Rethinking Antibiotics: Trends, Stewardship, and Educating Patients

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OKLAHOMA
State Department
of Health

Financial Disclosure and Mitigation

I have no relevant financial relationships with ineligible companies to disclose.

Objectives

Analyze antimicrobial resistance patterns, nationally and in Oklahoma

Describe strategies for optimizing antimicrobial prescribing

Evaluate methods to communicate the importance of antimicrobial stewardship to patients

Antimicrobial Resistance

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Antimicrobial Resistance

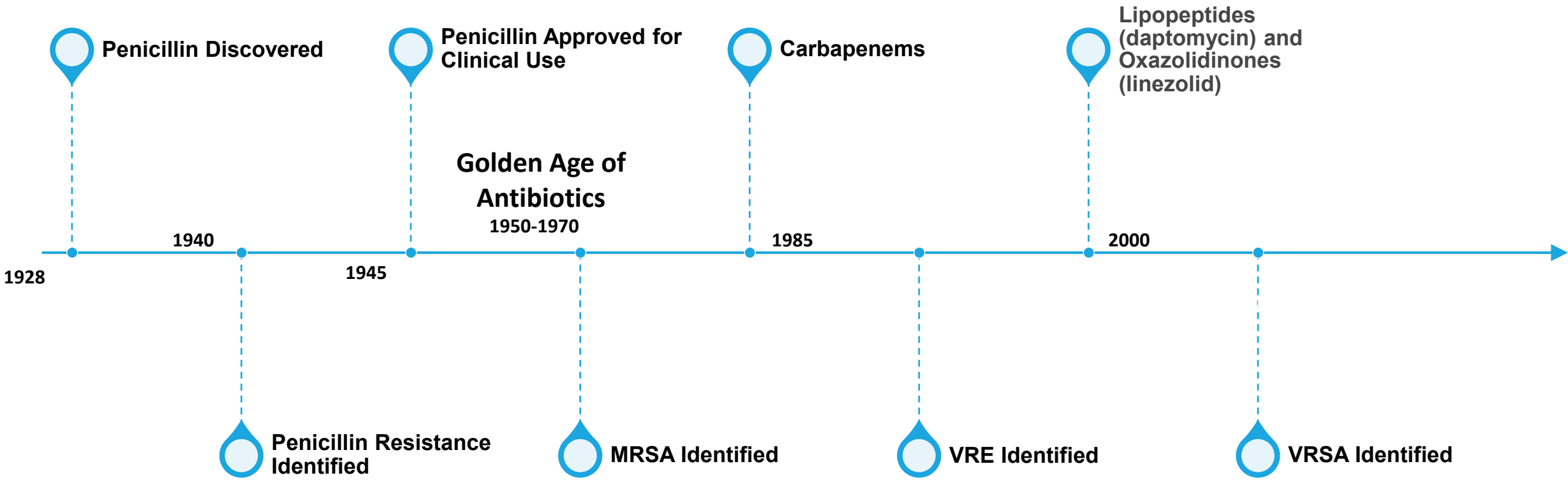
- Naturally occurring phenomenon consisting of genetic mutation and sharing of mutated genes for bacterial/fungal survival. Resistance mutations occur largely as a result of antimicrobial exposure.

- Due to the rapid spread and high mortality/morbidity associated with antimicrobial resistant infections, it is considered an urgent global public health threat.

CDC. Antibiotic Resistance Threats in the United States, 2019 and 2021-2022

Timeline of Antimicrobial Resistance

VRE was identified roughly 15 years before any antibiotics with activity entered the market



MRSA: methicillin resistant *Staphylococcus aureus*, VRE: vancomycin resistant *Enterococcus*, VRSA: vancomycin resistant *Staphylococcus aureus*

Current Opinion in Microbiology v51 p72-80

* Topics depicted are highlighted excepts from larger timeline

Impact of Resistance in the US

2013

- 2 million antimicrobial resistant infections per year
- 23,000 associated deaths

2019

- 2.8 million antimicrobial resistant infections per year
- 35,000 associated deaths

2021-2022

- Combined 20% increase in targeted antimicrobial resistant pathogens during the COVID-19 pandemic
- Rates of 5/6 targeted pathogens remained above pre-pandemic levels in 2022

CDC. Antibiotic Resistance Threats in the United States, 2019 and 2021-2022

CDC Threat Report 2024 Update

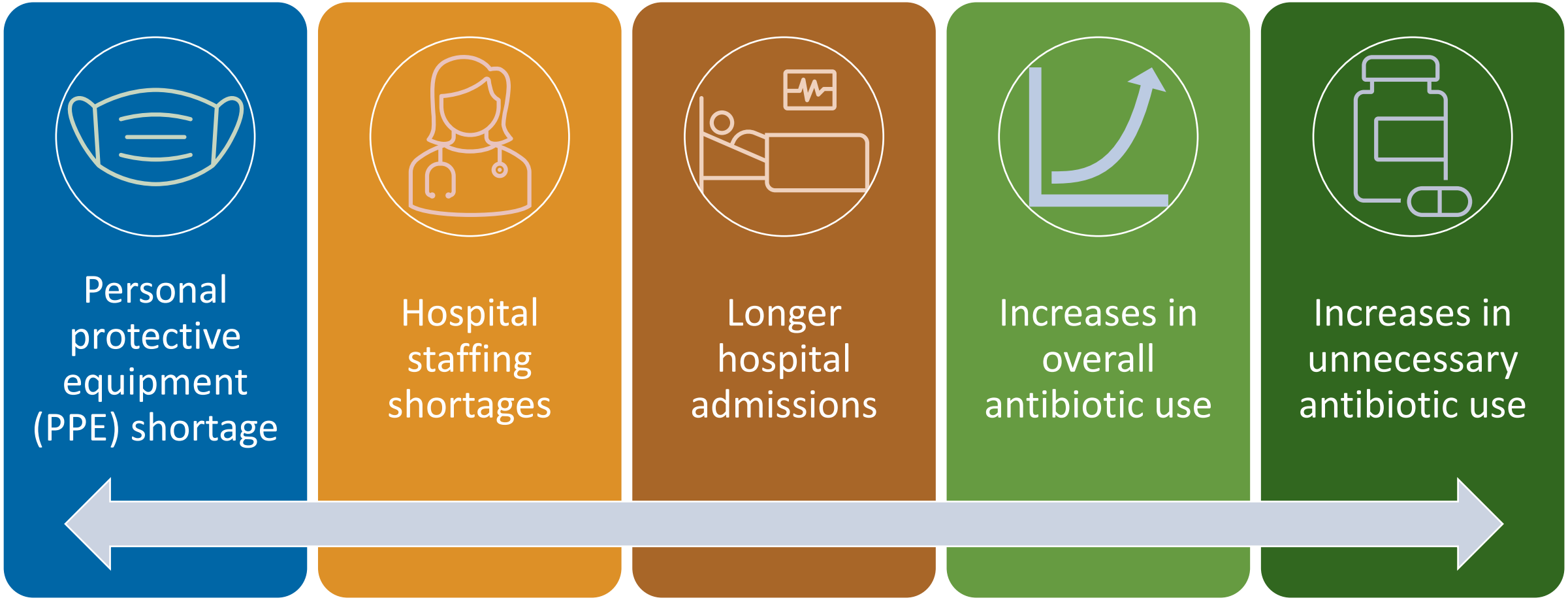
CDC Threat Report Update released in 2024 to demonstrate the impact of the COVID-19 pandemic on antimicrobial resistance throughout the country.

AR Threats

	Threat	Change in Rates or Number of Infections***			
		2020 vs. 2019	2021 vs. 2020	2022 vs. 2021	2022 vs. 2019
URGENT*	Hospital-onset CRE	▲ Increase	▲ Increase	▬ Stable	▲ Increase
URGENT*	Hospital-onset Carbapenem-resistant *Acinetobacter*	▬ Stable	▬ Stable	▬ Stable	▲ Increase**
URGENT*	Clinical Cases of *C. auris*	▲ Increase	▲ Increase	▲ Increase	▲ Increase
SERIOUS*	Hospital-onset MRSA	▲ Increase	▬ Stable	▼ Decrease	▬ Stable
SERIOUS*	Hospital-onset VRE	▲ Increase	▲ Increase	▬ Stable	▲ Increase
SERIOUS*	Hospital-onset ESBL-producing Enterobacterales	▲ Increase	▬ Stable	▬ Stable	▲ Increase
SERIOUS*	Hospital-onset MDR *Pseudomonas aeruginosa*	▲ Increase	▲ Increase	▬ Stable	▲ Increase

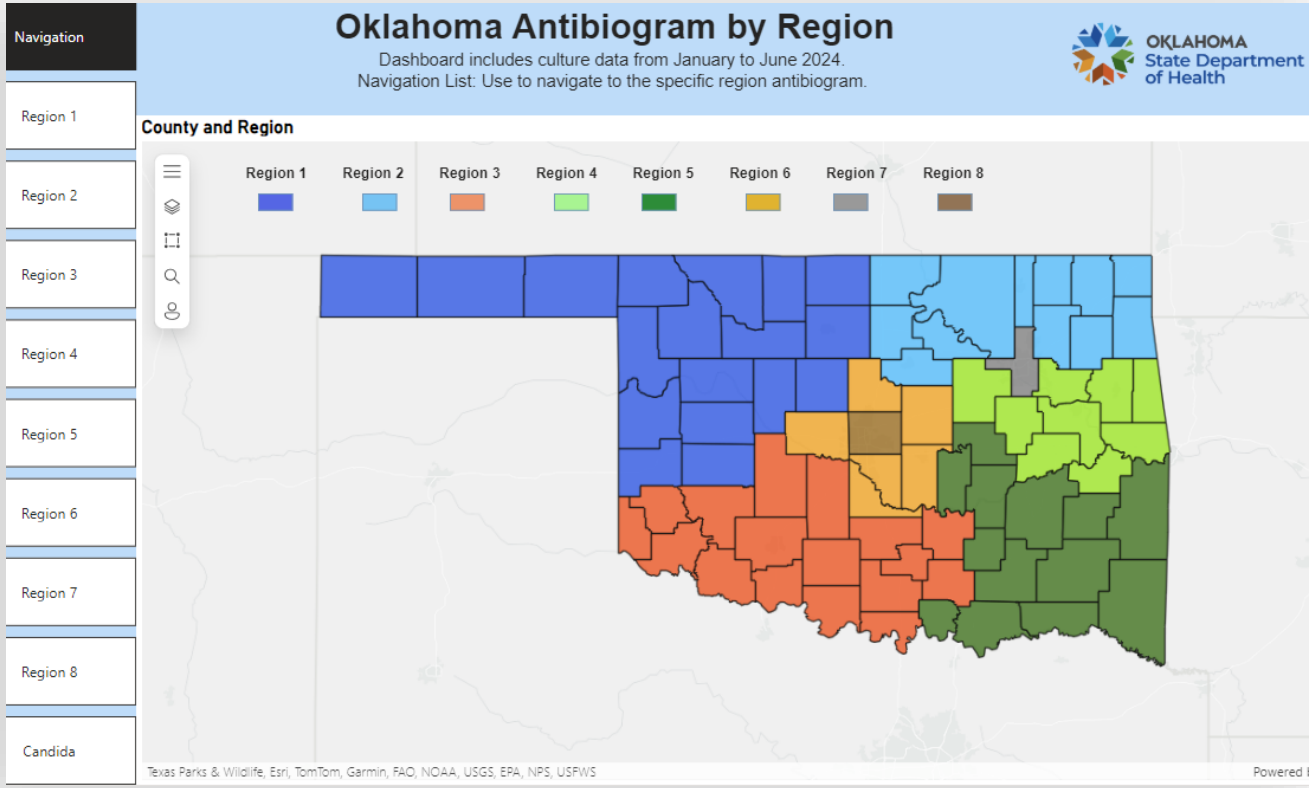
CDC. Antibiotic Resistance Threats in the United States, 2019 and 2021-2022

COVID-19 Pandemic Impact



Regional Antibiogram

- Resource developed to aid empiric therapy in instances where statistically significant antibiograms are limited or unavailable
- Dashboard available through the OSDH HAI website on the Antimicrobial Stewardship page [Antimicrobial Stewardship Resources for Clinicians]



Regional Antibiogram

Antibiogram – compilation of pathogens and susceptibility patterns for a set timeframe for a specific location

Utilized to guide empiric antibiotic prescribing by demonstrating the likelihood of resistance of a pathogen to a specific antibiotic.

Pooling regional culture data together provides larger isolate numbers and a more clinically significant local antibiogram.

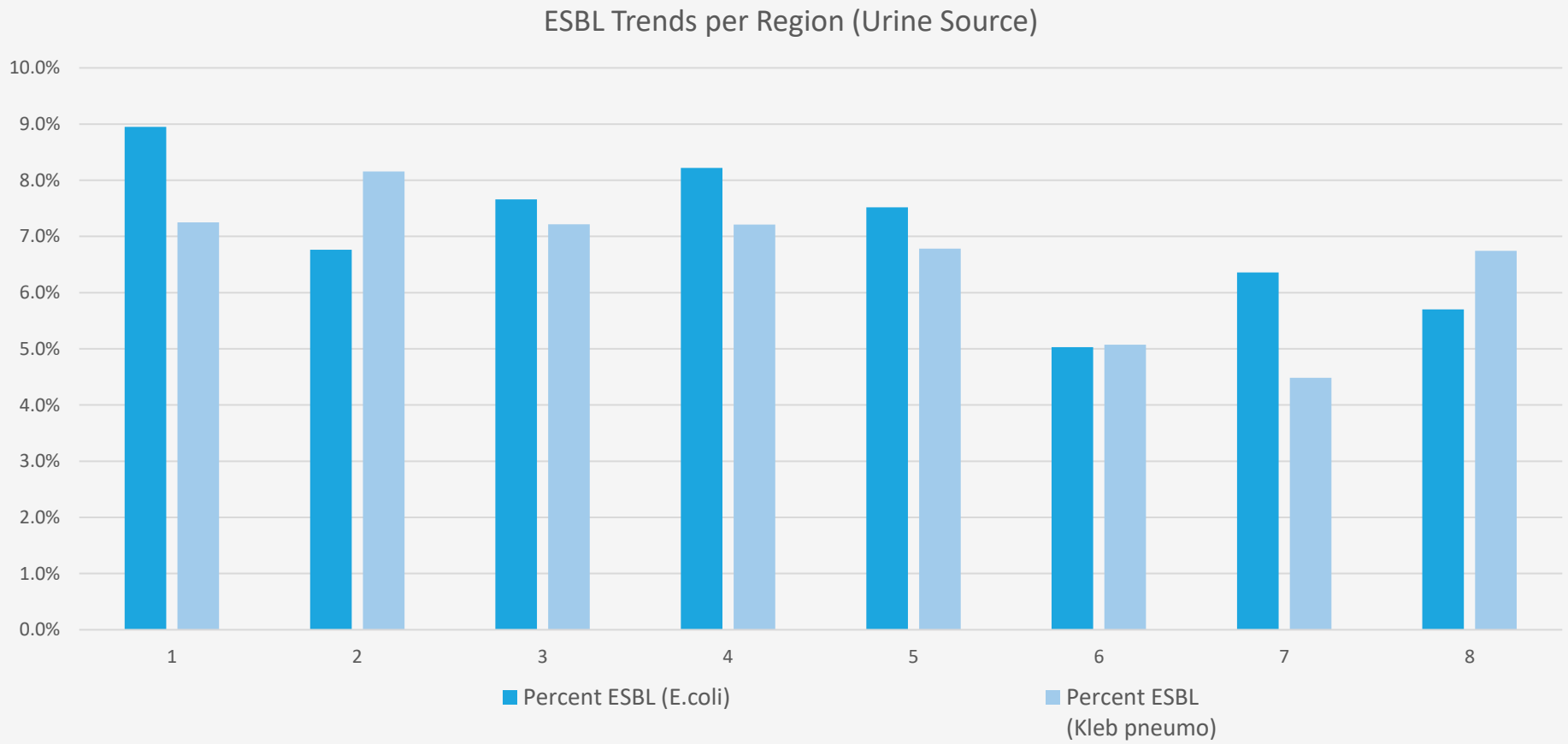
- Statistically significant antibiograms require ≥ 30 isolates of each applicable pathogen.
- Smaller facilities often do not have enough of less common but still clinically relevant pathogens to develop significant antibiograms.

Facility-specific antibiograms are always the most accurate and applicable picture of antimicrobial resistance.

- The hope for a regional antibiogram is to provide an idea of the antimicrobial resistance picture for facilities that have not had a local antibiogram to date.

CLSI. *Analysis and Presentation of Cumulative Antimicrobial Susceptibility Test Data*. 2022.

ESBL Trends (2025): Urine Source



Across the state:

- 2,234/32,078 *E. coli* isolates ESBL
- 412/5,978 *Klebsiella pneumoniae* isolates ESBL

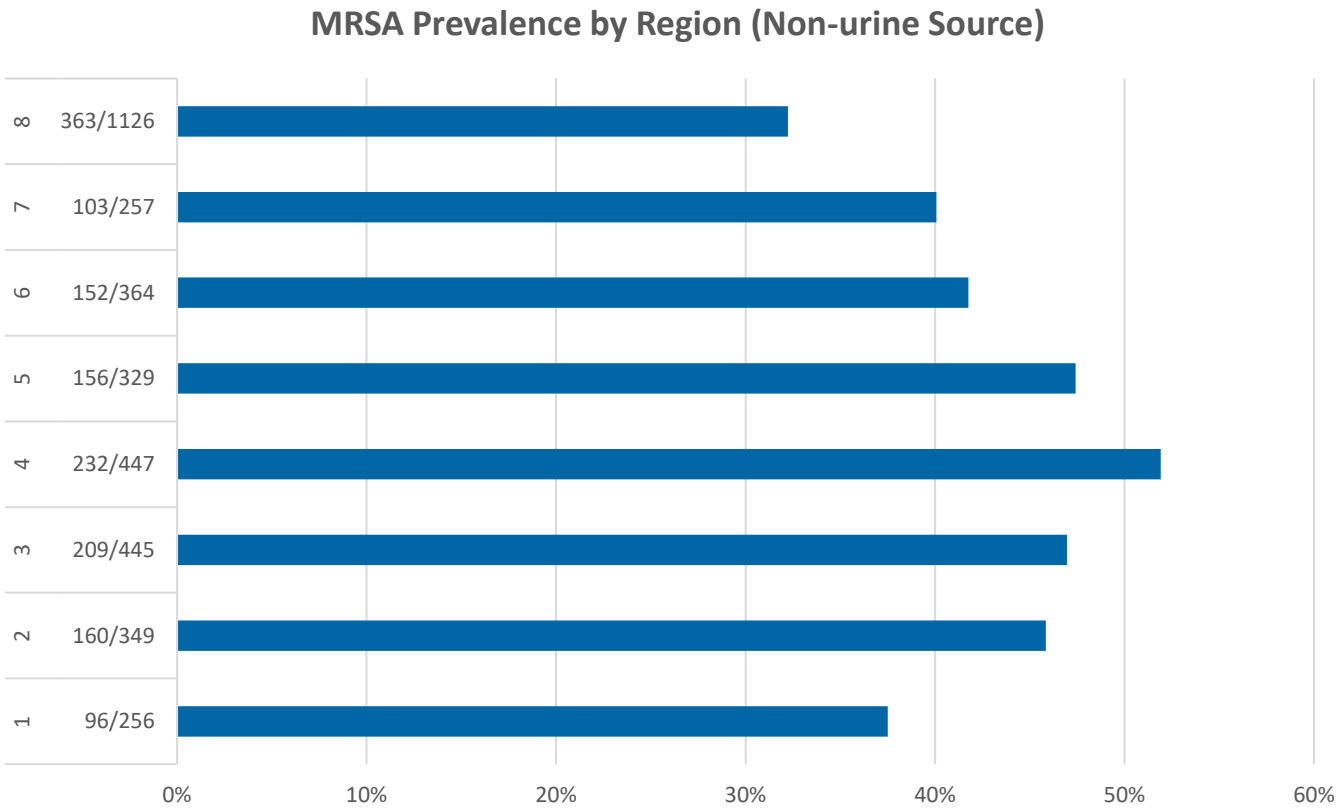
2025 *Pseudomonas aeruginosa*

ANTIMICROBIAL RESISTANCE

Region	Source	Cefepime	Ceftazidime	Ciprofloxacin	Levofloxacin	Meropenem	Piperacillin/ tazobactam
1	Urine	90	91	90	87	93	90
2	Urine	92	93	82	77	92	88
3	Urine	94	88	69	61	85	88
4	Urine	89	89	78	73	90	84
5	Urine	93	85	77	72	95	87
6	Urine	94	94	87	76	93	99
7	Urine	90	95	87	79	95	95
8	Urine	95	94	80	74	91	95

Pseudomonas aeruginosa susceptibility varies across the state, it is important to consider variability regionally and within each facility if available when prescribing empiric therapy.

Staphylococcus aureus



The prevalence of MRSA is less than 50% for most regions of the state in 2025.

Consider the impact that this finding could or should have on empiric prescribing habits.

Outpatient Antibiotic Prescribing Trends

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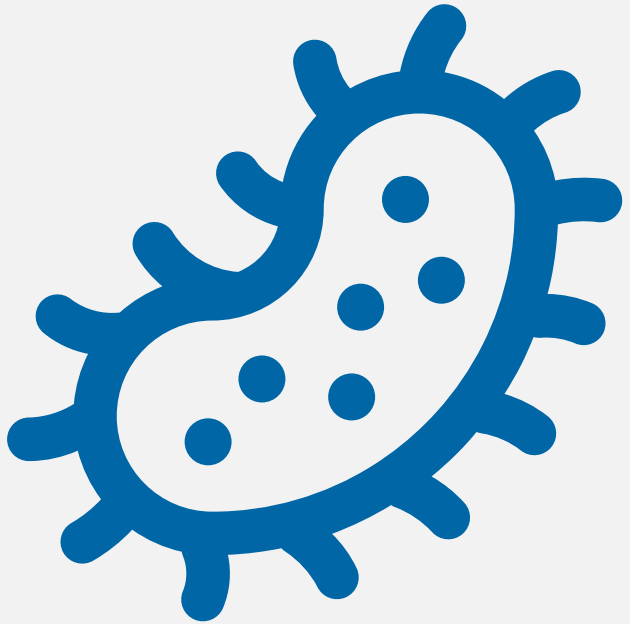
Outpatient Antibiotic Prescribing

Approximately 50% of outpatient antibiotic prescribing might be inappropriate.

At least 30% of outpatient antibiotic prescriptions are unnecessary.

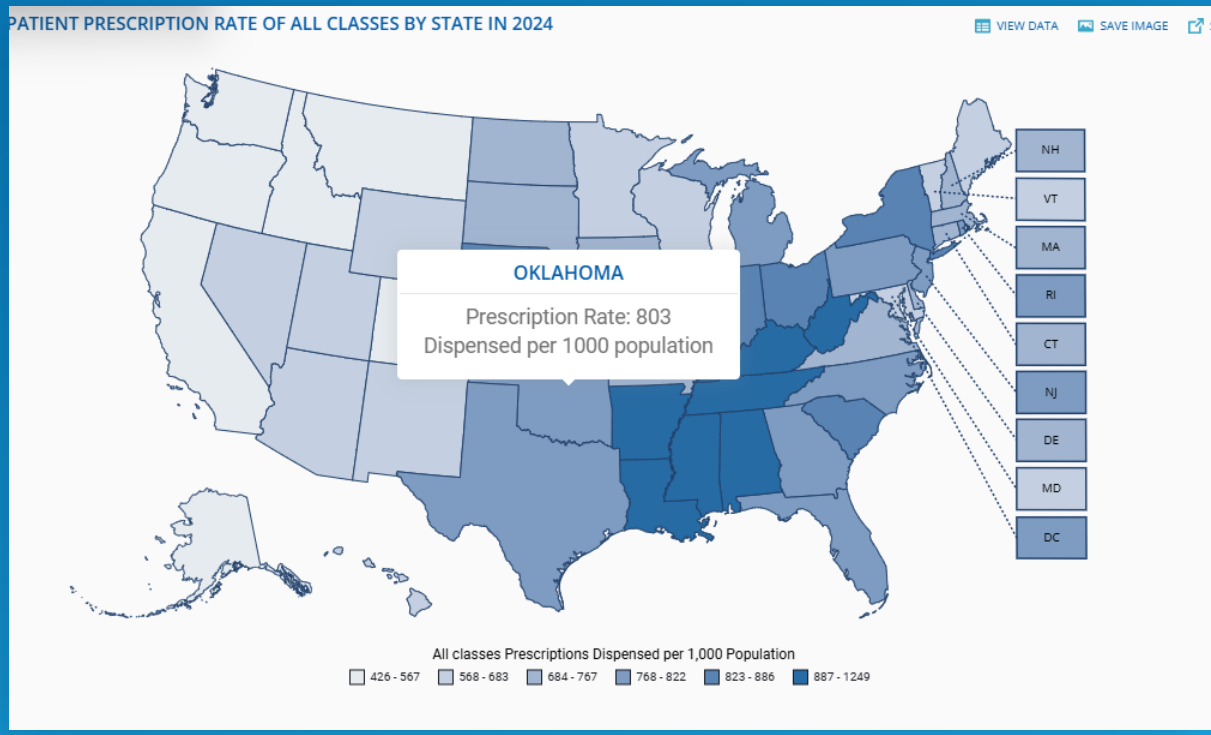


Roughly 60% of U.S. antibiotic expenditures are for outpatient care.

Sanchez et al., *Core Elements of Outpatient Antibiotic Stewardship*, 2016.

Outpatient Antibiotic Prescribing in Oklahoma

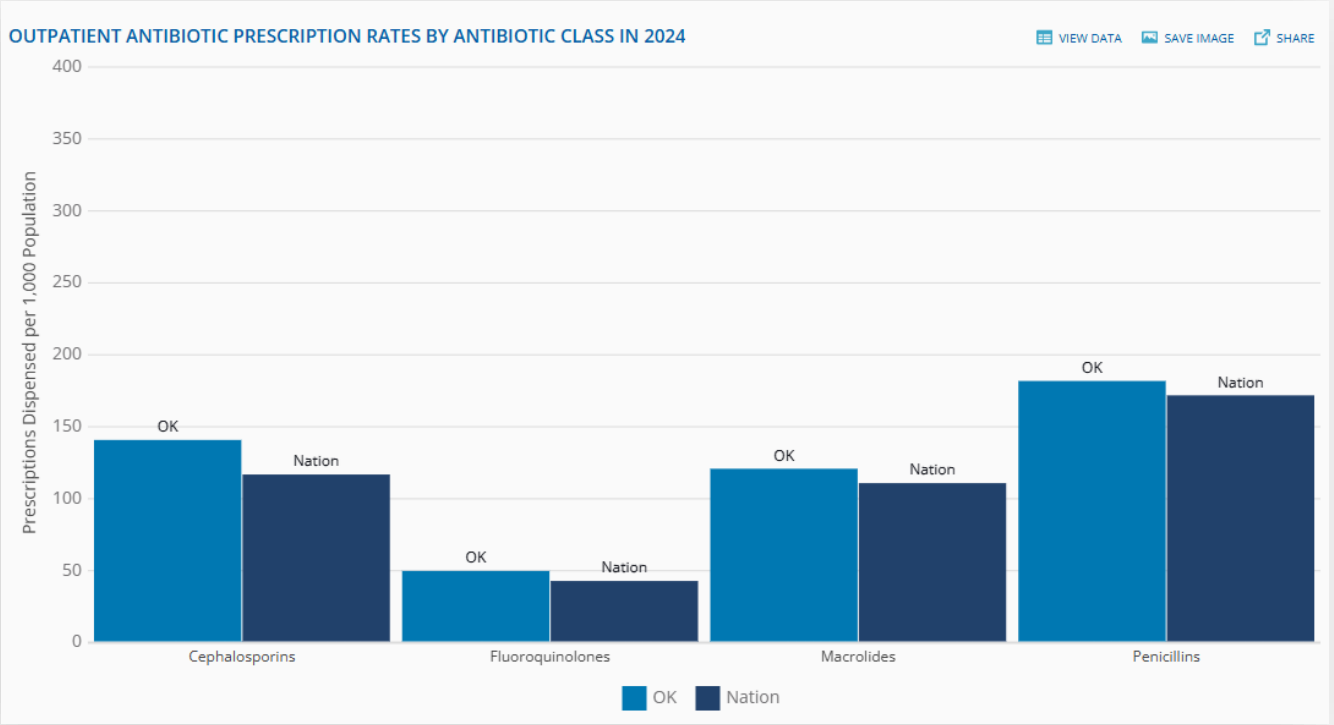
- U.S. national average for 2024 is 752 prescriptions of all antibiotic classes per 1,000 population
- The antibiotic prescribing rate for Oklahoma is above the national average at a rate of 803/1,000 population.



CDC. *Antibiotic Use: All Classes*. AR Patient Safety Portal.

Antibiotic Specific Prescribing in Oklahoma

- All antibiotic classes reported in the Patient Safety Portal from CDC were found to have higher prescribing rates than the national average.
- CDC resource for tracking national prescribing rates: Outpatient Antibiotic Use: Retail Pharmacy Prescription Data | A.R. & Patient Safety Portal



CDC. *Antibiotic Use: All Classes*. AR Patient Safety Portal.

Antimicrobial Stewardship

CDC's Core Elements of Stewardship

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Core Elements

Leadership Commitment

Accountability

Stewardship/ Pharmacy Expertise

Action

Tracking

Reporting

Education

Antimicrobial Stewardship Actions

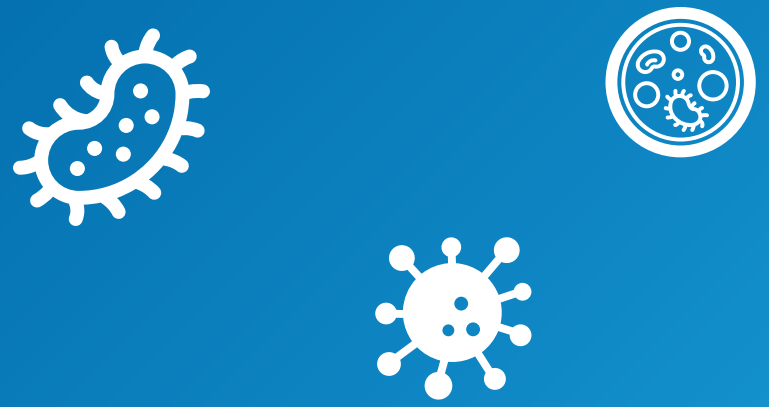
Preauthorization – require authorization to utilize certain antibiotics for example: carbapenems, extended spectrum beta lactams, etc.

Prospective Audit – external antibiotic therapy review accompanied by recommendations for optimization of antibiotic therapy

- Stewardship rounds
- Handshake Stewardship

Quality Improvement Protocols – implementation of processes or policies to guide appropriate prescribing

- Guidance order sets or panels
- Allergy de-labeling
- Days of therapy hard stops



CORE ELEMENTS

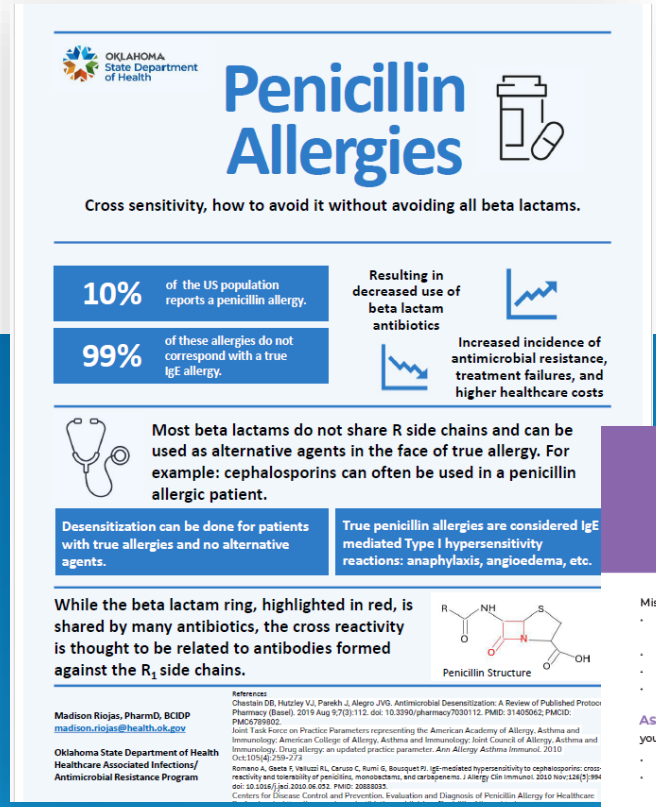
Penicillin Allergy De-labelling

Penicillin allergy de-labeling can be a great initiative that makes a positive impact on patient care.

Avoidance of beta-lactam allergies due to penicillin allergies often results in overly broad and non-first-line therapy selections.

There are multiple tools to aid implementation

- Educational tools
- Cross reactivity charts
- PEN-FAST scoring



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Penicillin Allergies

Cross sensitivity, how to avoid it without avoiding all beta lactams.

10% of the US population reports a penicillin allergy.

99% of these allergies do not correspond with a true IgE allergy.

Resulting in decreased use of beta lactam antibiotics

Increased incidence of antimicrobial resistance, treatment failures, and higher healthcare costs

Most beta lactams do not share R side chains and can be used as alternative agents in the face of true allergy. For example: cephalosporins can often be used in a penicillin allergic patient.

Desensitization can be done for patients with true allergies and no alternative agents.

True penicillin allergies are considered IgE mediated Type I hypersensitivity reactions: anaphylaxis, angioedema, etc.

While the beta lactam ring, highlighted in red, is shared by many antibiotics, the cross reactivity is thought to be related to antibodies formed against the R_1 side chains.

Penicillin Structure

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Oklahoma State Department of Health
Healthcare Associated Infections/
Antimicrobial Resistance Program

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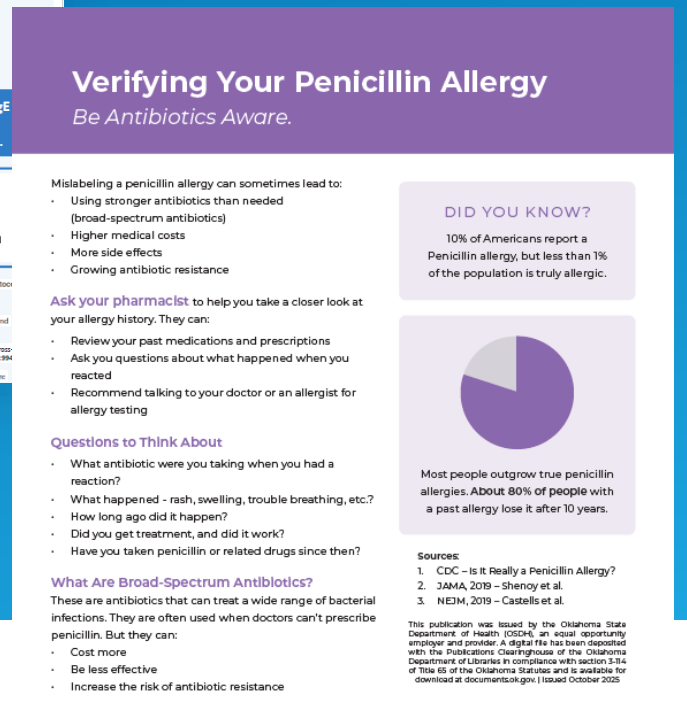


Verifying Your Penicillin Allergy

Be Antibiotics Aware.

Mislabeling a penicillin allergy can sometimes lead to:

- Using stronger antibiotics than needed (broad-spectrum antibiotics)
- Higher medical costs
- More side effects
- Growing antibiotic resistance

Ask your pharmacist to help you take a closer look at your allergy history. They can:

- Review your past medications and prescriptions
- Ask you questions about what happened when you reacted
- Recommend talking to your doctor or an allergist for allergy testing

Questions to Think About

- What antibiotic were you taking when you had a reaction?
- What happened - rash, swelling, trouble breathing, etc.?
- How long ago did it happen?
- Did you get treatment, and did it work?
- Have you taken penicillin or related drugs since then?

What Are Broad-Spectrum Antibiotics?

These are antibiotics that can treat a wide range of bacterial infections. They are often used when doctors can't prescribe penicillin. But they can:

- Cost more
- Be less effective
- Increase the risk of antibiotic resistance

DID YOU KNOW?

10% of Americans report a Penicillin allergy, but less than 1% of the population is truly allergic.

Most people outgrow true penicillin allergies. About 80% of people with a past allergy lose it after 10 years.

Sources:
1. CDC – Is It Really a Penicillin Allergy?
2. JAMA, 2019 – Shenoy et al.
3. NEJM, 2019 – Castells et al.

This publication was issued by the Oklahoma State Department of Health (OSDH), an equal opportunity employer and provider. A digital file has been deposited with the Publications Clearinghouse of the Oklahoma Department of Libraries in compliance with section 3-114 of Title 65 of the Oklahoma Statutes and is available for download at documents.ok.gov. | Issued October 2025

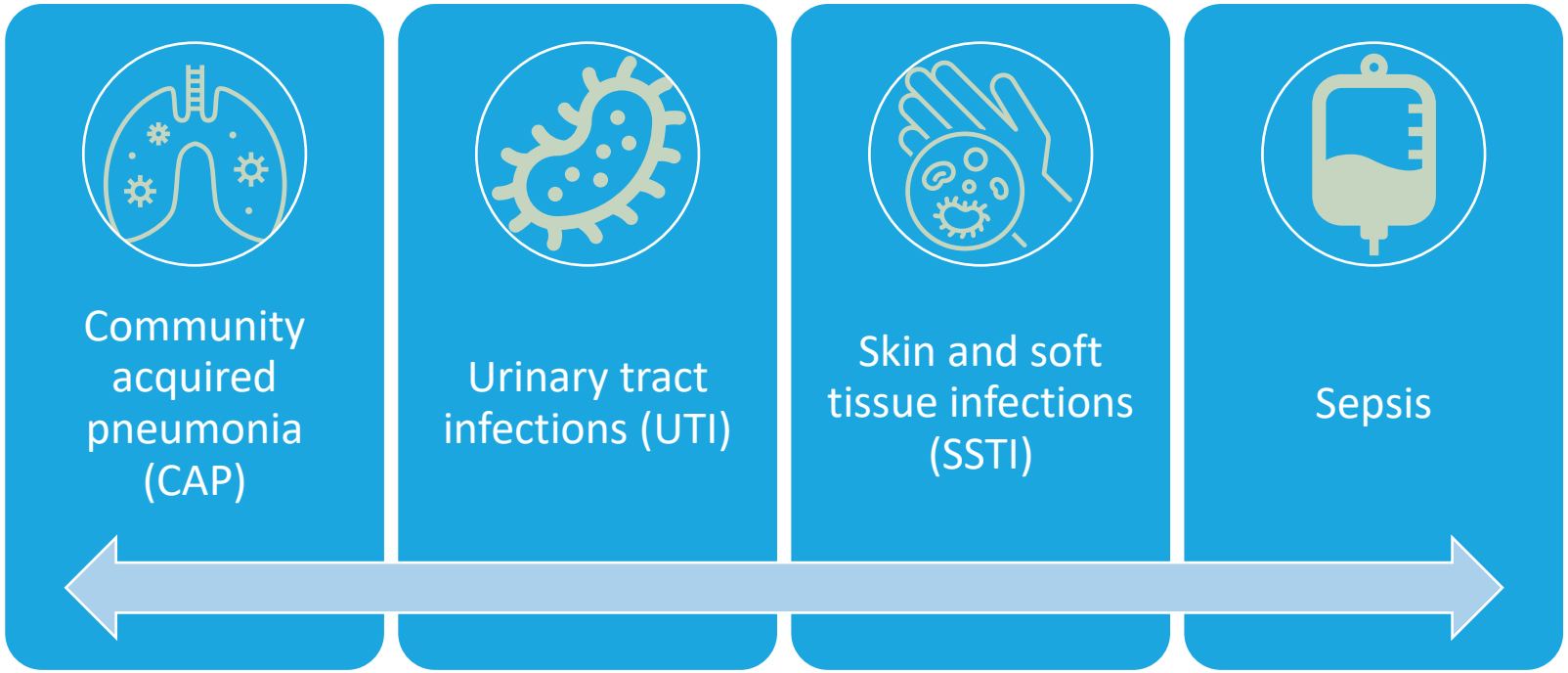
Ask your pharmacist today about verifying your penicillin allergy. It could lead to better care and better antibiotics for you.

OKLAHOMA State Department of Health | Infectious Disease Prevention and Response

OSDH RESOURCES

Facility Specific Treatment Pathways

Facility Specific Treatment Guidelines – clear recommendations rooted in evidence-based practices for optimal antibiotic use. Infection-based interventions focus on empiric antibiotic selection, appropriate culturing practices, and duration of therapy.



OSDH Resources for Antimicrobial Stewardship

OKLAHOMA STATE DEPARTMENT OF HEALTH

Community of Practice

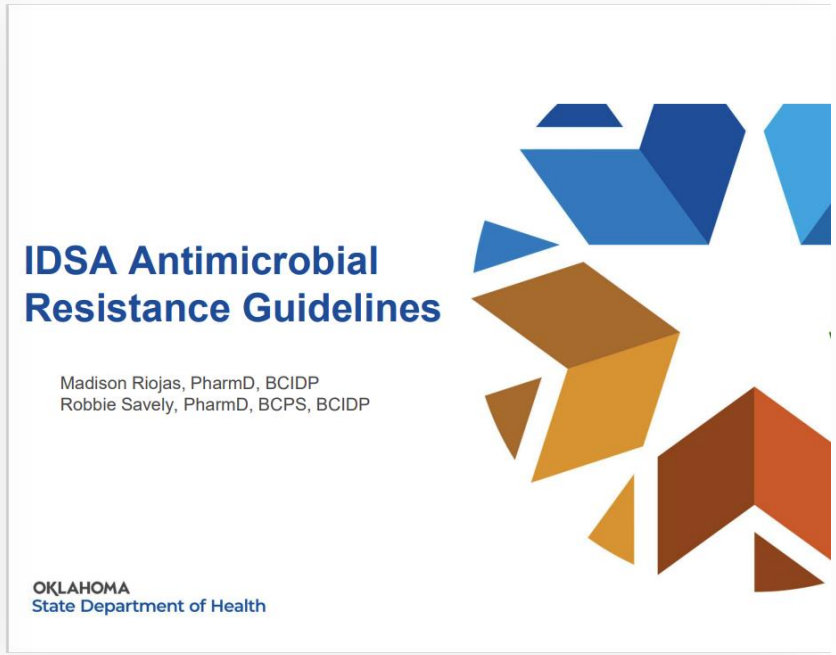
- Community email contact group for providing updates, asking questions, and generally connecting across the state
- Quarterly Antimicrobial Stewardship/Infectious Diseases topic webinars
  - Meetings held virtually only – next is June 23rd 12:00 – 1:30 pm

- Email Madison.riojas@health.ok.gov to join

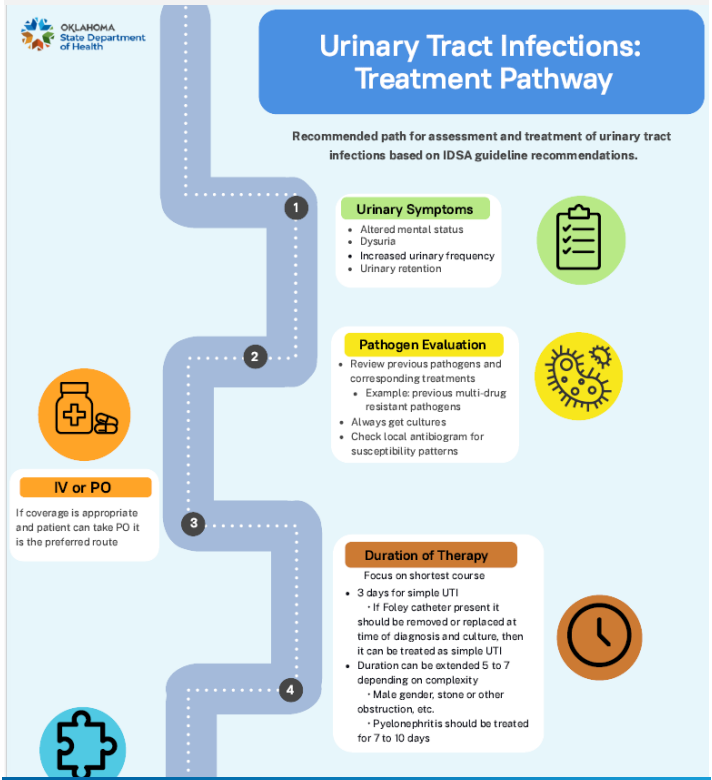
Webpage Resources

OSDH RESOURCES

Patient Handouts and Flyers

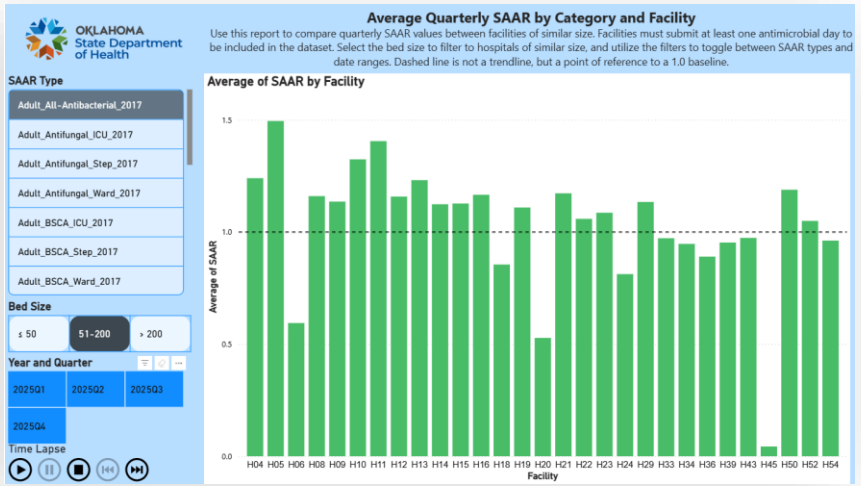


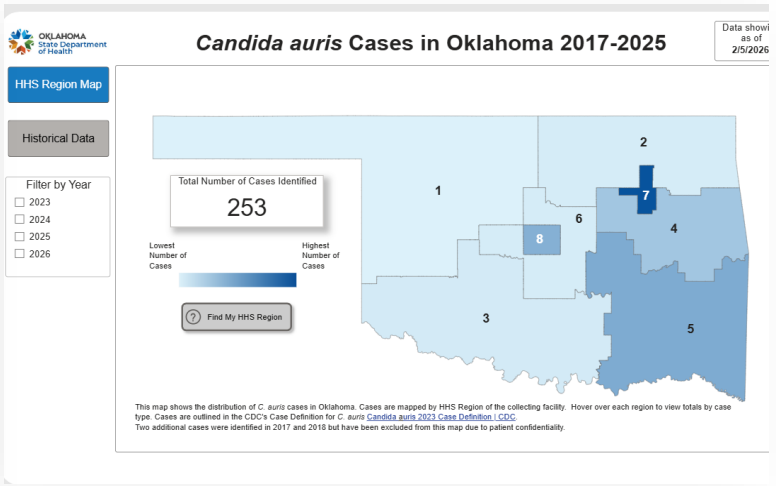
Educational Slide Sets

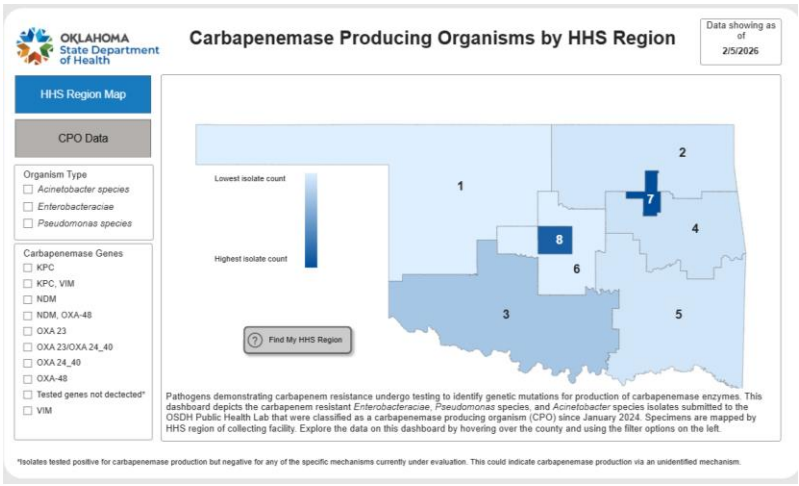


Infographics

Interactive Dashboards







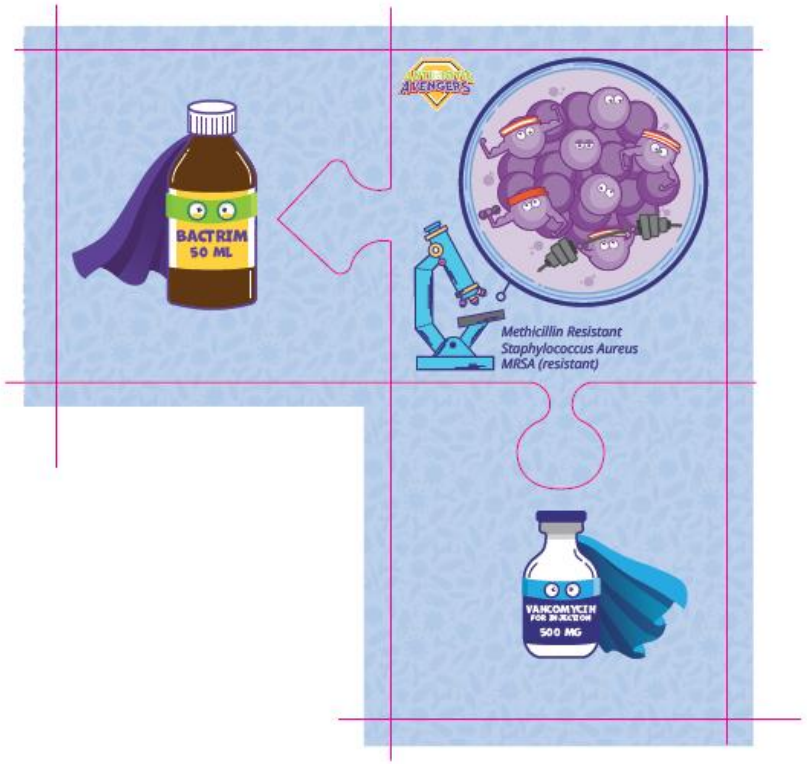
NHSN Antimicrobial Use Partner Dashboard

Candida auris

Carbapenemase Producing Organisms

Community Outreach

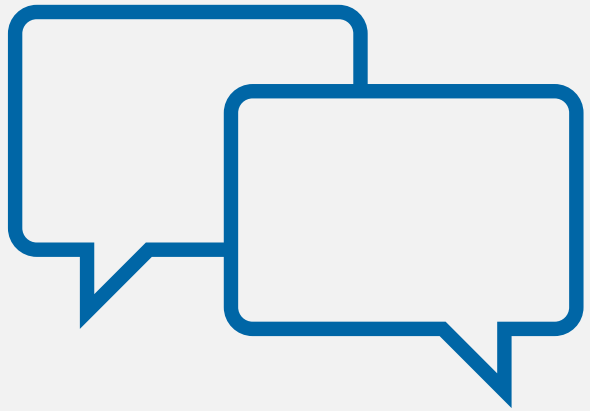
OSDH RESOURCES



Conclusion and Clinical Pearls

- Antimicrobial resistance trends continue to increase, making it an urgent global public health threat.
- Resources like the Oklahoma Regional Antibiogram can allow health care professionals to trend local resistance patterns.
- Antimicrobial stewardship is an integral piece of combatting antimicrobial resistance.
- The CDC's Core Elements of Antimicrobial Stewardship lay a road map for implementing and maintaining an effective stewardship program.
- OSDH has a variety of resources developed specifically for antimicrobial stewardship in all practice settings.
- Antimicrobial stewardship education extends beyond healthcare professionals to the community as a whole and emphasizes the importance of stewardship as a joint effort from everyone.

Changes in Practice



Start the Conversation

Analyze the Gaps

Spread the Message

Additional Resources

OSDH Antimicrobial Stewardship Resources for Clinicians

Antibiotic Avengers Toolkit

Multidrug Resistant Organism (MDRO) Data for Clinicians

NHSN AU Dashboard Access Request

Regional Antibiogram Access Request

Core Elements of Antibiotic Stewardship | Antibiotic Prescribing and Use | CDC

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