The ABC’s of Antimicrobial Stewardship Programs

Nicole Ruggiero, PharmD, BCPS
Clinical Coordinator Infectious Diseases
Kingsbrook Jewish Medical Center
I have no conflicts of interest to disclose.
Objectives

- Identify the impact of inappropriate antibiotic therapy on healthcare systems

- Define antimicrobial stewardship and discuss the role of Antimicrobial Stewardship Programs (ASP)

- Investigate Joint Commission Standard and CDC guidance on core elements of ASP

- Evaluate and apply ASP metrics and tools
Background

- Prompt initiation of antibiotic therapy for treatment of infections reduces morbidity and mortality

- 20-50% of all acute care antibiotics prescribed in the US is unnecessary or inappropriate\(^1\)

- 1 million courses of antibiotics dispensed to outpatients in US in 2014\(^2\)

---

2. Hicks LA. Clin Infect Dis. 2015 May 1;60(9):1308-16.
Antibiotic Use 2014

Center for Disease Dynamics, Economics & Policy (cddep.org)
Epidemiology

- Bacterial Resistance\(^1\):
  - 2 million infections annually
  - 700,000 deaths annually
    - Projected increase to 10 million/yr by 2050

- \textit{Clostridium difficile} infection (CDI)\(^2\):
  - ½ million infections annually
  - 29,000 deaths annually
  - Costs $4.8 billion/yr

1. CDC. \textit{Antibiotic resistance threats in the US}. 2013.
Antibiotic Resistance of *Escherichia coli* in the United States

![Graph showing the percentage of resistant isolates over time for different antibiotics.](image-url)
What is ASP?

- Coordinated interventions designed to improve and measure the appropriate use of antimicrobials

- Promotes the selection of:
  - Optimal antimicrobial drug regimen
  - Dose
  - Duration of therapy
  - Route of administration
Goals of ASP

- Optimize treatment of infections
  - Increase cure rates
  - Reduce treatment failure
  - Increase frequency of correct prescribing
  - Reduce healthcare cost

- Reduce adverse events associated with antibiotic use
  - Reduce CDI rates
  - Reduce antibiotic resistance
Regulatory Aspects of ASP
New Antimicrobial Stewardship Standard

- Joint Commission Standard effective January 1, 2017
  - Standard MM.09.01.01

- Applies to hospitals, critical access hospitals, and nursing care centers

- Supported by CMS, CDC, SHEA

- JC standard for ambulatory care and office based surgery practices still in development

Hospitals/Critical Access Hospitals

- Leadership
- Staff Education
- Patient Education
- Multi-disciplinary Team
- Policy/Protocol
- CDC Core Elements
- Data Analysis
- Action
- ASP
Leadership Support

Identify Leaders
- Physician Expert
- Pharmacist Expert
- Establish Accountability

Develop a Plan
- Identify barriers and strategies for resolution
- Emphasize requirement for protected time

Develop ASP Policy
- Outline goals of the program
- Detail plans for assessing impact of ASP
- Endorsement of the program
How can leadership support for ASP be established?

A) Formal statement of facility support
B) Including stewardship-related duties in job descriptions
C) Ensuring sufficient time to contribute to stewardship activities
D) Training and Education
E) All of the above
Staff Education

- All house staff and independent practitioners involved in **ordering antibiotics**
  - Education at time of hire and periodically thereafter
  - Educational competencies
  - Face to face interactions
Impact of a national antimicrobial stewardship mentoring program: Insights and lessons learned

- Seven-step mentoring program on ASP completed at 6 hospitals

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Mentees on ASP team complete an antimicrobial stewardship self-assessment survey (eAppendix)</td>
</tr>
<tr>
<td>2</td>
<td>Mentees and faculty mentors conduct a presite visit telephone call</td>
</tr>
<tr>
<td>3</td>
<td>Mentors and mentees participate in a 1-day onsite program with the ASP team and hospital administrators, with an in-depth evaluation of the hospital’s ASP and a continuing-education lecture for all healthcare professionals at the hospital</td>
</tr>
<tr>
<td>4</td>
<td>Mentors prepare a formal report with recommendations for advancing the ASP and an action plan</td>
</tr>
<tr>
<td>5</td>
<td>Mentees collect data on the required hang time outcome and implement process changes, monitor rate of CDI, and work on optional outcome projects</td>
</tr>
<tr>
<td>6</td>
<td>Mentors review the hang time outcomes data, provide feedback to mentees by conference calls, and assess the progress of the ASP</td>
</tr>
<tr>
<td>7</td>
<td>Mentees prepare a final report describing the results of their outcome projects (required and optional), develop a virtual poster focusing on 1 outcome project, and participate in a virtual poster interview posted on the ASHP website</td>
</tr>
</tbody>
</table>

*ASP = antimicrobial stewardship program, CDI = *Clostridium difficile* infection.
Impact of a national antimicrobial stewardship mentoring program: Insights and lessons learned

Table 3. Timeliness and Appropriateness of Intravenous Antibiotic Therapy in All Patients and Patients With Sepsis

<table>
<thead>
<tr>
<th>Hospital</th>
<th>All Patients, No. (%)&lt;sup&gt;a,b&lt;/sup&gt;</th>
<th>p</th>
<th>Patients With Sepsis, No. (%)&lt;sup&gt;b&lt;/sup&gt;</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Baseline</td>
<td>12 Months</td>
<td></td>
<td>Baseline</td>
</tr>
<tr>
<td>1</td>
<td>81 (52)</td>
<td>76 (33)</td>
<td>0.016</td>
<td>33 (21)</td>
</tr>
<tr>
<td>2</td>
<td>75 (49)</td>
<td>75 (76)</td>
<td>0.0007</td>
<td>43 (33)</td>
</tr>
<tr>
<td>3</td>
<td>75 (65)</td>
<td>75 (83)</td>
<td>0.016</td>
<td>14 (57)</td>
</tr>
<tr>
<td>4</td>
<td>75 (41)</td>
<td>75 (53)</td>
<td>0.14</td>
<td>32 (6)</td>
</tr>
<tr>
<td>5</td>
<td>75 (45)</td>
<td>75 (51)</td>
<td>0.51</td>
<td>23 (13)</td>
</tr>
<tr>
<td>6</td>
<td>27 (63)&lt;sup&gt;c&lt;/sup&gt;</td>
<td>20 (20)</td>
<td>0.003</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>408 (51)</td>
<td>396 (55)</td>
<td>0.11</td>
<td>145 (23)</td>
</tr>
</tbody>
</table>

<sup>a</sup>Timely and appropriate i.v. antibiotic therapy for patients without sepsis was defined as a hang time within two hours after physician order entry and broad-spectrum coverage for gram-negative pathogens administered first when combination therapy was used.

<sup>b</sup>Timely and appropriate i.v. antibiotic therapy for patients with sepsis was defined as a hang time within one hour after physician order entry and broad-spectrum coverage for gram-negative pathogens administered first when combination therapy was used.

<sup>c</sup>Small facility with limited i.v. antibiotic use, unable to meet minimum of 75 patients.

<sup>d</sup>Not applicable.
Patient Education

WARNING: Antibiotics don’t work for viruses like colds and the flu. Using them for viruses will NOT make you feel better or get back to work faster.

Antibiotics are strong medicines. Keep them that way. Prevent antibiotic resistance. Antibiotics don’t fight viruses—they fight bacteria. Using antibiotics for viruses can put you at risk of getting a bacterial infection that is resistant to antibiotic treatment. Talk to your healthcare provider about antibiotics, visit www.cdc.gov/getsmart, or call 1-800-CDC-INFO to learn more.

Viruses or Bacteria
What’s got you sick?

Antibiotics only treat bacterial infections. Viral illnesses cannot be treated with antibiotics. When an antibiotic is not prescribed, ask your healthcare professional for tips on how to relieve symptoms and feel better.

<table>
<thead>
<tr>
<th>Common Condition: What’s got you sick?</th>
<th>Common-Cause</th>
<th>Are antibiotics needed?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Common-Cause: Bacteria</td>
<td>Bacteria or Virus</td>
<td>Yes</td>
</tr>
<tr>
<td>Stridor</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Whooping cough</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Urinary tract infection</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Sinus infection</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Middle ear infection</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Rhinovirus, adult cold (in otherwise healthy children and adults)*</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Common cold/rashy nose</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Sore throat (except strep)</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Flu</td>
<td>No</td>
<td></td>
</tr>
</tbody>
</table>

* In some cases, adult cold is caused by bacteria, but even in these cases antibiotics still don't help.

Antibiotics Aren’t Always the Answer

www.cdc.gov/getsmart

CDC. Get Smart About Antibiotics Week. 2017
JC standards
- Leadership
- Education
- Multidisciplinary team
- Policy and Procedure
- Data Analysis
- Action
- CDC Core Elements

CDC Core Elements
- Leadership
- Education
- Drug Expertise
- Accountability
- Tracking
- Reporting
- Action

CDC. Core Elements of Hospital Antibiotic Stewardship Programs. 2017
Policy and Protocol Development

- Should have input from a multidisciplinary team
- Restricted/protected antibiotic system
- Clinical Pathways
  - Utilize information technology systems
SKIN AND SOFT TISSUE INFECTIONS

1 NONPURULENT INFECTION
   > Necrotizing
   > Cellulitis
   > Erysipelas

2 PURULENT INFECTION
   > Furuncle

NONPURULENT INFECTION

1 MILD
   > Typical cellulitis/erysipelas without systemic signs of infection

2 MODERATE
   > Typical cellulitis/erysipelas with systemic signs of infection
   > 1 SIRS criteria present (See below for SIRS criteria)

3 SEVERE

MILD NONPURULENT SKIN AND SOFT TISSUE INFECTION

1 MILD NONPURULENT SKIN AND SOFT TISSUE INFECTION FOR OUTPATIENT USE

2 MILD NONPURULENT SKIN AND SOFT TISSUE INFECTION FOR INPATIENT USE

MILD NONPURULENT SKIN AND SOFT TISSUE INFECTION FOR OUTPATIENT USE

PREFERRED THERAPY

1 Penicillin VK 500mg PO q6h
2 Cephalexin 500mg PO q6h
3 Dicloxacillin 500mg PO q6h

*The above doses are recommended for patients with EGFR >60mL/min/1.73m2*

FOR PENICILLIN ALLERGIC PATIENTS

4 Clindamycin 500mg PO q8h
SSTI

Mild
- Purulent
  - Incision & Drainage

- Non-purulent

Moderate

Severe

PNC Allergic:

Cephalexin 500mg PO q6h
Dicloxacillin 500mg q6h

Clindamycin 500mg PO q8h
Data Analysis

- Measure impact of ASP
  - Antimicrobial measures
  - Microbial measures

- Provide benchmarking tools

- Maintain administrative support
Antimicrobial Measures

- Defined daily dose
- Days of therapy
- Antimicrobial-free days
- Grams of antimicrobial therapy
- Antimicrobial cost of therapy
- Antimicrobial prevalence
- Length of stay
- Disease-specific consumption measures
- Targeted antimicrobials
- Appropriateness measures
- Process measures

CDC. Core Elements of Hospital ASPs. 2014.
Consumption Measures

- Metrics that reflect average amount of antimicrobials being consumed
  - Defined Daily Doses (DDD)
  - Days Of Therapy (DOT)
Defined Daily Doses

- Assumed average maintenance dose per day for a drug used for its main indication in adults

Total number of grams of each antibiotic used

WHO-assigned DDD

World Health Organization. ATC Index with DDDs. 2004
## WHO-Assigned DDD

<table>
<thead>
<tr>
<th>Antibiotic</th>
<th>WHO-Assigned DDD</th>
<th>Clinical Practice Dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cefepime</td>
<td>2 grams</td>
<td>2-6 grams</td>
</tr>
<tr>
<td>Piperacillin</td>
<td>14 grams</td>
<td>12-16 grams</td>
</tr>
<tr>
<td>Meropenem</td>
<td>2 grams</td>
<td>2-3 grams</td>
</tr>
<tr>
<td>Vancomycin</td>
<td>2 grams</td>
<td>Weight based dosing</td>
</tr>
</tbody>
</table>

World Health Organization. ATC Index with DDDs. 2004
General Principles of DDD

- Assumes routine dosing
  - Higher doses overestimates
  - Weight-based dosing not accurately reflected
  - Renal dysfunction underestimates

- Unit of measurement

- Difficult to infer DOT from DDDs

- Difficult to make conclusions about use of one abx vs another

A patient is admitted to your hospital with Febrile Neutropenia and initiated on cefepime 2g IV q8h. What is the calculated DDD?

A) 0.5
B) 1
C) 2
D) 3
E) 4
Days Of Therapy

- Considered more clinically relevant

- Small hospitals may be unable to calculate DOTs accurately and easily

- Biases against combo therapy

- Useful in weight-based dosing scenarios

- Used by the Antimicrobial Use and Resistance Module
A patient receives treatment for a complicated intra-abdominal infection with vancomycin 1g IV q12h + cefepime 2g IV q12h + flagyl 500mg IV q8h for 10 days. What is the calculated DOT?

A) 10
B) 15
C) 20
D) 25
E) 30
<table>
<thead>
<tr>
<th>Measurement Method</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
</table>
| **DDD**            | • Standardized comparisons of aggregate abx use between hospitals  
|                    | • Estimate use without computerized pharmacy data | • Does not accurately estimate DOT  
|                    |            | • Cannot be used in children  
|                    |            | • Underestimated in renal impairment  
|                    |            | • Approved DDDs subject to change |
| **DOT**            | • Can be used in children  
|                    | • Not influenced by changes in DDD | • Overestimates in combination therapy  
|                    |            | • Difficult to measure without computerized pharmacy data |
Which overall measure best reflects the impact of ASPs and their interventions?

A) DDD

B) DOT
Which overall measure best reflects the impact of ASPs and their interventions?

- IDSA/SHEA 2016 Implementing ASP Guidelines
  - DOT recommended (weak recommendation, low quality evidence)
  - DDD may be used as an alternative
  - Key points:
    - Measure appropriateness within your own institution
Antimicrobial Use and Resistance (AUR) Module

- Created by the National Healthcare Safety Network (NHSN)

- Provides a mechanism for facilities to report and analyze antimicrobial use/resistance

- Two options offered:
  - Antimicrobial use option (AU)
  - Antimicrobial resistance option (AR)
AU Option

- Released in 2011

- **Voluntary** reporting and analysis of antimicrobial use

- Requirements for participation:
  - eMAR or BCMA -and-
  - Ability to collect and package data using HL7 formatting
AU Option- Data Elements

- Numerator: DOTs
  - Includes 89 antimicrobials
  - Stratified by route of administration
  - Only looks at administration data

- Denominators:
  - Days present
    - # of days in which a patient spent *any* time in a specific unit or facility
  - Admissions
    - # of patients admitted to an inpatient location in the facility

CDC. AUR Module. 2017
Clinical Document Architecture (CDA)

- Provides standardized way to package and upload data
- Data cannot be entered by hand
- Monthly uploading of data
Vendor/Homegrown System
- Monthly summary
- Location specific & FacWideIN
  - 89 antimicrobials
  - Days present & admissions

Report in standard format

Pharmacists & Physicians compare and target education/interventions

Risk adjusted comparisons for specific locations, groupings of antimicrobials

Local access of data: NHSN web interface – analysis, visualization and data sharing

NHSN Servers

AU Option- Analysis Reports

![Antimicrobial Use Data]

- SIR SAAR Report - All SAARs
- SIR SAAR Report - All SAARs by Location
- Line Listing - Most Recent Month of AU Data for FACWIDEIN
- Line Listing - Most Recent Month of AU Data by Location
- Line Listing - All Submitted AU Data for FACWIDEIN
- Line Listing - All Submitted AU Data by Location
- Rate Table - Most Recent Month of AU Data - Antimicrobial Utilization Rates for FACWIDEIN
- Rate Table - All Submitted AU Data - Antimicrobial Utilization Rates for FACWIDEIN
- Rate Table - Most Recent Month of AU Data - Antimicrobial Utilization Rates by Location
- Rate Table - All Submitted AU Data - Antimicrobial Utilization Rates by Location
- Rate Table - Selected Drugs - FACWIDEIN - Most Recent Month
- Rate Table - Selected Drugs - FACWIDEIN - All Months
- Rate Table - Selected Drugs - by Location - Most Recent Month
- Rate Table - Selected Drugs - by Location - All Months
- Pie Chart - Most Recent Month of AU Data by Antibacterial Class and Location
- Pie Chart - All AU Data by Antibacterial Class and Location
- Pie Chart - Most Recent Month of AU Data by Antifungal Class and Location
- Pie Chart - All AU Data by Antifungal Class and Location
- Pie Chart - Most Recent Month of AU Data by Anti-influenza Class and Location
- Pie Chart - All AU Data by Anti-influenza Class and Location
- Bar Chart - Most Recent Month of AU Data by Antibacterial Class and Location
- Bar Chart - All AU Data by Antibacterial Class and Location
- Bar Chart - Most Recent Month of AU Data by Antifungal Class and Location
Standardized Antimicrobial Administration Ratio (SAAR)

- Metric for comparing observed-to-predicted days of antibiotic therapy
- Uses nationally aggregated AU data to determine predicted DOT
  - Adjusted for bed size, teaching status, ICU status, and ward type
- Provides benchmark for comparing your hospitals DOT to others nationally

CDC. Standardized Antimicrobial Administration Ratio (SAAR) Table. 2017
## Interpreting SAAR

### National Healthcare Safety Network

**SAARs Table - All Standardized Antimicrobial Administration Ratios (SAARs) High-Level Indicators and High-Value Targets**

As of: January 4, 2016 at 12:14 PM

Date Range: AU_SAAR summaryYQ 2014Q1 to 2014Q4

if (location = "MICU")

All antimicrobials used in adult ICUs and wards

<table>
<thead>
<tr>
<th>Facility Org ID</th>
<th>Summary Yr/Qtr</th>
<th>SAAR Type</th>
<th>Antimicrobial Days</th>
<th>Predicted Antimicrobial Days</th>
<th>Days Present</th>
<th>SAAR</th>
<th>SAAR p-value</th>
<th>95% Confidence Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>13860</td>
<td>2014Q1</td>
<td>IND-Adult-1</td>
<td>951</td>
<td>1159.477</td>
<td>1306</td>
<td>0.820</td>
<td>0.0000</td>
<td>0.769, 0.874</td>
</tr>
<tr>
<td>13860</td>
<td>2014Q2</td>
<td>IND-Adult-1</td>
<td>1084</td>
<td>1118.638</td>
<td>1260</td>
<td>0.969</td>
<td>0.3073</td>
<td>0.913, 1.028</td>
</tr>
<tr>
<td>13860</td>
<td>2014Q3</td>
<td>IND-Adult-1</td>
<td>1024</td>
<td>1158.589</td>
<td>1305</td>
<td>0.884</td>
<td>0.0001</td>
<td>0.831, 0.939</td>
</tr>
<tr>
<td>13860</td>
<td>2014Q4</td>
<td>IND-Adult-1</td>
<td>1050</td>
<td>1097.330</td>
<td>1236</td>
<td>0.957</td>
<td>0.1559</td>
<td>0.900, 1.016</td>
</tr>
</tbody>
</table>

Includes data for January 2014 and forward.

Data restricted to medical, medical/surgical and surgical locations.

Source of aggregate data: 2014 NHSN AU Data

Data contained in this report were last generated on December 4, 2015 at 9:55 AM.
Interpreting SAAR

- SAAR ≥ 1 indicates more antimicrobial use than predicted
- SAAR < 1 indicates antimicrobial use is less than predicted

“SAAR alone is not a definitive measure of the appropriateness or judiciousness of antibacterial use, and any SAAR may warrant further investigation” – CDC/NHSN

CDC. Standardized Antimicrobial Administration Ratio (SAAR) Table. 2017
Microbial Measures

- Antimicrobial resistance prevalence
  - Resistance rates
  - Antibiograms
- CDI rates
AR Option

- Released in 2014

- **Voluntary reporting** of antimicrobial resistance data

- Requirements for participation:
  - Electronic Laboratory Information System
  - Admission Discharge Transfer System
  - Ability to collect and package data using HL7 formatting
AR Option Data Elements

- **Numerator:** Isolate-level susceptibility results for specific organisms
  - Patient specific info
    - DOB, Gender, Admission Date, Location
  - Specimen specific info
    - Collection date, specimen source
  - Antimicrobial susceptibility info
    - Sign, value, and interpretation for test
    - Laboratory interpretation

- **Denominator:** patient days & admissions
### National Healthcare Safety Network
Facility-wide Antibiogram (Percent Non-Susceptible)
Rate per 100 Isolates
As of: August 15, 2014 at 4:32 PM
Date Range: All AUR_SUMMARY

<table>
<thead>
<tr>
<th>Pathogen</th>
<th>Drug</th>
<th>Acinetobacter spp. - ACS</th>
<th>Staphylococcus aureus - SA</th>
</tr>
</thead>
<tbody>
<tr>
<td>AMK</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AMPHS</td>
<td>100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AZITH</td>
<td></td>
<td></td>
<td>100</td>
</tr>
<tr>
<td>CEFEP</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CEFOT</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CEFFOX</td>
<td></td>
<td></td>
<td>49.0</td>
</tr>
<tr>
<td>CEFTAZ</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CEFTRX</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHLOR</td>
<td></td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>CIPRO</td>
<td>33.0</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>CLARTH</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CLIND</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DAPTO</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DOXY</td>
<td>33.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ERYTH</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GENTA</td>
<td>33.0</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>IMIIM</td>
<td>33.0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Taking Action

- Use data analysis to identify areas for improvement

- Implement targeted interventions to improve antibiotic use
  - Antibiotic specific
  - Disease Specific
Conclusions

- ASPs are needed to optimize treatment of infections and to reduce adverse events associated with abx use
- New JC standard provides 8 key performance elements for ASPs
- Numerous metrics and tools available for data analysis
  - Do what works for your hospital!
- Implement targeted interventions to improve outcomes
The ABC’s of Antimicrobial Stewardship Programs

Questions?
Nruggiero@kingsbrook.org

Nicole Ruggiero, PharmD, BCPS
Clinical Coordinator Infectious Diseases
Kingsbrook Jewish Medical Center
References


