Measuring Improvement in Outpatient Antibiotic Stewardship

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2/12/25

Disclosures

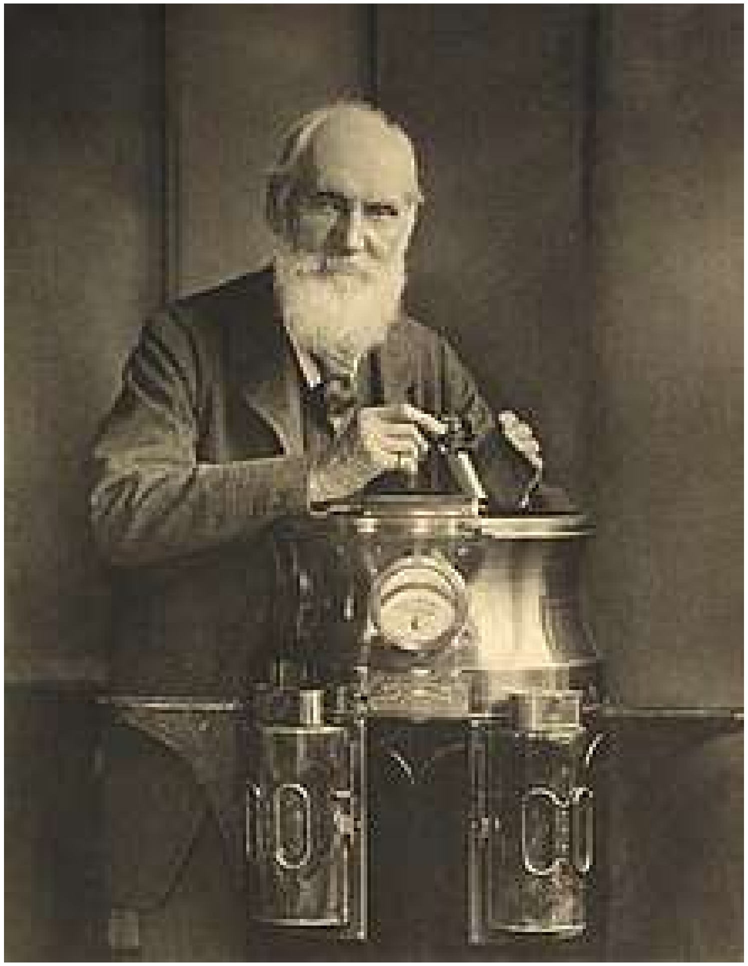
I have the following financial relationships with the manufacturer(s) and/or provider(s) of commercial services discussed in this activity:

- Contracted research with:
  - Pfizer (pediatric nirmatrelvir-ritonavir, maternal RSV vaccine)
  - Merck (monoclonal antibody for RSV prevention)

I do not intend to discuss an unapproved/investigative use of a commercial product/device in my presentation.

Learning Objectives

1. Understand the importance of measurement in outpatient antibiotic stewardship
2. Review some common targets for measurement, including antibiotic selection, antibiotic duration, and unnecessary antibiotic prescribing.
   - Literature examples of successful metric utilization in QI
3. Understand some measurement pitfalls that may emerge during an antibiotic stewardship projects
4. Discuss how more sophisticated metrics can affect project success



“If you can not measure it, you can not improve it”

Lord Kelvin

Start with a Target

- Assumption: We do not have a big antibiotic utilization dashboard
- It may start with a perception:
  - We give a lot of antibiotics for COPD exacerbation
  - Everyone in our practice uses different antibiotics for UTIs. Can’t we standardize?
  - It seems like some of us use a lot of cefdinir. What’s with that?

How to Overuse Antibiotics

Unnecessary antibiotics

Prescribing when not indicated

Viral URI, bronchitis, etc.

Excessive Spectrum

Treatment not targeted

Excessive Duration

Longer courses than necessary

A good target should be…

Common

- Salient to clinicians
- Measurable impact in reasonable timeframe

Impactful

- Avoiding toxicity, preventing *C-diff*
- Maximizing efficacy

Measurable

- Data is available
- Metric matches the desired change

Actionable

- Clear plan for change
- Sensible for stakeholders

Potential Targets: Conditions

Condition	Potential Problems
Otitis media	Unjustified cephalosporin use
Sinusitis	-Use of azithromycin or fluoroquinolones -Not applying strict diagnostic criteria -Durations: 5-7 days now recommended
Viral URI (e.g., pharyngitis with negative testing, bronchitis)	Prescribing any antibiotic at all
UTI	-Overdiagnosis (asymptomatic bacteriuria) -Prescribing doesn't match resistance patterns -Excessive durations for cystitis

Potential Targets: Drugs

Drug or Class	Potential Problems
Azithromycin	Overuse in acute respiratory infections when beta-lactams are more likely to be effective
Fluoroquinolones	Overuse in acute respiratory infections and/or urinary tract infections in which beta-lactams would be equally effective with less toxicity
Third-generation cephalosporins	Overuse in acute respiratory infections in which amox+/-clav would be sufficient: pneumonia, sinusitis, streptococcal pharyngitis

Data Elements Needed

Always Need

- Location (if multiple locations)
- Visit provider
- Antibiotic prescription
  - Drug identity

May Need

- Visit Diagnosis Codes
- Diagnostic test results
  - Strep results
  - Urine culture results
- Drug allergies
- Additional prescription data
  - Dose/frequency
  - Duration

Complex Patients

- Antibiotic prescribing guidelines always have exclusions
  - For example: immunocompromising conditions, functional/anatomic issues that predispose to infection (e.g., cystic fibrosis, sickle-cell disease), recent hospitalization, recent antibiotic exposure
- Steps to take:
  - Target settings with a lower proportion of complex patients
    - Urgent Care, Primary Care
  - If possible, remove patients with hospitalization or antibiotic prescription within prior 30 days
  - Remove patients with certain underlying diagnoses (this gets complex)
  - Usually ignore antibiotics with long durations (>21 days or so, or with refills)
    - Antibiotic prophylaxis, complex infections
  - Investigate outliers in the data

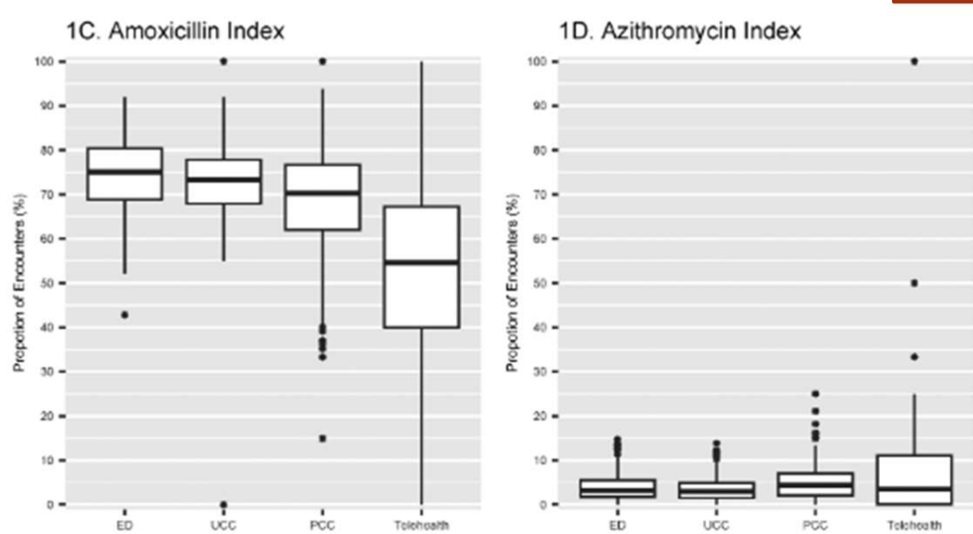
Optimal Antibiotic Selection

“Dumb” Antibiotic Selection Metrics

Benchmarking of Outpatient Pediatric Antibiotic Prescribing: Results of a Multicenter Collaborative

Rana E. El Feghaly,[1,2] Joshua C. Herigon,[1,2] Matthew P. Kronman,[3,4] Bethany A. Wattles,[5] Nicole M. Poole,[6] Michael J. Smith,[7] Ana M. Vaughan,[8] Rosemary Olivero,[9,10] Sameer J. Patel,[11,12] Ann Wirtz,[2,13] Zachary Willis,[14] and Brian R. Lee,[1,2] for the Sharing Antimicrobial Reports for Pediatric Stewardship OutPatient (SHARPS-OP) Collaborative

- “Dumb”: metrics that do not require patient data, diagnosis codes
- Examples:
  - “Amoxicillin index”: Percentage of antibiotic prescriptions that are amoxicillin
    - Higher is better
  - “Azithromycin index”: Percentage of Rxs that are azithro
    - Lower is better
- Could use this approach for third-gen cephalosporins, levofloxacin, amox-clav



Scenario

An Urgent Care network has noted that a significant percentage of patients with acute bacterial sinusitis and pneumonia are receiving either levofloxacin or cefdinir. You are leading a QI effort to encourage use of amoxicillin-clavulanate for these patients. You set an ambitious target of 90%, against a current average performance of 63%.

You provide education to prescribers and design clinical decision support that guides clinicians to amox-clav whenever sinusitis or pneumonia diagnosis codes are selected. Most locations quickly get to 80-85% compliance, regardless of where they started, but none are achieving the goal of 90%.

You do some informal outreach and the most common concern is penicillin allergies. What should you do next?

Incorporating Drug Allergies

- Penicillins are the first-line drugs for:
  - Pneumonia, sinusitis, ear infections, strep throat, etc.
- ~10% of adults report a penicillin allergy (only 1% are true allergies)
- When monitoring optimal antibiotic choice, you should either:
  - Exclude patients with listed allergy to recommended drug OR
  - Consider appropriate second-line treatment to be “guideline-compliant” OR
  - Set reasonable targets that account for commonly reported allergies
- Clinical guidelines should always include guidance for beta-lactam allergies. Other common intolerances, especially to fluoroquinolones, should also be considered.

“Smart” Antibiotic Selection Metrics

- Utilize common condition guidelines to identify first-line antibiotic selection
  - May include alternatives:
    - Allergies/intolerances
    - Appropriate treatment choices (i.e., multiple appropriate options for cystitis)
  - Acute otitis media: amoxicillin
- Identify patients with those conditions by ICD-10
  - Proportion of antibiotics prescribed that are first-line (or non-first-line)
- Increasing complexity:
  - Remove patients with recent hospital stay or antibiotic exposure
    - Acute otitis media: amox first-line; amox-clav if patient took amox in prior 30 days
  - Include allergy alternatives
    - For example: cefdinir OK for acute otitis media if (and only if) there is a penicillin allergy

Sinusitis Example

Dumb

- Proportion of antibiotics that are amoxicillin or amox-clav (first-line choices for sinusitis)

- Use ICD-10 code to identify patients with sinusitis. Proportion of prescriptions that are amox-clav

Smart

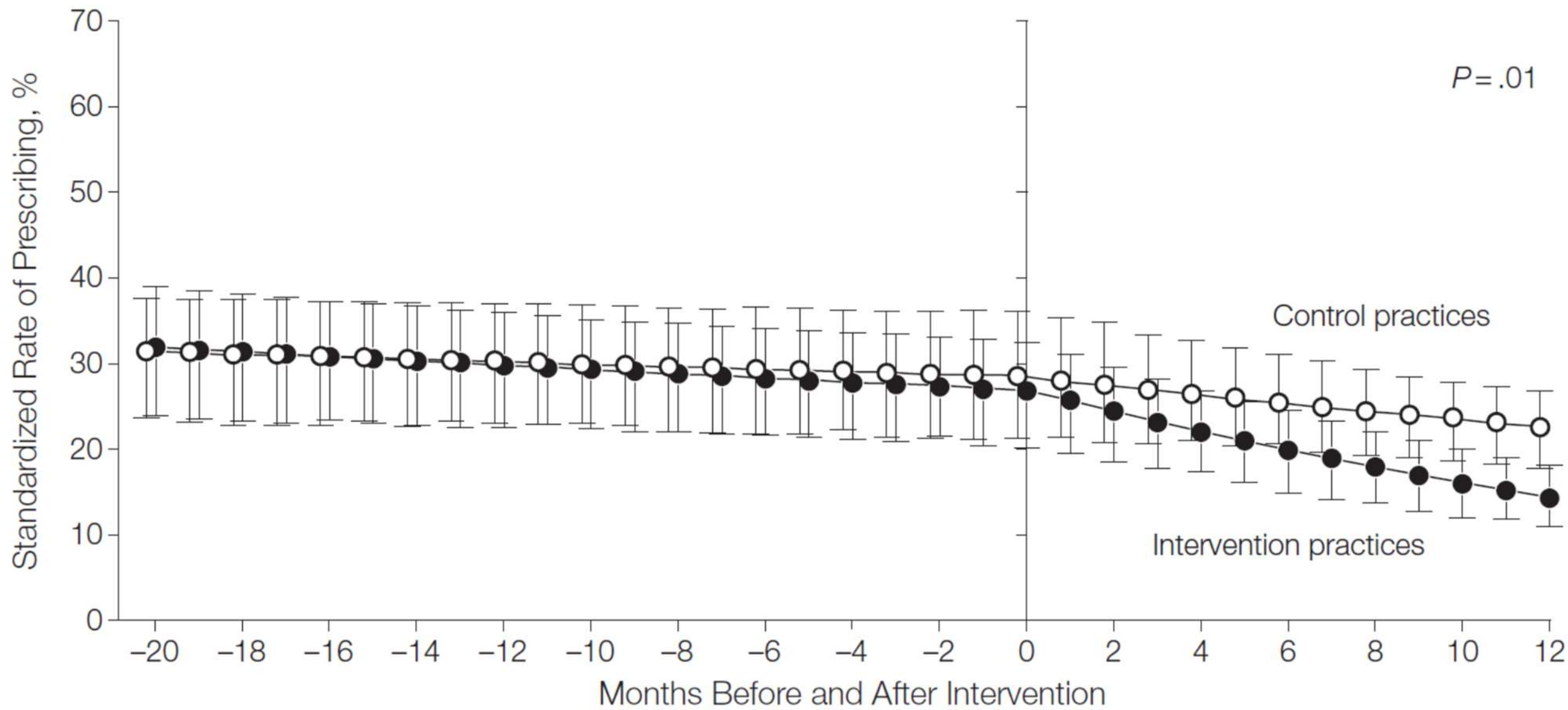
- Identify patients with sinusitis. Filter patients with prior chronic sinusitis diagnoses or recent ENT surgery. If penicillin-allergic, count use of first-line alternative (doxycycline) as success.

Effect of an Outpatient Antimicrobial Stewardship Intervention on Broad-Spectrum Antibiotic Prescribing by Primary Care Pediatricians
A Randomized Trial

Gerber et al., *JAMA*, 2013

- Cluster randomized trial of 18 pediatric practices in an academic network
- Intervention: education session plus quarterly emailed feedback on guideline-concordant antibiotic prescribing with comparison to peers ("you are in the Xth percentile")
- Outcomes: broad-spectrum antibiotics (anything but amoxicillin or penicillin) for sinusitis, pneumonia, and streptococcal pharyngitis

Figure 2. Standardized Rates of Broad-Spectrum Antibiotic Prescribing at Acute Care Office Visits Over Time



Gerber, et al., *JAMA* 2013
Figure used with permission.

Antibiotic Duration

Duration of Outpatient Antibiotic Therapy for Common Outpatient Infections, 2017

Laura M. King,[1] Adam L. Hersh,[2] Lauri A. Hicks,[1] and Katherine E. Fleming-Dutra[1]

[1]Division of Healthcare Quality Promotion, Centers for Disease Control and Prevention, Atlanta, Georgia, USA, and [2]Division of Pediatric Infectious Diseases, University of Utah, Salt Lake City, Utah, USA

- Commercial antibiotic prescription database
- Compared typical durations to guideline recommendations for:
  - Pharyngitis (IDSA)
  - Sinusitis (IDSA)
  - Acute otitis media (AAP)
  - Community-acquired pneumonia (IDSA)
  - Cellulitis and abscess (IDSA)
  - Acute cystitis (IDSA)

King, et al., *Clinical Infectious Diseases*, 2021

Condition and Population	Guideline-recommended Duration of Oral Antibiotic Therapy[a]	Median Course Duration in Days (IQR)
Pharyngitis		
Adult	10 days [2]	10 (10–10)
Pediatric	10 days [2]	10 (10–10)
Sinusitis		
Adult	5–7 days[c] [3]	10 (10–10)
Pediatric	10–14 days [3]	10 (10–10)
Acute otitis media		
Pediatric, all	10 days[d] [4]	10 (10–10)
Pediatric, <2 years	10 days[d] [4]	10 (10–10)
Pediatric, ≥2 years	10 days, shorter courses (5–7 days) may be appropriate for select older children[d] [4]	10 (10–10)
Community-acquired pneumonia		
Adult	≥5 days; 5 days appropriate for most patients[e] [5]	10 (7–10)
Pediatric	No recommendation[f] [6]	10 (10–10)
Cellulitis		
Adult	5 days[g] [7]	10 (7–10)
Pediatric	5 days[g] [7]	10 (10–10)
Abscess		
Adult	5–10 days [7]	10 (7–10)
Pediatric	5–10 days [7]	10 (10–10)
Acute cystitis		
Females 12–64 years	Varies by agent; 1–7 days [8]	7 (5–7)

King, et al., *Clinical Infectious Diseases*, 2021

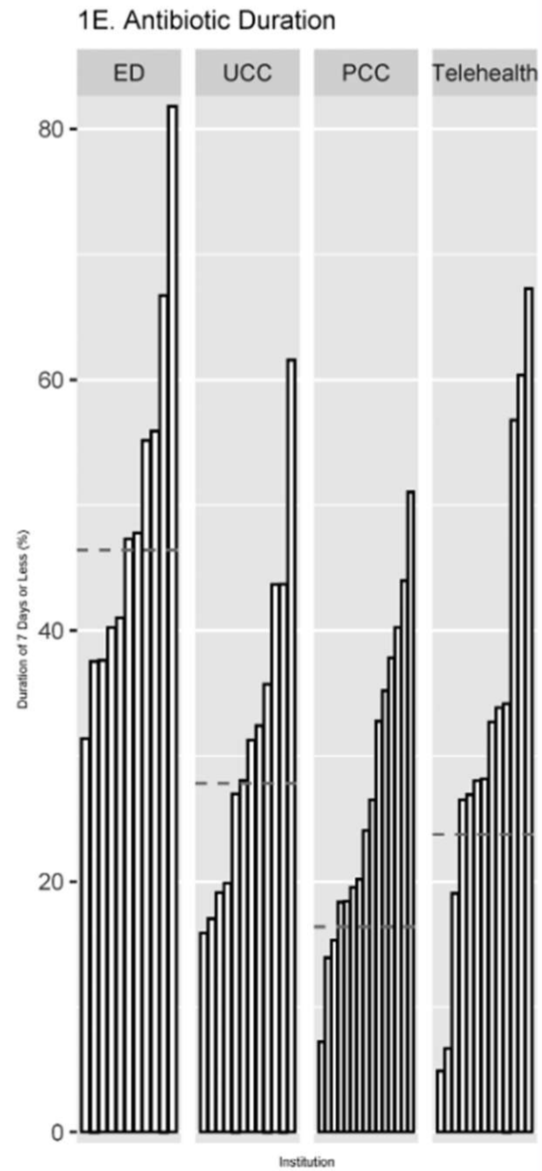
Duration Suggestions

Condition/Population	Recommended Duration	Comments and Strength
Cystitis	1 dose: gentamicin or Fosfomycin 3 days: fluoroquinolone or TMP-SMX 5-7 days: nitrofurantoin or cephalexin	Fairly well-established evidence
Pyelonephritis	7 days 7-10 days for beta-lactams, TMP-SMX	May consider longer course if urologic abnormalities, slow response, etc.
CAP	Adults: 5 days (assuming expected response) Pediatrics: 5 days (outpatient); 5-7 days (inpatient)	Inpatient duration in peds needs more study
Sinusitis	Adults: 5-7 days Pediatrics: 5-10 days (5-7?)	Adults: clear, strong recs Pediatrics: less data about <10 days
Streptococcal pharyngitis	IDSA: 10 days WHO: 5 days if low risk for RHD	Might still be controversial. Definitive study used PO penicillin at TID or QID dosing.
Acute otitis media	<2 years: 10 days 2-5 years: 7 days ≥5 years: 5-7 days	Fairly strong evidence, AAP guideline recommendations
Cellulitis	IDSA, ACP: 5-6 days	Strong evidence

“Dumb” Duration Metrics

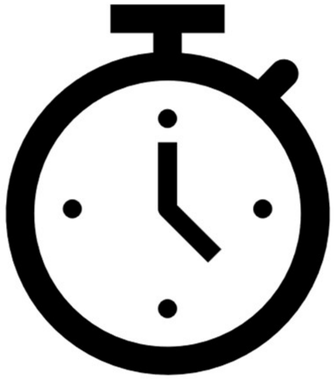
- Proportion of antibiotic prescriptions that are 7 days or less
- Each bar is a single institution, and we grouped by practice setting
- Surprisingly, EDs are doing the best at prescribing short courses!
    - If duration is an issue, we might target primary care and urgent care first
- But what don’t we know?
    - Maybe the EDs see different types of infections
        - Bite wound prophylaxis (5 days) vs Strep throat (10 days)
    - Maybe some of the durations are too short!
    - Maybe the EDs are giving way too many unnecessary antibiotics

El Feghaly et al., *JPIDS*, 2023



“Smart” Duration Metrics

- Incorporates diagnosis
  - Not much else needed!
- Antibiotic duration sometimes varies by antibiotic choice
  - Azithromycin – 5 days
  - Cystitis – 3 days for TMP-SMX or FQ, 5 days for nitrofurantoin or cephalexin

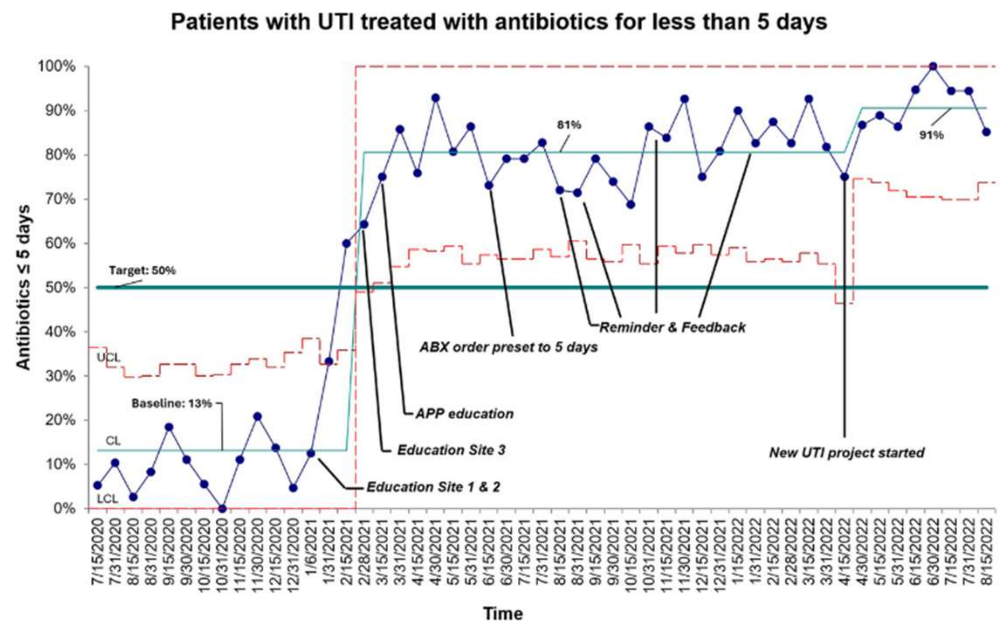


RESEARCH ARTICLE

Reducing Antibiotic Duration for Uncomplicated UTI in the Pediatric Emergency Department

Gagandeep K. Kooner, MD,[a,b] Marissa Bass, MD,[a,c] Vivek Saroha, MD, PhD,[a,d] P.J. Gonzalez, MD,[a,b] Shabnam Jain, MD, MPH[a,b]

- Uncomplicated UTI: 5-18 years old, no fever (>38.2), no report of back pain
- Goal: increase proportion of antibiotic courses <= 5 days
- Intervention: order set with 5 day duration pre-selected (most were cephalexin)



Kooner, et al., *Hospital Pediatrics*, 2024

Avoiding Unnecessary Antibiotics

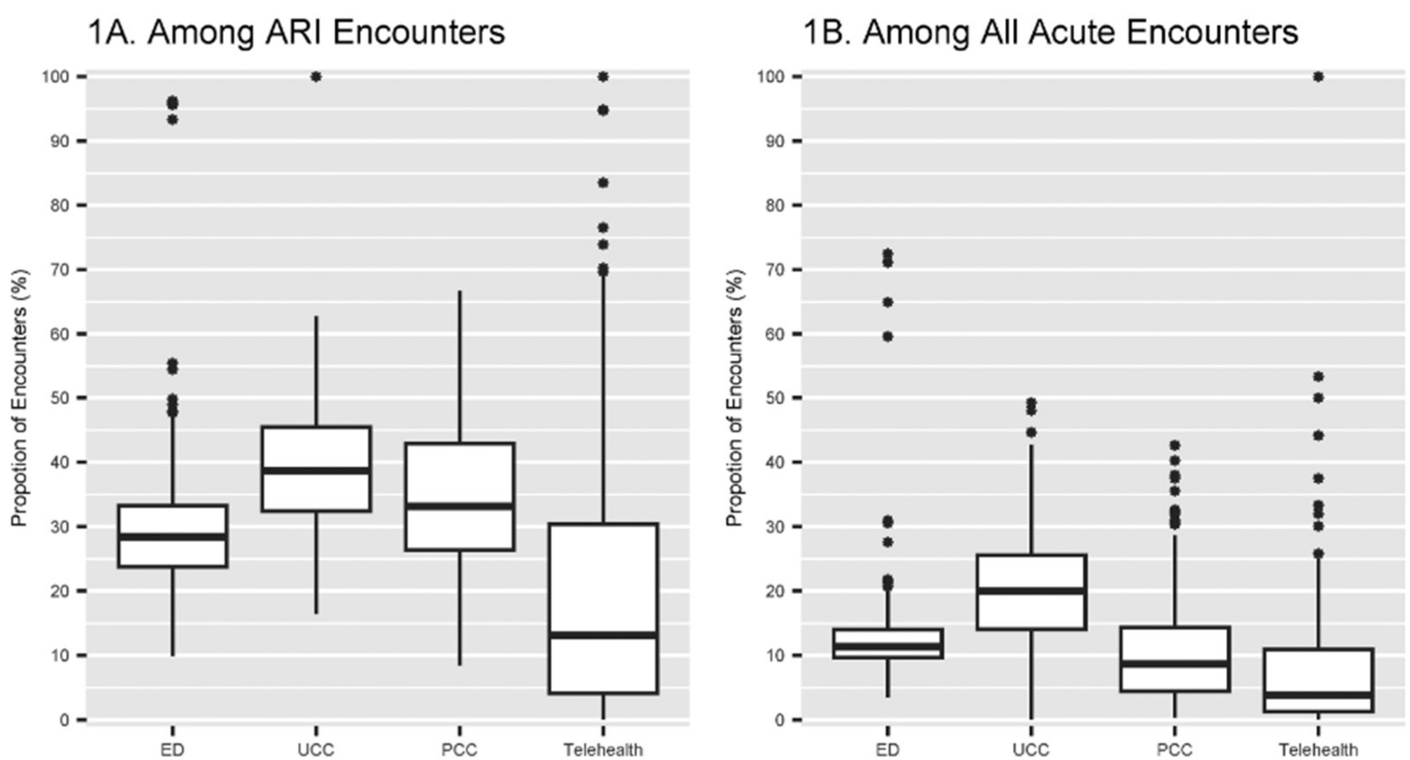
Unnecessary antibiotics

Fleming-Dutra, et al., *JAMA*, 2016

- Classified diagnosis codes for 184,000 ambulatory visits as usually, sometimes, or never needing antibiotics
- 50% of antibiotic prescriptions for acute respiratory infections were unnecessary
- Overall, at least 30% of total ambulatory antibiotic prescriptions appeared to be unnecessary

“Dumb” Measures

Proportion of all visits or all respiratory infection visits with antibiotics prescribed



El Feghaly, et al., *JPIDS*, 2023

Avoiding Unnecessary Antibiotics

- Likely most impactful, also the most challenging to implement and measure

- Two potential problems:
  1. Prescribing antibiotics for diagnoses that don't require antibiotics (viral URI, bronchitis, non-streptococcal pharyngitis)
  2. Overusing diagnoses that do require antibiotics (sinusitis, lower respiratory tract infection, UTI)

Avoiding Unnecessary Antibiotics

One of your clinic's most common private insurers announces a new emphasis on the HEDIS metric "URI": avoidance of antibiotics for patients with URIs. You are leading a QI effort to improve performance on this metric. You used a list of ICD-10 codes from CDC to identify patients with likely viral URIs. You found that 38% of patients with a URI diagnosis code (and no additional code that could indicate a bacterial diagnosis) received antibiotics in the past 6 months. You are targeting a reduction to achieve the benchmark of 25%.

You educate your providers about the new measure. You implement monthly prescriber feedback, comparing each prescriber's performance (confidentially) to the clinic average and the target.

Avoiding Unnecessary Antibiotics

After 6 months of this project, unnecessary prescribing has fallen to 32%, an improvement but short of the goal of 25%.

You work with your EMR provider to develop a pop-up that will appear whenever a prescriber associates an antibiotic prescription with diagnosis codes from the URI list. It's not a hard stop.

Warning!
You associated an antibiotic with a diagnosis code that is not caused by bacterial infection. Antibiotics are not recommended for this indication.

Within three months, the performance on the URI prescribing measure has fallen to 8%, far exceeding your target. You look at the total antibiotic prescriptions per visit, and there is no significant change. What should you investigate next?

Pitfall: Diagnosis Shifting

Warning!
You associated an antibiotic with a diagnosis code that is not caused by bacterial infection. Antibiotics are not recommended for this indication.

User has three choices:

1. Cancel the antibiotic order (which they've probably already discussed with the patient)
2. Ignore the warning and go about their day
3. "Oh, did I say URI? I meant acute bacterial sinusitis! Let me fix that."

Diagnosis Shifting

- Can occur whenever appropriateness of treatment is determined by the diagnosis code
- Diagnosis codes are not meaningful to the clinician
  - Much easier to change your diagnosis code than your practice
- Not malicious, just people trying to get their work done
  - Suggests inadequate buy-in or QI methodology that is too intrusive
- Some diagnosis shifting is probably *correct*
  - Probably some of those patients with antibiotics for URI really *did* have bacterial sinusitis and were coded incorrectly
- Detection is challenging. Need to look for:
  - Decrease in use of viral diagnoses
  - Increase in use of corresponding bacterial diagnoses
    - Both have seasonal variation anyway!

Measuring Diagnosis Shifting

Antibiotic stewardship to reduce inappropriate antibiotic prescribing in integrated academic health-system urgent care clinics

Dharmesh Patel MBA, CNMT, R.T.(N)(ARRT)[1], Teresa Ng[2], Lubna S. Madani MD[3], Stephen D. Persell MD, MPH[4,5,7], Mark Greg PharmD[6], Phillip E. Roemer MD[4,7], Sonali K. Oberoi OTR, MHA[7] and Jeffrey A. Linder MD, MPH[4,5,7]

- Complex: requires building a list of diagnosis shifting codes
  - Generally: antibiotic-appropriate codes (ex pneumonia) or antibiotics-sometimes-appropriate codes (ex sinusitis)
- Analyzed antibiotic prescription for *all* of those diagnosis codes
  - I.e., for all patients with a diagnosis code for which antibiotics *could* be appropriate, what proportion received antibiotics?
  - A significant increase would suggest diagnosis shifting

Acute Bacterial Sinusitis

Three ways to diagnose ABS:

1. Persistent symptoms that are not improving for ≥10 days
2. Severe illness (≥3-4 days)
   - High fever (≥39C) and purulent nasal discharge or facial pain
3. Worsening of a URI after ≥3-4 days that was either stable or improved ("double-sick")

- Based on internal data and literature:
  - Up to 50% of ABS cases do not meet diagnostic criteria (based on documentation)
  - Highly variable use of ABS diagnoses between clinics and providers
- Very challenging to assess appropriateness
  - No diagnostic test
  - Diagnostic criteria generally free-text in the HPI (and inconsistently documented)

Antibiotic Prescribing for Respiratory Tract Infections in Urgent Care: A Comparison of In-Person and Virtual Settings

Kathryn A. Martinez,[1] Abhishek Deshpande,[1] Elizabeth Stanley,[2] and Michael B. Rothberg[1]

- Analysis of antibiotic prescribing in-person vs telehealth
- Telehealth visits: 60% greater odds of antibiotic prescription
  - 71% greater odds among physicians who saw patients both in-person and virtual
- Sinusitis diagnoses **more than twice as common in telehealth**, including for physicians working in both settings

	N (%) In-Person	N (%) Virtual	*P* Value
Diagnosis	...	...	<.001
Acute respiratory tract infection, unspecified	20 949 (30)	5165 (27)	
Sinusitis	9725 (14)	6769 (36)	
Bronchitis/Lower respiratory tract infection	10 276 (15)	2520 (13)	
Pharyngitis/Tonsilitis/Sore throat	26 322 (38)	4336 (23)	
Influenza	1917 (3)	213 (1)	

Acute Bacterial Sinusitis: Measurement Recommendations

- Monitor proportion of acute visits or antibiotic prescriptions with ABS diagnosis
- Look for variation among clinics, settings (e.g., Urgent Care vs Primary Care), individual prescribers
- Watch for diagnosis shifting → sinusitis
- Interventions:
  - Targeted education on diagnostic criteria
  - Mitigation: use narrowest appropriate antibiotics (amox-clav first-line, or amox in peds) and shortest appropriate duration (usually 5-7 days)

“Dumb” vs “Smart” Measures

- “Perfect is the enemy of good!”
  - Can you build a dashboard that incorporates patient age, comorbidities, allergies, recent visits and visit diagnoses, then predicts the optimal antibiotic choice, dose, and duration?
  - Dumb metrics best for exploring multiple targets quickly:
    - “Who’s using the most fluoroquinolones?” “Who’s giving 10 days of antibiotics no matter what?” “Who’s giving antibiotics to almost every sick visit they see?”
- However, overly simplistic metrics might cause issues:
  - Provider buy-in, especially if feedback feels intrusive or punitive
  - Poor resolution in low-volume settings
  - Unrealistic targets
  - Easily gamed metrics
- Recommended approach:
  - Start with “dumb” measures to identify

Tolerances

- The real world is messy! Set realistic expectations
- Not every patient falls within guidelines
- Clinic workflows might affect measurement
  - Clinics may triage patients with likely viral infections → higher antibiotic prescribing rates
- Avoid comparing apples and oranges
  - Primary care vs Urgent Care vs ED
  - Rural vs urban; demographics; payors
  - Poor access to care → higher antibiotic prescribing

Conclusions

- If you can't measure it, you can't improve it
- Metrics can easily be applied to all three antibiotic overuse modes:
  - Suboptimal antibiotic selection
  - Excessive antibiotic duration
  - Unnecessary antibiotic prescriptions
- Metric sophistication can be an endless struggle
  - Don't wait for a perfect metric before you try to improve
  - But better metrics will permit higher standards and more valid comparisons
  - Blunt metrics can help with target identification
- Set reasonable expectations

References

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4. Leung V, Langford BJ, Ha R, Schwartz KL. Metrics for evaluating antibiotic use and prescribing in outpatient settings. JAC Antimicrob Resist **2021**; 3:dlab098.

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Upcoming Events

- **April 30th**: Outpatient antibiotic stewardship webinar, topic TBD
- **May 7th**: 2025 NC Antibiotic Stewardship Conference
- **June 18th**: Outpatient antibiotic stewardship webinar, topic TBD

Chat or email me topic suggestions: zachary_willis@med.unc.edu

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