Antimicrobial Stewardship Data for Action and Education

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Director of One Health Antibiotic Stewardship

PROTECTING, MAINTAINING AND IMPROVING THE HEALTH OF ALL MINNESOTANS
Objectives

1. Give examples of how analysis of antibiotic-use data has helped identify common opportunities for stewardship
2. Discuss approaches to using data to improve prescribing practices
3. Explain how antibiotic use is tracked in Minnesota care settings and how statewide outpatient prescribing rates can be used to educate patients and providers
Presentation Outline

- Antimicrobial Stewardship Measurement Background
- Overview of Prescribing in the U.S.
- Evidence Base for Using Data to Drive Practice Change
  - Benchmarking
  - Audit, Feedback, and Peer Comparison
  - Syndrome-Specific AU Tracking and Interventions
- Tools to Harness Clinical AU Data
  - NHSN AUR Module
  - Home-Grown Data Visualization
  - MDH Long-Term Care Infection Tracking Tool
  - Point Prevalence Surveys
- Population Data to Drive Change
Types of Antimicrobial Stewardship (AS) Measures

- Antimicrobial use (AU) data
  - Hospitals: days of therapy or defined daily dose
  - Outpatient facilities: prescriptions written

- AS process measures
  - Compliance with facility protocols, record-keeping

- Outcome measures
  - *Clostridioides difficile*, resistant infections
  - Adverse antibiotic events

- Antimicrobial stewardship program (ASP) implementation data
  - Implementation of CDC Core Elements of Antimicrobial Stewardship
Types of Antimicrobial Stewardship (AS) Measures

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Why are data important to AS?

- Establish baseline
- Measure change over time
- Benchmark against others
- Identify intervention opportunities
- Define determinants of practice
- Allocate resources
- Understand overall state of practice
- Inform guideline development and policy-making
## AU Data Sources

### Facilities and health systems
- Electronic medical record system
- Pharmacy system
- Manual chart review
- NHSN Antimicrobial Use and Resistance Module
- Claims data

### Academia and public health
- Claims data
  - e.g., Medicare, all payer claims databases
- National datasets
  - e.g., National Ambulatory Medical Care Survey
- Quality measures
  - e.g., Healthcare Effectiveness Data and Information Set (HEDIS)
- Proprietary datasets
  - e.g., IQVIA Xponent
- NHSN Antimicrobial Use and Resistance Module
AU Measurement Approaches

- Antimicrobial use (AU) data
  - Total use measure
  - Appropriateness of use
  - Cost
- Stratification categories
  - Drug class
  - Provider type
  - Syndrome/diagnosis
  - Hospital unit
- Approaches to measurement
  - Prospective tracking
  - Retrospective measurement
  - Point prevalence survey

AU data can differ by facility but should be:
- Accessible
- Manageable
- Repeatable
- Meaningful
Data Used to Establish Baseline Understanding of Inpatient AU

- **Hospitals**
  - Approximately 50% of hospitalized patients receive an antibiotic\(^1,8\)
  - 20–50% of antibiotic use in hospitals is likely unnecessary or inappropriate\(^1-3\)

- **Long-Term Care**
  - Prevalence of antimicrobial use among residents is ~11%\(^4,5\)
  - Up to 75% of antibiotics might be prescribed incorrectly\(^6,7\)
  - Antibiotics particularly overprescribed for urinary tract infection, respiratory tract infection

1. Fridkin SK et al. MMWR. Morbidity and mortality weekly report. 2014;63. doi:10.1086/605924
3. CDC. Core Elements of Hospital Antimicrobial Stewardship Programs. [https://www.cdc.gov/antibiotic-use/healthcare/implementation/core-elements.html](https://www.cdc.gov/antibiotic-use/healthcare/implementation/core-elements.html)
Data Used to Establish Baseline Understanding of Outpatient AU

- **Outpatient**
  - In 2010, 5 prescriptions written yearly for every 6 people in the U.S.\(^1\)
  - 13% of visits result in antibiotic prescription, and ≥ 30% of prescriptions are inappropriate or unnecessary\(^2\)
  - ≥ 50% of outpatient prescriptions are unnecessary for upper respiratory infections\(^2\)
  - 52% of patients with sinus infection, middle-ear infection, pharyngitis receive recommended first-line antibiotics\(^3\)
  - Children <2 years receive the most antibiotics (1.3/child/year)\(^2\)

- **Dentistry**
  - Dentists prescribe 10% of outpatient antibiotics\(^4\)
  - Dentists prescribe some antibiotic classes not usually indicated in dentistry (e.g., quinolones, urinary anti-infective agents)

4. Hicks LA, et al. CID. 2015;60(9):1308–16
Professions, Settings, Regions Have Different Needs

- Patient, practice, and provider characteristics are associated with inappropriate prescribing,\(^1,2\)
  - National and local data stratified by provider these characteristics can be used to target education and AS interventions
  - Recognize that professions and settings have different prescribing norms and needs for AS support
  - Awareness of how different professions prescribe can help target continuing education and resources, and changes can be tracked over time
  - Profession-wide prescribing challenges might benefit from pre-professional AS education

- Performance for appropriate outpatient antibiotic prescribing varies by state, region, health plan\(^3,4\)

Evidence Base for Using Data to Drive Practice Change: Benchmarking
Benchmarking

- **What is benchmarking?**
  - Comparison of AU measures to internal or external standards
  - Benchmarking is recommended as a key part of hospital ASP
- **Goal**
  - Identify hospitals, units, individual prescribers whose AU deviates from expected
- **Impact**
  - Helps identify AU outliers, target interventions, track over time
- **Risk adjustment**
  - Makes comparison of hospitals more meaningful by controlling for inter-hospital differences
  - Patient population (patient mix), unit type will impact needs for antimicrobial use
- **Caveats**
  - Cannot identify inappropriate prescribing
  - Does not include any diagnostic component

1. CDC. Core Elements of Hospital Antimicrobial Stewardship Programs.
Vancomycin use targeted for reduction in hospitals, Fridkin et al. 2002

- Hospitals participating in ICU vancomycin-resistant enterococci surveillance invited to participate

Benchmarking intervention

- Each hospital received local hospital area data, benchmarked to national data
- Stratified by hospital type (e.g., ICU, non-ICU) for risk adjustment
- Benchmark data disseminated to hospital committees, personnel

Outcomes

- Some ICUs identified unit-specific practices for improvement
- Significant decreases in vancomycin use (mean decrease=48 DDD/1,000 patient days)
- Stratification provided meaningful comparisons to target unit-specific practice changes
Benchmarking with the NHSN AUR Module

- National Healthcare Safety Network (NHSN) is CDC’s system for tracking and reporting healthcare-associated infections
  - Mainly used by hospitals
- The Antibiotic Use and Resistance (AUR) Module is a NHSN component used to:
  - Track hospital AU and/or AR
  - Highlight patient care areas for possible intervention
  - Facilitate benchmarking with other hospitals
  - First data were uploaded in July 2012
NHSN AU Option

- **Key features**
  - Data usable by submitting hospitals, CDC, state public health agencies
  - Single set of technical specifications and standard definitions

- **Electronic data**
  - Medication administration data
  - Admission and transfer data
  - No personal identifiers
  - Data submission to NHSN
  - Unlike other NHSN data, electronic file submission only
Hospital staff can access and analyze using NHSN-platform tools, and/or download data for further analysis.

Medication administration record data

Extracted along with admission and discharge data

Formatted and submitted electronically

Stored on NHSN Servers

Flow of Antibiotic Use Data
AUR Module

Health IT Vendor Services/Software
Benchmark Measure: Standardized Antimicrobial Administration Ratio (SAAR)

• SAAR is a ratio measure =

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

- SAAR is risk adjusted with the expected number calculated from a statistical model*
- Adjusted for:
  - Hospital characteristics (e.g., size, teaching status)
  - Ward type (general vs. ICU)
  - Patient group (adult/pediatric)

Statistically significant SAAR
- >1 signals more antibiotic use than peers
- <1 signals less antibiotic use than peers
- Does not in itself assess whether prescribing is appropriate or not

SAARs Currently Available through NHSN AUR Module

- All antibacterial agents
- Broad-spectrum agents predominantly used for hospital-onset infections
- Broad-spectrum agents predominantly used for community-acquired infections
- Antibacterial agents predominantly used for resistant Gram-positive infections (e.g., MRSA)
- Narrow-spectrum beta-lactam agents
- Antibacterial agents posing the highest risk for *C. difficile* infection
- Antifungal agents predominantly used for invasive candidiasis
- Azithromycin (pediatric only)
Evidence Base for Using Data to Drive Practice Change:
Audit and Feedback with Peer Comparison
Audit and Feedback with Peer Comparison

- **What is audit and feedback? Peer comparison?**
  - Tracking prescribing practices and reporting back to prescribers, with comparison of individual performance to that of peers\(^1\)

- **Goal**
  - Make individuals more aware of their prescribing practices, especially for conditions with defined guidelines, and highlight where they might diverge from peers

- **Impact**
  - Helps identify outlier prescribing and drive behavior change through peer comparison

- **Supplemental action:** Couple prescribing data reports with education, personalized letters
  - One-hour onsite clinician education session followed by quarterly personalized audit and feedback to primary care practitioners led to 13% decrease in prescribing\(^2\)
  - Personalized letters to highest-level prescribers can lead to decreased prescribing rates\(^4\)

- **Caveat**
  - When audit and feedback intervention is discontinued, prescribing might return to pre-intervention levels\(^3\)

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1. CDC. Core Elements of Outpatient Antimicrobial Stewardship Programs.
Audit and Feedback in Action

- Cluster randomized trial in 18 pediatric primary care practices, Gerber 2013
  - Pediatricians given education, feedback on prescribing of themselves, their practice, and their network
  - Focused on AU for bacterial infections with established guidelines
- 12.5% decrease in broad spectrum antibiotic prescriptions acute respiratory infections
- Off-guideline prescribing decreased for pneumonia (15.7% to 4.2%), acute sinusitis (38.9% to 18.8%)

Audit and Feedback Report Example

- **From Gerber 2013**

  
  ![Graph showing the usage of Broad Spectrum Antibiotics for Acute Sinusitis over different periods (Baseline, Q1, Q2)](image)

Provider Performance Email Example

- From Meeker 2016

Evidence Base for Using Data to Drive Practice Change:
Syndrome-Specific AU Tracking and Interventions
Syndrome-Specific AU Tracking and Interventions

- **What is syndrome-specific tracking?**
  - Focus on tracking AU for one or more syndromes (e.g., urinary tract infection (UTI), acute respiratory infection)

- **Goal**
  - Improve prescribing practices for conditions known to have high inappropriate prescribing, through targeted intervention, education, and measurement

- **Impact**
  - Provides way to implement and track AS interventions for when conditions of interest have clear prescribing guidelines
Targeted AS Improvement Project in MN LTC Facility

- AS to improve management of asymptomatic bacteriuria (AB) and UTI
- >250 LTC beds, residents managed by 15 providers
  - Medical director interest in quality
  - Identified need for improved knowledge, documentation of resident infections
- Interventions initiated
  - Education conducted for staff on AB and UTI management
  - Empiric recommendations provided to clinicians with facility-specific antibiogram for urinary *E. coli*
  - Modified Loeb criteria used to guide urine screening and UTI treatment
  - UTI SBAR* tool incorporated into workflow and electronic records
  - Daily UTI AU tracking by infection prevention nurse educator

Preliminary Outcomes
- First-line ciprofloxacin use 58% → 27%
- First-line cephalexin use 8% → 25%
- Consistent with ID guidance, antibiogram

*SBAR: Situation, Background, Assessment, Recommendation
Parker C. TOPICS in Geriatric Medicine and Medical Direction 2018;39(3).
Tools to Harness Clinical AU Data
Hospital Tools Used to Harness AU Data

- **NHSN AUR Module** for hospitals\(^1\)

- **Home-grown data visualization platform\(^2\)**
  - Intermountain Healthcare, Utah
  - Track inpatient and outpatient use, compare peers, assess outcomes
  - Electronic medical record system → data warehouse → structured query language (SQL) to extract relevant data → visualization of data by using Tableau software
  - Can review AU data retrospectively and/or in real-time
  - Customizable data visualization platform
  - Challenges: lack of standard comparator metrics, syndrome classification

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2. Dr. Eddie Stenehjem, Intermountain Healthcare. Personal Communication. April 2019
Data Visualization: Peer Comparison, Syndrome-Based Tracking

Dr. Eddie Stenehjem, Intermountain Healthcare. Personal Communication. April 2019
Images used with permission from Intermountain Healthcare.
Long-Term Care Tool Used to Harness AU Data

- **Minnesota Department of Health infection tracking tool for long-term care**
  - Serves dual purpose of tracking infections and AU, in monthly format
  - Each line on Excel-based tool is used for a single infection
  - Resident days/month are entered manually
  - “Summary” sheet automatically populates with infection and AU metrics, as data are entered each month

1. MDH. Infection and Antibiotic Use Tracking Tool. Available at: [https://www.health.state.mn.us/diseases/antibioticresistance/hcp/asp/ltc/index.html](https://www.health.state.mn.us/diseases/antibioticresistance/hcp/asp/ltc/index.html)
2. Thanks for Cody Schardin and tammy Hale, who have developed and refined this tool over the last year
### Long-Term Care Tool Summary Sheet

**MDH. Infection and Antibiotic Use Tracking Tool. Available at:** [https://www.health.state.mn.us/diseases/antibioticresistance/hcp/asp/ltc/index.html](https://www.health.state.mn.us/diseases/antibioticresistance/hcp/asp/ltc/index.html)
## Long-Term Care Infection Tracking Tool Data Elements

<table>
<thead>
<tr>
<th>Resident</th>
<th>Classification</th>
<th>History</th>
<th>Diagnostics</th>
<th>AU</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit</td>
<td>Infection type</td>
<td>Symptoms</td>
<td>Test performed?</td>
<td>Drug name, class</td>
<td>IPC needs</td>
</tr>
<tr>
<td>Resident name</td>
<td>Body system</td>
<td>Onset date</td>
<td>Test date</td>
<td>Dose, route, frequency</td>
<td>Date resolved</td>
</tr>
<tr>
<td>Room #</td>
<td>Infection surveillance definition met? (e.g., McGeer)</td>
<td>Device type</td>
<td>Test type</td>
<td>Prescriber name, location</td>
<td></td>
</tr>
<tr>
<td>Admit date</td>
<td>Device days</td>
<td>Specimen source</td>
<td>Start date, end date</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Infection risk factors</td>
<td>Results</td>
<td>Total days of therapy</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Antibiotic-resistant?</td>
<td>Meets antibiotic initiation criteria (e.g., Loeb)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Antibiotic time-out done?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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MDH. Infection and Antibiotic Use Tracking Tool. Available at: [https://www.health.state.mn.us/diseases/antibioticresistance/hcp/asp/ltc/index.html](https://www.health.state.mn.us/diseases/antibioticresistance/hcp/asp/ltc/index.html)
Point Prevalence Survey (PPS) to Track AU

- **PPS methodology** has been used to define national rates of healthcare-associated infections and AU in hospital and long-term care settings
  - AU in nursing homes\(^1,2\)
  - Health care-associated infections and AU in hospitals\(^3,4\)
- **Minimal data are collected on a single day or over a specified period ("period prevalence")**
  - Prospective or retrospective data collection
  - Can be repeated over time for a non-time-intensive way of summarizing practices
  - Used to define both overall AU rates and appropriateness for specific syndromes
- Can be conducted by using an Excel-based tool with defined SOP for data collectors

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**PPS Snapshot of U.S. Nursing Homes**

- One day PPS, 9 facilities in four states
- 11% of residents on antibiotics
- 32% of prescriptions for UTI
- 50% had wrong drug, dose, or duration.
- 38% lacked prescribing documentation

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Data collected on first Monday of every month
- Inpatients: All patients present on selected wards at 4pm
- Outpatients: All patients seen on selected services

Data sources:
- Electronic medical records
- Laboratory reports
- Treatment sheets

Outcome measures:
- % inpatients on antibiotic
- % outpatients prescribed antibiotic
- Summary of drugs/classes prescribed overall, by syndrome, by prescriber
- Appropriateness of prescription and drug selection
- % patients receiving diagnostic testing

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<tr>
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<th>Patient</th>
<th>History</th>
<th>Antibiotic</th>
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<tbody>
<tr>
<td>Survey date</td>
<td>Medical record no.</td>
<td>Complaint</td>
<td>Prescribed date</td>
</tr>
<tr>
<td>Data collector</td>
<td>Name</td>
<td>Visit Reason</td>
<td>Service</td>
</tr>
<tr>
<td>Service</td>
<td>Sex</td>
<td>Comorbidities</td>
<td>Prescriber</td>
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<tr>
<td>DOB</td>
<td>Diagnostics conducted?</td>
<td>Drug name, class</td>
<td></td>
</tr>
<tr>
<td>Species</td>
<td>Diagnostic results available?</td>
<td>Route, duration</td>
<td></td>
</tr>
<tr>
<td>Breed</td>
<td>Antibiotic?</td>
<td>Indication</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Antibiotic no.</td>
<td>Treatment classification</td>
<td></td>
</tr>
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</table>
Basic PPS for AU Tracking

For prescribing rate, collect at minimum:
- Total number of patients seen on date
- Total number prescribed an antibiotic on date
- Antibiotic drug name

For basic measure of prescribing reason, also collect:
- Diagnosis/indication for antibiotic prescription (e.g., otitis, sinusitis)
- Use of ICD codes provides standardization for repeated survey dates and across data collectors

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How have you used AU tracking methods in your setting?

What are the major challenges?
What makes things work better?
Population-Level Data to Drive Change
2014 National Targets for Outpatient Prescribing

Proportion of unnecessary antibiotic use: All conditions

30% Unnecessary use
70% Appropriate use

National goal for reducing inappropriate antibiotic use by 2020

50% 50 percent reduction, or approximately 23 million fewer prescriptions, by 2020

Outpatient Antibiotic Prescribing Reduction Targets

Acute respiratory conditions

- Current number of antibiotic prescriptions in millions: 67.6
- Recommended number of antibiotic prescriptions in millions: 33.8
- 50% Reduction

Other conditions

- Current number of antibiotic prescriptions in millions: 86.8
- Recommended number of antibiotic prescriptions in millions: 73.9
- 15% Reduction

Source: Analysis of NAMCS and NHAMCS data on U.S. antibiotic prescribing, 2010-2011
© 2016 The Pew Charitable Trusts
National Goal Setting for AU

- **White House National Action Plan for Combating Antibiotic-Resistant Bacteria**
  - By 2020, reduce inappropriate outpatient antibiotic use by 50%
  - To reach this goal, must reduce total antibiotic use by 15%

- **Healthy People 2020**: science-based, 10-year national objectives for improving health of Americans
  - Reduce AU for ear infections for young children
  - Reduce AU for the sole diagnosis of the common cold

- **Progress as of 2017**
  - On the population level, measuring inappropriate use of oral antibiotics is more difficult than total antibiotic use
  - Little progress made in reducing overall adult prescribing
  - More progress made for overall pediatric prescribing
  - Healthy People 2020 goals not yet achieved

### Healthy People Goal (% visits → antibiotic)

<table>
<thead>
<tr>
<th>Objective</th>
<th>2006-2007</th>
<th>2010-2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>70%: Pediatric Ear Infection</td>
<td>77.8</td>
<td>78.9</td>
</tr>
<tr>
<td>21%: Pediatric Common Cold</td>
<td>28.6</td>
<td>30.9</td>
</tr>
</tbody>
</table>

Community Antibiotic Prescriptions per 1,000 Population by State - 2016

Each year 270.2 million antibiotic prescriptions are written in the United States; equivalent to 836 antibiotic prescriptions per 1,000 persons.

Figure Source: CDC, https://www.cdc.gov/antibiotic-use/community/programs-measurement/state-local-activities/outpatient-antibiotic-prescriptions-US-2016.html
Outpatient Antibiotic Prescriptions per 1,000 Persons, U.S. and Minnesota, 2011-2016

Data Source: IQVIA™ Xponent® and CDC: https://gis.cdc.gov/grasp/PSA/indexAU.html
Mean Annual Outpatient Antibiotic Prescriptions per 1,000 Persons and Percent Change by Period, Minnesota and U.S.

<table>
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<th>2011-2012</th>
<th>2015-2016</th>
<th>Percent Change</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Prescriptions per 1000 Persons</td>
<td>Prescriptions per 1000 Persons</td>
<td></td>
</tr>
<tr>
<td>All Antibiotics</td>
<td>Minnesota</td>
<td>728</td>
<td>692</td>
</tr>
<tr>
<td></td>
<td>U.S.</td>
<td>872</td>
<td>837</td>
</tr>
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</table>

Data Source: IQVIA™ Xponent® and CDC: [https://gis.cdc.gov/grasp/PSA/indexAU.html](https://gis.cdc.gov/grasp/PSA/indexAU.html)
Outpatient Antibiotic Prescriptions per 1,000 Persons
Minnesota, 2015-2016

Data Source: IQVIA™ Xponent®
Outpatient Antibiotic Prescriptions by Drug Class, Minnesota, 2016

- Penicillins 25%
- Cephalosporins 14%
- Other Classes 25%
- Macrolides 17%
- Quinolones 9%
- Beta-lactams, with Increased activity 9%
- Other Classes 25%

Data Source: IQVIA Xponent™
Mean Annual Outpatient Antibiotic Prescriptions per 1,000 Persons and Percent Change by Period, Minnesota and U.S.

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<tr>
<td><strong>Macrolides</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minnesota</td>
<td>153</td>
<td>117</td>
<td>-24%</td>
</tr>
<tr>
<td>U.S.</td>
<td>186</td>
<td>151</td>
<td>-19%</td>
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<tr>
<td><strong>Quinolones</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Minnesota</td>
<td>76</td>
<td>67</td>
<td>-12%</td>
</tr>
<tr>
<td>U.S.</td>
<td>103</td>
<td>97</td>
<td>-6%</td>
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Data Source: IQVIA™ Xponent® and CDC: [https://gis.cdc.gov/grasp/PSA/indexAU.html](https://gis.cdc.gov/grasp/PSA/indexAU.html)
Proportion of All Outpatient Antibiotic Prescriptions by Type of Prescriber, U.S. and Minnesota, 2016


Abbreviations: NP: Nurse Practitioner, PA: Physician Assistant, OB/GYN: Obstetrics and Gynecology
Proportion of Outpatient Antibiotic Prescriptions by Prescriber Specialty and Drug Class, Minnesota, 2016

Data Source: IQVIA™ Xponent®
Abbreviations: NP: Nurse Practitioner, PA: Physician Assistant
Proportion of Outpatient Antibiotic Prescriptions by Prescriber Specialty and Drug Class, Minnesota, 2016

Data Source: IQVIA™Xponent®
Surgical Specialties include Surgery, Otolaryngology and Urology
What do you think about statewide goalsetting?

Would goals motivate you or your team?
Acknowledgments
Ruth Lynfield
Ashley Fell
Cody Schardin
Tammy Hale
Catherine Lexau
Emma Leof
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Eddie Stenehjem, Intermountain Healthcare

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