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Inappropriate Antibiotic Prescribing: A Quality Improvement Project in Urgent Care

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ABSTRACT

Background: *Antibiotics are overused. Resistance rates continue to increase, unnecessary money is spent, and often unwanted side effects follow. Reducing antibiotic resistance rates is a call to action for healthcare providers (HCP), pharmaceutical companies, patients, patient family members, and agricultural breeders.The purpose of this QI project wasto use an algorithm as a clinical support tool to assist providers practicing in an urgent care setting to reduce the number of antibiotics prescribed for common acute respiratory infections (ARIs) such as pharyngitis, sinusitis, and bronchitis.*

Methods: *The project setting was one urgent care system between two locations within the Dallas Metroplex with an annual volume of 16,000 patients. As a QI project, six providers were educated on and asked to review an algorithm tool prior to prescribing antibiotics for ARIs related complaints based on designate diagnoses (acute pharyngitis, acute sinusitis, and acute bronchitis). Using data obtained from EHR, the project compared the number of antibiotics prescribed for ARI related complaints in the intervention period compared to baseline period from same timeframe of previous year's prescribing rates.*

Results: *Project findings confirmed the project aim for this quality improvement project that using a clinical decision support algorithm tool leads to significant decreased antibiotic prescribing rates for the acute respiratory illnesses of acute pharyngitisX2 (1, N = 95) = 23.69, p = 0.000, acute sinusitisX2 (1, N = 94) = 9.94, p = 0.003, and acute bronchitisX2 (1, N = 95) = 23.69, p = 0.000.*

Conclusion: *A clinical decision support tool such as an algorithm along with patient and provider education can reduce antibiotic overuse burden. Unnecessary antibiotic prescribing for the treatment of acute respiratory illnesses has continued risks to patients and the community.*

Keywords : ***antibiotics, overuse, pharyngitis, sinusitis, bronchitis, clinical support tool, resistance rates, infections***

Introduction

Antibiotic overprescribing by healthcare providers (HCP) in the treatment of acute respiratory infections (ARIs) in primary care settings continues to be a nation-wide problem (Jones-Holley & Goodwin, 2015). In the United States, of 101 million ambulatory visits in which antibiotics were prescribed, 41% of all antibiotics were for respiratory tract infections (Hingorani, Mahmood, &Alweis, 2015). Jones-Holley and Goodwin (2015) identified that 60% of ARIs treated in the primary care setting involve the use of an antibiotic. Up to 25 million people in the United States are seen by their primary care provider for ARIs each year. Even with validated guidelines, up to 73% of adults will receive an antibiotic prescription for these ARIs visits(Hingorani, Mahmood, & Alweis, 2015). The improper use of antibiotics can impact the quality of care, economics, patient outcomes, and antibiotic resistance rates. In the United States, 2 million antibiotic-resistant illnesses and 23,000 deaths occur every year costing over $30 billion (Harris, Hicks, &Qaseem, 2016).

Upper respiratory infections (URIs) are defined as an acute infection of the respiratory tract involving the nasal passage, pharynx, larynx, and sinuses. The ARIillnesses are usually self-limiting with symptoms peaking at 1-3 days and lasting 7-10 days; however, can last up to 3 weeks (Allan &Arroll, 2014). Bronchitis is common self-limiting disease defined as a transient inflammation of the trachea and major bronchi. Diagnosis of bronchitis is generally clinical with symptoms of cough, sputum, dyspnea, and wheeze (Wark, 2015).

Acute respiratory infections are the most common presenting complaint in the ambulatory primary care setting(Jones-Holly & Goodwin, 2017). The high rate of antibiotic prescriptions from primary care and internal medicine clinics along with urgent care centers may be due to lack of treatment guidelines or algorithms being adopted at each center unifyingthe prescribing habits across the HCPs in the treatment of ARIs. These visual guidelines could be alow-cost effective start to a practice's antibiotic stewardship program(Lunn, 2017).

Literature Review

In a quality improvement study,Hingorani, Mahmood, andAlweis (2015) compared retrospective baseline data with that of interventional data using an EHR implemented clinical decision support tool (CDS) to guide clinicians using a visual guideline tool depicting when to prescribe antibiotics in acute URIs, sinusitis, or pharyngitis encounters. The inclusion of this clinical decision support tool positively influenced the prescribing habits of clinicians leading to a significant improvement of guideline adherence in antibiotic prescribing for all three diagnoses.

Gonzales et al. (2013) in a randomized controlled trial,divided 33 primary care clinics into 3 equal groups: printed decision support site, computerized decision support site, and control groups. A total of 9,808 patient encounters from both baseline and intervention periods for acute respiratory illnesses were included in the study. Using the EHR to obtain data, both the printed and computerized groups demonstrated a clinically significant reduction in antibiotic prescribing comparing baseline to interventional periods. In the control group, rates increased from baseline to intervention period. This study supports the use of a clinical decision support tool, either printed or computerized, to reduce antibiotic prescribing rates for acute respiratory illnesses in primary care settings.

Ina randomized control study, McGinn, McCullah, andKannry (2013) used clinical decision support tools for pneumonia and streptococcal pharyngitis by integrating the Heckerling and Walsh prediction rules in the EHR. The clinicians were divided between a study and a control group. A total of 984 patients were seen during the study period. The intervention group had a high adoption rate for the use of the clinical decision support tool, displayed a clinically significant reduction in antibiotics prescribed, and ordered fewer streptococcal tests. This study shows that implementation of a clinical decision support tool can decrease antibiotic overuse in patients who present with pharyngitis and pneumonia-related complaints.

Balcioglu, Culhaci, Tirpan, and Turan (2017) in a randomized controlled study, divided 34 family physicians into algorithm and control groups. The algorithm group used the McIsaac criteria and would prescribe an antibiotic if the score exceeded 60%. Of the 460 patients seen for upper respiratory symptoms, antibiotics were given 88 times. A significant reduction in antibiotics was prescribed in algorithm group compared to the control group. In this study, the use of an algorithm influenced a decreased rate of antibiotic prescribing for acute respiratory illnesses.

A quality improvement (QI) project by Jones-Holly and Goodwin (2017) took place in two urgent care clinics during the winter months. Ten clinicians participated in the QI project. A clinical pathway algorithm was created for each diagnosis (nasopharyngitis, bronchitis, sinusitis, and URI) and posted at each provider workstation. A retrospective baseline data was obtained from the EHR and compared to the implementation data displaying with a significant reduction in antibiotics prescribed during the intervention period in compared to baseline period. This QI project used education of clinicians with EBP guidelines, visual clinical pathway algorithms, and provider feedback to reduce unnecessary antibiotics prescribed for acute respiratory complaints in the urgent care setting.

A randomized control trial by Jenkins et al. (2013) using 8 internal medicine/family practice clinics divided between the study and control group. The study group used clinical pathway algorithms for 8 common adult and pediatric outpatient infections (URI, bronchitis, sinusitis, pharyngitis, otitis media, urinary tract infections, skin and soft tissue infections, and pneumonia). The algorithms were one page, easy to read with indications when an antibiotic should be prescribed, the optimal antibiotic of choice, and shortest beneficial length of treatment. The algorithms were place in each exam room, each clinician area, and available in digital format. A peer champion was also appointed at each location to promote use of these pathways. A retrospective 2-year baseline data were selected form the EHR and compared to intervention data. A significant reduction of antibiotics was prescribed during study period compared to baseline period. Clinical pathway algorithms coupled with a clinic champion is an effective method to reduce antibiotic overuse in the internal medicine/family practice settings.

Summary

A nationwide effort by the Centers for Diseases Control and Prevention (CDC), the Joint Commission, and the President's Council of Advisors on Science and Technology is underway to promote antibiotic stewardship to combat increasing antibiotic resistance rates. Many hospitals and long-term nursing facilities have antibiotic stewardship programs (ASPs) in place (Baker, 2018). In primary care settings, the rate of antibiotics prescribed for adults continues to remain elevated (Harris et al., 2016). The evidence demonstrated in this review of the literature suggests that incorporating evidence-based algorithms as either clinical pathways or a clinical decision support tool along with provider and patient training can lead to a decrease in unnecessary antibiotic prescriptions for acute respiratory infections--therefore decreasing the financial burden and lessening the antibiotic-resistant rates.

Framework

The Donabedian's Quality Framework (See Figure 1) was applied for this QI project. The model evaluates the three main components of any care process: Structures, Processes, and Outcomes (McDonald, Sundaram, &Bravata, 2007). Structures are defined as infrastructure, demographics, technology, education, and facilities. Processes are defined as the diagnosis, treatment, appropriateness, process of care, and resource requirements. Outcomes are defined as measures of mortality, morbidity, costs, factors creating costs, and quality of life (Lighter, 2015).

To reduce the rates of unnecessary antibiotics,the existing system structures, processes, and outcomes were examined.The current structure for the diagnosis and treatment of ARIs is for theclinicianto rely on their education, situational pressures (i.e., time constraints, patient/family demands, and peer pressure), and experience to determine when an antibiotic should be prescribed. The current process is to evaluate the patient and at the clinician's discretion an antibiotic is either prescribed or not. The current outcomes in literature indicate a significant number of acute respiratory visits are receiving antibiotic prescriptions unnecessarily with potential for poor outcomes and harm. Alteringthis structure of care to educate clinicians with current best evidence-based practices and changing the process toinclude reviewing a clinical decision support algorithm tool prior to prescribing antibiotics can lead toa reduced number of antibiotics prescribed for acute respiratory infections with the potential of improved outcomes and less harm.

Project Objective

In (P) ambulatory care patients age range 14 to 64 years old with suspected acute respiratory infection (ARIs), does a (I) clinical algorithm consisting of a decision-support flow chart (O) decrease antibiotic prescriptions compared to (C) normal prescribing habits over (T) a 30-day intervention period?

The objective of this quality improvement (QI) project was to measure antibiotic prescribing rates for ARIs by comparing retrospective baseline prescribing rates to intervention prescribing rates. The aim of this QI project is to reduce the prescribing rates of antibiotics in acute respiratory illness with suspected viral etiologies. This project was evaluated and approved by UTA's Institutional Review Board (IRB).

Methods

Project Design

This is a quality improvement project. Utilizing baseline and intervention data, the effect of a clinical support algorithm tool on decreasing the number of unnecessary antibiotics prescribed was demonstrated. The project was accomplished in three stages. Stage one involved creating the algorithm tools, educating the clinicians, and then distributing tools. Stage two was the implementation of project, which took place from June 1, 2019 through June 30, 2019. Stage three involved collecting, validating, and synthesizing data results for quality improvement feedback.

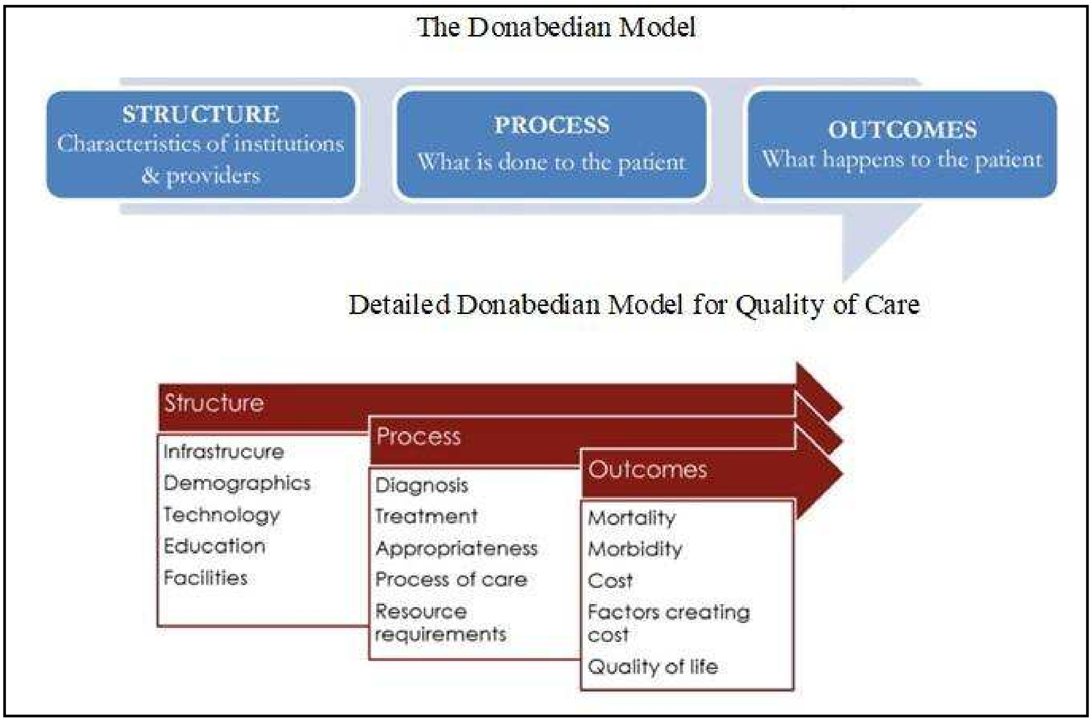


Figure 1. Diagram of Donabedian's quality framework of components and outcomes of care. Adapted from "The influence of early literacy competencies on later mathematical attainment: Evidence from TIMSS & PIRLS 2011," by Soto-Calvo, 2016, JRC Technical Reports. Retrieved April 14, 2019, from http://publications.jrc.ec.europa.eu/repository/bitstream/JRC102210/-lbna28010enn.pdf.

Population/Setting

Setting.Six prescribing clinicians participated in the QI project, all of whom rotated within one urgent care system between two locations in the Dallas Metroplex. These centers shared an EHR database and with a combined annual volume of 16,000 patients.

Sample. A convenience sampling of all visits for sinusitis, pharyngitis, and bronchitis diagnoses were selected from a retrospective 30-day baseline period and compared to 30-day intervention period.

Inclusion criteria. All patients age 14 through 64 years old presenting for the following ARI related complaint(s): acute pharyngitis, acute sinusitis, and acute bronchitis.

Exclusion criteria. Age range less than 14 or greater than 64, comorbidities such as chronic heart or lung diseases (excluding asthma), HIV, or malignancy, more than one visit for same diagnoses within the 30-day period, and visits where ARI was the secondary diagnoses to a condition indicating an antibiotic such as streptococcal pharyngitis, otitis media, or pneumonia.

Measure Methods

The Electronic Health Record (EHR) was utilized to retrieve the retrospective 30-day baseline and implementation project data. Printed algorithm support tools were utilized for clinical decision support. Due to software limitations, the algorithms were not electronically incorporated in the EHR for this project.

Procedure

Pre-intervention

A retrospective set of 30-day baseline data was collected from EHR for the QI project. All patient encounters from this time frame with diagnosis of acute pharyngitis, acute sinusitis, and acute bronchitis were reviewed to establish baseline prescribing rates. Demographic data was collected from EHR records such as age, gender, and diagnoses (acute pharyngitis, acute sinusitis, and acute bronchitis). Additional clinical data was collected such as the antibiotic prescribed, the duration of treatment, whether intended as a delayed prescription, prescriber, repeat visits for same illness within the 30 days and if any concurrent diagnosis was made requiring the use of antibiotics. This clinical and demographic data were collected using an MS Excel spreadsheet document and uploaded to an electronic, password-protected Google Drive, which will be deleted after three years. No patient identifying information was collected or stored.

Intervention. Three clinical algorithm tools were created and printed in an easy to read 8.5” x 11” paper format. The tools were based on current best evidence as distributed by entities of authority such as Centers for Disease Control and Prevention (CDC), American Academy of Otolaryngology-Head and Neck Surgery, and Infectious Diseases Society of America.

All clinicians received an email containing a letter describing the objective, methods, and design of the QI project. A copy of each clinical algorithm tool was included as a PDF attachment (See Figures 2, 3, and 4). The clinical algorithms were presented along with a 30-minute training session during a monthly provider meeting prior to project implementation. A laminated copy of each algorithm was placed at every provider workstation and posted in exam rooms. Following each intervention period week an email reminder was sent to each participating provider. All clinicians had worked asimilar number of shifts baseline compared to intervention.

Post-Intervention. Following the 30-day intervention period, using the EHR, all patient encounters from this timeframe with diagnosis of acute pharyngitis, acute sinusitis, and acute bronchitis were reviewed to establish baseline prescribing rates.Demographic data was collected such as age, gender, and diagnoses (acute pharyngitis, acute sinusitis, and acute bronchitis). Additional clinical data was collected such as the antibiotic prescribed, the duration of treatment, whether intended as a delayed prescription, prescriber, repeat visits for same illness within the 30 days and if any concurrent diagnosis was made requiring the use of antibiotics. Thisclinical and demographic data were collected using an MS Excel spreadsheet document and uploaded to an electronic, password-protected Google Drive, which will be deleted after three years. No patient identifying information was collected or stored.

Statistical Analysis

Data was imported from MS Excel spreadsheets into IBM SPSS Statistics Professional v25and analysis was performed.

Findings

All Groups Combined

A total of 260 encounters the patient as most likely to be 38 years old, female, and presenting for acute pharyngitis (See Tables 1, 2, & 3 below.)

Mean	38.8
Median	38
Std. Deviation	12.677
Minimum	14
Maximum	64

Table 1. Age Demographics

Gender	Frequency	Percent
Female	166	63.8
Male	94	36.2
Total	260	100

Table 2. Gender demographics

Diagnosis	Frequency	Percent
J01.90 – Acute Sinusitis	94	36.2
J02.9 – Acute Pharyngitis	95	36.5
J20.9 – Acute Bronchitis	71	27.3
Total	260	100

Table 3. Diagnosis by frequency

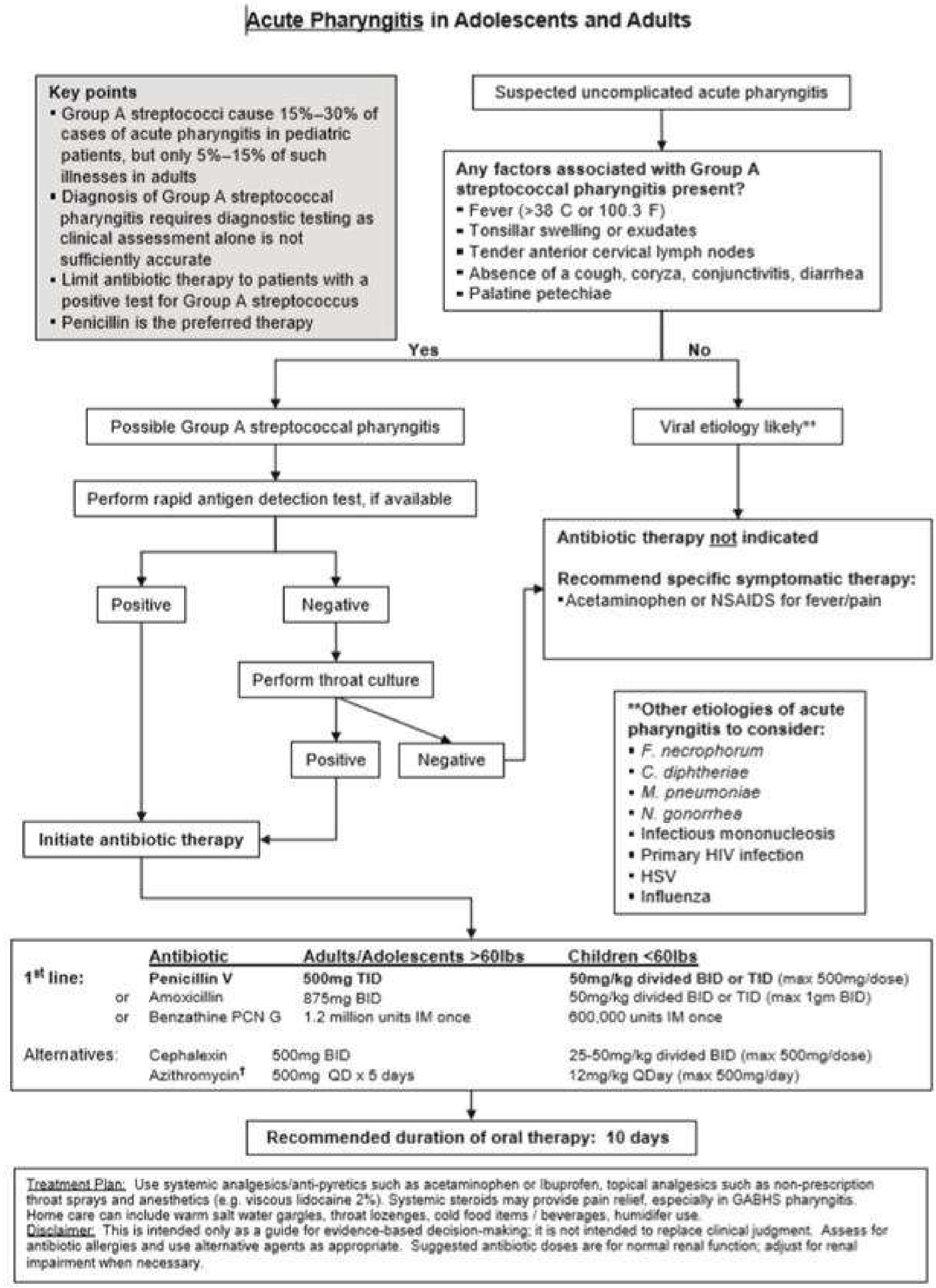


Figure 2

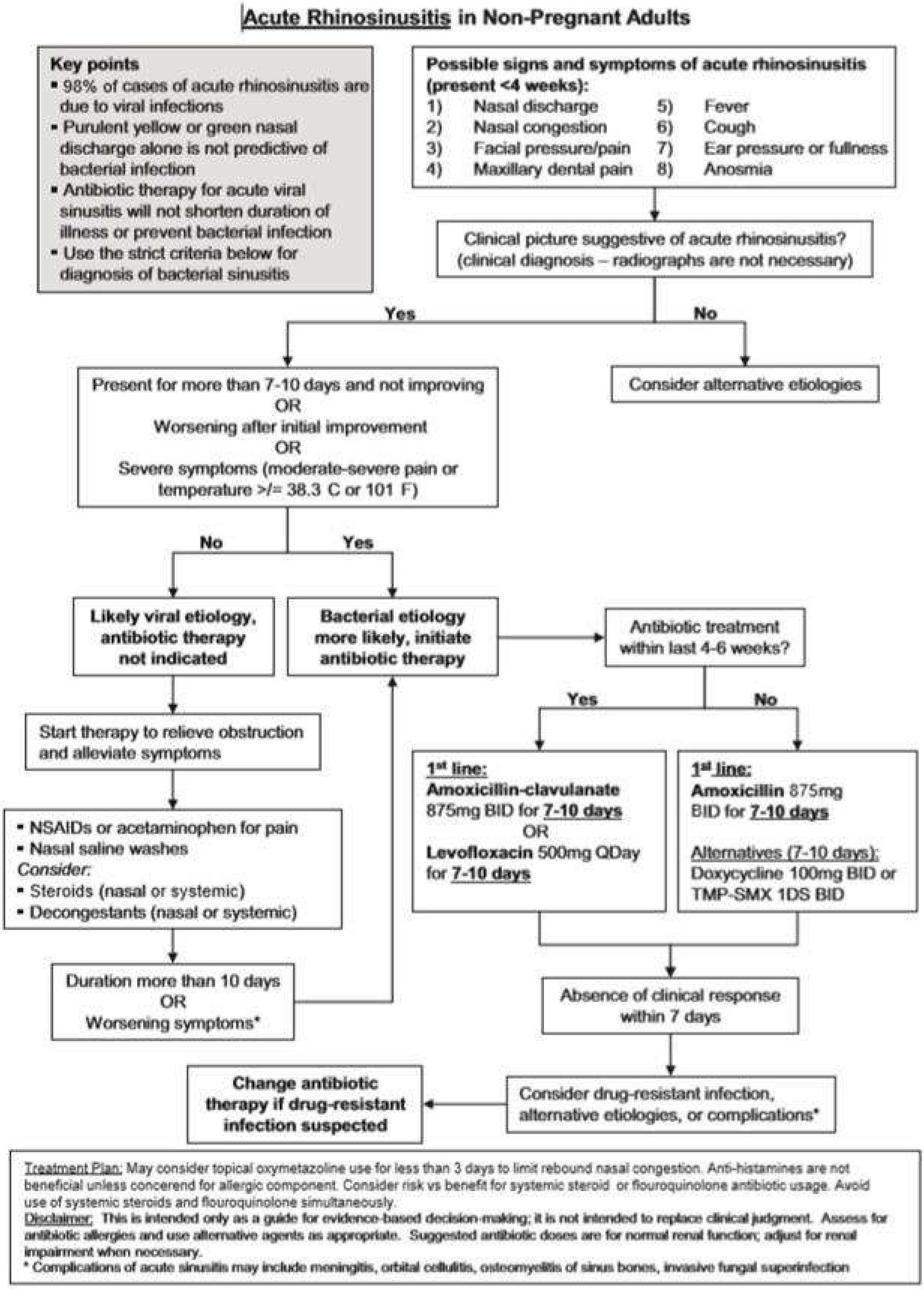

Acute Rhinosinusitis in Non-Pregnant Adults
Key points
▪ 98% of cases of acute rhinosinusitis are due to viral infections
▪ Purulent yellow or green nasal discharge alone is not predictive of bacterial infection
▪ Antibiotic therapy for acute viral sinusitis will not shorten duration of illness or prevent bacterial infection
▪ Use the strict criteria below for diagnosis of bacterial sinusitis
Possible signs and symptoms of acute rhinosinusitis (present <4 weeks):
1) Nasal discharge
2) Nasal congestion
3) Facial pressure/pain
4) Maxillary dental pain
5) Fever
6) Cough
7) Ear pressure or fullness
8) Anosmia
Clinical picture suggestive of acute rhinosinusitis? (clinical diagnosis – radiographs are not necessary)
Yes
No
Consider alternative etiologies
Present for more than 7-10 days and not improving OR Worsening after initial improvement OR Severe symptoms (moderate-severe pain or temperature >/= 38.3 C or 101 F)
No
Yes
Likely viral etiology, antibiotic therapy not indicated
Bacterial etiology more likely, initiate antibiotic therapy
Antibiotic treatment within last 4-6 weeks?
Start therapy to relieve obstruction and alleviate symptoms
▪ NSAIDs or acetaminophen for pain
▪ Nasal saline washes
Consider:
▪ Steroids (nasal or systemic)
▪ Decongestants (nasal or systemic)
Duration more than 10 days OR Worsening symptoms*
Yes
No
1st line: Amoxicillin-clavulanate 875mg BID for 7-10 days OR Levofloxacin 500mg QDay for 7-10 days
1st line: Amoxicillin 875mg BID for 7-10 days
Alternatives (7-10 days): Doxycycline 100mg BID or TMP-SMX 1DS BID
Absence of clinical response within 7 days
Consider drug-resistant infection, alternative etiologies, or complications*
Change antibiotic therapy if drug-resistant infection suspected
Treatment Plan: May consider topical oxymetazoline use for less than 3 days to limit rebound nasal congestion. Anti-histamines are not beneficial unless concerend for allergic component. Consider risk vs benefit for systemic steroid or flouroquinolone antibiotic usage. Avoid use of systemic steroids and flouroquinolone simultaneously.
Disclaimer: This is intended only as a guide for evidence-based decision-making; it is not intended to replace clinical judgment. Assess for antibiotic allergies and use alternative agents as appropriate. Suggested antibiotic doses are for normal renal function; adjust for renal impairment when necessary.
* Complications of acute sinusitis may include meningitis, orbital cellulitis, osteomyelitis of sinus bones, invasive fungal superinfection

Figure 3

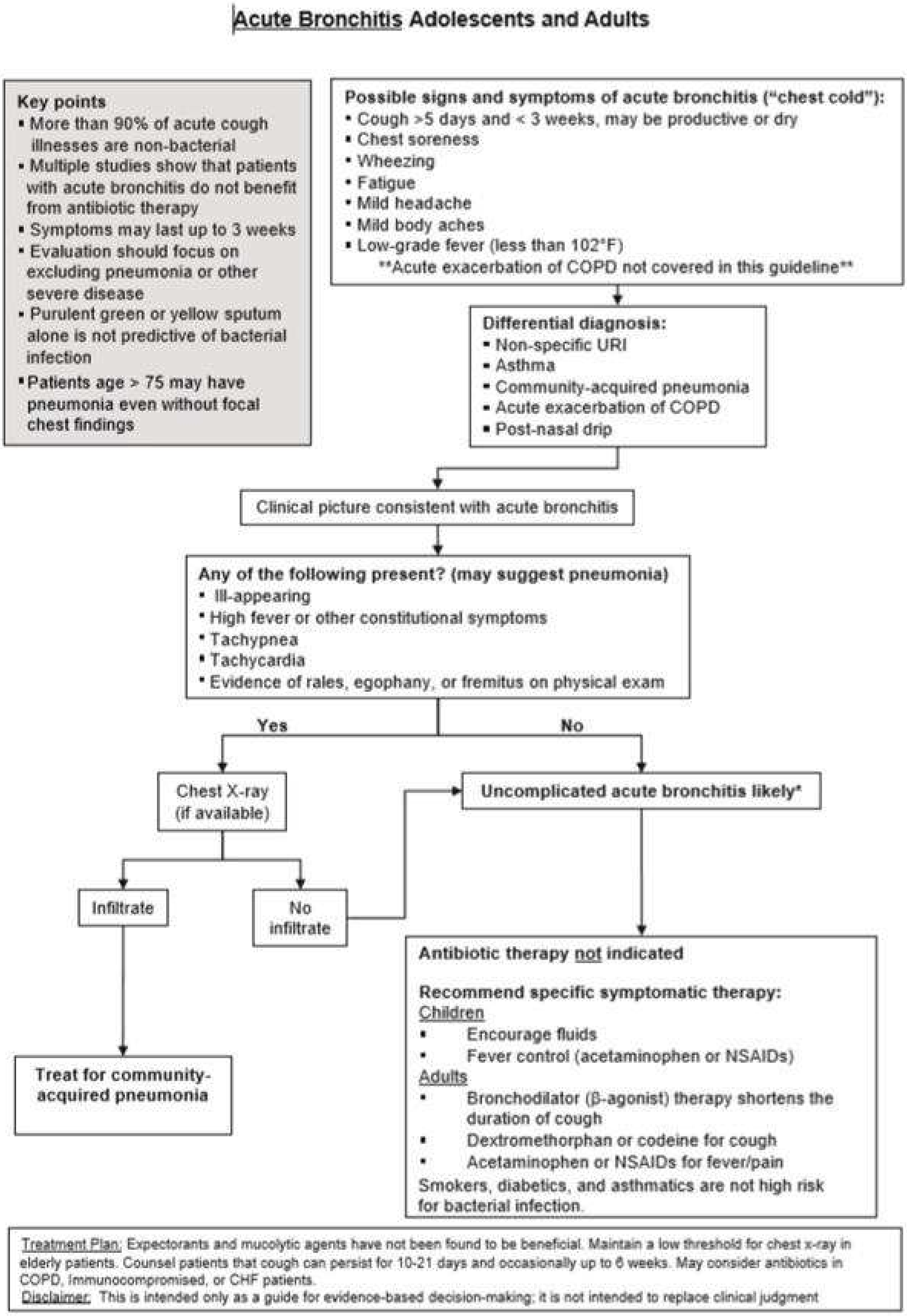
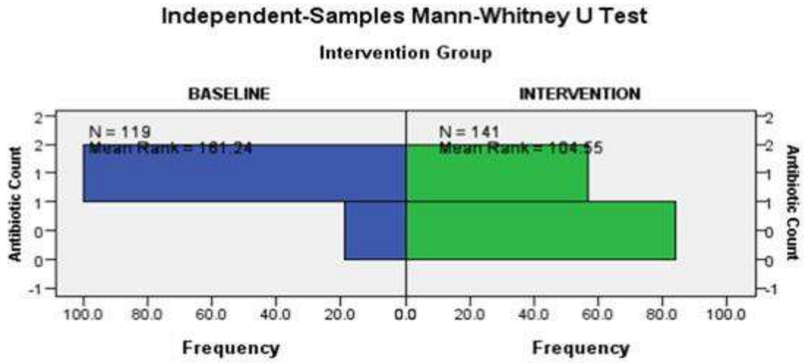

Acute Bronchitis Adolescents and Adults
Key points
▪ More than 90% of acute cough illnesses are non-bacterial
▪ Multiple studies show that patients with acute bronchitis do not benefit from antibiotic therapy
▪ Symptoms may last up to 3 weeks
▪ Evaluation should focus on excluding pneumonia or other severe disease
▪ Purulent green or yellow sputum alone is not predictive of bacterial infection
▪ Patients age > 75 may have pneumonia even without focal chest findings
Possible signs and symptoms of acute bronchitis ("chest cold"):
▪ Cough >5 days and < 3 weeks, may be productive or dry
▪ Chest soreness
▪ Wheezing
▪ Fatigue
▪ Mild headache
▪ Mild body aches
▪ Low-grade fever (less than 102°F)
Acute exacerbation of COPD not covered in this guideline
Differential diagnosis:
▪ Non-specific URI
▪ Asthma
▪ Community-acquired pneumonia
▪ Acute exacerbation of COPD
▪ Post-nasal drip
Clinical picture consistent with acute bronchitis
Any of the following present? (may suggest pneumonia)
▪ Ill-appearing
▪ High fever or other constitutional symptoms
▪ Tachypnea
▪ Tachycardia
▪ Evidence of rales, egophany, or fremitus on physical exam
Yes
No
Chest X-ray (if available)
Uncomplicated acute bronchitis likely*
Infiltrate
No infiltrate
Treat for community-acquired pneumonia
Antibiotic therapy not indicated
Recommend specific symptomatic therapy:
Children
▪ Encourage fluids
▪ Fever control (acetaminophen or NSAIDs)
Adults
▪ Bronchodilator (β-agonist) therapy shortens the duration of cough
▪ Dextromethorphan or codeine for cough
▪ Acetaminophen or NSAIDs for fever/pain
Smokers, diabetics, and asthmatics are not high risk for bacterial infection.
Treatment Plan: Expectorants and mucolytic agents have not been found to be beneficial. Maintain a low threshold for chest x-ray in elderly patients. Counsel patients that cough can persist for 10-21 days and occasionally up to 6 weeks. May consider antibiotics in COPD, Immunocompromised, or CHF patients.
Disclaimer: This is intended only as a guide for evidence-based decision-making; it is not intended to replace clinical judgment

Figure 4



Total N	260
Mann-Whitney U	4,731.000
Wilcoxon W	14,742.000
Test Statistic	4,731.000
Standard Error	511.766
Standardized Test Statistic	-7.149
Asymptotic Sig. (2-sided test)	.000

Figure 5

*Intervention Group * Antibiotic Count Crosstabulation*

			Antibiotic Count		
			No	Yes	Total
Intervention Group	BASELINE	Count	19	100	119
		% within Intervention Group	16.0%	84.0%	100.0%
	INTERVENTION	Count	84	57	141
		% within Intervention Group	59.6%	40.4%	100.0%
Total		Count	103	157	260
		% within Intervention Group	39.6%	60.4%	100.0%

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	51.302[a]	1	0.000		
Continuity Correction[b]	49.495	1	0.000		
Likelihood Ratio	54.365	1	0.000		
Fisher's Exact Test				0.000	0.000
N of Valid Cases	260				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 47.14.

b. Computed only for a 2x2 table

Figure 6 : Chi-square Test of Independence for All 3 Diagnosis Combined Comparing Baseline and Intervention

Chi-Square Tests

ICD10_CODE		Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
J01.90 - Acute Sinusitis	Pearson Chi-Square	9.939[a]	1	0.002		
	Continuity Correction[b]	8.165	1	0.004		
	Likelihood Ratio	9.997	1	0.002		
	Fisher's Exact Test				0.003	0.002
	N of Valid Cases	94				
J02.9 - Acute Pharyngitis	Pearson Chi-Square	23.688[c]	1	0.000		
	Continuity Correction[b]	21.659	1	0.000		
	Likelihood Ratio	24.415	1	0.000		
	Fisher's Exact Test				0.000	0.000
	N of Valid Cases	95				
J20.9 - Acute Bronchitis	Pearson Chi-Square	10.119[d]	1	0.001		
	Continuity Correction[b]	8.611	1	0.003		
	Likelihood Ratio	10.543	1	0.001		
	Fisher's Exact Test				0.003	0.001
	N of Valid Cases	71				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 5.66.

b. Computed only for a 2x2 table

c. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 15.58.

d. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 12.45.

Figure 7 : Chi-Square Test of Independence for Individual Diagnosis of Acute Sinusitis, Acute Pharyngitis, and Acute Bronchitis Comparing Baseline and Intervention.

All Diagnoses

A Mann-Whitney U test showed that there was a significant difference (U = 4,731, p = 0.000) between baseline group and intervention group antibiotic prescribing rates for all 3 diagnoses (See Figure 5). A chi-square test of independence was performed comparingbaseline and intervention periods (See Figures6 & 7). The relation between these variables was significant, X2 (1, N = 260) = 51.30, p = 0.000.

During the intervention period, clinicians were less likely to prescribe antibiotics for intervention visits than baseline visits for all diagnoses combined (See Figure 8 below).

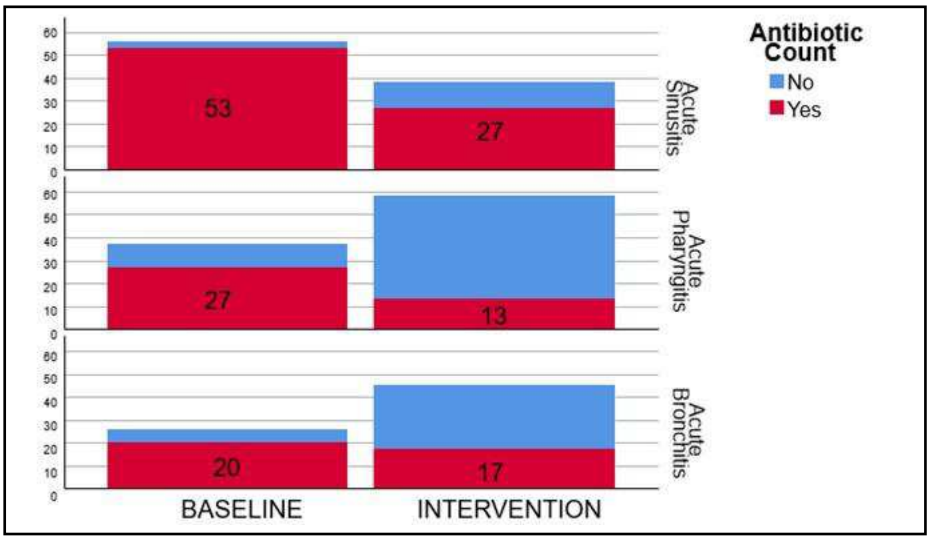


Figure 8. Stacked Histogram Count by Antibiotic Count by Diagnosis Acute Sinusitis

A chi-square test of independence was performed to examine the relationship of clinician prescribing of antibiotics for acute sinusitis visits between baseline and intervention timeframes (See Figure 9 below). The relationship between these two variables was significant. X2 (1, N = 94) = 9.94, p = 0.003. Clinicians were less likely to prescribe antibiotics for acute sinusitis visits during intervention period than baseline period (See Figure 9 below).

Acute Pharyngitis

A chi-square test was performed to examine the relationship of clinician prescribing of antibiotics for acute pharyngitis visits between baseline and intervention timeframes. The relationship between these two variables was significant. X2 (1, N = 95) = 23.69, p = 0.000. Clinicians were less likely to prescribe antibiotics for acute pharyngitis visits during intervention period than baseline period (See Figure 10 below).

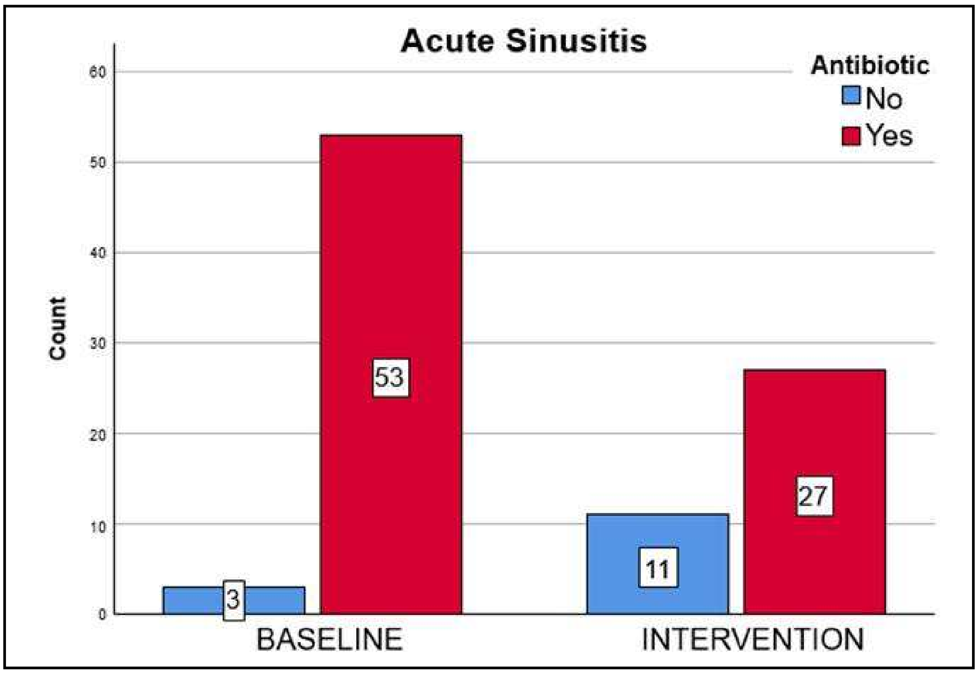


Figure 9. Bar graph comparing baseline to intervention prescription rates of antibiotics

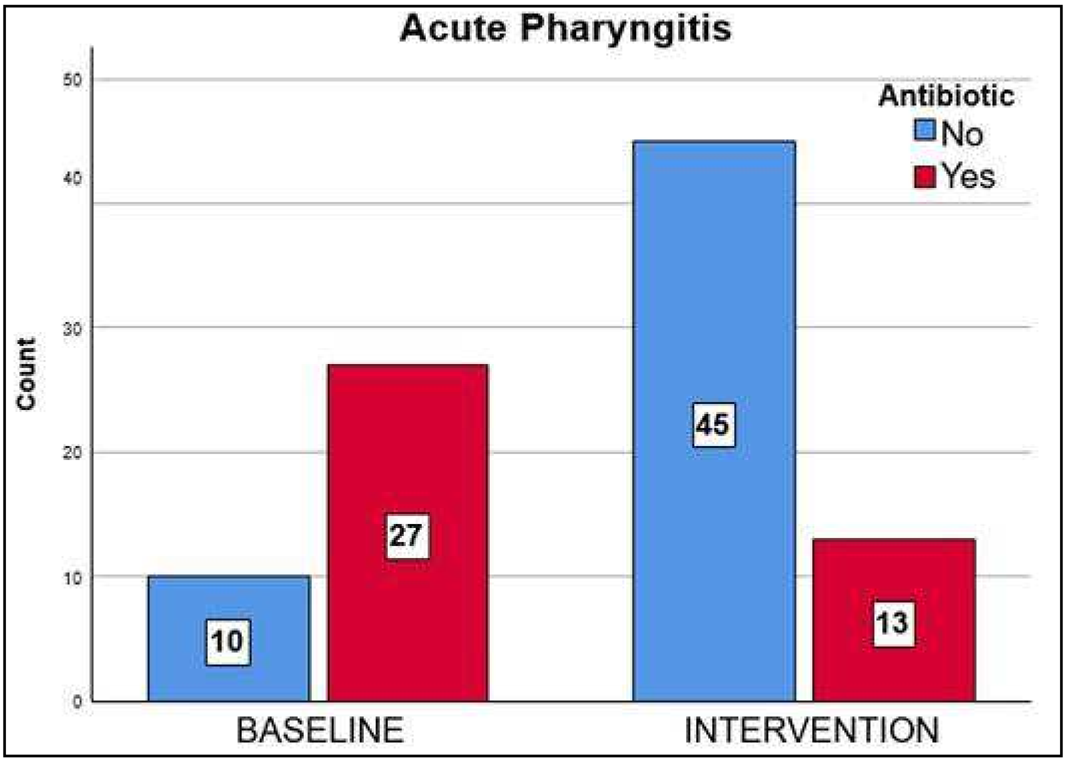


Figure 10. Bar graph comparing baseline to intervention prescription rates of antibiotics
Note: A streptococcal throat culture was sent out to laboratory in n = 65 encounters of which 16.9% (n = 11) cases were positive for group A streptococcus.

Acute Bronchitis

A chi-square test was performed to examine the relationship of clinician prescribing of antibiotics for acute bronchitis visits between baseline and intervention time frames. The relationship between these two variables was significant. X2 (1, N = 95) = 23.69, p = 0.000. Clinicians were less likely to prescribe antibiotics for acute bronchitis visits during intervention period than baseline period (See Figure 11 below).

Antibiotics

Augmentin was the most frequently prescribed medication with a mean treatment duration of 8.43 days (See Figure 12 below). Some encounters and some were prescribed due to other concurrent diagnoses requiring antibiotics (See Figures 13 &14 below).

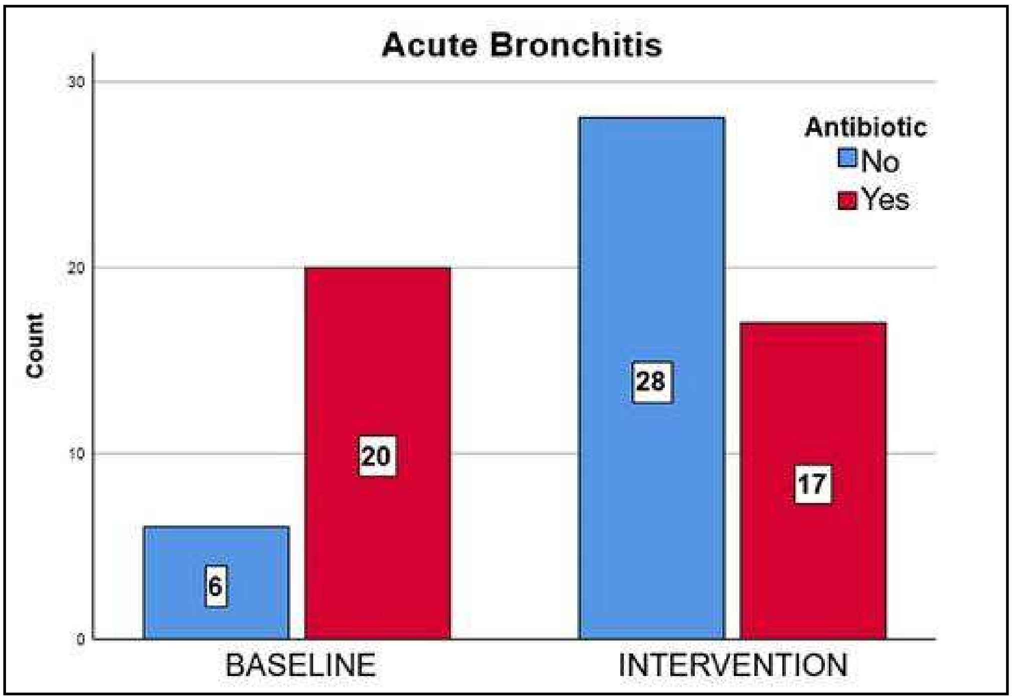


Figure 11. Bar graph comparing baseline to intervention prescription rates of antibiotics.

Baseline

Antibiotic Rx	Frequency	Percent
Amoxicillin	23	19.3
Augmentin	29	24.4
Azithromycin	23	19.3
Bactrim DS	1	0.8
Cefdinir	4	3.4
Doxycycline	19	16
Levaquin	1	0.8
No Abx Rx	19	16
Total	119	100

Intervention

Antibiotic Rx	Frequency	Percent
Amoxicillin	12	8.5
Augmentin	20	14.2
Azithromycin	17	12.1
Bactrim DS	0	0
Cefdinir	2	1.4
Doxycycline	5	3.5
Levaquin	0	0
Keflex	1	0.7
No Abx Rx	84	59.6
Total	141	100

Antibiotic Treatment Duration in Days

Mean	Median	Mode	Std. Dev	Min	Max
8.43	10	10	2.222	3	10

Figure 12. Table showing the frequency of antibiotics prescribed baseline compared to intervention

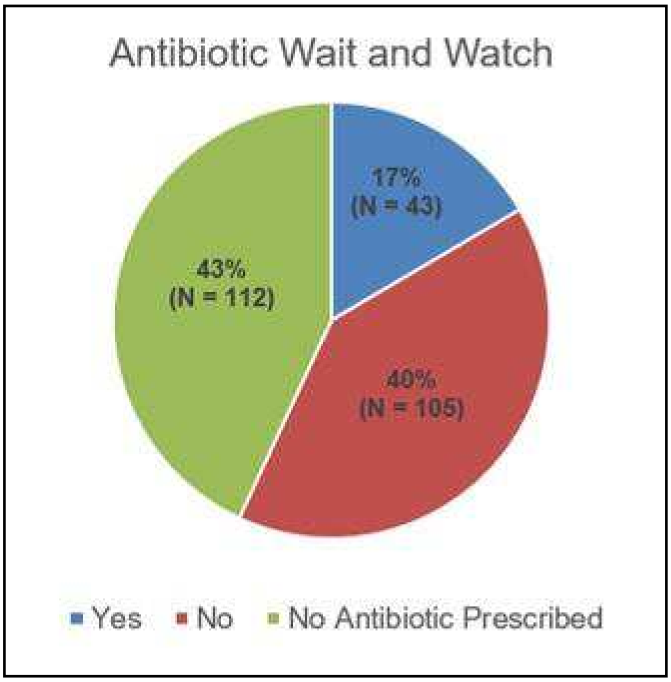


Figure 13. Pie chart of return visits within 30 days

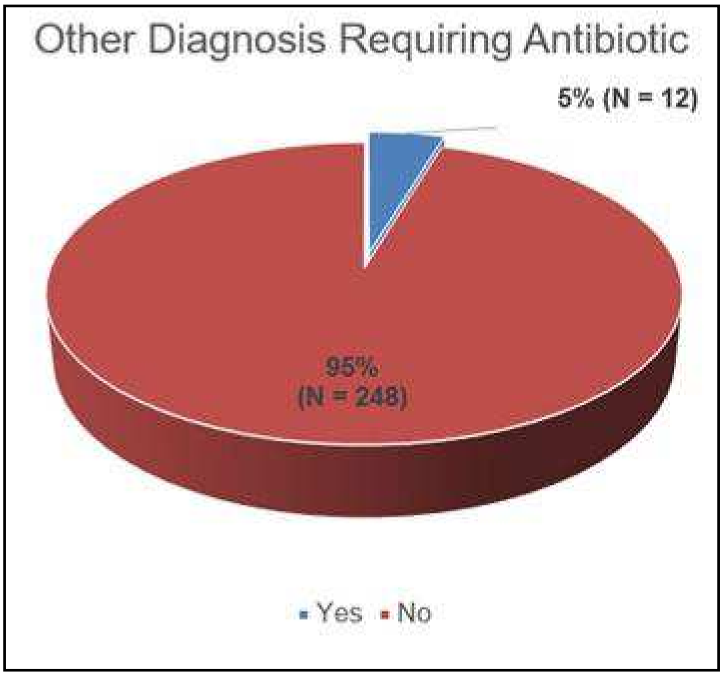


Figure 14. Pie chart of other concurrent dx requiring abx

Prescribing Clinicians

The six participating clinicians each had reduced antibiotic prescribing (See Table 5 below).

	Prescriber	Frequency	Percent
Baseline	1	45	37.8
	2	28	23.5
	3	2	1.7
	4	13	10.9
	5	1	0.8
	6	30	25.2
	Prescriber	Frequency	Percent
Intervention	1	43	30.5
	2	21	14.9
	3	32	22.7
	4	27	19.1
	5	0	0
	6	18	12.8

Table 5. Antibiotic frequency by the clinician

Discussion

Project finding confirms the project aims for this quality improvement project that using a clinical decision support algorithm toolleads to decreased antibiotic prescribing rates for the acute respiratory illnesses of acute pharyngitis, acute sinusitis, and acute bronchitis.

The baseline antibiotic prescribing rates for all diagnoses when compared to the intervention antibiotic prescribing rates for all diagnoses showed a statistically significant reduction after the implementation of visual algorithm tools. For baseline group (N = 119) 84% of visits received an antibiotic prescription compared to total intervention group (N = 141) where 40.4% of visits received an antibiotic prescription for all diagnoses with (p = 0.000). There was a reduction of 43.6% of visits that received antibiotics in the intervention period compared to baseline for all diagnoses.

For visits concerning acute sinusitis, in the baseline group (N =56) 94.6% of visits received an antibiotic prescription compared to intervention group (N = 38)where 71.1% of encounters received an antibiotic prescription (p=0.002). There was a reduction of 23.5% in prescribing antibiotics for intervention group visits compared to baseline group visits with a diagnosis of acute sinusitis.

For visits concerning acute pharyngitis, baseline group (N = 37) 73% of visits received an antibiotic prescription compared to intervention group (N =58) where 22.4% of visits received an antibiotic prescription with (p=0.000). There was a reduction of 50.6% in prescribing antibiotics for intervention group visits compared to baseline group visits with a diagnosis of acute pharyngitis. For visits concerning acute bronchitis, baseline group (N = 26) 76.9% of encounters received an antibiotic prescription compared to intervention group (N =45) where 37.8% of encounters received an antibiotic prescription with (p=0.001).There was a reduction of 39.1% in prescribing antibiotics for intervention group visits compared to baseline group visits with a diagnosis of acute bronchitis.

The findings from this QI project demonstrate thesignificance of a low-cost antibiotic stewardship method that can be feasibly and expediently implemented into a practice setting to make an impact on antibiotic prescribing rates.

Implications. Low costs methods such as printed algorithms placed in front of the clinician can influence their prescribing behavior. With the efforts of antibiotic stewardship to decrease unnecessary antibiotic usage, any and all methods that lead to a meaningful reduction in prescribed antibiotics should be considered. Using the algorithm as a tool to help educate the patients when coming to clinic for future infections can improve patient satisfaction and reduce already stressed workload of primary care providers. The satisfaction of patients and provider workload parametersare outside the scope of this quality improvement project.

Barriers. With acute bronchitis and sinusitis patients, they often voiced that they had always received an antibiotic from their primary care doctor in the past. Overcoming the tradition and expectations of patients to received antibiotics when they feel ill continue to be a challenge. The presence of the visual algorithm tool in the exam room was mentioned by clinicians as being useful in these challenging cases to walk patient through the decision process and highlighting when to present to clinic in future after over-the-counter methods were utilized. A concern for declining patient satisfaction and the potential for financial implications is often mentioned as a reason for giving in to a patient's demands for antibiotics. It is recommended that all stakeholders including finances are involved in implementation process of visible algorithms to incorporate antibiotic stewardship into company vision and culture. The review of literature demonstrates the use of a clinic champion to encourage the use of the algorithms and resolve competing viewpoints. This champion could be the medical director of the facility.

Limitations

This project had limitations including small sample sizeand project timeframe. Small sample size can affect clinical relevance by potentially not being applicable to larger clinical settings. A potential limitation, although not seen in this project, was the component of patient education. The review of the literature strongly emphasized the education of clinicians with best-practice evidence and providing patients with targeted information as a necessary component of antibiotic stewardship in the reduction of unnecessary antibiotics being prescribed for presumed viral etiologies. In this quality improvement project, the current patient education process included a standard in-room brief diagnosis and explanation by the clinician while in the exam room, followed by an Exit Care discharge instruction sheet printed based on clinical selection of diagnosis. The Exit Care instruction sheet includes a brief overview of the causes, symptoms, and treatments of the illness, a section of homecare when to reach back out to medical clinic, and when to go to the emergency room is also provided. One provider commented that having the algorithm in the room as an authoritarian tool helped to qualm concerns by patients who insisted antibiotics were necessary despite the viral diagnosis.

The time of the year this QI project was completed being a summer month during which acute respiratory illnesses are traditionally less common than the winter months could affect the scalability of these results to other timeframes of the year.

Suggestions for further research

Future studies would be recommended for further validation of project findings to a larger scale. Additional parameters to consider are: 1) Following up on antibiotics prescribed as wait and watch (delayed prescription) to see what percentage of antibiotics were filled at the pharmacy and what percentage of any antibiotic prescribed were taken as prescribed. 2) Perform a study over longer time to account for seasonal variations. 3) Use a larger sample population to account for geographic and socioeconomic variations. 4) Identify any change in customer satisfaction for visits before and after implementation of antibiotic stewardship efforts. 5) Review charts for adherence to guidelines in connection with antibiotic rates versus looking at prescribing rates alone.

Conclusions

A clinical decision support tool such as an algorithm along with patient andprovider education can reduce antibiotic overuse burden (Jones-Holly & Goodwin, 2017; Hingorani, Mahmood, & Alweis, 2015). Unnecessary antibiotic prescribing for the treatment of acute respiratory illnesses has continued risks to patients and the community (Jones-Holly & Goodwin, 2017). Prescribing antibiotics when unneeded is linked to increased antibiotic resistance rates, unwanted side effects such as diarrhea, allergic reactions such as rashes and anaphylaxis, and unnecessary cost burden (Harris, Hicks, & Qaseem, 2016). This quality improvement project provides a relatively simple solution for urgent care and primary care centers to implement a quick and cost-effectivemethodin their antibiotic stewardship plan. The clinical implications associated with the addition of easy to read, visual clinical decision support algorithms can influence the prescribing rates of clinicians. As more clinicians closely adhere to current best practices, this will lead to a reduction of antibiotics nationwide for acute respiratory illness. While the addition of the decision support algorithm tool had a measured effect on the antibiotic prescribing rate, this antibiotic stewardship method should be combined with other methods to achieve a large overall effect on antibiotics prescribed for all infections for all populations.

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