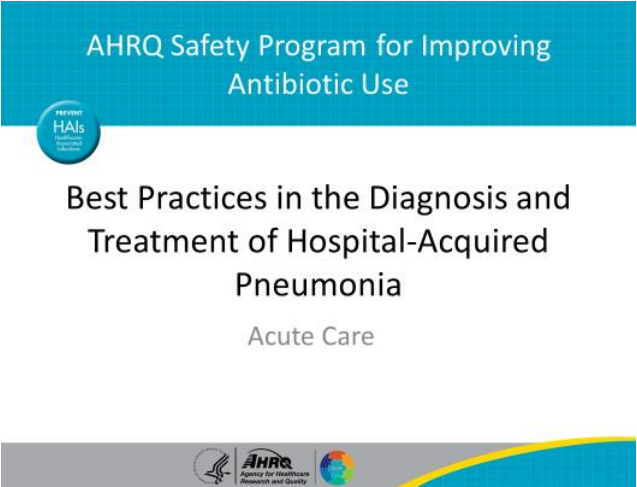
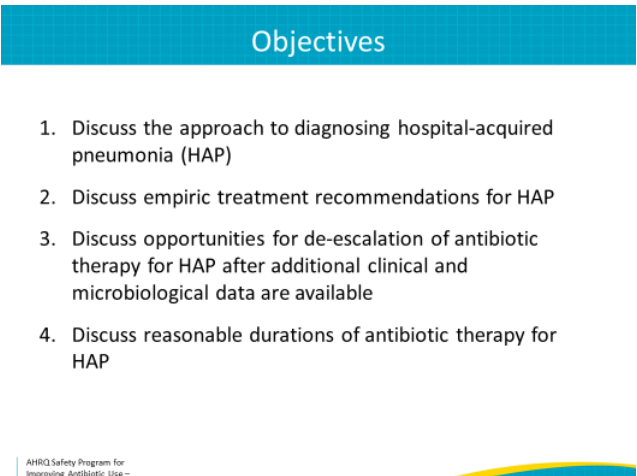


AHRQ Safety Program for Improving Antibiotic Use



Best Practices in the Diagnosis and Treatment Hospital-Acquired Pneumonia

Acute Care

Slide Title and Commentary	Slide Number and Slide
<p>Best Practices in the Diagnosis and Treatment of Hospital-Acquired Pneumonia</p> <p>SAY:</p> <p>This presentation is titled “Best Practices in the Diagnosis and Treatment of Hospital-Acquired Pneumonia.”</p>	<p>Slide 1</p> 
<p>Objectives</p> <p>SAY:</p> <p>This presentation will address:</p> <ol style="list-style-type: none"> 1. The approach to diagnosing hospital-acquired pneumonia, or HAP 2. Empiric treatment recommendations for HAP 3. Opportunities for de-escalation of antibiotic therapy for HAP after additional clinical and microbiological data are available 4. Reasonable durations of antibiotic therapy for HAP 	<p>Slide 2</p>  <ol style="list-style-type: none"> 1. Discuss the approach to diagnosing hospital-acquired pneumonia (HAP) 2. Discuss empiric treatment recommendations for HAP 3. Discuss opportunities for de-escalation of antibiotic therapy for HAP after additional clinical and microbiological data are available 4. Discuss reasonable durations of antibiotic therapy for HAP



Slide Title and Commentary

The Four Moments of Antibiotic Decision Making

SAY:

As we discuss the diagnosis and treatment of HAP, we will continue to use the Four Moments of Antibiotic Decision Making framework.

As a reminder, Moment 1 asks: Does my patient have an infection that requires antibiotics?

Moment 2 consists of two questions and asks: Have I ordered appropriate cultures before starting antibiotics? What empiric therapy should I initiate?

Moment 3 consists of three questions and asks: A day or more has passed since initiating antibiotics. As I have more clinical and microbiologic data available can I stop antibiotics, can I narrow antibiotics, or can I change from intravenous to oral antibiotics?

And finally, Moment 4 asks: What duration of therapy is needed for my patient's diagnosis?

The Four Moments of Antibiotic Decision Making

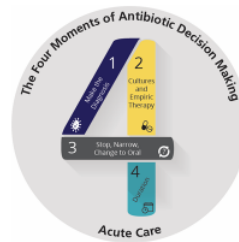
SAY:

The first moment of the Four Moments of Antibiotic Decision Making asks, "Does my patient have an infection that requires antibiotics?"

Slide Number and Slide

Slide 3

The Four Moments of Antibiotic Decision Making



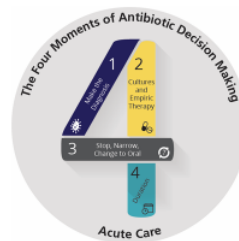
AHRQ Safety Program for Improving Antibiotic Use – Acute Care

HAP 3

1. Does my patient have an infection that requires antibiotics?
2. Have I ordered appropriate cultures before starting antibiotics? What empiric therapy should I initiate?
3. A day or more has passed. Can I stop antibiotics? Can I narrow therapy or change from IV to oral therapy?
4. What duration of antibiotic therapy is needed for my patient's diagnosis?

Slide 4


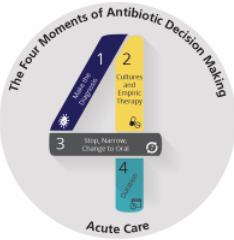
The Four Moments of Antibiotic Decision Making



AHRQ Safety Program for Improving Antibiotic Use – Acute Care

HAP 4

1. Does my patient have an infection that requires antibiotics?

Slide Title and Commentary	Slide Number and Slide
<p>Moment 1: Diagnosing HAP</p> <p>SAY:</p> <p>Patients have to be hospitalized for at least 48 hours before the development of clinical symptoms to meet criteria for HAP.</p> <p>The diagnosis of HAP includes clinical symptoms of pneumonia plus hypoxia and a new radiographic infiltrate that develops at least 48 hours after hospitalization. The diagnosis should not be made on chest x-ray findings in the absence of relevant respiratory symptoms.</p> <p>Common clinical symptoms include fever, cough, shortness of breath, and pleuritic chest pain. It is important to consider alternative causes of respiratory symptoms that could be contributing to clinical symptoms such as atelectasis, volume overload, aspiration pneumonitis, or pulmonary embolism.</p>	<p>Slide 5</p> <p>Moment 1: Diagnosing HAP</p> <ul style="list-style-type: none"> Not associated with mechanical ventilation at the time of onset in a hospitalized patient  <ul style="list-style-type: none"> Includes clinical symptoms of pneumonia PLUS hypoxia PLUS a new radiographic infiltrate that develops at least 48 hours after hospitalization <p>AHRQ Safety Program for Improving Antibiotic Use – Acute Care</p> <p>HAP 5</p>
<p>The Four Moments of Antibiotic Decision Making</p> <p>SAY:</p> <p>During Moment 2, ask, “Have I ordered appropriate cultures before starting antibiotics? What empiric therapy should I initiate?”</p>	<p>Slide 6</p> <p>The Four Moments of Antibiotic Decision Making</p> <ol style="list-style-type: none"> Does my patient have an infection that requires antibiotics? Have I ordered appropriate cultures before starting antibiotics? What empiric therapy should I initiate?  <p>AHRQ Safety Program for Improving Antibiotic Use – Acute Care</p> <p>HAP 6</p>

Slide Title and Commentary	Slide Number and Slide
<p>Moment 2: Diagnostic Tests for HAP</p> <p>SAY:</p> <p>HAP can be caused by either community-associated or healthcare-associated pathogens.</p> <p>These include <i>Streptococcus pneumoniae</i>, <i>Haemophilus influenzae</i>, <i>Staphylococcus aureus</i>, Gram-negative enteric bacteria, or <i>Pseudomonas aeruginosa</i>.</p> <p><i>Legionella</i> is uncommon but should be considered for hospitalized patients, particularly those who are immunocompromised or severely ill. If <i>Legionella</i> is suspected, consider obtaining a Legionella urinary antigen.</p> <p>Always attempt to obtain a sputum Gram stain and culture. An early-morning sputum specimen is preferred if the patient is upright most of the day. The likelihood of identifying a pathogen in sputum—if one exists—is increased if the following steps are taken: The health care provider should wash his or her hands and use new gloves prior to specimen collection. Request that the patient rinse his or her mouth before collection and ask that he or she try to produce phlegm from deep in his or her lungs. Collect the specimen in a sterile container and transfer it to the lab or a refrigerator within 15 minutes. Understandably, this process can be challenging in some patients—particularly those who are debilitated.</p> <p>Blood cultures should be considered for severely ill patients.</p> <p>Viral respiratory testing should be considered during respiratory virus season.</p>	<p>Slide 7</p> <p>Moment 2: Diagnostic Tests for HAP</p> <ul style="list-style-type: none"> • HAP can be caused by either community-associated or healthcare-associated pathogens <ul style="list-style-type: none"> – e.g., <i>Streptococcus pneumoniae</i>, <i>Haemophilus influenzae</i>, <i>Staphylococcus aureus</i>, Gram-negative enteric bacteria, <i>Pseudomonas aeruginosa</i> – Atypical organisms are uncommon • Obtain sputum Gram stain and culture • Obtain blood cultures for severely ill patients • <i>Legionella</i> urine antigen should be considered • Viral respiratory testing should be considered during respiratory virus season • Enterococci and <i>Candida</i> species are commonly isolated from sputum and are highly likely to be colonizers and not causes of pneumonia <p>AHRQ Safety Program For Improving Antibiotic Use – Acute Care</p> <p>HAP 7</p>

Slide Title and Commentary	Slide Number and Slide
<p>Moment 2: Empiric Therapy for HAP</p> <p>SAY:</p> <p>One approach is to administer an agent such as cefepime or piperacillin-tazobactam as empiric therapy for most suspected cases of HAP. For severely ill patients, patients who recently received either cefepime or piperacillin-tazobactam, or patients who previously had gram-negative organisms recovered which were resistant to either cefepime or piperacillin-tazobactam; the addition of an aminoglycoside or ciprofloxacin or levofloxacin to cefepime or piperacillin/tazobactam—or, alternatively, the use of an anti-pseudomonal carbapenem like meropenem or imipenem/cilastatin as monotherapy—should be considered.</p> <p>For patients with severe penicillin allergy, consider the use of aztreonam, ciprofloxacin, or levofloxacin. If the patient is severely ill, consider adding an aminoglycoside to these agents. Vancomycin or linezolid is needed for Gram-positive coverage unless levofloxacin is part of the regimen because neither aztreonam, aminoglycosides, nor ciprofloxacin provide Gram-positive coverage. Of note, as fluoroquinolones have coverage against <i>Legionella</i>, for patients receiving fluoroquinolone therapy, additional coverage is not needed to target <i>Legionella</i>.</p>	<p>Slide 8</p> <p>Moment 2: Empiric Therapy for HAP¹</p> <ul style="list-style-type: none"> • Cefepime (± aminoglycoside or ciprofloxacin or levofloxacin if severely ill) ± vancomycin or linezolid • Piperacillin-tazobactam (± aminoglycoside or ciprofloxacin or levofloxacin if severely ill) ± vancomycin or linezolid • Recent receipt of cefepime or piperacillin-tazobactam or recovery of pathogens resistant to these agents: anti-pseudomonal carbapenems (meropenem, imipenem) ± vancomycin or linezolid • Severe penicillin allergy: aztreonam (± aminoglycoside or ciprofloxacin or levofloxacin) + vancomycin or linezolid • Concern for legionella: add azithromycin to regimens that do not contain fluoroquinolones <p>AHRQ Safety Program for Improving Antibiotic Use – Acute Care</p> <p>HAP 8</p>

Slide Title and Commentary

Meta-analyses Evaluating Combination Therapy for *Pseudomonas* Infections

SAY:

In the past, some have advocated for combination therapy for *Pseudomonas aeruginosa* infections based on studies where aminoglycosides were used as monotherapy. However, aminoglycoside monotherapy is now discouraged for the treatment of nonurinary infections as bacteria can develop resistance to these agents relatively quickly. Additionally, aminoglycosides don't penetrate some body sites very efficiently when administered systemically—including lung tissue.

Combination therapy has not been shown to improve the outcomes of patients with invasive pseudomonal infections if a single agent with good activity against *Pseudomonas* is available.

Slide Number and Slide

Slide 9

Meta-analyses Evaluating Combination Therapy for *Pseudomonas* Infections

Study	Design	Clinical outcomes* OR/RR (95% CI)
Paul 2003 ² Cochrane	68 RCTs	Mortality: 0.87 (0.34–2.24) Clinical failure: 1.41 (0.90–2.22)
Paul 2003 ³ BMJ	47 RCTs	Mortality: 0.78 (0.24–2.56) Clinical failure: 1.46 (0.23–9.41)
Paul 2004 ⁴ BMJ	64 RCTs	Mortality: 1.50 (0.70–32.84) Clinical failure: 1.01 (0.68–1.49)
Paul 2006 ⁵ Cochrane	64 RCTs, observational	Clinical failure: 1.02 (0.68–1.51)
Marcus 2011 ⁶ J Antimicrob Ag	52 RCTs	Mortality: 3.18 (0.49–20.65) Clinical failure: 1.55 (1.24–1.93)

*Comparing monotherapy to combination therapy in adult patients

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HAP 9

Moment 2: Empiric Therapy for HAP

SAY:

Many patients with HAP do not require empiric anti-methicillin-resistant *Staphylococcus aureus* or MRSA therapy.

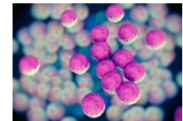
MRSA coverage should be considered for patients with a known history of MRSA colonization or infection. Other risk factors include intravenous drug use, necrotizing pneumonia, an ill-appearing patient with a recent stay in a nursing home or skilled nursing facility, hemodialysis patients, or a prolonged hospitalization with an unknown MRSA colonization status.

Many institutions routinely obtain MRSA nasal surveillance swabs. A negative MRSA nasal surveillance swab suggests a low likelihood of MRSA infection during the same hospitalization and this information can help with either avoiding the initiation of anti-MRSA coverage or discontinuation of MRSA-targeted coverage.

Slide 10


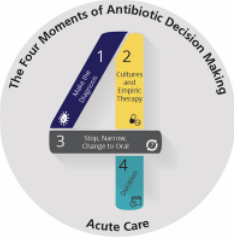
Moment 2: Empiric MRSA Therapy for HAP


- When should I add anti-MRSA coverage on an empiric basis?⁷⁻¹¹
 - Elevated local prevalence of MRSA
 - Known history of MRSA colonization or infection
 - A negative MRSA nasal surveillance swab suggests a low likelihood of MRSA infection during the same hospitalization
 - Intravenous drug use
 - Necrotizing pneumonia
 - Ill-appearing patient with a recent stay in a nursing home or skilled nursing facility
 - Hemodialysis patients
 - Prolonged hospitalization with unknown MRSA colonization status




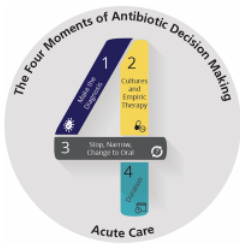
AHRQ Safety Program for
Improving Antibiotic Use –
Acute Care

HAP 10

Slide Title and Commentary	Slide Number and Slide
<p>Vancomycin Versus Linezolid?</p> <p>SAY:</p> <p>Both vancomycin and linezolid are reasonable options for MRSA coverage for pulmonary infections. At least four meta-analyses of randomized controlled trials have shown use of vancomycin versus linezolid for the treatment of MRSA pulmonary infections yield similar outcomes.</p> <p>Daptomycin is inactivated by pulmonary surfactant and is not a suitable option for the treatment of pneumonia.</p>	<p>Slide 11</p> <p>Vancomycin Versus Linezolid?</p> <ul style="list-style-type: none"> Both vancomycin and linezolid are reasonable options for MRSA coverage for pulmonary infections.¹²⁻¹⁵ At least 4 meta-analyses of randomized controlled trials have shown use of vancomycin versus linezolid for the treatment of MRSA pulmonary infections yield similar outcomes. Daptomycin is inactivated by pulmonary surfactant and is not a suitable option for the treatment of pneumonia.  <p>AHRQ Safety Program for Improving Antibiotic Use – Acute Care</p> <p>HAP 11</p>
<p>The Four Moments of Antibiotic Decision Making</p> <p>SAY:</p> <p>Moment 3 occurs after a day or more has passed. Ask: Can I stop antibiotics? Can I narrow therapy or change from IV to oral therapy?</p>	<p>Slide 12</p> <p>The Four Moments of Antibiotic Decision Making</p>  <ol style="list-style-type: none"> Does my patient have an infection that requires antibiotics? Have I ordered appropriate cultures before starting antibiotics? What empiric therapy should I initiate? A day or more has passed. Can I stop antibiotics? Can I narrow therapy or change from IV to oral therapy? Can I narrow therapy or change from IV to oral therapy? <p>AHRQ Safety Program for Improving Antibiotic Use – Acute Care</p> <p>HAP 12</p>

Slide Title and Commentary	Slide Number and Slide
<p>Moment 3: De-escalation of HAP Therapy</p> <p>SAY:</p> <p>In patients for whom an alternate diagnosis is identified, stop HAP-targeted therapy. <i>S. aureus</i> and gram-negative bacilli pathogens grow easily in culture. If HAP is the likely diagnosis, use sputum culture results to narrow therapy. If an aminoglycoside or fluoroquinolone was added to the β-lactam, discontinue if an appropriate β-lactam is available for treatment. If anti-MRSA coverage is added empirically, discontinue if MRSA is not recovered in sputum or nasal surveillance.</p> <p>A specimen growing “oral flora” indicates that the organisms recovered are likely to be bacteria expected to colonize the oral cavity and are unlikely to be responsible for an infection. In addition, enterococci and <i>Candida</i> species are commonly isolated from sputum and are highly likely to be colonizers and not causes of pneumonia.</p> <p>When cultures have not been obtained, directing therapy can be challenging, and the decision to de-escalate needs to be based on clinical judgment and individual patient risk factors.</p>	<p>Slide 13</p> <p>Moment 3: De-escalation of HAP Therapy</p> <ul style="list-style-type: none"> In patients for whom an alternate diagnosis is identified, stop HAP-targeted therapy  <ul style="list-style-type: none"> If HAP is the likely diagnosis, use sputum culture results to narrow therapy <p>AHRQ Safety Program for Improving Antibiotic Use – Acute Care</p> <p>HAP 13</p>

Slide Title and Commentary	Slide Number and Slide
<p>Moment 3: Oral Step-Down Therapy for HAP</p> <p>SAY:</p> <p>After the patient shows clinical improvement and the ability to tolerate oral medications, antibiotic therapy should be adjusted based on susceptibility results, if available.</p> <p>If pseudomonal coverage is needed, consider ciprofloxacin or levofloxacin. If pseudomonal coverage is not needed, consider a second or third generation oral cephalosporin or amoxicillin-clavulanate. If a patient has a severe penicillin allergy, consider a respiratory fluoroquinolone such as levofloxacin or moxifloxacin.</p> <p>After a patient shows clinical improvement and the ability to tolerate oral medications, switch to oral therapy. If <i>Pseudomonas</i> has been isolated in cultures, consider ciprofloxacin or levofloxacin, if susceptible. If pseudomonal coverage is not needed because <i>Pseudomonas</i> has not been isolated, consider agents like second- or third-generation oral cephalosporins or amoxicillin-clavulanate, based on culture results.</p> <p>If a patient has a severe penicillin allergy, consider a respiratory fluoroquinolone such as levofloxacin or moxifloxacin.</p> <p>If MRSA has been isolated, consider clindamycin, trimethoprim/sulfamethoxazole, or linezolid based on culture results.</p> <p>After the patient shows clinical improvement and the ability to tolerate oral medications, antibiotic therapy should be adjusted based on susceptibility results, if available.</p>	<p>Slide 14</p> <p>Moment 3: Oral Step-Down Therapy for HAP¹⁶</p> <ul style="list-style-type: none"> • Consider oral therapy after patient shows clinical improvement and the ability to tolerate oral medications • De-escalation should be guided by culture results <ul style="list-style-type: none"> – If pseudomonal coverage is needed: <ul style="list-style-type: none"> ○ Consider ciprofloxacin or levofloxacin – If pseudomonal coverage is not needed: <ul style="list-style-type: none"> ○ Consider second- or third-generation oral cephalosporin, amoxicillin-clavulanate – Severe penicillin allergy: respiratory fluoroquinolone  <p>AHRQ Safety Program for Improving Antibiotic Use – Acute Care</p> <p>HAP 14</p>

Slide Title and Commentary	Slide Number and Slide
<p>The Four Moments of Antibiotic Decision Making</p> <p>SAY:</p> <p>The fourth moment of antibiotic decision making is asking the question, “What duration of antibiotic therapy is needed for my patient’s diagnosis?”</p>	<p>Slide 15</p> <p>The Four Moments of Antibiotic Decision Making</p>  <ol style="list-style-type: none"> 1. Does my patient have an infection that requires antibiotics? 2. Have I ordered appropriate cultures before starting antibiotics? What empiric therapy should I initiate? 3. A day or more has passed. Can I stop antibiotics? Can I narrow therapy or change from IV to oral therapy? 4. What duration of antibiotic therapy is needed for my patient's diagnosis? <p>AHRQ Safety Program for Improving Antibiotic Use – Acute Care</p> <p>HAP 15</p>
<p>A Week of Antibiotic Therapy Is Sufficient</p> <p>SAY:</p> <p>Seven days of antibiotics is generally sufficient for the treatment of HAP. In a double-blind clinical trial conducted in 51 French intensive care units or ICUs, patients were randomized to 8 or 15 days of antibiotic therapy.</p> <p>There was no difference in all-cause mortality or length of ICU stay comparing the 8-day and 15-day groups. Multidrug-resistant bacteria emerged less frequently in patients receiving 8 days of antibiotics compared with those received 15 days. Prolonging antibiotic therapy beyond a week might cause harm to patients without any additional benefit to clinical outcomes.</p>	<p>Slide 16</p> <p>A Week of Antibiotic Therapy Is Sufficient¹⁶</p> <ul style="list-style-type: none"> • A week of antibiotic therapy is sufficient for the treatment of HAP. • In a double-blind clinical trial conducted in 51 French ICUs, patients were randomized to 8 or 15 days of antibiotic therapy. • There was no difference in all-cause mortality or length of ICU stay comparing the 8-day and 15-day groups • Multidrug-resistant bacteria emerged less frequently in patients who received 8 days of antibiotics compared with those who received 15 days. <p>AHRQ Safety Program for Improving Antibiotic Use – Acute Care</p> <p>HAP 16</p>

Improving the Management of HAP in Your Hospital

SAY:

For HAP, diagnosis is a significant clinical challenge given that respiratory symptoms can be multifactorial. AS team and providers can take steps to minimize inappropriate treatment and optimize treatment for patient with true pneumonia. First, ensuring sputum cultures are sent for all patients with suspected HAP whenever possible is critical to streamline therapy and discontinue antibiotics that are no longer needed. This can sometimes be challenging for HAP but all efforts should still be made to obtain sputum for Gram stain and culture.

Of note, a patient who cannot generate any sputum and has minimal or no respiratory symptoms may not have HAP at all and may benefit from watchful waiting rather than immediate antibiotic therapy.

Even if MRSA nasal surveillance swab data are not routinely obtained in your hospital, nasal swabs for MRSA should be considered for patients for whom anti-MRSA coverage has been initiated to assist with de-escalation—particularly for providers uncomfortable discontinuing MRSA coverage in these settings or if sputum cultures were unable to be successfully obtained before starting antibiotic therapy.

If appropriate based on local epidemiology, consider stratifying your local HAP guidelines to differentiate patients with suspected pneumonia who do not have risk factors for infection with *Pseudomonas* or other resistant Gram-negative pathogens from those that do have relevant risk factors.

Patients with suspected pneumonia that occurred within 72 hours of hospitalization and are otherwise healthy are more likely to be infected with common respiratory pathogens like *S. pneumoniae* or *H. influenzae* and unlikely to be infected with *Pseudomonas*. Ceftriaxone or ampicillin/sulbactam is a reasonable treatment option for these patients. Moxifloxacin can be considered for these low-risk patients if they have serious penicillin allergies.

Slide 17

Improving Management of HAP in Your Hospital

- Sputum cultures should be sent for all patients with suspected HAP, whenever possible
- If MRSA nasal surveillance swab data is not available, they should be considered for patients for whom anti-MRSA coverage has been initiated to assist with de-escalation
- Stratify local HAP guidelines to identify patients with suspected pneumonia at low risk of infection with *Pseudomonas* or other resistant Gram-negative pathogens
 - Includes patients who developed HAP early in their hospitalization who are otherwise healthy
- Ceftriaxone or ampicillin/sulbactam are reasonable treatment options for low-risk patients
 - Moxifloxacin can be considered for patients with serious penicillin allergies



AHRQ Safety Program for Improving Antibiotic Use – Acute Care

HAP 17

Slide Title and Commentary	Slide Number and Slide
<p>Similar stratification can occur for otherwise healthy patients who developed HAP early in their hospitalization as their risk for <i>Pseudomonas</i> is low.</p> <p>Finally, continued emphasis on shorter courses of therapy for HAP—7 days—is often needed because providers may be unaware of studies supporting this duration. A process should be put in place to ensure that an end date is noted in the medical record before patients are transferred out of the ICU to the floor.</p>	
<p>Take-Home Points for HAP</p> <p>SAY:</p> <p>Let's review some take-home points for HAP:</p> <ul style="list-style-type: none"> • Obtain a sputum culture whenever possible • Determine if risk factors for <i>Pseudomonas</i> are present to direct empiric therapy • Determine if risk factors for MRSA exist that warrant the addition of anti-MRSA coverage • Remember to narrow or stop therapy after 48–72 hours • Change to oral therapy after clinical improvement is seen and when able to tolerate PO • Seven days of therapy is generally sufficient 	<p>Slide 18</p> <div style="border: 1px solid black; padding: 10px;"> <p style="text-align: center; background-color: #00a0c0; color: white; padding: 5px;">Take-Home Points for HAP</p> <ul style="list-style-type: none"> • Obtain a sputum culture whenever possible • Determine if risk factors for <i>Pseudomonas</i> are present to direct empiric therapy • Determine if risk factors for MRSA are present that warrant the addition of anti-MRSA coverage • Remember to narrow or stop therapy after 48–72 hours • Change to oral therapy after clinical improvement is seen and when patient can tolerate PO • Seven days of therapy is generally sufficient </div> <p style="font-size: small; margin-top: 10px;">AHRQ Safety Program for Improving Antibiotic Use – Acute Care HAP 18</p>

Slide Title and Commentary	Slide Number and Slide
<p>Disclaimer</p> <p>SAY:</p> <p>The findings and recommendations in this presentation are those of the authors, who are responsible for its content, and do not necessarily represent the views of AHRQ. No statement in this presentation should be construed as an official position of AHRQ or of the U.S. Department of Health and Human Services.</p> <p>Any practice described in this presentation must be applied by health care practitioners in accordance with professional judgment and standards of care in regard to the unique circumstances that may apply in each situation they encounter. These practices are offered as helpful options for consideration by health care practitioners, not as guidelines.</p>	<p>Slide 19</p> <p style="text-align: center;">Disclaimer</p> <ul style="list-style-type: none"> • The findings and recommendations in this presentation are those of the authors, who are responsible for its content, and do not necessarily represent the views of AHRQ. No statement in this presentation should be construed as an official position of AHRQ or of the U.S. Department of Health and Human Services. • Any practice described in this presentation must be applied by health care practitioners in accordance with professional judgment and standards of care in regard to the unique circumstances that may apply in each situation they encounter. These practices are offered as helpful options for consideration by health care practitioners, not as guidelines. <p><small>AHRQ Safety Program for Improving Antibiotic Use – Acute Care</small></p> <p style="text-align: right;"><small>HAP 19</small></p>
<p>References</p>	<p>Slide 20</p> <p style="text-align: center;">References</p> <ol style="list-style-type: none"> 1. Kalil AC, Metersky ML, Klompas M, et al. Management of adults with hospital-acquired and ventilator-associated pneumonia: 2016 Clinical Practice Guidelines by the Infectious Diseases Society of America and the American Thoracic Society. Clin Infect Dis. 2016 Sep 1;63(5):e61-e111. PMID: 27418577. 2. Paul M, Soares-Weiser K, Grozinsky S, et al. Beta-lactam versus beta-lactam-aminoglycoside combination therapy in cancer patients with neutropenia. Cochrane Database Syst Rev. 2003;(2):CD003038. PMID: 12076467. 3. Paul M, Soares-Weiser K, Leibovici L. Beta lactam monotherapy versus beta lactam-aminoglycoside combination therapy for fever with neutropenia: systematic review and meta-analysis. BMJ. 2003 May 24;326(7399):1111. PMID: 12763980. 4. Paul M, Benuri-Silbiger I, Soares-Weiser K, et al. Beta lactam monotherapy versus beta lactam-aminoglycoside combination therapy for sepsis in immunocompetent patients: systematic review and meta-analysis of randomised trials. BMJ. 2004 Mar 20;328(7441):668. PMID: 14996699. 5. Paul M, Silbiger I, Grozinsky S, et al. Beta lactam antibiotic monotherapy versus beta lactam-aminoglycoside antibiotic combination therapy for sepsis. Cochrane Database Syst Rev. 2006 Jan 25;(1):CD003344. PMID: 16437452. <p><small>AHRQ Safety Program for Improving Antibiotic Use – Acute Care</small></p> <p style="text-align: right;"><small>HAP 20</small></p>

Slide Title and Commentary	Slide Number and Slide
<p>References</p>	<p>Slide 21</p> <p style="text-align: center;">References</p> <ol style="list-style-type: none"> 6. Marcus R, Paul M, Elphick H, et al. Clinical implications of β-lactam-aminoglycoside synergism: systematic review of randomised trials. <i>Int J Antimicrob Agents</i>. 2011 Jun;37(6):491-503. PMID: 21292449. 7. Wooten DA, Winston LG. Risk factors for methicillin-resistant <i>Staphylococcus aureus</i> in patients with community-onset and hospital-onset pneumonia. <i>Respir Med</i>. 2013 Aug;107(8):1266-70. PMID: 23756035. 8. Robicsek A, Suseno M, Beaumont JL, et al. Prediction of methicillin-resistant <i>Staphylococcus aureus</i> involvement in disease sites by concomitant nasal sampling. <i>J Clin Microbiol</i>. 2008 Feb;46(2):588-92. PMID: 18057132. 9. Dangerfield B, Chung A, Webb B, et al. Predictive value of methicillin-resistant <i>Staphylococcus aureus</i> (MRSA) nasal swab PCR assay for MRSA pneumonia. <i>Antimicrob Agents Chemother</i>. 2014;58(2):859-64. PMID: 24277023. 10. Parente DM, Cunha CB, Mylonakis E, et al. The clinical utility of methicillin resistant <i>Staphylococcus aureus</i> (MRSA) nasal screening to rule out MRSA pneumonia: A diagnostic meta-analysis with antimicrobial stewardship implications. <i>Clin Infect Dis</i>. 2018 Jun 18;67(1):1-7. PMID: 29340593. <p>AHRQ Safety Program For Improving Antibiotic Use – Acute Care HAP 21</p>
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