

Introduction to Antibiotic Stewardship

An educational program to engage students in the public health fight against antibiotic resistance



Prepared by:



Important Definitions

Germ (**Bacteria**, **Fungi**, **Virus**)

- Very small organisms which includes bacteria, fungi, parasites, and viruses
- Most germs are harmless, but harmful germs are called pathogens

Antimicrobials (**Antibiotic**, **Antifungal**, **Antiviral**)

- Drugs used to treat infections
- Either kills the pathogen or slow the growth of the pathogen

Glossary of Terms Related to Antibiotic Resistance. CDC. Updated March 15th, 2019. Accessed February 28th, 2024. <https://www.cdc.gov/narms/resources/glossary.html>



**BE
ANTIBIOTICS
AWARE**

SMART USE, BEST CARE

A national educational effort lead by the Centers for Disease Control and Prevention (CDC). Its goal is to help fight antibiotic resistance and improve antibiotic prescribing and use

Much of the information discussed herein is from the CDC **“Be Antibiotics Aware” Program.**

Be Antibiotics Aware: Smart Use, Best Care. CDC. Updated November 12, 2021. accessed March 4th, 2024. <https://www.cdc.gov/patientsafety/features/be-antibiotics-aware.html>

Raise your hand if...

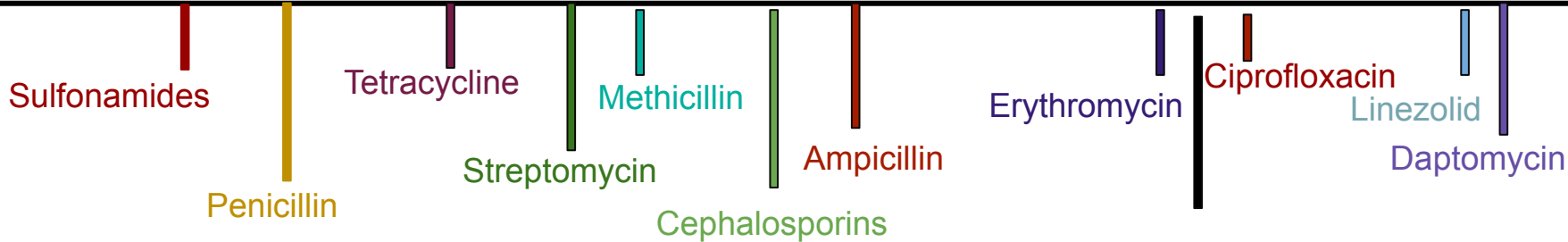
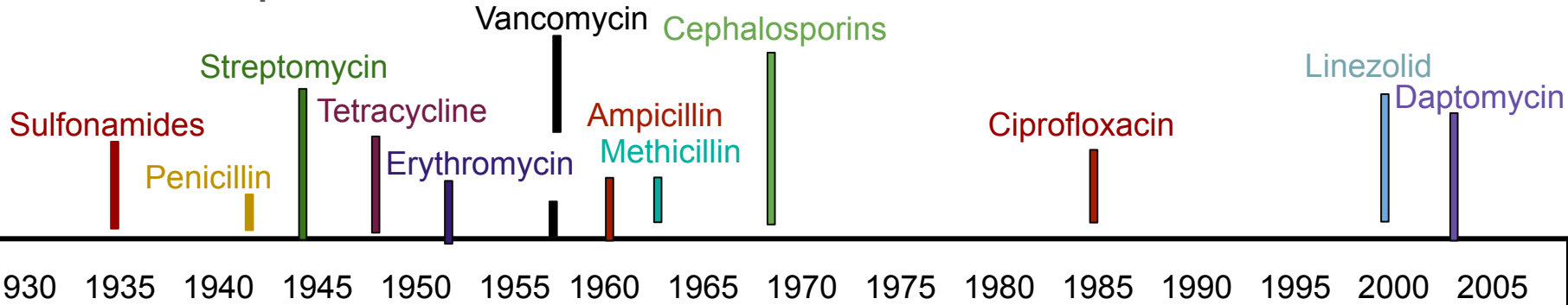
1. You, or someone you know, has ever been prescribed an antibiotic?
 - Do you recall the name?
 - Do you recall what the infection was?
2. Have you ever taken an antibiotic that wasn't prescribed for you?
3. Have you ever been concerned about taking antibiotics? or experienced a side effect?



Timeline of Antibiotic Resistance

Dam S. Bacteriology. 2018.

Antibiotic Developed



Antibiotic Resistance Observed

HOW ANTIBIOTIC RESISTANCE HAPPENS



1

There are lots of germs and a few are resistant to **antibiotics**.



2

When **antibiotics** kill bacteria causing illness, they also kill good bacteria protecting the body from infection.



3

The **antibiotic-resistant** bacteria grow and take over.



4

Some bacteria give their **antibiotic resistance** to other bacteria, causing more problems.



www.cdc.gov/antibiotic-use

How Antimicrobial Resistance Happens. CDC. Updated October 5th, 2022. Accessed March 4th, 2024. <https://www.cdc.gov/drugresistance/about/how-resistance-happens.html>.

What is Antimicrobial Resistance?

Antimicrobial resistance is when bacteria develop defense strategies against the antibiotics used to kill them

Bacteria develop new cell processes that avoid using the antibiotic's target

Bacteria change or destroy the antibiotics with enzymes (protein that break down the drug)

Bacteria restrict access by changing the entryways or limiting the number of entryways

Bacteria change the antibiotic's target so the drug no longer works



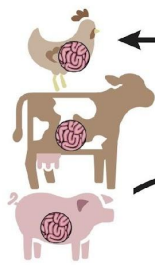
Bacteria get rid of antibiotics using pumps

How Bacteria and Fungi Fight Back Against Antibiotics. CDC. Accessed February 28th, 2028. <https://www.cdc.gov/drugresistance/pdf/threats-report/How-Germs-Fight-Back-Against-Antibiotics.pdf>



Examples of How Antibiotic Resistance Spreads

1



Animals get antibiotics and develop resistant bacteria in their guts.



George gets antibiotics and develops resistant bacteria in his gut.

4



Drug-resistant bacteria can remain on meat from animals. When not handled or cooked properly, the bacteria can spread to humans.



George stays at home and in the general community. Spreads resistant bacteria.

George gets care at a hospital, nursing home or other inpatient care facility.

Fertilizer or water containing animal feces and drug-resistant bacteria is used on food crops.



Drug-resistant bacteria in the animal feces can remain on crops and be eaten. These bacteria can remain in the human gut.

Resistant germs spread directly to other patients or indirectly on unclean hands of healthcare providers.



Resistant bacteria spread to other patients from surfaces within the healthcare facility.

2

Patients go home.

3

Simply using antibiotics creates resistance. These drugs should only be used to treat infections.

CS239559

Antibiotic Resistance and NARMS Surveillance. CDC. Updated July 20th, 2022. Accessed February 28th, 2024. <https://www.cdc.gov/narms/faq.html>

Why Antimicrobial Resistance Matters



In the U.S **more than 2.8 million antimicrobial-resistant infections** occur each year



In the U.S **more than 35,000 people die annually** as a result of antimicrobial resistant infections



Data from 2019-2020, during the COVID-19 pandemic, showed an **alarming increase in resistant infections** due to the increase in antimicrobial use and hospitalization

2019 AR Threats. CDC. Updated November 23rd, 2021. Accessed February 28th, 2024. <https://www.cdc.gov/drugresistance/biggest-threats.html>

Why Should You Be An Antibiotic Steward?

Without antibiotics that are effective against bacteria....



More people will **die from sepsis**, which is the body's extreme response to an infection



Prevention of surgical site infections will become difficult or impossible



Vulnerable patients, such as those receiving organ transplants or who have cancer, **will be at a greater risk of dying** due to infection

Antibiotic-Resistant Infections Threaten Modern Medicine. CDC. Accessed March 5th, 2024. <https://www.cdc.gov/drugresistance/pdf/threats-report/Threat-Modern-Medicine-508.pdf>

Antibiotic Resistance is one of the
Top 10 global public health threats,
according to the World Health Organization (WHO)



<https://www.pewtrusts.org/en/research-and-analysis/data-visualizations/2023/antibiotic-resistant-bacteria-is-a-growing-threat-2023>

What Causes Antimicrobial Resistance?

Unnecessary and inappropriate antimicrobial prescribing contributes to antimicrobial resistance

- **30% of antibiotic prescriptions in the outpatient setting are unnecessary**
- Equates to about **47 million unnecessary prescriptions** each year
- Total inappropriate antibiotic use, including incorrect selection, includes about 50% of all antibiotic use

Bacteria Versus Virus: What's The Difference?

BACTERIA	VIRUS
Able to live in many different types of environments	Requires a living host to multiply
Complex, single-celled creatures	Tiny without a cell structure
Many are harmless and some help with many functions of the body	Some viruses cause disease, and they're very specific in the cells they attack
Cause bacterial infections	Cause viral infections
Antibiotics can be used to treat these bacterial infections	Antibiotics are NOT effective against viruses; antiviral medications can be used for SOME viral infections

By NIAID (E. coli Bacteria) [CC BY 2.0 (<https://creativecommons.org/licenses/by/2.0/>)], via Wikimedia Commons, By NIAID - Ebola Virus Particles, CC BY 2.0, <https://commons.wikimedia.org/w/index.php?curid=36038631>

In-Class Activity

Viruses or Bacteria What's got you sick?

Antibiotics are only needed for treating certain infections caused by bacteria. Viral illnesses cannot be treated with antibiotics. When an antibiotic is not prescribed, ask your healthcare professional for tips on how to relieve symptoms and feel better.

Common Condition	Common Cause			Are Antibiotics Needed?
	Bacteria	Bacteria or Virus	Virus	
Strep throat				
Whooping cough				
Urinary tract infection				
Sinus infection				
Middle ear infection				
Bronchitis/chest cold (in otherwise healthy children and adults)*				
Common cold/runny nose				
Sore throat (except strep)				
Flu				

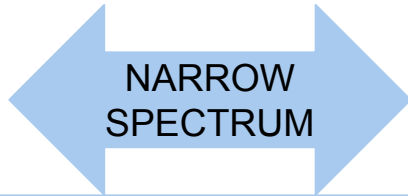


To learn more about antibiotic prescribing and use, visit www.cdc.gov/antibiotic-use.

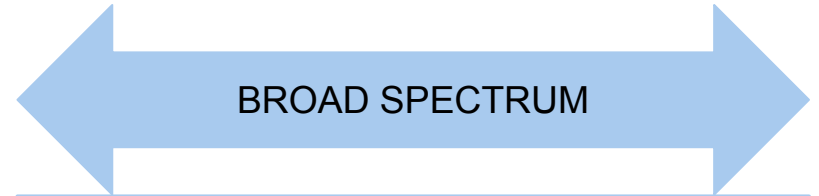


How Antibiotics Work

All antibiotics can negatively impact the gut flora, but some do more than others



Narrow spectrum antibiotics target specific, or **fewer**, bacteria species and are typically less impactful on the gut microbiome



Broad spectrum antibiotics target **more** bacteria species, including those found in your gut microbiome

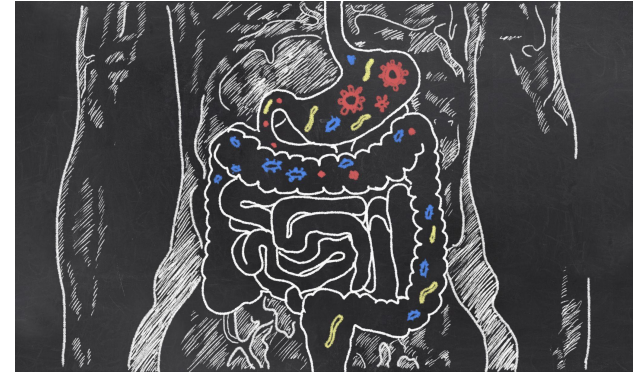
Good and Bad: Germs are Everywhere



Bacteria found in the mouth include:
Streptococcus mutans
Fusobacterium spp
Bacteroides fragilis

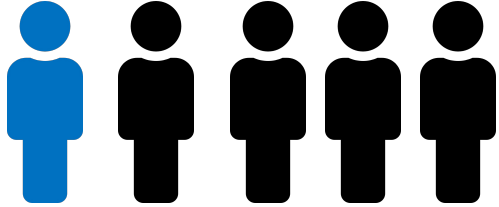


Bacteria found on the skin include:
Actinobacteria
Staphylococcus aureus
Staphylococcus epidermidis



Bacteria found in the gastrointestinal tract include:
Firmicutes
Bacteroidetes
Lactobacilli
Enterbacteracea

Antibiotic Safety



Antibiotics are responsible for almost **1 out of 5** emergency department visits for adverse drug events



Antibiotics are **the most common cause** of emergency department visits for adverse drug events in children under 18 years of age

Antibiotic Side Effects

Anytime antibiotics are used, they can cause these common side effects. However, the benefits may outweigh the risks when antibiotics are necessary.



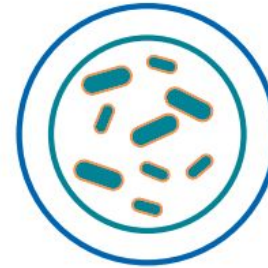
Rash



Dizziness



Nausea



Yeast Infection



Diarrhea

Most side effects are manageable and will go away after treatment completion

Do Antibiotics Have Side Effects? CDC. Accessed February 29th, 2024. www.cdc.gov/antibioitc-use

Patients with Penicillin Allergy Tend to Have Poor Outcomes

People with penicillin allergies are prescribed **2nd line** antibiotics that are either **not as effective or cause more side effects**

2nd-line antibiotics are “**broad-spectrum**” that can:

- increase risk of antimicrobial resistance
- negatively impact the gut microbiome

Why Should Patients With a History of Penicillin Allergy be Reevaluated?

9 **OUT OF** **10**

patients who think they have a penicillin allergy are not truly allergic



Knowing your allergy status prevents the spread of superbugs and helps you get the best care. Talk to your healthcare provider if you think you have a penicillin allergy.



- Many patients who say they are allergic to penicillins (eg. amoxicillin, Augmentin) **experienced a side effect, NOT an allergic reaction**
- 50% of people who had an allergic reaction will **no longer be allergic after 5 years**, 80% after 10 years and ~99% after 20 years

Evaluation and Diagnosis of Penicillin Allergy for Healthcare Professionals. Updated October 31st, 2017. Accessed February 29th, 2024. <https://www.cdc.gov/antibiotic-use/clinicians/Penicillin-Allergy.html>

Check your allergy to penicillin on MDCalc Medical Calculator



Penicillin Allergy Decision Rule (PEN-FAST)



Identifies low-risk penicillin allergies.

INSTRUCTIONS

Apply this calculator to patients who have reported a penicillin allergy.

When to Use ▾

Five years or less since reaction	No 0	Yes +2
Anaphylaxis or angioedema OR Severe cutaneous adverse reaction	No 0	Yes +2
Treatment required for reaction	No 0	Yes +1

0 points

PEN-FAST Score

<1 %

Very low risk of positive penicillin allergy test

Copy Results

Next Steps



MDCalc Medical Calculator

Clinical Decision Sup...

OPEN



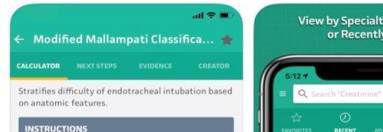
50K RATINGS	AGE	CHART	DE
4.9 ★★★★★	17+ Years Old	#172 Medical	MD

What's New [Version History](#)

Version 5.2.24 6d ago

Bug fixes & Improvements

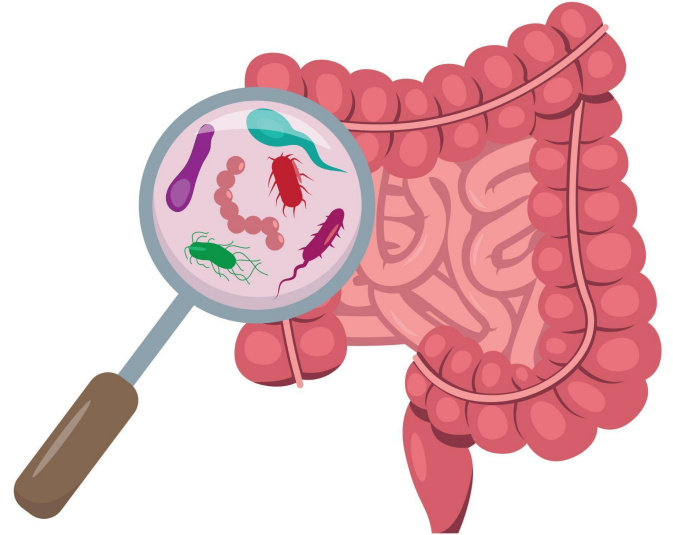
Preview



Antibiotics Effect Microbiome Diversity

Benefits of Microbiome Diversity

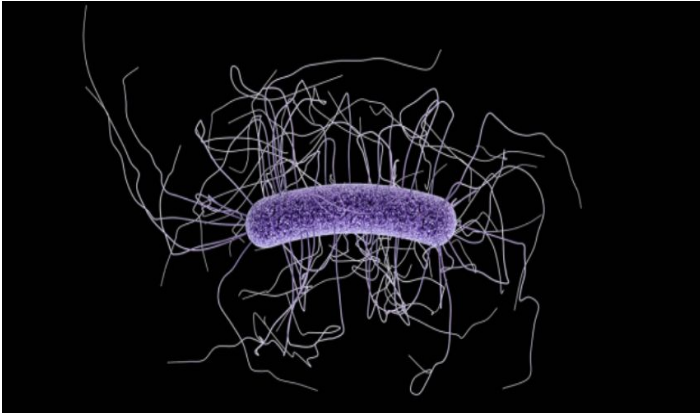
- Helps extract essential nutrients
- Helps prevent obesity
- Helps mitigate inflammatory diseases
- Helps produce essential neurotransmitters such as serotonin
- Helps protect against pathogenic bacteria



<https://www.nm.org/healthbeat/healthy-tips/what-does-gut-microbiome-have-to-do-with-your-health#:~:text=You%20are%20full%20of%20bacteria,helps%20control%20your%20immune%20system.>
<https://www.bmj.com/content/361/bmj.k2179>

Antibiotics Effect Microbiome Diversity

Antibiotics can impact the gut microbiome, increasing your risk for infections such as *Clostridioides difficile* (*C. difficile* or *C. diff*)



Learn more about *C. diff* @



PEGGY LILLIS FOUNDATION
FOR *C. DIFF* EDUCATION & ADVOCACY

- ***C. difficile*** is a bacteria that may grow in your gastrointestinal tract when antibiotics kill the good bacteria
- *C. difficile* releases toxins that can result in significant, potentially life-threatening, diarrhea
- Any antibiotic can cause *C. diff*, but “broad spectrum” antibiotics are more likely to cause
- Although one dose of an antibiotic can cause *C. diff*, the more antibiotics you take, the more at risk you are for developing *C. diff*
- A patient who has had *C. diff* in the past is at risk of getting it each time they take antibiotics

C. diff (Clostridioides difficile). CDC. Updated July 12, 2021. Accessed February 29th, 2024. <https://www.cdc.gov/cdiff/index.html>

Do Probiotics Help Antibiotics Work Better?

Live microorganisms found in some food and yogurts have health benefits

Help digest food, destroy bacteria that cause diseases, and produce vitamins

Data is limited on what kind of probiotic or how much is most efficacious



Class Activity:

1. Determine if the infection is caused by a bacteria or virus
2. Based upon what was prescribed, determine if the medication was “appropriate”

Patient Infection	Infection caused by bacteria or virus?	Medication prescribed by the healthcare provider	Is the prescription “appropriate”?
1. Cold		Z-pak	
2. Strep throat		Amoxicillin	
3. Urinary tract infection		Bactrim	
4. Flu		Tamiflu and Z-pak	
5. Whooping cough		Z-pak	

What Else You Can Do? Prevent Infections!



Get vaccinated

Vaccines are an important step to prevent infections, including resistant infections



Wash hands

Keeping your hands clean is one of the best ways to prevent infections, avoid getting sick, and prevent spreading germs

Make sure you know how to take your prescribed antibiotic!

Taking Your Antibiotics



You have just filled a prescription for antibiotics.

READ AND FOLLOW THIS IMPORTANT INFORMATION.

- Take your antibiotic as prescribed by your healthcare professional.
- Do not share it with others.
- Talk to your pharmacist about safely discarding leftover medicines.

WHY IS THIS CHECKLIST SO IMPORTANT?

All medicines have side effects. Common side effects of antibiotics can include:



Rash



Dizziness



Nausea



Yeast Infection



Diarrhea

More serious side effects include:

- Severe diarrhea, which could be a *C. diff* infection and needs immediate treatment.
- Severe and life-threatening allergic reactions, such as wheezing, hives, shortness of breath, and anaphylaxis (which also includes feeling that your throat is closing or choking, or your voice is changing).

Antibiotics can save lives. **When you need an antibiotic, the benefits outweigh the risks of side effects.** Talk with your healthcare professional if you have questions about your antibiotics, including interactions with other medications, or if you develop side effects.

1 out of 5 medication-related visits to the emergency room are from reactions to antibiotics.

To learn more about antibiotic prescribing and use, visit www.cdc.gov/antibiotic-use or call 1-800-CDC-INFO.



© 2015 CDC

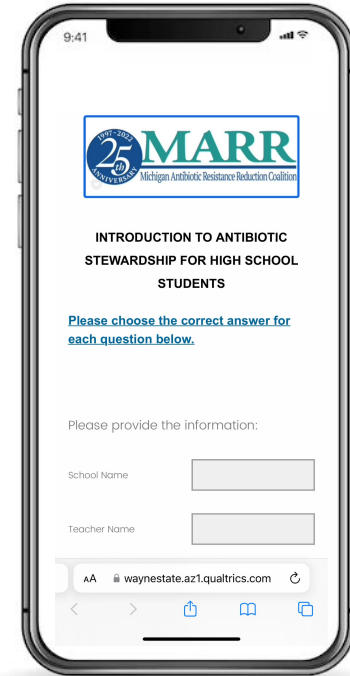
Summary of How You Can be an Antibiotic Steward



- ❑ If you have a cold or flu, ask a pharmacist for recommended over-the-counter medications to treat the symptoms
- ❑ If you seek medical care for symptoms of an infection, tell your provider that you are concerned about antibiotic resistance.
- ❑ If you are prescribed an antibiotic, ask your provider:
 - ❑ For the most narrow-spectrum antibiotic that is indicated for your infection
 - ❑ For the shortest duration of treatment that is indicated for your infection
 - ❑ Can you stop the antibiotic before finishing the entire prescription
- ❑ DO NOT FLUSH leftover antibiotics – bring them to the pharmacy for safe disposal
- ❑ If you have been told you are allergic to penicillin, calculate your PEN-FAST score; ask your provider if you may no longer be allergic
- ❑ Share this information with friends and family

How much did you learn?

Scan QR code to take the
required post-presentation test.



Optional activities to follow:

1. Watch the video “***Antibiotics: Just in case***” and write a reflection on how you might be an antibiotic steward.
2. Access the NARMS database and view antimicrobial resistance trends.

TED Antibiotics "just-in-case" | Debbie Goff | TEDxColumbus

Watch later Share



Watch on YouTube

Review: I² Strategy

Guide to Identify & Interpret graphs and figures

- Step 1: *Identify* “what you see”
 - Changes, trends, differences
- Step 2: *Interpret* “what it means”
 - Explain the changes, trends, and differences



National Antimicrobial Resistance Monitoring System (NARMS)

Use the interactive platform to illustrate resistance in humans and animals or to compare antimicrobial resistance trends

<https://www.fda.gov/animal-veterinary/national-antimicrobial-resistance-monitoring-system/narms-now-integrated-data>

NARMS Now: Integrated Data

National Antimicrobial Resistance Monitoring System



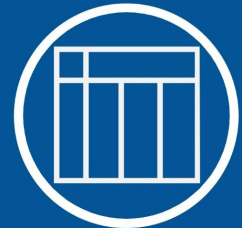
Map of Resistance



Multidrug Resistance by Number of Antimicrobial Classes



Resistance to Multiple Antimicrobial Agents



Antimicrobial Resistance by Year