National Healthcare Safety Network (NHSN)
Antimicrobial Use and Resistance (AUR) Reporting and the Standardized Antimicrobial Administration Ratio (SAAR)

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Centers for Disease Control and Prevention

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CDC's Role in Healthcare-Associated Infection (HAI) Surveillance – Some Major Milestones

1957-58
Investigative unit formed to assist hospitals with their responses to outbreaks of antibiotic-resistant staphylococcal infections

1965-66
HAI surveillance pilot projects at six hospitals

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Describe antimicrobial use and resistance (AUR) surveillance via NHSN, focusing on the AU reporting option

Summarize the Standardized Antimicrobial Administration Ratio (SAAR), which is the quantitative centerpiece of NHSN’s new AU measure

Conclude with some next steps for AU surveillance and the NHSN AU measure

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### NHSN: Growth in Facility Participation, 2006-2015

![Graph showing growth in NHSN participation from 2006 to 2015](image)

<table>
<thead>
<tr>
<th>Year</th>
<th>All Healthcare Facilities (Number)</th>
<th>Dialysis Facilities (Number)</th>
<th>Hospitals (Number)</th>
<th>Ambulatory Surgery Centers (Number)</th>
<th>Long Term Care Facilities (Number)</th>
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<td>4,000</td>
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<td>9,000</td>
<td>4,000</td>
<td>5,000</td>
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<td>9,000</td>
<td>10,000</td>
<td>4,500</td>
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<td>10,000</td>
<td>11,000</td>
<td>5,000</td>
<td>6,000</td>
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</table>

### CDC Reports Hospital-Specific HAI Event Data to the Centers for Medicare and Medicaid Services (CMS)

<table>
<thead>
<tr>
<th>HAI Event</th>
<th>Hospital Type</th>
<th>Start Date</th>
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</thead>
<tbody>
<tr>
<td>CLABSI</td>
<td>Acute Care Hospitals - ICU</td>
<td>2013</td>
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<tr>
<td></td>
<td>Long Term Care Hospitals</td>
<td>2014</td>
</tr>
<tr>
<td></td>
<td>Surgical Hospitals</td>
<td>2015</td>
</tr>
<tr>
<td></td>
<td>All Other Hospitals</td>
<td>2016</td>
</tr>
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<td>CAUTI</td>
<td>Acute Care Hospitals - ICU</td>
<td>2013</td>
</tr>
<tr>
<td></td>
<td>Long Term Care Hospitals</td>
<td>2014</td>
</tr>
<tr>
<td></td>
<td>Surgical Hospitals</td>
<td>2015</td>
</tr>
<tr>
<td></td>
<td>All Other Hospitals</td>
<td>2016</td>
</tr>
<tr>
<td>SSTI - skin and subacute</td>
<td>Acute Care Hospitals - ICU</td>
<td>2013</td>
</tr>
<tr>
<td>abdominal infection</td>
<td>Long Term Care Hospitals</td>
<td>2014</td>
</tr>
<tr>
<td></td>
<td>Surgical Hospitals</td>
<td>2015</td>
</tr>
<tr>
<td></td>
<td>All Other Hospitals</td>
<td>2016</td>
</tr>
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<td>MRSA Bacteremia LabID Event</td>
<td>Acute Care Hospitals - ICU</td>
<td>2013</td>
</tr>
<tr>
<td></td>
<td>Long Term Care Hospitals</td>
<td>2014</td>
</tr>
<tr>
<td></td>
<td>Surgical Hospitals</td>
<td>2015</td>
</tr>
<tr>
<td></td>
<td>All Other Hospitals</td>
<td>2016</td>
</tr>
<tr>
<td>C. Difficile LabID Event</td>
<td>Acute Care Hospitals - ICU</td>
<td>2013</td>
</tr>
<tr>
<td></td>
<td>Long Term Care Hospitals</td>
<td>2014</td>
</tr>
<tr>
<td></td>
<td>Surgical Hospitals</td>
<td>2015</td>
</tr>
<tr>
<td></td>
<td>All Other Hospitals</td>
<td>2016</td>
</tr>
<tr>
<td>Ventilator-Associated Event</td>
<td>Acute Care Hospitals - ICU</td>
<td>2013</td>
</tr>
<tr>
<td></td>
<td>Long Term Care Hospitals</td>
<td>2014</td>
</tr>
<tr>
<td></td>
<td>Surgical Hospitals</td>
<td>2015</td>
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<tr>
<td></td>
<td>All Other Hospitals</td>
<td>2016</td>
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### Antimicrobial Use and Resistance (AUR) Module – The Basics

- Designed to support healthcare and public health efforts to:
  1. Monitor and improve antimicrobial prescribing
  2. Identify, understand, and respond to antimicrobial resistance patterns or trends
- Provides a common set of technical specifications and a single surveillance platform for hospitals to report AU and AR data
- All data must be submitted electronically to the AUR Module
- Data that are successfully transmitted are available immediately to NHSN users for analysis and visualization
- Summary data provide AU and AR benchmarks that hospitals, healthcare systems, and public health agencies can use for comparative purposes and as a guide for further analysis and action

### NHSN AU Reporting Option: Operational Overview

#### Participation:
- General acute care hospitals, long-term acute care hospitals, inpatient rehabilitation facilities, oncology hospitals, critical access hospitals

#### Data Sources:
- Electronic Medication Administration Record (eMAR) or Bar Coding Medication Administration (BCMA) systems for AU data
- Admission/Discharge/Transfer (ADT) systems for patient location data

#### Monthly Numerator Data:
- Antimicrobial days/Day of therapy for a specified antimicrobial agent administered in a patient care location
- 89 antimicrobials are in scope - Antibacterial, antifungal, and anti-influenza agents, stratified by route of administration (intravenous, intramuscular, digestive, and respiratory)

#### Monthly Denominator Data:
- Days present/Number of patients in a specific location or facility, per day, aggregated for a monthly total
- Admissions/Number of patients admitted to the hospital

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Robert Wachter

“...the measurement fad has spun out of control..." We need more targeted measures, ones that have been vetted to ensure they really matter... for example, measuring the rates of certain hospital-acquired infections has led to greater emphasis on prevention and has most likely saved lives.


[Image of Robert Wachter]
Interpreting SAAR values
SAAR values are always greater than 0, and a value of 1.0 suggests equivalency between observed and predicted AU.

4. A high SAAR (above 1.0) that achieves statistical significance (i.e., different from 1.0) may indicate excessive AU
5. A low SAAR (below 1.0) that achieves statistical significance (i.e., different from 1.0) may indicate antimicrobial underuse

Note: A SAAR above 1.0 that does not achieve statistical significance may be associated with excessive AU and warrant further investigation. Also, a SAAR that differs statistically from 1.0 does not assure that further investigation will be productive.

AU Data Flow From Bedside to NHSN
- Extract, transform and load AU data by means of a vendor or homegrown IT solution
- Monthly summary data
- Days present and admissions
- Submit AU data using standard file format
- NHSN servers

AU Option – NHSN Analysis Output Options
- Basic analysis output options available
  - Line lists
  - Rate tables
  - Pie charts
  - Bar charts
  - SAAR (Standardized Antimicrobial Administration Ratio)

NHSSN Patient Care Locations for SAAR calculations
- The NHSSN AU Measure is comprised of 16 SAARs, each of which summarizes AU for a specified combination of patient care locations and antimicrobial agents.
- The patient care locations are:
  1. Adult medical, surgical, and medical/surgical intensive care units
  2. Adult medical, surgical, and medical/surgical wards
  3. Pediatric medical, surgical, and medical/surgical intensive care units
  4. Pediatric medical, surgical, and medical/surgical wards
  5. All adult medical, surgical, and surgical intensive care units and wards
  6. All pediatric medical, medical/surgical, and surgical intensive care units and wards

Standardized Antimicrobial Administration Ratio (SAAR) – The Basics
- The SAAR is the quantitative linchpin of the NHSSN AU Measure; it summarizes AU in the form of an observed-to-predicted ratio.
  - Numerator: Days of therapy reported by a healthcare facility for a specified category of antimicrobial agents used in a patient care location or group of locations
  - Denominator: Days of therapy predicted for a healthcare facility use of a specified category of antimicrobial agents in a patient care location or group of locations, calculated by applying negative binomial regression modeling to nationally aggregated AU data
- SAAR values can serve as a starting point for medication use evaluations by antimicrobial stewardship programs, but SAAR values are not definitive measures of judiciousness or appropriateness

Antibacterial Agent Categories Used for SAAR Calculations
High value targets for antimicrobial stewardship programs:
1. Broad spectrum agents predominantly used for hospital-onset/multi-drug resistant bacteria (e.g., ceftazidime, cefepime, colistimethate sodium, amikacin, meropenem, imipenem/cilastatin, ertapenem, some cephalosporins, some fluoroquinolones, and some aminoglycosides)
2. Antimicrobial agents predominantly used for community-acquired infection (e.g., trimethoprim/sulfamethoxazole, ceftaroline, ceftazidime, cefepime, ceftriaxone, and some carbapenems)
3. Agents predominantly used for surgical site infection prophylaxis (e.g., cefazolin, cefuroxime, and some lactic acid bunches)
4. Agents predominantly used for hospital-onset infection (e.g., vancomycin, daptomycin, and some carbapenems)

High level indicators for antimicrobial stewardship programs:
5. All antibacterial agents included in NHSSN AUR protocol
NHSN AU Measure – SAARs for High Value Targets
SAARs for broad spectrum antibacterial agents predominantly used for hospital-onset/multi-drug resistant infections:
1. Adult medical, medical/surgical, and surgical ICUs
2. Adult medical, medical/surgical, and surgical wards
3. Pediatric medical, medical/surgical, and surgical ICUs
4. Pediatric medical, medical/surgical, and surgical wards

SAARs for broad spectrum antibacterial agents predominantly used for community-acquired infections:
5. Adult medical, medical/surgical, and surgical ICUs
6. Adult medical, medical/surgical, and surgical wards
7. Pediatric medical, medical/surgical, and surgical ICUs
8. Pediatric medical, medical/surgical, and surgical wards

SAARs for anti-MRSA antibacterial agents:
9. Adult medical, medical/surgical, and surgical ICUs
10. Adult medical, medical/surgical, and surgical wards
11. Pediatric medical, medical/surgical, and surgical ICUs
12. Pediatric medical, medical/surgical, and surgical wards

SAARs for antibacterial agents predominantly used for surgical site infection prophylaxis:
13. Adult ICUs and wards (medical, medical/surgical, and surgical)
14. Pediatric ICUs and wards (medical, medical/surgical, and surgical)

NHSN AU Measure – High Level Indicator SAARs
SAARs for all antibacterial agents:
15. Adult ICUs and wards (medical, medical/surgical, and surgical)
16. Pediatric ICUs and wards (medical, medical/surgical, and surgical)

SAAR Predictive Models Include Hospital and Patient Location Variables
Broad Spectrum Agents: Predominantly Used for Hospital-Onset/Multi-drug resistant infections
- ICU: 4-way location-type variable (Levels: Medical Unit, Medical/Surgical Unit, Surgical Unit, Pediatric Unit)
- Teaching Status: ICU, Pediatric Location
- Anti-MRSA: Agents
  - ICU: 4-way location-type variable (Levels: Medical Unit, Medical/Surgical Unit, Surgical Unit, Pediatric Unit)*
  - Interaction Term: ICU and 4-way location-type variable
- Agents: Predominantly Used for Surgical Site Infection Prophylaxis
  - ICU, Surgical Location
- All Agents
  - ICU: 4-way location-type variable (Levels: Medical Unit, Medical/Surgical Unit, Surgical Unit, Pediatric Unit)*

SAAR Output in NHSN*

NHSN SAAR Distributions and Statistical Comparisons – Adult Patients, High Value Targets for Stewardship

NHSN AU Data Submission Metrics
132 hospitals have submitted at least 1 month of AU data from 2011 – 2016*
- From 30 states: AZ, CA, CO, CT, FL, IA, ID, IL, IN, KS, KY, MA, MI, MN, MO, NC, ND, NE, NM, NY, OH, OK, OR, RI, SD, TN, TX, UT, VA, WI
- Hospital bed size: Average = 225, Median = 208, Min/Max = 11, 919
- Teaching hospitals = 61%; Major teaching hospitals = 56%

AU Data from 43 hospitals submitted for calendar year 2014 were used to develop the SAAR predictive models

*NHSN SAAR Distributions and Statistical Comparisons – Adult Patients, High Value Targets for Stewardship

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SAAR Calculation in NHSN*

NHSN SAAR Distributions and Statistical Comparisons – Adult Patients, High Value Targets for Stewardship

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Next Steps for AU Surveillance and the NHSN AU Measure

- Increase hospital participation in the AU reporting option
  - Technical assistance and funding for AU option implementations
  - Collaborations with hospitals and healthcare systems that submit AU data and use the data in their antimicrobial stewardship programs
  - Follow through on federal interagency plans to include AU and AR reporting to NHSN in the Meaningful Use Stage 3 incentive program for electronic health record systems
- Use field experience, additional AU data collection, and systematic studies to enhance the SAAR predictive models
- Work on a second iteration of the NHSN AU Measure that will enable the measure to be used for public reporting and other accountability purposes

Thank You!

Please contact me at dap1@cdc.gov

For more information about NHSN:
http://www.cdc.gov/nhsn