Development of an Electronic Algorithm to Target Outpatient Antimicrobial Stewardship Efforts for Adults with Acute Pharyngitis

Ebbing Lautenbach, MD, MPH, MSCE [1-3]; Keith W. Hamilton, MD [1]; Robert Grundmeier, MD [4]; Melinda Neuhauser, PharmD, MPH [5]; Lauri Hicks, DO [5]; Anne Jaskowiak-Barr, MS, BSW [2-3]; Leigh Cressman, MA [3]; Tony James [3]; Jacqueline Omorogbe, MBE [3]; Nicole Frager, MPH [4]; Muida Menon [4]; Ellen Kratz [4]; Jeffrey S. Gerber, MD, MSCE, PhD [2-4] for the CDC Prevention Epicenters Program

[1]Division of Infectious Diseases, Department of Medicine; [2]Department of Biostatistics and Epidemiology; [3]Center for Clinical Epidemiology and Biostatistics; [4]Department of Pediatrics, Children's Hospital of Philadelphia (CHOP); [5]Centers for Disease Control and Prevention (CDC); Department of Medicine; Perelman School of Medicine, University of Pennsylvania, Philadelphia, PA, USA

Background

- Marked increases in antibiotic resistance
  - Antibiotic use is primary driver
  - Most antibiotic use occurs in outpatient settings
- Antibiotic stewardship programs (ASPs) have had success in curtailing inappropriate antibiotic use
  - ASP programs time- and labor-intensive
- To expand reach of ASPs, need to more efficiently target ASP efforts
  - Major challenge is lack of accurate and accessible electronic data to target interventions.

Objective

- To develop and validate an electronic algorithm to identify inappropriate antibiotic use in adult outpatients with pharyngitis

Methods

- Study sites
  - Outpatient practices of the University of Pennsylvania Health System
    - Academic and non-academic practices
    - Internal Medicine and Family Medicine
  - Shared electronic health record (EHR): EpicCare®
- Study period: 3/15/17 – 3/14/18
- Inclusion criteria
  - ICD-10 codes to identify acute pharyngitis encounters

ICD-10 Code	ICD-10 Code Description
J02.0	STREPTOCOCCAL PHARYNGITIS
J02.8	ACUTE PHARYNGITIS DUE TO OTHER SPECIFIED ORGANISMS
J02.9	ACUTE PHARYNGITIS, UNSPECIFIED
J03.00	ACUTE STREPTOCOCCAL TONSILLITIS, UNSPECIFIED
J03.80	ACUTE TONSILLITIS DUE TO OTHER SPECIFIED ORGANISMS
J03.90	ACUTE TONSILLITIS, UNSPECIFIED
J06.0	ACUTE LARYNGOPHARYNGITIS

- Exclusion criteria
  - Excluded subjects with encounters not designated as "office visit" (i.e., "laboratory visit", "procedure visit", "telephone visit")
  - Complex chronic conditions
  - Use of immunocompromising drug in past year
  - ICD-10 code at the same visit for a common concurrent infection
    - Sinusitis, pneumonia, otitis, pharyngitis, tonsillitis, genitourinary infection, skin infections.

Contact: Ebbing Lautenbach, MD, MPH, MSCE
ebbing@pennmedicine.upenn.edu; 215-898-6977

Methods (cont)

- Randomly selected 300 subjects
  - 150 academic / 150 non-academic
- Data collected:
  - Demographics, type of practice, type of prescriber
  - Antibiotic use and diagnosis of bronchitis/pharyngitis in past 30 days; allergy history
  - At encounter: antibiotic prescribed (yes/no); antibiotic choice, antibiotic duration; laboratory data; justification for prescribing.
- Data collected using two separate approaches
  1) manual chart review of the EHR
  2) review of EHR-based electronic database
- Manual EHR review performed by experienced research coordinator
  Random sample reviewed by investigators
- EHR-based approach used all data in database
  Demographics, allergy, diagnoses, prescribing, lab data
  Recognition some data (e.g., progress note information) would only be available on manual chart review
- Manual EHR review considered to be gold standard for analyses
- Criteria for Inappropriateness
  - Decision to prescribe: appropriate only if a rapid streptococcal antigen test was documented
  - Choice of antibiotic: penicillin or amoxicillin
    - If history of beta-lactam allergy, any antibiotic appropriate
  - Duration: ≤ 10 days considered appropriate
- Assessment of EHR-database test charcteristics
  - EHR-database compared to the gold standard EHR review to assess test characteristics of the electronic algorithm in determining appropriateness of 1) decision to prescribe; 2) antibiotic choice; 3) duration of antibiotic use
- Sensitivity, specificity, positive predictive value, negative predictive value

Results

- 7,412 unique "office visit" encounters with ICD-10 code for pharyngitis
  - 70 (0.94%) excluded for having a complex chronic condition
  - 36 (0.49%) excluded for having an immunocompromising drug
  - 601 (8.1%) excluded for having a concurrent infection
    - E.g., Sinusitis=423, otitis=158, skin infection=26, pneumonia=16
- Overall, 691 (9.3%) subjects excluded for at least one criterion.
- Demographics
  - Median age was 42.0 (Interquartile range: 30.6-53.6)
  - 225 (75.0%) subjects were female
  - 193 (64.3%) Internal Medicine practices
  - 107 (35.7%) Family Medicine practices
  - 207 (69.0%) Physician
  - 93 (31.0%) Advanced practice providers (APPs).

Results (cont)

Appropriateness based on EHR manual review
Decision to prescribe
- 206 (68.7%) subjects determined to have correct prescribing, including:
  - No antibiotic prescribed (n=173)
  - Antibiotic prescribed in setting of a positive test (n=29)
  - 4 subjects (on manual EHR review) had other indication for antibiotic
  - Overall, 94/127 (74%) subjects received an antibiotic inappropriately
Antibiotic choice
- Of 29 subjects with appropriate prescribing, 27 (93%) received correct agent; 3 with beta-lactam allergy noted only on manual EHR review
Antibiotic duration
- Of these 29 subjects, 29 (100%) had correct duration

Test characteristics of the EHR algorithm (compared to chart review)

Test Characteristic	Value
Inappropriate Prescribing	
Sensitivity	100% (94/94)
Specificity	97% (200/206)
Positive Predictive Value	94% (94/100)
Negative Predictive Value	100% (200/200)
Inappropriate Agent	
Sensitivity	100% (2/2)
Specificity	100% (25/25)
Positive Predictive Value	100% (2/2)
Negative Predictive Value	100% (25/25)
Inappropriate Duration	
Sensitivity	NA (0/0)
Specificity	100% (27/27)
Positive Predictive Value	NA (0/0)
Negative Predictive Value	100% (27/27)

Conclusions

- Inappropriate antibiotic prescribing for acute pharyngitis is common
- Electronic algorithm for identifying inappropriate prescribing, antibiotic choice, and duration is highly accurate
- Algorithm could be used to efficiently assess prescribing among practices and individual clinicians. The impact of interventions based on this algorithm should be tested in future work.

Disclosure

- Authors disclose no possible financial or personal conflicts of interest
- Approved by Institutional Review Board of the Univ of Pennsylvania.
- The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the CDC.

Acknowledgements