Antimicrobial Stewardship Programs: Are We Measuring Up to Our Full Potential?

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Disclosure

**Susan Davis**
Allergan: Advisory Board, Speaker’s Bureau; The Medicines Company: Advisory Board; Zavante: Advisory Board

**Elizabeth Dodds Ashley**
HANYS: Consultant; SHEA: Speaker’s Bureau

All other planners, presenters, and reviewers of this session report no financial relationships relevant to this activity.
Objectives

• Evaluate strategies to achieve programmatic compliance with current regulatory requirements
• Recommend appropriate analyses to measure antimicrobial consumption
• Interpret the effect of ASP initiatives on clinical outcomes
Measuring up

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Pharmacist Liaison
Duke Antimicrobial Stewardship
Outreach Network (DASON)
MEASURING UP

How to achieve compliance with regulatory mandates
IS STEWARDSHIP REQUIRED?
Our Marching Orders: National Action Plan

Specific goals:

- Within 3 years:
  - Condition of participation from CMS in line with CDC Core Elements of Hospital Antibiotic Stewardship Programs

- By 2020:
  - Establishment of antibiotic stewardship programs in all acute care hospitals and improved antibiotic stewardship across all healthcare settings.
  - Reduction of inappropriate antibiotic use by 50% in outpatient settings and by 20% in inpatient settings.
So, where are we today?
Current State Stewardship Mandates

• **California (SB-1311)**
  
  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.

• **Missouri (MO-SB579)**
  
  Additionally, this legislation requires Missouri hospitals and ambulatory surgical centers to establish antimicrobial stewardship programs for surveillance of use and resistance of certain antibiotics by Aug. 28, 2017. Mental health facilities are excluded from the antibiotic stewardship requirement. When federal Stage 3 “meaningful use” regulations take effect, hospitals and ambulatory surgical centers will report through the NHSN Antimicrobial Use and Resistance Module. Hospitals can learn more about establishing an effective antibiotic stewardship program by reviewing resources from the Centers for Disease Control and Prevention.

https://gis.cdc.gov/grasp/psa
Key Policy Developments in Stewardship

- July 2015: CMS released revised Conditions of Participation for nursing homes that include a requirement for stewardship programs.
- December 2015: The Joint Commission (TJC) issued proposed accreditation standards requiring antibiotic stewardship programs in all accredited facilities.
- June 2016: CMS released draft revised Conditions of Participation for nursing homes that include a requirement for stewardship programs.
- January 2017: TJC began surveying on antimicrobial stewardship standards.
- November 2017: Stewardship Requirement for nursing homes take effect.
The stewardship program would be part of the facility’s infection prevention and control program.

- CDC has developed “Core Elements for Antibiotic Stewardship Programs in Long Term Care” to help with implementation.
The Core Elements of Antibiotic Stewardship for Nursing Homes

APPENDIX B
Some are Not Waiting: New TJC Standards

Key Points:
• Fall in the Medication Management Section (MM)
• 8 Elements of Performance:
  • Leadership
  • Staff Education
  • Patient and Family Education
  • Stewardship Team (MD, RPh, IP)
  • CDC Core Elements
  • Protocols
  • Data
  • Action on improvement opportunities
Are we prepared?

Please ask yourself:

• If I work at an institution with no ID MD will I fail?
• Do I have to implement all of the suggested stewardship interventions?

https://www.jointcommission.org/assets/1/18/2017_Organization_SAG.pdf
Frequently Asked Questions

Please take a moment to review any applicable Featured or New FAQs!

- To limit your search to Featured and New FAQs, select the appropriate search options below.
- If your search below does not find the topic you are looking for please complete the standards online.
- For Joint Commission accredited and certified organizations:
  - If you have access to The Joint Commission Connect Login and go to Resources – Standards.
  - If you accessed this page via Resources – Standards Interpretation, close this browser and sub...

Do you want to be alerted to New Standard's FAQs? Sign Up.

The Joint Commission standards are NOT available on this website. The standards are available in print or Commission Resources.
Important Clarifications!

Medication Management (MM) (Hospital and Hospital Clinics / Hospitals)

Antimicrobial Stewardship – Multidisciplinary Team Requirements - Standard MM.09.01.01, EP 4

If an organization does not have an infectious disease physician on the antimicrobial stewardship multidisciplinary team will it receive a Requirement for Improvement (RFI)?

This depends on the availability of infectious disease physicians to serve in this capacity. The Joint Commission is aware that the composition of this multidisciplinary team may vary based on the type of organization being surveyed as well as the geographic location of the organization. This is the reason MM.09.01.01, EP 4 indicates that the four practitioners listed should be on the multidisciplinary team “when available in the setting.” However, it would not be acceptable for an organization to have a team consisting of only a pharmacist and a nurse when physicians and other licensed independent practitioners are available in the organization (e.g., an infectious disease consultation team exists).

Note: Some organizations such as critical access hospitals and nursing care centers may not have the Medication Management System Tracer. In these cases, antimicrobial stewardship will be evaluated during other scheduled activities, such as Orientation to the Organization, Data Use System Tracer, and Individual Patient Tracers.
Helpful Tool

Medication Management (MM) (Hospital and Hospital Clinic)

Antimicrobial Stewardship – Core Element Documentation - Standard MM.09.01.01 EP 5

What type of documentation is needed for MM.09.01.01 EP 5, the required core program?

The organization needs to have a document indicating how each core element is addressed. This information can be located in a separate document or can be included in other MM.09.01.01, EP 1). This documentation does not have to be provided in a length of elements are addressed in the antimicrobial stewardship program.

Checklist for Core Elements of Hospital Antibiotic Stewardship Programs

The following checklist is a companion to Core Elements of Hospital Antibiotic Stewardship Programs. This checklist should be used to systematically assess key elements and actions to ensure optimal antibiotic prescribing and limit overuse and misuse of antibiotics in hospitals. CDC recommends that all hospitals implement an Antibiotic Stewardship Program.

Facilities using this checklist should involve one or more knowledgeable staff to determine if the following principles and actions to improve antibiotic use are in place. The elements in this checklist have been shown in previous studies to be helpful in improving antibiotic use though not all of the elements might be feasible in all hospitals.

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<thead>
<tr>
<th>LEADERSHIP SUPPORT</th>
<th>ESTABLISHED AT FACILITY</th>
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<tbody>
<tr>
<td>A. Does your facility have a formal, written statement of support from leadership that supports efforts to improve antibiotic use (antibiotic stewardship)?</td>
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<tr>
<td>B. Does your facility receive any budgeted financial support for antibiotic stewardship activities (e.g., support for salary, training, or IT support)?</td>
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<table>
<thead>
<tr>
<th>ACCOUNTABILITY</th>
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<tbody>
<tr>
<td>A. Is there a physician leader responsible for program outcomes of stewardship activities at your facility?</td>
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https://www.cdc.gov/getsmart/healthcare/pdfs/checklist.pdf
https://www.jointcommission.org/standards_information/jcfqa.aspx?ProgramId=5&ChapterId=76&IsFeatured=False&IsNew=False&Keyword=
Important Clarifications

Medication Management (MM) (Hospital and Hospital Clinics / Hospitals)

Antimicrobial Stewardship – Education Requirements for Staff and Licensed Independent Practitioners - Standard MM.09.01.01 EP 2

Will Joint Commission surveyors review human resource records and medical staff credentialing and privileging records to determine if antimicrobial resistance and antimicrobial stewardship education was provided by the organization?

Joint Commission surveyors will not be reviewing staff or medical staff/licensed independent practitioner records on education received regarding antimicrobial resistance and antimicrobial stewardship. Joint Commission surveyors will inquire about the type of education provided by the organization during the Medication Management System Tracer (or other system tracers). During patient tracers, surveyors may ask staff and licensed independent practitioners about the education they have received. Providing written material such as the organization’s antibiogram will meet the educational requirement of MM.09.01.01, EP 2.
Important Clarifications - Examples are Examples

Medication Management (MM) (Hospital and Hospital Clinics / Hospitals)

Antimicrobial Stewardship – Improvement Opportunities - Standard MM.09.01.01 EP 8
Are there any specific improvement opportunities that surveyors will look for regarding the organization’s antimicrobial stewardship program?

Do organize:

Medication Management (MM) (Hospital and Hospital Clinics / Hospitals)

Antimicrobial Stewardship – Multidisciplinary Protocol Requirements - Standard

The exam requirement

Medication Management (MM) (Hospital and Hospital Clinics / Hospitals)

Antimicrobial Stewardship - Examples - Standard MM.09.01.01 EPs 1, 3, 5, 6, and 7
When examples are provided within an EP, are these example considered to be part of the requirement?

No. The examples that are provided in EPs 1, 3, 5, 6, and 7 are not Joint Commission requirements and are provided to assist organizations during their review of the antimicrobial stewardship standard based on the care, treatment, and services provided.
Is Reporting to the NHSN AU Option Required?

**Medication Management (MM) (Hospital and Hospital Clinics / Hospitals)**

**Antimicrobial Stewardship – Data Collection, Analysis, and Reporting - Standard MM.09.01.01 EP 7**

What type of antimicrobial stewardship data should organizations collect, analyze, and report?

The Joint Commission is not requiring any specific antimicrobial stewardship data in Standard MM.09.01.01. The organization must determine the antimicrobial stewardship data it will collect, analyze, and report. The CDC’s Core Elements of Hospital Antibiotic Stewardship Programs at [https://www.cdc.gov/getsmart/healthcare/pdfs/core-elements.pdf](https://www.cdc.gov/getsmart/healthcare/pdfs/core-elements.pdf) and The Core Elements of Antibiotic Stewardship for Nursing Homes at [https://www.cdc.gov/longtermcare/prevention/antibiotic-stewardship.html](https://www.cdc.gov/longtermcare/prevention/antibiotic-stewardship.html) provide examples of measures that can be used to collect antimicrobial stewardship data and should be considered by organizations.

Additionally, the National Quality Partners Playbook on Antibiotic Stewardship in Acute Care provides examples of basic, intermediate, and advanced measures. ([http://www.qualityforum.org/Publications/2016/05/National_Quality_Partners_Playbook_Antibiotic_Stewardship_in_Acute_Care.aspx](http://www.qualityforum.org/Publications/2016/05/National_Quality_Partners_Playbook_Antibiotic_Stewardship_in_Acute_Care.aspx))
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)
Standardized Antibiotic Administration Ratio (SAAR)

SAAR = Observed (O) Antimicrobial Use / 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
NQF: Endorsed Measure

• April 2015:
  – Locations categories
    • Adult and pediatric
    • ICU and ward
  – Agent categories
    • Broad spectrum gram negative agents
      – Primarily active against community pathogens
      – Primarily active against hospital pathogens
    • Anti-MRSA agents
    • Agents primarily for surgical prophylaxis
    • All antibiotics
  – Includes plans to standardized (stay tuned!)
List of Measures under Consideration for December 1, 2015

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<th>MUC15-531</th>
<th>National Healthcare Safety Network (NHSN) Antimicrobial Use Measure</th>
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<td>Numerous individual studies and systematic reviews provide strong evidence that measurement of antimicrobial use and data-driven interventions by antimicrobial stewardship programs (ASPs) lead to more judicious use of antibiotics, reduced antimicrobial resistance, and other favorable healthcare outcomes (Feazel 2014; Davey 2006; Davey 2013; Kaki 2011). Antimicrobial use measurement enables ASPs to understand prescribing practices, focus efforts on improvement, and determine the impact of their activities (Pollack, 2014). Although standardized metrics have been developed to measure antibiotic use, differences in measurement, limited uptake, and variation among facilities have impeded the ability to compare antibiotic use among hospitals. The measure will serve as a quantitative guide for hospital and health system ASPs, enabling them to benchmark antibiotic use in their facilities and patient care locations against nationally aggregated data. The measure focuses on antibiotic agents that have been shown to be high value targets for antimicrobial stewardship programs activities such as protocols for use or post-prescription reviews to determine need for de-escalation, dose-optimization or oral conversion. Knowledge about antibiotic use patterns of these agents is a primary means to prioritize and evaluate antimicrobial stewardship efforts.</td>
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Why Is This Important?

• The items on the Measures Under Consideration list are the ones that CMS is considering making part of some type of reporting and/or payment program.
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.
Meaningful Use Stage 3

NHSN Meaningful Use Overview

Some are Not Waiting: New Incentives for Stewardship

• Starting in 2016, Anthem Healthcare added compliance with the CDC Core Elements to its Hospital Quality Incentive Program- more than 1000 hospital eligible.

• The Leapfrog Group is adding questions on CDC Core Elements to their annual survey.
  – Important influence for many C-suites.
# Leapfrog Scores

Select up to 3 hospitals to compare:

<table>
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<tr>
<th>Remove Comparison</th>
<th>Steps to Avoid Harm</th>
<th>Never Events Management</th>
<th>Appropriate Use of Antibiotics in Hospitals</th>
<th>Specially trained doctors care for ICU patients</th>
<th>Readmissions for Common Acute Conditions</th>
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<td>University of North Carolina Hospitals</td>
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<td>Chapel Hill, North Carolina</td>
<td>MORE DETAILS</td>
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</tbody>
</table>

http://www.leapfroggroup.org/compare-hospitals
Key Takeaways

• **Key Takeaway #1**
  – Antimicrobial stewardship is an essential component of preventing antibiotic resistance

• **Key Takeaway #2**
  – There is currently no national mandate for antimicrobial stewardship, but several states and other agencies are already requiring proof of a program

• **Key Takeaway #3**
  – It is important for the stewardship team to stay current with proposed and pending regulations- it is a rapidly shifting landscape
Setting a standard

N. Jim Rhodes, Pharm.D., M.Sc., BCPS
Assistant Professor of Pharmacy Practice
Midwestern University, Chicago College of Pharmacy
Infectious Diseases Pharmacist
Northwestern Memorial Hospital
Reporting trends in antimicrobial consumption

SETTING A STANDARD
Why measure antimicrobial consumption?

• Many good reasons, not the least of which is...
The Joint Commission says it’s important

• Medication Management
  – Standard MM.09.01.01
    • Elements for Performance (EP):

• Hospitals with Antimicrobial stewardship programs (ASPs):
  – EP 5 Include core elements
    • Tracking and reporting utilization
  – EP 7 Collect and analyzes data
    • Example: use and resistance
  – EP 8 Act on improvement
Measuring Consumption

• Consumption metrics
  – Defined daily doses (DDD)
  – Days of therapy (DOT)

• Metric standardization
  – Some measure of occupancy or facility size
  – Should capture number “at-risk”

Metric = DDD or DOT x 1000
At-risk days

World Health Organization Collaborating Center for Drug Statistics Methodology. [http://wwwwhoccno/atc_ddd_index](http://wwwwhoccno/atc_ddd_index)
Counting the doses and days

• Knowledge of data sources is essential
  – Where and when are the doses being given?
  – How are the at-risk bedded days counted?
Approach #1:

CORRECT CLASSIFICATION THRESHOLDS
Question 1:
Which of the following will have the largest effect on the positive predictive for an event with a baseline incidence rate of ~10%?

A. Sensitivity increased 5%
B. Specificity increased 5%
C. Incidence increased 5%
D. Incidence decreased 5%
SO YOU HAVE DATA, NOW WHAT?
Is consumption out of control?

• Establishing consumption thresholds
  – Antimicrobial steward reviews consumption data...
    • Asks “Is my antibiotic use out of control (OOC)?”
    • Candidate thresholds can be used to classify whether or not use is OOC

<table>
<thead>
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<th>OOC</th>
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<th>Row Total</th>
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<tbody>
<tr>
<td>Use ≥ Threshold</td>
<td>A – true pos</td>
<td>B – false neg</td>
<td>PPV=A/A+B</td>
</tr>
<tr>
<td>Use &lt; Threshold</td>
<td>C – false neg</td>
<td>D – true neg</td>
<td>NPV=D/D+C</td>
</tr>
<tr>
<td>Column Total</td>
<td><strong>Sens=A/A+C</strong></td>
<td><strong>Spec=D/D+B</strong></td>
<td>OOC Incidence</td>
</tr>
</tbody>
</table>

PPV = Positive Predictive Value
NPV = Negative Predictive Value
Sens = Sensitivity
Spec = Specificity
Is consumption really out of control?

- Establishing consumption thresholds
  - **Predictive value** of threshold depends on the OOC incidence rate
  - Should prompt deeper look into how/why agents are being used

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<td>Sens=A/A+C</td>
<td>Spec=D/D+B</td>
<td>OOC Incidence</td>
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</tbody>
</table>
Time for a reality check?

- Establishing consumption thresholds
  - Classical detection limits for type I and II error: 5% and 20%

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</thead>
<tbody>
<tr>
<td>Use ≥ Threshold</td>
<td>A – 10 month</td>
<td>B – 17 months</td>
<td>27 months; PPV~37%</td>
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<tr>
<td>Use &lt; Threshold</td>
<td>B – 0 month</td>
<td>D – 69 months</td>
<td>78 months; NPV&gt;99%</td>
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<tr>
<td>Column Total</td>
<td>10 months; Sens: 95%</td>
<td>86 months; Spec: 80%</td>
<td>OOC: 10/96 months (10.4%)</td>
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Time for a reality check?

- Establishing consumption thresholds
  - What if we **required higher** specificity from the candidate threshold?

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<tr>
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<td>A – 9 months</td>
<td>B – 4 months</td>
<td>13 months; PPV=69%</td>
</tr>
<tr>
<td>Use &lt; Threshold</td>
<td>B – 1 month</td>
<td>D – 82 months</td>
<td>83 months; NPV=99%</td>
</tr>
<tr>
<td>Column Total</td>
<td>10 months; Sens: 90%</td>
<td>86 months; <strong>Spec: 95%</strong></td>
<td>OOC: 10/96 months (10.4%)</td>
</tr>
</tbody>
</table>
Time for a reality check?

• Establishing consumption thresholds
  – What if we **accepted a less sensitive** but **more specific** threshold?

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<tbody>
<tr>
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<td>A – 7 months</td>
<td>B – 4 months</td>
<td>11 months; PPV=64%</td>
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<td><strong>Use &lt; Threshold</strong></td>
<td>B – 3 month</td>
<td>D – 82 months</td>
<td>85 months; NPV=96%</td>
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<td><strong>Column Total</strong></td>
<td>10 months; Sens: 70%</td>
<td>86 months; Spec: 95%</td>
<td>OOC: 10/96 months (10.4%)</td>
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</table>
Choosing candidate thresholds

• Maximization of sensitivity of threshold value
  – Improves negative predictive value (NPV) at a fixed incidence
• Maximization of specificity of threshold value
  – Improves positive predictive value (PPV) at a fixed incidence
• Considerations for successful use of this approach:
  – Knowledge of underlying incidence for out of control use needed
  – Access to near real-time consumption data to investigate required
Approach #2:

ESTABLISHING LONGITUDINAL CONSUMPTION THRESHOLDS
Question 2:
Which of the following best describes the 95% CI?

A. Interval wherein 95/100 predictions of consumption will fall
B. Interval wherein 95/100 predictions of mean consumption will fall
C. Interval wherein mean consumption exists 95% of the time
D. Interval wherein consumption observations will fall into 95% of the time in an 8 year review period
HOW MUCH USE IS TOO MUCH?
Looking back to look forward: How much is too much?

- Longitudinal data can be modeled using least squares regression

MICU Linezolid Consumption 2012-2015

Use of Predictive Interval Thresholds

- 80% Predictive interval (PI)
  - Range that should capture 80% of future predictions
- 80% PI requires:
  - SE of the prediction (se_pred)
  - Degrees of freedom
  - Critical t value
    - $$\text{TINV(prob, df=obs-2) \times se\_pred}$$
    - $$\text{UB} = \text{pred} + \text{T-value} \times se\_pred$$
    - $$\text{LB} = \text{pred} - \text{T-value} \times se\_pred$$

## Calculation of Predictive Intervals

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Identifying the “outliers”

Important caveat:
Linear models don’t always work

Facility-wide Oseltamivir Longitudinal Consumption 2012-2015

Facility-wide Oseltamivir Monthly Consumption 2012-2015

Choosing candidate thresholds

• Significant deviation from theoretical population mean
  – Confidence interval approach

• Significant deviation from range of theoretical future values
  – Predictive interval approach

• Considerations for successful use of these approaches:
  – Estimation of underlying trends may require 5-7 years of data
  – Seasonal and cyclical patterns will be poorly predicted
Approach #3

ESTIMATING THE IMPACT OF QUALITY INTERVENTIONS ON CONSUMPTION
Question 3:
Which of the following is a distinct advantage of quasi-experimental studies?

A. They establish whether or not an intervention was effective
B. They accurately estimate intervention’s effect size
C. They are less expensive than randomized controlled trials
D. They are not subject to the biases typical of cohort studies
HOW DO I KNOW IF MY INTERVENTION IS WORKING?
Assessing changes over time

Smoothed 2-month moving average

Piece-wise regression analysis

Moving average (MA)

• Moving average (2-month)
  – Pre/post example
  – Forward MA:
    • Start 2 periods ahead
    • End 2 periods behind
  – Reverse MA:
    • Start 2 periods behind
    • End 2 periods ahead
Piece-wise linear regression

- FORECAST function
  - Least-squares linear regression
  - Pre/post example
    - Pre-intervention
    - Post-intervention
- Piecewise model parameters
  - Estimated using Excel SOLVER
Estimate trends for each period

<table>
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<tr>
<th>Date</th>
<th>Month</th>
<th>Period</th>
<th>Mean-FQ DOT/1000 DP</th>
<th>MA-PRE</th>
<th>MA-POST</th>
<th>MS-PRE</th>
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OLS estimates from Solver:
b0 = 84.5 (base level)
b1 = -1.13 (base trend)
b2 = -2 (Δ level)
b3 = -0.36 (Δ trend)
error = 0.5

b3/b1 x 100 = 32% change

Trend analysis:
P-value pre = 0.296
P-value post = 0.004

\[ Y = b0 + b1 \times \text{time}_{total} + b2 \times \text{period} + b3 \times \text{time}_{post} + \text{error} \]
Evaluating the impact of interventions

• Quasi-experimental and interrupted time series are useful
  – Provide data on performance, though effect sizes less certain
• Piecewise regression analysis can estimate rough “impact”
  – Change in the level by period might be attributable to intervention
• Considerations for successful use of these approaches:
  – Estimation of underlying trends requires at least 12 obs. before/after
  – Adequate control groups / approaches needed
Key Takeaways

• Key Takeaway #1
  – Measuring antimicrobial consumption is a key element of antimicrobial stewardship and essential for meeting Joint Commission Standards

• Key Takeaway #2
  – Consistency in measures recorded over time (e.g., DDD, DOT, NHSN AU days) essential for evaluation of threshold levels for stewardship action

• Key Takeaway #3
  – Quasi-experimental methods can be applied to program interventions using interrupted time series methods but adequate controls required
Making an Impact

Susan L. Davis, Pharm.D.
Clinical Associate Professor
Eugene Applebaum College of Pharmacy and Health Sciences,
Wayne State University
Infectious Diseases Pharmacist
Henry Ford Hospital
Measuring the impact of ASP on clinical outcomes

MAKING AN IMPACT
Goals of Stewardship Programs

- Improve Patient Outcomes
- Improve Patient Safety
- Reduce Antimicrobial Resistance
- Reduce Antimicrobial Expenditures

Is There an Ideal Antibiotic Quality Measure?

- Easy to assess compliance
- Will improve practice, change behavior
- Has no unintended consequences
- Practical for any healthcare setting (acute care, long term care, pediatrics)
- Useful to many audiences
  - Stewardship program staff
  - Clinicians
  - Accreditation/regulatory agencies
So many metrics!

- Antimicrobial consumption
- Appropriateness of therapy
- Time to appropriate therapy
- Documented indication for antimicrobial therapy

Process Measures

- Infection-related mortality
- Length of stay
- Readmission rates
- *Clostridium difficile* rates
- Antimicrobial resistance rates
- Clinical success / cure

Outcomes Measures

Structure Measures

- Components of the stewardship program, e.g. Core Elements


What influences what we measure?

- Expert opinion
- Local preferences, ASP goals
- Ease of measurement
- Regulatory requirements
Leadership Commitment

Action

Drug Expertise

Tracking

Tracking

Reporting

Education

Core Elements?

Match your metrics to your strategies

Stewardship Intervention Examples

Adapted from Moehring RW, Anderson DJ. Curr Infect Dis Rep 2012; 14:592-600

Restrictions
Order Sets

Dose Optimization

Audit reports
Educational programs
Guidelines

Audit and real-time feedback
IV to PO programs
Dose Optimization

Technology-based alerts:
Bug-drug mismatch
de-escalation
Duration of therapy

Active
Provider
Antibiotic prescription
Patient disposition

Passive
Front End
Before Rx

Back End
After Rx

Active
Passive

Active
Passive
## Core Element 4. Action

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<th>Intermediate</th>
<th>Advanced</th>
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<tr>
<td>• Implement policy for formulary restriction/authorization</td>
<td>• Establish antibiotic time-out process</td>
<td>• Implement rapid diagnostics or biomarkers</td>
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<tr>
<td>• Develop order forms, guidelines</td>
<td>• Dosing and IV/PO guidelines</td>
<td>• Implement evidence-based disease state care bundles</td>
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</table>

Core Element 5. Tracking and Monitoring

**Basic**
- Adherence to institutional guidelines
- Acceptance rate for ASP interventions

**Intermediate**
- Resistance for pathogens of interest
- *C. difficile* infections
- Readmission

**Advanced**
- Antibiotic utilization
- Standardized antibiotic administration ratio (SAAR) – NQF endorsed measure

Core Element 6. Reporting

**Basic**
- Reporting of ASP measures for key committees, staff meetings, web-based reports

**Intermediate**
- Reports include suggestions for improvements
- Participate in public reporting
- Present unit-specific data to unit staff

**Advanced**
- Distribute provider-level feedback
- Implement a real-time analytics dashboard

www.qualityforum.org
## Core Strategy: Rationale for Formulary Restrictions

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<th>Representative Example</th>
<th>Goal Supported by Restriction</th>
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<td><strong>ID Restricted + Criteria</strong></td>
<td>Daptomycin, Linezolid</td>
<td>↓ resistance, ↓ cost, ↓ resistance, ↓ cost, ↑ safety</td>
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<tr>
<td><strong>ID Restricted</strong></td>
<td>Polymyxins, Meropenem</td>
<td>↓ resistance, ↑ safety, ↓ resistance</td>
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<tr>
<td><strong>Criteria-Monitored</strong></td>
<td>Aztreonam, Quinolones</td>
<td>↓ resistance, ↓ cost, ↑ outcome, ↓ resistance, ↑ outcome</td>
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<tr>
<td><strong>Unrestricted</strong></td>
<td>Nafcillin, Cefazolin</td>
<td>↑ outcome, ↑ outcome</td>
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</table>

Toxicity, resistance, superinfection, cost; need to preserve efficacy

Question:
What metrics would you choose to monitor the success/failure of antimicrobial formulary restrictions?

A. Antibiotic Days of Therapy
B. Antibiotic Expenditures
C. Adverse Drug Events
D. Guideline Compliance/Appropriate Therapy
Problems with Cost Measures

• Evaluating drug related cost misses the bigger picture of overall length of stay
• Drug prices are not always comparable over time and between institutions
• Economic endpoints should be used to complement other stewardship goals
• Like drug utilization, cost should be adjusted by census
Problems with Antibiotic Consumption

• Heavy restrictions may do more harm than good
  – “restriction” versus “protection”
  – The most expensive antibiotic is the one that doesn’t work
• Never focus on just one drug
  – “Squeezing the balloon”
• Consider measuring and aggregating drugs with a common target or feature
  – e.g. MRSA agents, all quinolones
• Some antibiotic use is necessary! “Zero” is not an appropriate goal!
Using your data: Benchmarks

- There is currently no regulatory or other standard goal for antibiotic use
  - You can set the goal. **The goal cannot be zero**
- Benchmarking allows comparison of use (not appropriateness) across similar institutions
  - High performers may represent best practices
  - Low performers may represent inappropriate prescribing
  - Need to adjust for confounding factors before making assumptions
Problems with Resistance

• Difficult to Measure
• Changes can take a long time
• Confounded by multiple factors (e.g. infection control, community endemicity)
• Breakpoint and testing changes over time can bias results

Most of these same problems also apply to measuring clinical outcomes and safety

Stewardship Improves Patient Outcomes

RCT: Antimicrobial Management Team (with pharmacist) versus Standard of Care (with ID fellows)

OR 7.7 (3.7-16.2)
OR 2.4 (1.3-4.5)
OR 0.5 (0.2-0.9)

- Appropriate therapy
- Clinical Cure
- Clinical Failure

### Guideline Adherence Improves Patient Outcomes

Pre-post study of a guideline for management of ventilator associated pneumonia (VAP)

<table>
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<th>Pre-VAP Clinical Guideline</th>
<th>Post-VAP Clinical Guideline</th>
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<tbody>
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<td>Adequate initial therapy</td>
<td>48%</td>
<td>94%</td>
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<tr>
<td>Duration of therapy</td>
<td>14.8 days</td>
<td>8.6 days</td>
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<tr>
<td>VAP recurrence</td>
<td>24%</td>
<td>8%</td>
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</table>

Ibrahim EH et al. *Crit Care Med* 2001;29:1109-15
Antibiotic Adverse Events: Opportunity for Stewardship

1 in 5 emergency visits

- Allergic reactions (80%)
- Adverse effects (18%)
  - Diarrhea, headache, dizziness
- Most common antibiotics
  - Penicillins (37%)
  - Fluoroquinolones (14%)
  - Cephalosporins (12%)
  - Trimethoprim-sulfamethoxazole (11%)

1 in 5 inpatient/discharge prescriptions

- 30-day ADEs: GI (42%), Renal (24%), Hematologic (15%)

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<tr>
<th>Class</th>
<th>% pts with Rx</th>
<th>% of ADEs</th>
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<td>B-lactam</td>
<td>80%</td>
<td>65%</td>
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<tr>
<td>Macrolide</td>
<td>27%</td>
<td>3%</td>
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<td>Quinolone</td>
<td>26%</td>
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<tr>
<td>Vancomycin</td>
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<td>12%</td>
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## Table 1. Adverse drug events (ADEs) in hospital inpatient settings, 32 states, 2011

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<th>Adverse drug event cause</th>
<th>ADEs based on diagnoses present on admission</th>
<th>ADEs based on diagnoses that originated during the hospital stay</th>
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<td>Percent of ADEs</td>
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<td>Any ADE cause</td>
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<td>Antibiotics</td>
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<td>Clostridium difficile infection</td>
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<td>Anticoagulants</td>
<td>40.6</td>
<td>10.5</td>
</tr>
<tr>
<td>Other agents that affect blood constituents</td>
<td>3.9</td>
<td>1.0</td>
</tr>
<tr>
<td>Analgesics</td>
<td>45.5</td>
<td>11.7</td>
</tr>
<tr>
<td>Opiates/Narcotics</td>
<td>18.8</td>
<td>4.9</td>
</tr>
<tr>
<td>NSAIDS</td>
<td>28.3</td>
<td>7.3</td>
</tr>
</tbody>
</table>


Infection control + Stewardship reduced *C. difficile*
For your chosen ASP problem, what metrics represent the relevant goals?

<table>
<thead>
<tr>
<th>Stewardship goals</th>
<th>What can you impact?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Improve patient outcome</td>
<td>Mortality</td>
</tr>
<tr>
<td></td>
<td>Readmission</td>
</tr>
<tr>
<td></td>
<td>Clinical cure</td>
</tr>
<tr>
<td>Improve patient safety</td>
<td>C. difficile</td>
</tr>
<tr>
<td></td>
<td>Acute kidney injury</td>
</tr>
<tr>
<td></td>
<td>Adverse drug events</td>
</tr>
<tr>
<td>Reduce resistance</td>
<td>Antibiogram trends</td>
</tr>
<tr>
<td>Reduce cost</td>
<td>Drug expenditures</td>
</tr>
<tr>
<td></td>
<td>Drug utilization</td>
</tr>
<tr>
<td></td>
<td>LOS</td>
</tr>
</tbody>
</table>

What data is available?

Who cares about this measure?

Does it match your ASP interventions?
Question: What stewardship metrics do you think are most important to physicians?

A. Antibiotic Days of Therapy
B. Appropriate Therapy
C. Adverse Drug Events
D. Mortality
# Importance of ASP Outcomes*

*survey of 94 physicians and pharmacists in acute care hospitals

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Actually used</th>
<th>Most important*</th>
<th>Admins</th>
<th>Pharmacy Director</th>
<th>P&amp;T Committee</th>
<th>ID Physician</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abx USE</td>
<td>73%</td>
<td>15%</td>
<td>2%</td>
<td>22%</td>
<td>32%</td>
<td>2%</td>
</tr>
<tr>
<td>Abx COST</td>
<td>73%</td>
<td>10%</td>
<td>41%</td>
<td>56%</td>
<td>15%</td>
<td>0%</td>
</tr>
<tr>
<td>Appropriate</td>
<td>51%</td>
<td>56%</td>
<td>5%</td>
<td>5%</td>
<td>15%</td>
<td>27%</td>
</tr>
<tr>
<td>Mortality</td>
<td>7%</td>
<td>34%</td>
<td>2%</td>
<td>5%</td>
<td>2%</td>
<td>37%</td>
</tr>
<tr>
<td>LOS</td>
<td>12%</td>
<td>22%</td>
<td>5%</td>
<td>0%</td>
<td>2%</td>
<td>7%</td>
</tr>
</tbody>
</table>

Putting it together
comprehensive ASP metrics via Delphi method

<table>
<thead>
<tr>
<th>Measure</th>
<th>Strong agreement (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Domain 1: Consumption</strong></td>
<td></td>
</tr>
<tr>
<td>DOTs</td>
<td>80</td>
</tr>
<tr>
<td>DDDs</td>
<td>50</td>
</tr>
<tr>
<td><strong>Domain 2: Resistance</strong></td>
<td></td>
</tr>
<tr>
<td># patients with drug-resistant organisms</td>
<td>78</td>
</tr>
<tr>
<td>De-escalation/optimized therapy</td>
<td>70</td>
</tr>
<tr>
<td><strong>Domain 3: Outcomes</strong></td>
<td></td>
</tr>
<tr>
<td>Antimicrobial related organism mortality</td>
<td>78</td>
</tr>
<tr>
<td>All cause mortality</td>
<td>70</td>
</tr>
<tr>
<td>Conservesable days of therapy among certain patients</td>
<td>80</td>
</tr>
<tr>
<td>Unplanned 30d readmission</td>
<td>100</td>
</tr>
</tbody>
</table>

Key Takeaways: Measure Something!

• Key Takeaway #1
  – Antimicrobial consumption measures alone are limited in utility

• Key Takeaway #2
  – Choose a combination of process, outcome and consumption measures to describe the full scope of your ASP impact

• Key Takeaway #3
  – Compelling outcomes like appropriate use, adverse effects, clinical cure, can demonstrate value to targeted audiences
Select resources and readings


- Joint Commission. [https://www.jointcommission.org/assets/1/6/New_Antimicrobial_Stewardship_Standard.pdf](https://www.jointcommission.org/assets/1/6/New_Antimicrobial_Stewardship_Standard.pdf)
Acknowledgements

- Society of Infectious Diseases Pharmacists
- Centers for Disease Control and Prevention
Antimicrobial Stewardship Programs: Are We Measuring Up to Our Full Potential?

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N. Jim Rhodes, Pharm.D., M.Sc., BCPS
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Panel

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