Examples of Antimicrobial Stewardship Interventions: a couple of starter projects

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Where to start?

• Baseline knowledge
  – Regulation around antimicrobial stewardship programs
    • Currently only Joint Commission but CMS is proposed
  – Identified an ASP leader
  – Gained leadership support
  – Gained provider and support staff buy in
    • Facility commitment to supporting appropriate use of antimicrobial agents
  – You have learned how to get your DOT data
• BUT where do I start now??????
ASP Strategies

• **Core strategies**
  – Auditing
    • Prospective or retrospective
    • De-escalation/escalation, therapy optimization, dose optimization, duration of therapy
  – Formulary restriction
  – Prior authorization

• **Supplemental Strategies**
  – Education
  – Antibiotic timeouts
  – Guidelines
  – Pathways
  – Antibiotic order forms
  – Automatic stop dates
  – IV to PO

Things to Remember....

• There is no single template for a program to optimize antibiotic prescribing in a facility
  – Complexity of medical decision making surrounding antibiotic use
  – Variability in the size and types of care among U.S. hospitals require flexibility in implementation
  – Experience demonstrates that ASPs can be implemented effectively in a wide variety of hospitals and that success is dependent on defined leadership and a coordinated multidisciplinary approach

Before picking a starting point:

• Do an honest evaluation of where the facility is at in regards to antibiotic use
  – CDC checklist, online ASP gap analysis, etc

• Determine ASP goals for your facility with your team
  – Keep these tangible and realistic

• ASP implementation strategy depends on facility dependent factors and goals
Lower hanging fruit

• IV to PO automatic conversion for antibiotics with high bioavailability
  – Quinolones, macrolides, doxycycline, metronidazole
• Dose optimization
• Guidelines/clinical pathway/order forms
IV to PO Antibiotic conversion

• Goals:
  – Reduce length of stay
  – Reduce risk of infections
    • If patient’s IV is only for an IV antibiotic and it is changed to PO the line may be potentially discontinued
  – Improve patient satisfaction
    • Less time tied to IV pole
  – Reduce cost
Association Between Initial Route of Fluoroquinolone Administration and Outcomes in Patients Hospitalized for Community-acquired Pneumonia

Raquel K. Belforti,1,2 Tara Lagu,1,2,3 Sarah Haessler,1,2,4 Peter K. Lindemayer,1,2,3 Penelope S. Pekow,2,5 Aruna Priya,3 Marya D. Zilberberg,6 Daniel Skiest,1,2,4 Thomas L. Higgins,1,2,7 Mihaela S. Stefan,1,2,3 and Michael B. Rothberg8

• Oral vs IV fluoroquinolones for treatment of CAP
  – No difference in clinical outcomes
    • Mortality, late ICU admission, vasopressor use or cost
      – Unable to evaluate drug acquisition cost

Example List: IV to PO

Pharmacy driven protocol to change IV antibiotics to oral
DOSE OPTIMIZATION
Optimizing the antimicrobial dose

- Inappropriate antimicrobial doses can lead to poor outcomes and promote resistance
- Must accounts for patient characteristics, causative organism, infection site, pharmacokinetics/pharmacodynamics of the drug
  - Examples:
    - Automatic pharmacy renal dosing
    - Extended infusion
    - Empiric dosing guidelines for providers (embed in ordersets)
- Educate providers, nurses and pharmacists
- Update orders in the computer system
Dose Optimization – cefazolin example

• Cefazolin dosing in tertiary references is confusing

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**Usual dosage range:** IM, IV: 1 to 1.5 g every 8 hours, depending on severity of infection; maximum: 12 g daily

**Catheter-related bloodstream infections (off-label use):** IV: 2 g every 8 hours (IDSA [Mermel 2009])

**Cholecystitis, mild-to-moderate:** IV: 1 to 2 g every 8 hours for 4 to 7 days (provided source controlled)

**Endocarditis, treatment:** IV:

  - Manufacturer’s labeling: 1 to 1.5 g every 6 hours

    Alternate dosing (AHA [Baddour 2015]): MSSA in penicillin-allergic (nonanaphylactoid) patients:

      - Native valve: 2 g every 8 hours for 6 weeks

**Moderate to severe infections:** IV: 500 mg to 1 g every 6 to 8 hours

**Mild infection with gram-positive cocci:** IV: 250 to 500 mg every 8 hours

**Severe infection:** IV: 1 to 1.5 g every 6 hours
Dose Optimization – cefazolin example

- Cefazolin breakpoint in the microbiology lab

(10) **Breakpoints** when cefazolin is used for therapy of infections other than uncomplicated UTIs due to *E. coli, K. pneumoniae,* and *P. mirabilis.* Breakpoints are based on a dosage regimen of 2 g every 8 h.

- Had trouble teaching providers this dose so we updated the order sentences in the computer

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**Order sentences for: ceFAZolin**

- ****IV PUSH****
- 2 gm IV Push q8Hr, Soln
- 2 gm IV Push On Call, Injection for reconstitution
- ****IVPB****
- 2 gm IVPB q8Hr

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CLSI M100 S27:2017
### Restricted Antimicrobial Agents
AMS –x5619 or 927-6186; M-F 0800-1600

<table>
<thead>
<tr>
<th>Antibiotic</th>
<th>Dose</th>
<th>Cost per day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aztreonam</td>
<td>2 g Q8h</td>
<td>$4.27</td>
</tr>
<tr>
<td>Cefazolin</td>
<td>2 g Q8h</td>
<td>$2.16</td>
</tr>
<tr>
<td>Ceftriaxone</td>
<td>2 g Q24h</td>
<td>$1.16</td>
</tr>
<tr>
<td>Cefepime^</td>
<td>2 g Q8-12h</td>
<td>$14.12-21.19</td>
</tr>
<tr>
<td>Ampicillin</td>
<td>2 g Q4h</td>
<td>$15.18</td>
</tr>
<tr>
<td>Ampicillin-sulbactam</td>
<td>3 g Q6h</td>
<td>$8.64</td>
</tr>
<tr>
<td>Nafcillin</td>
<td>2 g Q4h</td>
<td>$45.24</td>
</tr>
<tr>
<td>Piperacillin-tazobactam^</td>
<td>3.375 g Q8h</td>
<td>$26.55</td>
</tr>
<tr>
<td>Ertapenem</td>
<td>1 g daily</td>
<td>$101.66</td>
</tr>
<tr>
<td>Meropenem^</td>
<td>1 g Q8h</td>
<td>$28.89</td>
</tr>
<tr>
<td>Aztreonam</td>
<td>2 g Q8h</td>
<td>$152.01</td>
</tr>
<tr>
<td>Ciprofloxacin</td>
<td>400 mg Q8-12h</td>
<td>$3.30-4.95</td>
</tr>
<tr>
<td>Levofloxacin</td>
<td>750 mg daily</td>
<td>$2.20</td>
</tr>
<tr>
<td>Azithromycin</td>
<td>500 mg daily</td>
<td>$2.23</td>
</tr>
<tr>
<td>Clindamycin</td>
<td>600 -900 mg Q8h</td>
<td>$5.85-11.79</td>
</tr>
<tr>
<td>Doxycycline</td>
<td>100 mg Q12h</td>
<td>$34.74</td>
</tr>
<tr>
<td>Metronidazole</td>
<td>500 mg Q8h</td>
<td>$2.58</td>
</tr>
<tr>
<td>Vancomycin</td>
<td>1 g Q12h</td>
<td>$15</td>
</tr>
<tr>
<td>Linezolid</td>
<td>600 mg Q12h</td>
<td>$72.16</td>
</tr>
<tr>
<td>Daptomycin</td>
<td>500 mg daily</td>
<td>$295.16</td>
</tr>
</tbody>
</table>

*cost is based on inpatient acquisition cost
^ utilizes extended infusion

### Oral Antimicrobial Agents*

<table>
<thead>
<tr>
<th>Antibiotic</th>
<th>Dose</th>
<th>Cost per day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amoxicillin</td>
<td>500-1000 mg TID</td>
<td>$0.15-0.30</td>
</tr>
<tr>
<td>Amox-clav^~</td>
<td>875/125 mg BID</td>
<td>$1.10</td>
</tr>
<tr>
<td>Cephalexin</td>
<td>1000 mg TID</td>
<td>$0.54</td>
</tr>
<tr>
<td>Cefdinir</td>
<td>300 mg BID</td>
<td>$1.56</td>
</tr>
<tr>
<td>Ciprofloxacin</td>
<td>500 mg BID</td>
<td>$0.24</td>
</tr>
<tr>
<td>Levofloxacin</td>
<td>750 mg daily</td>
<td>$0.21</td>
</tr>
<tr>
<td>Clindamycin</td>
<td>300 mg QID</td>
<td>$1.76</td>
</tr>
<tr>
<td>Azithromycin</td>
<td>500 mg daily</td>
<td>$0.86</td>
</tr>
<tr>
<td>Doxycycline</td>
<td>100 mg BID</td>
<td>$0.58</td>
</tr>
<tr>
<td>Minocycline</td>
<td>100 mg BID</td>
<td>$0.48</td>
</tr>
<tr>
<td>TMP/SMX^</td>
<td>1 DS BID</td>
<td>$0.16</td>
</tr>
<tr>
<td>Linezolid</td>
<td>600 mg BID</td>
<td>$6.40</td>
</tr>
<tr>
<td>Nitrofurantoin</td>
<td>100 mg BID</td>
<td>$1.86</td>
</tr>
<tr>
<td>Metronidazole</td>
<td>500 mg TID</td>
<td>$0.27</td>
</tr>
<tr>
<td>Vancomycin</td>
<td>125 mg QID</td>
<td>$2.90</td>
</tr>
</tbody>
</table>

*cost is based on inpatient acquisition cost
^ Amoxicillin-clavulanate
^ Trimethoprim-sulfamethoxazole

### IV Antimicrobial Agents*

<table>
<thead>
<tr>
<th>Antibiotic</th>
<th>Dose</th>
<th>Cost per day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cefazolin</td>
<td>2 g Q8h</td>
<td>$4.27</td>
</tr>
<tr>
<td>Ceftriaxone</td>
<td>2 g Q24h</td>
<td>$2.16</td>
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<tr>
<td>Cefepime^</td>
<td>2 g Q8-12h</td>
<td>$14.12-21.19</td>
</tr>
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<td>Ampicillin</td>
<td>2 g Q4h</td>
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</tr>
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<td>Ampicillin-sulbactam</td>
<td>3 g Q6h</td>
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<tr>
<td>Nafcillin</td>
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</tr>
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<tr>
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<td>$28.89</td>
</tr>
<tr>
<td>Aztreonam</td>
<td>2 g Q8h</td>
<td>$152.01</td>
</tr>
<tr>
<td>Ciprofloxacin</td>
<td>400 mg Q8-12h</td>
<td>$3.30-4.95</td>
</tr>
<tr>
<td>Levofloxacin</td>
<td>750 mg daily</td>
<td>$2.20</td>
</tr>
<tr>
<td>Azithromycin</td>
<td>500 mg daily</td>
<td>$2.23</td>
</tr>
<tr>
<td>Clindamycin</td>
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<td>$5.85-11.79</td>
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<tr>
<td>Doxycycline</td>
<td>100 mg Q12h</td>
<td>$34.74</td>
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<tr>
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<td>500 mg Q8h</td>
<td>$2.58</td>
</tr>
<tr>
<td>Vancomycin</td>
<td>1 g Q12h</td>
<td>$15</td>
</tr>
<tr>
<td>Linezolid</td>
<td>600 mg Q12h</td>
<td>$72.16</td>
</tr>
<tr>
<td>Daptomycin</td>
<td>500 mg daily</td>
<td>$295.16</td>
</tr>
</tbody>
</table>

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^ utilizes extended infusion

### Reference Laboratory Update

**Sensitivity Profile for 2016**

**Antibiogram for 2016**
Prepared by:
Camilla Saberhagen, MD, FACP
Infectious Diseases
Paula Jackson, MT (ASCP)
Microbiology Laboratory
Jennifer Ott, PharmD, BCPS
Pharmacy

For questions or more information, please call the Billings Clinic Laboratory at (406) 657-4074
www.billingsclinic.com
Example: Pre-operative Prophylaxis Recommendations

B. Exhibit B Antimicrobial agents used in surgical prophylaxis

<table>
<thead>
<tr>
<th>Antimicrobial</th>
<th>Adults</th>
<th>Pediatrics</th>
<th>Drug half-life with normal renal function</th>
<th>Recommended re-dosing interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amp/sulbactam</td>
<td>3 g</td>
<td>50 mg/kg (dosed on ampicillin component)</td>
<td>0.8-1.3</td>
<td>2</td>
</tr>
<tr>
<td>Ampicillin</td>
<td>2 g</td>
<td>50 mg/kg</td>
<td>1-1.9</td>
<td>2</td>
</tr>
<tr>
<td>Cefazolin</td>
<td>2 g for pt &lt; 120 kg 3 g for pt ≥ 120 kg</td>
<td>30 mg/kg</td>
<td>1.2-2.2</td>
<td>4</td>
</tr>
<tr>
<td>Cefoxitin</td>
<td>2 g</td>
<td>40 mg/kg</td>
<td>0.7-1.1</td>
<td>2</td>
</tr>
<tr>
<td>Ciprofloxacin</td>
<td>400 mg</td>
<td>10 mg/kg</td>
<td>3-7</td>
<td>NA</td>
</tr>
<tr>
<td>Clindamycin</td>
<td>900 mg</td>
<td>10 mg/kg</td>
<td>2-4</td>
<td>6</td>
</tr>
<tr>
<td>Gentamicin</td>
<td>5 mg/kg</td>
<td>2.5 to 5 mg/kg</td>
<td>2-3</td>
<td>NA</td>
</tr>
<tr>
<td>Metronidazole</td>
<td>500 mg</td>
<td>15 mg/kg</td>
<td>6-8</td>
<td>NA</td>
</tr>
<tr>
<td>Vancomycin¹</td>
<td>1000 mg for pt &lt; 80 kg 1500 mg for pt 80-110 kg 2000 mg for pt &gt; 110 kg</td>
<td>15 mg/kg</td>
<td>4-8</td>
<td>NA</td>
</tr>
</tbody>
</table>

1. For vancomycin doses <1000 mg, infuse over 60 minutes; if vancomycin dose >1000 mg infuse over 90 minutes.
# Example - Dose Optimization

## Billings Clinic Antibacterial Agents Recommended Dosing and Renal Adjustments

<table>
<thead>
<tr>
<th>Drug / Use</th>
<th>Normal Dose</th>
<th>CrCl 30-50 ml/min</th>
<th>CrCl 10-29 ml/min</th>
<th>CrCl&lt;10 ml/min</th>
<th>HD Supplement*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amikacin</td>
<td>See Aminoglycoside Dosing algorithm</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Amoxicillin</td>
<td>Normal dose 500 mg tid.</td>
<td>No change</td>
<td>500 mg q12h</td>
<td>500 mg q24h</td>
<td>Dose AD***</td>
</tr>
<tr>
<td></td>
<td>875 mg bid</td>
<td>No change</td>
<td>Do not use 875 mg formulation for CrCl&lt;30</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>High dose (CAP, other serious) 1000 mg tid</td>
<td>No change</td>
<td>1000 mg q12h</td>
<td>1000 mg q24h</td>
<td>Dose AD</td>
</tr>
<tr>
<td>Amoxicillin/clavulanate</td>
<td>Normal dose (500/125 mg, 875/125 mg) 500 mg tid</td>
<td>No change</td>
<td>500 mg q12h</td>
<td>500 mg q24h</td>
<td>Dose AD</td>
</tr>
<tr>
<td></td>
<td>875 mg bid</td>
<td>No change</td>
<td>Do not use 875 mg formulation for CrCl&lt;30</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>High dose (CAP, sinusitis, etc) (XR = 1000/62.5 mg) (NF) 2 g (XR) bid</td>
<td>No change</td>
<td>Do not use XR formulation for CrCl&lt;30</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ampicillin IV</td>
<td>Low dose (UTI) 1-2 g q6h</td>
<td>1-2 g q6h</td>
<td>1-2 g q12h</td>
<td>2 g q24 h</td>
<td>Dose AD</td>
</tr>
<tr>
<td></td>
<td>Standard dose 2 g q4h</td>
<td>2 g q6h</td>
<td>2 g q12h</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ampicillin/subactam</td>
<td>3 g q6h</td>
<td>May consider 3 g q8 h</td>
<td>3 g q12h</td>
<td>3 g q24 h</td>
<td>Dose AD</td>
</tr>
<tr>
<td>Azithromycin (IV/PO)</td>
<td>500 mg q24h</td>
<td>No change</td>
<td>No change</td>
<td>No change</td>
<td>Extra 0.25 to 0.5 g AD</td>
</tr>
<tr>
<td>Aztreonam</td>
<td>2 g q8h</td>
<td>No change</td>
<td>1 g q8h</td>
<td>0.5 g q8h</td>
<td></td>
</tr>
<tr>
<td>Cefazolin</td>
<td>2 g q8h</td>
<td>No change</td>
<td>2 g q12h</td>
<td>1 g q24h</td>
<td>1 g daily or 2 g 3 x wk after HD (3g before the 3 day period off – ie – MW=2g, F=3g</td>
</tr>
<tr>
<td>Cefdinir</td>
<td>300 mg q12h or 600 mg q24h</td>
<td>No change</td>
<td>300 mg q24h</td>
<td>300 mg q24h</td>
<td>300 mg AD or QOD</td>
</tr>
<tr>
<td>Cefepime</td>
<td>non-CNS infections, organisms with lower MICs 1 g q8h (=2 g q12h)</td>
<td>2 g q24h (30-60)**</td>
<td>1 g q24h</td>
<td>0.5 – 1 g q24h</td>
<td>1 g daily (AD on HD days) or 2 g 3 x wk after HD</td>
</tr>
<tr>
<td></td>
<td>Meningitis, febrile neutropenia, CF, organisms w/higher MIC 2 g q8h</td>
<td>2 g q12h (30-60)</td>
<td>2 g q24h</td>
<td>1 g q24h</td>
<td>Dose AD</td>
</tr>
</tbody>
</table>
Dose Optimization

• Consider your most commonly used antibiotics
  – Create the list of appropriate or recommended doses
  – Update order sentences, ordersets, pathways, protocols to promote appropriate dosing of antimicrobial agents
PATHWAYS/ORDERSETS
Pathways/Ordersets

- Improve antimicrobial use and streamlines usage of antimicrobial agents
  - Get provider buy in
- Computer ordersets can be used to drive provider ordering of antibiotics
  - Disadvantage – possible poor adherence
- Determine what your common uses of antibiotics are and which disease states drive those antibiotics
  - UTI vs SSTI vs pneumonia
Pathway example

• Noticed our fluoroquinolone use was very high

• Mini-MUE
  – Drivers were pneumonia and COPD
    • Some pyelonephritis orders

• Re-evaluated pneumonia powerplans
  – 4 plans
    • All were different
Pneumonia Order Set Example

Community-acquired pneumonia (CAP)

Non-ICU CAP
- Ceftriaxone 2 g IV q24h + azithromycin 500 mg IV q24h
- *Penicillin anaphylaxis*: levofloxacin 750 mg IV q24h

ICU - CAP
- Ceftriaxone 2 g IV q24h + azithromycin 500 mg IV q24h
- Ceftriaxone 2 g IV q24h + levofloxacin 750 mg IV q24h

Healthcare-associated pneumonia/Hospital-acquired pneumonia

HCAP/HAP
- Ceftriaxone 2 g IV q24h
- *Penicillin anaphylaxis*: levofloxacin 750 mg IV q24h

HCAP/HAP with Pseudomonas aeruginosa risk factors (chronic lung disease and exposure to multiple antibiotics)
- Cefepime 2 g IV q8h (EI)
- Piperacillin-tazobactam 3.375 g IV q8h (EI)
- *Penicillin anaphylaxis*: Vancomycin per pharmacist + aztreonam 2 g IV q8h

MRSA risk factors add vancomycin
- Vancomycin per pharmacist (15-20)

Aspiration pneumonia

Aspiration pneumonia
- Ceftriaxone 2 g IV q24h
- *Penicillin anaphylaxis*: levofloxacin 750 mg IV q24h

Aspiration pneumonia with empyema or lung abscess
- Ceftriaxone 2 g IV q24h + metronidazole 500 mg IV q8h
- *Penicillin anaphylaxis*: levofloxacin 750 mg IV q24h + metronidazole 500 mg IV q8h
Results of Powerplan Update

• Updated antibiotic sections of pneumonia powerplans in 2014
Opportunities for Stewardship

Inappropriate Management of Asymptomatic Patients With Positive Urine Cultures: A Systematic Review and Meta-analysis

Myrto Eleni Flokas,¹a Nikolaos Andreatos,¹a Michail Alevizakos,¹ Alireza Kalbasi,² Pelin Onur,¹ and Eleftherios Mylonakis¹

¹Infectious Diseases Division, Warren Alpert Medical School of Brown University, Rhode Island Hospital, Providence, Rhode Island; and ²Department of Medical Oncology, Dana-Farber Cancer Institute, Harvard Medical School, Boston, Massachusetts

• 8 studies implemented interventions aimed at reducing the rate of inappropriate treatment.
  – resulted in up to an 80% reduction in the inappropriate management of ASB

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Pyelonephritis

- Outpatient
- No
- Complicated
- Inpatient
- Yes

Urine cultures should only be ordered for symptomatic patients (not for cloudy / foul smelling urine)

Notes:
- Pyuria does not differentiate symptomatic UTI from asymptomatic bacteriuria
- Urine cultures should only be ordered for symptomatic patients (not for cloudy / foul smelling urine)

UTI Treatment

*Excludes suspected prostatitis

Is patient symptomatic?

- Dysuria + frequency / urgency
- Suprapubic pain +/- hematuria
- Catheters: new onset delirium / rigors/fever with no alternate site of infection
- Spine injury: ↑ spasticity, autonomic dysreflexia, and/or sense of unease

No

Yes

Does patient have indwelling urinary catheter?

No

Yes

Cystitis

Inpatient and Outpatient

Uncomplicated

Complicated

Preferred:
- Nitrofurantoin 100mg BID x 5 days#
- SMX/TMP 1 DS tab BID x 3 days^a
- Cephalexin 1000mg TID x7 days^a

Alternatives:
- Amoxicillin-clavulanate 875/125mg BID x 5-7 days^a
- Cefuroxime 250mg BID x5-7 days^a
- Cefdinir 300mg BID x 5-7 days^a
- Ciprofloxacin 250mg BID x3 days^a^a
- Levofoxacin 250mg daily x3 days^a^a

Inpatient - if unable to take PO may consider ceftriaxone 2 g q24h and de-escalate based on culture results

*Use only if severe allergy to other agents / Pseudomonas aeruginosa history or non-removable device (eg ureteral stent)

Same regimens as uncomplicated, but extend duration to 7-10 days.
- May consider 14 if patient severely ill

Pyelonephritis

Inpatient

- Ceftriaxone 2g IV q24h x14 days
- Ciprofloxacin 400mg IV q12h x7 days^a*
- Levofoxacin 750mg IV q24h x5 days^a*

*Use only if severe allergy to other agents or non-removable device (eg ureteral stent)

Outpatient

- SMX/TMP 1 DS tab BID x14 days^a*
- Cefdinir 300mg BID x14 days^a*
- Cephalexin 1000mg TID x14 days^a*
- Ciprofloxacin 500mg BID x7 days^a*
- Levofoxacin 750mg daily X5 days^a*

Optional initial IV dose:
- Ceftriaxone 2g IV x1
- Ciprofloxacin 400mg IV x1^a*

*Use only if severe allergy to other agents or non-removable device (eg ureteral stent)

De-escalation:
- Narrow agents based on culture and sensitivity results
- If E. coli is susceptible to cefazolin, de-escalate to cefazolin 2g IV q8h

Transition to PO

- Transition to PO agent of the SAME class if possible (eg. ceftriaxone → cefdinir → cefazolin → cephalexin)

Notes:
- Requires renal dose adjustment
- # do NOT use for CrCl < 30 mL/min

Catheter-Associated UTI

Remove catheter (if possible)

Cystitis

Pyelonephritis

If antibiotics initiated, see cystitis and pyelonephritis regimens

Duration:
- 7 days if symptoms resolve, 10-14 days if severely ill or delayed response to treatment

Urine collection:
- In catheterized patients, urine culture should be collected following replacement of the catheter (if current catheter has been in place ≥ 14 days)
### Eskenazi Health

**Recommended Empiric Antibiotic Regimens by Infection for Adult Patients**

<table>
<thead>
<tr>
<th>Infection and Suspected Organisms</th>
<th>Recommended Regimen</th>
<th>Alternative Regimen</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Community Acquired Pneumonia</strong></td>
<td>Ceftiraxone + Azithromycin</td>
<td>Levofloxacin 750mg Daily (normal renal function)</td>
</tr>
<tr>
<td>Streptococcus pneumoniae, Haemophilus influenzae, Legionella pneumophila, etc</td>
<td>Piperacillin-Tazobactam or Cefepime + Levofloxacin 750mg Daily</td>
<td>Piperacillin-Tazobactam, Cefepime or Meropenem + Tobramycin + Azithromycin or Levofloxacin 750mg Daily</td>
</tr>
<tr>
<td>Pseudomonas aeruginosa - consider in patients with structural lung disease, recent hospitalization, recent antibiotic therapy, or need for ICU admission</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>HAP/VAP</strong> = Early onset (&lt; 5 days), no risk for MDR pathogens, any severity</td>
<td>Ceftiraxone or Levofloxacin</td>
<td>Cefepime</td>
</tr>
<tr>
<td>Streptococcus pneumoniae, Haemophilus influenzae, MSSA, antibiotic sensitive enteric Gram-negative bacilli</td>
<td>Piperacillin/tazobactam (preferred in ICU patients) or Cefepime</td>
<td>Meropenem or Cefepime + Tobramycin or Ciprofloxacin⁷ + Vancomycin (if MRSA suspected)</td>
</tr>
<tr>
<td><strong>HAP/VAP/HCAP</strong> = Late onset (≥ 5 days) or risk factors for MDR pathogens, any severity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Same as early onset PLUS MDR pathogens such as Pseudomonas aeruginosa, Klebsiella pneumoniae, MRSA</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Urinary Tract Infections</strong> - Community</td>
<td>Nitrofurantoin, Ciprofloxacin or Levofloxacin</td>
<td>Trimethoprim-Sulfamethoxazole or Cephalexin</td>
</tr>
<tr>
<td>Escherichia coli, Proteus mirabilis</td>
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<td></td>
</tr>
<tr>
<td><strong>Urinary Tract Infections</strong> - Nosocomial</td>
<td>Ceftriaxone or Cefepime</td>
<td>Aztreonam</td>
</tr>
<tr>
<td>Escherichia coli, Enterobacter spp, Serratia marcescens, Pseudomonas aeruginosa, etc</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Acute Bacterial Meningitis</strong> - Adults</td>
<td>Ceftiraxone + Vancomycin</td>
<td>Vancomycin + Meropenem</td>
</tr>
<tr>
<td>Streptococcus pneumoniae, Neisseria meningitidis</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Cellulitis</strong> - without open skin wound</td>
<td>Nafcillin or Cefazolin</td>
<td>Clindamycin or Vancomycin</td>
</tr>
<tr>
<td>Staphylococcus aureus (MSSA), β-hemolytic streptococcus (S. pyogenes, etc)</td>
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<td></td>
</tr>
<tr>
<td><strong>Cellulitis</strong> - with abscess formation or pus/tube</td>
<td>Vancomycin</td>
<td>Trimethoprim-Sulfamethoxazole or Clindamycin</td>
</tr>
<tr>
<td>Same as above including possible CA-MRSA</td>
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</tr>
<tr>
<td><strong>Diabetic Foot Infections</strong> - ulcer with ≥ 2 features of inflammation (erythema, warmth, pain, purulence, induration)</td>
<td>Likely Causative Organism</td>
<td>Empiric Therapy</td>
</tr>
<tr>
<td>PO clindamycin, dicroxacillin, amoxicillin/clavulanate; use clindamycin or TMP/SMX if MRSA suspected</td>
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</tr>
<tr>
<td><strong>Mild</strong>⁸ = Cellulitis extends &lt; 2 cm around ulcer, infection limited to skin/subcutaneous tissue; patient without SIRS</td>
<td>β-hemolytic Streptococcus, S. aureus</td>
<td>Ceftiraxone (or vancomycin if patient has MRSA risk factors listed below)</td>
</tr>
<tr>
<td><strong>Moderate</strong>²⁹ = Cellulitis extending ≥ 2 cm or involving structures deeper than skin/Subcutaneous tissue (e.g., abscess, septic arthritis, osteomyelitis, fasciitis); patient without SIRS</td>
<td>β-hemolytic Streptococcus, S. aureus</td>
<td>Consider Enterobacteriaceae if on antibiotics within past 30 days</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Consider obligate anaerobes if necrotic wound that has not been debrided</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Add PO metronidazole if anaerobes suspected</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- PO cefazolin/cefepime and PO metronidazole; OR</td>
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<tr>
<td></td>
<td></td>
<td>levofloxacin/ciprofloxacin with PO metronidazole</td>
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</tbody>
</table>

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¹⁴ PO clindamycin, dicroxacillin, amoxicillin/clavulanate; use clindamycin or TMP/SMX if MRSA suspected.

¹⁵ Ceftriaxone plus Vancomycin.

¹⁶ Vancomycin plus PO metronidazole.

¹⁷ Consider Enterobacteriaceae if on antibiotics within past 30 days.

¹⁸ Consider clindamycin (or equivalent) if organisms identified.

¹⁹ Cefazolin or cefepime (if patient has MRSA risk factors).

²⁰ PO clindamycin, dicroxacillin, amoxicillin/clavulanate; use clindamycin or TMP/SMX if MRSA suspected.

²¹ PO clindamycin, dicroxacillin, amoxicillin/clavulanate; use clindamycin or TMP/SMX if MRSA suspected.

²² Ceftriaxone plus Vancomycin.

²³ PO clindamycin, dicroxacillin, amoxicillin/clavulanate; use clindamycin or TMP/SMX if MRSA suspected.

²⁴ PO clindamycin, dicroxacillin, amoxicillin/clavulanate; use clindamycin or TMP/SMX if MRSA suspected.

²⁵ PO clindamycin, dicroxacillin, amoxicillin/clavulanate; use clindamycin or TMP/SMX if MRSA suspected.

²⁶ PO clindamycin, dicroxacillin, amoxicillin/clavulanate; use clindamycin or TMP/SMX if MRSA suspected.

²⁷ PO clindamycin, dicroxacillin, amoxicillin/clavulanate; use clindamycin or TMP/SMX if MRSA suspected.

²⁸ PO clindamycin, dicroxacillin, amoxicillin/clavulanate; use clindamycin or TMP/SMX if MRSA suspected.

²⁹ PO clindamycin, dicroxacillin, amoxicillin/clavulanate; use clindamycin or TMP/SMX if MRSA suspected.

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Once culture results are available, please streamline antibiotic therapy.
Stewardship – Formulary Restriction and Preauthorization (front end approach)

• Advantage
  – Immediate and substantial reductions in antimicrobial use and costs
  – Direct control over antimicrobial usage

• Disadvantages
  – Increased staffing requirements
  – Possible delayed initiation of therapy while awaiting approval from authorized prescriber
  – Increased use of alternative antimicrobial agents
  – Prescriber pushback due to perceived loss of autonomy


Antimicrobial restriction- either through formulary limitation of by the requirement of preauthorization and justification – is the most effective method of achieving the process goal of controlling antimicrobial use

Carbapenem Restriction
Summary

• There are multiple approaches to ASP implementation
  – Facility dependent factors and resources should be considered when determining a starting point for ASP interventions

• Start with what is reasonable given your resources
Additional resources

• MT antibiotic stewardship initiative
  http://mpqhf.com/corporate/health-and-technology-services/resources/abs-collaborative-resources/

• Antimicrobial stewardship websites (ie multiple pathways and examples):
  https://www.idstewardship.com/resources/

• Duke Antimicrobial Stewardship Outreach Network
  https://dason.medicine.duke.edu/edason
QUESTIONS?
IV to PO Study Support

• Prospectively converted levofloxacin from IV to PO
  – Est $60/day savings in medication/supply cost
  – Reduced length of stay by 3.5 days
    • Est overall cost savings approximately $3,300/pt

• Early conversion from IV to PO for community-acquired pneumonia
  – Decreased length of stay by almost 2 days
  – No negative impact on mortality or clinical cure

IV to PO Myths

• Infectious diseases need IV antibiotics and oral therapy should be used sparingly. Oral antibiotics are not equivalent to IV
  – Some agents have excellent bioavailability (quinolones, metronidazole, sulfamethoxazole/trimethoprim, macrolides)
  – Literature supports IV to PO is efficacious, convenient and safe in selected patients

• Medicare will not reimburse for inpatients on oral antimicrobial therapy
  – Many use intravenous antimicrobial need as their primary justification for hospitalization
    • Typically, if the patient has other medical issues, then converting to PO therapy should not compromise the ability to remain hospitalized
    • If no other medical issues to address, conversion to PO therapy will expedite discharge

  – Education must be performed to alter this thought process.