



Antimicrobial Resistance

Erica Reed, PharmD, BCIDP, FIDSA
*Lead Specialty Practice Pharmacist, Infectious Diseases/Antimicrobial Stewardship
 The Ohio State University Wexner Medical Center*

MedNet21
 Center for Continuing Medical Education

THE OHIO STATE UNIVERSITY
 WEXNER MEDICAL CENTER

Objectives

- Highlight the burden of antimicrobial resistance (AMR)
- Discuss factors contributing to the emergence of AMR
- Review common pathogens displaying AMR

Antimicrobial Resistance (AMR)

"If we do not act to address the problem of AR, we may lose quick and reliable treatment of infections that have been a manageable problem in the United States since the 1940s. Drug choices for the treatment of common infections will become increasingly limited and expensive - and, in some cases, nonexistent."

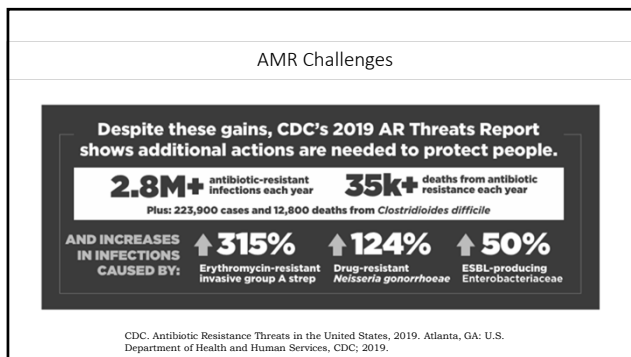
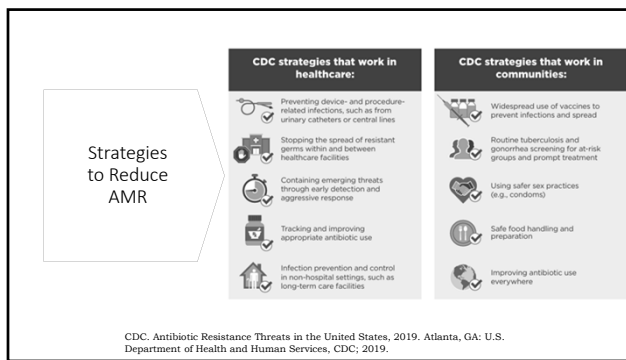
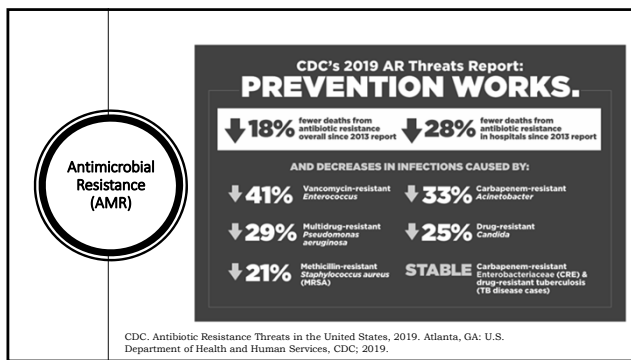
-A Public Health Action Plan to Combat Antimicrobial Resistance

CDC 1999

Background

- Antibiotics are unlike any other agent in that use in one patient can compromise efficacy in another
- Prevalent use
 - 200-300 million antibiotic prescriptions annually
 - 45% outpatient
- 25-40% of hospitalized patients receive antibiotics
 - 10-70% are unnecessary or sub-optimal
 - 5% of hospitalized patients who receive antibiotics experience an adverse reaction
- Changes in antibiotic use are paralleled by changes in resistance patterns

Overens et al. Public Health Res. 2017;12(2):160-166.
 Stone et al. Am J Inf Control. 2005;33(9):942-947.



One billion people cross through international borders each year. This includes 350 million travelers arriving in the United States through more than 300 points of entry.

A resistant threat anywhere can quickly become a threat at home. Global capacity is needed to slow development and prevent spread of antibiotic resistance.

CDC. Antibiotic Resistance Threats in the United States, 2019. Atlanta, GA: U.S. Department of Health and Human Services, CDC, 2019.

How Antibiotic Resistance Spreads

CDC. Antibiotic Resistance Threats in the United States, 2019. Atlanta, GA: U.S. Department of Health and Human Services, CDC, 2019.

Bacterial Resistance

How Antibiotic Resistance Happens

1. Lots of germs. A few are drug resistant.
2. Antibiotics kill bacteria causing the illness, as well as good bacteria protecting the body from infection.
3. The drug-resistant bacteria are now allowed to grow and take over.
4. Some bacteria give their drug-resistance to other bacteria, causing more problems.

CDC's Antibiotic Resistance Threats in the United States, 2019.

Antibiotic Resistance Can Emerge Quickly

Antibiotic Approved or Released	Year Released	Resistant Germ Identified	Year Identified
Penicillin	1941	Penicillin-resistant <i>S. aureus</i>	1942
Methicillin	1960	MRSA	1960
Extended-spectrum cephalosporins	1980	ESBL-producing <i>E. coli</i>	1983
Daptomycin	2003	Daptomycin-resistant MRSA	2004
Ceftazidime-avibactam	2015	Ceftazidime-avibactam KPC-producing <i>K. pneumoniae</i>	2015

The Threat of Antibiotic Resistance in the United States

Antibiotic resistance—when germs (bacteria, fungi) develop the ability to defeat the antibiotics designed to kill them—is one of the greatest global health challenges of modern time.

New National Estimate*

Each year, antibiotic-resistant bacteria and fungi cause at least an estimated:

- 2,868,700** infections
- 35,900** deaths

+ *Clostridioides difficile*** is related to antibiotic use and antibiotic resistance:

- 223,900** cases
- 12,800** deaths

New Antibiotic Resistance Threats List
Updated: urgent, serious, and concerning threats—totaling 18

5 urgent threats **2** new threats **NEW:** Watch List with **3** threats

Antibiotic resistance remains a significant One Health problem, affecting humans, animals, and the environment. Data show detection, prevention, and control is saving lives—especially in hospitals—but threats may undermine this progress without continued aggressive action now.

Learn more: www.cdc.gov/DrugResistance/Biggest-Threats.html

CDC Antibiotic Resistance Threat Report

ANTIBIOTIC RESISTANCE THREATS IN THE UNITED STATES
2019

November 2019

DRUG-RESISTANT NEISSERIA GONORRHOEAE

THREAT LEVEL: **URGENT**

- 550,000** drug-resistant infections each year
- 1.14M** infections each year
- \$133.4M** in extra medical costs

Neisseria gonorrhoeae causes gonorrhea, a sexually transmitted disease (STD) that can result in life-threatening ectopic pregnancy and infertility, and can increase the risk of getting and giving HIV.

- Gonorrhea spreads easily & is often asymptomatic
- Can cause serious health issues including ectopic pregnancy and infertility
- Timely diagnosis & routine screening with prompt & effective treatment is crucial
- Ceftriaxone last reliable agent
- CDC STI Treatment Guidelines excellent resource

CDC. Antibiotic Resistance Threats in the United States, 2019. Atlanta, GA: U.S. Department of Health and Human Services, CDC; 2019.

EXTENDED-SPECTRUM BETA-LACTAMASE (ESBL) PRODUCING ENTEROBACTERIACEAE

THREAT LEVEL: **SERIOUS**

- 197,400** drug-resistant infections in 2017
- 9,100** deaths in 2017
- \$1.2B** in extra healthcare costs in 2017

ESBL-producing Enterobacteriaceae (a family of different types of bacteria) are a concern in healthcare settings and the community. They can spread rapidly and cause or complicate infections in healthy people.

- Infections include UTIs, intra-abdominal infections, pneumonia, and bacteremia
- ESBL enzymes easily spread from one bacteria to another
- Hydrolyze penicillins and cephalosporins
 - May require hospitalization for IV carbapenem therapy (unless urinary isolate susceptible to PO options)

CDC's Antibiotic Resistance Threats in the United States, 2019

METHICILLIN-RESISTANT STAPHYLOCOCCUS AUREUS

THREAT LEVEL: SERIOUS

323,700 Estimated cases in hospitalized patients in 2017

10,600 Estimated deaths in 2017

\$1.7B Estimated attributable healthcare costs in 2017

Staphylococcus aureus (*S. aureus*) are common bacteria that spread in healthcare facilities and the community. Methicillin-resistant *S. aureus* (MRSA) can cause difficult-to-treat staph infections because of resistance to some antibiotics.

- Hospital reductions in MRSA have stalled
- Community MRSA infections may be connected to the opioid crisis
- Now resistant to many first-line options including clindamycin

CDC. Antibiotic Resistance Threats in the United States, 2019. Atlanta, GA: U.S. Department of Health and Human Services, CDC, 2019.

DRUG-RESISTANT STREPTOCOCCUS PNEUMONIAE

THREAT LEVEL: SERIOUS

900,000 Estimated infections in 2014

3,600 Estimated deaths in 2014

Streptococcus pneumoniae (pneumococcus) is a leading cause of bacterial pneumonia and meningitis in the United States. It also is a common cause of bloodstream infections, and ear and sinus infections.

- One of the only drug-resistant bacteria with an effective vaccine to prevent infections
- Encouraging vaccination can slow the spread of pneumococcal resistance
- Resistance to penicillin (PO), tetracycline, and erythromycin common

CDC. Antibiotic Resistance Threats in the United States, 2019. Atlanta, GA: U.S. Department of Health and Human Services, CDC, 2019.

ERYTHROMYCIN-RESISTANT GROUP A STREPTOCOCCUS

THREAT LEVEL: CONCERNING

5,400 Estimated infections in 2017

450 Estimated deaths in 2017

Group A *Streptococcus* (GAS) bacteria can cause mild infections such as sore throat and impetigo, and severe invasive disease such as cellulitis, pneumonia, flesh-eating infections, and sepsis.

- Implicated in "strep throat"
- No resistance to penicillin/amoxicillin but allergies commonly reported
- Resistance to erythromycin and clindamycin is rising

CDC. Antibiotic Resistance Threats in the United States, 2019. Atlanta, GA: U.S. Department of Health and Human Services, CDC, 2019.

CLINDAMYCIN-RESISTANT GROUP B STREPTOCOCCUS

THREAT LEVEL: CONCERNING

13,000 Estimated infections in 2016

720 Estimated deaths in 2016

Group B *Streptococcus* (GBS) is a type of bacteria that can cause severe illnesses—including bloodstream infections, pneumonia, meningitis, and skin infections—in people of all ages.

- Can be passed from mother to infant during labor threatening newborns with sepsis
- Clindamycin resistance limits prevention and treatment options for adults with severe penicillin allergies

CDC. Antibiotic Resistance Threats in the United States, 2019. Atlanta, GA: U.S. Department of Health and Human Services, CDC, 2019.



Antimicrobial Stewardship 101


Sydney Agnello, DO
*Assistant Professor
 Infectious Diseases
 The Ohio State University Wexner Medical Center*

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Objectives

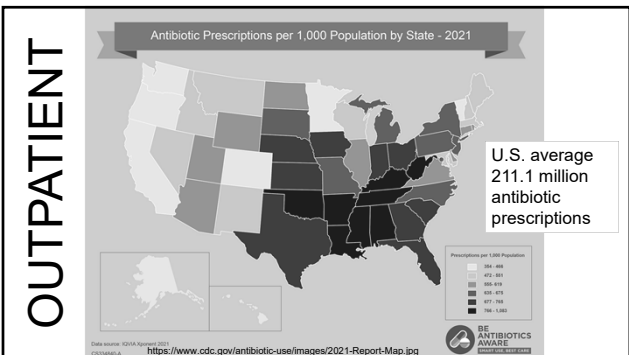
- Examine the core elements of outpatient antimicrobial stewardship
- Discover resources available (🔍 QR codes)
- Discern how to best implement in your clinical setting



Inpatient Antimicrobial Stewardship

- Required at all hospitals by Joint Commission
- Encountering these efforts daily while rounding
 - Restricted antimicrobials
 - Prospective audits with intervention & feedback
 - IV to oral conversion of antimicrobials
 - Education
 - Guidelines & clinical pathways





IMPROVE OUTPATIENT ANTIBIOTIC USE

72% of antibiotic prescriptions are likely necessary.
(But we still need to improve drug selection, dose and duration)

At least **28%** of antibiotic prescriptions are unnecessary.
In U.S. Doctor's Offices and EDs

BE ANTIBIOTICS AWARE
SMART USE. BEST CARE.

Learn more at [cdc.gov/antibiotic-use](https://www.cdc.gov/antibiotic-use)

<https://www.cdc.gov/antibiotic-use/week/images/Improve-Outpatient-Antibiotic-Use.jpg>

Total inappropriate antibiotic use

50%

STOP Unnecessary use

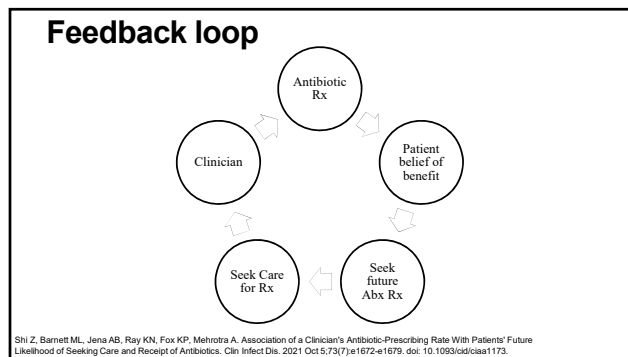
Inappropriate Selection

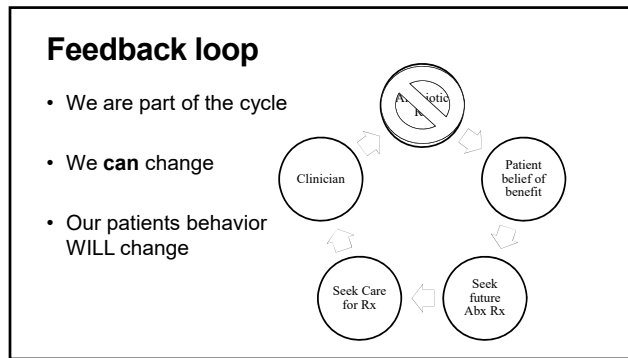
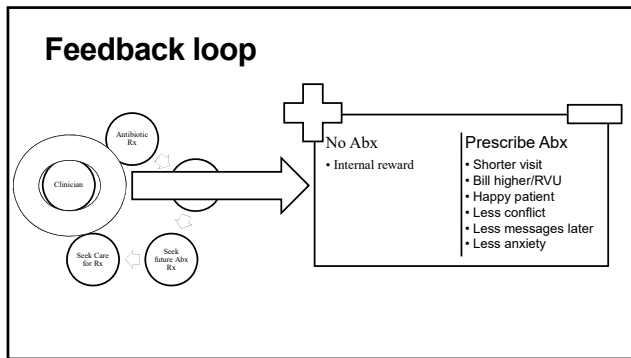
Inappropriate Dosing

Inappropriate Duration

Reasons behind inappropriate Rx

- Primarily psychologically & socially rooted
 - Rx is a **BEHAVIOR**, not a scientific decision
- Lack of awareness
 - Clinicians do not perceive they are prescribing inappropriately
- Misaligned incentives
- Inadequate knowledge regarding guidelines
- Fear from complications of infections
- All complicated by a feedback loop





CDC Core Elements of Outpatient Antimicrobial Stewardship

- Commitment**
Organizational dedication to and accountability for optimizing antibiotic prescribing and patient safety.
- Action for policy and practice**
Development of local and policy of practice to optimize antibiotic prescribing, assess whether it is working, and modify as needed.
- Tracking and reporting**
Monitor antibiotic prescribing practices and offer regular feedback to clinicians, or have clinicians assess their own antibiotic prescribing practices themselves.
- Education and expertise**
Provide educational resources to clinicians and patients on antibiotic prescribing, and ensure access to needed expertise on optimizing antibiotic prescribing.

<https://www.cdc.gov/antibiotic-use/core-elements/outpatient.html>

CDC Core Elements of Outpatient ASP

- **Commitment**
 - Dedication to appropriate antibiotic prescription & patient safety
- Action for policy & practice
- Tracking & reporting
- Education & expertise

Commitment

- Display **public commitments** in support of ASP
- Identify a **leader** to direct activities within a facility
- Communicate with **all clinic staff** members to set patient expectations
 - This includes front desk, medical assistants, nurses, administrative staff

Commitment Poster

- In 2014 study by Meeker et al, evaluated use of poster in exam rooms effect on antibiotic prescriptions in acute URI
- Result: 19.7% absolute percentage reduction of inappropriate antibiotic prescribing rate relative to control
 - Results did not diminish over time

Commitment Poster



Antibiotics are powerful, life-saving medications. We are dedicated to ensuring antibiotics are used only when needed, and we will avoid prescribing antibiotics when they are not needed or prescribing the wrong drug, dose, duration, or professional prescriber. Antibiotic-resistant infections caused by bacteria, fungi, and parasites are a global health threat. Antibiotics don't work against viruses that cause the common cold, most flu, and other viral illnesses. You can strengthen your immune system by taking antibiotics. Complete your antibiotic course exactly as your doctor prescribes, and do not share your antibiotics with others. If you have any questions about your antibiotic, ask your doctor. Using antibiotics also gives bacteria a chance to become more resistant to drugs. You can check your antibiotic therapy by using the antibiotic stewardship program at your facility. Taking antibiotics only when needed helps keep you healthy. Newer, safer antibiotic medications, and various treatment options will be available for future generations. We will continue our education about the use of antibiotics in your treatment.

Sincerely,



Source: cdc.gov

Commitment Poster



Antibiotics Aren't Always The Answer

At Ohio State, we're committed to responsible antibiotic stewardship. We're helping our patients live longer, healthier lives.

Antibiotics are powerful, life-saving medications. We are dedicated to ensuring antibiotics are used only when needed, and we will avoid prescribing antibiotics when they are not needed or prescribing the wrong drug, dose, duration, or professional prescriber. Antibiotic-resistant infections caused by bacteria, fungi, and parasites are a global health threat. Antibiotics don't work against viruses that cause the common cold, most flu, and other viral illnesses. You can strengthen your immune system by taking antibiotics. Complete your antibiotic course exactly as your doctor prescribes, and do not share your antibiotics with others. If you have any questions about your antibiotic, ask your doctor. Using antibiotics also gives bacteria a chance to become more resistant to drugs. You can check your antibiotic therapy by using the antibiotic stewardship program at your facility. Taking antibiotics only when needed helps keep you healthy. Newer, safer antibiotic medications, and various treatment options will be available for future generations. We will continue our education about the use of antibiotics in your treatment.



YOUR OHIO STATE PRIMARY CARE PROVIDERS



Commitment Poster - Minnesota



Commitment Poster - DIY



<https://www.health.mn.gov/diseases/antibioticresistance/hcp/commitkit>

CDC Core Elements of Outpatient ASP

- Commitment
- **Action for policy & practice**
 - Implement at least one policy or practice to improve, assess if it works & modify as needed
- Tracking & reporting
- Education & expertise

Action for Policy & Practice

- Use **evidence-based diagnostic criteria & treatment** recommendations
- Use delayed prescribing practices or watchful waiting, when appropriate
 - Acute otitis media, sinusitis, etc

[CDC treatment guidelines](https://www.cdc.gov/antibiotic-use/clinicians/adult-treatment-rec.html)

<https://www.cdc.gov/antibiotic-use/clinicians/adult-treatment-rec.html>



Action for Policy & Practice

- Support for clinical decisions
- Utilizing call centers or RN hotlines as triage to prevent unnecessary visits

Action - Over the Counter “Prescription Pad”

- Education for patients on how to manage symptom control in acute respiratory illness
- Improves efficiency for clinician, decreases errors & allows for transaction to occur
 - ALL improve patient satisfaction

Over the Counter “Prescription Pad”

Symptom Relief for Viral Illnesses

1. CHALLENGE

2. GENERAL INSTRUCTIONS

3. SPECIFIC MEDICINES

4. FOLLOW UP

Source: cdc.gov

Over the Counter “Prescription Pad”

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Prescription Pad

Medications to Avoid

CDC Core Elements of Outpatient ASP

- Commitment
- Action for policy & practice
- **Tracking & reporting**
 - Monitor antibiotic prescribing practices & offer regular feedback to clinicians or have them monitor themselves
- Education & expertise

Tracking & Reporting

- Self-evaluate antibiotic prescription practices
- Participate in CME & QI activities
- Implement at least one antibiotic prescription tracking & reporting system
- Assess & share performance on quality measures & established reduction goals
 - HEDIS measures

Tracking & Reporting – CDC

Technical Assistance Tool | 2022

Measurement and Evaluation Approaches to Improve Outpatient Antibiotic Prescribing in Health Systems

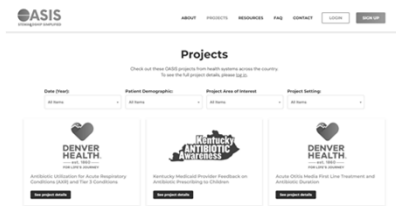
Contents	
Introduction	1
Methods to Measure and Evaluate Outpatient Antibiotic Use and Appropriateness	2
Antibiotic Prescribing Across Categories: Measure of High-Risk Prescriptions	3
Antibiotic Prescribing for Antibiotic-Susceptible Conditions	4
Antibiotic Prescribing for Antibiotic-Susceptible Appropriate Conditions	5
Antibiotic Selection for Specific Antibiotic Classes	6
Excess Duration of Antibiotic Prescriptions	7
Use of Diagnostic Testing	8
Conclusion	9
Table 1. Outpatient Antibiotic Prescribing Measurement Strategies, Key Considerations, and Examples	10
Table 2. HEDIS® Measures for Outpatient Antibiotic Prescribing	12
Table 3. Technical Resources for Tracking Outpatient Antibiotic Use Metrics*	13
References	14



<https://www.cdc.gov/antibiotic-use/pdfs/Measurement-Evaluation-Improve-Outpatient-508.pdf>

Tracking & Reporting

- **OASIS Stewardship Simplified**



<https://oasisstewardship.org/>

CDC Core Elements of Outpatient ASP

- Commitment
- Action for policy & practice
- Tracking & reporting
- **Education & expertise**
 - Provide educational resources to clinicians & patients on antibiotic prescribing
 - Ensure access to needed expertise on optimizing antibiotic prescribing

Education & Expertise

- Educate patients about
 - when antibiotics are needed & not needed
 - potential harms of antibiotics treatments
 - risks of antimicrobial resistance
- Discussing antibiotic allergy versus intolerance
 - Penicillin allergies...



Education & Expertise

- Educate patients – CDC infographics

Common Respiratory Infections
Do you need antibiotics?

BE ANTIBIOTICS AWARE
WWW.YOURBESTCARE

Common Cold, Chest Cold, Flu, COVID-19

Antibiotics **DO NOT WORK** against viruses that cause the common cold, most chest colds, flu, and COVID-19. Ask your healthcare professional about the best way to feel better while your body fights off the virus.

For more information, visit www.cdc.gov/antibiotic-use or call 1-800-CDC-INFO.

Education & Expertise

- Communication skills training for clinicians
- Providers poorly predict when patients want antibiotics
- **DART – Dialogue Around Respiratory Illness Treatment modules**
 - Free online (directed towards parents of children)
 - <https://www.uwimtr.org/dart/>




ASP → in practice


- Patient with pharyngitis



ASP → in practice



- Patient calls with complaint of sore throat
- **Triage line:** recommends patient present to clinic for further evaluation


 **Commitment & Policy**




ASP → in practice

- Patient sees poster in exam room


 **Commitment**


ASP → in practice



MA sets expectations

- Does NOT promise antibiotics
- Reassure patient they will get great care

 **Commitment & Policy**



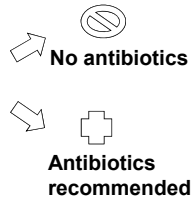
Policy & Practice – pharyngitis

✓ Evidence based diagnostic criteria

Centor criteria (>2)

- Fever
- Tonsillar exudates
- Tender cervical lymphadenopathy
- Absence of cough

⇒ **Rapid antigen detection test**



<https://www.cdc.gov/antibiotic-use/clinicians/adult-treatment-rec.html>

Policy & Practice – pharyngitis

✓ Evidence based treatment



- + Centor → + RADT → Antibiotics for GAS
- Pick the correct antibiotic for the correct duration
- You appropriately select amoxicillin for 10 days... until patient **declares PCN allergy**

Education – pharyngitis

- Discuss allergy further ✓



- Recall GAS antibiotic resistance to azithromycin & clindamycin are increasingly common ✓

Source: cdc.gov

Education – pharyngitis

- Discuss allergy further ✓
- Decide amoxicillin is safe to use, educate patient AND adjust flag in the chart / EMR ✓



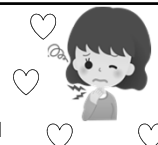
ASP – pharyngitis



- + Centor → - RADT → No Antibiotics

☑ Evidence based diagnostic criteria

ASP– pharyngitis



- + Centor → - RADT → No Antibiotics
- Astute clinician you suspect it is likely viral

☑ Educate patient
☑ **Effective Education**

☑ Provide supportive care recommendations
☑ **Policy & practice**



Tracking – pharyngitis



- Depending on size of practice this can vary

• **Example:**

- Review rapid test results & antimicrobial use
 - Even small chart review can be beneficial
- HEDIS measure for pharyngitis
- OASIS project

☑ Tracking



All Healthcare Professionals can Be Antibiotics Aware



For more information, visit www.cdc.gov/antibiotic-use.

