Diagnosis Confirmed: Proceed to Urine analysis results on Confirmed Phase
PHASE II (Confirmed)

Inclusion Criteria
- 1 year or older
- Symptomatic/chief complaint of UTI
- Flank pain, nausea or vomiting and
- High suspicion of Nephrolithiasis

Exclusion Criteria
- Less than 1 year
- Low suspicion of Nephrolithiasis
- Concern for septic shock (use septic shock pathway)

Admission Criteria
- Not tolerating PO
- Pain not controlled
- Need for IV antibiotics
- Per Urology Recommendation
- Fever ≥ 101.5 F

Initial Management
(If not already received)
- Renal bladder ultrasound
- CT (not required)
- If ultrasound not diagnostic/clinical suspicion high discuss with urology prior to CT scan
- IV Fluids: 20mL/kg, NS, 1L maximum
- NPO

Pain Medications
- Ketorolac
- Morphine

Anti-emetics
- Ondansetron

Urinalysis
- Reflex Culture

Reassessment
- Pain Management (oxycodone, ibuprofen and acetaminophen)
- Tamsulosin (only over 2 years of age) if ureteral calculus
- Maintenance IV Fluids
- Trial PO (Clear liquids)

Review Urinalysis Results
- UA negative for infection
- UA positive for infection

Suspected Infection
- Urology consultation
- Antibiotics
- Labs: CBC with diff; BUN; creatinine; lytes; blood culture if concern for obstructed stone & sepsis (Use septic shock pathway)

Discharge Criteria
- Pain well managed
- Tolerating PO

Discharge Instructions
- PCP referral needed for follow up appointment in urology clinic
- Antiemetics, antibiotics & pain medications if needed
- Return to clinic – 4-6 weeks for stone in kidney; 2-4 weeks for stone in ureter
- Tamsulosin if indicated

UA Concern for Infection:
- Nitrites OR
- Leukocytes esterase OR
- Microscopy shows bacteria OR
- ≥ 10 WBC/HPF

Urology consultation to determine need for admission and plan of care (if not already consulted)
Indications for consult: suspected infection; inability to tolerate PO; poor pain control; return to the ED

For questions concerning this pathway, contact: Nephrolithiasis@seattlechildrens.org
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Last Updated: Sept 2015
Next Expected Revision: Sept 2020
**PHASE III (INPATIENT)**

**Inclusion Criteria**
- 1 year or older
- Symptomatic/chief complaint of UTI flank pain, nausea or vomiting and
- Confirmed diagnosis by a providing MD by ultrasound or CT scan

**Exclusion Criteria**
- Less than 1 year
- Concern for septic shock (use septic shock pathway)

**Admission**
- IV Fluids per Maintenance IV Fluids Pathway
- Ketorolac; acetaminophen; oxycodone/morphine; ondansetron
- If surgery, **IV cefazolin** for peri-operative prophylaxis
- If infection then ampicillin + gentamicin OR cefazolin

**Ongoing Management**

**IV Fluids**
- Administer IV Fluids per pathway

**Pain Management**
- Ketorolac
- Narcotics

**Tamsulosin** (only over 2 years of age) if ureteral calculus

**Anti-emetics**
- Ondansetron

**IV Antibiotics** (if infection)

**Labs**
- CBC with diff
- Blood culture
- Lytes

**Nursing**
- Pain assessment

**Diet**
- NPO if surgical patient

**Vital signs**
- Strict I/O

**Discharge Instructions**
- PCP referral needed for follow up appointment in urology clinic
- Antiemetics, antibiotics & pain medications if needed
- Return to clinic – 4 to 6 weeks for stone in kidney; 2-4 weeks for stone in ureter
- Tamsulosin if indicated

**Discharge Criteria**
- Pain well managed
- Tolerating PO
**Suspected Nephrolithiasis**

- This phase is for patients *without* an imaging-confirmed diagnosis of nephrolithiasis.
- Clinical suspicion for nephrolithiasis should be high (see table below).

<table>
<thead>
<tr>
<th>CLINICAL PREDICTORS FOR NEPHROLITHIASIS</th>
<th>Odds Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Personal history of nephrolithiasis</td>
<td>OR 6.55</td>
</tr>
<tr>
<td>&gt; 5 RBC per HPF on microscopic urinalysis</td>
<td>OR 3.10</td>
</tr>
<tr>
<td>History of nausea/vomiting</td>
<td>OR 2.39</td>
</tr>
<tr>
<td>Flank pain on physical exam</td>
<td>OR 2.23</td>
</tr>
</tbody>
</table>

Renal/Bladder Ultrasound is the recommend 1\textsuperscript{st} line imaging study for children with suspected nephrolithiasis (AUA\textsuperscript{1}, ESPU\textsuperscript{2}).

Urology on-call should be contacted to help guide ordering of CT in the following situations:

- Negative ultrasound and very high suspicion of nephrolithiasis
- Hydronephrosis
- Twinkle artifact
- Ureteral dilation


Initial Management of Nephrolithiasis

- Combined administration of NSAIDs and narcotics for initial analgesic control is recommended based on additive effects of each medication.

- Ondansetron is the recommended 1st-line anti-emetic given lack of proven superior efficacy of any individual anti-emetic agent and low side-effect profile.
Suspected Infection

- Fevers or urinalysis suspicious for infection (+ nitrates, bacteria or \( > 10 \) WBC/HPF) should prompt urological consultation and antibiotics.

- Note: a completely obstructing ureteral calculus with a proximal infected urinary system may present with a normal urinalysis; if clinical signs of infection (i.e., high fever) and obstructing ureteral calculus is seen, these patients should be treated as a suspected infection even in the absence of abnormalities on the urinalysis.
Pre-Operative Antibiotics

- Cefazolin or ampicillin + gentamicin are considered equal alternative 1st-line pre-operative options according to AUA guidelines\(^1\)

- Ampicillin + gentamicin should be considered when there is a history of enterococcal or multi-drug resistant colonization/infection, or if there is a high suspicion of current bacterial colonization

- Culture-directed peri-operative antibiotics should be utilized if a current urine culture is available for review
Follow Up

- Patients should receive education materials prior to discharge
- Patients with ureteral calculi:
  - warrant shorter-interval follow-up, between 2–4 weeks as they may be surgical candidates if the calculus does not pass
  - Will need to strain their urine and watch for a passed calculus
Approved by the CSW Nephrolithiasis Team for the September 29, 2015 go live.

CSW Nephrolithiasis Team:

Urology, Owner                  Jonathon Ellison, MD
Urology, Owner                  Paul Merguerian, MD, MS, FAAP
Urology, Stakeholder            Thomas Lendvay, MD
Emergency Department, MD        Russ Migita, MD
Emergency Department, CNS       Sara Fenstermacher, RN
Clinical Pharmacy               Eric Harvey, PharmD, MBA
Pharmacy Informatics             Rebecca Ford, PharmD
Surgical Unit, CNS              Kristine Lorenzo, RN
Urology Clinic Nurse            Andrea Bakke, RN

Clinical Effectiveness Team:

Consultant                     Sara Vora, MD
Project Manager                 Jennifer Magin, MBA
CE Analyst                      Holly Clifton, MPH
CIS Informatician               Mike Leu, MD, MS, MHS
CIS Analyst                     Carlos Villavicencio, MD, MMI
Librarian                       Heather Marshall
Program Coordinator             Sue Groshong, MLIS

Executive Approval:

Sr. VP, Chief Medical Officer   Mark Del Beccaro, MD
Sr. VP, Chief Nursing Officer   Susan Heath, RN, MN, NEA-BC
Surgeon-in-Chief                Bob Sawin, MD

Retrieval Website: [http://www.seattlechildrens.org/pdf/nephrolithiasis.pdf](http://www.seattlechildrens.org/pdf/nephrolithiasis.pdf)

Please cite as:
This pathway was developed through local consensus based on published evidence and expert opinion as part of Clinical Standard Work at Seattle Children’s. Pathway teams include representatives from Medical, Subspecialty, and/or Surgical Services, Nursing, Pharmacy, Clinical Effectiveness, and other services as appropriate.

When possible, we used the GRADE method of rating evidence quality. Evidence is first assessed as to whether it is from randomized trial or cohort studies. The rating is then adjusted in the following manner (from: Guyatt G et al. J Clin Epidemiol. 2011;4:383-94.):

- Quality ratings are **downgraded** if studies:
  - Have serious limitations
  - Have inconsistent results
  - If evidence does not directly address clinical questions
  - If estimates are imprecise OR
  - If it is felt that there is substantial publication bias

- Quality ratings are **upgraded** if it is felt that:
  - The effect size is large
  - If studies are designed in a way that confounding would likely underreport the magnitude of the effect OR
  - If a dose-response gradient is evident

Guideline – Recommendation is from a published guideline that used methodology deemed acceptable by the team.

Expert Opinion – Our expert opinion is based on available evidence that does not meet GRADE criteria (for example, case-control studies).

**Quality of Evidence:**
- 🌟🌟🌟🌟 High quality
- 🌟🌟🌟🌟 Moderate quality
- 🌟🌟🌟 Low quality
- 🌟🌟🌟 Very low quality

Guideline
Expert Opinion
• **Version 1.0 9/29/2015**: Go live
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.
Studies were identified by searching electronic databases using search strategies developed and executed by a medical librarian, Susan Groshong. An initial search was performed in March, 2015. The following databases were searched – on the Ovid platform: Medline and Cochrane Database of Systematic Reviews; elsewhere: Embase, Clinical Evidence, National Guideline Clearinghouse, TRIP and Cincinnati Children’s Evidence-Based Recommendations. Retrieval was limited to humans, English language and 2005 to current. 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 using text words. Concepts searched were nephrolithiasis, urolithiasis, ureterolithiasis, urinary calculi and renal colic. Additional articles were identified by team members and added to the results.

Two additional searches were conducted in June, 2015. The first of these used the same databases as above, for the concept antiemetic therapy. Retrieval was limited to ages 0 – 18, English language and 2005 to date. The following databases were used for the last search – on the Ovid platform: Medline and Cochrane Central Register of Controlled Trials; plus Embase. Concepts searched were nephrolithiasis, and related concepts as above, and antibiotic therapy. Search results were limited to humans, English language, and 2000 to date. Retrieval for all searches was further limited to certain evidence categories, such as relevant publication types, Clinical Queries, index terms for study types and other similar limits.

Identification

469 records identified through database searching

6 additional records identified through other sources

Screening

475 records after duplicates removed

475 records screened

382 records excluded

Eligibility

93 records assessed for eligibility

62 full-text articles excluded, 57 did not answer clinical question 5 outdated relative to other included study

Included

31 studies included in pathway

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


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: