Interventions To Improve Antibiotic Prescribing for Uncomplicated Acute Respiratory Tract Infections

Focus of This Summary

This is a summary of a systematic review evaluating the evidence regarding the effectiveness and adverse consequences of strategies for reducing antibiotic use in adults and children with uncomplicated acute respiratory tract infections (RTIs). The systematic review included 133 unique studies published from 1990 to February 2015. The full report, listing all studies, is available at *www.effectivehealthcare.ahrq.gov/antibiotics-RTI.* Although this summary provides a review of evidence, it should not be construed to represent clinical recommendations or guidelines.

Background

In the United States, at least 2 million people are infected with antibiotic-resistant bacteria each year, causing approximately 23,000 deaths. A key factor for the increased rate of antibiotic resistance is high outpatient consumption of antibiotics. Antibiotics are frequently inappropriately used for uncomplicated acute RTIs.

For the purpose of this summary, acute RTIs include acute bronchitis, acute otitis media, pharyngitis/tonsillitis, rhinitis, sinusitis, influenza, and various viral syndromes but not community-acquired pneumonia or acute exacerbations of chronic obstructive pulmonary disease, bronchiectasis, or other chronic underlying lung diseases. Deciding whether to prescribe antibiotics for acute RTIs is a complex process. Guidelines generally recommend withholding antibiotic treatment for most uncomplicated acute RTIs, with certain exceptions such as Group A streptococcus pharyngitis or severe sinusitis. Nevertheless, most outpatient antibiotic prescriptions in the United States are for acute RTIs.

The factors associated with overuse of antibiotics for uncomplicated acute RTIs are numerous and diverse. These factors include patient demographics (e.g., children vs. adults); patient and clinician preferences and communication; patient expectations and physician perception of patient expectations; clinician specialty, knowledge, and experience; clinical inertia; geographic location; clinic type; availability of followup care; and feedback from infectious disease experts.

Consequently, strategies to reduce antibiotic use vary in targets and designs. Interventions include clinical strategies (e.g., use of point-of-care diagnostic tests, delayed antibiotic prescribing), system-level strategies (e.g., electronic decision support), education (e.g., strategies to improve communication between clinicians and patients, public education campaigns), and multifaceted approaches that incorporate various elements. See Table A in the Appendix for further explanations and examples of these interventions.

Improving antibiotic prescribing has become an urgent public health priority. Reducing antibiotic overuse may achieve various potential outcomes, including slowed evolution of antibiotic resistance, decreased health care costs, and fewer adverse drug events. The systematic review summarized herein assesses the effectiveness and adverse consequences of possible strategies for reducing antibiotic use in adults and children with acute RTIs.

Conclusions

Current evidence supports the use of procalcitonin point-of-care testing in adults, specific education interventions for patients/parents and clinicians, and electronic decision support to reduce overall antibiotic prescribing (and, in some cases, improve appropriate prescribing) without increasing the risk of adverse consequences, although the reduction in prescribing varied widely. Additional interventions were also effective in reducing antibiotic prescribing, but evidence on adverse consequences of these interventions was lacking, insufficient, or mixed.

While procalcitonin point-of-care testing reduced antibiotic prescribing in adults, use of an adult algorithm for procalcitonin testing in children increased antibiotic prescribing and adverse consequences. Other point-of-care tests (such as the rapid strep test, multi-viral polymerase chain reaction [PCR] in adults, and C-reactive protein [CRP] testing) reduced antibiotic prescribing, but evidence on adverse consequences associated with these tests either showed an increase in some adverse outcomes or was unavailable.

Delayed prescribing reduced antibiotic prescribing but also reduced patient satisfaction and increased persistence of symptoms.

Current evidence is inadequate to determine key modifying factors that affected outcomes of the interventions examined.

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Overview of Research Evidence

The effectiveness and adverse consequences of several interventions to reduce antibiotic use for acute RTIs are presented below and compared in most instances with usual care. The strength of evidence (SOE) of these findings is included. Because of the difficulty in determining "appropriate" antibiotic use, most studies assessed overall antibiotic use or prescribing as a proxy.

Clinical Interventions (Point-of-Care Testing):

- Procalcitonin point-of-care testing in adults reduced overall antibiotic prescribing for acute RTIs by 12 to 72 percent (●●○) and did not increase the rate of adverse consequences, including days of limited activity or missed work and rates of continuing symptoms, hospitalization, treatment failure, or mortality (●○○) (Appendix Table B).
  - By contrast, use of an adult algorithm for procalcitonin testing in children increased overall prescribing and the rate of adverse events (●○○).
- Streptococcal antigen point-of-care testing (rapid strep testing) reduced overall prescribing by 20 to 52 percent (●●○) and inappropriate prescribing by 33 percent (●○○), but no evidence was found regarding adverse consequences (Appendix Table B).
- Rapid viral point-of-care testing (multi-viral PCR) in adults reduced overall prescribing by 8 percent (●○○), but no evidence was identified regarding adverse consequences (Appendix Table B).
- CRP point-of-care testing reduced overall prescribing by 2 to 34 percent (●●○) but increased the rate of reconsultation (●●○), possibly increased the risk of hospitalization (●○○), and had no effect on symptom resolution (●○○) (Appendix Table B).
- Point-of-care testing for influenza in children had no effect on antibiotic prescribing (●●○).
- The combination of a rapid strep test with a clinical score (FeverPAIN or a scale based on the presence of the number of predefined symptoms) used as a decision rule was superior to the decision rule alone in reducing overall antibiotic prescribing (●●○). No evidence was found regarding the effect of the combination on adverse consequences.

Strength of Evidence Scale*

High:	●●●	High confidence that the evidence reflects the true effect. Further research is very unlikely to change our confidence in the estimate of effect.
Moderate:	●●○	Moderate confidence that the evidence reflects the true effect. Further research may change our confidence in the estimate of effect and may change the estimate.
Low:	●○○	Low confidence that the evidence reflects the true effect. Further research is likely to change our confidence in the estimate of effect and is likely to change the estimate.
Insufficient:	○○○	Evidence either is unavailable or does not permit a conclusion.

Clinical Interventions (Delayed Versus Immediate Prescribing):

- Delayed prescribing of antibiotics (see Appendix Table A for examples of specific strategies) reduced overall prescribing by 34 to 76 percent (●●○). In acute otitis media, it also reduced the rate of diarrhea and multidrug resistance for streptococcal pneumonia strains (●○○) (Appendix Table B).
- Delayed prescribing reduced patient satisfaction (●●○), increased persistence of moderate to severe symptoms (●○○), and had no effect on reconsultation rate (●●○) (Appendix Table B).

System-Level Interventions:

- Electronic decision support reduced overall prescribing by 5 to 9 percent and inappropriate antibiotic prescribing by 3 to 24 percent (●●○), without affecting health care utilization (●○○) or the risk of complications (●○○) (Appendix Table C).

Educational Interventions (Alone or as Components of Multifaceted Interventions):

- A combined patient-parent public education campaign and clinician education reduced overall prescribing by 7 percent (●●○) and inappropriate prescribing in children with pharyngitis and adults with acute RTIs (●○○), without affecting acute otitis media complications (●○○) or parent or patient satisfaction (●○○) (Appendix Table D).
- Clinic-based education of parents of children aged ≤14 years reduced overall prescribing by 21 percent (●●○) and did not affect the rate of adverse consequences (●○○) (Appendix Table D).
- Public education campaigns for parents decreased the rate of overall prescribing for children with upper RTIs, pharyngitis, and acute otitis media (●○○); reduced subsequent visits (●○○); and did not influence the rate of complications (●○○) (Appendix Table D).
- Communication training for clinicians reduced overall prescribing by 9 to 26 percent (●●○) but slightly increased the duration of symptoms (●○○) (Appendix Table D).
- Provider and patient education plus practice profiling plus academic detailing reduced overall prescribing for acute bronchitis by 24 to 26 percent (●○○), but there was insufficient evidence regarding adverse consequences (Appendix Table D). Practice profiling involved audits of clinicians with feedback, and academic detailing involved face-to-face education specific to the clinician's profile.
- Provider communication training plus CRP point-of-care testing reduced overall prescribing by 28 percent (●●○) but was associated with an increased number of days with moderately severe symptoms and possibly increased risk of hospitalization (●○○) (Appendix Table D).

* Owens DK, Lohr KN, Atkins D, et al. AHRQ series paper 5: grading the strength of a body of evidence when comparing medical interventions—Agency for Healthcare Research and Quality and the Effective Health-Care Program. J Clin Epidemiol. 2010 May;63(5):513-23. PMID: 19595577.

Other Findings of the Review

- Some interventions varied in their effectiveness in improving antibiotic prescribing according to the type of RTI:
  - Patient education (effective for pharyngitis but not acute otitis media)
  - Clinician education (effective for acute otitis media and pharyngitis but not sinusitis)
  - Combined patient and clinician education (effective for bronchitis but mixed evidence of effectiveness for pharyngitis and sinusitis)
  - Clinician communication training combined with guideline education (effective for sinusitis but not bronchitis)
- Three interventions significantly improved antibiotic use across three RTI types:
  - Electronic decision support (acute otitis media, bronchitis, and pharyngitis)
  - A multifaceted intervention combining clinician and patient education with CRP testing (bronchitis, pharyngitis, and sinusitis)
  - A multifaceted intervention combining clinician and patient education with clinician audit and feedback (bronchitis, pharyngitis, and sinusitis)

What To Discuss With Your Patients and/or Their Caregivers

- Potential harms of overuse of antibiotics (including adverse drug effects and antibiotic resistance)
- Their participation and responsibilities in interventions or programs in which patients may have a role, such as educational interventions

Ordering Information

For electronic copies of this clinician research summary and the full systematic review, visit *www.effectivehealthcare.ahrq.gov/antibiotics-RTI.*

Source

The information in this summary is based on *Improving Antibiotic Prescribing for Uncomplicated Acute Respiratory Tract Infections*, Comparative Effectiveness Review No. 163, prepared by the Pacific Northwest Evidence-based Practice Center under Contract No. 290-2012-00014-I for the Agency for Healthcare Research and Quality, January 2016. Available at *www.effectivehealthcare.ahrq.gov/antibiotics-RTI.* This summary was prepared by the John M. Eisenberg Center for Clinical Decisions and Communications Science at Baylor College of Medicine, Houston, TX.

Gaps in Knowledge and Limitations of the Evidence Base

Several gaps and limitations were identified in the evidence base reviewed for this report:

- There is no agreement about the magnitude of reduction in overall antibiotic use required to achieve clinical significance. Therefore, the ability to judge the meaningfulness of overall prescribing reductions was limited.
- Reporting on adverse clinical outcomes was limited and inconsistent, leading to difficulty in evaluating comparative benefits and adverse consequences.
- Assessing how to optimize the use of effective interventions was precluded by the lack of sufficient detail on potential effect modifiers (e.g., patient, clinician, and setting characteristics).
- Evidence on combinations of interventions is unclear because it is challenging to assess evidence from single studies that present entirely new combinations of interventions that apply only to that setting.
- Most studies focused on overall prescribing, with few studies reporting on appropriate prescribing and resistance or on the clinical consequences of reduced prescribing.
- With only 45 percent of studies in this review conducted in the United States, it is not clear whether evidence generated in other cultures and health care systems is applicable to U.S. settings.

Appendix Table A: Categories of Interventions To Reduce Antibiotic Prescribing

Category	Explanations and Examples
Clinical	Point-of-care tests to rapidly determine the likelihood that a patient has a specific infection (e.g., rapid strep test of a throat swab sample, multi-viral PCR or an influenza-specific test of throat/nasopharyngeal secretions) or has a bacterial instead of viral infection (e.g., blood procalcitonin, blood CRP); tympanometry to aid in diagnosing AOM; delayed antibiotic prescribing (e.g., giving prescriptions to patients with instructions to delay filling, leaving prescriptions for patient collection, postdating prescriptions, requesting recontact with clinician); clinical scoring tools based on combinations of signs and symptoms
System-level	Electronic decision support (computer-aided evidence-based prescribing recommendations); paper-based clinician reminders about prescribing; clinician audit plus feedback; financial or regulatory incentives for clinicians or patients; antimicrobial stewardship programs
Educational	Clinic-based patient or parent education about when antibiotics may be appropriate (e.g., videos, pamphlets, verbal education, waiting room posters); public education campaigns (e.g., billboards, bus advertisements, radio and television advertisements); clinician education about current treatment guidelines; communication skills training programs for clinicians
Multifaceted	Combination of numerous interventions from one or more categories

AOM = acute otitis media; CRP = C-reactive protein; PCR = polymerase chain reaction

Appendix Table B: Clinical Interventions That Improve or Reduce Antibiotic Prescribing for Acute RTIs*

Outcome	Absolute Change	Relative Effect/Result	Number of Studies	SOE
Procalcitonin point-of-care testing vs. usual care				
Overall prescribing *(Adults only)*	-12% to -72%	Greater reduction with procalcitonin testing: Acute RTI: OR 0.14 (95% CI, 0.09 to 0.22) Acute bronchitis: OR 0.15 (95% CI, 0.10 to 0.23)	1 SR of 4 RCTs	●●○
Adverse consequences	–	No difference in number of days of limited activity or missed work or continuing symptoms at 28 days for URTI or LRTI in primary care	1 RCT	●○○
	–	No difference in hospitalizations or combined adverse effects/lack of efficacy outcome	1 RCT	
	–	No difference in mortality or treatment failure at 30 days for acute bronchitis/URTIs in primary care or ED care and for URTIs or LRTIs in primary care	5 RCTs	
Streptococcal antigen point-of-care testing (rapid strep testing) vs. usual care				
Overall prescribing	-20% to -52%	Greater reduction with rapid strep testing	3 RCTs	●●○
Inappropriate prescribing	-33%	Greater reduction with rapid strep testing	1 RCT	●○○
Adverse consequences	–	No evidence regarding adverse consequences	–	○○○
Rapid viral point-of-care testing (multi-viral PCR) vs. usual care in adults				
Overall prescribing	-7.8%; p<0.01	Greater reduction with multi-viral PCR	1 RCT	●○○
Adverse consequences	–	No evidence regarding adverse consequences	–	○○○
CRP point-of-care testing vs. usual care				
Overall prescribing	-1.9% to -33.5%	Greater reduction with CRP testing: RR 0.73 (95% CI, 0.60 to 0.90)	7 RCTs	●●○
Adverse consequences	–	Greater reconsultation rate within 4 weeks with CRP testing	3 RCTs	●●○
	–	Potentially increased risk of hospitalization at 30 days with CRP testing	7 RCTs	●○○
	–	No effect on symptom resolution	4 RCTs	●○○
Delayed vs. immediate prescribing				
Overall prescribing	-34% to -76%	Greater reduction with delayed prescribing: OR range, 0.00 to 0.12	6 RCTs	●●○
Other benefits	–	Reduced multidrug resistance for streptococcal pneumonia strains in AOM with delayed prescribing	1 RCT	●○○
	–	Reduced diarrhea in AOM with delayed prescribing	2 RCTs	●○○
Adverse consequences	–	No difference in reconsultation	4 RCTs	●●○
	–	Reduced satisfaction with delayed prescribing	5 RCTs	●●○
	–	Increased persistence of moderate to severe symptoms with delayed prescribing	2 RCTs	●○○

* All populations are adults and children with acute RTIs unless otherwise specified.

AOM = acute otitis media; CI = confidence interval; CRP = C-reactive protein; ED = emergency department; LRTI = lower respiratory tract infection; OR = odds ratio; PCR = polymerase chain reaction; RCT = randomized controlled trial; RR = relative risk; RTI = respiratory tract infection; SOE = strength of evidence; SR = systematic review; URTI = upper respiratory tract infection

Appendix Table C: System-Level Interventions That Improve or Reduce Antibiotic Prescribing for Acute RTIs*

Category	Absolute Change	Results	Number of Studies	SOE
Electronic decision support vs. usual care				
Overall prescribing (systems with ≥50% use)	-5% to -9%	Greater reduction with decision support: RR 0.73 (95% CI, 0.58 to 0.92)	2 RCTs	●●○
Inappropriate prescribing (for acute bronchitis and AOM)	-3% to -24%	Greater reduction with decision support	2 RCTs	●●○
Adverse consequences	–	No difference in health care utilization or complications	1 RCT	●○○

* All populations are adults and children with acute RTIs.

AOM = acute otitis media; CI = confidence interval; RCT = randomized controlled trial; RR = relative risk; RTI = respiratory tract infection; SOE = strength of evidence

Appendix Table D: Educational Interventions That Improve or Reduce Antibiotic Prescribing for Acute RTIs**

Outcome	Absolute Change	Relative Effect/Result	Number of Studies	SOE
Combined patient-parent public education campaign and clinician education vs. usual care				
Overall prescribing	-7.3% (95% CI, -4.0% to -10.6%)	Greater reduction with the combination intervention: OR 0.56 (95% CI, 0.36 to 0.87) to 0.62 (95% CI, 0.54 to 0.75)	5 RCTs	●●○
Inappropriate prescribing				
Children with pharyngitis	-10.4%	Greater reduction with the combination intervention: OR 0.62 (95% CI, 0.54 to 0.75)	2 RCTs	●○○
Adults with acute RTIs	-9.7%	Greater reduction with the combination intervention		
Adverse consequences	–	No difference in AOM complications	1 OBS	●○○
	–	No difference in patient or parent satisfaction	2 RCTs	●○○
Clinic-based education of parents of children aged ≤14 years vs. usual care				
Overall prescribing	-21.3% (1 RCT)	Greater reduction with clinic-based parent education: pooled OR 0.39 (95% CI, 0.26 to 0.58)	2 RCTs	●●○
Adverse consequences	–	No difference in return visits	2 RCTs	●○○
Public education campaigns for parents vs. usual care				
Overall prescribing *(Children only)*	Not reported	Greater reduction with public education campaigns: URTI: OR 0.75 (95% CI, 0.69 to 0.81) AOM: OR 0.65 (95% CI, 0.59 to 0.72) Pharyngitis: OR 0.93 (95% CI, 0.89 to 0.97)	2 OBSs	●○○
Adverse consequences	–	No difference in the diagnosis of complications; subsequent visits were decreased with campaigns	1 OBS	●○○
Communication training for clinicians vs. usual care				
Overall prescribing	-9.2% to -26.1%	Greater reduction with communication training: RR 0.17 to 0.69	5 RCTs	●●○
Adverse consequences	–	Slightly longer duration of symptoms with communication training	3 RCTs	●○○
Provider and patient education + practice profiling + academic detailing vs. usual care				
Overall prescribing	*Acute bronchitis:* -24% to -26%	Greater reduction with the combination intervention	3 OBSs	●○○
Adverse consequences	–	Insufficient evidence regarding return clinic visits	1 OBS	○○○
Provider communication training + CRP point-of-care testing vs. usual care				
Overall prescribing	-28%	Greater reduction with the combination intervention: OR 0.30 (95% CI, 0.26 to 0.36)	2 RCTs	●●○
Adverse consequences	–	Increased days of moderately severe symptoms with the combination intervention	1 RCT	●○○
	–	Potentially increased risk of hospital admissions with the combination intervention	2 RCTs	●○○
	–	No difference in reconsultation, diagnostic testing use, or days off work	1 RCT	●○○

** All populations are adults and children with acute RTIs unless otherwise specified.

AOM = acute otitis media; CI = confidence interval; CRP = C-reactive protein; OBS = observational study; OR = odds ratio; RCT = randomized controlled trial; RTI = respiratory tract infection; SOE = strength of evidence; URTI = upper respiratory tract infection

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