# Appendicitis v.1.2

Executive Summary

Citation Information

Summary of Version Changes

Additional Information Slides

**Inclusion Criteria**

- Age > 3 months with confirmed appendicitis by the surgical team requiring acute or delayed appendectomy

**Exclusion Criteria**

- Age < 3 months and patients who do not have a confirmed appendicitis diagnosis by the surgical team

**Appendicitis Diagnosis Confirmed:**
1) Appendicitis diagnosis confirmed by surgical team
**AND**
2) Treatment plan includes either urgent appendectomy or non-operative appendicitis

No → **Off Pathway**

Yes

Communication of treatment plan by Surgical Attending/Fellow to ED Attending/Fellow

**ED Confirmed Appendicitis Phase:**

- **Antibiotics (FIRST DOSE)**
  CEFTRIAXONE & METRONIDAZOLE
  - If severe beta lactam allergy, then ciprofloxacin & metronidazole
- NPO
- NG Tube if distended and vomiting
- IV Fluids
- Pain Management

**Non-Operative Appendicitis**

**Surgical Team**

- Confirm ED Phase is complete
  - **If ED phase not complete, then complete and order first dose of antibiotics**
- Admit to Floor or ICU
- NPO
- NG Tube if distended and vomiting
- IV Fluids
- Pain Management
- Monitoring
- Antibiotics
  - CEFTRIAXONE & METRONIDAZOLE
  - If severe beta lactam allergy then ciprofloxacin + metronidazole
  - At least 7 days of antibiotics
  - Consider PICC line as per hospital policy

**Urgent Appendectomy**

**Surgical Team**

- Confirm ED Phase is complete
  - **If ED phase not complete, then complete and order first dose of antibiotics**
- Admission Orders
- Transfer to Operating room or Admit
- NPO
- NG Tube if distended and vomiting
- IV Fluids
- Pain Management
- Monitoring
- Antibiotics
  - CEFTRIAXONE & METRONIDAZOLE
  - If severe beta lactum allergy then ciprofloxacin + metronidazole



Last Updated: July 2014
Valid Until: July 2016

# Appendicitis v.1.2

**Care in the OR**

IV Antibiotics for surgical site prophylaxis
- Antibiotics need to be given less than one hour prior to incision
- If no antibiotics have been given in less than one hour prior to incision, then cefoxitin
- If severe beta lactam allergy then give clindamycin + gentamicin

- Anesthesia to assess and establish good IV access

**OR Findings**

**Complicated vs Uncomplicated Appendicitis:**
- Perforated
- Gangrenous
- Suppurative
- Peritonitis
- Abscess

Yes → **Complicated Appendicitis Post Operative Care:**
- NG Tube if distended or vomiting
- NPO
- Advance diet as tolerated
- IV Fluids
- Pain Management
- Monitoring
- IV Antibiotics for at least 72 hours
  - CEFTRIAXONE & METRONIDAZOLE
  - If severe beta lactam allergy then ciprofloxacin + metronidazole

**Discharge Readiness Assessment:**
**Beginning at POD#3, continuing daily until post op/ discharge criteria are met:**

**IF**
- Afebrile (T<38C)
- Tolerating Diet
- Pain well managed
- No sign of wound infection

**THEN** Check CBC differential

**If CBC/Differential NORMAL – Transition to PO Antibiotics and Discharge**

**Transition to PO antibiotics**
**IV + PO antibiotics = 7days Total**
- PO Augmentin
- If severe beta lactam allergy transition to ciprofloxacin + metronidazole

**Discharge Criteria**
- Afebrile (T<38C) x 24 hrs
- Tolerating Diet
- No sign of wound infection
- Pain is controlled
- CBC + Diff Evaluation
- Tolerated transition to PO

**Post Discharge Care**
- Family to return to clinic 1-3 weeks post discharge

**If CBC/Differential ABNORMAL – Continue IV antibiotics and reassess daily until patient meets discharge criteria or POD #7**

If patient has not met discharge criteria by POD #7 then reassess

**7 Day Assessment if not improving consider:**
- CT Scan
- Labs – CBC + differential
- CRP
- BUN/Creatinine
- AST
- ALT

**Off Pathway**

No → **Uncomplicated Appendicitis Post Operative Care:**
- Diet – Advance as tolerated
- IV Fluids
- Pain Management
- Monitoring
- Labs - None
- IV Antibiotics – None

**Discharge Criteria**
- Afebrile (T<38C)
- Tolerating Diet
- No sign of wound infection
- Pain is controlled

**Post Discharge Care**
- Clinic RN to call family 5-7 days post op

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For questions concerning this pathway, contact:Appendicitis@seattlechildrens.org



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Valid until: July 2016

# Additional Information

## Communication of Treatment Plan

*•The goal is for the patient to receive appropriate intravenous antibiotics as soon as possible after the surgery team confirms the diagnosis of appendicitis and makes a treatment plan.*

*•To facilitate this goal the surgery attending/fellow will communicate the treatment plan directly to the ED attending/fellow as soon as possible.*

*•Once notified by the surgery team the ED team will order the ED Confirmed Appendicitis Phase of the Appendicitis Pathway as soon as possible and expedite the administration of the appropriate antibiotics.*

*•As the surgical team prepares the patient for admission and operating room they will confirm that the ED Confirmed Appendicitis Phase orders have been ordered and if not already ordered then the Surgery team will order the ED Confirmed Appendicitis Phase .*

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# Antibiotics – First Dose

*Broad spectrum antibiotics that are used to treat complicated intra-abdominal infections are indicated for children going to the operating room for appendectomy for presumed appendicitis because clinical evaluation – including history, physical examination, laboratory studies and imaging – is not accurate at distinguishing complicated from uncomplicated appendicitis. Therefore we initiate treatment for complicated appendicitis for all patients.*

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# Non-Operative Appendectomy:

- *The “non-operative” appendicitis pathway is meant for patients who at the time of admission are not planned to have an appendectomy.*
- *These patients have no appendectomy “scheduled”.*
- *Some of the these patients may have an appendectomy during their initial hospitalization and then they would go onto the appropriate postoperative care pathway as determine by the findings at the time of operation.*

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# Urgent Appendectomy:

- *The “urgent appendectomy” pathway is meant for patients whose plan is that they will go to the operating room for appendectomy as soon as their clinical condition is stable and the operating room and appropriate care teams (anesthesia, nursery and surgery) are available.*

- *These patients will have their procedures “scheduled”.*

- *Most of these procedures will be within a few hours and almost all will be within 12-24 hours of the decision for operation.*

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# Additional Information

## Ceftriaxone & Metronidazole

- For patients with diagnosis of appendicitis empiric treatment with broad spectrum antibiotics active against enteric gram-negative aerobic and facultative bacilli, enteric gram-positive streptococci and obligate anaerobic bacilli is indicated.*
- Acceptable broad-spectrum antibiotic regimens for children with complicated intra-abdominal infection include*

  1. Aminoglycoside based regimen (ex. “triple antibiotics” gentamicin, ampicillin and metronidazole
  2. Carbapenem (ex. Meropenem)
  3. Beta-lactam/beta-lactamase-inhibitor combination (ex. Piperacillin-tazobactam)
  4. Advanced generation cephalosporin (ex. Ceftriaxone) and metronidazole

- We have elected to use the combination of ceftriaxone and metronidazole because it
  - avoids the toxicity of aminoglycosides and the extra blood draws necessary to monitor aminoglycoside levels
  - preserves carbapenem use for immunosuppressed patients or to treat resistant organisms
  - avoids the multiple blood draws required to monitor renal function in patients receiving multiple potentially nephrotoxic drugs (ex. Piperacillin-tazobactam and the postoperative analgesic ketorolac)
  - is easy to transition to home treatment of oral metronidazole and once-a-day IV ceftriaxone

*Solomkin JS, et al. Diagnosis and management of complicated intra-abdominal infection in adults and children: guidelines by the Surgical Infection Society and the Infectious Disease Society of America. Clinical Infectious Diseases 2010; 50:133-164

## If severe Beta Lactam Allergy:

**For patients with either a history of Ig-E mediated beta-lactam allergy (urticaria, angioedema, bronchospasm, hypotension, or anaphylaxis) or serious adverse reaction to ampicillin (Stevens Johnson, serum sickness, or toxic epidermal necrolysis), use ciprofloxacin and metronidazole.**

**Many patients who report a history of a penicillin allergy are no longer allergic to penicillin.**

- Patients with a history of a reaction to penicillin who have formal allergy testing will be found to have IgE-mediated penicillin allergy approximately 10-15% of the time.

**The risk of a penicillin-allergic patient reacting to a cephalosporin is low.**

- Approximately 2% of patients who are skin-test positive to penicillin will react to a cephalosporin

**The risk of a penicillin-allergic patient reacting to a cephalosporin is related to the type of reaction they had to the penicillin.**

- Patients with a history of reacting to penicillin and no formal skin-testing results who have the highest risk of a severe reaction to a cephalosporin are those who suffered anaphylaxis or other IgE-mediated, immediate type hypersensitivity reactions (angioedema, bronchospasm, urticaria or hives) occurring within one hour of exposure.

**For further information please see “Allergy to penicillins” and “Penicillin-allergic patients: Use of cephalosporins, carbapenems, and monobactams” in UpToDate.**

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# Transfer to Operating Room or Admission:

**Patients on the "urgent appendectomy" pathway will have orders for both "Transfer to the OR" and "Admission"**

•The determination of whether the patient goes straight from the ED to the Operating Room or whether they first are admitted to the floor before going to the Operating Room will depend upon:

•The patients clinical condition

•The availability of the OR and OR care teams (anesthesia, nursing and surgery)

•The availability of ED beds and staff

•The availability of floor beds and staff

**Patients on the "Non-Operative Appendectomy" pathway will go to the floor or ICU based on their clinical condition.**

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# Ciprofloxacin & Metronidazole

- *If the patient has a history of severe beta lactam allergy then the next antibiotic choice is intravenous ciprofloxacin and metronidazole.*

- *The safety profile of ciprofloxacin in children makes it a reasonable second line drug.*

***Solomkin JS, et al. Diagnosis and management of complicated intra-abdominal infection in adults and children: guidelines by th e Surgical Infection Society and the Infectious Disease Society of America. Clinical Infectious Diseases 2010; 50:133-164**

***Adefurin A. Ciprofloxacin safety in pediatrics: a systematic review**

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# Additional Information

## IV Antibiotics: Care in the OR

- Children undergoing appendectomy require a dose of broad-spectrum prophylactic antibiotics within one hour of the incision to minimize the risk of Surgical Site Infection (SSI). 1
- If the patient has not received broad spectrum antibiotics for treatment of appendicitis (as outlined in previous pathway steps) or if these antibiotics have been given more than one hour from the time of incision then an additional dose of antibiotics (either cefoxitin or in patients with severe beta lactam allergies, gentamicin and clindamycin) should be given in the operating room immediately prior to the incision.2
- For SSI prophylaxis the dose of cefoxitin in 40 mg/kg up to a maximum of 2 grams and the dose should be repeated every 2 hours during the operation.3


1. **Lee SL, et al. Antibiotics and appendicitis in the pediatric population: an American Pediatric Surgical Association Outcomes an d Clinical Trials Committee Systematic Review. J Pediatr Surg 2010 45:2181-2185.**
2. **Solomkin JS, et al. Diagnosis and management of complicated intra-abdominal infection in adults and children: guidelines by the Surgical Infection Society and the Infectious Disease Society of America. Clinical Infectious Diseases 2010; 50:133-164**
3. **Bratzler DW, et al. Clinical practice guidelines for antimicrobial prophylaxis in surgery. Am J Health-Syst Pharm. 2013; 70:195-283.**


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## Clindamycin & Gentamicin: Care in the OR

- To provide appropriate antibiotic prophylaxis in a timely manner for patients with severe beta lactam allergies clindamycin and gentamicin will be used rather than ciprofloxacin and metronidazole since the latter combination has a prolonged administration time.
- If further antibiotic therapy is indicated postoperatively for patients with severe beta lactam allergy then ciprofloxacin and metronidazole will be used.


**Bratzler DW, et al. Clinical practice guidelines for antimicrobial prophylaxis in surgery. Am J Health-Syst Pharm. 2013; 70:195-283.**



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# IV Access: Care in the OR

**Recommendations**

• If complicated appendicitis is found during the procedure, the anesthesia provider should ensure that there is a good peripheral IV in a “stable location” such as the hand or forearm prior to emergence from anesthesia.

•If the original PIV is working well and in a stable location, there is no need to move it.

•If a new IV is placed, the original PIV should be DC’ed prior to departure from the PACU.

**Issues**

•Patients with acute appendicitis often have small PIV’s placed upon arrival in the ER.

•Small antecubital PIV’s are uncomfortable for patients and have a tendency to infiltrate more quickly than PIV’s placed in other locations.

•Since PICC lines are no longer routinely placed in patients with complicated appendicitis, it is optimal to have a comfortable PIV that will last for the duration of postoperative antibiotic treatment.

• This should link to page 15 which defines complicated vs uncomplicated appendicitis.

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# Additional Information

## OR Findings:

- Further treatment will be determined based on the operative findings
- Uncomplicated appendicitis is defined as an inflamed but grossly intact, nongangrenous, nonsuppurative appendix with no associated abscess or peritonitis
- Complicated appendicitis is defined as an appendix that is gangrenous, suppurative, grossly perforated or associated with an abscess or peritonitis.

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# Additional Information

## Discharge Readiness Assessment:

- All patients with complicated appendicitis will receive at least 72 hours of IV antibiotics.
- All patients with complicated appendicitis will receive a total of 7 days of IV+PO antibiotics.
- On or after POD #3 when patient is well on exam (afebrile, tolerating a diet, with no signs of wound infection and with only expected pain and tenderness) then CBC with diff will be checked.
- If CBC and diff are normal (based on the normal ranges for age as described in CIS) then the patient can be transitioned to PO antibiotics and if PO antibiotics are tolerated then discharged home.
- If CBC and diff are abnormal then patient will continue to receive IV antibiotics and patient will be reassessed daily.

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## Assessment at 7 days:

- The Complicated appendicitis postoperative pathway stops after POD #7.
- If after 7 days of treatment the patient is not ready for discharge home; ie if they are febrile, not tolerating a diet, have signs of wound infection or more than expected pain and tenderness, or an abnormal WBC or diff, then they will be reassessed and further treatment individualized.
- For the patient who is not ready for discharge on POD#7 blood tests should be obtained
  - CBC and diff and CRP to assess on-going inflammation and infection
  - BUN/Creatinine and transaminases to assess possible drug side effects
- For the patient who is not ready for discharge on POD#7 abdominal imaging (CT scan) should be considered either at this time or at a defined time in the near future to evaluate for possible intra-abdominal abscess (i.e., inadequate source control)
- Additional antibiotics or change in antibiotics should be considered.

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# Executive Summary

## Objective

1. To provide standardized, evidence based preoperative and post operative care for patients admitted with non-complicated and complicated appendicitis.
2. To integrate physician safety checklists into discharge order sets for appendicitis diagnoses.

## Recommendations

1. If a patient has an uncomplicated appendicitis they should not receive antibiotics post operatively.

2. For treatment of patients with a complicated appendicitis, antibiotic duration of IV plus PO should equal 7 days of treatment with the IV antibiotic treatment duration of at least 72 hours.

3. Patient safety checklists for appendicitis are to be used at the time of discharge by surgeons, resident physicians, nurse practitioners or physician assistants.

## Rationale

1. These recommendations are consistent with national guidelines by the Surgical Infection Society and the Infectious Disease Society of America and the American Pediatric Surgical Association Outcomes and Clinical Trials Committee.

2. Patient safety checklists are well established tools for improving process and performance.

- They are known to improve team communication and reduce errors.
- They include process steps where there may not be conclusive evidence.
- They allow for individual variability while at the same time promoting safe and sequential care for the patients.

## Evidence

- SL Lee et al Antibiotics and appendicitis in the pediatric population: an American Pediatric Surgical Association Outcomes and Clinical Trials Committee: Systematic Review 2010
- Solomkin JS Diagnosis and Management of Complicated Intra-abdominal Infection in Adults and Children: Guidelines by the Surgical Infection Society and the Infectious Disease Society of America

## Implementation Items

Patient safety checklists are embedded into the appendicitis power plans and order sets so that the orders can not be signed unless the patient safety checklists are completed.

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# Executive Summary

## Metrics Plan

CSW Core Metrics

1. Count of Inpatient/obs discharges
    a. Total number of discharges meeting specified population criteria
2. Median Length of Stay (LOS by Hrs, discharge by time of day)
    a. Length of stay – fractional is defined as the time from the first time the patient is recorded in Epic as entering a Inpatient or Observation unit, until the date and time the patient is recorded in Epic as discharged.
3. % of patients with any of the specified order set
    a. CSW goal compliance metric
    b. Number of discharges with any of the specified order sets divided by total number of discharges meeting population criteria
4. Average charges per case
    a. Total charges for the entire encounter/number of discharges
5. Readmission
    a. Number of discharges with a return visit for any condition, planned or unplanned.
    b. Stratified by whether the return visit is to Inpatient/Obs or ED
    c. Stratified by returns within 3, 7 or 30 days after original discharge

CSW Process metrics

Antibiotic Use Include dose, route of admin (Home, Infusion)

Reoperations- Additional procedures after original appendectomy.

Rate of:

- PICC Lines
- Drains
- Other Procedures-flag for chart review.

Discharge Checklist – Temp, Diet, Pain, WBC, Wound

## PDCA Plan

Meet monthly for the first three months to review concerns and monitor metrics. We will then meet quarterly.

## Revision History

Date Approved: **July 2013**

Next Review Date: **July 2016**

# Executive Summary

Appendicitis

## CSW Approval – June 2013

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**CSW Owner:** Daniel Ledbetter, MD

***Approved by the Appendicitis Clinical Standard Work (CSW) Team, June 2013.***

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# Summary of Version Changes

- **Version 1 (7/9/2013):** Go live
- **Version 1.1 (7/8/2014):** Additional information slide attached to beta lactam allergy description
- **Version 1.2 (3/13/2015):** Added page 2 of Executive Summary

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# Medical Disclaimer

Medicine is an ever-changing science. As new research and clinical experience broaden our knowledge, changes in treatment and drug therapy are required.

The authors have checked with sources believed to be reliable in their efforts to provide information that is complete and generally in accord with the standards accepted at the time of publication.

However, in view of the possibility of human error or changes in medical sciences, neither the authors nor Seattle Children's Healthcare System nor any other party who has been involved in the preparation or publication of this work warrants that the information contained herein is in every respect accurate or complete, and they are not responsible for any errors or omissions or for the results obtained from the use of such information.

Readers should confirm the information contained herein with other sources and are encouraged to consult with their health care provider before making any health care decision.

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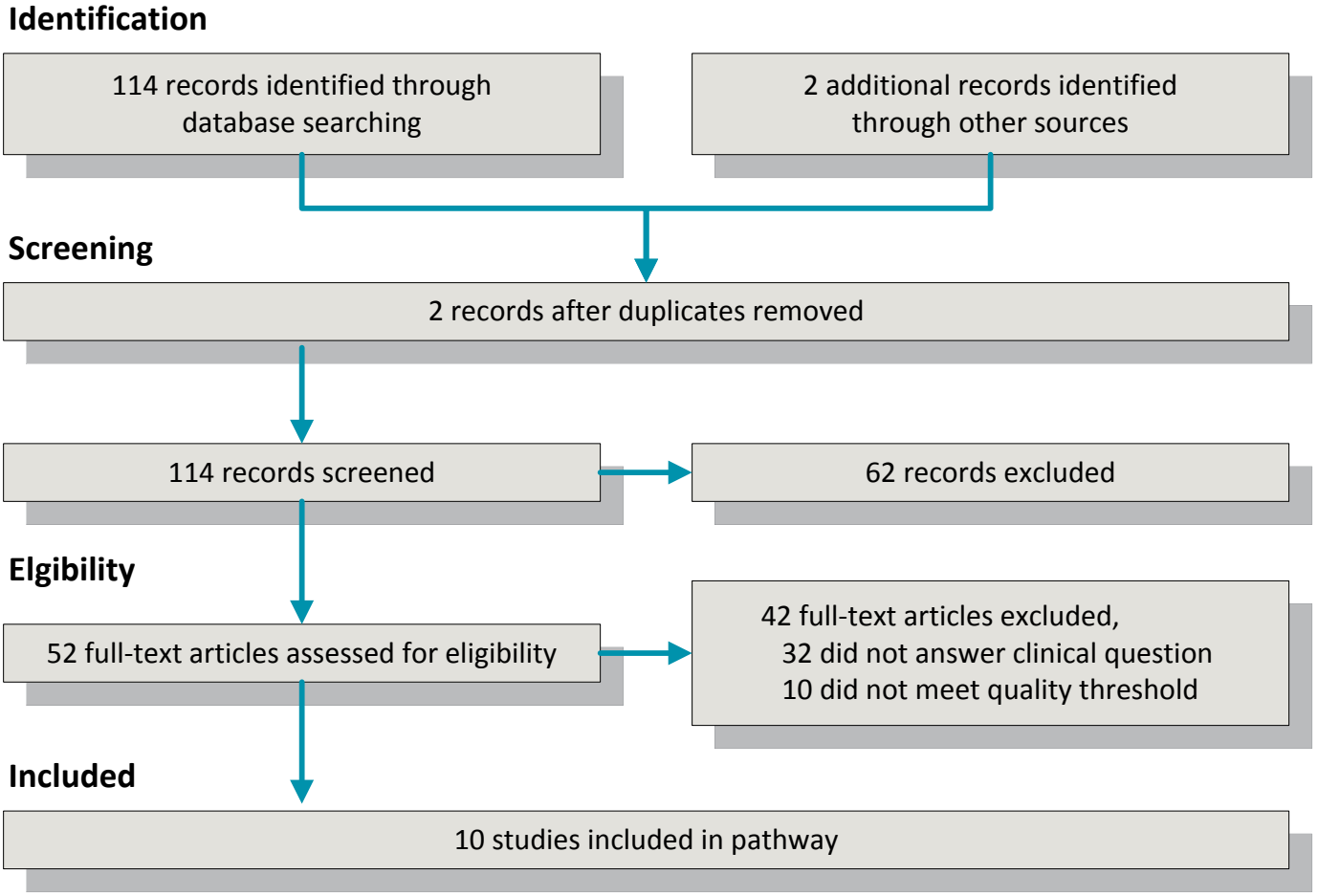
# Bibliography

**Search Methods, Appendectomy, Clinical Standard Work**

Studies were identified by searching electronic databases using search strategies developed and executed by a medical librarian, Susan Klawansky. Searches were performed in November 2012 in the following databases – on the Ovid platform: Medline and Cochrane Database of Systematic Reviews; elsewhere: Embase, Clinical Evidence, National Guideline Clearinghouse and TRIP. Retrieval was limited to 2002 to current, humans, and English language. In Medline and Embase, appropriate Medical Subject Headings (MeSH) and Emtree headings were used respectively, along with text words, and the search strategy was adapted for other databases as appropriate. Concepts searched were appendectomy, intraabdominal infection, appendicitis or appendix. All retrieval was further limited to certain evidence categories, such as relevant publication types, index terms for study types and other similar limits.

Susan Klawansky, MLS, AHIP

March 27, 2013




Flow diagram adapted from Moher D et al. BMJ 2009;339:bmj.b2535

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# Bibliography

Adefurin A, Sammons H, Jacqz-Aigrain E, Choonara I. Ciprofloxacin safety in paediatrics: A systematic review. *Arch Dis Child* [Appendectomy]. 2011;96(9):874-880

Lee SL, Islam S, Cassidy LD, Abdullah F, Arca MJ, 2010 American Pediatric Surgical Association Outcomes and Clinical Trials,Committee. Antibiotics and appendicitis in the pediatric population: An american pediatric surgical association outcomes and clinical trials committee systematic review. *J Pediatr Surg* [Appendectomy]. 2010;45(11):2181-2185.

Solomkin JS, Mazuski JE, Bradley JS, et al. Diagnosis and management of complicated intra-abdominal infection in adults and children: Guidelines by the surgical infection society and the infectious diseases society of america. *Clin Infect Dis* [Appendectomy]. 2010;50(2):133-164.

Solomkin JS, Mazuski JE, Baron EJ, et al. Guidelines for the selection of anti-infective agents for complicated intra-abdominal infections. *Clin Infect Dis* [Appendectomy]. 2003;37(8):997-1005

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# Visio Algorithm Template Guidelines

## Margins

**Portrait (vertical) flowchart pages:** Left and right: 0.5 inch; top: 0.5 inch; bottom: Dotted footer line at 0.5 inch from bottom; text not to be positioned below 0.25 inch margin from (bottom of letters can be sitting just above 0.25 inch).

**Landscape (horizontal) pages:** Left and right: 0.5 inch; top: 0.5 inch; bottom: Dotted footer line at 0.75 inch from bottom; Children's logo not to be positioned below 0.25 inch margin from bottom.

When creating a new page or document, use guides to visually set the margins; turn them on (under View), then drag them onto the doc from the ruler edge into place before you start positioning items on the page.

## Fonts

- Fonts used must be Georgia (for body text only) or Arial (all headings and also body text if desired), in regular, bold, italic, and bold italic. No other fonts are allowed, including variations of Arial (like Arial Narrow or Condensed).

## Objects and Arrow Connector Lines

- Easiest way to designate shapes and their colors and attributes is to copy existing shapes from this template and paste into new page or document.
- All shapes should have rounded corners, in Children's branding color palette. Most are rounded either at 0.125 or 0.0925 (found under Line). All shapes except circle must have an outline designated in order to enable the rounded corner feature. However, the outline color must not be different than the fill color.
- **Arrow connector lines:** Pattern: 01, Weight 05, Rounded Corner 0.125, black

## Footer and Header Dotted Lines

- Pattern: 10, Weight 05, cool gray (R: 117, G:119, B:123)

## Text Styles

- **Titles in objects:** Arial 10 pt, bold, white or black, centered
- **Body text in objects:** Arial 9 pt, regular, white or black, centered (exception is exclamation point in yellow triangle, which is 13 pt bold for increased visibility
- **Titles in mastheads:** Arial 25 pt, bold, white or black, left aligned
- **Line connector text:** Arial 8 pt, regular, black, centered
- **Hyperlinks:** Can be in Microsoft default blue and underlined.

Text should generally be left aligned (exceptions are title and body text within objects, which can be centered).

## Colors

Children's has a specific color palette that must be followed. This document contains some of these colors set up under Recent Colors; however, because of Visio limitations, they may not always be retained for future use. Here are the RGB formulas for future re-creation:

**108u:** R:255 G:229 B:18

**1235u:** R:253 G:193 B:53

**158u:** R:255 G:146 B:63

**180u:** R:225 G:98 B:37

**311u:** R:59 G:176 B:194

**3135u:** R:0 G:146 B:172

**314u:** R:0 G:123 B:155

**540u:** R:25 G:55 B:100

**396u:** R:230 G:225 B:070

**382u:** R183 G:200 B:91

**356u:** R:18 G:149 B:72

**Cool grey 11u:** R:117 G:119 B:123

**Cool grey 1u:** R:226 G:225 B:220

**7499u:** R:252 G:244 B:210

**7457u:** R:211 G:237 B:240

**7485u:** R:234 G:243 B:222

# Appendicitis Citation

**Title:** Appendicitis Pathway

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- Elaine Beardsley
- Vincent Hsieh
- Jennifer Magin
- Erin Moriarty
- Mike Leu
- Jean Popalisky

**Date:** July 8, 2014

**Retrieval Website:** http://www.seattlechildrens.org/pdf/appendicitis-pathway.pdf

**Example**:
Seattle Children's Hospital, Ledbetter D, Mazor S, Beardsley E, Hsieh V, Magin J, Moriarty E, Leu M, Popalisky J. 2014 July. Appendicitis Pathway. Available from: http://www.seattlechildrens.org/pdf/appendicitis-pathway.pdf

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