The Implementation of Antimicrobial Stewardship Using a Multidisciplinary Approach

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Program Overview

Antimicrobial resistance is a worldwide health problem. Increases in morbidity, mortality, hospital length of stay, and healthcare costs are associated with antimicrobial resistance. Inappropriate antimicrobial use is strongly associated with the emergence of antimicrobial-resistant pathogens. An effective antimicrobial stewardship program, with appropriate drug product selection, dosing, route of administration, and duration of antimicrobial therapy, in conjunction with a comprehensive infection control program has been shown to limit the emergence and transmission of antimicrobial-resistant microorganisms. Implementing an antimicrobial stewardship program in the institutional setting can present a challenge. In early 2007, the Infectious Diseases Society of America and the Society for Healthcare Epidemiology of America published guidelines for developing an institutional program to enhance antimicrobial stewardship. These guidelines call for a multidisciplinary team approach to antimicrobial stewardship.

The 2006 Tax Relief & Health Care Act required a study of ways that Medicare payments to hospitals could be recouped for "never events", as defined by the National Quality Forum, including hospital infections. In August 2007, the Centers for Medicare and Medicaid Services (CMS) announced that it will stop payments to hospitals for several negative consequences of care that result in injury, illness or death. Pharmacists need to increase their knowledge of Medicare reimbursement as it relates to antimicrobial stewardship.

This program will describe the relationships between inappropriate antimicrobial use, antimicrobial resistance, and increased morbidity, mortality, and hospital length of stay. Pharmacy expenditures and factors affecting reimbursement will be addressed. The potential impact of antimicrobial stewardship programs on the emergence and transmission of antimicrobial-resistant microorganisms also will be discussed. Challenges associated with antimicrobial stewardship program implementation and examples of successful multidisciplinary team approaches to antimicrobial stewardship will be provided.

Learning Objectives

At the conclusion of this program, participants should be able to:

- Discuss the financial impact and pharmacy practice implications of CMS pay-for-performance quality improvement standards in the management of infectious diseases.
- Characterize the impact of inappropriate antimicrobial use on antimicrobial resistance, morbidity, mortality, hospital length of stay, and healthcare costs.
- Discuss the potential impact of antimicrobial stewardship programs on the emergence and transmission of antimicrobial-resistant microorganisms.
- Identify a potential pitfall in antimicrobial stewardship program implementation and an advantage of using a multidisciplinary team approach in an institutional setting.

Program Faculty

Debra A. Goff, Pharm.D., FCCP
Clinical Associate Professor
The Ohio State University College of Pharmacy
Infectious Diseases Specialist
The Ohio State University Medical Center
Columbus, Ohio
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The Implementation of Antimicrobial Stewardship Using a Multidisciplinary Approach

Debra A. Goff, Pharm.D., FCCP  
Clinical Associate Professor  
The Ohio State University College of Pharmacy  
Infectious Diseases Specialist  
The Ohio State University Medical Center  
Columbus, Ohio

Debra A. Goff, Pharm.D., FCCP is Infectious Diseases Specialist and Antibiotic Utilization Review Coordinator at The Ohio State University Medical Center (OSUMC) in Columbus, Ohio. Dr. Goff is also Clinical Associate Professor at OSU College of Pharmacy.

Dr. Goff serves as a preceptor in the infectious diseases residency program at OSUMC and she is Chairperson for the OSUMC Robert J. Fass Memorial Infectious Diseases Fund. She received her Bachelor of Science and Doctor of Pharmacy degrees and completed a pharmacy residency at the University of Illinois at Chicago.

Dr. Goff serves as an abstract reviewer for the American College of Clinical Pharmacy. She was honored by the OSUMC Leadership Council for Clinical Value Enhancement for developing clinical practice guidelines entitled “Community-Acquired Pneumonia in Immunocompetent Adult Patients.” She has received over 100 research grants and presented over 200 lectures nationally and internationally. Dr. Goff has published in several scientific journals, including Pharmacotherapy, Current Opinion in Infectious Diseases, Archives of Internal Medicine, and Clinical Infectious Diseases. Dr. Goff is a fellow of the American College of Clinical Pharmacy and a member of the Infectious Diseases Society of America, the American Society for Microbiology, and the Society of Infectious Diseases Pharmacists.

Dr. Goff’s research interests include antimicrobial resistance, clinical outcomes research, and antifungal agents.
The Implementation of Antimicrobial Stewardship Using a Multidisciplinary Approach

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Clinical Associate Professor
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Outline

- Impact of antimicrobial resistance
- Antimicrobial stewardship
- Tools to get started
- Examples of stewardship
- CMS (Centers for Medicare/Medicaid Services)
- SCIP (Surgical care improvement project)

Impact of Antibacterial Resistance

- In 2004, ~2 million hospital-acquired infections in US hospitals → >90,000 deaths
- In-hospital costs of nosocomial infection caused by 6 common resistant bacteria: at least $1.3 billion
- Oct 1, 2008 Medicare will no longer reimburse for hospital acquired conditions deemed preventable catheter-associated urinary infections Vascular catheter-associated infections mediastinitis after CABG surgery

The “Superbugs” Aren’t Waiting!

- Industry is getting out of the anti-infective business
- No new gram-negative class of antibiotics in the pipeline
- From discovery to approval is 10 years and cost $800 million to 1.7 billion

Total Approved Antibacterials: US

Adapted from Spellberg, et al., 2004 CID;38:1279-86.

The Ohio State University Football Stadium
Capacity 105,000 people

Infectious Disease Society of America (IDSA)
6 Top Resistant Pathogens
IDSA “Hit List”

Gram negatives
- *Pseudomonas aeruginosa*
- ESBL (Extended spectrum β-lactamase)
- *Klebsiella pneumoniae*
- *Acinetobacter*

Gram positives
- CA-MRSA community-associated methicillin-resistant Staph aureus
- PRSP penicillin-resistant Strep pneumoniae (and macrolide)
- VRE vancomycin-resistant enterococci

MRSA
Methicillin-resistant Staph aureus
- Community-associated and healthcare-associated
- Estimated rate of invasive MRSA in 2005 is greater than the combined rate for pneumococcal disease, group A strep, meningococcal disease and H. influenzae.
- Estimated 18,650 deaths in the U.S.
- This is greater than the # of deaths in 2005 due to HIV/AIDS in U.S.
- An old disease has learned new tricks

Cold Hard Facts
California state law requiring health inspections

<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>AIDS</td>
<td>129,149</td>
<td>124,090</td>
<td>119,121</td>
</tr>
<tr>
<td>MRSA</td>
<td>17,968</td>
<td>17,182</td>
<td>16,555</td>
</tr>
<tr>
<td>Flu</td>
<td>11,952</td>
<td>11,390</td>
<td>9,910</td>
</tr>
<tr>
<td># of deaths</td>
<td>40,000</td>
<td>39,000</td>
<td>38,000</td>
</tr>
</tbody>
</table>


Extreme Drug Resistance (XDR)
grain negative bacilli
- XDR ESBL
  - *K. pneumoniae* mortality rate is 45-57%
- Outbreaks reported in Chicago, Pittsburg, NYC
- The outbreaks reported are resistant to carbapenems and tigecycline.
- ESBL *K. pneumoniae* coming from the community has increased at OSUMC
- OSUMC has 1 effective antibiotic class (carbapenems).

Paterson et. al. 2007 CID:45:1179-81.

Multidisciplinary Team
- Infectious Disease M.D.
- Infectious Disease Pharm. D.
- Microbiologist
- Information system specialist
- Infection Control
- Epidemiologist
What if your “Team” looks like this?

Infectious Disease Pharm.D.

Tools to Get Started

• Practice Guideline
  IDSA publication Clin Inf Dis 2007;44:159-77.
• Knowledge of Medicare reimbursement as it relates to antimicrobial stewardship
  CMS (Centers for Medicare/Medicaid Services)
  SCIP (Surgical Care Improvement Project)
  Oct 2008 Medicare will no longer reimburse for hospital-acquired conditions deemed preventable
  - catheter-associated urinary infections
  - vascular catheter-associated infections
  - mediastinitis
• Meet the other “team members” in your hospital
• Explore existing computer software programs
  Theradoc, Sentri7, Cereplex, QC Pathfinder

Why is Antimicrobial Stewardship Important?

• 200-300 million antibiotics are prescribed annually
  – 45% for outpatient use
• 25-40% of hospitalized patients receive antibiotics
  – 10-70% are unnecessary or sub-optimal
  – 5% of hospitalized patients who receive antibiotics experience an adverse reaction
• Antibiotics are unlike any other drugs, in that use of the agent in one patient can compromise its efficacy in another

Finding the Solution

• “The combination of effective antimicrobial stewardship with a comprehensive infection control program has been shown to limit the emergence and transmission of antimicrobial-resistant bacteria.”
  Paterson D. CID 2006;42:S90-5.
• “A secondary goal of antimicrobial stewardship is to reduce health care costs without adversely impacting quality of care.”
  Dellit et al CID 2007;44:159-177.

Impact of Antimicrobial Management

• Comprehensive programs can be financially self-supporting and improve patient care
• Multiple studies have consistently demonstrated a decrease in antimicrobial use (22%-36%)
• $200,000-$900,000 annual savings

Hospitals with Antimicrobial Management Programs: Published Impact on Resistance Rates

• VRE colonization rates decreased from 47% to 15%
  Quale et al. CID 1996;23:1020-5.
• ESBL Klebsiella infections
  44% hospital-wide decrease
• Antibiotic induced C. difficile
  50% reduction in antibiotics associated with outbreak
### Impact of Antibiotic Resistance

<table>
<thead>
<tr>
<th>Organism</th>
<th>Increased risk of death (OR)</th>
<th>Attributable LOS (days)</th>
<th>Attributable Cost ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MRSA bacteremia</td>
<td>1.9</td>
<td>2.2</td>
<td>$6,916</td>
</tr>
<tr>
<td>MRSA surgical infection</td>
<td>3.4</td>
<td>2.6</td>
<td>$13,901</td>
</tr>
<tr>
<td>VRE infection</td>
<td>2.1</td>
<td>6.2</td>
<td>$12,766</td>
</tr>
<tr>
<td>Resistant Pseudomonas infection</td>
<td>3.0</td>
<td>5.7</td>
<td>$11,981</td>
</tr>
<tr>
<td>Resistant Enterobacter infection</td>
<td>5.0</td>
<td>9</td>
<td>$29,379</td>
</tr>
</tbody>
</table>

**Total cost of antimicrobial resistance is estimated to be $30 billion dollars annually.**

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### Evidence-based Interventions

- Pre-prescription approval
- Post-prescription approval
- Education
- Guidelines and clinical pathways
- Antimicrobial cycling/switching/mixing
- Antimicrobial order forms
- Streamlining or de-escalation of therapy
- IV to PO switch

**Clin Infect Dis 2007;44:159-177.**

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### Components of Antimicrobial Management

- **“Front End”—provided at the point of prescribing**
  - Prior authorization
  - Interactive decision support
  - Guidelines, order sets
  - Requires additional IS support and personnel (e.g., pharmacists)
- **“Back End”—after the antimicrobial has been prescribed**
  - Feedback audit
  - Streamlining or de-escalation
  - Dose optimization
  - IV to PO switch
  - Requires additional personnel support (e.g., pharmacists)

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### Formulary Restriction/Prior Authorization

- Targeted drugs
  - Create well-defined, evidence-based indications for each targeted drug
- Dedicated pager for approval
- AMP team to review for approval
- Develop mechanism for ordering restriction
- Education programs
- Performance feedback to providers
- Consequences for non-compliance

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### Feedback Audit

- ID Pharmacist with ID Attending
- Targeted Units and Targeted Drugs
- Review cases within 48-72 hours of starting antimicrobial agents
  - Streamlining/de-escalation
  - Dose optimization
  - IV to PO switching
  - “Bug-Drug” mismatches

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How does an antimicrobial management team actually work together?
OSUMC Example

1. Infectious Disease Pharm.D.
2. Microbiologist
3. Information system specialist
4. Infectious Disease M.D.
5. Epidemiologist

1. SICU Pharm D calls to say he has an XDR Acinetobacter

2. I call infection control practitioner

3. I ask micro to set up an Etest to tigecycline

4. ID is consulted and we discuss options with the surgeon

5. Hospital epidemiology tracks the patient’s care in our hospital.


Extreme Drug Resistance (XDR) Acinetobacter baumannii

- Extensive drug resistance in M. tuberculosis was “CNN breaking news”
- XDR Acinetobacter baumannii is documented in several U.S. hospitals


<table>
<thead>
<tr>
<th>Antibiotic</th>
<th>XDR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impenem</td>
<td>√</td>
</tr>
<tr>
<td>Amp/sulb</td>
<td>√</td>
</tr>
<tr>
<td>Pip/tazo</td>
<td>√</td>
</tr>
<tr>
<td>Cefepime</td>
<td>√</td>
</tr>
<tr>
<td>Cipro</td>
<td>√</td>
</tr>
<tr>
<td>Amikacin</td>
<td>√</td>
</tr>
<tr>
<td>Tigecycline</td>
<td>√</td>
</tr>
<tr>
<td>Colistin</td>
<td>√</td>
</tr>
</tbody>
</table>

Colistin Resistance

- 265 isolates of Acinetobacter from 2 Korean hospitals
- Forty-eight isolates (18.1%) and 74 isolates (27.9%) were resistant to polymyxin B and colistin, respectively.

*J Antimicrob Chemother:* 2007 Aug 29

What will be your approach if you identify this in your hospital?

Antimicrobial Stewardship and CMS: What’s our role?

- Core measures are submitted and available for public view on the JCAHO and CMS websites.
  - [JCAHO](http://www.qualitycheck.org)
  - CMS: [www.hospitalcompare.hhs.gov](http://www.hospitalcompare.hhs.gov)
- Consumers should be given the opportunity to make informed decisions regarding their healthcare.
- Hospitals should improve the quality of care they provide.

Publicly Reported Core Measures

- Acute myocardial infarction
- Heart failure
- Community acquired pneumonia
- Surgical care improvement project (SCIP)
**Community-acquired Pneumonia**

- 30 million operations performed annually in the US
- Most common complications include:
  - Surgical site infections
    - CDC estimates 500,000 SSI occur annually
    - Each infection is estimated to increase LOS by 7 days
  - Patients who develop SSI
    - 60% more likely to spend time in the ICU
    - 5x more likely to be readmitted
    - 2x the mortality rate

**SCIP**

- 30 million operations performed annually in the US
- Most common complications include:
  - Surgical site infections
    - CDC estimates 500,000 SSI occur annually
    - Each infection is estimated to increase LOS by 7 days

**SCIP Measures**

- CABG & other cardiac surgeries, hip/knee arthroplasties, hysterectomies, colorectal and vascular surgery
- Prophylactic antibiotics received within 1 hour prior to surgical incision
- Prophylactic antibiotic selection for surgical patients
- Prophylactic antibiotics discontinued within 24 hours after surgery end time (48 hours for CABG/Cardiac)

**Surgical Prophylaxis Grid OSUMC**

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Agent</th>
<th>MIC (µg/mL)</th>
<th>Dose</th>
<th>Calcium Chloride</th>
<th>Inactive</th>
<th>Indication</th>
</tr>
</thead>
<tbody>
<tr>
<td>CABG &amp; Other Cardiac</td>
<td>Vancomycin*</td>
<td>15-20</td>
<td>2g</td>
<td>2g IV</td>
<td>1g</td>
<td>Vancomycin</td>
</tr>
<tr>
<td>Hip/Knee Arthroplasty</td>
<td>Cefazolin*</td>
<td>10-30</td>
<td>2g</td>
<td>2g IV</td>
<td>1g</td>
<td>Cefazolin</td>
</tr>
</tbody>
</table>

**Surgical Prophylaxis**

- Percent of surgeries patients who received appropriate prophylactic antibiotics for their surgery

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*OSUMC General Prophylactic Antibiotic Orders 10-05-07

**Community-Acquired Pneumonia**

- Vaccination

- 30 million operations performed annually in the US
- Most common complications include:
  - Surgical site infections
    - CDC estimates 500,000 SSI occur annually
    - Each infection is estimated to increase LOS by 7 days

**Vaccination**

- 30 million operations performed annually in the US
- Most common complications include:
  - Surgical site infections
    - CDC estimates 500,000 SSI occur annually
    - Each infection is estimated to increase LOS by 7 days

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*OSUMC General Prophylactic Antibiotic Orders 10-05-07
Stop Antibiotics

Are you involved in the process?

Most of the core measures involve drugs. Pharmacists must get involved!

Surgeons

Have you asked the anesthesiologist about pre-op prophylactic antibiotics yet?

Anesthesia

Have you asked your surgeon about the pre-operative prophylactic antibiotic yet?

Nursing Staff

Have you asked your anesthesiologist or surgeon about the pre-operative prophylactic antibiotic?

Pharmacist

Have you checked to see if the correct antibiotic is ordered?

Have you discontinued it within 24 hours (48 hr for cardiac)?

If the antibiotic is continued due to infection, have you documented it in the chart?
End of Presentation

Please go to www.ashp.org/advantage/ce/
to take the CE test.
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Selected References


Muto CA. Methicillin-resistant Staphylococcus aureus control: we didn't start the fire, but it's time to put it out. Infect Control Hosp Epidemiol. 2006 Feb;27(2):111-5.
The Implementation of Antimicrobial Stewardship Using a Multidisciplinary Approach
This program is located at http://esymposia.ashp.org/cemornings

This self-assessment test has been provided as a study aid only. At the conclusion of the internet-based program, click on “Take CE Test” to proceed to the ASHP CE Testing Center and take the on-line program post-test. You may print your CE statement immediately after successful completion of the post-test.

There are 10 questions associated with this self-assessment test.

1. For which of the following preventable hospital-acquired conditions will reimbursement from the Centers for Medicare and Medicaid Services no longer be provided after October 1, 2008?
   b. Community-associated *Escherichia coli* urinary tract infections.
   c. Methicillin-resistant *Staphylococcus aureus* (MRSA) skin infections.
   d. Vascular catheter-associated infections.

2. Which of the following pathogens is on the Infectious Diseases Society of America hit list of top resistant pathogens?
   a. Community-associated *Haemophilus influenzae*.
   b. Penicillin-resistant *Escherichia coli*.
   c. Extended-spectrum $\beta$-lactamase-producing *Klebsiella pneumoniae*.
   d. Extended-spectrum $\beta$-lactamase-producing *Streptococcus pneumoniae*.

3. The estimated rate of invasive MRSA in the United States during 2005 was found to be significantly less than the combined rate for pneumococcal disease, group A strep, meningococcal disease and *H. influenzae*.
   a. True
   b. False

4. Antibiotics are unlike any other drugs in that use of the agent in one patient can compromise its efficacy in another patient.
   a. True
   b. False

5. Which of the following statements about antimicrobial stewardship is correct?
   a. The primary goal of antimicrobial stewardship is to reduce healthcare costs without adversely impacting quality of care.
   b. An effective antimicrobial stewardship program can limit the emergence and transmission of antimicrobial-resistant bacteria.
   c. Antimicrobial stewardship programs are not financially self-supporting.
   d. Antimicrobial stewardship programs increase the use of antimicrobial agents.

6. The attributable costs for antimicrobial resistance annually in the United States is estimated to be:
   a. $10 billion.
   b. $20 billion.
   c. $30 billion.
   d. The costs have not been identified.
7. Which of the following is considered a “back-end” approach to antimicrobial management?
   a. Formulary restriction.
   b. Interactive decision support.
   c. Streamlining.
   d. Order sets.

8. In isolates of which of the following pathogens has extreme drug resistance (XDR) that includes colistin recently been identified?
   a. *Acinetobacter baumannii*.
   b. *Clostridium difficile*.
   c. *Escherichia coli*.
   d. *Mycobacterium tuberculosis*.

9. Which of the following is a publicly reported core measure related to infections that often reflects antimicrobial use and resistance?
   b. Catheter-related urinary tract infections.
   c. Nosocomial infection after cardiac surgery.
   d. Sepsis in intensive care unit patients.

10. Which of the following is a Surgical Care Improvement Program (SCIP) measure?
    a. Prophylactic antibiotics received within 1 hour after non-cardiac surgery end time.
    b. Prophylactic antibiotics discontinued within 12 hours after non-cardiac surgery end time.
    c. Prophylactic antibiotics discontinued within 10 days after cardiac surgery end time.
    d. Prophylactic antibiotics received within 1 hour before surgical incision.