C.S. MOTT CHILDREN'S HOSPITAL
MICHIGAN MEDICINE

GUIDELINES FOR THE TREATMENT OF INTRA-ABDOMINAL INFECTIONS IN PATIENTS ON PEDIATRIC SERVICES

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Clinical Setting	Empiric Therapy	Comments
Severe sepsis or septic shock secondary to intra-abdominal infection (excluding NEC in neonates)	See Guidelines for Undifferentiated or Severe Sepsis in Pediatric Patients for antibiotic selection and dosing Follow recommendations for intra-abdominal source	Duration is dictated by underlying process, once determined
Necrotizing enterocolitis (NEC) in neonates, including patients with severe sepsis/septic shock	See NEC guidelines for staging and antibiotic selection	See NEC guidelines for duration
Appendicitis (managed with immediate appendectomy) Increased multi-drug resistant gram-negative (MDR-GN) risk: • Immunocompromised • At risk[1] implanted or indwelling device • >72 hours hospitalization in past 90 days **Empiric regimen may require adjustment for patients with infection or colonization with multidrug-resistant organisms in past 6 months**	1st line (see comment for allergies): **Ceftriaxone** 75 mg/kg/dose IV q24h (max: 2 g/dose) + **Metronidazole** 30 mg/kg/dose IV q24h (max: 1.5 g/dose) Increased MDR-GN risk (definition to left): **Piperacillin-tazobactam** 75 mg/kg/dose of piperacillin IV q6h (max: 4 g of piperacillin/dose) Increased MDR-GN risk -AND- low/medium-risk allergy[2] to penicillins: **Cefepime** 50 mg/kg/dose IV q8h (max: 2 g/dose) + **Metronidazole** 30 mg/kg/dose IV q24h (max: 1.5 g/dose) High-risk allergy[3]/contraindication[4] to beta-lactams: **Ciprofloxacin** 10 mg/kg/dose IV **q12h** (max: 400 mg/dose) (increased MDR-GN risk: 10 mg/kg/dose IV **q8h** [max: 400 mg/dose)]) + **Metronidazole** 30 mg/kg/dose IV q24h (max: 1.5 g/dose) Note: Standard preoperative prophylaxis is indicated unless above antibiotics have been given within 60 minutes of incision: **cefoxitin** 40 mg/kg x1 dose [max: 2 g] 15-60 minutes prior to incision	Duration: *Non-perforated:* discontinue after surgical intervention *Perforated without bacteremia:* IV antibiotics until 24 hours afebrile and tolerating regular diet, then oral antibiotics to complete 7 days from appendectomy *Perforated with bacteremia:* Consult Infectious Diseases Patients with low/medium-risk allergy[2] to penicillins and cephalosporins other than cefepime, ceftriaxone, cefpodoxime, and cefotaxime can receive ceftriaxone or cefepime Oral step-down therapy: *1st line:* **Amoxicillin-clavulanate** 15 mg amoxicillin/kg/dose PO TID (max: 500 mg amoxicillin/dose) *Increased MDR-GN risk OR penicillin allergy:* **Ciprofloxacin** 15 mg/kg/dose PO BID (max: 750 mg/dose) + **Metronidazole** 10 mg/kg/dose PO TID (max: 500 mg/dose)

Clinical Setting	Empiric Therapy	Comments
Intra-abdominal abscess (including appendicitis managed with delayed appendectomy, post-operative abscess following appendectomy, and other post-operative abscesses) Increased multi-drug resistant gram-negative (MDR-GN) risk: • Immunocompromised • At risk[1] implanted or indwelling device • >72 hours hospitalization in past 90 days **Empiric regimen may require adjustment for patients with infection or colonization with multidrug-resistant organisms in past 6 months**	1st line (see comment for allergies): **Ceftriaxone** 75 mg/kg/dose IV q24h (max: 2 g/dose) + **Metronidazole** 30 mg/kg/dose IV q24h (max: 1.5 g/dose) Increased MDR-GN risk (definition to left) **Piperacillin-tazobactam** 75 mg/kg/dose of piperacillin IV q6h (max: 4 g of piperacillin/dose) Increased MDR-GN risk -AND- low/medium-risk allergy[2] to penicillins: **Cefepime** 50 mg/kg/dose IV q8h (max: 2 g/dose) + **Metronidazole** 30 mg/kg/dose IV q24h (max: 1.5 g/dose) High-risk allergy[3]/contraindication[4] to beta-lactams: **Ciprofloxacin** 10 mg/kg/dose IV **q12h** (max: 400 mg/dose) (increased MDR-GN risk: 10 mg/kg/dose IV **q8h** [max: 400 mg/dose)]) + **Metronidazole** 30 mg/kg/dose IV q24h (max: 1.5 g/dose)	Adjust antimicrobial coverage based on organism identification and antimicrobial susceptibilities Duration: *Appendicitis managed with delayed appendectomy:* IV antibiotics until 24 hours afebrile and tolerating regular diet, then treat 3-4 more days with oral antibiotics (typically 7-14 days total) *All other abscesses:* 4-5 days from source control[5] *Any patient with bacteremia or therapy duration >14 days:* Consult Infectious Diseases Patients with low/medium-risk allergy[2] to penicillins and cephalosporins other than cefepime, ceftriaxone, cefpodoxime, and cefotaxime can receive ceftriaxone or cefepime Oral step-down therapy: *1st line:* **Amoxicillin-clavulanate** 15 mg amoxicillin/kg/dose PO TID (max: 500 mg amoxicillin/dose) *Increased MDR-GN risk OR penicillin allergy:* **Ciprofloxacin** 15 mg/kg/dose PO BID (max: 750 mg/dose) + **Metronidazole** 10 mg/kg/dose PO TID (max: 500 mg/dose)
Post-operative prophylaxis for: • bowel injuries (penetrating, blunt, iatrogenic) that are repaired within 12 hours • intra-operative contamination with enteric contents	1st line: **Cefoxitin** 40 mg/kg/dose IV q6h (max: 2 g/dose) Allergy to cefoxitin -OR- high-risk allergy[3]/contraindication[4] to beta-lactams: **Ciprofloxacin** 10 mg/kg/dose IV q12h (max: 400 mg/dose) + **Metronidazole** 30 mg/kg/dose IV q24h (max: 1.5 g/dose)	Duration: 24 hours No post-operative prophylaxis is indicated for clean-contaminated intra-abdominal procedures in which no gross contamination occurs

Clinical Setting	Empiric Therapy	Comments
Cholangitis & cholecystitis Increased multi-drug resistant gram-negative (MDR-GN) risk: • >72 hours hospitalization in past 90 days • Presence of at risk[1] device • Immunocompromised **Empiric regimen may require adjustment for patients with infection or colonization with multidrug-resistant organisms in past 6 months**	1st line (see comment for allergies): **Ceftriaxone** 75 mg/kg/dose IV q24h (max: 2 g/dose) *Presence of biliary-enteric anastomosis (including s/p Kasai):* ADD **Metronidazole** 30 mg/kg/dose IV q24h (max: 1.5 g/dose) Increased MDR-GN risk (definition to left): **Piperacillin-tazobactam** 75 mg/kg/dose of piperacillin IV q6h (max: 4 g of piperacillin/dose) Increased MDR-GN risk -AND- low/medium-risk allergy[2] to penicillins: **Cefepime** 50 mg/kg/dose IV q8h (max: 2 g/dose) *Presence of biliary-enteric anastomosis (including s/p Kasai):* ADD **Metronidazole** 30 mg/kg/dose IV q24h (max: 1.5 g/dose) High-risk allergy[3]/contraindication[4] to beta-lactams: **Ciprofloxacin** 10 mg/kg/dose IV **q12h** (max: 400 mg/dose) (increased MDR-GN risk: 10 mg/kg/dose IV **q8h** [max: 400 mg/dose)]) *Presence of biliary-enteric anastomosis (including s/p Kasai):* ADD **Metronidazole** 30 mg/kg/dose IV q24h (max: 1.5 g/dose)	Duration: *Acute cholecystitis without evidence of infection outside of gallbladder wall or bacteremia:* Discontinue after surgical intervention *Cholangitis without bacteremia:* 4-5 days from source control[5] 10-14 days if source control[5] cannot be obtained (e.g. biliary atresia, primary sclerosing cholangitis) *Cholecystitis/cholangitis with bacteremia:* Consult Infectious Diseases Oral step-down therapy: *1st line:* **Amoxicillin-clavulanate** 15 mg amoxicillin/kg/dose PO TID (max: 500 mg amoxicillin/dose) *Increased MDR-GN risk OR penicillin allergy:* **Ciprofloxacin** 15 mg/kg/dose PO BID (max: 750 mg/dose) + **Metronidazole** 10 mg/kg/dose PO TID (max: 500 mg/dose) Patients with low/medium-risk allergy[2] to penicillins and cephalosporins other than cefepime, ceftriaxone, cefpodoxime, and cefotaxime can receive ceftriaxone or cefepime Cholangitis prophylaxis following Kasai procedure: **TMP-SMX** 4 mg/kg/dose of TMP PO daily x1 year, then re-evaluate

Clinical Setting	Empiric Therapy	Comments
Spontaneous Bacterial Peritonitis (SBP)	1st line (see comment for allergies): **Ceftriaxone** 75 mg/kg/dose IV q24h (max: 2 g/dose) High-risk allergy[3]/contraindication[4] to beta-lactams -AND- NOT receiving fluoroquinolone prophylaxis: **Levofloxacin*:** <5 years: 10 mg/kg/dose IV q12h (max: 375 mg/dose) ≥5 years: 10 mg/kg/dose IV q24h (max: 750 mg/dose) High-risk allergy[3]/contraindication[4] to beta-lactams -AND- receiving fluoroquinolone prophylaxis: **Aztreonam*** 50 mg/kg/DOSE IV q8h (max: 2 g/DOSE) + **Vancomycin*** IV (see Vancomycin Dosing Guideline)	Duration: 5 days (may extend to 7 if not significantly improved by 5 days) Patients with low/medium-risk allergy[2] to penicillins and cephalosporins other than cefepime, ceftriaxone, cefpodoxime, and cefotaxime can receive ceftriaxone or cefepime Oral step-down is appropriate for the following populations: • Culture positive and clinically improving after 48-72 hours of IV therapy with oral antibiotic options feasible per culture and susceptibility results • Patients with culture-negative SBP who are hemodynamically stable and responding (exam, lab parameters, and repeat paracentesis if performed) after 48 hours of empiric therapy Oral step-down therapy for culture-negative SBP: 1st line: **Amoxicillin-clavulanate** 15 mg amoxicillin/kg/dose PO TID (max: 500 mg amoxicillin/dose) High-risk allergy[3]/contraindication[4] to beta-lactams: **Ciprofloxacin** 15 mg/kg/dose PO BID (max: 750 mg/dose)
Prophylaxis in Patients at High Risk for Spontaneous Bacterial Peritonitis	1st line: **TMP-SMX** 4 mg TMP/kg/dose PO daily (max: 80 mg TMP/dose) Allergy to TMP-SMX: **Ciprofloxacin** 15 mg/kg/dose PO q24h (max: 500 mg/dose) Choice of agent should be reviewed and adjusted based on previous ascitic culture results in patients with breakthrough or previous SBP. Options besides those listed may be considered in such scenarios.	SBP prophylaxis is warranted in patients with prior SBP SBP prophylaxis may be warranted in the following situations: • Ascitic protein levels <1.5 g/dL • Diuretic-refractory ascites (requires paracentesis) • Child-Pugh C

Clinical Setting	Empiric Therapy	Comments
Prophylaxis in Patients with Cirrhosis and GI Bleeds	1st line (see comment for allergies): **Ceftriaxone** 50 mg/kg/dose IV q24h (max: 1 g/dose) High-risk allergy[3]/contraindication[4] to beta-lactams -AND- NOT receiving fluoroquinolone prophylaxis: **Ciprofloxacin*** 10 mg/kg/dose IV q12h (max: 400 mg/dose) High-risk allergy[3]/contraindication[4] to beta-lactams -AND- receiving fluoroquinolone prophylaxis: **Aztreonam*** 50 mg/kg/DOSE IV q8h (max: 2 g/DOSE) + **Vancomycin*** IV (see Vancomycin Dosing Guideline)	Duration: 5-7 days (total duration, including IV and PO) Patients with low/medium-risk allergy[2] to penicillins and cephalosporins other than cefepime, ceftriaxone, cefpodoxime, and cefotaxime can receive ceftriaxone or cefepime Oral step-down is appropriate for patients who are hemodynamically stable and whose bleeding is controlled (no further procedures or transfusions in past 24 hours), after 48 hours of prophylaxis Oral step-down therapy for completion of prophylaxis course: 1st line: **Amoxicillin-clavulanate** 15 mg amoxicillin/kg/dose PO TID (max: 500 mg amoxicillin/dose) High-risk allergy[3]/contraindication[4] to beta-lactams: **Ciprofloxacin*** 15 mg/kg/dose PO BID (max: 500 mg/dose)
Acute pancreatitis without necrosis or abscess	No antibiotics indicated	
Necrotizing pancreatitis, in the following settings only: • Hemodynamic instability • Persistent/worsening signs of sepsis 7-10 days into course • Proven infection In patients with initial hemodynamic instability, antibiotics should be discontinued after 48 hours unless infection is documented.	1st line: **Piperacillin-tazobactam** 75 mg/kg/dose of piperacillin IV q6h (max: 4 g of piperacillin/dose) Low/medium risk[2] penicillin allergy: **Cefepime** 50 mg/kg/dose IV q8h (max: 2 g/dose) + **Metronidazole** 30 mg/kg/dose IV q24h (max: 1.5 g/dose) High-risk allergy[3]/contraindication[4] to beta-lactams: **Ciprofloxacin** 10 mg/kg/dose IV **q12h** (max: 400 mg/dose) (increased MDR-GN risk: 10 mg/kg/dose IV **q8h** [max: 400 mg/dose)]) + **Metronidazole** 30 mg/kg/dose IV q24h (max: 1.5 g/dose)	For persistent/worsening SIRS, obtain culture and tailor antibiotic therapy accordingly. Duration of therapy will depend on results of culture and resolution of signs and symptoms of inflammation. For proven infection, duration of treatment depends on timing of operative debridement, percutaneous drainage, and improvement in clinical signs and symptoms of infection. Adjust antimicrobial coverage based on organism identification and antimicrobial susceptibilities

Footnotes:

*Adjust dose based on renal function

[1]At risk implanted or indwelling devices are those deemed by the clinician to have a high risk of colonization or infection with resistant gram-negative organisms, including but not limited to Pseudomonas aeruginosa (e.g., central venous catheter, tracheostomy, nephrostomy/suprapubic catheter, percutaneous biliary catheter)

[2]Low-risk allergies include: pruritus without rash, remote (>10 years) unknown reaction, patient denies allergy but is on record, mild rash with no other symptoms (mild rash: non-urticarial rash that resolves without medical intervention). Medium-risk allergies include: urticaria/hives with no other symptoms, severe rash with no other symptoms (severe rash: requires medical intervention [corticosteroids, anti-histamines] and/or ER visit or hospitalization). See β-lactam allergy evaluation and empiric guidance for further information.

[3]High-risk allergies include: respiratory symptoms (chest tightness, bronchospasm, wheezing, cough), angioedema (swelling, throat tightness), cardiovascular symptoms (hypotension, dizzy/lightheadedness, syncope/passing out, arrhythmia), anaphylaxis. If a patient has a high-risk allergy to penicillins, cephalosporins, or carbapenems, the only beta-lactam antibiotic that can be safely used without Allergy consult is aztreonam (**if the allergy is to ceftazidime or aztreonam, aztreonam should be avoided as well**). See β-lactam allergy evaluation and empiric guidance for further information.

[4]Previous reactions that are contraindications to further beta-lactam use (**except aztreonam, which can be used unless the reaction was to ceftazidime or aztreonam**) unless approved by Allergy: organ damage (kidney, liver), drug-induced immune-mediated anemia/thrombocytopenia/leukopenia, rash with mucosal lesions (Stevens Johnson Syndrome/Toxic Epidermal Necrosis), rash with pustules (acute generalized exanthematous pustulosis), rash with eosinophils and organ injury (DRESS – drug rash eosinophilia and systemic symptoms), rash with joint pain, fever, and myalgia (Serum Sickness). See β-lactam allergy evaluation and empiric guidance for further information.

[5]Source control is defined as any procedure that stops the ongoing contamination of the peritoneal cavity and removes the majority of the contaminated intraperitoneal contents to the extent that no further acute interventions are felt to be necessary.

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