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Measurement and Evaluation Approaches to Improve Outpatient Antibiotic Prescribing

A key consideration for jurisdictions seeking to improve outpatient antibiotic prescribing is how to measure and evaluate baseline performance and progress over time and how to identify goals for antibiotic stewardship initiatives. This technical assistance tool describes metrics that may be used to accomplish these aims, along with pros, cons, and considerations for each approach. It also summarizes data sources that jurisdictions can use to evaluate antibiotic stewardship initiatives.

Table 1 summarizes the pros, cons, and operational considerations of various measurement approaches, and Table 2 provides information about the numerators, denominators, and exclusions for specific measures that are referenced below.

IN BRIEF

This technical assistance tool describes metrics that state Medicaid and public health agency partners can use to evaluate and target opportunities to improve antibiotic prescribing practices. It also provides a summary of data sources that can be used to evaluate efforts focused on improving antibiotic stewardship.

Metrics to Measure and Evaluate Antibiotic Use and Appropriateness

Selecting a measurement strategy is the first step in using data to improve antibiotic use in a jurisdiction. Different metrics may serve a variety of purposes, such as identifying targets for improvement or tracking progress over time. The same metrics may be useful for multiple purposes. Jurisdictions may consider using one or multiple approaches depending on a variety of factors, including:

- Available data, including pharmacy and medical claims, pharmacy claims alone, or electronic health record (EHR) data;
- Existing investment in a given approach;
- Alignment with other payers or nearby states/localities;
- Provider or other stakeholder buy-in; and
- Analytic bandwidth/time constraints.

The measurement approaches discussed below can all be applied to EHR and/or claims data. Several of the measurement approaches described require access to either EHR data or both pharmacy and medical claims that can be linked via a common patient identifier, but others can be operationalized solely with pharmacy data.

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1. Numbers and Rates of Overall Antibiotic Prescriptions

Jurisdictions may decide to track overall numbers of antibiotic prescriptions by provider, facility, and/or region. Population-based rates can be generated if jurisdictions have access to data that captures all antibiotic prescriptions, such as an all-payers claims database (APCD). Visit-based rates of antibiotic prescriptions (i.e., antibiotics prescribed divided by the total number of medical visits) can be calculated with EHR data or medical claims.

One example of this approach comes from the National Health Service in England where information about overall antibiotic prescribing was generated for general practitioners. Specifically, they divided the total number of antibiotics prescribed by each practitioner annually by the number of patients registered to that provider and compared practitioners in the same service area to one another. Those with high rates were notified by letter that they were prescribing more antibiotics than 80 percent of their peers in their local area. This intervention led to a 3.3 percent decrease in the rate of antibiotics prescribed per 1,000 population, which resulted in an estimated 73,000 fewer antibiotics dispensed.[1]

Data Requirements

Calculating numbers of antibiotic prescriptions can be implemented with pharmacy data only if the data contain information about the prescribing physician, facility, region, or other desired level of analysis. Calculating visit-based rates requires access to either EHR or medical claims to calculate the denominator. Following are pros and cons for this measurement approach:

Pros:

- Total number of antibiotics prescribed requires only pharmacy claims data and does not require linking pharmacy and medical claims or access to EHR data.
- There is little potential for diagnostic shifting with this approach. Diagnostic shifting refers to providers changing the diagnosis code to one that is more antibiotic appropriate to justify the antibiotic.[2,3]

Cons:

- Antibiotic appropriateness, meaning whether the antibiotics were prescribed in accordance with clinical practice guidelines, cannot be assessed without information about the diagnosis associated with the prescription, which would require linking to claims or EHR data.4 This process may decrease provider buy-in and make findings less actionable.
- There is no clear goal or benchmark for performance for this type of broad measure for antibiotic prescribing. As a result, providers may not know how to use these data to change practice.
- These metrics do not control for case-mix of patients seen by providers, and providers taking care of higher acuity patients may prescribe higher rates of antibiotics per visits. As a result, it is preferable to compare physicians practicing in the same specialty and type of setting to one another.
- Numbers of antibiotic prescriptions does not control for volume of patients seen by providers, so providers who see more patients may write more antibiotic prescriptions.

2. Numbers and Rates of Prescriptions for Select Antibiotic Classes or Agents

Some antibiotic classes and agents are rarely indicated as first-line therapy and are associated with adverse events (e.g., fluoroquinolones) or are often used inappropriately (e.g., azithromycin). Tracking prescribing of these specific antibiotic classes may improve antibiotic use as a whole.

Data Requirements

This measure can be implemented with pharmacy data only if the data contain information about the prescribing physician, facility, region, or other desired level of analysis. Calculating visit-based rates requires EHR data or the ability to link pharmacy data to medical claims. Following are pros and cons for this measurement approach:

Pros:

- Tracking the total number of antibiotics in a given class can be done with pharmacy data alone.
- There is less potential for diagnostic shifting.
- Focusing on specific antibiotic classes may be more actionable for clinicians than reducing overall antibiotic use.

Cons:

- Antibiotic appropriateness cannot be assessed without information about the diagnosis associated with the prescription, which would require linking to claims or EHR data.5 This may decrease provider buy-in and make findings less actionable.
- There is no clear goal or benchmark for performance on this type of measure and prescribers may not know how to use this data to change practice.
- Clinicians may increase prescribing of other antibiotics as they decrease prescribing of targeted classes, therefore this measure may not target unnecessary prescribing in the same way as other measures.

3. Targeting Conditions for Which Antibiotics Should Never be Prescribed

For some conditions, such as acute bronchitis, influenza, and viral upper respiratory infections (URI), antibiotics are almost never appropriate.[6,7] These types of metrics are usually reported as a percent of visits for the diagnosis of interest (e.g., viral URIs) that received antibiotics. Jurisdictions may choose to target unnecessary prescribing for one or more of these conditions.

An example of this type of measure is the MITIGATE metric, which was developed by researchers from the University of California-Davis to improve antibiotic use in emergency departments and urgent care facilities.[8] The MITIGATE metric is part of a broader set of antimicrobial stewardship activities (detailed information is available in the MITIGATE toolkit).[9] The MITIGATE metric targets antibiotic prescribing for antibiotic-inappropriate acute respiratory infections (ARIs); a detailed description of the metric and relevant ICD-10 codes is included in the toolkit. A study using feedback from the MITIGATE metric (leveraged in EHR data) as part of a suite of interventions reduced antibiotic prescribing for these antibiotic never-appropriate respiratory conditions from 6.2 percent at the beginning of the study to 2.4 percent by the end of the study.[10]

The Healthcare Effectiveness Data and Information Set (HEDIS) 2019 measures Avoidance of Antibiotic Treatment for Adults with Acute Bronchitis and Appropriate Treatment for Children with Upper Respiratory Infection are also examples of measures targeting conditions where antibiotics should never be prescribed.[11,12] The HEDIS 2020 updates to these measures include several changes — most notably the updates broaden the age ranges of patients that are included. The updated measures are: Avoidance of Antibiotic Treatment for Acute Bronchitis/Bronchiolitis and Appropriate Treatment for Upper Respiratory Infection.[13,14] A detailed summary of the changes to the HEDIS 2020 measures is available at the National Committee for Quality Assurance website.[15] The HEDIS 2019 metrics are also part of the Centers for Medicare & Medicaid Services' Merit Based Incentive Program Clinical Quality Measures.[16]

Data Requirements

This type of measure requires access to either EHR data or both medical and pharmacy claims. Jurisdictions must be able to link the visit where the antibiotic was prescribed to the prescription record and identify relevant diagnostic codes; typically, by searching for antibiotic prescriptions within a specified time-frame (e.g., three days) of the visit. This type of measure requires examining all diagnostic codes for a visit to exclude visits with antibiotic-appropriate diagnoses. Comorbidity data may also be useful to exclude patients with comorbidities that impact antibiotic prescribing decisions (e.g., chronic obstructive pulmonary disease [COPD]). The MITIGATE and HEDIS metrics referenced above exclude patients with relevant co-infections and comorbidities that might warrant antibiotics. Following are pros and cons for this measurement approach:

Pros:

- One of the key advantages of this type of metric is its clarity — it focuses on "antibiotic-never" respiratory conditions, so the goal is clear. For the MITIGATE metric, the goal is zero. For the HEDIS measures, the goals are 100 percent — that 100 percent of patients receive appropriate treatment (were not prescribed antibiotics) for these conditions.
- Another advantage of this type of metric is that it is structured to exclude patients with comorbidities where antibiotics may be warranted. This may be more palatable to providers than other measures that include conditions where the decision about prescribing antibiotics is less clear.

Cons:

- This type of measure is very sensitive to diagnostic shifting because the range of "antibiotic-never" conditions does not include conditions with similar symptoms where an antibiotic may be warranted, such as acute sinusitis. As a result, providers may have incentives to code a patient as having an antibiotic-appropriate condition to justify a prescription for antibiotics, even when the patient is actually suffering from a condition where antibiotics are not needed, such as a cold or acute bronchitis.
- These measures do not capture common conditions for which antibiotics may sometimes be indicated, but are not always, such as sinusitis. Sinusitis is the most common condition for which antibiotics are prescribed in outpatient settings and is an important stewardship target.

4. Targeting Conditions for Which Antibiotics Are Sometimes Indicated but Often Over Prescribed

Conditions including sinusitis, pharyngitis, and acute otitis media are major drivers of antibiotic use in outpatient settings. For these conditions, antibiotics are warranted for patients with some clinical symptoms; however, antibiotics are often over-prescribed.[17,18,19] Improving diagnosis (following guideline-recommended diagnostic criteria) and using guideline-recommended treatment strategies may help reduce antibiotic use for these conditions. Delayed prescribing of antibiotics for sinusitis and acute otitis media are guideline-recommended treatment strategies for select patients and help reduce overuse of antibiotics.[20]

An example of this type of measure to assess antibiotic prescribing is the Antibiotics for Respiratory Infections measure that was developed and implemented by the Washington Health Alliance as part of the state's broader Choosing Wisely campaign.[21] The Choosing Wisely campaign focuses on a range of care that is potentially overused, including antibiotic prescriptions for ARIs. This measure includes both acute respiratory conditions for which antibiotics are never indicated (e.g., viral URI) as well as sinusitis, a condition for which antibiotics are sometimes indicated. As a result, the goal for this measure is not zero antibiotic prescribing. Rather, providers that prescribe antibiotics between 10-20 percent of the time are considered to be performing well. Jurisdictions interested in adhering to the technical specifications from the Washington Choosing Wisely campaign are prohibited from using the

metric for public reporting of provider rates. Washington found that 26 percent of patients with URIs were prescribed potentially unnecessary antibiotics in 2014, with lower rates in Medicaid (16 percent) than among those with commercial insurance (30 percent).[22]

The HEDIS 2019 metric Appropriate Testing for Children with Pharyngitis and HEDIS 2020 metric Appropriate Testing for Pharyngitis are other examples of measures that can test antibiotic prescribing practices. [23] This measure evaluates the appropriate diagnosis of pharyngitis by the presence of a streptococcal test for those prescribed antibiotics, which reduces inappropriate antibiotic use for non-streptococcal pharyngitis.

Data Requirements

Measures that assess antibiotic prescribing require access to both medical and pharmacy claims. Jurisdictions must be able to link the visit to the prescription, typically, by searching for antibiotic prescriptions within three days of the relevant visit. These measures require examining all diagnostic codes for a visit to exclude visits with antibiotic-appropriate diagnoses. Comorbidity data may also be useful in excluding patients with comorbidities that impact antibiotic prescribing decisions (e.g., COPD). The Choosing Wisely and HEDIS metrics referenced above are already constructed to exclude patients with relevant co-infections and comorbidities. Following are pros and cons for this measurement approach:

Pros:

- This type of metric is potentially less susceptible to diagnostic shifting than metrics that focus only on antibiotic-inappropriate diagnoses.
- By including a spectrum of highly related respiratory conditions, use of this metric may help improve diagnostic accuracy. For example, many viral URIs are misdiagnosed as sinusitis. A metric that assesses antibiotic prescribing for both viral URIs and sinusitis encourages prescribers to improve antibiotic prescribing for both conditions and discourages diagnostic shifting from viral URI to sinusitis.
- By focusing on a broader set of conditions including sinusitis, which is a major driver of antibiotic use, these measures are likely to have a larger impact on unnecessary use than measures that only target conditions for which antibiotics are never indicated.

Cons:

- The goal is less clear than with conditions where antibiotics are never indicated — the goal should not be zero. As a result, providers may have more difficulty using this information to change prescribing practices.

5. Targeting Antibiotic Selection for Conditions Where Antibiotics Are Appropriate

In addition to unnecessary antibiotic use, inappropriate antibiotic agent selection contributes to inappropriate antibiotic use and patient harm.[24,25] For conditions where antibiotics are appropriate, clinical practice guidelines recommend first-line and alternative agents. Metrics evaluating the use of first-line, alternative, and non-recommended therapies may reduce inappropriate antibiotic use.

An example of this type of metric is the Merit-based Incentive Payment System clinical quality measure Adult Sinusitis: Appropriate Choice of Antibiotic.[26] Jurisdictions could consider adapting this metric to their population.

Data Requirements

This type of measure requires access to both medical and pharmacy claims. Analysts must be able to link the visit to the prescription; this is typically accomplished by searching for antibiotic prescriptions within three days of the relevant visit. Following are pros and cons for this measurement approach:

Pros:

- This metric addresses a type of inappropriate antibiotic use distinct from the other measures discussed in this brief. It may be helpful in jurisdictions with low rates of unnecessary antibiotic use.

Cons:

- This type of measure can only be used in evaluating antibiotics prescribed for conditions where antibiotics are appropriate or sometimes appropriate.
- Appropriateness may be difficult to evaluate when multiple diagnoses are present.

All types of metrics discussed above can be combined to inform antibiotic stewardship efforts. For example, the Choosing Wisely campaign integrated metrics on both antibiotic never-appropriate and antibiotic-sometimes-appropriate conditions.

Data Sources

Jurisdictions can consider leveraging a range of data sources to report on antibiotic use and antibiotic appropriateness. Several possible data sources are outlined below.

Claims Data

Jurisdictions can leverage Medicaid data, Medicare data, or data from local health insurance plans as a source of claims data. An additional source of claims data available in some jurisdictions is APCD.

All Payers Claims Data

States that have access to APCD may also be able to leverage these data for measurement. APCD data may facilitate comparisons between Medicaid and other coverage types and to statewide outcomes. APCD vary considerably by state in how the data can be used, costs for access, etc. The APCD Council provides information about which states have APCD in place and potential use summaries.[27]

Electronic Health Record Data

Jurisdictions with access to EHR data from local health systems, or who are providing technical assistance to local health systems, can consider using EHR data for these measures. EHR data will allow for more precise mapping of an antibiotic prescription to a specific diagnosis than is possible in claims data.

HEDIS Measures

As mentioned above, the HEDIS measures related to antibiotic use can be adapted and applied to EHR and claims data. In addition, data on HEDIS measure performance reported by managed care organizations and other organizations can be used to evaluate progress and identify opportunities for improvement.

Center for Disease Control's Patient Safety Atlas/Patient Safety Portal

The Centers for Disease Control and Prevention's (CDC) Patient Safety Atlas contains information about antibiotic prescribing by state and nationally.[28] The prescription data in the Patient Safety Atlas are for all oral antibiotics dispensed from outpatient community pharmacies. Rates estimating the number of outpatient prescriptions per 1,000 population are provided. Beginning in November 2019, CDC transitioned from the Patient Safety Atlas to the Patient Safety Portal, available through the same link.

IQVIA Prescriber Data

As part of CDC's Antimicrobial Resistance Challenge, IQVIA, a company that aggregates data on prescriptions nationwide, has committed to providing each state with data on top antibiotic prescribers in select specialties by national provider identification number for 2018.[29] Jurisdictions may be able to use this data to target high-volume prescribers. It is important to note that these data will only reflect the number of antibiotics dispensed and will not include information on diagnosis, antibiotic appropriateness, or number of visits. There are restrictions on how this data can be used and shared.

Medical Chart Review

In situations where data challenges preclude using electronic data pulls and/or a deeper dive into prescribing decisions is desired, chart review to assess antibiotic appropriateness may be useful. The United Hospital Fund has developed a toolkit for evaluating antibiotic appropriateness through chart review.[30]

ADVANCING IMPLEMENTATION OF THE CDC'S 6|18 INITIATIVE

Through support from the Robert Wood Johnson Foundation, the Center for Health Care Strategies, in collaboration with a number of partners, is coordinating technical assistance to facilitate state Medicaid and public health implementation of the Centers for Disease Control and Prevention's (CDC) 6|18 Initiative. The CDC's 6|18 Initiative promotes the adoption of evidence-based interventions that can improve health and control costs related to six high-burden, high-cost health conditions — tobacco use, high blood pressure, inappropriate antibiotic use, asthma, unintended pregnancies, and type 2 diabetes. For more information and additional resources, visit www.618resources.chcs.org.

ENDNOTES

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Table 1: Outpatient Antibiotic Prescribing Measurement Strategies, Key Considerations, and Examples

Approach	Key Operational Considerations	Pros	Cons	Example Measures
Numbers and Rates of Overall Antibiotic Prescriptions	■ Overall numbers and rates per population can be produced with pharmacy claims only ■ Rates per visit require information from EHR or medical claims to calculate denominator	■ Relative simplicity of data analysis ■ Not vulnerable to diagnostic shifting	■ Antibiotic appropriateness cannot be assessed, may be less actionable than other measures as a result ■ Does not adjust for patient acuity or volume	■ Overall rates by provider, facility, or region ■ Overall rates by visit
Numbers and Rates of Prescriptions for Select Antibiotic Classes or Agents	■ Does not require linkage to an outpatient visit so long as information about prescribing provider, facility, and/or region is available	■ Relative simplicity of data analysis ■ Not vulnerable to diagnostic shifting ■ Focusing on specific classes makes information more actionable	■ Antibiotic appropriateness cannot be assessed, may decrease provider buy-in ■ Potential for providers to shift to other antibiotics not targeted	■ Rates of fluoroquinolones by provider, facility, or region ■ Rates of fluoroquinolones by visit
Targeting Conditions for Which Antibiotics Should Never be Prescribed	■ Requires linkage of prescription to a visit to classify diagnosis associated with prescription ■ Requires examining all diagnostic codes for a visit to exclude visits with antibiotic-appropriate diagnoses	■ Clarity-focuses on "never events" and goal is zero ■ Excludes patients with comorbidities where antibiotics may be warranted; may be more palatable to providers as a result	■ Vulnerable to diagnostic shifting, e.g., coding diagnoses to avoid classification of an antibiotic prescription as inappropriate ■ Does not capture common conditions where antibiotics are sometimes warranted but frequently overprescribed (e.g., sinusitis)	■ MITIGATE ■ HEDIS metric: Avoidance of antibiotic treatment with acute bronchitis ■ HEDIS metric: Appropriate treatment for URI
Targeting Conditions for Which Antibiotics are Sometimes Indicated but Often Over-Prescribed	■ Requires linkage of prescription to a visit to classify diagnosis associated with prescription ■ Requires examining all diagnoses codes to exclude visits with antibiotic-appropriate diagnoses	■ Less susceptible to diagnostic shifting ■ May help improve diagnostic accuracy ■ Focusing on conditions that are major drivers of antibiotic use likely to have larger impact than only focusing on conditions for which antibiotics are never indicated	■ Goal is less clear than measures focusing on conditions where antibiotics are never warranted	■ Choosing Wisely ■ HEDIS metric: Appropriate Testing for Pharyngitis
Targeting Antibiotic Selection for Conditions Where Antibiotics Are Appropriate	■ Requires linkage of prescription to a visit to classify diagnosis associated with prescription	■ Addresses a type of inappropriate antibiotic use distinct from the other measures	■ Can only be used in evaluating antibiotics prescribed for conditions where antibiotics are appropriate or sometimes appropriate	■ Adult Sinusitis: Appropriate Choice of Antibiotic

Table 2: Outpatient Antibiotic Prescribing Measure Specifications

Measure	Numerator	Denominator	Exclusions
Overall antibiotic prescribing (numbers)	Number of antibiotic prescriptions	N/A	N/A
Overall antibiotic prescribing (rates)	Number of antibiotic prescriptions	Number of providers, practices, or visits, as relevant. Visits can be derived from EHR data or medical claims. Population (if all prescriptions for a given population are captured).	N/A
Select classes/agents antibiotic prescribing (number)	Number of relevant antibiotic prescriptions	N/A	N/A
Select classes/agents antibiotic prescribing (rates)	Number of relevant antibiotic prescriptions	Number of providers, practices, or visits, as relevant. Visits can be derived from EHR data or medical claims. Population (if all prescriptions for a given population are captured).	N/A
Targeting Conditions for Which Antibiotics Should Never be Prescribed: MITIGATE	Number of visits associated with an antibiotic-inappropriate diagnosis of acute upper respiratory infections where an antibiotic was prescribed	Total number of visits for an antibiotic-inappropriate diagnosis of acute upper respiratory infections	Cases where a comorbid condition or antibiotic-appropriate infection may warrant antibiotic use
Targeting Conditions for Which Antibiotics Should Never be Prescribed: Avoidance of antibiotic treatment for acute bronchitis/bronchiolitis	Number of patients with a diagnosis of acute bronchitis or bronchiolitis in the measurement period who were not prescribed an antibiotic	Number of patients with a diagnosis of acute bronchitis or bronchiolitis in the measurement period	Cases where a comorbid condition may warrant antibiotic use; observations or ED visits that result in inpatient admission
Targeting Conditions for Which Antibiotics Should Never be Prescribed: Appropriate treatment for URI	Patients aged 3 months or older who had a visit with a diagnosis of upper respiratory infection (URI) during the measurement period and were not prescribed an antibiotic within 3 days of relevant visit	Patients aged 3 months or older who had an visit with a diagnosis of upper respiratory infection (URI) during the measurement period	Children prescribed or dispensed antibiotic for documented medical reason within 3 days of URI diagnosis; taking antibiotics 30 days prior to URI diagnosis; patients using hospice any time during measurement period
Targeting Conditions for which Antibiotics are Sometimes Indicated but Often Over-prescribed: Choosing Wisely, Antibiotics for Respiratory Infections	Unique members with diagnosis codes related to acute ARI that have antibiotics prescribed within 0-3 days of visit	Unique members with visits with diagnosis codes related to acute ARI	Comorbid (e.g., HIV, cystic fibrosis) or competing (e.g., pertussis) diagnoses at visit
Targeting Conditions for which Antibiotics are Sometimes Indicated but Often Over-prescribed: Appropriate Testing for Pharyngitis	Patients aged 3 years and older who were diagnosed with pharyngitis, ordered an antibiotic and received a group A streptococcus (strep) test	Patients aged 3 years and older who had visit with a diagnosis of pharyngitis during the measurement period and an antibiotic ordered on or three days after the visit	Children prescribed or dispensed antibiotic for documented medical reason within 3 days of pharyngitis diagnosis; taking antibiotics 30 days prior to pharyngitis diagnosis; patients using hospice any time during measurement period
Targeting Antibiotic Selection for Conditions Where Antibiotics Are Appropriate: Adult Sinusitis: Appropriate Choice of Antibiotic	Patients aged 18 years and older with a diagnosis of acute bacterial sinusitis that were prescribed amoxicillin, with or without clavulanate, as a first line antibiotic at the time of diagnosis	Patients aged 18 years and older with a diagnosis of acute bacterial sinusitis who are prescribed an antibiotic	Claims with telehealth modifiers