Supplement Methods

Intervention

Educational sessions: Educational sessions were conducted in-person by an infectious diseases specialist, though providers also had the option to watch a pre-recorded video. The sessions focused on evidence-based recommendations for common respiratory tract infections (RTIs), including sinusitis, bronchitis, pharyngitis, community acquired pneumonia, otitis media, and pertussis. In particular, the sessions highlighted key diagnostic criteria to use in deciding whether to prescribe antibiotics for these six conditions, as well as guideline-recommended antibiotic selection. Additionally, these sessions provided guidance on improving communication with patients surrounding antibiotic prescribing, specifically addressing common provider concerns regarding patient expectations in cases where an antibiotic is not indicated. Four key recommendations were made: (1) giving a clear diagnosis, including explaining non-bacterial causes of symptoms (e.g. viral, allergic); (2) making a negative treatment recommendation about antibiotics not being necessary (when not indicated); (3) making a positive treatment recommendation about treatments to help manage symptoms; and (4) providing a contingency plan about expectations regarding symptoms and when a patient should contact their provider again [1, 2]. Providers were also given pre-written text that could be readily provided to patients through the electronic health record (EHR) containing explanations of each diagnosis as well as positive treatment recommendations. During the educational sessions, providers were also introduced to the monthly feedback reports that they would subsequently begin receiving.

Peer comparison feedback reports: In monthly feedback reports, providers received information comparing their percentage of RTD visits with an antibiotic prescription to (1) the mean percentage of all University of Pennsylvania Health System (UPHS) primary care providers, (2) the mean percentage within a cohort of providers with patients with similar mean Charlson Comorbidity Index (CCI) scores, and (3) the provider with the lowest prescribing for each metric with at least 20 monthly observations. Providers were also told their prescribing quartile for each metric.

ICD-10-CM codes: ICD-10-CM codes in ambulatory care are entered by the provider in the EHR following completion of each visit for billing purposes; providers do not receive formal training in selection of these codes.

Ethical oversight: UPHS ambulatory leadership agreed to participation on behalf of practices. Patients were exempted from consent for participation in this study given the infeasibility of consent of a large population and given that the intervention only involved implementation of standard of care practices.

Statistical analysis

To build the multivariable model, mixed effects univariate analysis was performed for each variable of interest; variables with an odds ratio (OR) significant at a p-value of <0.25 were considered for inclusion in the final model. Interaction was assessed between visit diagnosis tier and the intervention, given the hypothesis that the intervention would have a larger effect on tiers 2 and 3, compared to tier 1. Month and year were included separately in the model, allowing for adjustment for both seasonal variation in antibiotic prescribing (month variable) and secular trends in antibiotic prescribing over the study period (year variable). Variables were added to the model one at a time, and all variables found to be significant ($p<0.05$) upon addition were included in the final model. A McKelvey & Zavoina Pseudo-R2 was calculated.

Supplement Table 1: *International Classification of Diseases, Tenth Revision, Clinical Modifica*tion (*ICD-10-CM*) codes for all respiratory tract conditions included, grouped by diagnosis tier

	***ICD-10-CM* Code**
Tier 1 diagnoses (antibiotic almost always indicated) Bacterial/unspecified pneumonia, miscellaneous other respiratory bacterial infections	A20.2 (pneumonic plague), A21.2 (pulmonary tularemia), A22.1 (pulmonary anthrax), A36.0 – A36.2 (pharyngeal/nasopharyngeal/laryngeal diphtheria), A37 (whooping cough), A48.1 (Legionnaires' disease), A70 (*Chlamydia psittaci* infections), D57.01/D57.211/D57.411/D57.811 (sickle cell disease with acute chest syndrome), H70 (mastoiditis), J02.0 (streptococcal pharyngitis), J03.0 (streptococcal tonsillitis), J13-J18 (bacterial pneumonia), J36 (peritonsillar abscess), J39.0/J39.1 (pharyngeal abscess), J85 (lung/mediastinal abscess), J86 (pyothorax), J95.851 (ventilator associated pneumonia), J98.51 (mediastinitis)
Tier 2 diagnoses (antibiotic may be indicated) Pharyngitis, sinusitis, suppurative/unspecified otitis media, COPD/bronchiectasis with acute exacerbation, other respiratory conditions	A38 (scarlet fever), H66 (suppurative/unspecified otitis media), H67 (other otitis media), J01 (acute sinusitis), J02.8/J02.9 (acute pharyngitis), J03.8/J03.9 (acute tonsillitis), J05.1 (acute epiglottitis), J32 (chronic sinusitis), J34.0 (nasal abscess), J44.0/J44.1 (COPD with acute exacerbation), J47.0/J47.1 (bronchiectasis with acute exacerbation), J95.02 (infection of tracheostomy stoma), O29.01 (aspiration pneumonitis due to anesthesia during pregnancy), O74.0 (aspiration pneumonitis due to anesthesia during labor and delivery), O89.0 (pulmonary complications of anesthesia during the puerperium)
Tier 3 diagnoses (antibiotic rarely indicated) Asthma, allergy, bronchitis (acute/unspecified), influenza, viral pneumonia, non-suppurative otitis media, viral upper respiratory infection, chronic bronchitis, emphysema, other respiratory conditions	B01.2 (varicella pneumonia), B05.2 (measles complicated by pneumonia), B25.0 (cytomegaloviral pneumonia), B34.0 (adenovirus infection), B34.2 (coronavirus infection), B44.81 (allergic bronchopulmonary aspergillosis), B97.0 (adenovirus infection), B97.2 (coronavirus infection), B97.4 (respiratory syncytial virus infection), B97.81 (human metapneumovirus infection), B97.89 (other viral infection), D86.0/D86.2 (sarcoidosis of the lung), H65 (non-suppurative otitis media), H68 (Eustachian salpingitis), H69 (other Eustachian tube disorders), J00 (acute nasopharyngitis), J04 (acute laryngitis/tracheitis), J05.0 (acute obstructive laryngitis), J06 (acute upper respiratory infections), J09/J10/J11 (influenza infection), J12 (viral pneumonia), J20 (acute bronchitis), J21 (acute bronchiolitis), J22 (other acute lower respiratory infection), J30 (vasomotor/allergic rhinitis), J31 (chronic rhinitis/nasopharyngitis/pharyngitis), J33 (nasal polyp), J34.1 – J34.9 (other nasal disorders), J35 (chronic diseases of tonsils/adenoids), J37 (chronic laryngitis/tracheitis), J38 (vocal cord/laryngeal diseases), J39.2 – J39.9 (other upper respiratory tract diseases), J40 (unspecified bronchitis), J41/J42 (chronic bronchitis), J43 (emphysema), J44.9 (COPD), J45 (asthma), J47.9 (bronchiectasis), J60/J61/J62/J63/ J64/J65/J66 (pneumoconiosis), J67/J68/J69/J70 (pneumonitis), J80 (acute respiratory distress syndrome), J81 (pulmonary

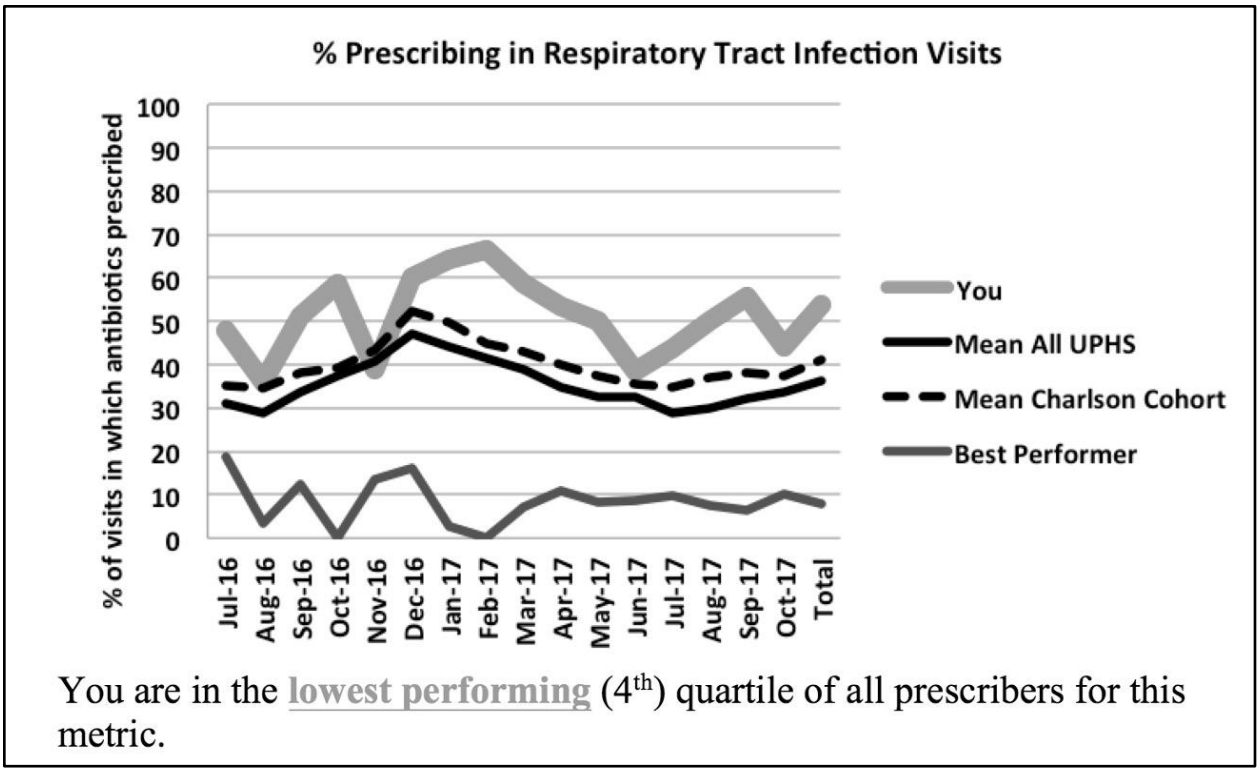
	edema), J82 (pulmonary eosinophilia), J84 (other interstitial pulmonary diseases), J90/J91 (pleural effusion), J92 (pleural plaque), J93 (pneumothorax), J94 (other pleural conditions), J95 (except J95.02 and J95.851) (intraoperative/postprocedural respiratory complications), J96 (respiratory failure), J98 (except J98.51)/J99 (other respiratory disorders), M34.81 (systemic sclerosis with lung involvement), R04.2/R04.8/R04.9 (hemoptysis/other respiratory tract bleeding), R05 (cough), R06.0 (dyspnea), R06.1 (stridor), R06.2 (wheezing), R06.3 (periodic breathing), R06.4 (hyperventilation), R06.8/R06.9 (other breathing abnormalities), R07.0 (throat pain), R09.0 (asphyxia/hypoxemia), R09.1 (pleurisy), R09.3 (abnormal sputum), R09.81 (nasal congestion), R09.82 (postnasal drip), T78.4 (other allergy)

Abbreviation: COPD = chronic obstructive pulmonary disease

Supplement Table 2. Percentage of encounters with an antibiotic prescription in the pre-intervention and intervention periods, by practice

Practice	Pre-intervention antibiotic prescription (%)	Intervention antibiotic prescription (%)
1	20.9	16.7
2	12.3	12.3
3	30.3	25.7
4	22.1	14.7
5	38.9	28.1
6	23.5	20.5
7	49.7	18.9
8	39.2	28.7
9	28.9	23.6
10	39.3	28.5
11	55.4	33.9
12	8.0	2.8
13	36.4	22.2
14	17.4	13.1
15	47.4	29.9
16	70.6	53.4
17	17.7	11.4
18	12.4	5.6
19	24.7	14.7
20	33.7	17.2
21	49.0	29.6
22	12.8	9.7
23	28.9	13.7
24	51.1	27.7
25	14.1	9.4
26	9.7	7.4
27	49.5	26.8
28	37.2	22.5

29	63.8	49.7
30	41.6	22.5



Supplement Figure 1. Example of provider feedback report. Mean Charlson Cohort refers to a cohort of providers with patients with similar mean Charlson Comorbidity Index (CCI) scores. Abbreviation: UPHS = University of Pennsylvania Health System

Supplement References:

1. Heritage J, Elliott MN, Stivers T, Richardson A, Mangione-Smith R. Reducing inappropriate antibiotics prescribing: the role of online commentary on physical examination findings. Patient Educ Couns **2010**; 81(1): 119-25.
2. Kronman MP, Gerber JS, Grundmeier RW, et al. Reducing Antibiotic Prescribing in Primary Care for Respiratory Illness. Pediatrics **2020**; 146(3): e20200038.