Rational Prescribing for Common Pediatric Infections

Andy Nowalk MD, PhD
Pediatric Infectious Disease
March 17, 2017
Objectives

- Define how pharmacology impacts treatment of infections
- Review evidence for optimizing therapy of common illnesses, including current guidelines
- Discuss common cases of challenging pediatric infections and best choices for antibiotics
Pharmacology and making antibiotic choices

- Which oral drugs are reliable based on peak serum levels
- Why a shot of ceftriaxone works
- Why the kidney makes everything better
- And always remember Johnny Depp…
“Keep to the code… They’re more like guidelines…”

- All of the infections we will discuss have recent guideline updates from
  - American Academy of Pediatrics
  - Infectious Disease Society of America
Case 1

Combinations are great

- A 11 mo boy in your office with fever (39.3°C rectal)
- 3 days of cold symptoms with impressive rhinorrhea
- Crying, pulling at right ear
- Exam is normal except AOM
Case 1
Microbiology

- **Primary bugs**
  - *S. pneumoniae* ~ *H. influenzae* > *M. catarrhalis*

- **Differing mechanisms of resistance**
  - *S. pneumoniae* – altered penicillin binding proteins (MIC 0.5-8) – **overcome with more drug**
  - *H. influenzae* and *M. catarrhalis* – beta-lactamases (MIC >256) – **overcome with beta-lactamase inhibitor**
    - *H. influenzae* increasing since PCV-7/13

Guideline: AOM

American Academy of Pediatrics
DEDICATED TO THE HEALTH OF ALL CHILDREN™

CLINICAL PRACTICE GUIDELINE

The Diagnosis and Management of Acute Otitis Media

Pediatrics 2013;131:e964
Case 1

Antibiotic choice?

- Lots of questions...
- Baseline?
- Allergic to penicillin? (really?)
- Do they need antibiotic?
### AAP recommendations

<table>
<thead>
<tr>
<th>Age</th>
<th>Otorrhea With AOM</th>
<th>Unilateral or Bilateral AOM With Severe Symptoms</th>
<th>Bilateral AOM Without Otorrhea</th>
<th>Unilateral AOM Without Otorrhea</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 mo to 2 y</td>
<td>Antibiotic therapy</td>
<td>Antibiotic therapy</td>
<td>Antibiotic therapy</td>
<td>Antibiotic therapy or additional observation</td>
</tr>
<tr>
<td>≥2 y</td>
<td>Antibiotic therapy</td>
<td>Antibiotic therapy</td>
<td>Antibiotic therapy or additional observation</td>
<td>Antibiotic therapy or additional observation</td>
</tr>
</tbody>
</table>

Severe symptoms = toxic, otalgia >48 h, T ≥39°C in past 48 h, uncertain follow-up
### AAP recommendations: initial therapy

<table>
<thead>
<tr>
<th>Recommended First-line Treatment</th>
<th>Alternative Treatment (if Penicillin Allergy)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Amoxicillin</strong> (80–90 mg/kg per day in 2 divided doses)</td>
<td>Cefdinir (14 mg/kg per day in 1 or 2 doses)</td>
</tr>
<tr>
<td>or <strong>Amoxicillin-clavulanate</strong> (90 mg/kg per day of amoxicillin, in 2 divided doses)</td>
<td>Cefuroxime (90 mg/kg per day in 2 divided doses)</td>
</tr>
<tr>
<td>or <strong>Cefuroxime</strong> (30 mg/kg per day in 2 divided doses)</td>
<td>Cefpodoxime (10 mg/kg per day in 2 divided doses)</td>
</tr>
<tr>
<td>or <strong>Ceftriaxone</strong> (50 mg IM or IV per day for 1 or 3 days)</td>
<td><strong>X</strong></td>
</tr>
</tbody>
</table>
## AAP recommendations: failure therapy

<table>
<thead>
<tr>
<th>Recommended First-line Treatment</th>
<th>Alternative Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Amoxicillin-clavulanate</strong> (90 mg/kg per day of amoxicillin, in 2 divided doses)</td>
<td>Ceftriaxone, 3 d Clindamycin (30–40 mg/kg per day in 3 divided doses), with or without third-generation cephalosporin</td>
</tr>
<tr>
<td>or</td>
<td>Clindamycin (30–40 mg/kg per day in 3 divided doses) plus third-generation cephalosporin</td>
</tr>
<tr>
<td><strong>Ceftriaxone</strong> (50 mg IM or IV per day for 1 or 3 d)</td>
<td>Consult specialist</td>
</tr>
</tbody>
</table>

Tympanocentesis
What about cefdinir?

- Tastes great!
- But not first line...
- ...and pretty lousy peak serum
  - Cefpodoxime and cefuroxime have superior serum levels and MIC in most studies
- Try **not** to use cephalosporins (which increase resistance to both classes) before amoxicillin or amox-clav

For example, recent US data on in vitro susceptibility of *S. pneumoniae* to cefdinir and cefuroxime are 70% to 80%, compared with 84% to 92% amoxicillin efficacy.\(^{130,147–149}\) In vitro efficacy of
Is there data behind this?

- Excellent 2009 review by Dagan
- Summarized the connection between
  - Antibiotic levels
  - Microorganism
  - Clearance of infection
non-susceptible *S. pneumoniae*

susceptible *S. pneumoniae*

*H. influenzae*
Why not ceftriaxone?

- Salvage therapy…and it works
  - 1 dose ceftriaxone gives 150 μg/mL in serum
  - 1 dose cefdinir gives 1.6 μg/mL in serum

- Ceftriaxone has high levels and long half life in ear fluid (25 hours)

- But increased use = increased resistance, so use sparingly
Questions?
Get down with PBP

- A 1 yo boy comes to Urgent Care with fever (39.3°C rectal)
- 3 days of mild cold symptoms and low grade temps
- Now tachypneic, higher fever
- Exam is normal except for crackles heard over his right lung
Case 2

Pneumonia

- Antibiotic choice?
Pediatric pneumonia <5 yo

- Pneumococcus, pneumococcus, pneumococcus (and viruses)
- Amoxicillin!
Pediatric pneumonia <5 yo

- No need for cephalosporins
- Pneumococcus is different from H flu
  - Changes the target (PBP) a little (low level resistance, overcome with more drug)
- High dose amoxicillin (80-90 mg/kg/day divided BID) is sufficient to do the job
  - Serum levels of 10-15 μg/mL
  - Enough to overcome even penicillin-intermediate strains
  - Very little gram negative activity
Guideline: pneumonia

The Management of Community-Acquired Pneumonia in Infants and Children Older Than 3 Months of Age: Clinical Practice Guidelines by the Pediatric Infectious Diseases Society and the Infectious Diseases Society of America

John S. Bradley,1,* Carrie L. Byington,2,* Samir S. Shah,3,* Brian Alverson,4 Edward R. Carter,5 Christopher Harrison,6 Sheldon L. Kaplan,7 Sharon E. Mace,8 George H. McCracken Jr,9 Matthew R. Moore,10 Shawn D. St Peter,11 Jana A. Stockwell,12 and Jack T. Swanson13

Clin Infect Dis 2011;53:e25
<table>
<thead>
<tr>
<th>Site of care</th>
<th>Presumed bacterial pneumonia</th>
<th>Presumed atypical pneumonia</th>
<th>Presumed influenza pneumonia</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;5 years old (preschool)</td>
<td>Amoxicillin, oral (90 mg/kg/day in 2 doses\textsuperscript{b}); alternative: oral amoxicillin clavulanate (amoxicillin component, 90 mg/kg/day in 2 doses\textsuperscript{b})</td>
<td>Azithromycin oral (10 mg/kg on day 1, followed by 5 mg/kg/day once daily on days 2–5); alternatives: oral clarithromycin (15 mg/kg/day in 2 doses for 7-14 days) or oral erythromycin (40 mg/kg/day in 4 doses)</td>
<td>Oseltamivir</td>
</tr>
<tr>
<td>≥5 years old</td>
<td>Oral amoxicillin (90 mg/kg/day in 2 doses\textsuperscript{b} to a maximum of 4 g/day\textsuperscript{c}); for children with presumed bacterial CAP who do not have clinical, laboratory, or radiographic evidence that distinguishes bacterial CAP from atypical CAP, a macrolide can be added to a β-lactam antibiotic for empiric therapy; alternative: oral amoxicillin clavulanate (amoxicillin component, 90 mg/kg/day in 2 doses\textsuperscript{b} to a maximum dose of 4000 mg/day, eg, one 2000-mg tablet twice daily\textsuperscript{b})</td>
<td>Oral azithromycin (10 mg/kg on day 1, followed by 5 mg/kg/day once daily on days 2–5 to a maximum of 500 mg on day 1, followed by 250 mg on days 2–5); alternatives: oral clarithromycin (15 mg/kg/day in 2 doses to a maximum of 1 g/day); erythromycin, doxycycline for children ≥7 years old</td>
<td>Oseltamivir or zanamivir (for children 7 years and older); alternatives: peramivir, oseltamivir and zanamivir (all intravenous) are under clinical investigation in children; intravenous zanamivir available for compassionate use</td>
</tr>
</tbody>
</table>
## Empiric outpatient therapy

<table>
<thead>
<tr>
<th>&lt; 5 year old</th>
<th>Empiric bacterial pneumonia</th>
<th>Empiric atypical pneumonia</th>
<th>Empiric influenza pneumonia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amoxicillin (90 mg/kg/day in 2 doses) or amox/clav</td>
<td>Azithromycin (10 mg/kg x 1 day then 5 mg/kg x days) or clarithromycin</td>
<td>Oseltamivir or zanamivir</td>
<td></td>
</tr>
<tr>
<td>&gt; 5 year old</td>
<td>Amoxicillin ± azithromycin</td>
<td>Azithromycin or clarithromycin or doxycycline</td>
<td>Note the absence of cefdinir or quinolones</td>
</tr>
</tbody>
</table>
Guidelines

- For <5 yo – amoxicillin at high dose
- Try never to use cephalosporins before amoxicillin
- For >5 yo – amoxicillin at high dose and/or azithromycin (gets the *Mycoplasma*)
- Azithromycin works for many kids because it’s viral, not *Mycoplasma*!
Questions?
I say tomato, you say cephalosporin

- An 8 yo boy comes in to your office with fever to 39.3°C oral
- 3 days of sore throat, headache, and mild abdominal pain
- Exam is normal except for...
Case 3
Acute suppurative pharyngitis

- His rapid strep is positive for group A strep (**S. pyogenes**)
- Antibiotic choice?
Is this a trick question?! 

- For many many many many years, penicillin
- NO ANTIBIOTIC RESISTANCE!!
- Amoxicillin would be fine, too
- Guideline?
Guideline: strep pharyngitis

Clinical Practice Guideline for the Diagnosis and Management of Group A Streptococcal Pharyngitis: 2012 Update by the Infectious Diseases Society of America

Stanford T. Shulman,1 Alan L. Bisno,2 Herbert W. Clegg,3 Michael A. Gerber,4 Edward L. Kaplan,5 Grace Lee,6 Judith M. Martin,7 and Chris Van Beneden8

1Department of Pediatrics, Division of Infectious Diseases, Ann & Robert H. Lurie Children’s Hospital, Northwestern University Feinberg School of Medicine, Chicago, Illinois; 2Department of Medicine, University of Miami Miller School of Medicine, Miami Veterans Affairs Healthcare System, Miami, Florida; 3Department of Pediatrics, Hemby Children’s Hospital and Eastover Pediatrics, Charlotte, North Carolina; 4Department of Pediatrics, Cincinnati Children’s Hospital Medical Center, Cincinnati, Ohio; 5Department of Pediatrics, University of Minnesota Medical School, Minneapolis, Minnesota; 6Division of Infectious Diseases, Boston Children’s Hospital, Boston, Massachusetts; 7Department of Pediatrics, University of Pittsburgh, Pittsburgh, Pennsylvania; and 8Respiratory Diseases Branch, National Center for Immunization and Respiratory Diseases, Centers for Disease Control and Prevention, Atlanta, Georgia

Clin Infect Dis 2012;55:1279
## Table 4. Epidemiologic and Clinical Features Suggestive of Group A Streptococcal and Viral Pharyngitis

<table>
<thead>
<tr>
<th>Feature, by Suspected Etiologic Agent</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>GROUP A STREPTOCOCCAL</strong></td>
</tr>
<tr>
<td>Sudden onset of sore throat</td>
</tr>
<tr>
<td>Age 5–15 years</td>
</tr>
<tr>
<td>Fever</td>
</tr>
<tr>
<td>Headache</td>
</tr>
<tr>
<td>Nausea, vomiting, abdominal pain</td>
</tr>
<tr>
<td>Tonsillopharyngeal inflammation</td>
</tr>
<tr>
<td>Patchy tonsillopharyngeal exudates</td>
</tr>
<tr>
<td>Palatal petechiae</td>
</tr>
<tr>
<td>Anterior cervical adenitis (tender nodes)</td>
</tr>
<tr>
<td>Winter and early spring presentation</td>
</tr>
<tr>
<td>History of exposure to strep pharyngitis</td>
</tr>
<tr>
<td>Scarlatiniform rash</td>
</tr>
<tr>
<td><strong>VIRAL</strong></td>
</tr>
<tr>
<td>Conjunctivitis</td>
</tr>
<tr>
<td>Coryza</td>
</tr>
<tr>
<td>Cough</td>
</tr>
<tr>
<td>Diarrhea</td>
</tr>
<tr>
<td>Hoarseness</td>
</tr>
<tr>
<td>Discrete ulcerative stomatitis</td>
</tr>
<tr>
<td>Viral exanthema</td>
</tr>
</tbody>
</table>
### Treatment recommendations

**Table 2. Antibiotic Regimens Recommended for Group A Streptococcal Pharyngitis**

<table>
<thead>
<tr>
<th>Drug, Route</th>
<th>Dose or Dosage</th>
<th>Duration or Quantity</th>
<th>Recommendation Strength, Quality&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Reference(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>For individuals without penicillin allergy</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Penicillin V, oral</td>
<td>Children: 250 mg twice daily or 3 times daily; adolescents and adults: 250 mg 4 times daily or 500 mg twice daily</td>
<td>10 d</td>
<td>Strong, high</td>
<td>[125, 126]</td>
</tr>
<tr>
<td>Amoxicillin, oral</td>
<td>50 mg/kg once daily (max = 1000 mg); alternate: 25 mg/kg (max = 500 mg) twice daily</td>
<td>10 d</td>
<td>Strong, high</td>
<td>[88–92]</td>
</tr>
<tr>
<td>Benzathine penicillin G, intramuscular</td>
<td>&lt;27 kg: 600 000 U; ≥27 kg: 1 200 000 U</td>
<td>1 dose</td>
<td>Strong, high</td>
<td>[53, 125, 127]</td>
</tr>
<tr>
<td><strong>For individuals with penicillin allergy</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cephalexin&lt;sup&gt;b&lt;/sup&gt;, oral</td>
<td>20 mg/kg/dose twice daily (max = 500 mg/dose)</td>
<td>10 d</td>
<td>Strong, high</td>
<td>[128–131]</td>
</tr>
<tr>
<td>Cefadroxil&lt;sup&gt;b&lt;/sup&gt;, oral</td>
<td>30 mg/kg once daily (max = 1 g)</td>
<td>10 d</td>
<td>Strong, high</td>
<td>[132]</td>
</tr>
<tr>
<td>Clindamycin, oral</td>
<td>7 mg/kg/dose 3 times daily (max = 300 mg/dose)</td>
<td>10 d</td>
<td>Strong, moderate</td>
<td>[133]</td>
</tr>
<tr>
<td>Azithromycin&lt;sup&gt;c&lt;/sup&gt;, oral</td>
<td>12 mg/kg once daily (max = 500 mg)</td>
<td>5 d</td>
<td>Strong, moderate</td>
<td>[97]</td>
</tr>
<tr>
<td>Clarithromycin&lt;sup&gt;c&lt;/sup&gt;, oral</td>
<td>7.5 mg/kg/dose twice daily (max = 250 mg/dose)</td>
<td>10 d</td>
<td>Strong, moderate</td>
<td>[134]</td>
</tr>
</tbody>
</table>

*Once a day amoxicillin WORKS!*
Case 4

Double, double, boils are trouble

- A 1 yo boy comes into a local PCP office with a “spider bite”
- His mother noted the “spider bite” on his left buttock three days ago
- Now it’s getting big, red and turning into a pimple
- Exam shows…
Case 4
Case 4

“Spider bite”

- The abscess is drained in the office with copious purulent fluid
- It grows (surprise!) MRSA
- Antibiotic choice?
Show of hands

• What drug would you start with?
  – Trimethoprim-sulfa (Bactrim)
  – Clindamycin
  – Any other drug
  – Nothing
Which will work?

- Trimethoprim-sulfa (Bactrim)
- Clindamycin
- Any other drug
- Nothing
Guideline: MRSA

Clinical Practice Guidelines by the Infectious Diseases Society of America for the Treatment of Methicillin-Resistant \textit{Staphylococcus Aureus} Infections in Adults and Children

Catherine Liu,\textsuperscript{1} Arnold Bayer,\textsuperscript{3,5} Sara E. Cosgrove,\textsuperscript{6} Robert S. Daum,\textsuperscript{7} Scott K. Fridkin,\textsuperscript{8} Rachel J. Gorwitz,\textsuperscript{9} Sheldon L. Kaplan,\textsuperscript{10} Adolf W. Karchmer,\textsuperscript{11} Donald P. Levine,\textsuperscript{12} Barbara E. Murray,\textsuperscript{14} Michael J. Rybak,\textsuperscript{12,13} David A. Talan,\textsuperscript{4,5} and Henry F. Chambers\textsuperscript{1,2}

Clin Infect Dis 2011;52:e18
I. What is the management of skin and soft-tissue infections (SSTIs) in the era of community-associated MRSA (CA-MRSA)?

1. For a cutaneous abscess, incision and drainage is the primary treatment (A-II). For simple abscesses or boils, incision and drainage alone is likely to be adequate, but additional data are needed to further define the role of antibiotics, if any, in this setting.
So...do I need to treat?

- For small abscesses which are well drained – no
- Focus on good wound care – soaks, topical antibiotics
- Larger abscesses, systemic symptoms probably deserve therapy
- A *good* incision and drainage is key!
  - Sedation if necessary
  - Aggressive palpation
  - Minor exploration to break up septations
Questions?
Summary

- Pharmacology – not so bad!
- A little knowledge of drug levels goes a long way
- When the evidence is there use
- When there is no evidence, figure it out!!
Questions?

- If you ever have need for inpatient, outpatient or phone consultation...
- We are happy to help!
Extra slides
I. What is the management of skin and soft-tissue infections (SSTIs) in the era of community-associated MRSA (CA-MRSA)?

*SSTIs*

### Table 2.

<table>
<thead>
<tr>
<th>Conditions in which Antimicrobial Therapy is Recommended after Incision and Drainage of an Abscess due to Community-Associated Methicillin-Resistant <em>Staphylococcus aureus</em></th>
</tr>
</thead>
<tbody>
<tr>
<td>Severe or extensive disease (e.g., involving multiple sites of infection) or rapid progression in presence of associated cellulitis</td>
</tr>
<tr>
<td>Signs and symptoms of systemic illness</td>
</tr>
<tr>
<td>Associated comorbidities or immunosuppression (diabetes mellitus, human immunodeficiency virus infection/AIDS, neoplasm)</td>
</tr>
<tr>
<td>Extremes of age</td>
</tr>
<tr>
<td>Abscess in area difficult to drain completely (e.g., face, hand, and genitalia)</td>
</tr>
<tr>
<td>Associated septic phlebitis</td>
</tr>
<tr>
<td>Lack of response to incision and drainage alone</td>
</tr>
</tbody>
</table>
I. What is the management of skin and soft-tissue infections (SSTIs) in the era of community-associated MRSA (CA-MRSA)?

SSTIs

3. For outpatients with purulent cellulitis (eg, cellulitis associated with purulent drainage or exudate in the absence of a drainable abscess), empirical therapy for CA-MRSA is recommended pending culture results. Empirical therapy for infection due to β-hemolytic streptococci is likely to be unnecessary (A-II). Five to 10 days of therapy is recommended but should be individualized on the basis of the patient’s clinical response.
<table>
<thead>
<tr>
<th>Manifestation</th>
<th>Treatment</th>
<th>Adult dose</th>
<th>Pediatric dose</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purulent cellulitis (defined as cellulitis</td>
<td>Clindamycin</td>
<td>300–450 mg PO TID</td>
<td>10–13 mg/kg/dose PO every 6–8 h, not to exceed</td>
<td><em>Clostridium difficile</em>-associated disease may occur more frequently, compared with other oral agents.</td>
</tr>
<tr>
<td>associated with purulent drainage or exudate in</td>
<td></td>
<td></td>
<td>40 mg/kg/day</td>
<td></td>
</tr>
<tr>
<td>the absence of a drainable abscess)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>TMP-SMX</td>
<td>1–2 DS tab PO BID</td>
<td>Trimethoprim 4–6 mg/kg/dose, sulfamethoxazole</td>
<td>TMP-SMX is pregnancy category C/D and not recommended for women in the third trimester of pregnancy</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>20–30 mg/kg/dose PO every 12 h</td>
<td>and for children &lt;2 months of age.</td>
</tr>
<tr>
<td></td>
<td>Doxycycline</td>
<td>100 mg PO BID</td>
<td>≤45kg: 2 mg/kg/dose PO every 12 h &gt;45kg: adult</td>
<td>Tetracyclines are not recommended for children under 8 years of age and are pregnancy category D.</td>
</tr>
<tr>
<td></td>
<td>Minocycline</td>
<td>200 mg × 1, then 100</td>
<td>4 mg/kg PO × 1, then 2 mg/kg/dose PO every 12 h</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>mg PO BID</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Linezolid</td>
<td>600 mg PO BID</td>
<td>10 mg/kg/dose PO every 8 h, not to exceed 600 mg/dose</td>
<td>More expensive compared with other alternatives</td>
</tr>
</tbody>
</table>
Any drug will do

- A 1 yo girl comes in to your office with fever
- She has had 3 days of fevers to 102F
- No rashes, respiratory symptoms, or other localizing signs
- You are smart enough to send a urine, which shows pyuria (lots of WBC) and bactiuria (lots of gram negative rods)
Urinary tract infection (UTI)

- You diagnose her with UTI and the culture comes back with a sensitive *E. coli*
Microbiology

- *E. coli*
- *E. coli*
- *E. coli*
- *E. coli*
- *E. coli*
- *Klebsiella, Enterobacter and cousins*
- *Pseudomononas*
- *Enterococcus and gram positive*
Pediatric UTI

- Most common serious bacterial infection in the Hib/PCV-7 era
- Most common infection in RSV+ children
- Extremely common in females <5 yo, white > other race, no source
  - When selected by this, at our ED, you have a >10% chance of having a UTI!
  - Increased risk in children with urinary tract abnormalities

Guideline: UTI

CLINICAL PRACTICE GUIDELINE

Urinary Tract Infection: Clinical Practice Guideline for the Diagnosis and Management of the Initial UTI in Febrile Infants and Children 2 to 24 Months

Pediatrics 2011;128:595
MANAGEMENT

Action Statement 4

**Action Statement 4a**
When initiating treatment, the clinician should base the choice of route of administration on practical considerations. Initiating treatment orally or parenterally is equally efficacious. The clinician should base the choice of agent on local antimicrobial sensitivity patterns (if available) and should adjust the choice according to sensitivity testing of the isolated uropathogen (evidence quality: A; strong recommendation).

**Action Statement 4b**
The clinician should choose 7 to 14 days as the duration of antimicrobial therapy (evidence quality: B; recommendation).
# Oral therapy

**TABLE 3  Some Empiric Antimicrobial Agents for Oral Treatment of UTI**

<table>
<thead>
<tr>
<th>Antimicrobial Agent</th>
<th>Dosage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amoxicillin-clavulanate</td>
<td>20–40 mg/kg per d in 3 doses</td>
</tr>
<tr>
<td>Sulfonamide</td>
<td></td>
</tr>
<tr>
<td>Trimethoprim-sulfamethoxazole</td>
<td>6–12 mg/kg trimethoprim and 30-60 mg/kg sulfamethoxazole per d in 2 doses</td>
</tr>
<tr>
<td>Sulfisoxazole</td>
<td>120–150 mg/kg per d in 4 doses</td>
</tr>
<tr>
<td>Cephalosporin</td>
<td></td>
</tr>
<tr>
<td>Cefixime</td>
<td>8 mg/kg per d in 1 dose</td>
</tr>
<tr>
<td>Cefpodoxime</td>
<td>10 mg/kg per d in 2 doses</td>
</tr>
<tr>
<td>Cefprozil</td>
<td>30 mg/kg per d in 2 doses</td>
</tr>
<tr>
<td>Cefuroxime axetil</td>
<td>20–30 mg/kg per d in 2 doses</td>
</tr>
<tr>
<td>Cephalexin</td>
<td>50–100 mg/kg per d in 4 doses</td>
</tr>
</tbody>
</table>
The helpful kidney

- Concentrates most medications
- Example: ceftriaxone
  - Serum peak: 150 ug/mL
  - Urine peak: 3000 ug/mL!
- Current recommendation: oral third generation cephalosporin (cefixime or cefdinir) to start
  - Pittsburgh TMP-SMX resistance 10-15%
Remember to narrow!!

- Urine culture result is key
- When possible use a much narrower agent
  - TMP-SMX
  - Amoxicillin
  - Amoxicillin-clavulanate