Antimicrobial Resistance and Antimicrobial Stewardship: An Update

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Disclosures

• None
Objectives

• Review current and emerging trends in healthcare associated infections (HAI) and antimicrobial resistance
• Discuss the evidence supporting antimicrobial stewardship
• Describe elements of effective antimicrobial stewardship programs
Impact of Healthcare Associated Infections

1.7 million patients impacted annually
5-10% of hospitalized patients
99,000 Deaths annually
$28.4 - 45 Billion estimated annual direct medical costs to US hospitals

Increasing Antimicrobial resistance
Decreasing pipeline of new antibiotics

Mandatory Reporting of HAI in California
Healthcare Associated Infections: Key Issues 2015

• Increasing antimicrobial resistance
• Decreasing pipeline of new antibiotics
• Public reporting now legislated in US
• Mandatory MRSA screening
• HAI Reimbursement penalties
• Health care reform
### Estimates of Selected Healthcare-Associated Infections Occurring in Acute Care Hospitals, 2011† or 2012†

<table>
<thead>
<tr>
<th>Type of Healthcare-Associated Infection</th>
<th>Estimated No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Catheter-associated urinary tract infections (wards and critical care units)</td>
<td>54,500†</td>
</tr>
<tr>
<td>Central line-associated bloodstream infections (wards and critical care units)</td>
<td>30,100†</td>
</tr>
<tr>
<td>Surgical Site Infections associated with 10 surgical procedures</td>
<td>53,700†</td>
</tr>
<tr>
<td>Hospital-onset Clostridium difficile infections (all hospital locations)</td>
<td>107,700±</td>
</tr>
</tbody>
</table>

* Infections closely tied to performance measures reported as part of the CMS Hospital Quality Reporting Program.
## Table 1. Representative Reports of Attributable Costs and Excess Length of Stay (LOS) Associated With Various Hospital-Acquired Infections

<table>
<thead>
<tr>
<th>Infection type</th>
<th>Attributable costs, mean (range), 2005 US$</th>
<th>Excess LOS, mean (range), days</th>
<th>Reports</th>
</tr>
</thead>
<tbody>
<tr>
<td>VAP</td>
<td>22,875 (9,986-54,503)</td>
<td>9.6 (7.4-11.5)</td>
<td>[19-23]</td>
</tr>
<tr>
<td>Catheter-related BSI</td>
<td>18,432 (3,592-34,410)</td>
<td>12 (4.5-19.6)</td>
<td>[24-26]</td>
</tr>
<tr>
<td>CABG-associated SSI</td>
<td>17,944 (7,874-26,668)</td>
<td>25.7 (20-35)</td>
<td>[27-30]</td>
</tr>
<tr>
<td>Catheter-associated UTI</td>
<td>1,257 (804-1,710)</td>
<td>...</td>
<td>[31, 32]</td>
</tr>
</tbody>
</table>

**Note:** BSI, bloodstream infection; CABG, coronary artery bypass graft surgery; SSI, surgical site infection; UTI, urinary tract infection; VAP, ventilator-associated pneumonia.
Resistance Rates in the ICU

Methicillin (oxacillin)-resistant *Staphylococcus aureus (MRSA)* Among ICU Patients, 1995-2004

Source: National Nosocomial Infections Surveillance (NNIS) System

Fluoroquinolone-resistant *Pseudomonas aeruginosa* Among ICU Patients, 1995-2004

Source: National Nosocomial Infections Surveillance (NNIS) System

NHSN Antimicrobial Resistance Trends 2009-2010

• MRSA trends stabilized

• **Acinetobacter spp**
  - >60% reported multidrug resistance and carbapenem resistance (CR)
  - 70%–80% of facilities reporting an HAI with *Acinetobacter* spp. reported at least one multidrug-resistant strain

• **Klebsiella spp.**
  - 13% carbapenem resistance (CR)
  - 1 in 5 hospitals reporting CLABSIs or CAUTIs with *Klebsiella* spp. reported CR

• Conclusion:
  - highly resistant GNB causing HAIs not limited to a small subset of hospitals
  - reinforces need for prevention efforts designed to prevent further emergence and spread

<table>
<thead>
<tr>
<th>Pathogen, antimicrobial agents</th>
<th>CLABSI ICU</th>
<th>Non-ICU</th>
<th>CAUTI ICU</th>
<th>Non-ICU</th>
</tr>
</thead>
<tbody>
<tr>
<td>Staphylococcus aureus, oxacillins</td>
<td>51.5</td>
<td>59.3</td>
<td>52.0</td>
<td>63.3</td>
</tr>
<tr>
<td><em>Enterococcus</em> species</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>E. faecium</em>, vancomycin</td>
<td>83.6</td>
<td>80.7</td>
<td>81.8</td>
<td>83.1</td>
</tr>
<tr>
<td><em>E. faecalis</em>, vancomycin</td>
<td>9.4</td>
<td>9.5</td>
<td>5.5</td>
<td>11.8</td>
</tr>
<tr>
<td><em>Klebsiella (pneumoniae/oxytoca)</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ES cephalosporins 4</td>
<td>29.7</td>
<td>27.7</td>
<td>24.6</td>
<td>29.0</td>
</tr>
<tr>
<td>Carbapenems</td>
<td>14.2</td>
<td>10.9</td>
<td>12.4</td>
<td>12.6</td>
</tr>
<tr>
<td>Multidrug resistant 1</td>
<td>19.1</td>
<td>13.7</td>
<td>15.2</td>
<td>17.0</td>
</tr>
<tr>
<td><em>Escherichia coli</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ES cephalosporins 4</td>
<td>18.6</td>
<td>19.5</td>
<td>11.5</td>
<td>13.2</td>
</tr>
<tr>
<td>Fluoroquinolones 3</td>
<td>36.5</td>
<td>47.1</td>
<td>29.1</td>
<td>33.5</td>
</tr>
<tr>
<td>Carbapenems</td>
<td>1.9</td>
<td>2.0</td>
<td>1.7</td>
<td>2.9</td>
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<tr>
<td>Multidrug resistant 1</td>
<td>3.4</td>
<td>4.0</td>
<td>1.6</td>
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<tr>
<td><em>Enterobacter</em> species</td>
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<tr>
<td>ES cephalosporins 4</td>
<td>38.0</td>
<td>36.2</td>
<td>38.8</td>
<td>38.2</td>
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<tr>
<td>Carbapenems</td>
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<td>2.2</td>
<td>5.5</td>
<td>3.5</td>
</tr>
<tr>
<td>Multidrug resistant 1</td>
<td>4.0</td>
<td>3.1</td>
<td>4.6</td>
<td>5.0</td>
</tr>
<tr>
<td><em>Pseudomonas aeruginosa</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aminoglycosides</td>
<td>11.6</td>
<td>7.5</td>
<td>11.8</td>
<td>9.9</td>
</tr>
<tr>
<td>ES cephalosporins 2</td>
<td>28.3</td>
<td>22.6</td>
<td>22.5</td>
<td>28.3</td>
</tr>
<tr>
<td>Fluoroquinolones 2</td>
<td>30.3</td>
<td>30.8</td>
<td>31.8</td>
<td>35.5</td>
</tr>
<tr>
<td>Carbapenems</td>
<td>26.8</td>
<td>24.9</td>
<td>20.6</td>
<td>22.3</td>
</tr>
<tr>
<td>Piperacillin/tazobactam</td>
<td>19.6</td>
<td>13.8</td>
<td>16.1</td>
<td>17.1</td>
</tr>
<tr>
<td>Multidrug resistant 2</td>
<td>16.8</td>
<td>13.3</td>
<td>12.6</td>
<td>15.6</td>
</tr>
<tr>
<td><em>Acinetobacter baumannii</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carbapenems</td>
<td>64.5</td>
<td>56.1</td>
<td>73.8</td>
<td>75.0</td>
</tr>
<tr>
<td>Multidrug resistant 3</td>
<td>69.7</td>
<td>60.4</td>
<td>78.6</td>
<td>76.1</td>
</tr>
</tbody>
</table>
CARBAPENEM-RESISTANT ENTEROBACTERIACEAE

9,000 DRUG-RESISTANT INFECTIONS PER YEAR
600 DEATHS

CARBAPENEM-RESISTANT KLEBSIELLA SPP.
7,900
CARBAPENEM-RESISTANT E. COLI
1,400

CRE HAVE BECOME RESISTANT TO ALL OR NEARLY ALL AVAILABLE ANTIBIOTICS

THREAT LEVEL
URGENT

This bacteria is an immediate public health threat that requires urgent and aggressive action.
## Susceptibility Profile of KPC-Producing *K. pneumoniae*

<table>
<thead>
<tr>
<th>Antimicrobial</th>
<th>Interpretation</th>
<th>Antimicrobial</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amikacin</td>
<td>I</td>
<td>Chloramphenicol</td>
<td>R</td>
</tr>
<tr>
<td>Amox/clav</td>
<td>R</td>
<td>Ciprofloxacin</td>
<td>R</td>
</tr>
<tr>
<td>Ampicillin</td>
<td>R</td>
<td>Ertapenem</td>
<td>R</td>
</tr>
<tr>
<td>Aztreonam</td>
<td>R</td>
<td>Gentamicin</td>
<td>R</td>
</tr>
<tr>
<td>Cefazolin</td>
<td>R</td>
<td>Imipenem</td>
<td>R</td>
</tr>
<tr>
<td>Cefpodoxime</td>
<td>R</td>
<td>Meropenem</td>
<td>R</td>
</tr>
<tr>
<td>Cefotaxime</td>
<td>R</td>
<td>Pipercillin/Tazo</td>
<td>R</td>
</tr>
<tr>
<td>Cetoletan</td>
<td>R</td>
<td>Tobramycin</td>
<td>R</td>
</tr>
<tr>
<td>Cefoxitin</td>
<td>R</td>
<td>Trimeth/Sulfa</td>
<td>R</td>
</tr>
<tr>
<td>Ceftazidime</td>
<td>R</td>
<td>Polymyxin B</td>
<td>MIC &gt;4mg/ml</td>
</tr>
<tr>
<td>Ceftriaxone</td>
<td>R</td>
<td>Colistin</td>
<td>MIC &gt;4mg/ml</td>
</tr>
<tr>
<td>Cefepime</td>
<td>R</td>
<td>Tigecycline</td>
<td>R</td>
</tr>
</tbody>
</table>
C. difficile Incidence and mortality are increasing in US


CLOSTRIDIUM DIFFICILE

- 250,000 INFECTIONS PER YEAR
- 14,000 DEATHS
- $1,000,000,000 IN EXCESS MEDICAL COSTS PER YEAR

THREAT LEVEL: URGENT

This bacteria is an immediate public health threat that requires urgent and aggressive action.
Estimated Burden of C. difficile Infection in the US

- Almost 500,000 cases and 29,000 deaths
- 82% of CA-CDI estimated to be associated with outpatient health care exposure

You are the next class of drug-resistant bacteria. As humans continue to abuse and overuse antibiotics, your ranks will swell. So, go out there and mutate! And remember: that which does not kill us makes us stronger!!
Factors Increasing Antibiotic Resistance

**Patient**
- Increased severity of illness
- More severely immunocompromised patients
- Newer devices and procedures
- Resistance in the community
- International travel, migration, distribution of fresh produce and prepared food items

**Healthcare worker**
- Ineffective infection control and compliance
- Increased prophylactic, empiric antibiotics
  - Inappropriate and prolonged use of antibiotics

**Others**
- Higher antibiotic use per area per unit time
  - Over-the-counter availability of antibiotics
  - Antibiotics used in animal feeds
Declining Number of Antimicrobial Agents Approved

Number of new systemic antibiotic agents has declined since 1980

Source: http://www.cddep.org/sites/default/files/policy_brief6_may08_newdrugs1_6.pdf
Each general acute care hospital, as defined in subdivision (a) of Section 1250, shall do all of the following by July 1, 2015:

(a) Adopt and implement an antimicrobial stewardship policy in accordance with guidelines established by the federal government and professional organizations. This policy shall include a process to evaluate the judicious use of antibiotics in accordance with paragraph (3) of subdivision (a) of Section 1288.8.

(b) Develop a physician supervised multidisciplinary antimicrobial stewardship committee, subcommittee, or workgroup.

(c) Appoint to the physician supervised multidisciplinary antimicrobial stewardship committee, subcommittee, or workgroup, at least one physician or pharmacist who is knowledgeable about the subject of antimicrobial stewardship through prior training or attendance at continuing education programs, including programs offered by the federal Centers for Disease Control and Prevention, the Society for Healthcare Epidemiology of America, or similar recognized professional organizations.

(d) Report antimicrobial stewardship program activities to each appropriate hospital committee undertaking clinical quality improvement activities.
Five Truths About In-patient Antibiotic Use

• Antibiotics are misused in hospitals
• Antibiotic misuse is bad
• Improving antibiotic use can improve medical care
• There are many ways to improve antibiotic use
• Every facility can improve antibiotic use
Antibiotics are misused in hospitals

- “It has been recognized for several decades that up to 50% of antimicrobial use is inappropriate”
- IDSA/SHEA Guidelines for Antimicrobial Stewardship Programs
- [http://www.journals.uchicago.edu/doi/pdf/10.1086/510393](http://www.journals.uchicago.edu/doi/pdf/10.1086/510393)
Antibiotic misuse in a variety of ways

- Given when they are not needed
- Continued when they are no longer necessary
- Given at the wrong dose
- Broad spectrum agents are used to treat very susceptible bacteria
- The wrong antibiotic is given to treat an infection
Most Common Reasons for Unnecessary Days of Therapy

576 (30%) of 1941 days of antimicrobial therapy deemed unnecessary

Antibiotic misuse adversely impacts patients- *C. difficile*

- Antibiotic exposure is the single most important risk factor for the development of *Clostridium difficile* associated disease (CDAD).
  - Up to 85% of patients with CDAD have antibiotic exposure in the 28 days before infection\(^1\)

Does Antimicrobial Stewardship work?

“The first step toward change is awareness”
Clinical outcomes better with antimicrobial management program


AMP = Antibiotic Management
Program UP = Usual Practice
Targeted antibiotic consumption and nosocomial \textit{C. difficile} disease

Tertiary care hospital; Quebec, 2003-2006

What is Antimicrobial Stewardship?

- **Antimicrobial stewardship** is a rational, systematic approach to the use of antimicrobial agents to achieve optimal outcomes\(^1,2\)
- The primary goal should be to improve patient care and public health\(^1,2\)
  - Financial goals are *secondary*

Correct agent  Cure or prevent infection
Correct dose   Minimize toxicity
Appropriate duration  Prevent resistance

Antimicrobial Stewardship

Goals

• Prevent or slow the emergence of antimicrobial resistance
• Optimize selection, dose and duration of Rx
• Reduce adverse drug events including secondary infection (e.g. *C. difficile* AAD)
• Reduce morbidity and mortality
• Reduce length of stay
• Reduce health care expenditures

Ohl CA. *J. Hosp Med*. In press.
Infectious Diseases Society of America and the Society for Healthcare Epidemiology of America Guidelines for Developing an Institutional Program to Enhance Antimicrobial Stewardship

Timothy H. Dellit,1 Robert C. Owens,2 John E. McGowan, Jr.,3 Dale N. Gerding,4 Robert A. Weinstein,5 John P. Burke,6 W. Charles Huskins,7 David L. Paterson,8 Neil O. Fishman,9 Christopher F. Carpenter,10 P. J. Brennan,9 Marianne Billeter,11 and Thomas M. Hooton12

1Harborview Medical Center and the University of Washington, Seattle; 2Maine Medical Center, Portland; 3Emory University, Atlanta, Georgia; 4Hines Veterans Affairs Hospital and Loyola University Stritch School of Medicine, Hines; and 5Stroger (Cook County) Hospital and Rush University Medical Center, Chicago, Illinois; 6University of Utah, Salt Lake City; 7Mayo Clinic College of Medicine, Rochester, Minnesota; 8University of Pittsburgh Medical Center, Pittsburgh, and 9University of Pennsylvania, Philadelphia, Pennsylvania; 10William Beaumont Hospital, Royal Oak, Michigan; 11Ochsner Health System, New Orleans, Louisiana; and 12University of Miami, Miami, Florida
Antibiotics save lives, but poor prescribing practices are putting patients at unnecessary risk for preventable allergic reactions, super-resistant infections, and death from diarrhea. Errors in prescribing decisions also contribute to antibiotic resistance, making these drugs less likely to work in the future.

To protect patients and preserve the power of antibiotics, hospital CEOs/medical officers can:

1. **Leadership commitment:** Dedicate necessary human, financial, and IT resources.
2. **Accountability:** Appoint a single leader responsible for program outcomes. Physicians have proven successful in this role.
3. **Drug expertise:** Appoint a single pharmacist leader to support improved prescribing.
4. **Act:** Take at least one prescribing improvement action, such as requiring reassignment within 48 hours, to check drug choice, dose, and duration.
5. **Track Monitoring:** Measure prescribing and antibiotic resistance patterns.
6. **Report Regularely:** Report to staff prescribing and resistance patterns, and steps to improve.
7. **Educate:** Offer education about antibiotic resistance and improving prescribing practices.

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**See page 4**

Want to learn more? Visit [www.cdc.gov/vitalsigns](http://www.cdc.gov/vitalsigns)
Prevent Infection
1. Vaccinate
2. Get the catheters out

Diagnose and Treat Infection Effectively
3. Target the pathogen
4. Access the experts

Use Antimicrobials Wisely
5. Practice antimicrobial control
6. **Use local data**
7. Treat infection, not contamination
8. Treat infection, not colonization
9. Know when to say “no” to vanco
10. Stop treatment when infection is cured or unlikely

Prevent Transmission
11. Isolate the pathogen
12. Break the chain of contagion
Ventilator-Associated Pneumonia
8 vs. 15 Days of Antibiotic Therapy

- Prospective, randomized, double-blind (until day 8) clinical trial
  - 51 French ICUs
- Patients received mechanical ventilation for at least 48 hours
- Drug selection based on discretion of treating physician
  - Protocol specified adherence to ATS guidelines
- Primary outcome measure
  - Death
  - Microbiologically confirmed recurrence
  - Antibiotic-free days assessed 28 days after first bronchoscopy for suspected onset of VAP

Ventilator-Associated Pneumonia
8 vs. 15 Days of Antibiotic Therapy (cont’d)

Survey of Intubated Patients at CSMC

- Chart review found 21 of 23 intubated patients (91%) are on abx:
  - 19/23 (83%) on anti-*Pseudomonas* agents
  - 12/23 (52%) on anti-MRSA agents
  - 10/23 (43%) on anti-fungal agents

- Of the 10 intubated patients currently on treatment for pneumonia:
  - 2 patients had *Pseudomonas* isolated from sputum, yet 9 were on anti-*Pseudomonal* treatment (pip-tazo, cefepime, carbapenems)
  - 0 patients had MRSA isolated from sputum, yet 4 were on vancomycin

- Conclusions: Broad antimicrobial use does not appear to match the spectrum of pathogens isolated from respiratory cultures
How to implement Antimicrobial Stewardship
Elements for constructing a comprehensive antimicrobial stewardship program

**Multidisciplinary team**
- Infectious diseases physician
- Clinical pharmacist (with ID training)
  - Both compensated for their time
- Additional
  - Clinical microbiology
  - Information systems specialist
  - Infection control professional/ hospital epidemiologist

**Medical Staff function**
Elements for constructing a comprehensive antimicrobial stewardship program

- Support/collaboration
  - Hospital administration
  - Medical staff leadership
  - Local providers
  - Part of quality/ safety program
Key elements of an ASP

• Know your local antimicrobial resistance profile (antibiogram)
• Drive decisions of antimicrobial formulary based on antibiogram
• Develop local guidelines for empiric and prophylactic antimicrobial use based on evidence based guidelines AND local antimicrobial trends
• Obtain consensus from key stakeholders
• Use committee process to establish expectations
• Develop measures to track (drug utilization or interventions and outcomes)
• Give regular updates on progress on key metrics
• Keep messages simple “5 Rights”
• Educate! But it is not enough
Recommended Components of an Antimicrobial Stewardship Program

• Foundation = \textit{2 core, proactive strategies}
  
  ▪ Prospective audit with intervention and feedback
  ▪ Formulary restriction and preauthorization
Getting Started

• Establish a core planning committee
  ◦ Subcommittee of P&T?
  ◦ Subcommittee of Infection Control?
  ◦ Other interested and like minded people

• Establish goals and mission statement

• Draft an idea
  ◦ Program structure
  ◦ Program elements

• Identify existing and needed resources

• Market the need – use real case examples!

• Focus on process and clinical outcomes
Rethinking Our Relationships Across the Continuum
Hospitals Must Partner With Previously Siloed Stakeholders

Continuum of Care

<table>
<thead>
<tr>
<th>Stakeholders involved:</th>
<th>Preacute Care</th>
<th>Inpatient Acute Care</th>
<th>Postacute Care</th>
</tr>
</thead>
<tbody>
<tr>
<td>Case Manager</td>
<td>PCP</td>
<td>Patient</td>
<td>Nurses</td>
</tr>
<tr>
<td>Patient</td>
<td>Specialists</td>
<td>Hospitalists</td>
<td>Allied Health</td>
</tr>
<tr>
<td>Specialties</td>
<td>Hospitalists</td>
<td>Nurses</td>
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</tbody>
</table>

Care coordination imperatives:
- Adequate preventive care
- Disease prevention
- Length of stay management
- Inpatient utilization management
- Reduce readmissions
- Partner with postacute providers
- Standardize care site transitions
- Reduce readmissions

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PCP = primary care physician. SNF = skilled nursing facility.

Facilities work together to protect patients.

**Common Approach** *(Not enough)*
- Patients can be transferred back and forth from facilities for treatment without all the communication and necessary infection control actions in place.

**Independent Efforts** *(Still not enough)*
- Some facilities work independently to enhance infection control but are not often alerted to antibiotic-resistant or *C. difficile* germs coming from other facilities or outbreaks in the area.
- Lack of shared information from other facilities means that necessary infection control actions are not always taken and germs are spread to other patients.

**Coordinated Approach** *(Needed)*
- Public health departments track and alert health care facilities to antibiotic-resistant or *C. difficile* germs coming from other facilities and outbreaks in the area.
- Facilities and public health authorities share information and implement shared infection control actions to stop spread of germs from facility to facility.

More patients get infections when facilities do not work together.

*(Example: 5 years after CRE enters 10 facilities in an area sharing patients)*

**Common Approach** *(status quo)*
- 2,000 patients will get CRE.
- CRE will impact 12% of patients.

**Independent Efforts**
- 1,500 patients will get CRE.
- CRE will impact 8% of patients.

**Coordinated Approach**
- 400 patients will get CRE.
- CRE will impact 2% of patients.
Antimicrobial Use: Nursing Homes

1. Centers for Medicare and Medicaid Services, Long Term Care Minimum Data Set, Resident profile table as of 05/02/2005. Baltimore, MD.
3. Centers for Medicare and Medicaid Services, Long Term Care Minimum Data Set, Resident Profile Table as of 05/02/2005. Baltimore, MD.

Clostridium difficile in NHs: Acquisition
New Regulations on AS in SNFs

- President’s Council of Advisors on Science and Technology (PCAST) Report
  - Introduced September 2014
  - “By the end of 2017, CMS should have Federal Regulations in place that require…long-term care and nursing home facilities to develop and implement robust AS programs that adhere to best practices.”

- CA SB361: SNFs: Antimicrobial Stewardship Guidelines
  - Introduced by Senator Hill February 24, 2015
  - Requires “all skilled nursing facilities by no later than January 1, 2017, to adopt and implement an AS policy.”
  - AND…” require each SNF, within 3 months of the establishment of AS guidelines by the federal CDC or professional organizations, including SHEA, to amend its policy to be consistent with those antimicrobial stewardship guidelines.”
Antimicrobial Stewardship in Skilled Nursing Facilities (SNFs):

**CS** Collaboration with geographic network of SNFs

- Assist ECP SNFs in establishing Antibiotic Stewardship Program elements using checklist and tools
- Choose one QI activity for FY16 on AS
  - Propose focus on UTI
Why Focus on UTIs?

Treatment for suspected UTI estimated to account for 30-60% of antibiotic prescriptions in LTCFs


1 J Am Geriatr Soc. 2008;56:2039-44. PMID 19016937.
Conclusions

• Combination of effective antimicrobial stewardship with a comprehensive infection control program has been shown to limit the emergence and transmission of antimicrobial resistance bacteria

• The time for stewardship is now.

• Every facility should be doing stewardship
  o Limited interventions as a place to start, more comprehensive programs as the goal

• Improving antibiotic use is a public health imperative

• Collaboration with health care partners across the continuum of care will be critical to overall success
THANK YOU!!