PAMC Appendicitis Guideline/Clinical Pathway

Scope of Guideline:
- This guideline is intended for use in immunocompetent patients with appendicitis only.
- A formal Infectious Diseases consult should be considered when treating patients with severe disease, inadequate source control, or immunocompromised patients.
- All doses listed below assume normal renal/hepatic function. Doses should be modified as appropriate for patients with renal/hepatic impairment.

Diagnosis and Management:

Diagnosis:
- Patients with a diagnosis of appendicitis should receive antibiotics covering for most common pathogens
  - Most common pathogens include: *Escherichia coli*, *Streptococcus sp.*, and *Bacteroides fragilis*
  - For patients with septic shock, administer antibiotics as soon as possible (preferably within one hour of presentation)
  - Patients without shock should be started on antibiotics in the emergency department
- Patients can be considered high risk/severity if any of the following are met:
  - Severe physiologic disturbance and/or clinical factors predicting failure of source control:
    - Delay in initial intervention >24 hours
    - APACHE II score ≥15
    - Degree of organ dysfunction
    - Poor nutritional status
    - Extensive peritoneal involvement or diffuse peritonitis
    - Active malignancy
  - Advanced age (age >70 years)
  - Immunocompromised state
    - Solid organ and hematopoietic stem-cell transplant patients
    - Congenital immune defects or autoimmune disorders
    - HIV/AIDS
    - Patients receiving chemotherapy
    - Anatomic or functional asplenia

Management:
- Non-perforated appendicitis:
  - Operative route for patients with non-perforated appendicitis should be performed as soon as reasonably feasible.
    - Per IDSA guidelines, non-operative management may be considered for male patients provided that the patient is admitted for 48 hours and shows sustained improvement in clinical symptoms and signs within 24 hours while receiving antimicrobial therapy
- Perforated appendicitis or abscess
  - Patients should undergo urgent intervention in order to obtain adequate source control
  - Patients with well-circumscribed peri-appendiceal abscess can be managed with percutaneous drainage or operative drainage
  - Interval appendectomy after percutaneous drainage or non-operative management may be considered; however, is controversial.

When to Obtain Cultures:
- Routinely obtaining cultures is not recommended for community acquired infections.
- Cultures SHOULD be obtained in patients with nosocomial infection or who require re-operation for prior treatment failure, or in whom surgery is delayed for >24 hours after initial receipt of antibiotics.
Initial Antibiotic Selection for Patients >18 years old:

**Mild to Moderate Severity**

**Preferred Therapy**
- Cefazolin 2 grams IV Q8 hours
- Metronidazole 500 mg IV/PO Q8H

**Anaphylactic Beta Lactam Allergy**
- Levofloxacin 750 mg IV/PO Q24 hours
- Metronidazole 500 mg IV/PO Q8 hours

**High Severity** (Severe physiologic disturbance, Advanced age >70 years old, or Immunocompromised state)

**Preferred Therapy**
- Piperacillin/Tazobactam 3.375 g IV Q6 hours

**Anaphylactic Beta Lactam Allergy**
- Levofloxacin 750 mg IV/PO Q24 hours
- Metronidazole 500 mg IV/PO Q8 hours

---

Initial Antibiotic Selection for Pediatric Patients:

**Mild to Moderate Severity**

**Preferred Therapy**
- Ceftriaxone 75 mg/kg IV every 24 hours
- Metronidazole 10 mg/kg IV/PO every 8 hours

**Anaphylactic Beta Lactam Allergy**
- Ciprofloxacin 10 mg/kg IV (15 mg/kg PO) every 12 hours
- Metronidazole 10 mg/kg IV/PO every 8 hours

**High Severity** (Severe physiologic disturbance, Advanced age >70 years old, or Immunocompromised state)

**Preferred Therapy**
- Piperacillin/Tazobactam 50 mg/kg (piperacillin component) IV every 6 hours

**Anaphylactic Beta Lactam Allergy**
- Ciprofloxacin 10 mg/kg IV every 12 hours
- Metronidazole 10 mg/kg IV/PO every 8 hours

---

**Pediatric Dosing Recommendations**

<table>
<thead>
<tr>
<th>Antibiotic</th>
<th>Dose</th>
<th>Frequency</th>
<th>Maximum Dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ceftriaxone</td>
<td>75 mg/kg IV</td>
<td>Every 24 hours</td>
<td>Maximum 2000 mg daily IV</td>
</tr>
<tr>
<td>Ciprofloxacin[^]</td>
<td>10 mg/kg (IV)</td>
<td>Every 24 hours</td>
<td>Maximum 800 mg daily (IV)</td>
</tr>
<tr>
<td></td>
<td>15 mg/kg (PO)</td>
<td></td>
<td>Maximum 1500 mg daily (PO)</td>
</tr>
<tr>
<td>Metronidazole</td>
<td>10 mg/kg IV/PO</td>
<td>Every 8 hours</td>
<td>Maximum 1500 mg daily IV/PO</td>
</tr>
<tr>
<td>Piperacillin/Tazobactam</td>
<td>50 mg/kg IV</td>
<td>Every 6 hours</td>
<td>Maximum 3.375 g/dose IV</td>
</tr>
<tr>
<td></td>
<td>(Piperacillin component)</td>
<td></td>
<td>(Piperacillin component)</td>
</tr>
</tbody>
</table>

[^] Fluoroquinolones should not be used during pregnancy
Assessment of Beta-lactam Allergy:
Approximately 10% of patients in the general population will report a penicillin allergy, most commonly rash. True drug allergy is based on the presence of one or more of the following signs/symptoms:
- Respiratory difficulty
- Hypotension
- Immediate-onset rash or hives.

The likelihood of 1st generation cephalosporin allergy in those with a true penicillin allergy is below 10%.

Patients answering “no” to all of the following questions may be given a cephalosporin despite a reported penicillin allergy:
- Have you ever had a LIFE-THREATENING reaction?
- Have you had an IMMEDIATE reaction of:
  - ANAPHYLAXIS (sudden lowering of blood pressure, wheezing, trouble breathing)
  - ANGIOEDEMA (swelling of the throat, tongue, lips, or face)
  - URTICARIA (hives, swollen red bumps or patches that occur within 1 hour of the dose administered)
  - NOTE: Rashes or itching that appear a few days into treatment are not hives and are not contraindications to cephalosporin use.

If it is determined that the penicillin allergy does not preclude the use of the cephalosporin then the phrase “MD aware of penicillin allergy” should be added to the administration instructions on the cephalosporin order. This will alert pharmacy and avoid unnecessary delays.

Duration of Therapy:
Acute appendicitis WITHOUT perforation, abscess or gangrenous appearance (mild, moderate or high severity):
- Prophylactic antibiotics should be given peri-operatively to cover for most likely pathogens listed above
  - See PAMC Surgical Prophylaxis Antibiotic Guideline
  - Intra-operative re-dosing may be necessary as outlined in the PAMC Surgical Prophylaxis Antibiotic Guideline
- Discontinuation of antibiotics should occur within 24 hours of surgery end time with no doses required postoperatively

Acute appendicitis WITH perforation, abscess or gangrenous appearance (mild to moderate severity):
- Therapeutic antibiotics should be given pre-operatively as outlined above
- Discontinuation of antibiotics should occur on post-operative day 4-7 if adequate source control was attained
- If adequate source control not attained and/or patient not clinically improving, an infectious disease consult should be considered

Complicated appendicitis WITH perforation, abscess or gangrenous appearance (high risk severity):
- Therapeutic antibiotics should be given pre-operatively as outlined above
- Discontinuation of antibiotics should occur on post-operative day 4-7 if adequate source control was attained
- If adequate source control not attained and/or patient not clinically improving, an infectious disease consult should be considered

De-escalation to Oral Medications:
If continuation of antibiotics is needed after 24 hours, transitioning to oral antibiotics is often appropriate. When possible, antibiotics may be narrowed based on culture results (if cultures were obtained).
- Patients meeting the below criteria should be considered for transition to an oral antimicrobial regimen:
  - Tolerating food/enteral feedings or other oral medications
  - Afebrile at least 24 hours
- Improving trend in WBC count
- Stable vital signs

Suggested antibiotic conversions from IV to PO if no culture data available:

<table>
<thead>
<tr>
<th>Initial IV Antibiotic</th>
<th>Suggested Oral Antibiotic Equivalent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cefazolin 2 g IV Q8H</td>
<td>Cephalexin 1000 mg PO Q8H</td>
</tr>
<tr>
<td>Levofloxacin 750 mg IV Q24H</td>
<td>Levofloxacin 750 mg PO Q24H</td>
</tr>
<tr>
<td>Metronidazole 500 mg IV Q8H</td>
<td>Metronidazole 500 mg PO Q8H</td>
</tr>
<tr>
<td>Piperacillin/Tazobactam 3.375 g IV Q6H</td>
<td>Depends on clinical scenario; consider antimicrobial pharmacy or infectious diseases consultation</td>
</tr>
</tbody>
</table>

*Note: Doses listed above are for ADULT patients*

**Use of Antifungal Medications:**

Empiric utilization of anti-fungal medications is **NOT** routinely recommended.
- An anti-fungal (fluconazole 400 mg IV/PO q24hrs) should be initiated if yeast is identified in the intra-abdominal culture.
- If critically ill and yeast on gram stain or fluconazole resistant *Candida sp.* (e.g. *Candida glabrata*), broad spectrum antifungal therapy may be indicated and a formal Infectious Diseases consult should be considered.
PAMC ADULT Appendicitis Clinical Pathway (Figure 1) (Last Updated 5/2015)

Suspected Appendicitis: History, physical examination, labs, imaging

**High Risk Criteria**
- Immunocompromised
- Advanced age (>70 yo)
- Severe physiologic disturbance

Operable

Does patient meet criteria for high risk?

No

Initiate IV antibiotics and repeat imaging to assess for improvement
*Consider ID consult for antibiotic duration

Yes

Anaphylactic Beta-lactam allergy

Yes

Levofloxacin* 750 mg IV/PO Q24H and Metronidazole 500 mg IV/PO Q8H

No

Piperacillin/Tazobactam 3.375 g IV Q6H

No

Anaphylactic Beta-lactam allergy

Yes

Levofloxacin* 750 mg IV/PO Q24H and Metronidazole 500 mg IV/PO Q8H

No

Cefazolin 2 g IV Q8H and Metronidazole 500 mg IV/PO Q8H

Was adequate source control attained?

No

Consider ID consult, duration will be patient specific based on clinical response

Yes

Was appendix perforated, gangrenous, or abscessed?

No

Stop antibiotics within 24 hours, no additional doses needed post-operatively

Yes

Did patient have rapid response to therapy?

No

Continue therapy for total 4 days (IV+PO)

Yes

Continue therapy for total 7 days (IV+PO)

**IV to PO Conversion per P&T**
- Tolerating food/enteral feedings or other oral medications
- No contraindications to oral medications
- Afebrile at least 24 hours
- Improving trend in WBC
- Stable vital signs

**IV to PO Transitions**
- Cefazolin 2g IV Q8H \(\rightarrow\) Cephalexin 1000 mg PO Q8H
- Levofloxacin 750 mg IV Q24H \(\rightarrow\) Levofloxacin 750 mg PO Q24H
- Metronidazole 500 mg IV Q8H \(\rightarrow\) Metronidazole 500 mg PO Q8H

* Fluoroquinolones should not be used during pregnancy
PAMC PEDIATRIC Appendicitis Clinical Pathway (Figure 2)
(Last Updated 5/2015)

Suspected Appendicitis: History, physical examination, labs, imaging

High Risk Criteria
- Immunocompromised
- Severe physiologic disturbance

Operable
- Yes
- Does patient meet criteria for high risk?
- Anaphylactic Beta-lactam allergy
  - Yes
  - Ciprofloxacin* and Metronidazole*
  - No
  - Piperacillin/Tazobactam*
- Anaphylactic Beta-lactam allergy
  - Yes
  - Ciprofloxacin* and Metronidazole*
  - No
  - Ceftriaxone and Metronidazole*

Was adequate source control attained?
- Yes
- Was appendix perforated, gangrenous, or abscessed?
  - Yes
  - Stop antibiotics within 24 hours, no additional doses needed post-operatively
  - No
  - Did patient have rapid response to therapy?
    - Yes
    - Continue therapy for total 4 days (IV+PO)
    - No
    - Continue therapy for total 7 days (IV+PO)
  - No
  - Consider ID consult, duration will be patient specific based on clinical response

Initiate IV antibiotics and repeat imaging to assess for improvement
*Consider ID consult for antibiotic duration

IV to PO Conversion per P&T
- Tolerating food/enteral feedings or other oral medications
- No contraindications to oral medications
- Afebrile at least 24 hours
- Improving trend in WBC
- Stable vital signs

IV to PO Transitions
- Ceftriaxone 75 mg/kg IV Q24H (max 2000 mg daily) → Cephalexin 12.5 mg/kg PO Q6H (max 4 g daily)
- Ciprofloxacin 10 mg/kg IV Q12H (max 800 mg daily) → Ciprofloxacin 15 mg/kg PO Q12H (max 1500 mg daily)
- Metronidazole 10 mg/kg IV Q8H → Metronidazole 10 mg/kg PO Q8H (max 1500 mg daily)

^ Fluoroquinolones should not be used during pregnancy
* Dosing in IV to PO transitions box
References


