Measurement of Antimicrobial Drug Use

Elizabeth Dodds Ashley, PharmD, MHS, FCCP, BCPS
DASON Liaison Pharmacist
Defined Daily Dose

• **Target Audience: Administrators and Epidemiologists**
  - Standardized definition of daily antibiotic dose
  - Created by the World Health Organization
  - Correction factor: Total Units (i.e. mg) Drug

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**DDD Correction Factor**

• **Pros:**
  - Attempts to convert raw purchasing data into utilization data
  - Allows comparisons with other institutions
  - Easy to calculate

• **Cons:**
  - Not everyone agrees with the DDD correction factors
  - Many use institution-specific correction factors (prescribed daily dose)
  - Not patient level information
<table>
<thead>
<tr>
<th>ATC code</th>
<th>Name</th>
<th>DDD</th>
<th>U</th>
<th>Adm.R</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>J01CR05</td>
<td>piperacillin and enzyme inhibitor</td>
<td>14</td>
<td>g</td>
<td>P</td>
<td>Refers to piperacillin</td>
</tr>
</tbody>
</table>

List of abbreviations

Last updated: 2009-10-27

http://www.whocc.no/atc_ddd_index/
Days of Therapy (AKA Antimicrobial Days)

- Aggregate sum of days for which any amount of specific antimicrobial agent was administered to individual patients

- Obtained from electronic medication administration record (eMAR) or bar code medication administration (BCMA) data
DDD vs. DOT
(Defined Daily Dose vs Days of Therapy)

**DDD**
- **Pros:**
  - Standard comparisons using aggregate utilization data
  - Will change estimate of drug use if high doses are used, but standard is not changed
- **Cons:**
  - Not a surrogate for DOT when dose is different than standard:
    - Cannot be used for: children, renal dysfunction
  - DDD can change with time

**DOT**
- **Pros:**
  - Can be used in children
  - Not influenced by changes in the DDD standards
  - Not subject to differences in institutional preference
  - Patient-specific information
- **Cons:**
  - Overestimates use for drugs given multiple times per day
  - More difficult to measure without computerized records

Getting to the bottom of the problem....

- Measures of antibiotic use are difficult to interpret and compared when examined alone

\[
\text{DDD} \\
\text{DOT} \\
\text{Cost}
\]

\[
\]

A denominator is needed to standardize measurement of antibiotic use!
Available Denominators for Measuring Antibiotic Use

- **Admissions:**
  - CDC Definition: The aggregate number of patients admitted to the facility starting on the first day of each month through the end of the calendar month

- **Patient Days:**
  - CDC Definition: A daily count of the number of patients in the patient care location during a time period. To calculate patient days, for each day of the month, at the same time each day, record the number of patients.

- **Days Present:**
  - CDC Definition: number of patients present in a given location for any portion of any day
SO WE HAVE DATA - WHAT DO WE DO NEXT?
Find Out What Others are Doing: Example Benchmark Data

Facility-wide Antimicrobial Use
DASON Benchmark: 885

- DOT per 1,000 Patient Days
- Hospitals 1 to 15
- Categories: Anti-bacterial, Anti-fungal, Anti-viral, Miscellaneous

DukeMedicine
DASON
Duke Antimicrobial Stewardship Outreach Network
What will we do with standardized data?
US Benchmarking Efforts

CDC- Antimicrobial Use and Resistance module
Objective: The primary objective of Antimicrobial Use option is to facilitate risk-adjusted inter- and intra-facility benchmarking of antimicrobial usage.

– Secondary objective: to evaluate trends of antimicrobial usage over time at the facility and national levels.

Primary metric: antimicrobial days/ 1000 days present

Data source: electronic MAR (with or without barcode medication administration)
But what about differences between facilities?

• National efforts underway to standardize antibiotic use in acute care hospitals
  – Similar to Standardized Infection Ratio (SIR) for US
    • Summary measure used to track HAIs
    • Summary statistic that compares a rate to baseline US experience adjusting for known risk factors
  – Proposed measure is Standardized Antibiotic Administration Ratio (SAAR)
    • Compares actual to expected antibiotic use after controlling for facility-level factors
Standardized Antibiotic Administration Ratio (SAAR)

SAAR = \frac{\text{Observed (O) Antimicrobial Use}}{\text{Predicted (P) Antimicrobial Use}}

- Predicted - Calculated by CDC based on predictive models based on nationally aggregated AU data
- Calculated for 5 different drug categories
- 4 different patient care locations
  - Adult/Pediatric medical, medical/surgical and surgical ICUs
  - Adult/Pediatric medical, medical/surgical and surgical wards
Antibiotic Groupings

- **Broad spectrum agents for hospital-onset/multi-drug resistant infections**
  - Amikacin, aztreonam, cefepime, ceftazidime, ceftazidime/avibactam, ceftolozane/tazobactam, colistimethate, doripenem, gentamicin, imipenem/cilastatin, meropenem, piperacillin, piperacillin/tazobactam, polymixin B, ticarcillin/clavulanate, tigecycline, tobramycin

- **Broad spectrum agents predominantly used for community-acquired infections**
  - Cefotaxime, ceftriaxone, ciprofloxacin, ertapenem, gemifloxacin, levofloxacin, moxifloxacin

- **Anti-MRSA agents**
  - Ceftaroline, dalbavancin, daptomycin, linezolid, oritavancin, quinupristin/dalfopristin, tedizolid, telavancin, vancomycin

- **Agents for surgical site infection prophylaxis**
  - Cefazolin, cefotetan, cefoxitin, cefuroxime, cephalexin

- **All agents**
Locations Included

• Broad spectrum agents for hospital-onset and community acquired, anti-MRSA agents
  • 1. adult medical, medical/surgical, and surgical ICU’s
  • 2. adult medical, medical/surgical and surgical wards
  • 3. pediatric medical, medical/surgical and surgical ICU’s
  • 4. pediatric medical, medical/surgical and surgical wards
• Surgical prophylaxis and ALL antibacterials
  • 1. adult ICUs and wards
  • 2. pediatric ICUs and wards
### Example Data

**National Healthcare Safety Network**

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

As of April 18, 2016 at 4:11 PM

Date Range: All AU_SAAR

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**All antimicrobials used in adult ICUs and wards**

<table>
<thead>
<tr>
<th>orgID</th>
<th>summaryYQ</th>
<th>SAARType</th>
<th>antimicrobialDays</th>
<th>numAUDaysPredicted</th>
<th>numDaysPresent</th>
<th>SAAR</th>
<th>SAAR_pval</th>
<th>SAAR95CI</th>
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Includes data for January 2014 and forward.

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

Source of aggregate data: 2014 NHEM AU Data

Data contained in this report were last generated on March 15, 2016 at 10:32 AM.

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Slide courtesy of Amy Webb, CDC
Directing Interventions

National Healthcare Safety Network
SAARs Table - All Standardized Antimicrobial Administration Ratios (SAARs) High-Level Indicators and High-Value Targets

Antimicrobials used for hospital-onset/multi-drug resistant infections in adult ICUs

<table>
<thead>
<tr>
<th>orgID</th>
<th>summaryYQ</th>
<th>SAARType</th>
<th>antimicrobialDays</th>
<th>numAU/DaysPredicted</th>
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<th>SAAR_pval</th>
<th>SAAR95CI</th>
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</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 March 15, 2016 at 10:33 AM.

Slide courtesy of Amy Webb, CDC
Making Better use of Your Time

<table>
<thead>
<tr>
<th>orgID</th>
<th>summaryYQ</th>
<th>SAARType</th>
<th>antimicrobialDays</th>
<th>numAIDsPredicted</th>
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<th>SAAR_pval</th>
<th>SAAR95CI</th>
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</table>

Includes data for January 2014 and forward.
Data restricted to medical, medical/surgical and surgical locations.
Source of aggregate data: 2014 NAISN AU Data
Data contained in this report were last generated on March 15, 2015 at 10:35 AM.

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NHSN Output

SAARs by Quarter and Location, Broad Spectrum Community Onset

SAARs by Quarter and Location, Anti-MRSA Agents

SAARs by Quarter and Location, SSI Prophylaxis Agents
Hospital Inpatient Prospective Payment System
2017 Proposed Rule

• “In the future, we are considering proposing the NHSN Antimicrobial Use measure to advance national efforts to reduce the emergence of antibiotic resistance by enabling hospitals and CMS to assess national trends of antibiotic use to facilitate improved stewardship by comparing antibiotic use that hospitals report to antibiotic use that is predicted based on nationally aggregated data.”
Drill Down: Anti-MRSA Therapy
Drill Down: Daptomycin
.. But there are lots of options

Length of therapy (LOT): number of calendar days in which the selected antimicrobial was received
When divided by the # of patients who received the agent this is a surrogate of duration per patient

Proportions:
% of patients receiving targeted agent
% of all patients receiving any antibiotic who receive the targeted agent
DOT vs LOT

| Criteria | Required | Query | Date range | Filters | Save | Execute |

<table>
<thead>
<tr>
<th>Hospital Id</th>
<th>Patient Id</th>
<th>Admission Id</th>
<th>Gender</th>
<th>Admission Date</th>
<th>Clinical Service</th>
<th>First Admin</th>
<th>Days of Therapy</th>
<th>Length of Therapy</th>
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<tbody>
<tr>
<td>1000</td>
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## Examples of Using Alternate Metrics Data

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<thead>
<tr>
<th>Metric</th>
<th>Numerator</th>
<th>Denominator</th>
<th>Rate</th>
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<tbody>
<tr>
<td>Daptomycin use in DOT/1000 patient days</td>
<td>714</td>
<td>72.35 DOT 1K Patient Days</td>
<td>9.87%</td>
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<tr>
<td>% of patient admissions in which daptomycin was given</td>
<td></td>
<td></td>
<td>0.57%</td>
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<tr>
<td>% of antimicrobial admissions in which daptomycin was given</td>
<td></td>
<td></td>
<td>0.95%</td>
</tr>
<tr>
<td>LOT/Admission in which daptomycin was given</td>
<td>714</td>
<td>149 LOT Admissions</td>
<td>4.79%</td>
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</tbody>
</table>
## Using Alternate Metrics for Action

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>Vancomycin use in DOT/1000 patient days</td>
<td>7,565</td>
<td>72.35 DOT 1K Patient Days</td>
<td>104.56</td>
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<tr>
<td>% of patient admissions in which vancomycin was given</td>
<td>11.13%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>% of antimicrobial admissions in which vancomycin was given</td>
<td>18.74%</td>
<td></td>
<td></td>
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<tr>
<td>LOT/Admission in which vancomycin was given</td>
<td>7,565</td>
<td>2,487 LOT Admissions</td>
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<td>72.35 DOT 1K Patient Days</td>
<td>104.56</td>
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<tr>
<td>% of patient admissions in which vancomycin was given</td>
<td>7%</td>
<td></td>
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<td>% of antimicrobial admissions in which vancomycin was given</td>
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<td>7,565</td>
<td>1,244 LOT Admissions</td>
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</table>
Making the Data Actionable

- Data alone will not answer all the questions, but allows more refined reviews
  - Who?- Who is writing for the antibiotics?
  - What?- What is the most frequently used antibiotic?
  - Where?- Are there units that tend to use the most antibiotics?
  - When?- Are there times when antibiotics are most likely to be prescribed?
  - Why? - What is the most common reason antibiotics are used?
- From there
  - Conversations become more productive
  - Guidelines for use can be created with provider input
  - Remember- always ask why- the reasons behind the use might not be what you had guessed!
Conclusions

• There are many different ways to measure antibiotic use, each with distinct advantages and disadvantages.

• Important considerations when selecting a metric include:
  – Institutional vs. patient-level data
  – Desire to externally benchmark antibiotic use
  – Availability of data and ease of access

It is important to have some measure of antibiotic use:
  “Don’t just count your antibiotics, make your antibiotic counting count”