

Provincial Clinical Knowledge Topic

Appendicitis, Pediatric – Inpatient

V 1.0

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Revision History

Version	Date of Revision	Description of Revision	Revised By
1.0	November 2018	Topic Complete	See Acknowledgements

Important Information Before You Begin

The recommendations contained in this knowledge topic have been provincially adjudicated and are based on best practice and available evidence. Clinicians applying these recommendations should, in consultation with the patient, use independent medical judgment in the context of individual clinical circumstances to direct care. This knowledge topic will be reviewed periodically and updated as best practice evidence and practice change.

The information in this topic strives to adhere to Institute for Safe Medication Practices (ISMP) safety standards and align with Quality and Safety initiatives and accreditation requirements such as the Required Organizational Practices. Some examples of these initiatives or groups are: Health Quality Council Alberta (HQCA), Choosing Wisely campaign, Safer Healthcare Now campaign etc.

Keywords

- Pediatric
- Appendicitis
- Appendectomy
- Simple Appendicitis
- Complicated Appendicitis
- Late Perforated Appendicitis with Phlegmonous Mass or Abscess
- Surgery

Rationale

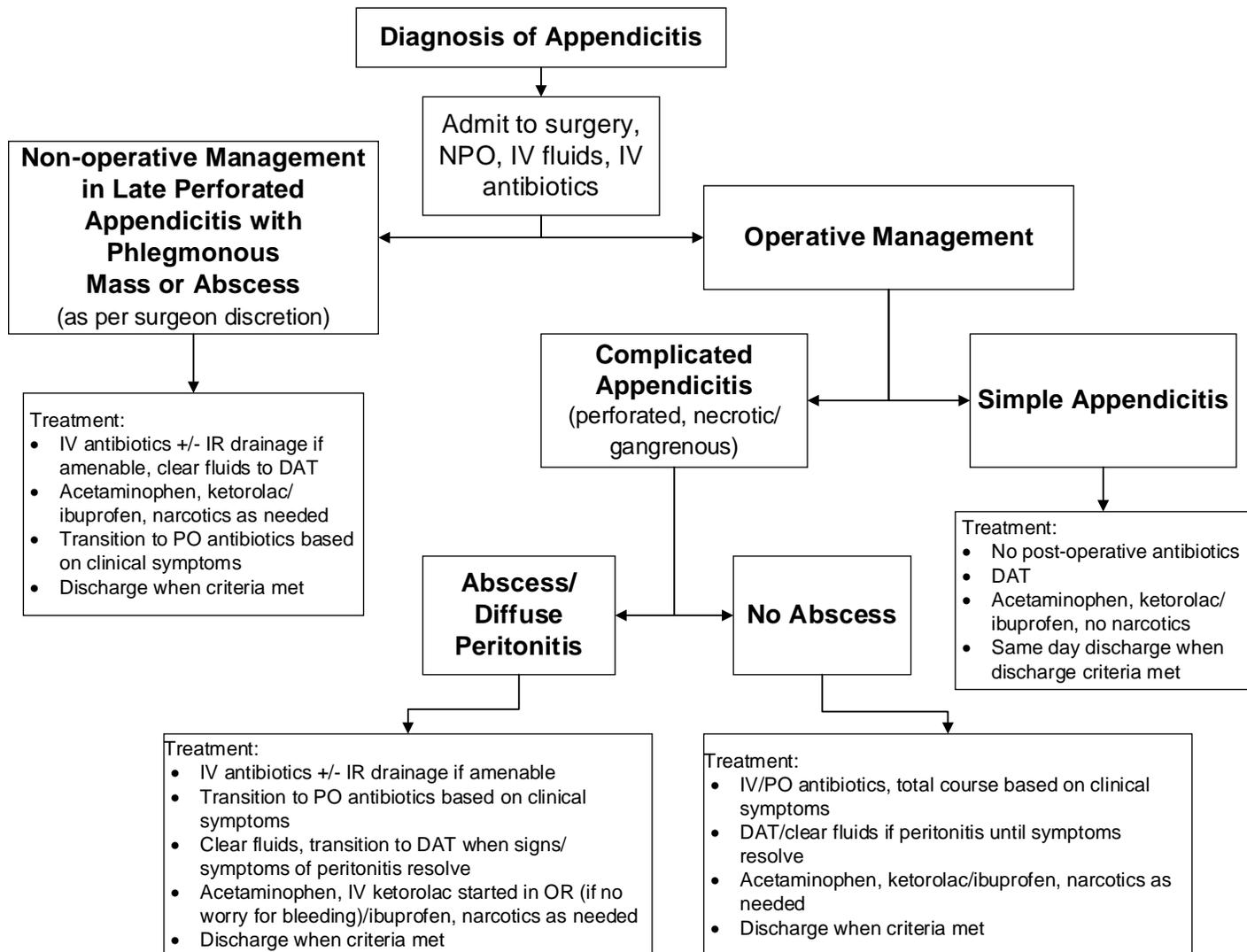
Acute appendicitis is the most common abdominal surgical emergency in children^{1,2}. The lifetime risk of developing appendicitis is 7-8%, with the incidence being highest in the second decade of life²⁻⁴. Appendicitis can be subdivided between simple, non-perforated appendicitis and complicated appendicitis with perforation and/or abscess formation³. Treatment varies depending on the presentation. Given how common appendicitis is, it is important to have a directed approach to management of all pediatric patients who present with appendicitis.

Goals of Management

1. Ensure pre-operative goal-directed resuscitation with appropriate IV fluids
2. Use of effective antimicrobial regimens and improve compliance with ideal timing for antimicrobial administration for surgical site infection prophylaxis
3. Once the diagnosis of appendicitis is made, ensure safe and timely surgical management
4. Streamline post-operative care pathways and disposition planning to help decrease length of stay

Diagnosis of Appendicitis

Figure #1 Diagnosis of Appendicitis Algorithm



Decision Making

Assessment of patient stability ⁵⁻⁹

- Septic/unstable
 - Initiate 20 mL/kg IV fluid bolus of crystalloid solution (normal saline or ringers lactate), repeat as necessary for adequate end organ perfusion followed by maintenance IV fluids with isotonic solution (KCl 20 mmol/L in dextrose 5% [D5W] - sodium chloride 0.9%). Strict avoidance of hypotonic solutions in pediatric patients to prevent neurologic complications secondary to hyponatremia.
 - Early administration of broad spectrum antibiotics
 - Consider ICU assessment
 - Initiate vasopressor medications before exceeding 60 mL/kg IV fluid
 - Expedited surgical intervention
- Stable
 - Maintenance IV fluids with isotonic solution (KCl 20 mmol/L in dextrose 5% [D5W] - sodium chloride 0.9%). Strict avoidance of hypotonic solutions in pediatric patients to prevent neurologic complications secondary to hyponatremia.
 - Early administration of appropriate antibiotics
 - Timely surgical intervention (e.g. within 6 to 24 hours)

Assessment of simple versus complicated appendicitis

- Consider length of symptoms, patient vital signs including temperature, evidence of peritonitis, lethargy, inflammatory markers, evidence of perforation, fluid, phlegmon or abscess formation on imaging studies

Simple appendicitis: inflamed, non-perforated

- Current standard practice for acute appendicitis is laparoscopic appendectomy.
 - When equipment and surgical expertise is available, laparoscopic appendectomy is preferred over open appendectomy given the lower wound infection rate and possible shorter hospital stay and quicker return to activity.^{2, 10}
 - Trials to compare appendectomy with primary antibiotic treatment of acute appendicitis are ongoing and controversial. The evidence on the role of antibiotics for the treatment of appendicitis is currently evolving. At this time, surgery remains the standard of care for treatment of the patient with uncomplicated appendicitis.^{2, 11}
- Patients should empty their bladder just prior to surgery. If not done, an in and out catheter should be placed to empty the bladder prior to starting the procedure.
- Ideal timing of antimicrobial administration for prophylaxis of surgical site infection is within 60 minutes prior to skin incision.¹²
- Appropriate prophylactic antibiotic regimens include^{1-2, 12-14}:
 - Cefazolin and metronidazole
 - While cefoxitin is reported as effective surgical prophylaxis in other national guidelines, within Alberta, there is poor E. coli susceptibility as well as much

- higher cost associated with cefoxitin. Therefore, the use of cefoxitin for surgical site prophylaxis is not recommended in Alberta.
- Alternative regimens for patients with allergy to cefazolin or severe non-IgE mediated reaction to any β -lactam include^{12, 15}:
 - Clindamycin and gentamicin
 - Metronidazole and gentamicin

Note: Due to known side effects and significant increased gram negative resistance, ciprofloxacin and other fluoroquinolones in combination with metronidazole or clindamycin are reserved for when there is no other reasonable alternative. Review of local antibiograms should be considered.
- Post-operative management^{1, 13-14, 16-17}
 - Full diet
 - No post-operative antibiotics required
 - Pain management with acetaminophen and one dose of IV ketorolac in the OR (transition to ibuprofen when tolerating PO intake); no narcotics
 - Continue isotonic IV solution at 100% maintenance until drinking well, then saline lock
 - Same day discharge is appropriate as long as discharge criteria are met (see [Disposition Planning](#))¹⁸⁻²²

Complicated appendicitis – gangrenous/necrotic, perforated

- Patients should empty their bladder just prior to surgery. If not done, an in and out catheter should be placed to empty the bladder prior to starting the procedure. If the patient is septic and the post-operative fluid balance is of concern, an in-dwelling catheter should be left in place. On post-operative day 1, once there is evidence of adequate urine output, the indwelling urinary catheter should be removed.
- Ideal timing of antimicrobial administration for prophylaxis of surgical site infection with cefazolin and metronidazole is within 60 minutes prior to skin incision^{1, 12-13} unless adequate coverage with another appropriate antibiotic is administered.
- Appropriate therapeutic antibiotic regimens for treatment include¹²:
 - Ceftriaxone and metronidazole
 - Ampicillin and gentamicin and metronidazole
 - Piperacillin/tazobactam (septic patients)
 - Studies have shown that single agent and dual agent therapy is as effective and more cost efficient than triple therapy^{2, 12, 16-17}
- Alternative regimens for patients with allergy to cefazolin or severe non-IgE mediated reaction to any β -lactam include¹²
 - Clindamycin and gentamicin
- Post-operative management
 - Continue isotonic IV solution at 100% maintenance until drinking well, then saline lock
 - Continue IV antibiotics (same as preoperative regimen); course of treatment is based on resolution of clinical symptoms such as lack of fever, improvement of abdominal pain, resolution of ileus^{2, 13, 16-7}

- Studies have not shown improved outcomes with empiric minimum lengths of IV antibiotic therapy as compared to clinically based course of treatment^{1, 13, 16-17}
- Transition to PO antibiotics to fulfill an empiric length of antibiotic treatment is not necessary^{13, 16-17}.
- If clinical symptoms do not improve by 5-7 days, CBC, INR/PTT should be checked and an ultrasound of the abdomen/pelvis should be performed to look for an abscess
 - Presence of an abscess should prompt interventional radiology (IR) assessment for image guided drainage
 - Drains should be flushed with 10 mL of normal saline BID to help keep them patent
 - Drains should be removed when there is minimal output (less than 10 mL/24 hours)
- Clear fluid diet with progression to a full diet as signs/symptoms of peritonitis resolve
- Pain management with PO/PR acetaminophen and IV ketorolac for up to 48 hours (first dose given in the OR), transition ketorolac to PO ibuprofen as soon as tolerating oral feeds, or after 48 hours. Narcotics only if necessary, limit duration.¹⁷
- Early ambulation, incentive spirometry, deep breathing and coughing should be encouraged
- Discharge home when criteria are met (see disposition planning)

Complicated appendicitis – with abscess or diffuse contamination/peritonitis

- Antibiotic regimens, timing for surgical site prophylaxis, postoperative diet, analgesic requirements and discharge planning are similar to recommendations given for complicated appendicitis without abscess (see complicated appendicitis – gangrenous/necrotic, perforated section above for list of appropriate antibiotics).
- Preoperative IV antibiotic regimen should be continued in the postoperative period until resolution of clinical symptoms such as lack of fever, improvement of abdominal pain, resolution of ileus and normalization of WBC. At which point, the patient should be transitioned to PO antibiotics to finish a total course of 7-10 days of antibiotic therapy based on clinical judgement. Of note, there is no definitive evidence to guide the exact length of treatment in patients with complicated appendicitis with abscess.^{2, 13, 16-17}
- Appropriate PO antibiotic regimens include^{15, 17}:
 - Amoxicillin-clavulanate
 - Ciprofloxacin and metronidazole

Note: Due to known side effects and significant increased gram negative resistance, ciprofloxacin and other fluoroquinolones in combination with metronidazole is reserved for when there is no other reasonable alternative. Review of local antibiograms should be considered.
- If clinical symptoms do not improve by 5-7 days, check a CBC, INR/PTT and an ultrasound of the abdomen/pelvis should be performed to look for an abscess

- Presence of an abscess should prompt interventional radiology (IR) assessment for image guided drainage
- Drains should be flushed with 10 mL of normal saline BID to help keep them patent
- Drains should be removed when there is minimal output (less than 10 mL/24 hours)

Non-operative management of late perforated appendicitis with phlegmonous mass or abscess

- Appropriate for patients who have a prolonged length of symptoms and evidence of walled off abscess on imaging. Non-operative management may be appropriate in select patients with prolonged history of symptoms with evidence of a phlegmonous mass on imaging that is large or presents with associated complications (such as but not limited to hydronephrosis)
- Presence of a walled off abscess should prompt IR assessment for image guided drainage
 - Drains should be flushed with 10 mL of normal saline BID to help keep them patent
 - Drains should be removed when there is minimal output (less than 10 mL/24hours)
- IV antibiotics should be continued until resolution of clinical symptoms such as lack of fever, improvement of abdominal pain, resolution of ileus and normalization of WBC.^{13, 17} If patient deteriorates or fails to improve, surgical management should be considered.
- Appropriate antibiotic regimens include^{12-13, 17}:
 - Ceftriaxone and metronidazole
 - Ampicillin and gentamicin and metronidazole
 - Piperacillin/tazobactam (septic patients)
 - Studies have shown that single agent and dual agent therapy is as effective and more cost efficient than triple therapy
- Alternative regimens for patients with allergy to cefazolin or severe non-IgE mediated reaction to any β -lactam¹²
 - Clindamycin and gentamicin
- The patient should be transitioned to PO antibiotics to finish a total course of 10-14 days of antibiotic therapy based on clinical judgement. Of note, there is minimal evidence to guide the length of treatment in patients who undergo non-operative management of appendicitis with phlegmon/abscess^{13, 17}
- Appropriate PO antibiotic regimens include¹⁵:
 - Amoxicillin-clavulanate
 - Ciprofloxacin and metronidazole

Note: Due to known side effects and significant increased gram negative resistance, ciprofloxacin and other fluoroquinolones in combination with metronidazole is reserved for when there is no other reasonable alternative. Review of local antibiograms should be considered.
- Patients may be started on a clear fluid diet with progression to a full diet as signs/symptoms of peritonitis resolve

- Pain management with PO/PR acetaminophen and IV ketorolac for up to 48 hours (first dose given in the OR), transition ketorolac to PO ibuprofen as soon as tolerating oral feeds, or after 48 hours. Narcotics only if necessary, limit duration.¹⁷
- Early ambulation, incentive spirometry, deep breathing and coughing should be encouraged
- Discharge home once discharge criteria are met (see disposition planning)
 - No follow up imaging is required
 - A follow up appointment with general surgery should be made to discuss the risks/merits of interval appendectomy²

Appendicitis, Pediatric Pre-Op Order Set

Order Set Components

Order Set Keywords: appendicitis, appendectomy, appy, peds, pre-op

Order Set Requirements: weight

Admit, Transfer, Discharge

- Admit To: _____, Diagnosis: _____

Diet and Nutrition

- NPO
 Clear Fluids
 Pediatric Diet

Activity

- Activity as Tolerated

Patient Care

- Weigh Patient

Monitoring

- Vital Signs: respiratory rate(RR), pulse (P), blood pressure(BP), temperature and oxygen saturation (SpO₂)
- every 1 hours
 - every 2 hours
 - every 4 hours
- Intake and Output – Measure all ins/outs
- every 2 hours
 - every 4 hours
 - every 8 hours
- Notify MD if urine output less than 1 mL/kg/hour or less than 0.5 mL/kg/hr for adolescents

Laboratory Investigations

- Complete Blood Count (CBC) with differential
 Carbon dioxide (CO₂)
 Chloride (Cl)
 Creatinine
 Potassium (K)
 Sodium (Na)

For late perforated appendicitis with phlegmonous mass or abscess choose:

- PT INR
 PTT

Diagnostic Investigations

- US Abdomen, Complete - Rule out appendicitis

For late perforated appendicitis with phlegmonous mass or abscess choose:

- US Abdomen, Complete to rule out drainable collection
- SP Mass or Organ Biopsy or Aspiration (IR guided aspiration/drainage)

Intravenous Therapy

- Intravenous Cannula – Insert: Initiate IV and apply normal saline 0.9% lock
- Intravenous Cannula – Insert: Initiate upon arrival to operating room (OR)

For sodium chloride bolus, recommended dosage is 10 to 20 mL/kg

- sodium chloride 0.9% bolus _____ mL IV as fast as possible
- sodium chloride 0.9% infusion at _____ mL/hr IV 1 x maintenance
- lactated ringers infusion at _____ mL/hr IV x 1 maintenance
- KCl 20 mmol/L in dextrose 5% (D5W) - sodium chloride 0.9% infusion at _____ mL/hour IV 1 x maintenance

Medications

Antibiotic Prophylaxis

Refer to the AHS surgical prophylaxis guidelines / [Bugs & Drugs](#) for specific antibiotic recommendations based on surgery type and clinical indications. Pre-operative dose to be given within 60 minutes prior to skin incision for optimal Surgical Site Infection (SSI) prophylaxis.

Choose ONE antibiotic option for surgical prophylaxis:

Option 1

For ceFAZolin, recommended dosage is 30 mg/kg/dose

- ceFAZolin _____ mg IV once pre-op for surgical prophylaxis, within 60 minutes prior to skin incision. Maximum 2 g/dose.
Omit if scheduled antibiotic dose is administered within 60 minutes prior to skin incision.

AND

For metronidazole, recommended dosage is 15 mg/kg/dose

- metronIDAZOLE _____ mg IV once pre-op for surgical prophylaxis, within 60 minutes prior to skin incision. Maximum 500 mg/dose
Omit if scheduled antibiotic dose is administered within 60 minutes prior to skin incision.

Option 2

Choose for patients with ceFAZolin allergy or severe non-IgE mediated reaction to any β -lactam:

For clindamycin, recommended dosage is 15 mg/kg/dose

- clindamycin _____ mg IV once pre-op for surgical prophylaxis, within 60 minutes prior to skin incision. Maximum 600 mg/dose
Omit if scheduled antibiotic dose is administered within 60 minutes prior to skin incision.

AND

For gentamicin, recommended dosage 2.5 mg/kg/dose

- gentamicin _____ mg IV once pre-op for surgical prophylaxis, within 60 minutes prior to skin incision.

Omit if scheduled antibiotic dose is administered within 60 minutes prior to skin incision.

Antibiotic Treatment for Appendicitis

Refer to [Bugs & Drugs](#) for specific antibiotic recommendations based on surgery type and clinical indications.

Simple Appendicitis

Guidelines suggest 1st dose of antibiotics as soon as possible at time of diagnosis with pre-operative dose to be given within 60 minutes prior to skin incision for optimal Surgical Site Infection (SSI) prophylaxis. 1st dose is given within one hour of skin incision, re-dosing is not necessary.

Choose ONE antibiotic option for treatment of simple appendicitis:

Option 1

For cefazolin, recommended dosage is 30 mg/kg/dose

- ceFAZolin _____ mg IV every 8 hours. Maximum 2 g/dose

AND

For metronidazole, recommended dosage is 15 mg/kg/dose

- metroNIDAZOLE _____ mg IV every 12 hours Maximum 500 mg/dose

Option 2

Choose for patients with ceFAZolin allergy or severe non-IgE mediated reaction to any β -lactam:

For clindamycin, recommended dosage is 15 mg/kg/dose

- clindamycin _____ mg IV every 8 hours Maximum 600 mg/dose

AND

For gentamicin, recommended dosage 2.5 mg/kg/dose

- gentamicin _____ mg IV every 8 hours

Option 3

Due to known side effects and significant increased gram negative resistance, ciprofloxacin and other fluoroquinolones in combination with metronidazole or clindamycin are reserved for when there is no other reasonable alternative. Review of local antibiograms should be considered.

For metronidazole, recommended dosage is 15 mg/kg/dose

- metroNIDAZOLE _____ mg IV every 12 hours Maximum 500 mg/dose

AND

For gentamicin, recommended dosage is 2.5 mg/kg/dose

- gentamicin _____ mg IV every 8 hours

Complicated Appendicitis / Non-Operative Management of Late Perforated Appendicitis with Phlegmonous Mass or Abscess

Guidelines suggest 1st dose of antibiotics as soon as possible at time of diagnosis with pre-operative dose to be given within 60 minutes prior to skin incision for optimal Surgical Site Infection (SSI) prophylaxis. If 1st dose is given within an hour of skin incision, re-dosing is not necessary.

Choose ONE antibiotic option for treatment of Complicated Appendicitis / Non-Operative Management of Late Perforated Appendicitis with Phlegmonous Mass or Abscess:

Option 1

For ceftriaxone, recommended dosage is 50 to 75 mg/kg/dose

- cefTRIAxone _____ mg IV every 24 hours. Maximum 2 g/dose

AND

For metronidazole, recommended dosage is 15 mg/kg/dose

- metroNIDAZOLE _____ mg IV every 12 hours. Maximum 500 mg/dose

OR

For ampicillin, recommended dosage is 50 mg/kg/dose

- ampicillin _____ mg IV every 6 hours. Maximum 2 g/dose

AND

For gentamicin, recommended dosage is 2.5 mg/kg/dose

- gentamicin _____ mg IV every 8 hours

AND

For metronidazole, recommended dosage is 15 mg/kg/dose

- metroNIDAZOLE _____ mg IV every 12 hours. Maximum 500 mg/dose

Option 2

Reserved for patients with signs and symptoms of severe sepsis.

Dosed as piperacillin component, 100 mg piperacillin/kg/dose

- piperacillin / tazobactam _____ mg piperacillin IV every 8 hours. Maximum 4 g piperacillin/dose

For patients greater than 40 kg

- piperacillin / tazobactam 3 g piperacillin IV every 6 hours

Option 3

For patients with ceFAZolin allergy or severe non-IgE mediated reaction to any β -lactam:

For clindamycin, recommended dosage is 15 mg/kg/dose

- clindamycin _____ mg IV every 8 hours. Maximum 600 mg/dose

AND

For gentamicin, recommended dosage is 2.5 mg/kg/dose

- gentamicin _____ mg IV every 8 hours

Analgesics

For acetaminophen, recommended dosage is 15 mg/kg/dose

- acetaminophen _____ mg PO every 4 hours PRN for pain. Maximum 1 g/dose, 5 doses/24 hours OR 4 g/day
- acetaminophen supp _____ mg rectally every 4 hours PRN for pain. Maximum 1 g/dose, 5 doses/24 hours OR 4g/day

For ibuprofen, recommended dosage is 10 mg/kg/dose

- ibuprofen _____ mg PO every 6 hours PRN for pain. Maximum 400 mg/dose, 40 mg/kg/day, 2400 mg/day

For morphine PO, recommended dosage is 0.1 to 0.2 mg/kg/dose

- morphine _____ mg PO every 3 hours PRN for pain. Stop after 24 hours

For morphine IV, recommended dosage is 0.05 - 0.1 mg/kg/dose

- morphine _____ mg IV every 3 hours PRN for pain. Stop after 24 hours

Antiemetics

For dimenhydrinate, recommended dosage is 1 mg/kg/dose

- dimenhydrINATE _____ mg PO every 4 hours PRN for nausea. Maximum 50 mg/dose
- dimenhydrINATE _____ mg IV every 4 hours PRN for nausea. Maximum 50 mg/dose

For ondansetron, recommended dosage is 0.1 mg/kg/dose

- ondansetron _____ mg PO every 8 hours PRN for nausea. Maximum 8 mg/dose
- ondansetron _____ mg IV every 8 hours PRN for nausea. Maximum 4 mg/dose

Consults / Referrals

- MD Consult: _____

Simple Appendicitis, Pediatric Post-Op Order Set

Order Set Components

Order Set Keywords: appendicitis, appy, peds, postop

Order Set Requirements: weight

Diet and Nutrition

- Pediatric Diet

Activity

- Activity as Tolerated

Monitoring

- Post-Op Vital Sign Protocol
- Intake and Output – Measure all ins/outs every 4 hours
- Notify MD if urine output less than 1 mL/kg/hour or less than 0.5 mL/Kg/hr for adolescents
-

Respiratory Care

- Deep Breathing and Coughing every 1 hour while awake
- Incentive Spirometer every 1 hour while awake
- O2 Therapy - Titrate to Saturation, Maintain SpO2 92% or greater

Intravenous Therapy

- lactated ringers infusion at _____ mL/hr IV x 1 maintenance
- KCl 20 mmol in dextrose 5% (D5W) – sodium chloride 0.9% infusion at _____ mL/hour IV 1 x maintenance, stop when drinking well

Medications

Analgesics

For acetaminophen, recommended dosage is 15 mg/kg/dose

- acetaminophen _____ mg PO every 4 hours PRN for pain. Maximum 1 g/dose, 5 doses/24 hours OR 4 g/day
- acetaminophen supp _____ mg rectally every 4 hours PRN for pain. Maximum 1 g/dose, 5 doses/24 hours OR 4g/day

For ibuprofen, recommended dosage is 10 mg/kg/dose

- ibuprofen _____ mg PO every 6 hours PRN for pain. Maximum 400 mg/dose, 40 mg/kg/day, 2400 mg/day

Antiemetics

For dimenhydrinate, recommended dosage is 1 mg/kg/dose

- dimenhyDRINATE _____ mg PO every 4 hours PRN for nausea. Maximum 50 mg/dose
- dimenhyDRINATE _____ mg IV every 4 hours PRN for nausea. Maximum 50 mg/dose

For ondansetron, recommended dosage is 0.1 mg/kg/dose

- ondansetron _____ mg PO every 8 hours PRN for nausea. Maximum 8 mg/dose
- ondansetron _____ mg IV every 8 hours PRN for nausea. Maximum 4 mg/dose

Discharge

- Post-operative antibiotic treatment not required after discharge
- Discharge Patient when the patient meets the following criteria:
 - Tolerating oral intake
 - Pain controlled on oral analgesics
 - Ambulating
 - Vital signs within normal limits
- Discharge Instructions: Follow up with surgeon in 4 to 6 weeks
- Discharge Instructions: If dressing in place (excluding steri-strips), remove in 48 hours
- Discharge Instructions: May shower at 48 hours
- Discharge Instructions: Patient may go swimming 1 week after procedure
- Discharge Instructions: Return to school when able
- Discharge Instructions: Start gym/sports/heavy lifting in 4 weeks
- Discharge Instructions: Notify physician if there are any warning signs – fever, increased pain, swelling or spreading redness, drainage from incision, increasing diarrhea
- Provide family with discharge instructions as per institutional guidelines

Complicated Appendicitis, Pediatric Post-Op Order Set

Order Set Components

Order Set Keywords: appendicitis, appendectomy, appy, peds, post-op

Order Set Requirements: weight

Diet

- Progressive Diet: Clear Fluids to DAT (*please also select a diet order*)
- Clear Fluids
- Pediatric Diet

Activity

- Activity as Tolerated

Patient Care

- Clinical communication: Flush drains with 10 mL normal saline BID

Monitoring

- Post-Op Vital Sign Protocol
- Vital Signs: respiratory rate(RR), pulse (P), blood pressure(BP), temperature and oxygen saturation (SpO₂)
 - every 1 hours
 - every 2 hours
 - every 4 hours
- Intake and Output – Measure all ins/outs
 - every 2 hours
 - every 4 hours
- Notify MD if urine output less than 1 mL/kg/hour or less than 0.5 mL/Kg/hr for adolescents

Respiratory Care

- Deep Breathing and Coughing every 1 hour while awake
- Incentive Spirometer every 1 hour while awake
- O₂ Therapy - Titrate to Saturation, Maintain SpO₂ 92% or greater

Intravenous Therapy

For sodium chloride bolus, recommended dosage is 10 to 20 mL/kg

- sodium chloride 0.9% bolus _____ mL as fast as possible if urine output not meeting target of 1 mL/kg/hour
- dextrose 5% (D5W) – sodium chloride 0.9% infusion at _____mL/hour IV 1 x maintenance
- lactated ringers infusion at _____ mL/hr IV x 1 maintenance
- KCl 20 mmol in dextrose 5% (D5W) – sodium chloride 0.9% infusion at _____mL/hour IV 1 x maintenance

- KCl 40 mmol in dextrose 5% (D5W) – sodium chloride 0.9% infusion at _____ mL/hour
IV 1 x maintenance

Medications

Antibiotic treatment for complicated appendicitis

- Clinical communication: Resume appendicitis treatment antibiotics ordered pre-op

Choose ONE antibiotic option for complicated appendicitis:

Option 1

- For ceftriaxone, recommended dosage is 50 to 75 mg/kg/dose*
- cefTRIAxone _____ mg IV every 24 hours Maximum 2 g/dose
- AND**
- For metronidazole, recommended dosage is 15 mg/kg/dose*
- metroNIDAZOLE _____ mg IV every 12 hours Maximum 500 mg/dose

OR

- For ampicillin, recommended dosage is 50 mg/kg/dose*
- ampicillin _____ mg IV every 6 hours Maximum 4 g/day
- AND**
- For gentamicin, recommended dosage is 5 to 7 mg/kg/dose*
- gentamicin _____ mg IV every 24 hours
- AND**
- For metronidazole, recommended dosage is 15 mg/kg/dose*
- metroNIDAZOLE _____ mg IV every 12 hours Maximum 500 mg/dose

Option 2

Reserved for patients with signs and symptoms of severe sepsis.

- Dosed as piperacillin component, 100 mg piperacillin/kg/dose*
- piperacillin / tazobactam _____ mg piperacillin IV every 8 hours Maximum 4 g piperacillin/dose
- For patients greater than 40 kg*
- piperacillin / tazobactam 3 g piperacillin IV every 6 hours

Option 3

For patients with ceFAZolin allergy or severe non-IgE mediated reaction to any β -lactam:

- For clindamycin, recommended dosage is 10 mg/kg/dose*
- clindamycin _____ mg IV every 8 hours Maximum 600 mg/dose
- AND**
- For gentamicin, recommended dosage is 5 to 7 mg/kg/dose*
- gentamicin _____ mg IV every 24 hours

Analgesics

For acetaminophen, recommended dosage is 15 mg/kg/dose

- acetaminophen _____ mg PO every 4 hours PRN for pain. Maximum 1 g/dose, 5 doses/24 hours OR 4 g/day
- acetaminophen supp _____ mg rectally every 4 hours PRN for pain. Maximum 1 g/dose, 5 doses/24 hours OR 4g/day

For ketorolac, recommended dosage is 0.5 mg/kg/dose

- ketorolac _____ mg IV every 8 hours, stop after 48 hours. Maximum 15 mg/dose
AND THEN

For ibuprofen, recommended dosage is 10 mg/kg/dose

- ibuprofen liquid _____ mg PO every 6 hours PRN for pain. Start 6 hours after last ketorolac dose. Maximum 400 mg/dose, 40 mg/kg/day, 2400 mg/day

For morphine PO, recommended dosage is 0.1 to 0.2 mg/kg/dose

- morphine _____ mg PO every 3 hours PRN for pain

For morphine IV, recommended dosage is 0.05 - 0.1 mg/kg/dose

- morphine _____ mg IV every 3 hours PRN for pain
- Refer to local institutional practices for Morphine Continuous Infusion until provincial orders available

Antiemetics

For dimenhydrinate, recommended dosage is 1 mg/kg/dose

- dimenhyDRINATE _____ mg PO every 4 hours PRN for nausea. Maximum 50 mg/dose
- dimenhyDRINATE _____ mg IV every 4 hours PRN for nausea. Maximum 50 mg/dose

For ondansetron, recommended dosage is 0.1 mg/kg/dose

- ondansetron _____ mg PO every 8 hours PRN for nausea. Maximum 8 mg/dose
- ondansetron _____ mg IV every 8 hours PRN for nausea. Maximum 4 mg/dose

Rural Considerations

Outside of Calgary or Edmonton, once there is suspicion of appendicitis in a pediatric patient an emergent referral to the local surgical service should be made. The local surgeon should assess the child and have a discussion with anesthesia regarding whether the local expertise and facilities available are capable of managing the child's care. Should there be any concern that the child requires pediatric specialists (pediatric surgeon, pediatric anesthetist, pediatric ICU or pediatric interventional radiology), the child should be stabilized and transferred to the nearest pediatric center (Stollery or Alberta Children's Hospital).

Disposition Planning

1. Considerations for Discharge/Transfer

Discharge criteria^{14, 17}

- Afebrile and vital signs are within normal limits for last 24 hours
- Tolerating a full diet with no emesis
- Ambulating without assistance (as age appropriate)
- Pain controlled with oral analgesics (acetaminophen and ibuprofen)
- Same day discharge has been shown to be safe and effective in appropriate pediatric patients who have simple appendicitis and are treated with laparoscopic appendectomy.¹⁸⁻²²
 - Institutions with protocols in place for fast-track discharge post laparoscopic appendectomy for simple appendicitis have shown significantly decreased length of stay and cost associated with treatment while maintaining similar post-operative complication rates and emergency room visits/admissions.
 - Patients may be discharged from the ward, post anesthetic care unit (PACU) or day stay unit once the above discharge criteria are met, with slight adjustments for same day discharge being: once patients are afebrile and vital signs are within normal limits in the post-operative period as opposed to the last 24 hours
 - While fast-track protocols are generally aimed at enhancing recovery in the post-operative period, it is imperative to start the discharge process during the initial assessment and throughout their care.
 - Emergency department physicians and nurses must be aware of same day discharge protocols for simple appendicitis to prevent discussing routine overnight admission thereby confusing patients and family members when the surgical team advises same day discharge
 - The surgery team (including residents, fellows and attending surgeons) should discuss the discharge criteria and instructions beginning in the emergency department, continuing in the OR holding area and finally immediately post-operatively while the attending discusses the outcomes of the case with the family

- Anesthesiologists should be made aware of the same day discharge protocol to assist with post-operative enhanced recovery as well as pain control, specifically with an intra-operative dose of IV ketorolac
- Nursing teams on the ward, day stay unit and PACU must be educated about the same day discharge protocol for it to be successful
 - Once awake, patients are started on a full oral diet. Upon tolerating PO intake, the IV is saline locked
 - Patients are encouraged to ambulate early in the recovery period (i.e. within 2 hours)
 - No IV analgesics are administered
 - Discharge instructions are discussed early in the post-operative period to expedite the process

2. Outpatient follow-up

- Follow up in 4-6 weeks with surgeon
- Follow up/discharge instructions as per below

Clinical Questions & Recommendations

Clinical Questions help us to ask pertinent information about the knowledge topic in order to facilitate finding an evidence based answer that will guide decision making. Working groups have the option of identifying 2-3 key clinical questions. The questions chosen will then be prioritized using a Likert scale and evidence search strategy determined. Clinical questions may be formulated based on the PICO format as supported by Sackett¹ and Guyatt² in their User's Guide to the Medical Literature to define the clinical question. PICO-D format identifies the patient problem or population (P), intervention (I), comparison (C) and outcome(s) (O).

1. Sackett D, Richardson WS, Rosenberg W, Haynes RB. How to practice and teach evidence based medicine. 2nd ed. Churchill Livingstone; 1997.
2. Guyatt GH, Oxman AD, Vist GE, et al; for the GRADE Working Group. GRADE: an emerging consensus on rating quality of evidence and strength of recommendations. *BMJ*. 2008; 336(7650):924-926.

GRADE Methodology - Used to address quality of evidence and strength of recommendations of answers to the clinical questions. Whenever possible answers are identified from recent high quality guidelines or high quality systematic reviews and recommendations provided are based on GRADE definitions. Where guidelines or systematic reviews are not available to answer certain questions rapid reviews are undertaken and/or a consensus approach used to try to answer clinically relevant questions. **Only where the evidence is supportive and the benefits clearly outweigh the harm is a “we recommend” strength of recommendation applied.**

Table 1. GRADE Quality of Evidence¹

High GRADE A	We have high confidence that the true effect lies close to that of the estimate of the effect.
Moderate GRADE B	We are moderately confident in the effect estimate: The true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different.
Low GRADE C	Our confidence in the effect estimate is low: The true effect may be substantially different from the estimate of the effect.
Very low GRADE D	We have very low confidence in the effect estimate: The true effect is likely to be substantially different from the estimate of effect.

Table 2. GRADE Strength of Recommendations¹

Strong GRADE 1	Strong recommendation, with desirable effects clearly outweighing undesirable effects/burdens (or vice versa). Wording of Recommendation: We recommend in favor of / We recommend against.....
Weak GRADE 2	Weak recommendation, with desirable effects closely balanced with undesirable effects. Wording of Recommendation: We suggest in favor of / We suggest against
Insufficient evidence or no consensus	Wording of Recommendation: There is insufficient evidence or the confidence in the effect estimates is so low that the panel is unable to make a recommendation regarding.....

1. Guyatt GH, Oxman AD, Vist GE, et al; for the GRADE Working Group. GRADE: an emerging consensus on rating quality of evidence and strength of recommendations. *BMJ*. 2008; 336(7650):924-926.

Clinical Question #1: What are the ideal antibiotic regimens for surgical site prophylaxis for pediatric appendicitis in Alberta and what is the ideal timing of antibiotic administration?

Clinical Recommendation #1: We recommend either cefazolin and metronidazole or ceftriaxone and metronidazole as first line antibiotic regimens for surgical site prophylaxis in pediatric appendicitis in Alberta. Antibiotic administration should ideally be given within 60 min prior to skin incision.

Quality of Evidence: High, GRADE A

Strength of Recommendation: GRADE 1, Strong

Clinical Question #2: In pediatric patients with appendicitis requiring maintenance IV fluids, what type of fluid should be administered.

Clinical Recommendation #2: We recommend use of isotonic IV fluid as maintenance fluid therapy in the pre-operative and post-operative period until patients are maintaining adequate PO intake. Strict avoidance of hypotonic fluid in pediatric patients is mandatory to prevent hyponatremia and subsequent neurologic complications.

Quality of Evidence: High, GRADE A

Strength of Recommendation: GRADE 1, Strong

Clinical Question #3: In pediatric patients who have had a laparoscopic appendectomy for simple appendicitis, is same day discharge a safe and effective model?

Clinical Recommendation #3: We recommend the use of a same day discharge protocol for pediatric patients who are treated with a laparoscopic appendectomy for simple appendicitis. It is a safe model that has been shown in prior studies to decrease length of stay and cost without an increase in post-operative complications, emergency department visits or admissions. Studies have also shown patient and family satisfaction with the expedited discharge protocol.

Quality of Evidence: Moderate, GRADE B

Strength of Recommendation: GRADE 1, Strong

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