Actionable Data for Antibiotic Stewardship: Case Examples
May 8, 2018

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Housekeeping

- Participant phone/microphone lines are muted.
- Questions/comments? Type your questions in the chat box.
- Slides will be provided after the call.
1. View on Antibiotic Use Reporting from the CDC
   Melinda Neuhauser, PharmD, MPH, Centers for Disease Control and Prevention

2. Introduction to the Antimicrobial Use and Resistance Module for Antimicrobial Use Reporting
   Catherine Lexau, PhD, MPH, RN, Minnesota Department of Health

3. Antibiotic Use Visualization and Assessment at the Unit Level Using an Excel-based tool
   Erik Stensgard, PharmD, BCPS, Minneapolis Veterans Affairs Health Care System

4. Practical Application of NHSN Antimicrobial Use Data
   Clark Force, RPh, BCPS, Tucson Medical Center

5. Wrap-Up and Questions
View on Antibiotic Use Reporting from the CDC

Melinda Neuhauser, PharmD, MPH, Centers for Disease Control and Prevention
CDC Updates: NHSN AU Option

Melinda Neuhauser, PharmD, MPH
Pharmacist and Acute Care Lead
Office of Antibiotic Stewardship
Division Quality Healthcare Promotion

May 8, 2018
CDC’s Approach in Improving Antibiotic Use

DATA FOR ACTION
- Providing data about facility-level antibiotic use in outpatient settings, hospitals, and nursing homes to help healthcare providers identify opportunities to improve prescribing.
- Working with partners to develop a benchmark for hospitals to assess their antibiotic use and monitor the impact of antibiotic stewardship programs.

IMPLEMENTATION
- Providing recommendations for antibiotic stewardship programs and practices in multiple healthcare settings.
- Providing tools to help organizations incorporate antibiotic stewardship principles into antibiotic use guidelines.
- Developing tools and providing expertise to support and expand local implementation.
- Providing expertise to, and coordinating with, other federal partners to develop guidance and tools to implement antibiotic stewardship.
- Engaging a broad network of partners in healthcare, such as healthcare professional organizations, hospitals, health systems and industry, to implement antibiotic stewardship.

INNOVATION
- Funding universities and healthcare partners to identify novel ways to implement stewardship activities and improve the implementation of CDC’s Core Elements of Antibiotic Stewardship in hospitals, nursing homes, outpatient settings, and small hospitals in rural areas.
- Advancing the development of diagnostic tests to identify and characterize resistant bacteria by accelerating research and development for new antibiotics.

EDUCATION
- Leading a national effort to educate Americans about appropriate antibiotic use, and strategies to protect themselves from antibiotic resistance.
- Spearheading an annual global observance promoting appropriate prescribing and use.
- Developing an educational effort to emphasize the early recognition, treatment, and reassessment of therapy of sepsis as an important part of antibiotic stewardship.

Number of hospitals reporting to NHSN's Antimicrobial Use (AU) Option over time

*As of April 1, 2018*
*As of April 1, 2018*
Standardized Antimicrobial Administration Ratio (SAAR)

- SAAR expresses observed to expected antibiotic use where expected use is calculated based on models using facility characteristics.

- SAARs for different groups of antibiotics:
  - HAI: Agents mainly for healthcare associated pathogens
  - CO: Agents mainly for community pathogens
  - MRSA: Agents active against MRSA
  - Surg: Agents frequently use for surgical prophylaxis
  - All antibacterial agents
SAAR Analysis within a Given Facility

Example data only
SAAR Updates

- Adult and Pediatric SAARs being updated with 2017 AU data
  - Seeking input from adult and pediatric experts to optimize SAAR categories
  - Anticipated launch ~January 2019

- NICU SAARs being developed
  - Seeking input from Vermont Oxford Network
  - Anticipated launch ~ January 2020
Advancing the SAAR Measure

- The Duke Antimicrobial Stewardship Outreach Network (DASON) was awarded funding to enroll a group of hospitals in NHSN AU option and then implement and/or expand stewardship efforts.
  - Does the SAAR help find improvement opportunities?
  - Does the SAAR change in response to stewardship?

- Duke University was awarded funding to identify patient- and facility-level factors predictive of antimicrobial use that can be used in risk adjustment strategies for benchmarking antimicrobial use.
Introduction to the Antimicrobial Use and Resistance Module for Antimicrobial Use Reporting

Catherine Lexau, PhD, MPH, RN, Minnesota Department of Health
What is the National Healthcare Safety Network?

The National Healthcare Safety Network (NHSN) is the CDC system for tracking and reporting health care-associated infections (HAIs).

NHSN establishes standard definitions and detailed protocols for each metric.

After submission, CDC securely stores data on its servers and facilities maintain access to their own data.
What is the National Healthcare Safety Network?

Neither NHSN nor CDC “requires” any data submission, but the Centers for Medicare and Medicaid Services (CMS) requires submission of some data to NHSN as a condition for participation in programs like Value Based Purchasing.

NHSN Antimicrobial Use data discussed today are not publically reported nor is reporting mandated by CMS.
NHSN Antimicrobial Use and Resistance (AUR) Module

Purpose:
- Track hospital antimicrobial use (AU) and antimicrobial resistance (AR)
- Highlight patient care areas for possible intervention
- Facilitate benchmarking with other hospitals

Key Features:
- Data useable by multiple entities, including submitting hospitals, CDC and state public health agencies
- Single set of technical specifications and standard definitions
AUR Module: Antimicrobial Use Option

Data sources: Electronic
   Medication administration data
   Admission and transfer data

Data submission to NHSN
   Unlike HAI/other NHSN data, electronic file submission only
   No personal identifiers
Flow of Antimicrobial Use Data - AUR Module

Medication administration record data

Health IT Vendor Services/Software

Extracted along with admission, discharge and transfer data

Clinical Document Architecture (CDA)

Formatted and submitted electronically

Hospital staff can access and analyze using NHSN-platform tools, and/or download data for further analysis

Stored on NHSN Servers
Antibiotic administration data
  Drug and route of administration
  Date given
  Patient location

Patient census information from electronic admission, discharge, transfer (ADT) system
  Inpatient wards
  Emergency Department
  Outpatient observation units
How is Antimicrobial Use Measured?

“Antibiotic Day”
One antibiotic, one or more doses, to one patient on one day

“Days present”
Similar to patient days

A count of patients spending any time in a patient care location on a given day

Antibiotic Use Rates:
Antibiotic Days/Days Present

Antibiotic Days/Admissions
Retrievable Antimicrobial Use Data

Antibiotic days by:
- Drug
- Drug class

Grouped by:
- Single patient care areas
- Facility-wide inpatient

Benchmark Measure: Standardized Antimicrobial Administration Ratio (SAAR)
Standardized Antimicrobial Administration Ratio (SAAR)

A ratio measure:

\[
\frac{\text{Observed (actual) antimicrobial days}}{\text{Expected (predicted) antimicrobial days}}
\]

SAAR is risk adjusted with expected number calculated from statistical model*

Adjusted for:

- Hospital characteristics
- Ward type (general vs. ICU)
- Patient group (adult/pediatric)

Standardized Antimicrobial Administration Ratio (SAAR)

\[
\frac{\text{Observed (actual) antimicrobial days}}{\text{Expected (predicted) antimicrobial days}}
\]

If statistically significant, a SAAR

- Higher than 1 signals more antibiotic use than peers
- Lower than 1 signals less antibiotic use than peers
- Does not in itself assess whether prescribing is appropriate or not
# Clinical Categories for SAAR Measures

<table>
<thead>
<tr>
<th>Antibacterials by Common Clinical Use:</th>
<th>Agents Included:</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Broad-spectrum agents, used primarily for hospital-onset or multi-drug resistant (MDR) infections</strong></td>
<td>aminoglycosides, carbapenems (except ertapenem), 4th and 5th generation cephalosporins, penicillin B-lactam/b-lactamase inhibitor combinations, and others</td>
</tr>
<tr>
<td><strong>Broad-spectrum agents, used primarily for community-acquired infections</strong></td>
<td>ertapenem, some cephalosporins, and some fluoroquinolones</td>
</tr>
<tr>
<td><strong>Antibiotics used primarily to treat MRSA</strong></td>
<td>ceftaroline, dalbavancin, daptomycin, linezolid, oritavancin, quinupristin/dalfopristin, tedizolid, telavancin, and IV vancomycin</td>
</tr>
<tr>
<td><strong>Antibiotics used primarily for surgical site infection (SSI) prophylaxis</strong></td>
<td>cefazolin (IV), cefotetan (IV), cefoxitin (IV), cefuroxime (IV), and cephalaxin (PO)</td>
</tr>
<tr>
<td><strong>All antibacterial agents</strong></td>
<td>All 74 antibacterial agents included in NHSN AUR protocol</td>
</tr>
</tbody>
</table>
Requirements for Antimicrobial Use Data Submission

• Hospitals/care areas using Electronic Medication Administration Records (eMARs) or Bar Coded Medication Administration (BCMA) systems

• Ability to collect and package data using standardized format via 3rd party vendors:
  • Self reported information for AU: http://www.sidp.org/aurvendors
  • 25 certified EHR/other vendors listed here: https://chpl.healthit.gov/#/search
    • Search under Certification Criteria >
    • 170.315 (f)(6): Transmission to Public Health Agencies - Antimicrobial Use and Resistance Reporting
  • “Homegrown” submission discouraged
### National Healthcare Safety Network

**Line Listing - Most Recent Month of AU Data by Location**

As of: February 20, 2015 at 5:01 PM  
Date Range: All SUMMARYAU1MONTH  

<table>
<thead>
<tr>
<th>Facility Org ID</th>
<th>Summary Year/Month</th>
<th>Antimicrobial Agent Description</th>
<th>Location</th>
<th>Days Present</th>
<th>Antimicrobial Days</th>
<th>Route: IM</th>
<th>Route: IV</th>
<th>Route: Digestive</th>
<th>Route: Respiratory</th>
</tr>
</thead>
<tbody>
<tr>
<td>13860</td>
<td>2015M01</td>
<td>AMAN - Amantadine</td>
<td>MICU</td>
<td>421</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>13860</td>
<td>2015M01</td>
<td>AMK - Amikacin</td>
<td>MICU</td>
<td>421</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>13860</td>
<td>2015M01</td>
<td>AMOX - Amoxicillin</td>
<td>MICU</td>
<td>421</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>13860</td>
<td>2015M01</td>
<td>AMOXWC - Amoxicillin with Clavulanate</td>
<td>MICU</td>
<td>421</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>13860</td>
<td>2015M01</td>
<td>AMP - Ampicillin</td>
<td>MICU</td>
<td>421</td>
<td>4</td>
<td>0</td>
<td>4</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Source: CDC Data for example only

Source: CDC Data for example only
Antimicrobial Use Data Visualization from NHSN Platform

Source: CDC Data for example only
Antibiotic Use Data Visualization and Assessment at the Unit level Using Excel-based tool

Erik Stensgard, PharmD, BCPS
Antimicrobial CDSS Program Manager
Minneapolis Veterans Affairs Health Care System
Utilizing NHSN Data to Identify Areas for Quality Improvement - Minneapolis VA

SAAR Quarterly Trends

- All antibiotics ALL wards and ICU
- Anti-MRSA Agents ICU
- Anti-MRSA Agents Wards
Clustering of MRSA post-operative infections/mediastinitis 2006-2007

Several changes made in peri-op care at that time:

- Reduced OR temperature
- Better blood glucose control
- Vancomycin + cefuroxime for all open-heart surgery patients: pre-op, intra-op, post-op x 24h (counted as 2 antimicrobial days - SAAR 1.5-2 times predicted)

Changes resulted in significant reduction in MRSA post-op infections

Time to re-evaluate our practice?

- Intervention: Post-operative antibiotics decreased to one dose
Results of Reducing to One Dose Post-Op

Updated SAAR Quarterly Trends

- All antibiotics ALL Wards and ICU
- Anti-MRSA Agents ICU
- Anti-MRSA Agents Wards
Visualizing NHSN Data

- Raw data downloaded from NHSN
- Imported into Microsoft® Access® database
  - Perform queries to parse data
- Queries incorporated into Microsoft® Excel® data model
  - Create PivotCharts in Excel® workbook
- PivotCharts updated by importing new NHSN reports
  - Data is appended to Access® database
  - All historic data is stored
• Track and compare usage of antimicrobials over time

• Slicers can be used to change antimicrobial, time frame and ward
• Target IV or PO use for interventions
• Identify wards with high PO or IV usage
• Target Anti-MRSA antimicrobials for intervention
- Target broad spectrum antimicrobials for intervention
• Track SAAR over time by type and location
• Identify SAAR type and wards for intervention
• Andrea Aylward, PharmD, NHSN Dashboard Developer
• Dimitri Drekonja, MD, Chief of ID MVAHCS
• Makoto Jones, MD, VA NHSN Support Group Salt Lake City
• Bobbie Masoud, PharmD, NHSN Administrator VISN 23
• Lauren Rademacher, Antimicrobial Stewardship Pharmacist MVAHCS
• Micheal Vasek, MBA, NHSN Dashboard Developer
Practical Application of NHSN Antimicrobial Use Data

Clark Force, RPh, BCPS
Antimicrobial Stewardship Pharmacist
Tucson Medical Center
Tucson Medical Center (TMC)

Nonprofit, community teaching hospital
600+ licensed beds
Average census: 375

Specialty areas include:
• Critical care for adults, pediatrics, and newborns
• Cardiovascular
• Orthopedic Surgery
Percentage of facilities ever-reporting to NHSN's AU Option

*As of March 1, 2018*
Background:

Spring 2016:

Request from TMC Administration and Infection Control for the Antimicrobial Stewardship Program (ASP) to initiate an improvement project to help meet the hospital goal of reducing the incidence of Hospital-Onset *C. difficile* Infections (HO-CDI)
Background:

- Multiple meetings with Director of Pharmacy and ASP Medical Director to plan initiative
  - Needs to be attainable
  - Needs to be easily measurable

- Early 2016 TMC ASP
  - NHSN SAAR data released
  - ASP/Pharmacy added indications to antibiotic orders
  - UTI indications identified as a “gold mine” of ASP interventions
  - Daily antibiotic indications reports were built for ASP
SAAR - Standardized Antimicrobial Administration Ratio
Community Onset Antimicrobials in Adult Wards
Data restricted to medical, medical/surgical and surgical locations.
Source of aggregate data: 2014 NHSN AU Data
NHSN AU Option
SAAR - Five Antibacterial Agent Groupings
(TMC formulary antibiotics listed)

High value targets for antimicrobial stewardship programs
SAAR Groupings designated by NHSN

1. Broad spectrum agents predominantly used for hospital-onset/multi-drug resistant bacteria – CEFEPIME, CEFTAZIDIME, MEROPENEM, PIPERACILLIN/TAZOBACTAM

2. Broad spectrum agents predominantly used for community-acquired infection – CEFTRIAXONE, CIPROFLOXACIN, ERTAPENEM, LEVOFLOXACIN

3. Anti-MRSA agents – CEFTAROLINE, DAPTOMYCIN, LINEZOLID, VANCOMYCIN (IV route only)

4. Agents predominantly used for surgical site infection prophylaxis – CEFAZOLIN, CEPHALEXIN

5. All antibacterial agents – Includes all antibacterial agents reported into the AU Option including the agents listed in the category specific SAARs.
## Top 20 Antibiotic Indications Ordered 2016 Q1

<table>
<thead>
<tr>
<th>Rank</th>
<th>Indication</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>SURGICAL PROPHYLAXIS</td>
<td>3856</td>
</tr>
<tr>
<td>2</td>
<td>COMMUNITY ACQUIRED PNEUMONIA (CAP)</td>
<td>1395</td>
</tr>
<tr>
<td>3</td>
<td>INTRA-ABDOMINAL INFECTION</td>
<td>1043</td>
</tr>
<tr>
<td>4</td>
<td>UTI (SYMPTOMATIC)</td>
<td>972</td>
</tr>
<tr>
<td>5</td>
<td>SKIN AND SOFT TISSUE INFECTION</td>
<td>892</td>
</tr>
<tr>
<td>6</td>
<td>HEALTHCARE-ASSOCIATED PNEUMONIA</td>
<td>714</td>
</tr>
<tr>
<td>7</td>
<td>GROUP B STREP NEONATAL TRANSMISSION PPX</td>
<td>692</td>
</tr>
<tr>
<td>8</td>
<td>ABSCESS</td>
<td>299</td>
</tr>
<tr>
<td>9</td>
<td>CLOSTRIDIUM DIFFICILE</td>
<td>284</td>
</tr>
<tr>
<td>10</td>
<td>BACTEREMIA</td>
<td>188</td>
</tr>
<tr>
<td>11</td>
<td>ASPIRATION PNEUMONIA</td>
<td>154</td>
</tr>
<tr>
<td>12</td>
<td>SEPTIC SHOCK</td>
<td>146</td>
</tr>
<tr>
<td>13</td>
<td>FEMALE PELVIC INFECTION</td>
<td>135</td>
</tr>
<tr>
<td>14</td>
<td>PYELONEPHRITIS</td>
<td>98</td>
</tr>
<tr>
<td>15</td>
<td>POSTOPERATIVE INFECTION</td>
<td>96</td>
</tr>
<tr>
<td>16</td>
<td>OSTEOMYELITIS</td>
<td>82</td>
</tr>
<tr>
<td>17</td>
<td>MENINGITIS</td>
<td>68</td>
</tr>
<tr>
<td>18</td>
<td>BONE AND JOINT INFECTION</td>
<td>48</td>
</tr>
<tr>
<td>19</td>
<td>BACTERIAL PERITONITIS</td>
<td>36</td>
</tr>
<tr>
<td>20</td>
<td>FEBRILE NEUTROPENIA</td>
<td>28</td>
</tr>
</tbody>
</table>

Orders entered by pharmacists were deleted.
Plan:

• Needs to be easily measurable
  • Antibiotic Use (AU) rates, SAAR
  • ASP Pharmacist interventions

• Needs to be attainable
  • **Plan**: Reduce AU rate by 10% for:
  • Ceftriaxone
  • Ciprofloxacin
  • Levofloxacin
  • (baseline = 2015 AU rate)
Method:

- July 2016, presented formalized plan with UTI and CAP guidelines at Medicine Department Meeting
- Conduct patient reviews w/ prospective audit and feedback on patients with orders for UTI and CAP
- Pharmacy Interventions:
  - De-escalate antibiotics and PPI
  - Set antibiotic duration
  - Dose adjustment per hospital protocols
  - IV to PO conversion per hospital protocol
## Summary of ASP Pharmacist Activity

<table>
<thead>
<tr>
<th>Summary</th>
<th>Monthly Avg.</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAP and UTI Patients Reviewed</td>
<td>182</td>
</tr>
<tr>
<td>Stop Antibiotic Interventions Accepted</td>
<td>27</td>
</tr>
<tr>
<td>Stop Antibiotic Interventions Declined</td>
<td>3.5</td>
</tr>
<tr>
<td>Intervention % Acceptance</td>
<td>88.5%</td>
</tr>
<tr>
<td># of Patients Reviewed per Stop Intervention</td>
<td>7</td>
</tr>
</tbody>
</table>

July 2016 to June 2017
Ceftriaxone Use Rate for Adult Wards
(Days of therapy per 1000 patient days)
Ciprofloxacin Use Rate for Adult Wards
(Days of therapy per 1000 patient days)

Days of Therapy per 1000 Patient Days

Jan '16  Feb '16  Mar '16  Apr '16  May '16  Jun '16  Jul '16  Aug '16  Sep '16  Oct '16  Nov '16  Dec '16  Jan '17  Feb '17  Mar '17  Apr '17  May '17  Jun '17  Jul '17

Ciprofloxacin
Baseline
Ciprofloxacin
Goal

Ciprofloxacin Use Rate for Adult Wards
(Days of therapy per 1000 patient days)
Levofloxacin Use Rate for Adult Wards
(Days of therapy per 1000 patient days)

Days of Therapy per 1000 Patient Days

- Levofloxacin Baseline
- Levofloxacin
- Levofloxacin Goal
### Results:

<table>
<thead>
<tr>
<th>Antibiotic</th>
<th>2015 AU Rate (Baseline)</th>
<th>AU Rate (for Initiative Time Period)</th>
<th>% Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ceftriaxone</td>
<td>49.1</td>
<td>46.1</td>
<td>6.1%</td>
</tr>
<tr>
<td>Ciprofloxacin</td>
<td>52.3</td>
<td>42.7</td>
<td>18.4%</td>
</tr>
<tr>
<td>Levofloxacin</td>
<td>29.2</td>
<td>18.7</td>
<td>36.1%</td>
</tr>
</tbody>
</table>
Results:

ASP initiative was part of the 2016 hospital-wide C diff reduction program which also included changes to:

• Environmental cleaning
• Hand hygiene
• C diff testing
SAAR Antimicrobials used for community-onset infections in adult wards and SIR for CDI FacwideIN

Quarterly Data

- Sum of SAAR
- Sum of CDI SIR
Conclusions:

• With prospective audit and feedback, over a 12 month period we applied downward pressure on the Ward SAAR for Community Onset Infections and saw reduction in use of the targeted antibiotics. Although it is part of a multi-pronged approach, we feel it is an important contributor towards the decrease in HO-CDI at our institution.

• Access to NHSN AU data
  • Directed us to target an improvement
  • Allowed for easy tracking of progress

• Antibiotic indications reporting helped us focus on specific patients/orders.
Lessons Learned:

• This initiative includes the following CDC ASP (Joint Commission) core elements of:
  • **Tracking**: AU data
  • **Action**: Prospective audit and feedback, improve AU
  • **Education**: Providers
  • **Reporting**: Hospital administration, ASP

• UTI and CAP guidelines are a good starting point to “train” providers to de-escalate and set durations

• SAAR has no seasonal variation
Next Steps:

• In November 2017, we rotated to new indications group:
  • Intra-abdominal infections
  • Healthcare-associated pneumonia
  • Skin and soft tissue infections

• Will progress be from CAP and UTI reviews sustained?
Annual SAAR - Antimicrobials used for community-onset infections in adult wards (Ceftriaxone, Ciprofloxacin, Ertapenem, Levofloxacin)
AU Reporting:

TMC AU Reporting
  • Began reporting in June of 2014
  • Homegrown extraction from Epic
    • Pharmacy IS Analyst
    • Antimicrobial Stewardship Pharmacist
    • Assistance from CDC

Reporting AU to NHSN is highly recommended
Wrap-up

Catherine Lexau, PhD, MPH, RN, Minnesota Department of Health
Antibiotic Use Reporting: Implementation Steps

1. Hospital Enrolled and Reporting to NHSN, Staff with NHSN Expertise
2. NHSN Protocol for Reporting Plans and Location Mapping In Place
3. Electronic or Bar Code Medication record (eMAR, BCMA)
4. Electronic Health Record/Data Mining Software to Extract, Format Data
5. Report, Validate and Use Data!
Acknowledgements:

Dawn Chen, Amanda Beaudoin and Ashley Fell from MDH
Amy Webb, Wendy Wise and Chaity Naik from CDC
Questions!

Please Enter Your Questions in the Chat Box

More detailed information on NHSN AUR Module:

AUR Toolkit from this site: https://www.cdc.gov/nhsn/cdaportal/toolkits.html
AU Option FAQs: https://www.cdc.gov/nhsn/faqs/faq-au.html
Thank you!

Catherine Lexau

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