The Roles of Antimicrobial Stewardship

INTRODUCTION
Antibiotics are used to treat and prevent bacterial infections. When antibiotics are used, it puts biological pressure on bacteria and promotes the development of resistance. Research has shown approximately 50% of antibiotics prescribed for humans are unnecessary or misused. The more antibiotics are misused, the greater the chance bacteria will develop resistance in the future. As a result, health professionals locally, nationally, and globally are adopting principles of responsible antibiotic use, often called antibiotic stewardship.

Administrators, nurses, physicians, microbiologists, pharmacists, veterinarians, public health professionals, and many others within the continuum of care need to work together on antibiotic stewardship to improve patient outcomes and reduce antimicrobial resistance. We all have a role in antibiotic stewardship and are responsible to prevent the development and spread of antibiotic resistance.

WE ALL HAVE A ROLE TO PLAY
- Prescribers
- Nursing
- Pharmacists
- Dentists and Oral Maxillofacial Surgeons
- Laboratory Scientists
- Infection Preventionists
- Veterinarians
- Public Health
- Patients and Family Members
- General Public and Pet Owners
Facility and state antibiograms are great tools to aid in antibiotic prescribing

PREScribers
Healthcare providers (e.g., physicians, physician assistants, nurse practitioners, etc.) that prescribe antibiotics play a significant role in antibiotic stewardship. Prescribers follow best practices when choosing antimicrobials to ensure patients receive ideal doses, duration, and route of administration with minimal toxicity, based on age, weight, organ function, infection severity, location, and causative agent. Doing so limits the selective pressure that creates antibiotic resistance.

Prescribers are aware of antibiotic resistance patterns in their setting and communities through the use of antibiograms. Those providing antibiotics also take into account antibiotic susceptibility results for bacteria isolated from a culture, once available, to assist with any treatment adjustments.

Healthcare providers play a key role in communicating to patients and their family members when antibiotics are or are not needed. If antibiotics are not necessary, prescribers can talk to the patient about other methods to relieve symptoms. When antibiotics are needed prescribers can discuss potential side effects such as allergic reactions, Clostridium difficile, and antibiotic-resistant infections.

NURSES
Nurses make up the largest segment of the healthcare workforce and are at the center of patient care, spending more time with patients than any other healthcare discipline, providing consistency, continuity, and coordination of care as the cornerstone of the patient care team.

It is important for nurses to perform initial assessments to obtain an accurate antibiotic allergy history, identify potential source(s) of infection, and implement appropriate infection control precautions. Another key step is obtaining early and appropriate cultures before starting antibiotics and discouraging culturing urine that simply looks cloudy or smells pungent. Nurses often monitor culture results, evaluate the need for antibiotics, record antibiotic administration, check for allergic reactions, and report results to prescribers.

Nurses are patient advocates and encourage the removal of invasive devices such as urinary catheters and central lines when no longer needed, to reduce a patient’s risk of developing drug resistant infections. Education surrounding antibiotics is also frequently provided by nurses, such as explaining what transmission precautions are, why they are needed, why the patient is being given an antibiotic, how the patient should be taking an antibiotic at home, what the possible side effects are, etc.
INFECTION PREVENTIONISTS

Infection preventionists are a critical partner in the success of antimicrobial stewardship programs and perform many daily functions. Such professionals monitor fundamental infection prevention and control practice compliance in healthcare settings, such as transmission based precautions, hand hygiene, and implementation of best practices to prevent healthcare associated infections (HAIs). Based on hospital policy, when a patient is identified to have an infectious disease or a drug resistant organism, infection preventionists promptly communicate with other healthcare staff to implement transmission based precautions, keeping patients safe.

Infection Preventionists use real-time surveillance data to support stewardship programs by assisting pharmacy operations in the identification of bug-drug mismatches and excessive use of broad spectrum antibiotics that may contribute to the development of increasingly resistant organisms. Some electronic surveillance software used by infection preventionists can assist with designing clinical algorithms and other support tools used to determine appropriate treatment and response to specific infections. They often have experience translating data into actionable knowledge for clinicians and administration, which can help maintain support for the antimicrobial stewardship program and significantly contribute to patient safety initiatives targeted at infection reduction.

PHARMACISTS

Clinical pharmacists also play a key role in antimicrobial stewardship. Their expertise in antimicrobial effectiveness, toxicity, drug interactions, pharmacodynamics, and pharmacokinetics of antibiotics assist in multiple stewardship activities. These activities include creating and editing order sets, antibiotic usage policies, pre-authorizing selection of antibiotics, providing consultations, as well as tracking antimicrobial use and resistance.

Pharmacists ensure antibiotics are ordered correctly based on infection site, national guidelines, facility, and state resistance patterns. These professionals monitor and help prevent antibiotic-related adverse drug events and drug-drug interactions by promoting broad to narrow spectrum antibiotics, appropriate de-escalation of antibiotics, and making recommendations for intravenous to oral conversions.

Many times pharmacists are the last health professionals to come into contact with a patient or family member when being treated, and play a vital role in patient education on drug use. Pharmacists provide clear instructions on how to take medication correctly, adverse reactions, important precautions, drug-food interactions, as well as storage conditions.
Patients sometimes receive antibiotic prescriptions at dental offices. Therefore, dentists play an important role in antibiotic stewardship. Dentists, endodontists, and oral surgeons can recognize when antibiotics are not the primary treatment to control a localized infection, and when incisions and drainage, extraction, or endodontic therapy are appropriate first steps in treating oral bacterial infections. When dentists prescribe antibiotics, it is important to consider toxicity, allergy, adverse effects, and *C. difficile* infections even with a single dose. Oral health professionals provide important education to patients about taking the antibiotic exactly as prescribed, not to share the antibiotics, and not to save the antibiotic for future illness.

Dentists and oral maxillofacial surgeons develop educational tools, antibiotic stewardship policies, procedures, resources as well as messaging for dentists and patients about the importance of antibiotic stewardship in oral health.

**LABORATORY SCIENTISTS**

Laboratory scientists perform rapid diagnostic and antimicrobial susceptibility testing for a variety of infectious agents in the clinical and public health setting. The results of rapid diagnostics, such as influenza or Group A *Streptococcus* testing, can assist clinicians in determining if a patient needs an antibiotic. Antimicrobial susceptibility testing is commonly performed in the microbiology laboratory providing interpretations to aid prescribers in antibiotic selection for the treatment of ill patients. Isolates recovered from culture with high levels of resistance are sometimes sent for further genetic testing in a state or regional public health lab.

Utilizing the collected antibiotic susceptibility data, clinical microbiology laboratories perform annual reviews of test results, aggregating the data into an antibiogram. Antibiograms provide a profile for each organism and reported susceptibility to the group of antimicrobial agents the organism was tested against. These antibiograms can be used to guide empiric antimicrobial therapy and provide important information about local resistance patterns and strains circulating in the community.

Laboratory scientists also play a valuable role in the pre-analytical testing process, before specimens are even tested. For example, laboratorians lend expertise when developing criteria for the collection of stool samples for *C. difficile* testing to reduce the chances of a colonized patient receiving treatment as if the patient had an active infection.
**VETERINARIANS**

**Companion Animals**

Appropriate use of antibiotics is important regardless of your patient’s species. Antimicrobial stewardship in veterinary medicine requires maintaining animal health and welfare by implementing strategies to prevent or treat illnesses using evidence based approaches in antibiotic prescribing. Companion animals, unlike livestock species, are likely to cohabitate or spend extensive amounts of time with humans. It is important to recognize the increased risk of transmitting resistance genes between the microbiomes of humans and animals when in such intimate settings. Ensuring courses of antibiotics are both prescribed and administered appropriately is critical to prevent the development of zoonotic household transmission of resistant organisms and resistance genes.

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**One Health—recognizing human, animal, and environmental health are connected**

**Livestock**

It is also important to understand how antibiotics in livestock affect the evolution of antimicrobial resistance. Appropriate use of antibiotics in livestock will preserve the long-term efficacy of antibiotics and reduce the transmission of antibiotic resistant organisms to humans. We rely on livestock for food and clothing. Appropriate therapeutic use of antibiotics in production animals will ensure humane and effective husbandry practices through treatment of conditions that impact quality of life and quality of the meat, milk, fiber, leather, and other animal sourced products. Veterinarians have a unique opportunity to provide a valuable educational experience about the importance of antibiotic stewardship, concerns of resistance, and maintenance of antibiotic efficacy for human and animal health.
PUBLIC HEALTH PROFESSIONALS

Public health professionals strive to protect and improve the health of all citizens through health promotion efforts, research, policy development, as well as detection, prevention, and response to public health concerns. Antimicrobial resistance is a local and global threat and has increasingly been an area of focus within public health. Public health organizations can provide a population-based approach, which involves connecting healthcare facilities and public health organizations together to address antimicrobial resistance. Public health organizations and/or jurisdictions can collect antimicrobial susceptibility data to monitor and track burden of disease as well as educate the public and providers on appropriate antibiotic use. Public health efforts can help reduce antimicrobial resistance by monitoring and responding to antimicrobial resistant pathogens and convening key stakeholders to preserve antibiotics for future generations. Public health professionals encourage statewide coordinated antibiotic stewardship efforts to prevent antibiotic resistance and slow the spread of multi-drug resistant organisms.

Currently, the New Hampshire Division of Public Health Services (DPHS) Healthcare-Associated Infectious (HAI) Program monitors antimicrobial resistance patterns and publishes an annual antibiogram. The statewide antibiogram can be used as a baseline to compare local data and be used by healthcare facilities without access to a local antibiogram to assist with appropriate antibiotic prescribing. Furthermore, the HAI Program regularly convenes a large statewide multidisciplinary workgroup, otherwise known as the Antimicrobial Resistance Advisory Workgroup (ARAW), to guide future antibiotic stewardship work, public health directions, and coordinate efforts between key organizations and stakeholders.

PATIENTS AND FAMILY MEMBERS

When patients seek healthcare, there is a potential risk of developing a healthcare-associated infection (HAI) which can sometimes be caused by a drug resistant bacteria. HAIs are infections developed during the time a patient received medical care in a facility. There are various types of infections that can occur while staying in a hospital or other healthcare setting such as central line-associated bloodstream infections, catheter-associated urinary tract infections, and surgical site infections.

However, there are several things patients can do to protect themselves from developing a HAI. Patients should talk to their healthcare provider about any questions or concerns they have and make sure everyone cleans their hands before an examination. If patients do not see their healthcare provider practice hand hygiene, they can help remind them to do so. Patients or a family member with a central line catheter or a urinary catheter, can ask each day if the device is still necessary, since leaving a catheter in place too long increases the risk of developing an infection.

Patients and family members also play a vital role in their own healthcare by knowing what infection an antibiotic is treating, how long antibiotics are needed, taking antibiotics only as prescribed and what side effects may occur when an infection is diagnosed.
GENERAL PUBLIC AND PET OWNERS

We all have a role in antimicrobial stewardship. Most importantly, we need to take care of ourselves and our loved ones, including family members and pets. Below is a list of stewardship activities that can be incorporated into daily activities:

- Wash hands with soap and water for at least 20 seconds after you use the bathroom, take out the trash, change a diaper, visit someone who is ill, care for patients or loved ones, prepare food items, or after playing with a pet.
- Covering your cough and sneeze.
- Staying home when sick.
- Ensuring you, your family, and pets are up-to-date on vaccines.
- Know the difference between viral and bacterial infections and when antibiotics will work and when they won’t.
- Have a conversation with your healthcare or veterinary provider about symptom relief if not prescribed an antibiotic.
- If you had a penicillin allergy as a child, or cannot remember your reaction to penicillin, you should talk to your healthcare provider about penicillin allergy testing. If you find out you are no longer allergic to penicillin, you should provide test result documentation to your healthcare providers and pharmacist.

*Stay healthy and prevent the need for an antibiotic*
THINGS WE CAN ALL DO

We need to communicate more! We need to ensure patients and families are getting the necessary information about antibiotics. We need to educate the public on ways to prevent infections and the difference between bacteria and viruses. The general public needs to know antibiotics are not effective against viral illnesses. There needs to be clear instructions on how to take the antibiotic, food-drug interactions, and important precautions. The conversations should also include drug choice, route, dose, duration, and frequency. Patients should understand the possible side effects of the antibiotic which include allergic reactions and the risk of developing *C. difficile* infection and antimicrobial resistance.

We need to convey the need for antimicrobial stewardship to our political administration, coworkers, and patients. We should include antimicrobial stewardship in facility policies and procedures, educational tools, resources, and messaging. We need to implement best practices that reflect appropriate antimicrobial use and antimicrobial stewardship.

We can all start collecting data to aid our stewardship efforts. Data collection could include surveillance on the type of infections identified or diagnosed at a facility and the antimicrobial use and antimicrobial susceptibility patterns. We can use these data for surveillance purposes as well as guiding targeted interventions. Data must then be disseminated to the appropriate audience, including healthcare leadership. We all have a role in antimicrobial stewardship. We need to start taking action in a coordinated approach to prevent antimicrobial resistance and stop the transmission of multi-drug resistant organisms.
Is it Really a Penicillin Allergy?

Evaluation and Diagnosis of Penicillin Allergy for Healthcare Professionals

Did You Know?

5 Facts About Penicillin Allergy (Type 1, Immunoglobulin E (IgE)-mediated)

1. Approximately 10% of all U.S. patients report having an allergic reaction to a penicillin class antibiotic in their past.

2. However, many patients who report penicillin allergies do not have true IgE-mediated reactions. When evaluated, fewer than 1% of the population are truly allergic to penicillins.¹

3. Approximately 80% of patients with IgE-mediated penicillin allergy lose their sensitivity after 10 years.¹

4. Broad-spectrum antibiotics are often used as an alternative to penicillins. The use of broad-spectrum antibiotics in patients labeled “penicillin-allergic” is associated with higher healthcare costs, increased risk for antibiotic resistance, and suboptimal antibiotic therapy.¹

5. Correctly identifying those who are not truly penicillin-allergic can decrease unnecessary use of broad-spectrum antibiotics.¹

10% of the population reports a penicillin allergy but <1% of the whole population is truly allergic.

Before prescribing broad-spectrum antibiotics to a patient thought to be penicillin-allergic, evaluate the patient for true penicillin allergy (IgE-mediated) by conducting a history and physical, and, when appropriate, a skin test and challenge dose.

History and Physical Examination

The history and physical examination are important components when evaluating a patient’s drug reactions.¹

• Questions to ask during the examination:
  – What medication were you taking when the reaction occurred?
  – What kind of reaction occurred?
  – How long ago did the reaction occur?
  – How was the reaction managed?
  – What was the outcome?²

• Characteristics of an IgE-mediated (Type 1) reaction:
  – Reactions that occur immediately or usually within one hour¹
  – Hives: Multiple pink/red raised areas of skin that are intensely itchy³
  – Angioedema: Localized edema without hives affecting the abdomen, face, extremities, genitalia, oropharynx, or larynx⁴
  – Wheezing and shortness of breath
  – Anaphylaxis

• Broad-spectrum antibiotics are often used as an alternative to narrow-spectrum penicillins.
• Using broad-spectrum antibiotics can increase healthcare costs and antibiotic resistance, and may mean your patient receives less than the best care.
• Correctly identifying if your patient is actually penicillin-allergic can decrease these risks by reducing unnecessary use of broad-spectrum antibiotics.
Anaphylaxis requires signs or symptoms in at least two of the following systems:
- Skin: Hives, flushing, itching, and/or angioedema
- Respiratory: Cough, nasal congestion, shortness of breath, chest tightness, wheeze, sensation of throat closure or choking, and/or change in voice quality (laryngeal edema)
- Cardiovascular: Hypotension, faintness, tachycardia or less commonly bradycardia, tunnel vision, chest pain, sense of impending doom, and/or loss of consciousness
- Gastrointestinal: Nausea, vomiting, abdominal cramping, and diarrhea

**Penicillin Skin Tests and Challenge Doses**

Based on the patient history and physical exam, additional tests may be needed to confirm a penicillin allergy.

Penicillin skin testing and challenge doses are reliable and useful methods for evaluating for IgE-mediated penicillin allergy.⁵

**Penicillin Skin Testing**

A positive result means the patient is likely to have a penicillin allergy. If negative, the skin test is usually followed by an oral penicillin class challenge (e.g., with amoxicillin) to safely rule out an IgE-mediated penicillin allergy.¹,⁷

- The current standard of care is to perform a skin test with the major determinant penicilloylpolylysine and commercially-available penicillin G.
- To rule out penicillin allergy, an oral challenge dose can be done after skin testing. The negative predictive value of skin testing with the major and minor determinants is more than 95%, but approaches 100% when followed by a challenge dose.²

A direct oral challenge without prior skin testing may also be performed in selected patients and can rule out penicillin allergy. For more information, please consult an allergist.

**Special Considerations**

**Patients with severe hypersensitivity syndromes**

Patients with other severe hypersensitivity syndromes—like Stevens-Johnson syndrome, toxic epidermal necrolysis, serum sickness, acute interstitial nephritis, hemolytic anemia, and drug rash with eosinophilia and systemic symptoms (DRESS)—should not use the offending drug in the future. The skin test and challenge described here are not appropriate for patients with these severe hypersensitivity syndromes.¹,²,⁶

**Cephalosporin use in penicillin-allergic patients**

Many cephalosporins, especially in the later generations, can be safely tolerated despite a penicillin allergy.⁶,⁸ Patients with anaphylaxis or other severe reactions to penicillin may require further evaluation prior to the use of cephalosporins.

**Pediatric patients**

Children who are receiving amoxicillin or ampicillin and have Epstein-Barr virus infection can develop a non-allergic, non-pruritic rash that can appear similar to an allergic reaction.¹,⁹

For more information about antibiotic use, visit [www.cdc.gov/antibiotic-use](http://www.cdc.gov/antibiotic-use).

**References**


CDC thanks Mina Hong, PharmD Student Class of 2016 at Northeastern University, and Kimberly G. Blumenthal, MD, Division of Rheumatology, Allergy, and Immunology, Department of Medicine, Massachusetts General Hospital, Harvard Medical School, for their assistance preparing this fact sheet.
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**Interested in ARAW?**

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