Comments
Cardiac					
• Congenital heart surgery • Valve repair • Placement of cardiac implantable device (pacemaker, ICD, VAD) • Heart transplantation (± previous VAD)	Cefazolin	Vancomycin	Vancomycin plus Cefazolin Allergy: Vancomycin	≤ 24 hours	**Delayed sternal closure:** Optimal duration is not well defined but should be ≤ 24 hours after closure
Urological					
Hypospadias repair	Cefazolin (Option to limit prophylaxis to proximal hypospadias)	Clindamycin (Option to limit prophylaxis to proximal hypospadias)	Vancomycin plus Cefazolin Allergy: Vancomycin (Option to limit prophylaxis to proximal hypospadias)	Single pre-op dose	
Ureteral reimplantation	Cefazolin	Clindamycin plus Gentamicin	Vancomycin plus Cefazolin Allergy: Vancomycin plus Gentamicin	Single pre-op dose	
Sacral neuromodulator implantation	Cefazolin plus Gentamicin	Clindamycin plus Gentamicin	Vancomycin plus Cefazolin Allergy: Vancomycin plus Gentamicin	Single pre-op dose	

Aim: To standardize surgical antibiotic prophylaxis.

TABLE 1. RECOMMENDATIONS FOR PERIOPERATIVE ANTIBIOTIC SELECTION

Type of Procedure	Recommended Agent(s)	Severe ß-lactam Allergy (Link to Appendix A)	MRSA Colonization OR History of MRSA Infection	Postoperative Duration	Comments
Urological, *continued*					
Pyeloplasty, open	Cefazolin	Clindamycin plus Gentamicin	Vancomycin plus Cefazolin Allergy: Vancomycin plus Gentamicin	Single pre-op dose	
Pyeloplasty, robotic	Cefazolin	Clindamycin plus Gentamicin	Vancomycin plus Cefazolin Allergy: Vancomycin plus Gentamicin	Single pre-op dose	
Nephrectomy	Cefazolin	Clindamycin plus Gentamicin	Vancomycin plus Cefazolin Allergy: Vancomycin plus Gentamicin	Single pre-op dose	
Vesicostomy	Cefazolin	Clindamycin plus Gentamicin	Vancomycin plus Cefazolin Allergy: Vancomycin plus Gentamicin	Single pre-op dose	
Ureterostomy	Cefazolin	Clindamycin plus Gentamicin	Vancomycin plus Cefazolin Allergy: Vancomycin plus Gentamicin	Single pre-op dose	
Ureteroscopy w/wo stone manipulation	Cefazolin	Clindamycin plus Gentamicin	Vancomycin plus Cefazolin Allergy: Vancomycin plus Gentamicin	Single pre-op dose	
Cystoscopy with urothelial manipulation	Cefazolin	Clindamycin plus Gentamicin	Vancomycin plus Cefazolin Allergy: Vancomycin plus Gentamicin	Single pre-op dose	
Cystoscopy without urothelial manipulation	None	None	None	N/A	
Ureterocele puncture	Cefazolin	Clindamycin plus Gentamicin	Vancomycin plus Cefazolin Allergy: Vancomycin plus Gentamicin	Single pre-op dose	
Posterior urethral valves incision	Cefazolin	Clindamycin plus Gentamicin	Vancomycin plus Cefazolin Allergy: Vancomycin plus Gentamicin	Single pre-op dose	
Circumcision, chordee repair, Orchiopexy, Urethromeatoplasty, Torsion repair	None	None	None	N/A	
Augment cystoplasty discharge with SP-tube	Cefoxitin	Levofloxacin plus Metronidazole	Vancomycin plus Cefoxitin Allergy: Vancomycin plus Levofloxacin plus Metronidazole	24 hours or until intra-op urine culture results are available to allow targeted antimicrobial treatment	
ACE procedure	Cefoxitin	Levofloxacin plus Metronidazole	Vancomycin plus Cefoxitin Allergy: Vancomycin plus Levofloxacin plus Metronidazole	24 hours	
Mitrofanoff procedure	Cefoxitin	Levofloxacin plus Metronidazole	Vancomycin plus Cefoxitin Allergy: Vancomycin plus Levofloxacin plus Metronidazole	24 hours	

SURGICAL GUIDELINE

SURGICAL ANTIBIOTIC PROPHYLAXIS

Age < 25 years of age

Children's MINNESOTA

Aim: To standardize surgical antibiotic prophylaxis.

Type of Procedure	Recommended Agent(s)	Severe ß-lactam Allergy (Link to Appendix A)	MRSA Colonization OR History of MRSA Infection	Postoperative Duration	Comments
Neurosurgical					
Spinal procedures without hardware implantation					
Idiopathic or neuromuscular/ syndromic patients with bowel and bladder control	Cefazolin	Clindamycin	Vancomycin plus Cefazolin Allergy: Vancomycin	24 hours	
Neuromuscular/syndromic patients without bowel and bladder control	Cefazolin plus Gentamicin	Clindamycin plus Gentamicin	Vancomycin plus Gentamicin	24 hours	
Myelomeningocele repair in patients ≤ 72 hours of age	Ampicillin plus Gentamicin	N/A	Vancomycin plus Ampicillin plus Gentamicin	24 hours	
Spinal procedures with hardware implantation					
Halo application, cervical and thoracic fusion	Cefazolin	Clindamycin	Vancomycin plus Cefazolin Allergy: Vancomycin	24 hours	
Lumbar fusion, insertion of lumbar drain	Cefazolin plus Gentamicin	Clindamycin plus Gentamicin	Vancomycin plus Gentamicin	24 hours	
Cranial procedures					
Cranial procedures without sinus violation	Cefazolin	Clindamycin	Vancomycin plus Cefazolin Allergy: Vancomycin	24 hours	
Cranial procedures with sinus violation	Ampicillin-sulbactam	Clindamycin plus Gentamicin	Vancomycin plus Ampicillin-sulbactam Allergy: Vancomycin plus Clindamycin plus Gentamicin	24 hours	
Ophthalmic					
All ophthalmic surgeries	Practice varies to include: • Topical neomycin–polymyxin B–dexamethasone OR tobramycin-dexamethasone at the **end** of procedure • Cefazolin (50 mg) by subconjunctival injection or intracameral moxifloxacin (450–600 mcg) at the **end** of procedure • Erythromycin ointment at the **end** of procedure	N/A	N/A	Practice varies to include: • Topical neomycin–polymyxin B–dexamethasone OR tobramycin-dexamethasone drops TID x 7 days or BID x 10 days	

SURGICAL GUIDELINE

SURGICAL ANTIBIOTIC PROPHYLAXIS

Age < 25 years of age

Children's MINNESOTA

Aim: To standardize surgical antibiotic prophylaxis.

Type of Procedure	Recommended Agent(s)	Severe ß-lactam Allergy (Link to Appendix A)	MRSA Colonization OR History of MRSA Infection	Postoperative Duration	Comments
ENT					
Otic/Ear					
Implants (cochlear and other)	Cefazolin	Clindamycin	Vancomycin plus Cefazolin Allergy: Vancomycin	Single pre-op dose	Post-op amoxicillin-clavulanate x 5 days
Ear cases (clean)	None	None	None	N/A	
Ear cases (clean-contaminated)	None unless active infection	None unless active infection	None unless active infection	N/A	
Tympanoplasty with tube placement Tympanoplasty with skin incision Mastoidectomy/ Tympanomastoidectomy	None unless active infection	None unless active infection	None unless active infection	N/A	
Salivary gland procedures (including removal/ligation)	Ampicillin-sulbactam	Clindamycin	Vancomycin plus Ampicillin-sulbactam Allergy: Vancomycin plus Clindamycin	Continue post-op IV antibiotics x 7 days (combined IV and oral therapy)	
Salivary gland tumor removal	None	None	None	N/A	
Facial					
Facial fractures (maxillary, zygomatic, or mandibular condyle surgery)	None	None	None	N/A	
Facial fractures with concern for sinus involvement	Ampicillin-sulbactam	Clindamycin	Vancomycin plus Ampicillin-sulbactam Allergy: Vancomycin plus Clindamycin	•If no significant disruption, no post-op prophylaxis needed •If significant disruption, continue post-op IV antibiotics x 3–5 days	
Facial fractures with incision through face and orbital fracture	Cefazolin	Clindamycin	Vancomycin plus Cefazolin Allergy: Vancomycin	Single pre-op dose	
Nasal					
Septoplasty	None	None	None	N/A	
Open septorhinoplasty	Cefazolin	Clindamycin	Vancomycin plus Cefazolin Allergy: Vancomycin	• If allograft used, no post-operative IV antibiotics needed • If allograft not used, post-operative antibiotics only if splints left in place	If splints in place, post-op cephalexin or clindamycin until removal

SURGICAL ANTIBIOTIC PROPHYLAXIS

Age < 25 years of age

Aim: To standardize surgical antibiotic prophylaxis.

Type of Procedure	Recommended Agent(s)	Severe ß-lactam Allergy (Link to Appendix A)	MRSA Colonization OR History of MRSA Infection	Postoperative Duration	Comments
ENT, *continued*					
Sinus					
Sinus surgery	None If cystic fibrosis, antibiotic selection may be directed by pulmonology for appropriate coverage	None If cystic fibrosis, antibiotic selection may be directed by pulmonology for appropriate coverage	None If cystic fibrosis, antibiotic selection may be directed by pulmonology for appropriate coverage	N/A	
Oropharyngeal					
Intra-oral procedures (including mucosal/tongue biopsy), Tonsillectomy	None	None	None	N/A	
Mandibular distraction	Cefazolin	Clindamycin	Vancomycin plus Cefazolin Allergy: Vancomycin	Continue postop antibiotics until external pins removed for ≤ 7 days (combined IV and oral therapy)	
Facial plastics/cleft lip and palate repair	None	None	None	N/A	
Cervical/Neck					
Neck surgery clean-contaminated	Cefazolin	Clindamycin	Vancomycin plus Cefazolin Allergy: Vancomycin	Single pre-op dose	
Neck mass/cyst excision	None	None	None	N/A	
Brachial cleft cyst	None unless actively infected	None unless actively infected	None unless actively infected	N/A	
Tracheostomy/tracheotomy	None (continue antibiotics if previously prescribed)	None (continue antibiotics if previously prescribed)	None (continue antibiotics if previously prescribed)	N/A	
Total Thyroidectomy, parathyroidectomy	None	None	None	N/A	
Airway reconstruction	Cefazolin if no *Pseudomonas;* If *Pseudomonas* colonization, Cefepime	Clindamycin if no *Pseudomonas*; If *Pseudomonas* colonization, Clindamycin plus Ciprofloxacin	Vancomycin plus Cefazolin Allergy: Vancomycin	If no MRSA, continue IV antibiotics until drain removed If MRSA, continue IV antibiotics until able to take oral TMP-SMX	If MRSA colonization or infection, TMP-SMX x 3 days before surgery and to complete 14 total days of post-op antibiotics
Pharyngeal flap	None	None	None	N/A	

SURGICAL ANTIBIOTIC PROPHYLAXIS

Age < 25 years of age

Aim: To standardize surgical antibiotic prophylaxis.

Type of Procedure	Recommended Agent(s)	Severe ß-lactam Allergy (Link to Appendix A)	MRSA Colonization OR History of MRSA Infection	Postoperative Duration	Comments
ENT, *continued*					
Craniofacial Reconstruction					
Cranioplasty/facial reconstruction	Cefazolin	Clindamycin	Vancomycin plus Cefazolin Allergy: Vancomycin	72 hours	
Skull base surgery	Cefazolin	Clindamycin	Vancomycin plus Cefazolin Allergy: Vancomycin	Continue post-op IV antibiotics until packing removed	
Oral and Maxillofacial Surgery					
Palatoplasty with bone grafting	Cefazolin	Clindamycin	Vancomycin plus Cefazolin *Allergy*: Vancomycin	24 hours	
Orthognathic surgery	Ampicillin	Clindamycin	Vancomycin plus Ampicillin *Allergy*: Vancomycin plus Clindamycin	24 hours	Oral antibiotics may be continued upon conclusion of post-operative IV antibiotics to complete a 7 day course
Alloplastic temporomandibular joint (TMJ) replacement	Cefazolin	Clindamycin	Vancomycin plus Cefazolin *Allergy*: Vancomycin plus Clindamycin	48 hours	After completion of IV antibiotics, oral antibiotics will be continued to complete a 7 day course.
Third molar extraction/Dental implants	Ampicillin	Clindamycin	Vancomycin plus Ampicillin *Allergy*: Vancomycin plus Clindamycin	Single pre-op dose	High risk cardiac patients should follow preoperative antibiotic prophylaxis per American Heart Association (AHA) guidelines. Antibiotics to be continued after surgery if adherence to oral hygiene measures is not feasible (e.g. neurodevelopmental delay or aspiration risk) or if preceding tissue inflammation
Maxillofacial fracture surgery	Ampicillin-sulbactam	Clindamycin	Vancomycin plus Ampicillin-sulbactam *Allergy*: Vancomycin plus Clindamycin	•If no significant disruption, no post-op prophylaxis needed If significant disruption, continue post-op IV antibiotics □ 3-5 days	Prophylaxis is not recommended in setting of maxillary, zygomatic, or mandibular condyle surgery

SURGICAL GUIDELINE

SURGICAL ANTIBIOTIC PROPHYLAXIS

Age < 25 years of age

Children's MINNESOTA

Aim: To standardize surgical antibiotic prophylaxis.

Type of Procedure	Recommended Agent(s)	Severe ß-lactam Allergy (Link to Appendix A)	MRSA Colonization OR History of MRSA Infection	Postoperative Duration	Comments
Gynecological					
Hysterectomy (supracervical, vaginal, abdominal, laparoscopic, robotic)	Cefazolin	Clindamycin plus Gentamicin	Vancomycin plus Cefazolin Allergy: Vancomycin plus Gentamicin	Single pre-op dose	Screening for bacterial vaginosis in patients undergoing hysterectomy can be considered
Colporrhaphy	Cefazolin	Clindamycin plus Gentamicin	No change	Single pre-op dose	
Laparotomy without entry into bowel or vagina	Consider cefazolin	Consider clindamycin	Vancomycin plus Cefazolin Allergy: Vancomycin plus Gentamicin	Single pre-op dose	Decision for antibiotic surg. prophylaxis is based on risk factors (e.g., obesity, diabetes)
Cystoscopy	None	None	None	N/A	Rule out urinary tract infection; treat positive urine culture prior to procedure
Hysterosalpingogram and Chromotubation	None, unless history of PID or abnormal tubes; If history of PID or abnormal tubes, doxycycline 100 mg BID for 5 days starting the night prior to procedure AND Cefazolin pre-operatively	If history of PID or abnormal tubes, Doxycycline plus Clindamycin plus Gentamicin	No change	Single pre-op dose of cefazolin If tubes abnormal at time of procedure, discharge on doxycycline 100 mg BID x 5 days	History of PID or abnormal tubes, doxycycline 100 mg BID x 5 days total
Sonohysterography (saline infusion sonography)	None	None	None	N/A	
Cervical tissue excision procedures (LEEP, biopsy, endocervical curettage)	None	None	None	N/A	
Endometrial biopsy	None	None	None	N/A	
Laparoscopic procedures without entry into bowel or vagina	None	None	None	N/A	
Hysteroscopy (operative or diagnostic)	None	None	None	N/A	
Intrauterine device insertion	None	None	None	N/A	
D&C for non-pregnancy indications	None	None	None	N/A	

SURGICAL GUIDELINE

SURGICAL ANTIBIOTIC PROPHYLAXIS

Age < 25 years of age

Children's MINNESOTA

Aim: To standardize surgical antibiotic prophylaxis.

Type of Procedure	Recommended Agent(s)	Severe ß-lactam Allergy (Link to Appendix A)	MRSA Colonization OR History of MRSA Infection	Postoperative Duration	Comments
Orthopedic Trauma					
Open fractures	See Recommendations for Open Fracture Antibiotic Prophylaxis				
Closed fractures with implantation of internal fixation devices (e.g., nails, screws, plates, wires)	Cefazolin	Clindamycin	Vancomycin plus Cefazolin	≤ 24 hours	
Simple supracondylar humeral fractures pinned percutaneously	None	None	None	N/A	
Plastic Surgery					
Clean with risk factors or clean-contaminated	Cefazolin	Clindamycin	Vancomycin plus Cefazolin Allergy: Vancomycin	≤ 24 hours	
Vascular					
All	Cefazolin	Clindamycin	Vancomycin plus Cefazolin Allergy: Vancomycin	≤ 24 hours	
Fetal Surgery					
All	Cefazolin	Clindamycin	Vancomycin plus Cefazolin Allergy: Vancomycin	≤ 24 hours	
General Surgery					
Thoracic					
Lobectomy, pneumonectomy, lung resection, thoracotomy, video-assisted thoracoscopic surgery	Cefazolin	Clindamycin	Vancomycin plus Cefazolin Allergy: Vancomycin	Single pre-op dose	
Tracheoesophageal fistula (TEF) repair	Cefazolin OR Ampicillin plus Gentamicin (if other maternal/ neonatal indications)	N/A	Vancomycin plus Cefazolin	≤ 24 hours	
Congenital diaphragmatic hernia (CDH)	Cefazolin	N/A	Vancomycin plus Cefazolin	• No patch: Single pre-op dose • Patch w/o chest tube: < 24 hrs • Patch w/ chest tube: 24–48 hrs	

SURGICAL ANTIBIOTIC PROPHYLAXIS

Age < 25 years of age

Aim: To standardize surgical antibiotic prophylaxis.

Type of Procedure	Recommended Agent(s)	Severe ß-lactam Allergy (Link to Appendix A)	MRSA Colonization OR History of MRSA Infection	Postoperative Duration	Comments
General Surgery, *continued*					
Biliary tract					
Open procedure	Cefazolin	Clindamycin plus Gentamicin	Vancomycin plus Cefazolin Allergy: Vancomycin plus Gentamicin	Single pre-op dose	
Laparoscopic procedure Elective, low-risk	Cefazolin OR consider no antibiotic prophylaxis	Clindamycin plus Gentamicin OR consider no antibiotic prophylaxis	Vancomycin plus Cefazolin Allergy: Vancomycin plus Gentamicin OR consider no antibiotic prophylaxis	Single pre-op dose	
Laparoscopic procedure Elective, high-risk	Cefazolin	Clindamycin plus Gentamicin	Vancomycin plus Cefazolin Allergy: Vancomycin plus Gentamicin	Single pre-op dose	
Gastroduodenal					
Procedures involving entry into lumen of gastrointestinal tract (e.g., duodenal atresia)	Cefazolin	Clindamycin plus Gentamicin	Vancomycin plus Cefazolin Allergy: Vancomycin plus Gentamicin	Single pre-op dose	
Gastroschesis	Cefazolin OR Ampicillin plus Gentamicin (if other maternal/ neonatal indications)	N/A	Vancomycin plus Cefazolin	≤ 48 hours	• Antibiotics are recommended from delivery until silo placed or primary closure. • No antibiotics needed while silo in place • Initiate perioperative coverage at time of final closure until 48 hours postoperatively
Procedures without entry into GI tract for high-risk patients	Cefazolin	Clindamycin plus Gentamicin	Vancomycin plus Cefazolin Allergy: Vancomycin plus Gentamicin	Single pre-op dose	
Small intestine and colorectal *(continues on next page)*					
Hernia repair (hernioplasty and herniorrhaphy)	None	None	None	N/A	
Nonobstructed small intestine	Cefazolin	Clindamycin plus Gentamicin	Vancomycin plus Cefazolin Allergy: Vancomycin plus Gentamicin	Single pre-op dose	
Obstructed small intestine	Cefoxitin	Ciprofloxacin plus Metronidazole	Vancomycin plus Cefoxitin Allergy: Vancomycin plus Ciprofloxacin plus Metronidazole	Single pre-op dose	
Stoma revisions and/or closures (small intestine only)	Cefazolin	Clindamycin plus Gentamicin	Vancomycin plus Cefazolin Allergy: Vancomycin plus Gentamicin	< 24 hours	
Stoma revisions and/or closures (small intestine and colon or colostomy)	Cefoxitin	Ciprofloxacin plus Metronidazole	Vancomycin plus Cefoxitin Allergy: Vancomycin plus Ciprofloxacin plus Metronidazole	< 24 hours	

SURGICAL ANTIBIOTIC PROPHYLAXIS

Age < 25 years of age

Aim: To standardize surgical antibiotic prophylaxis.

Type of Procedure	Recommended Agent(s)	Severe ß-lactam Allergy (Link to Appendix A)	MRSA Colonization OR History of MRSA Infection	Postoperative Duration	Comments
General Surgery, *continued*					
Small intestine and colorectal, *continued*					
Colorectal procedures	Cefoxitin	Ciprofloxacin plus Metronidazole	Vancomycin plus Cefoxitin Allergy: Vancomycin plus Ciprofloxacin plus Metronidazole	Single pre-op dose	
Necrotizing enterocolitis (NEC)	See Star Net Clinical Guidelines and Decision Support page for Antibiotic Stewardship Recommendations for NEC in the CVICU and NICU				
Appendectomy					
Uncomplicated (including gangrenous appendicitis)	Ceftriaxone plus Metronidazole	Ciprofloxacin plus Metronidazole	Vancomycin plus Ceftriaxone plus Metronidazole Allergy: Vancomycin plus Ciprofloxacin plus Metronidazole	Single pre-op dose	
Complicated appendicitis or other ruptured colorectal viscus	Ceftriaxone plus Metronidazole	Ciprofloxacin plus Metronidazole	Vancomycin plus Ceftriaxone plus Metronidazole Allergy: Vancomycin plus Ciprofloxacin plus Metronidazole	≤ 24 hours	Appropriate antibiotic treatment should be administered for underlying infection beyond perioperative prophylaxis.

Aim: To standardize surgical antibiotic prophylaxis.

TABLE 2. RECOMMENDATIONS FOR PERIOPERATIVE DOSING OF PROPHYLACTIC ANTIBIOTICS IN NEONATES [POSTMENSTRUAL AGE (PMA) <44 WEEKS]

Antibiotic	Pre-Op Dose	Timing of Pre-Op Dose	Administration	Intra-Op Dose	Post-Op Dose
Ampicillin	50 mg/kg	Begin within **60** min before incision; If possible, complete 15 min prior to incision	IVP over 3–5 min	50 mg/kg q4h	50 mg/kg q12h
Cefazolin	30 mg/kg		IVP over 3–5 min	30 mg/kg q4h	**PNA 0–7 days:** 30 mg/kg q12h **PNA ≥ 8 days:** 30 mg/kg q8h
Cefazolin (cardiopulmonary bypass, CPB)	30 mg/kg		IVP over 3–5 min	15 mg/kg at initiation of CPB AND again with weaning off of CPB or at 4 hours (whichever is shorter)	**PNA 0–7 days:** 30 mg/kg q12h **PNA ≥ 8 days:** 30 mg/kg q8h
Cefepime	**PNA ≤ 28 days and ≤ 2 kg** 30 mg/kg **All others:** 50 mg/kg		IV over 30 min	If procedure lasts > 8 hours, redose based on Post-Op dosing interval	**PNA ≤ 28 days and ≤ 2 kg** 30 mg/kg q12h **PNA ≤ 28 days and > 2 kg** 50 mg/kg q12h **PNA > 28 days** 50 mg/kg q8h
Cefoxitin	30 mg/kg		IVP over 3–5 min	30 mg/kg q2h	30 mg/kg q8h
Gentamicin	4 mg/kg		IV infusion over 20 min with 10 min flush	None	**PNA ≤ 7 days and < 1,250 g** 4 mg/kg q48h **All others** 4 mg/kg q24h
Vancomycin	15 mg/kg	Begin within **120** min before incision; If possible, complete 15 min prior to incision	IV over 60 min	If procedure lasts > 8 hours, redose based on Post-op dosing interval	PMA ≤ 29 weeks **PNA ≤ 14 days:** 15 mg/kg q18h **PNA > 14 days:** 10-15 mg/kg q12h PMA 30–36 weeks **PNA ≤ 14 days:** 10-15 mg/kg q12h **PNA > 14 days:** 10-15 mg/kg q8h PMA 37–44 weeks **PNA ≤ 14 days:** 15 mg/kg q8-12h **PNA > 14 days:** 10-15 mg/kg q8h

Abbreviations: PNA = postnatal age

SURGICAL ANTIBIOTIC PROPHYLAXIS

Age < 25 years of age

Aim: To standardize surgical antibiotic prophylaxis.

TABLE 3. RECOMMENDATIONS FOR PERIOPERATIVE DOSING OF PROPHYLACTIC ANTIBIOTICS IN PEDIATRIC [POSTMENSTRUAL AGE (PMA) ≥ 44 WEEKS] AND ADULT PATIENTS

Antibiotic	Pre-Op Dose	Timing of Pre-Op Dose	Administration	Intra-Op Dose	Post-Op Dose
Ampicillin	50 mg/kg (max 2000 mg)	Begin within **60** min before incision; If possible, complete 15 min prior to incision	IVP over 3–5 min	q2h	q6h
Ampicillin-Sulbactam	50 mg/kg (max 2000 mg) of ampicillin component		IV over 15 min	q2h	q6h
Cefazolin	30 mg/kg (max 2000 mg) If ≥ 120 kg: 3000 mg		IVP over 3–5 min	q4h	q8h
Cefazolin (cardiopulmonary bypass, CPB)	30 mg/kg (max 2000 mg) If ≥ 120 kg: 3000 mg		IVP over 3–5 min	15 mg/kg at initiation of CPB AND again with weaning off of CPB or at 4 hours (whichever is shorter)	30 mg/kg q8h
Cefepime	50 mg/kg		IV over 30 min	q4h	q8h
Cefoxitin	40 mg/kg (max 2000 mg)		IVP over 3–5 min	q2h	q6h
Ceftriaxone	50 mg/kg (max 2000 mg)		IV over 30 min	No redose	q24
Ciprofloxacin	10 mg/kg (max 400 mg)	Begin within **120** min before incision; If possible, complete 15 min prior to incision	IV over 60 min	If procedure lasts > 12 hours, redose based on Post-op dosing interval	q12h
Clindamycin	10 mg/kg (max 900 mg)	Begin within **60** min before incision; If possible, complete 15 min prior to incision	IV infusion at ≤ 30 mg/min	If procedure lasts > 6 hours, redose based on Post-op dosing interval	q8h
Gentamicin	2.5 mg/kg (use adjusted body weight if ≥ 95% percentile BMI for age and sex)		IV infusion over 20 min with 10 min flush	If procedure lasts > 8 hours, redose based on Post-op dosing interval	q8h
Levofloxacin	10 mg/kg (max 500 mg)	Begin within **120** min before incision; If possible, complete 15 min prior to incision	IV over 60 min	N/A	q12h (if 6 months to < 5 years old) q24h (if ≥ 5 years old)
Metronidazole	10 mg/kg (max 500 mg)	Begin within **60** min before incision; If possible, complete 15 min prior to incision	IV over 30–60 min	If procedure lasts > 8 hours, redose based on Post-op dosing interval	q8h
Metronidazole (appendicitis)	30 mg/kg (max 1500 mg)		IV over 30–60 min	N/A	q24h
Vancomycin	15 mg/kg (max 1500 mg)	Begin within **120** min before incision	IV over 60 min (if dose is ≤ 1000 mg) or over 90 min (if dose is > 1000–1500 mg)	If procedure lasts > 8 hours, redose based on Post-op dosing interval	q8h

Aim: To standardize surgical antibiotic prophylaxis.

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SURGICAL GUIDELINE

SURGICAL ANTIBIOTIC PROPHYLAXIS

Age < 25 years of age

Children's MINNESOTA

Appendix A

Aim: To standardize surgical antibiotic prophylaxis.

Patient with PENICILLIN allergy label

Discuss with Infectious Disease if allergy label to: carbapenem, aztreonam, or multiple classes of beta-lactams (e.g penicillin and cephalosporin).

- Evaluate reported allergy and severity (**Table 4**) by obtaining information on:
  - Previous evaluation by an allergist for penicillin allergy.
  - Name of penicillin(s) that allergy label applies to.
  - Reaction details (e.g. see **page 18** for rash type examples).
  - Timing/onset of reaction: Immediate/acute (≤ 24 hrs of penicillin dosing), delayed (> 24 hrs of penicillin dosing).
  - Treatment of reaction: None/antibiotic continued, antibiotic discontinued, antihistamines, steroids, epinephrine, hospitalization/ED.
  - Tolerance of culprit penicillin and other beta-lactams before and after course that caused the reaction.
- Update EMR with information above.

Severe Type II-IV reactions(delayed)

- Stevens-Johnson syndrome (SJS).
- Toxic epidermal necrolysis (TEN).
- Drug reaction with eosinophilia and systemic symptoms (DRESS).
- Acute generalized exanthematous pustulosis (AGEP).
- Generized bullous fixed drug eruption (GBFDE).
- Linear IgA bullous dermatosis.
- **Severe** maculopapular rash.
- Drug-induced autoimmune disease (bullous pemphigoid, pemphigus vulgaris, drug-induced lupus).
- Serum sickness.
- Blood disorders (hemolytic anemia, agranulocytosis, thrombocytopenia).
- Drug-induced liver injury, nephritis, pneumonitis, meningitis, pancreatitis, vasculitis.
- Drug fever.

Use NON beta-lactam antibiotics appropriate to procedure (see **Table 1**, **"Severe ß-lactam Allergy" column**).

Severe Type I reactions (immediate)

- Anaphylaxis (**Table 5**).
- **Skin**: **Acute** urticaria (hives), angioedema, flushing/redness.
- **CV**: Hypotension, syncope.
- **GI**: Repetitive vomiting, abdominal cramping.
- **MSK**: Hypotonia.
- **Resp**: Dyspnea, wheezing, hypoxia, repetitive coughing, stridor, aphonia, dysphonia.

Non-severe reactions

- **Mild/moderate** maculopapular rash.
- Isolated pruritus without rash.
- **Delayed** urticaria* with pruritus and without other systemic symptoms.
- Patient denies allergy but is on record.

Can use cefazolin, cefoxitin, or ceftriaxone.

Reactions inconsistent with allergy

- Isolated intolerances: diarrhea, nausea, vomiting (not repetitive), mild abdominal pain, headache, fatigue, vaginitis.
- Family history of allergy to penicillin.
- Patient tolerated culprit penicillin after allergy label.

Can use cefazolin, cefoxitin, ceftriaxone, or ampicillin-sulbactam.

*__Delayed urticaria:__ Onset at >24 hours of penicillin dosing, or after 2 doses, whichever is longer.

†__Classification of maculopapular rash:__
Severe: Widespread rash that may become confluent and develop into erythroderma; >1-wk duration, with systemic involvement (e.g., fever, eosinophilia); rarely, with minimal vesicles or pustules.
Moderate: More or less widespread rash; >1-wk duration, without systemic involvement.
Mild: More or less widespread rash; <1-wk duration, without systemic involvement.

SURGICAL GUIDELINE

SURGICAL ANTIBIOTIC PROPHYLAXIS

Age < 25 years of age

Children's MINNESOTA

Appendix A

Aim: To standardize surgical antibiotic prophylaxis.

Patient with CEPHALOSPORIN allergy label

Discuss with Infectious Disease if allergy label to: carbapenem, aztreonam, or multiple classes of beta-lactams (e.g penicillin and cephalosporin).

- Evaluate reported allergy and severity (**Table 4**) by obtaining information on:
  - Previous evaluation by an allergist for penicillin allergy.
  - Name of cephalosporin(s) that allergy label applies to.
  - Reaction details (e.g. see **page 18** for rash type examples).
  - Timing/onset of reaction: Immediate/acute (≤24 hrs of cephalosporin dosing), delayed (> 24 hrs of cephalosporin dosing).
  - Treatment of reaction: None/antibiotic continued, antibiotic discontinued, antihistamines, steroids, epinephrine, hospitalization/ED.
  - Tolerance of culprit cephalosporin and other beta-lactams before and after course that caused the reaction.
- Update EMR with information above.

Severe Type II-IV reactions (delayed)

- Stevens-Johnson syndrome (SJS).
- Toxic epidermal necrolysis (TEN).
- Drug reaction with eosinophilia and systemic symptoms (DRESS).
- Acute generalized exanthematous pustulosis (AGEP).
- Generized bullous fixed drug eruption (GBFDE).
- Linear IgA bullous dermatosis.
- **Severe**† maculopapular rash.
- Drug-induced autoimmune disease (bullous pemphigoid, pemphigus vulgaris, drug-induced lupus).
- Serum sickness.
- Blood disorders (hemolytic anemia, agranulocytosis, thrombocytopenia).

Drug-induced liver injury, nephritis, pneumonitis, meningitis, pancreatitis, vasculitis.

- Drug fever.

Severe Type I reactions (immediate)

- Anaphylaxis (**Table 5**)
- **Skin**: **Acute** urticaria (hives), angioedema, flushing/redness.
- **CV**: Hypotension, syncope.
- **GI**: Repetitive vomiting, abdominal cramping.
- **MSK**: Hypotonia.
- **Resp**: Dyspnea, wheezing, hypoxia, repetitive coughing, stridor, aphonia, dysphonia.

Use NON beta-lactam antibiotics appropriate to procedure (see **Table 1**, **"Severe ß-lactam Allergy" column**).

Non-severe reactions

- **Mild/moderate**† maculopapular rash.
- Isolated pruritus without rash.
- **Delayed** urticaria* with pruritus and without other systemic symptoms.
- Patient denies allergy but is on record.

Use table below to asses if cefazolin, cefoxitin, ceftriaxone can be used based on cephalosporin allergy label:
-If **green box**, can use.
-If **red box**, use NON beta-lactam antibiotic.

Reactions inconsistent with allergy

- Isolated intolerances: diarrhea, nausea, vomiting (not repetitive), mild abdominal pain, headache, fatigue, vaginitis.
- Family history of allergy to penicillin.
- Patient tolerated culprit penicillin after allergy label.

Can use cefazolin, cefoxitin, ceftriaxone, or ampicillin-sulbactam.

Reported allergy to: / Surgical Prophylaxis agent	1st			2nd			3rd						4th	5th		
	Cefadroxil	Cephalexin	Cefazolin	Cefoxitin	Cefuroxime	Cefprozil	Cefdinir	Cefixime	Ceftriaxone	Cefotaxime	Cefpodoxime	Ceftazidime	Cefepime	Ceftaroline	Ceftolozane	Cefiderocol
Cefazolin																
Cefoxitin																
Ceftriaxone																

1st, 2nd, 3rd, etc. refer to generation of cephalosporins.

*Delayed urticaria: See definition on page 15.

†Classification of maculopapular rash: See page 15.

Disclaimer: This guideline is designed for general use with most patients; each clinician should use their own independent judgment to meet the needs of each individual patient. This guideline is not a substitute for professional medical advice, diagnosis or treatment.

Appendix A

Aim: To standardize surgical antibiotic prophylaxis.

Table 4. Immune-Mediated Antibiotic Hypersensitivity Reactions

Type	Description	Pathogenesis	Onset of Reaction	Typical Clinical Findings
I (Immediate)	IgE-mediated hypersensitivity	Antibiotic-specific IgE binds to mast cells and basophils. Subsequent antibiotic exposure leads to mast cell and basophil degranulation	Minutes to an hour (can also be considered within 6 hours of exposure)	Anaphylaxis, urticaria (hives), angioedema, repetitive vomiting, SOB, wheezing, chest pain, palpitations, syncope, cardiac arrest
II (Delayed)	IgG-mediated hypersensitivity	Antibiotic binds to WBC, RBC, or platelet and acts as antigen leading to antibody medicated cell destruction	Days to weeks	Hemolytic anemia, thrombocytopenia, neutropenia
III (Delayed)	Immune-complex mediated hypersensitivity	Antibiotic and IgG/IgM bind to form immune complex activate complement	Days to weeks	Serum sickness (fever, urticaria, arthralgia, lymphadenopathy), drug fever, vasculitis
IV (Delayed)	Cell-mediated hypersensitivity	Antigen specific T-cell activation	Days to weeks	Pustules, vesicles, desquamation, exfoliative exanthema, contact dermatitis, maculopapular rash, DRESS, SJS, TEN, AGEP, acute interstitial nephritis, drug-induced liver injury,

AGEP: acute generalized exanthematous pustulosis. **DRESS**: drug rash with eosinophilia and systemic symptoms. **RBC**: red blood cell. **WBC**: white blood cell. **SJS**: Stevens-Johnson Syndrome. **SOB**: shortness of breath. **TEN**: toxic epidermal necrolysis.

Table 5. Anaphylaxis is highly likely when any one of the following 2 criteria are fulfilled:

1. **Acute onset* of an illness with involvement of the skin, mucosal tissue, or both (e.g. generalized hives, pruritus or flushing, swollen li ps-tongue-uvula) AND ≥ 1 of the following:**
   a. Respiratory compromise (e.g. dyspnea, wheeze-bronchospasm, stridor, reduced peak expiratory flow (PEF), hypoxemia)
   b. Reduced blood pressure** or associated symptoms of end-organ dysfunction (e.g. hypotonia [collapse], syncope, incontinence)
   c. Severe gastrointestinal symptoms (e.g. severe crampy abdominal pain, repetitive vomiting)
2. **Acute onset of hypotension* or bronchospasm or laryngeal involvement (stridor, vocal changes, odynophagia) even in the absence of typical skin involvement**

*Minutes to several hours from exposure. Most immediate reactions occur within the 1st hour following drug administration.
**Hypotension defined as systolic blood pressure (mm Hg):

- < 12 months of age: < 70
- 1-10 years of age: < 70 + (2 × age in years)
- > 10 years of age: < 90.

Appendix A

Aim: To standardize surgical antibiotic prophylaxis.

Examples of Rash Types

Macular papular rash

- Typically non-severe skin reaction
- Tiny red dots covering a large area of the body, may feel rough to the touch.
- Appears after 2—3 days (or later) of antibiotic administration (delayed reaction).
- Can be treated through, does not contraindicate future antibiotic use.
- May not recur with future drug administration.

Urticaria (hives)

- Itchy, red bumps with white centers (look like new mosquito bites).
- Typically appear within 6 hours of antibiotic administration (but can be a delayed reaction too).
- Bumps disappear after a few hours and new ones may appear.

Severe skin drug reaction (exfoliating dermatitis)

- Skin peeling or blistering with mucosal (eyes, mouth, genital) involvement
- Develops after several days of antibiotics.
- Examples: Stevens-Johnson syndrome, Toxic Epidermal necrolysis (TEN)
- Requires hospitalization

Erythema multiforme

- Rings containing a "bull's-eye"
- Appears after 2-3 days of antibiotic administration (delayed reaction)

Images used with p ermission from the following referen ces:
- penicillin-allergy-algorithm-with-pictures.pdf (hopkinsmedicine.org)
- Atlas of Dermatological Conditions in Populations of African Ancestry. CMYA Donkor, J Aryee-Boi, IR Osazuwa, FK Afflu, AF Alexis. Springer Cham 2021

Appendix A

Aim: To standardize surgical antibiotic prophylaxis.

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