WISCONSIN DEPARTMENT of HEALTH SERVICES

Wisconsin HAI Long-Term Care Education Series

January 26, 2023

Today's Agenda

Microbiology and Surveillance of Targeted Multidrug-Resistant Organisms (MDROs)

- **Megan Lasure,** Antimicrobial Resistance Lab Network Epidemiologist, Wisconsin State Laboratory of Hygiene (WSLH) and HAI Prevention Program
- **Ashley O'Keefe**, Infection Preventionist, HAI Prevention Program

Preventing and Controlling Respiratory Illness Outbreaks in Long-Term Care Facilities (LTCFs) Webpage Review

- **Molly Bieber,** Health Educator, HAI Prevention Program

Microbiology and Surveillance of Targeted MDROs

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Ashley O'Keefe, MLS(ASCP)^{CM}, CIC, CDIPC

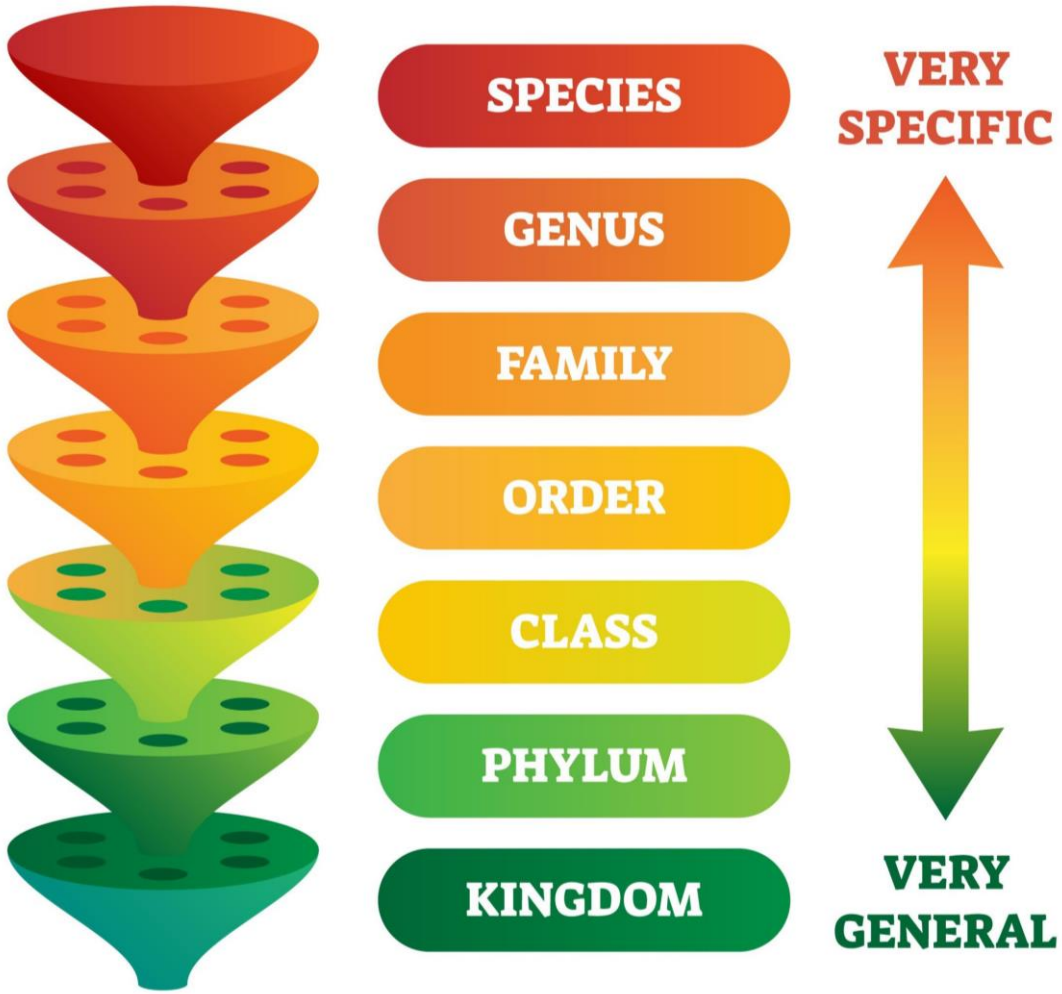
Objectives

After listening, attendees will better understand:

- Bacterial microbiology
- Antimicrobial resistance (AR)
- Targeted MDROs
- Laboratories in relation to infection prevention

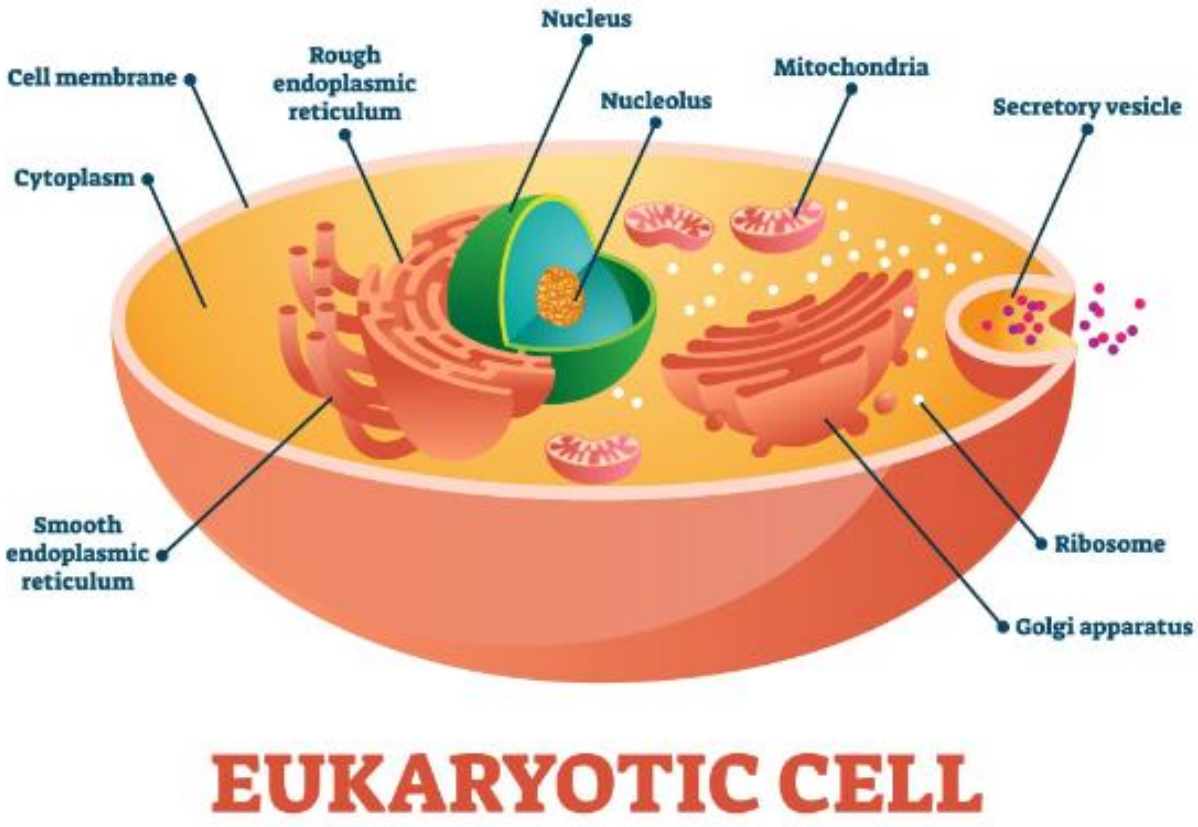
Bacteria

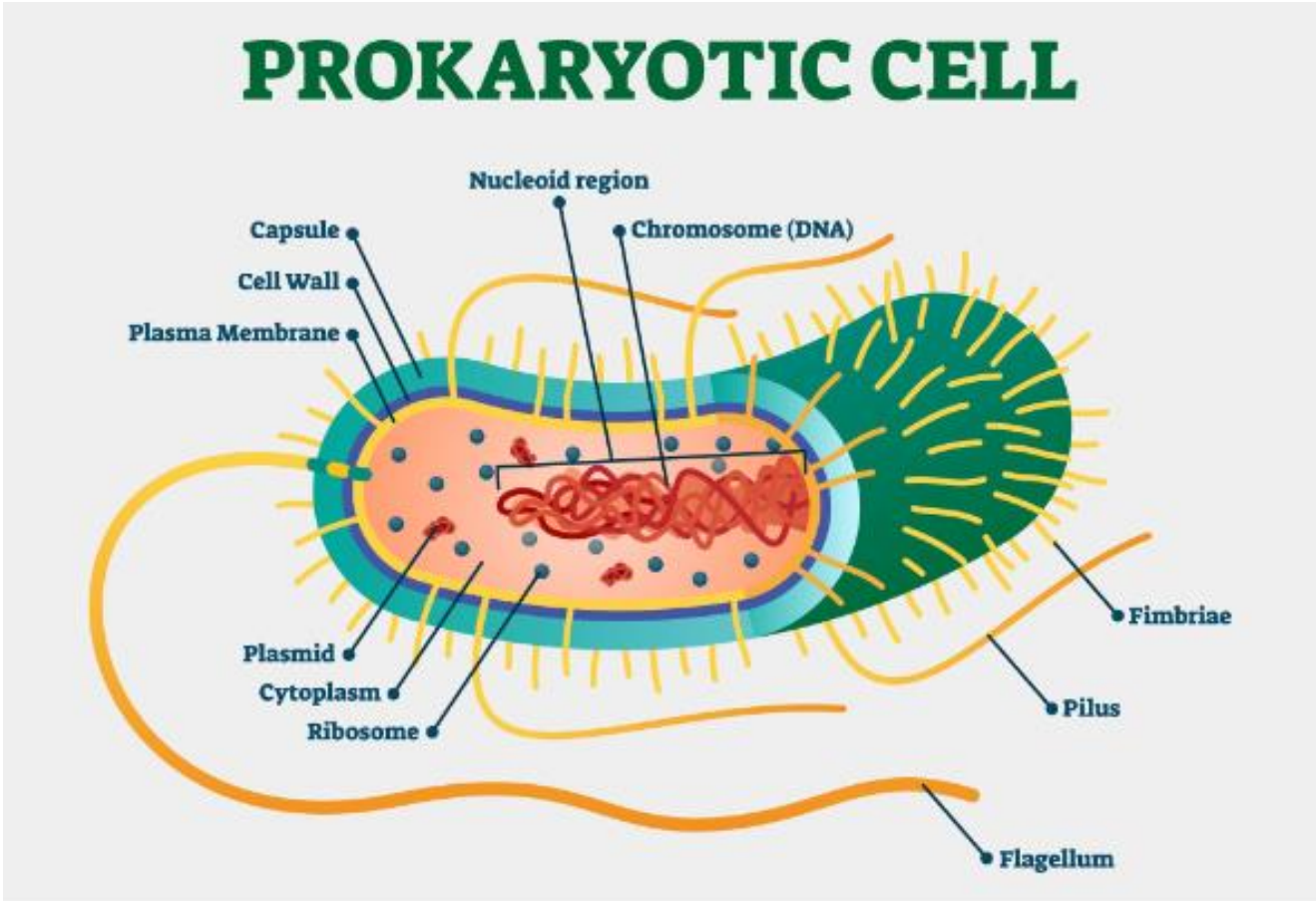
- Single-celled organisms
- Live almost everywhere on Earth
- Most do not cause disease, some are beneficial



Fungi

- Can be single-celled or multicellular (many cells)
- Includes both yeasts and molds
- Acquire food by absorbing dissolved molecules
- Closely related to humans
  - This makes development of new antifungals very difficult.
  - Existing antifungals are very toxic.

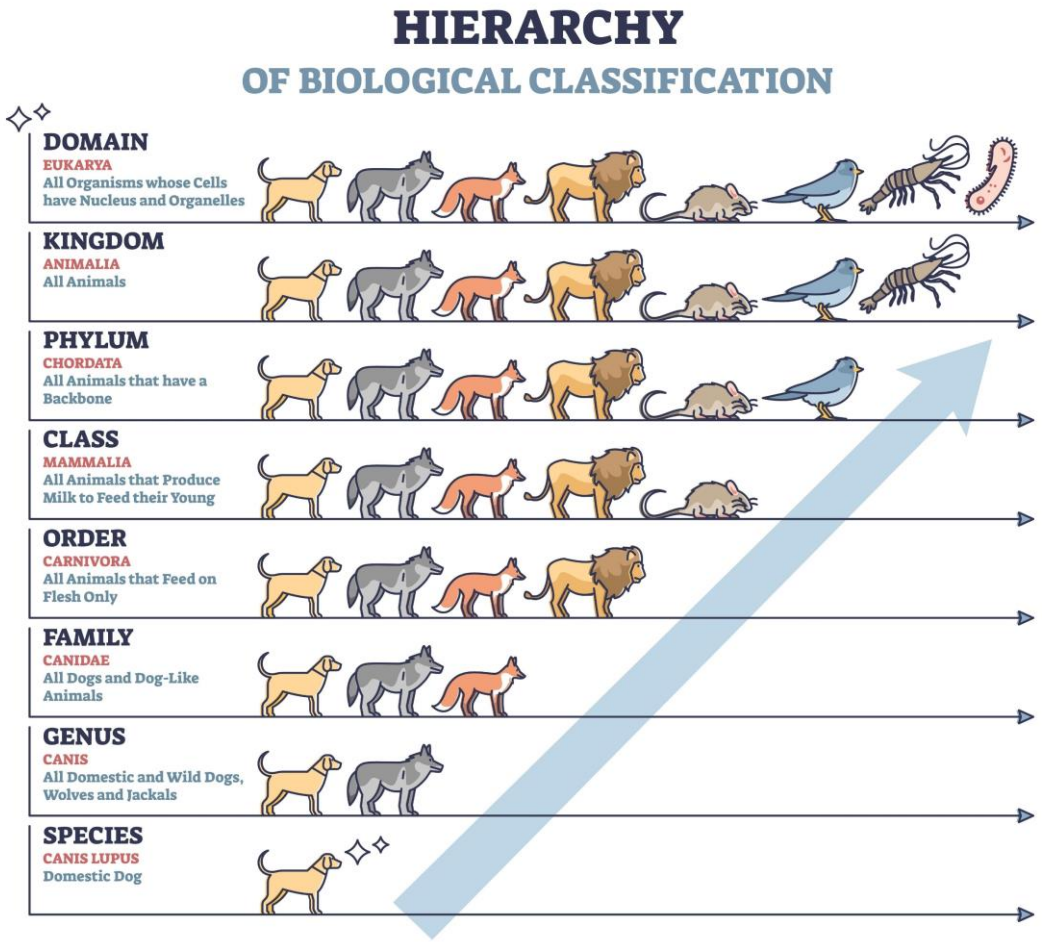

Nucleus
Cell membrane
Rough endoplasmic reticulum
Nucleolus
Mitochondria
Secretory vesicle
Cytoplasm
Smooth endoplasmic reticulum
Ribosome
Golgi apparatus
EUKARYOTIC CELL


PROKARYOTIC CELL
Nucleoid region
Capsule
Chromosome (DNA)
Cell Wall
Plasma Membrane
Fimbriae
Plasmid
Cytoplasm
Ribosome
Pilus
Flagellum

Bacterial Classification

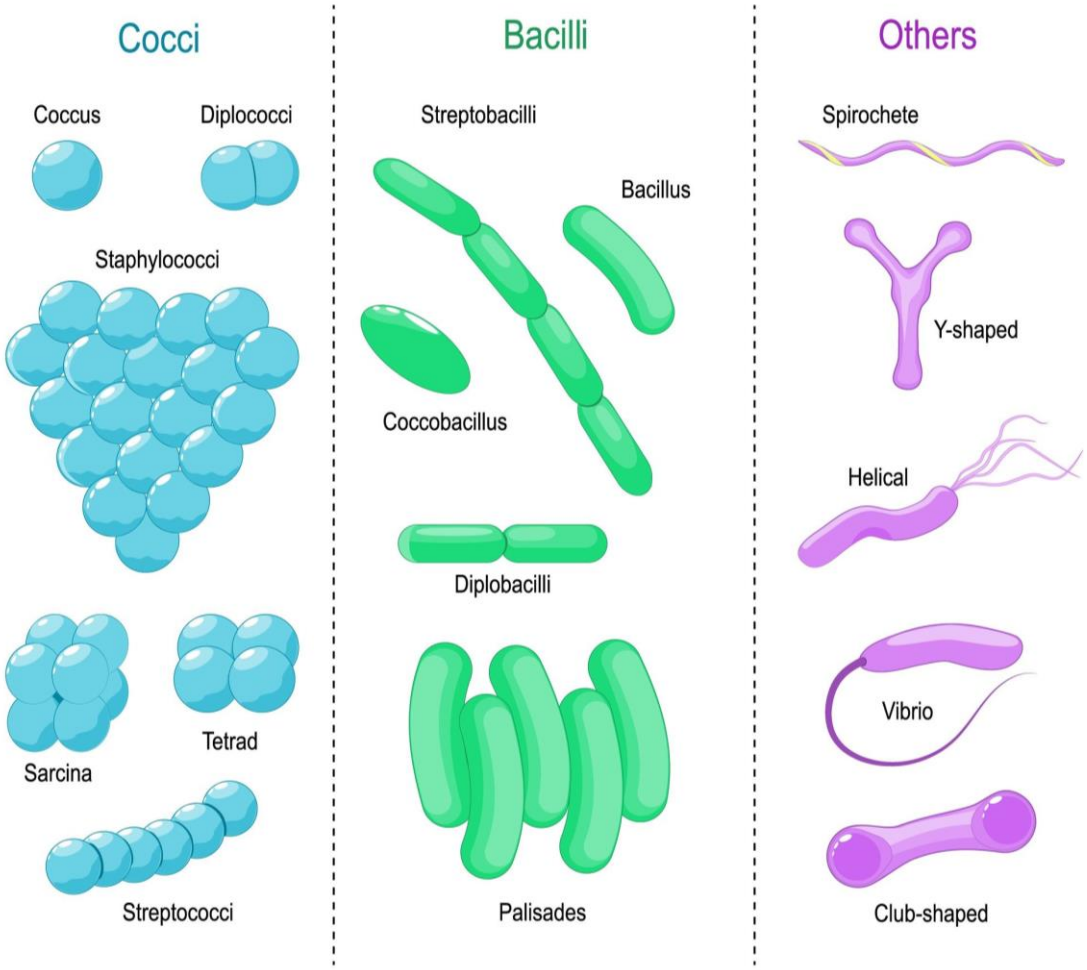
Methods of classification:

- Morphology (bacteria shape)
- Metabolism (how they "eat")
- Environment (where they live)
- Phylogeny (reconstructing how they evolved)



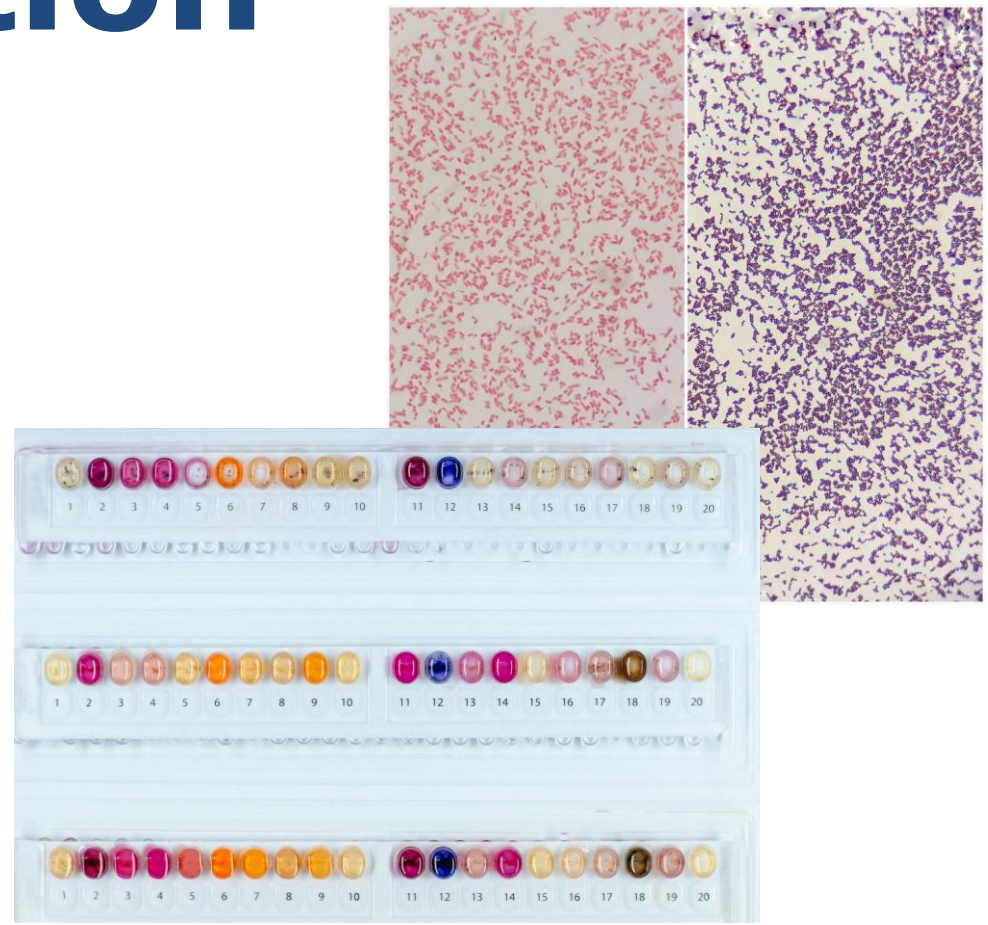
Morphologic Classifications

- Most common shapes are spheres (coccus/cocci) and rods (bacillus/bacilli)
- Describes how they "group" together
  - Streptococcus: cocci bacteria in a chain
  - Staphylococcus: cocci bacteria in clusters



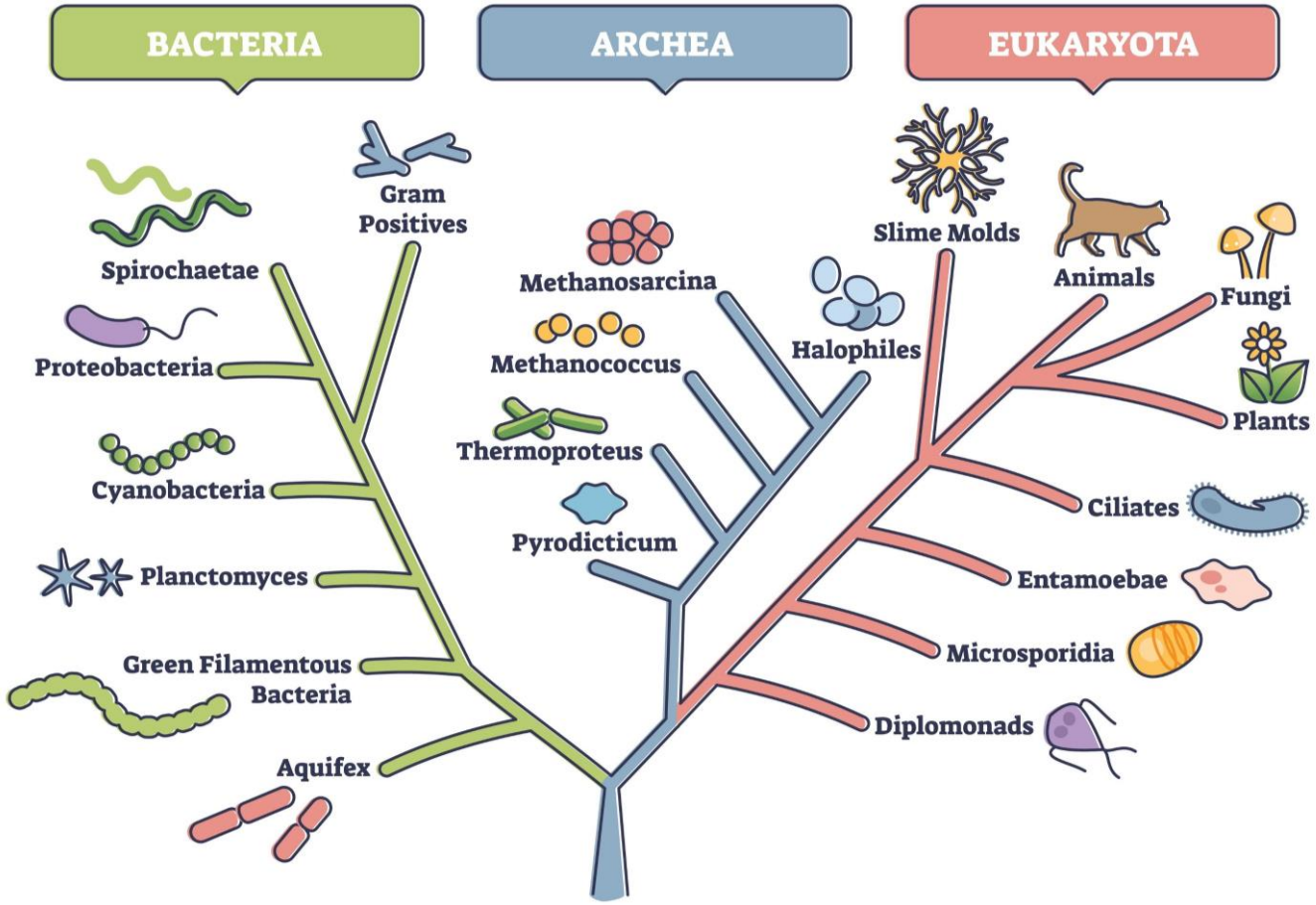
Morphologic and Metabolic Classification

- Gram stain: Differences in cell wall structure
- Analytical profile index (API) testing: Determines ~20 different biochemical reactions



Phylogenetic Classification

- Genome sequencing allows for more accurate classification.
- This can be a very slow method of identification.



Antigens

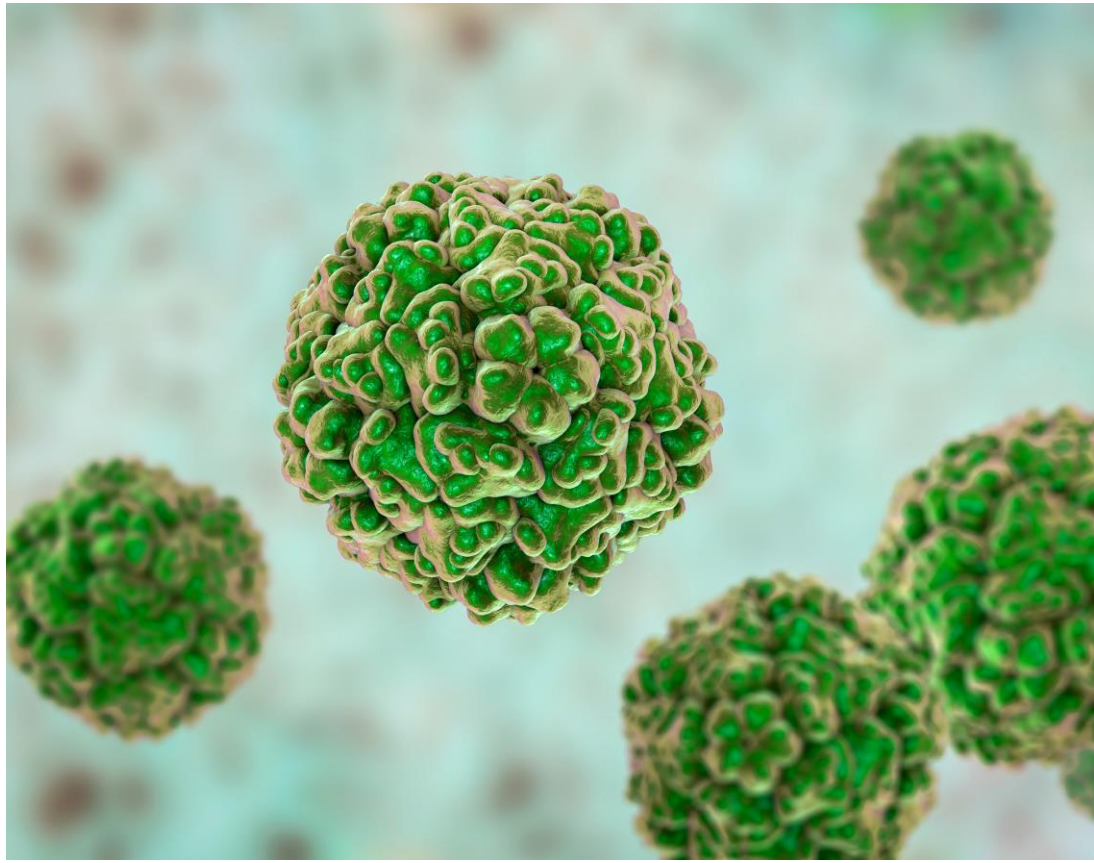
- This includes any molecule that our immune system recognizes.
- Bacterial antigens are external proteins.
  - Many are on the cell wall or membrane.
  - Some are on flagella or other motility proteins.
- This can also refer to any protein of interest detected by a bioassay or test.

Humans versus Pathogens

- When we get sick, our immune system responds in lots of ways.
- Methods our body can use to protect against bacteria:
  - Skin and mucus membranes.
  - Body pH.
  - White blood cells.
  - Antibodies.

Obligate Pathogen

- Obligate pathogens require a host to survive and reproduce.
  - This induces disease.
- Viruses are considered obligate pathogens.



Opportunistic Pathogen

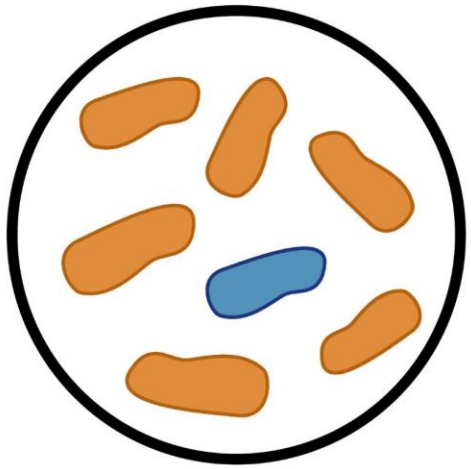
- Live in or on humans but don't help or harm them
  - Normal flora
- Cause disease in certain conditions
  - Immunocompromised
  - Tissue damage
  - Disruption of normal flora

Antimicrobial Resistance (AR)

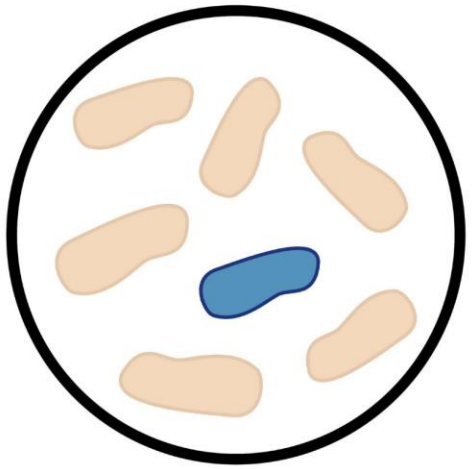
Antimicrobial Resistance

- When microorganisms develop mechanisms to protect themselves from antimicrobial medicines.
- "Selective pressure" from use of antimicrobials accelerates the process.

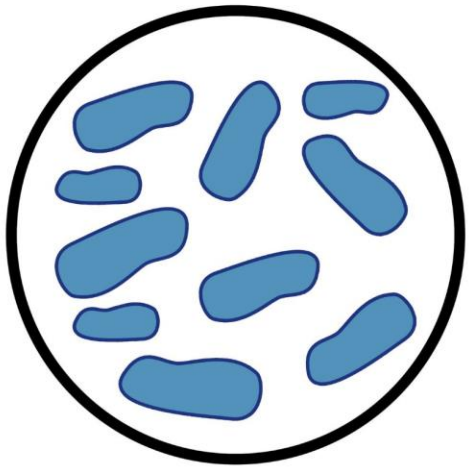
HOW ANTIBIOTIC RESISTANCE HAPPENS



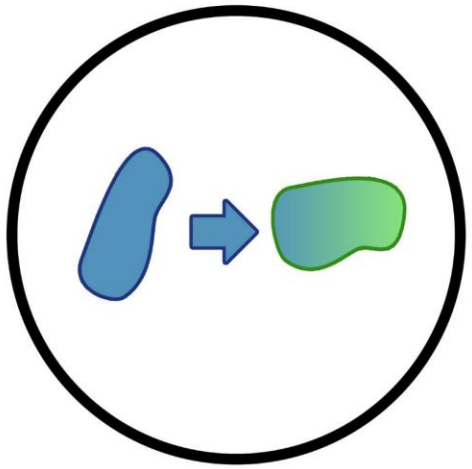
Lots of germs and some are drug resistant



Antibiotics kill the bacteria causing the illnes as well as the good bacteria protecting the body from infection



The drug resistant bacteria is now able to grow and take over



Some bacteria give their drug resistance to other bacteria

 - Normal bacterium

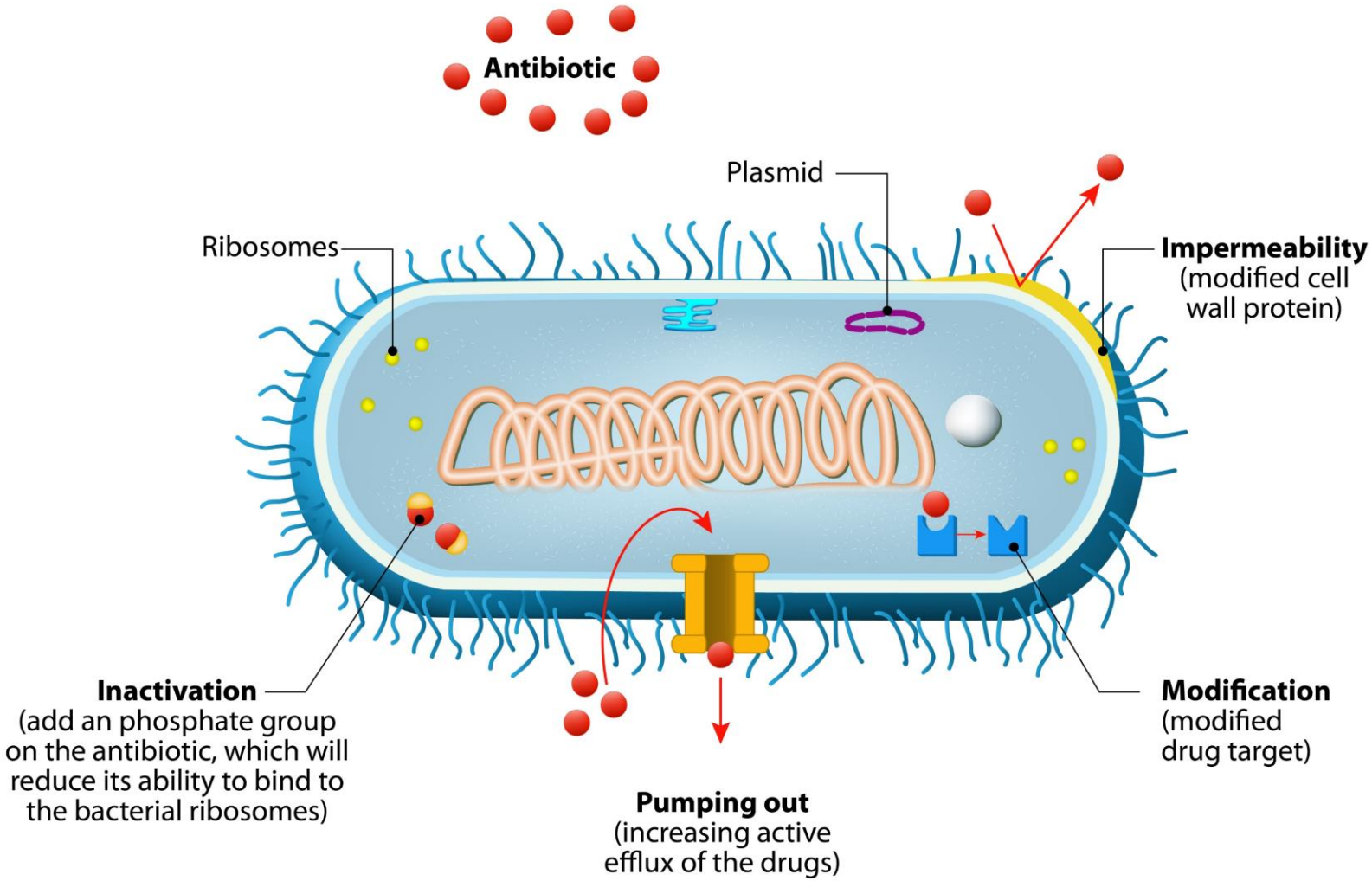
 - Resistant bacterium

 - Dead bacterium

Methods of Resistance

1. Decreased permeability of cell wall to antibiotic
2. **Enzymes to inactivate antibiotics**
3. Drug target site changes
4. Efflux pumps that remove antibiotic from the cell

MECHANISMS OF ANTIMICROBIAL RESISTANCE



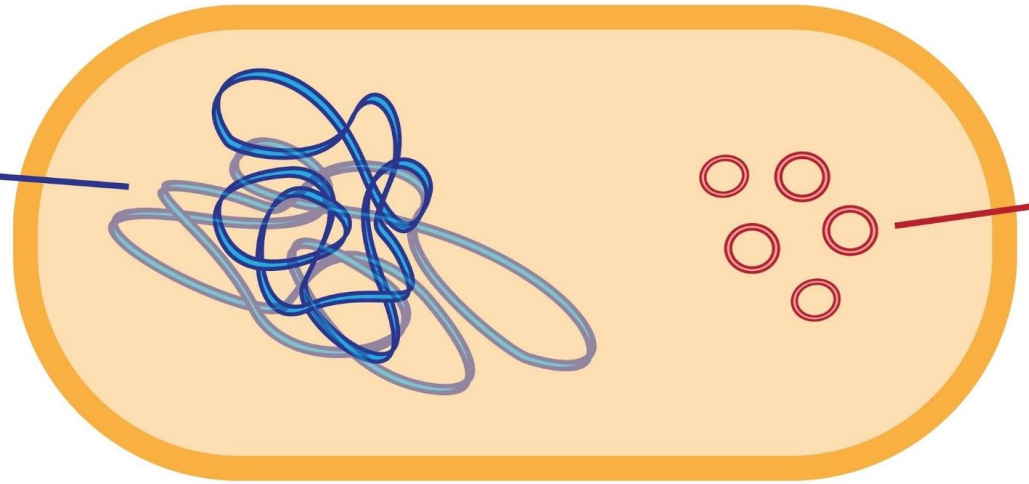
Intrinsic versus Acquired Resistance

Intrinsic	Acquired
Antibiotic never worked against the pathogen. Example: *Pseudomonas aeruginosa*	Resistance was achieved through transfer of genetic material that confers resistance, such as plasmids.

Chromosomal versus Plasmid-Mediated Resistance

Chromosomal	Plasmids
▪ Featured on the main bacterial DNA	▪ Small, circular DNA molecules ▪ Can be moved from cell to cell via conjugation ▪ Copy themselves independently of the chromosome

Chromosomal DNA



Plasmid DNA

- Genomic DNA that carry all of genetic informations
- Found in both of eukaryote and prokaryote
- Replicate with replication process
- Carry multiple genes for cell survival

- Extra chromosomal DNA
- Found in prokaryote
- Independent self replication
- Carry genes with special features (antibiotic resistance, drought tolerance, etc.)
- Important for recombinant DNA technology

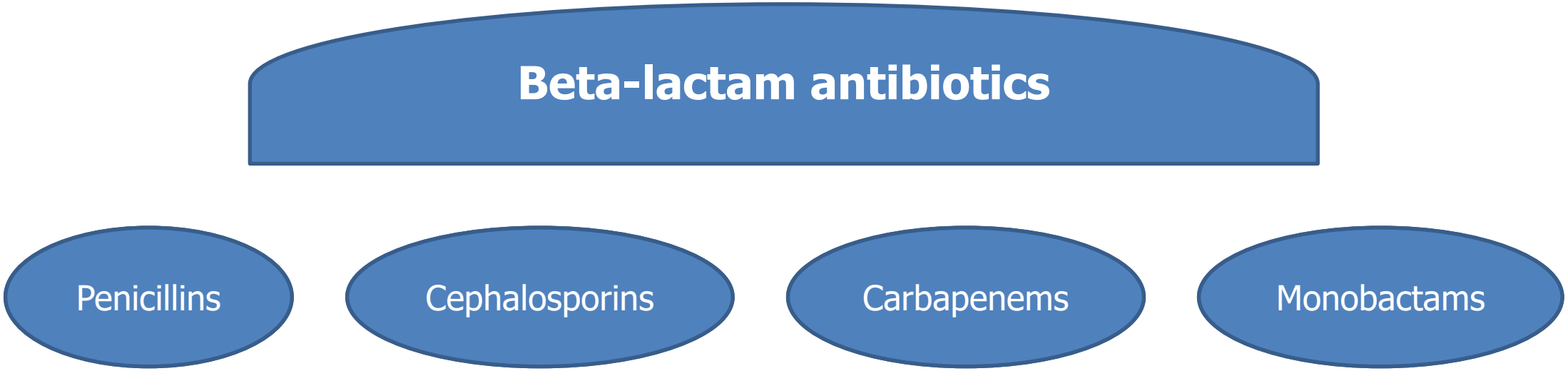
Targeted MDROs

Targeted MDROs

- The Centers for Disease Control and Prevention (CDC) track emerging AR threats.
- The CDC has developed a list of targeted MDROs, many of which are healthcare-associated organisms.

Antibiotics

- Drugs used to kill bacteria
- Use different mechanisms and bacterial targets
- Many different families of antibiotics



Carbapenemases

- Carbapenemase is an enzyme.
- Carbapenemases hydrolyze (break down) carbapenem antibiotics.
- Examples of carbapenem antibiotics:
  - Ertapenem
  - Doripenem
  - Imipenem
  - Meropenem

Enterobacterales

- Carbapenem-resistant **Enterobacterales** (CRE) is well-suited for survival in the human gut.
- Most species of Enterobacterales are normal gut flora that help digest food.

Enterobacterales Species

- *Enterobacter* species
  - *Enterobacter cloacae*
  - *Enterobacter cloacae* complex
- *Escherichia coli* (*E. coli*)
- *Klebsiella* species
  - *Klebsiella pneumoniae*
  - *Klebsiella aerogenes*
  - *Klebsiella oxytoca*

Pseudomonales

- *Pseudomonas* and *Acinetobacter* genera
- Not normal flora
- Often found in soil or water
- Survives well in patient care environments and on skin
  - *Pseudomonas* species can cause biofilms and have been found in drains.
  - *Acinetobacter* species colonizes human skin.

Carbapenemase-Producing Organisms (CPOs)

- CPOs are a broad category that can include isolates of any species with a carbapenemase resistance gene.
- Carbapenemase-producing (CP) can also be used to specify types of resistance for:
  - Carbapenem-resistant Enterobacterales (CP-CRE).
  - Carbapenem-resistant *A. baumannii* (CP-CRAB).
  - Carbapenem-resistant *P. aeruginosa* (CP-CRPA).

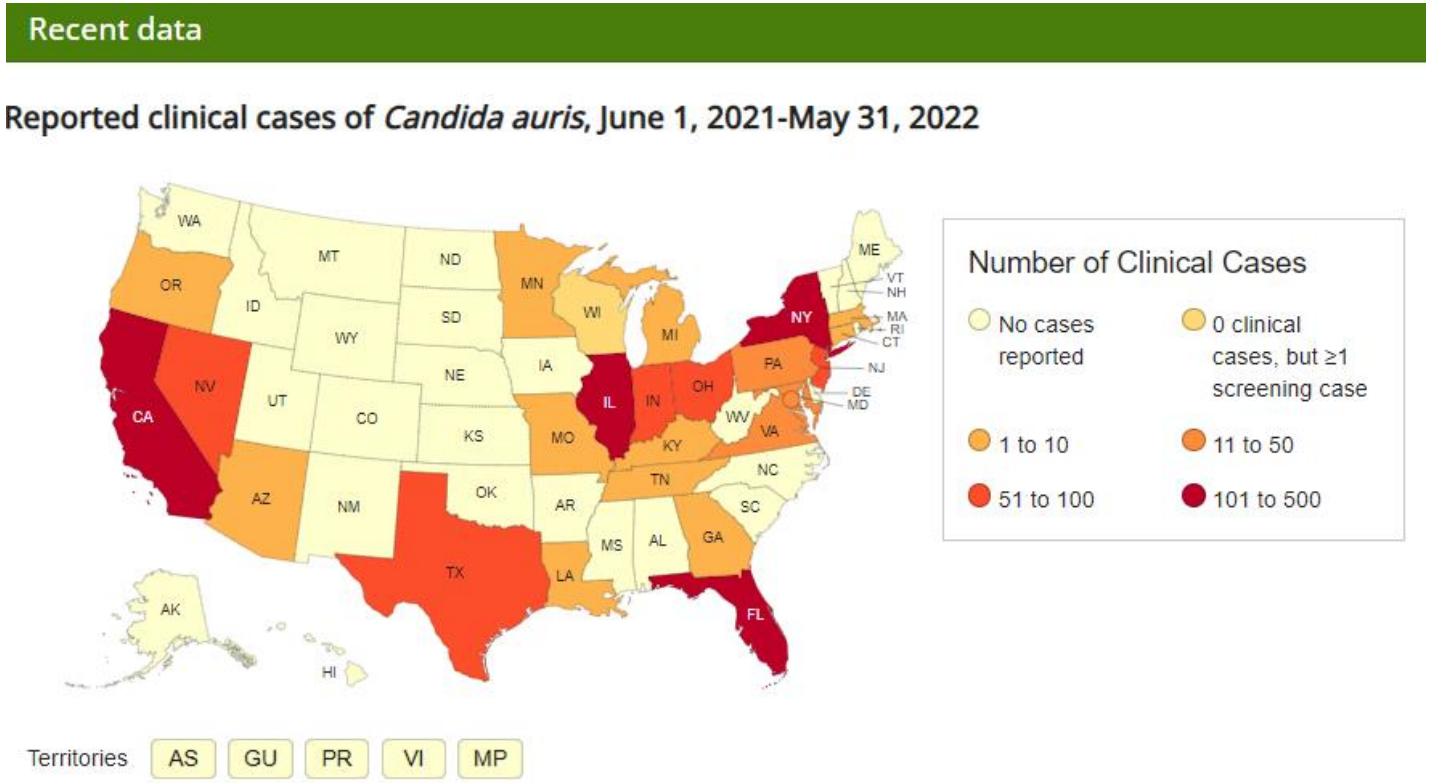
Candida auris (C. auris)

C. auris

- *C. auris* is a type of fungus that is resistant to most antifungal medication.
- *C. auris* is rare but potentially life-threatening.
- *C. auris* can spread rapidly in health care settings.

C. auris

- First identified in 2009
- Emerged in multiple countries over the next few years
- Chicago emerged as a major reservoir in the U.S.



https://www.cdc.gov/fungal/candida-auris/tracking-c-auris.html

C. auris Identification

- Identification can be difficult.
  - Many automated systems misidentify it as other species (like *Candida haemulonii*).
- Matrix-assisted laser desorption/ionization-time of flight (MALDI-TOF) is the gold standard identification method.

Antifungal Susceptibility Testing

- Three classes of antifungals:
  - Triazoles
  - Echinocandins
  - Amphotericin B
- Limited drug options
- No official susceptibility breakpoints

Colonization Testing

- Axilla and groin swabs
- PCR test to detect presence of *C. auris* after some growth in broth

Labs and Infection Prevention

The Connection to Infection Prevention

- Lab tests are an important piece of the puzzle when evaluating patients or residents for potential infection.
- Microbiology and other lab tests are used to provide information and guide decisions.

Lab Results

- A system should be in place to receive and review lab results.
- Infection logs should be maintained.
- Policies should be in place to determine next steps.

Review Lab Results

- The infection preventionist must understand how to interpret lab results.
- Things to consider:
  - Who is responsible for initial review of lab results?
  - How soon or often does follow up happen?

Review Lab Results

Result reports will differ based on the specimen type.

- **Urine culture:** Includes a quantitative number, as well as the bacterial identification.
- **Respiratory or wound culture:** Includes a qualitative number, as well as bacterial identification.
- **Sensitivity results:** Indicate whether the identified pathogen can be effectively treated against a variety of antimicrobial agents.

Colonization versus Infection

- **Colonization:** An organism is present on or in the body but not causing any harmful symptoms, illness, or disease.
- **Infection:** An organism is present on or in the body and is causing symptoms, illness, or disease.

TEST ORDERED: CULTURE, URINE, ROUTINE

RESULT	VALUE	UNITS	REFERENCE RANGES	ABNORMAL	RESULT STATUS
ISOLATE 1:	Klebsiella pneumoniae (ESBL)			Abnormal	Final
BACTERIA ISLT CULT	Klebsiella pneumoniae (ESBL)			Abnormal	Final

THIS ORGANISM IS A CARBAPENEM RESISTANT
ENTEROBACTERIACEAE.
KLEBSIELLA PNEUMONIAE (ESBL)
GREATER THAN 100,000 CFU/ML OF
ESBL RESULT: THE ORGANISM HAS BEEN CONFIRMED AS AN ESBL PRODUCER.

Infection Logs

Include relevant details such as:

- Resident information
- Symptoms
- Diagnosis
- Treatment

Next Steps

- Reportable communicable diseases must be reported to public health per state statute.
  - MDROs, influenza, measles
- The timing of reporting depends on the identified disease (Category I, II, etc.).
- Some organisms will also trigger an immediate infection prevention response.

Next Steps

- Utilize surveillance definitions
- Report to Quality Assurance/Performance Improvement (QAPI) Committee
- Utilize transfer forms

In Summary

- You can prevent outbreaks by correctly interpreting lab results.
- You need to be organized in your review of lab results.
- You should have a way of communicating results with other key stakeholders.

IP-Focused Laboratory Resources

- *The Infection Preventionist's Guide to the Lab*, Association for Professionals in Infection Control and Epidemiology (APIC)
- *Clinical Microbiology Made Ridiculously Simple,* Mark Gladwin
- *Control of Communicable Diseases Manual,* James Chin
- *Ready Reference for Microbes,* Kathy Brooks

Questions?

Preventing and Controlling Respiratory Illness Outbreaks in LTCFs Webpage Review

Molly Bieber, CHES

Preventing and Controlling Respiratory Illness Outbreaks in Long-Term Care Facilities

This webpage includes guidance for preventing and controlling acute respiratory illness outbreaks in Wisconsin long-term care facilities (LTCFs). For the purposes of this guidance, LTCFs include skilled nursing facilities (SNFs), community-based residential facilities (CBRFs), and residential care apartment complexes (RCACs).

The information on this webpage was previously located in BCD Memo 2021-13. Please check this webpage frequently, as the content will be updated as guidance for LTCFs changes.

Responding to respiratory disease outbreaks

When an outbreak of acute respiratory illness (ARI), such as COVID-19 or another viral respiratory disease is suspected, **timely testing, reporting, and infection control is imperative**. Until the cause of an ARI outbreak is determined, facilities should initiate empiric precautions at the most protective level, including gown, gloves, fit tested N95, and eye protection, such as goggles or a face shield.

Preventing and Controlling Respiratory Illness Outbreaks in Long-Term Care Facilities

Infection control and prevention

Duration of transmission-based precautions: non-COVID-19 respiratory disease outbreaks

Follow CDC guidelines for the specific type and duration of precautions.

- **For confirmed or suspected influenza**, residents should remain on droplet precautions for seven days after onset of illness or until 24 hours after the resolution of fever and respiratory symptoms, whichever is longer.
- **For other respiratory illnesses**, the resident should remain on appropriate precautions for the duration of illness, defined as 24 hours after resolution of fever without the use of fever-reducing medications and without respiratory symptoms (see ARI symptoms above). Criteria for determining ARI among staff or residents should focus on whether cough is a new or worsening symptom. For discontinuation of droplet or contact precautions, exclude cough as a criterion unless the cough produces purulent sputum. In many cases, a non-infectious post-viral cough may continue for several weeks following resolution of other respiratory symptoms.

Duration of transmission-based precautions: COVID-19 outbreaks

When a resident has confirmed or suspected COVID-19, the resident should remain on standard, airborne, and contact (plus eye protection) precautions at minimum until conditions for discontinuation* are met:

- At least 10 days have passed since onset of symptoms, AND
- At least 24 hours have passed since last fever without the use of fever-reducing medications, AND
- Symptoms (such as cough and shortness of breath) have improved.

*Some individuals with severe illness OR who are severely immunocompromised should be maintained on droplet and contact precautions until at least 10 days and up to 20 days have passed since symptom onset AND at least 24 hours since the last fever with symptom improvement. Use of a test-based strategy and (if available) consultation with an infectious disease specialist is recommended to determine when Transmission-Based Precautions could be discontinued for moderately to severely immunocompromised patients.

Facilities should continue to follow the latest guidance from federal and state agencies. This includes the use of full PPE for residents with suspected or confirmed COVID-19: gown, gloves, fit tested N95, and eye protection. Aerosol generating procedures (AGP) should take place in an airborne infection isolation room (AIIR), if possible. When AGPs cannot be performed in an AIIR, staff present during the procedure should be limited and the door should remain closed.

Questions?

HAI Prevention Program Contact Information

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608-267-7711

For additional contact information visit
www.dhs.wisconsin.gov/hai/contacts.htm

https://www.dhs.wisconsin.gov/hai/ip-education.htm

Upcoming LTC Education Session

February 23, 2023

Topic: Infection Control Risk Assessments (ICRAs)