The Emergence of Antimicrobial Resistance in Cincinnati (2017-2022)

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What We Know

Antimicrobial resistance (AR) occurs when bacteria, viruses, fungi, and parasites adapt over time and develop the ability to defeat the antimicrobials (drugs or disinfectants) designed to kill them. These adaptions make treating infections harder and increase the risk of transmission, severe illness, and death.[2] Bacteria, viruses, fungi, and parasites do not have to be resistant to every medication to be considered resistant. These organisms only need to be resistant to a single medication to be a major public health threat. Antibiotic, antiviral, antifungal, and antiparasitic resistance all fall under the term antimicrobial resistance. AR diseases can also be referred to as multi-drug resistant organisms (MDRO).

According to the Centers for Disease Control and Prevention (CDC), more than 2.8 million AR infections and 35,000 deaths occur every year in the United States.[2]

AR can occur in anyone regardless of age or health status. Individuals who are at a greater risk for AR are those who self-medicate or are overprescribed antibiotics. Individuals who are immunocompromised are also at a greater risk for developing AR and are more likely to contract and develop infections.[3]

Once AR occurs in a patient, infections are difficult to treat with medications. Many medical conditions and procedures are dependent on medication to prevent infection. If these medications are no longer an effective treatment, healthcare providers will be forced to use less effective treatments, resulting in more aggressive side effects or longer recovery. Some AR infections have no secondary treatment options, and patients cannot be treated.

The Discovery of Penicillin and Antibiotic Resistance

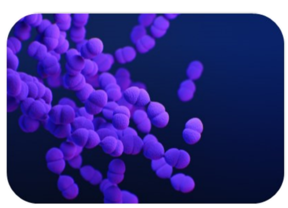
In 1928, the first antibiotic penicillin was discovered by Alexander Fleming. In 1929, Fleming published his findings in the British Journal of Experimental Pathology. In 1939, Fleming's research was picked up by Oxford researchers, and by 1941, the researchers had sufficient material to expand the penicillin research to human trials. Later that year, penicillin was brought to the United States for large scale industrial production. This production was primarily used for medical support of the Allied armies in Europe during World War II. In 1945, penicillin was made available over the counter in U.S pharmacies (Appendix A).[1]

Soon after the discovery of penicillin came the threat of antibiotic resistance. In 1940, a strain of *Escherichia coli* (*E. coli*) *was* discovered that could inactivate penicillin, making it useless against the resistant *E. coli.*

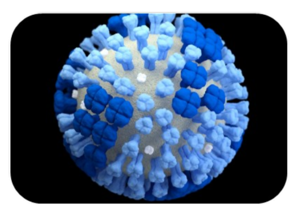
As early as 1942, the first four documented strains of penicillin resistant *Staphylococcus aureus (S. aureus)* were found in hospitalized patients. By the late 1960s, more than 80% of both community and hospital acquired strains of *S. aureus* were penicillin resistant.

In the 1960s, the antibiotic methicillin was developed, which halted the spread of penicillin resistant *S. aureus*. However, soon a methicillin resistant strain emerged. Within 20 years of its development, methicillin resistance became endemic in the United States, affecting 29% of hospitalized *S. aureus* infected patients.[1]

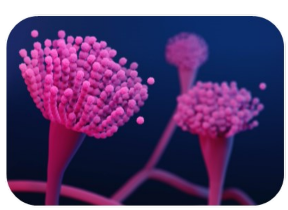
The discovery of penicillin remains one of the most important medical discoveries in history, saving countless lives. However, the discovery of penicillin brought antimicrobial and antibiotic resistance. All of which are at the forefront of today's public health challenges.



Bacteria



Virus



Fungi

Parasite

How does Antimicrobial Resistance Develop

AR is a naturally occurring process. However, the speed in which diseases and infections become resistant can be accelerated by the presence of antimicrobials that pressure germs to adapt. A germ is any microorganism such as bacteria, virus, fungus, or parasite.

While antimicrobials kill some germs that cause infection and disease, they also kill healthy germs that protect the body from infection or disease. In a situation where antimicrobials eliminate all germs except the AR germs, those AR germs will multiply, making the next generation resistant to that antimicrobial treatment.

When organisms find the right combinations of resistance mechanisms, AR germs can share their resistance mechanisms with other germs that have not been exposed to antibiotics. This process continues the spread of AR germs, leading to the greater likelihood of untreatable infections[.4]

(Figure 1).

Figure 1: How Germs Fight Against Antibiotics

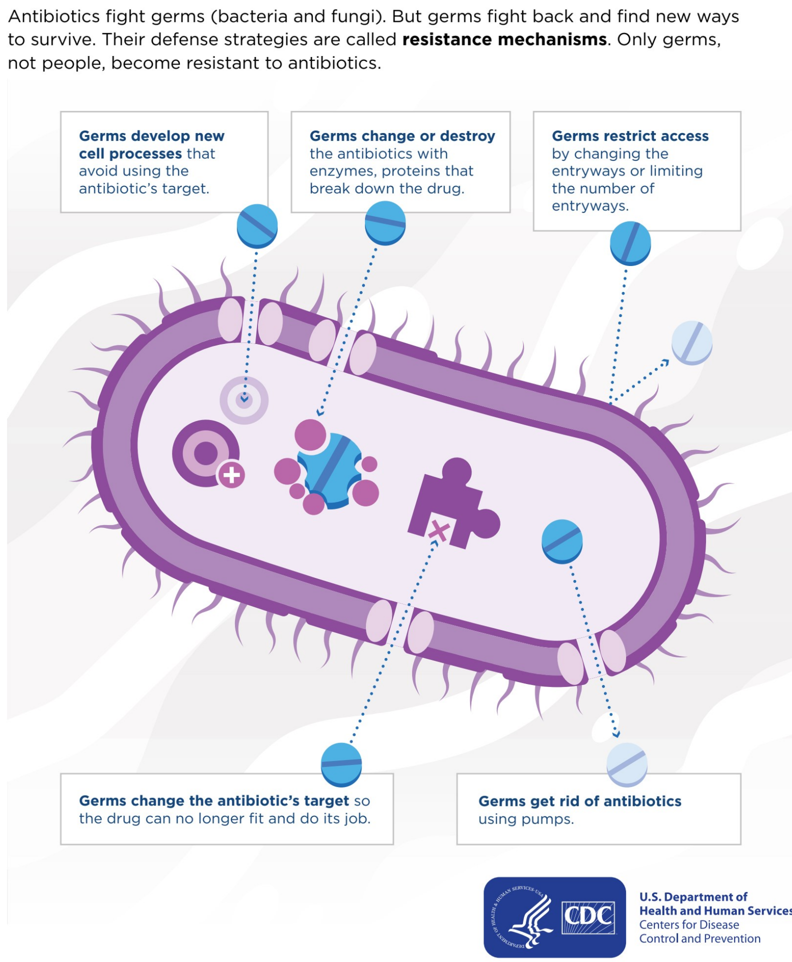
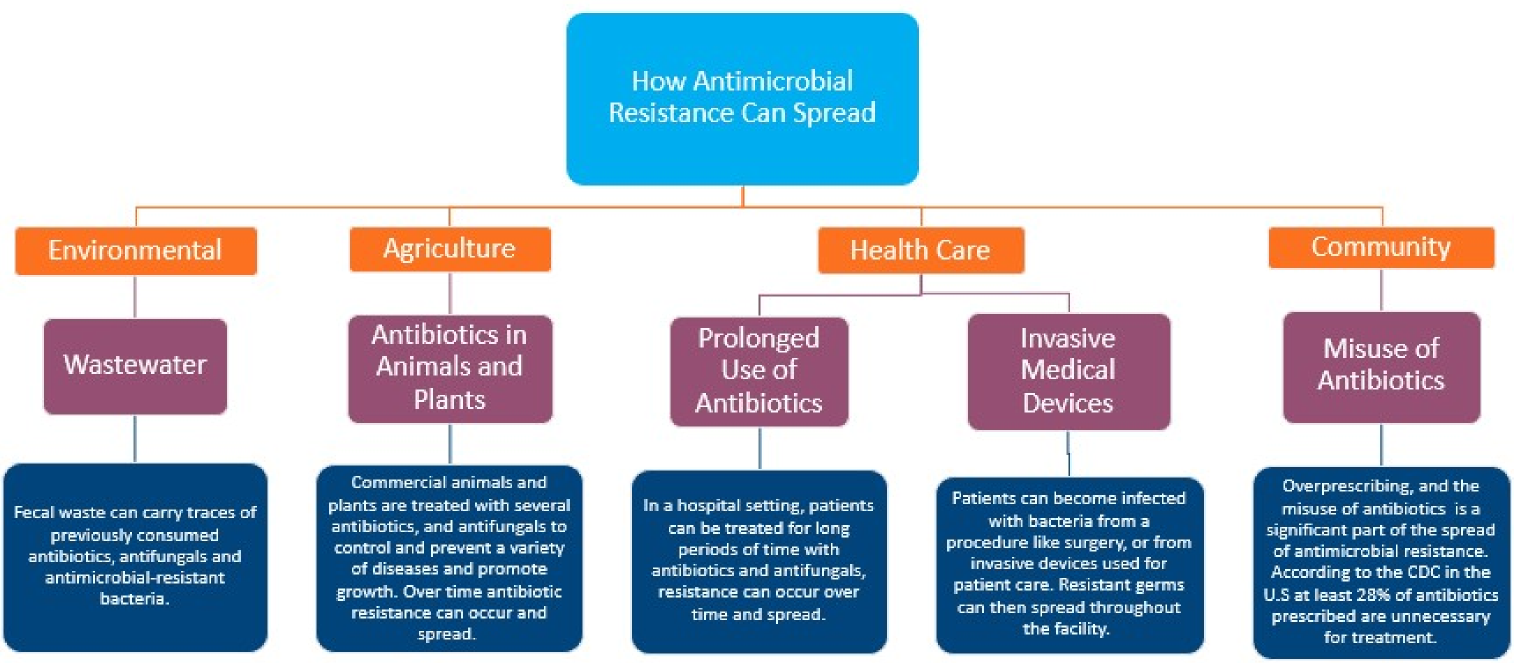


Figure 2: How Antimicrobial Resistance Can Spread



Most Watched Antimicrobial Resistant Diseases in the United States

In 2019, the Antimicrobial Resistant Threat Report (ARTR) was published by CDC. Resistant diseases were divided into four categories based on severity of the concern to human health. The category with the most concern is known as an "Urgent Threat." The second most concerning is "Serious Threat," then "Concerning Threat," and the least concerning "Watch List." [5]

Urgent Threats:

Carbapenem-resistant *Acinetobacter:* *Acinetobacter* can cause infections in the blood, urinary tract, and lungs or in wounds. It can also colonize and live on a patient without causing infections or symptoms. Carbapenem-resistant *Acinetobacter* was first identified in the U.S in 1985.[6] In 2017, CDC reported an estimated 8,500 infections in hospitalized patients and an estimated 700 deaths in the U.S related to Carbapenem-resistant *Acinetobacter.* [5]

Candida auris (C. auris): *C. auris* is a fungus that can cause serious bloodstream infections. *C. auris* was first identified in the U.S in 2013. This is most often found in patients in long-term care facilities and hospitals. Individuals with a clinical case of *C. auris* will likely show symptoms of an active infection. Individuals who are colonized were tested via skin swab and *C. auris* was detected on the surface of their skin. Persons who are colonized are normally asymptomatic and can spread *C. auris* without knowing it. In 2021, CDC reported 1,470 clinical cases of *C. auris* in the U.S.[5]

Clostridioides difficile (C. diff): *C. diff* is a bacteria that causes diarrhea and colitis (inflammation of the colon). *C. diff* was first identified in the U.S in 1978.[7] Most cases of *C. diff* infections occur during an antibiotic treatment or shortly after a patient has completed a course of antibiotics. CDC estimates about 223,900 infections and 12,800 deaths occur each year in the U.S related to *C. diff.*[5]

Carbapenem-resistant Enterobacterales (CRE): Enterobacterales are a large collection of different types of bacteria that commonly cause infections in healthcare settings, such as *E. coli* and *Klebsiella pneumoniae.* The first resistant CRE infection identified in the U.S was *Klebsiella pneumoniae* carbapenem in 2001.[8] CDC estimated in 2017 that there were about 13,100 hospitalized patients and estimated 1,100 deaths in the U.S related to Carbapenem-resistant Enterobacterales.[5]

Drug-resistant *Neisseria gonorrhoeae*: The first case of any drug resistant *Neisseria gonorrhoeae* in the U.S was identified around 1946.[9] More recently in 2023, strains of *Neisseria gonorrhoeae* resistant to all antimicrobials have been identified in the U.S.[10] Gonorrhea is a sexually transmitted infection (STI) that can result in life threatening ectopic pregnancy or infertility. CDC estimates 555,000 cases of AR gonorrhea each year in the U.S.[5] Currently, all STIs reported in Cincinnati are investigated by the Hamilton County Health Department (HCHD).

Serious Threats

- Drug-resistant *campylobacter,* drug-resistant *candida,* ESBL-producing enterobacterales, vancomycin-resistant *enterococci* (VRE), multidrug-resistant *pseudomonas aeruginosa,* drug-resistant nontyphoidal *salmonella,* drug-resistant *salmonella* serotype typhi, drug-resistant *Shigella,* methicillin-resistant *staphylococcus aureus* (MRSA), Drug-resistant *streptococcus pneumoniae,* drug-resistant tuberculosis

Concerning Threats

- Erythromycin-resistant group A *streptococcus,* clindamycin-resistant group B *streptococcus*

Watch List

- Azole-resistant *aspergillus fumigatus, drug-resistant mycoplasma genitalium,* drug-resistant *bordetella pertussis*

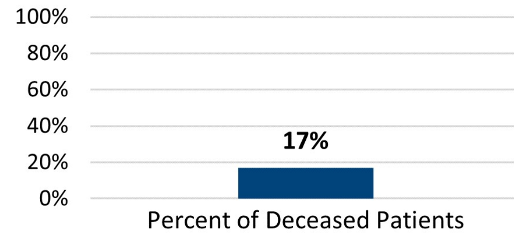
Reportable Antimicrobial Resistant Diseases in Cincinnati, 2017-2022

From 2017 through 2022, Cincinnati reported 281 cases of AR diseases. Discussed in the following data are cases of:

- *Candida auris* (clinical and colonized)
- *Staphylococcal aureus* (resistance to vancomycin)
- *Streptococcus pneumoniae* (antibiotic resistant)
- Carbapenemase-Producing Carbapenem-Resistant Enterobacteriaceae (CP-CRE)

Among the cases analyzed, 17% were deceased. The individual patient's cause of death could not be conclusively linked to the AR disease. Many patients had several chronic or long-term health conditions known as comorbidities, which could also be considered a cause of death.

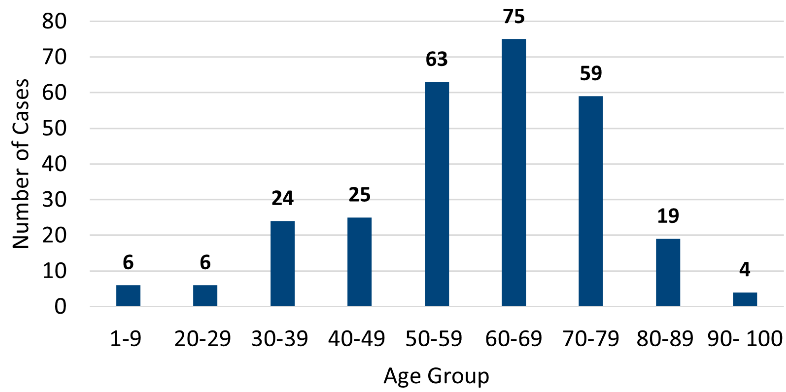
Figure 3: Percent of AR Deceased Patients in Cincinnati, 2017-2022 (n=281)



The age group most affected in Cincinnati among the four AR diseases are patients between 50 and 79 years old. This group accounts for about 72% of all the cases reported in Cincinnati.

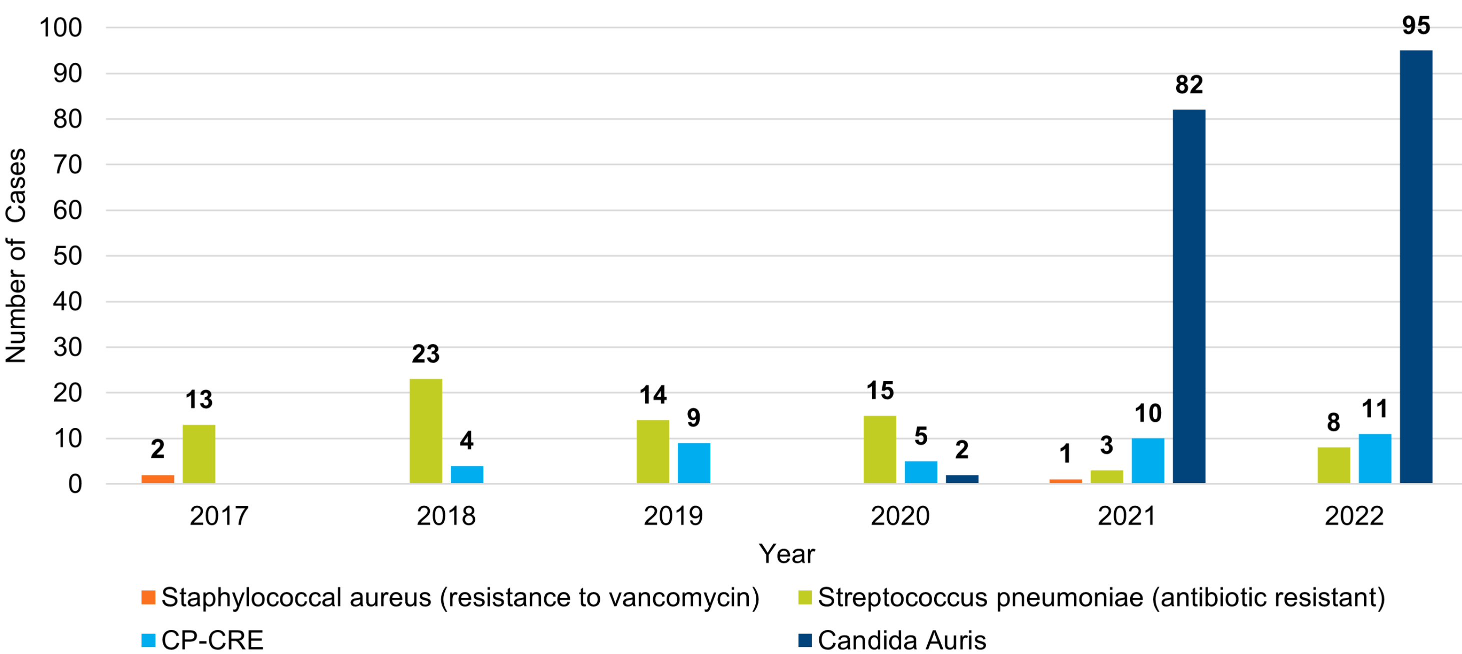
The most significant increase in AR disease over the past five years in Cincinnati has been the emergence of *C. auris* (Figure 5). The COVID-19 pandemic may have contributed to the increase in *C. auris* and CP-CRE and at the same time, the decrease in other types of AR disease from 2021-2022. The stress COVID-19 had on the healthcare system could have led to cases not being diagnosed and infection prevention strategies not being utilized due to staffing shortages and limited PPE.[11]

Figure 4: Percent of AR Disease by Age Group in Cincinnati, 2017-2022 (n=281)



Note: n=281 due to some patients being counted twice due to clinical and colonized cases being marked separately.

Figure 5: AR Diseases Reported by Year in Cincinnati, 2017-2022 (n=297)



*The first case of *Candida Auris* was reported in 2020, and CP-CRE was only made reportable in Ohio as of May, 2018.

** Source: Ohio Disease Reporting System
All data is provisional and subject to change

Candida Auris in Cincinnati

From 2020-2022, Cincinnati has reported 179 cases of *C. auris*. These cases reported include both clinical and colonized cases.

C. auris cases identified from 2020-2022 report about 20% of patients with *C. auris* were deceased at the time of investigation (figure 6). A patients cause of death cannot be conclusively linked to *C. auris*. Many of these patients have several chronic or long-term health conditions, known as comorbidities, which can be factors in their death.

C. auris is seen most frequently in patients between the ages of 50 and 79 years old. This range accounts for 73% of all the cases reporting in Cincinnati (figure 7).

Over the past three years, seven different facilities in Cincinnati have reported cases of *C. auris*. As of the end of 2022 only one of these facilities is screening for *C. auris* upon admission to their facility. Screening is highly recommended for all high-risk healthcare facilities in order to prevent the spread of *C. auris* within their facilities, and other facilities through patient transfers.

Figure 6: Percent of *C. auris* Deceased Patients in Cincinnati, 2020-2022 (n=163)

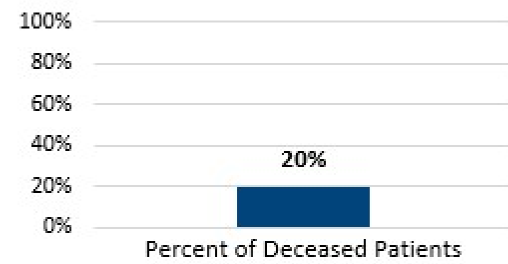
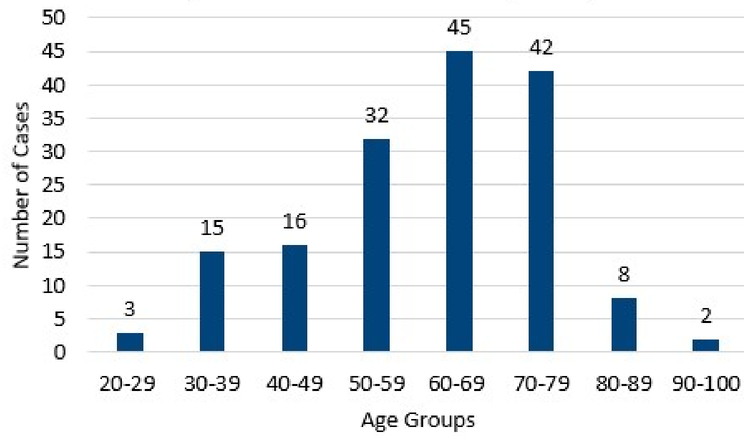
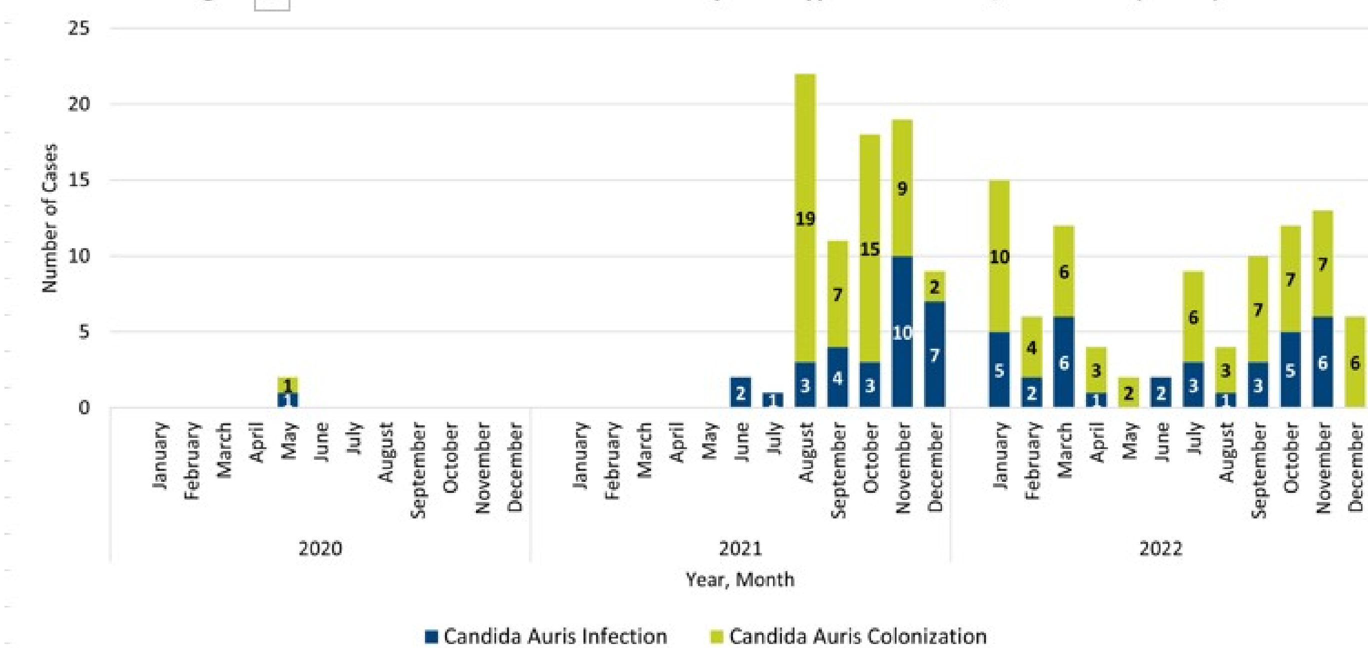


Figure 7: Percent of *Candida Auris* Cases by Age Group in Cincinnati, 2020-2022 (n=163)



Note: n=163 due to some patients being counted twice due to clinical and colonized cases being marked separately.

Figure 8: Number of *Candida Auris* Patients by Case Type in Cincinnati, 2020-2022 (n=179)

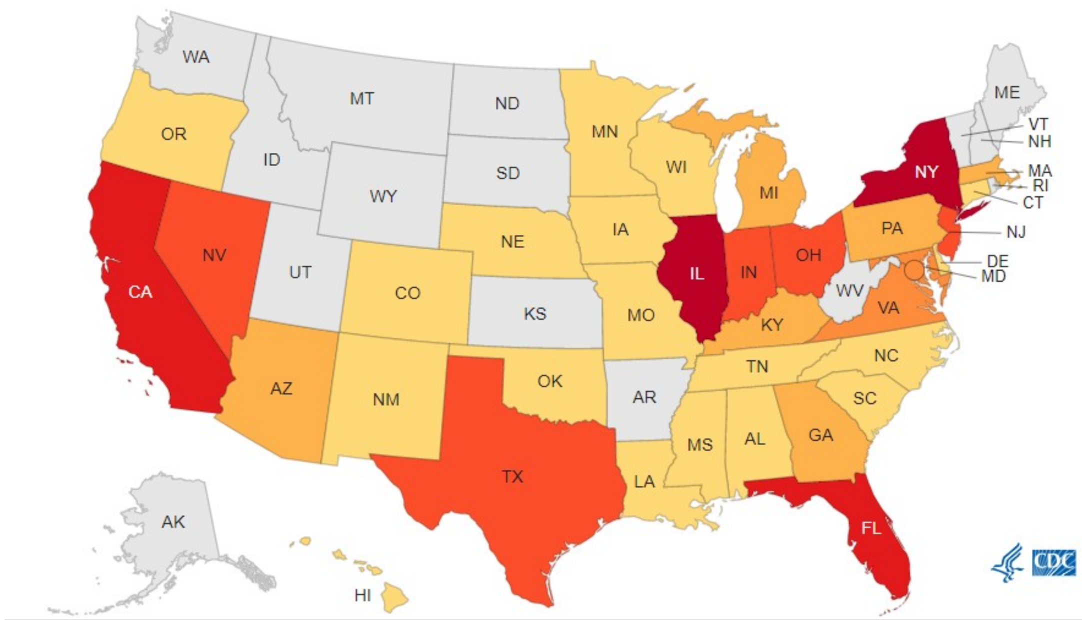


The Threat of *Candida Auris*

Over the last five years, the most significant increase in AR disease has been *C. auris*. The alarming rise during the COVID-19 pandemic has led to several large outbreaks not only in Cincinnati but also the larger southwestern region of Ohio. *C.auris* continues to spread in Ohio as well as 35 other U.S. states.

***Candida auris* (*C. auris*)** is a species of ascomycetous fungus of the *Candida* genus, which grows yeast. It was first isolated in 1998 and described in 2009. There are at least four major clades of *C. auris* based on geographic location. *C. auris* is commonly referred to as a healthcare acquired infection (HAI) because it is most often found in patients in long-term or intensive-care settings in healthcare facilities.

Figure 9: *C. auris* Cases in the U.S from 2013-2022 Reported by CDC



Number of *C. auris* clinical cases through December 31, 2022

There have been 5,654 clinical cases and 13,163 screening cases since 2013.

- 0 clincial cases and at least 1 screening case
- 1 to 10
- 11 to 50
- 51 to 100
- 101 to 500
- 501 to 1000
- 1001 or more

For more information on CDC Candida Auris Tracking https://www.cdc.gov/fungal/candida-auris/tracking-c-auris.html

Mode of Transmission: *C. auris* is transmitted person to person through direct contact with infected bodily tissues or fluid. It can cause infections when it enters the body. Often it enters through medical devices such as ventilators, intravenous catheters, or wounds from surgery. CDC has estimated that *C. auris* can live on surfaces for at least 14 days. In healthcare facilities, *C. auris* has been spread through contact with highly touched surfaces within a patient's room or through shared medical equipment. [12]

Symptoms: Symptoms vary depending on the part of the body that is affected. *C. auris* can cause several types of infection such as blood, wound, or ear infections. Sometimes symptoms are not noticeable because patients with *C. auris* are often receiving care for another serious condition or illness and are in a hospital or long-term care unit. A laboratory test needs to be conducted to determine whether a patient has *C. auris*. Patients who are colonized (*C. auris* living on the body) with this fungus are often asymptomatic and do not show additional signs of infection. Roughly 5-10% of individuals who are colonized with *C. auris* develop some type of *Candida* related infection within one year and are then considered a clinical case of *C. auris*.[12]

Treatment: Treatment is given only if a clinical *C. auris* infection is present. In cases of clinical infection, an echinocandin drug is recommended for initial treatment. However, some *C. auris* infections have been resistant to all main echinocandin antifungal medications making them difficult or impossible to treat. Any treatment of a *C. auris* infection should be carefully monitored as AR can develop quickly.[12] There are currently no recommended treatments for patients colonized with *C. auris*, there is no data on the efficacy of decolonizing patients with *C. auris*.[13]

Prevention: Prompt identification and implementation of recommended infection control measures is the best way to prevent additional patients from being infected or colonized. Healthcare settings can help prevent the spread of *C. auris* by following all PPE (personal protective equipment) recommendations and hand washing procedures. Healthcare facility staff should use proper surgical sterilization procedures for equipment and establish strong antibiotic stewardship practices. Additionally, patients who test positive in a healthcare setting should be placed under contact precautions immediately. In facilities with cases of *C. auris*, screening tests when admitting new patients are recommended.[12]

Candida Auris in Ohio

C. auris first became reportable in Ohio in 2019. The first *C. auris* case in Ohio was reported in 2020. *C. auris* is threatening for several important reasons:

- It is often multidrug-resistant: resistant to multiple antifungal drug commonly used to treat *Candida* infections.[14]
- It is difficult to identify using standard laboratory methods: it can be misidentified in labs without specific technology, which may lead to inappropriate management.[14]
- It can cause outbreaks in healthcare settings: it is important to quickly identify *C. auris* in a hospitalized patient so that healthcare facilities can take special precautions to stop its spread. [14]

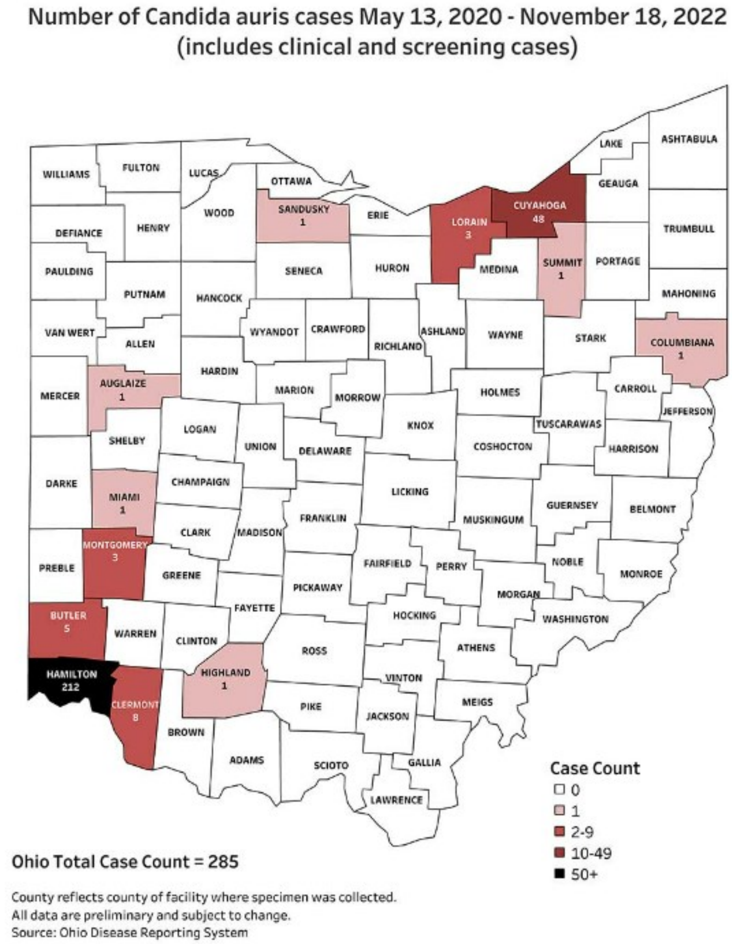
When *C. auris* cases are counted, they are divided into two main categories: clinical cases and colonized cases.

Clinical cases: When cases of *C. auris* are identified from a specimen collected during clinical care for the purpose of diagnosing or treating disease, such as a wound, urine, sputum, or blood. [12]

Colonized cases: When cases of *C. auris* are identified upon swabbing a person's axilla (under arm) and groin regions to test for colonization (when a person is carrying the organism somewhere on their bodies without symptoms of an active infection.)[14] Colonized cases are also referred to as screening cases. Patients who are colonized with *C. auris* are at risk of being infected with a *C. auris* infection. About 5-10% of all colonized cases convert into clinical cases; this is called a conversion case.[12]

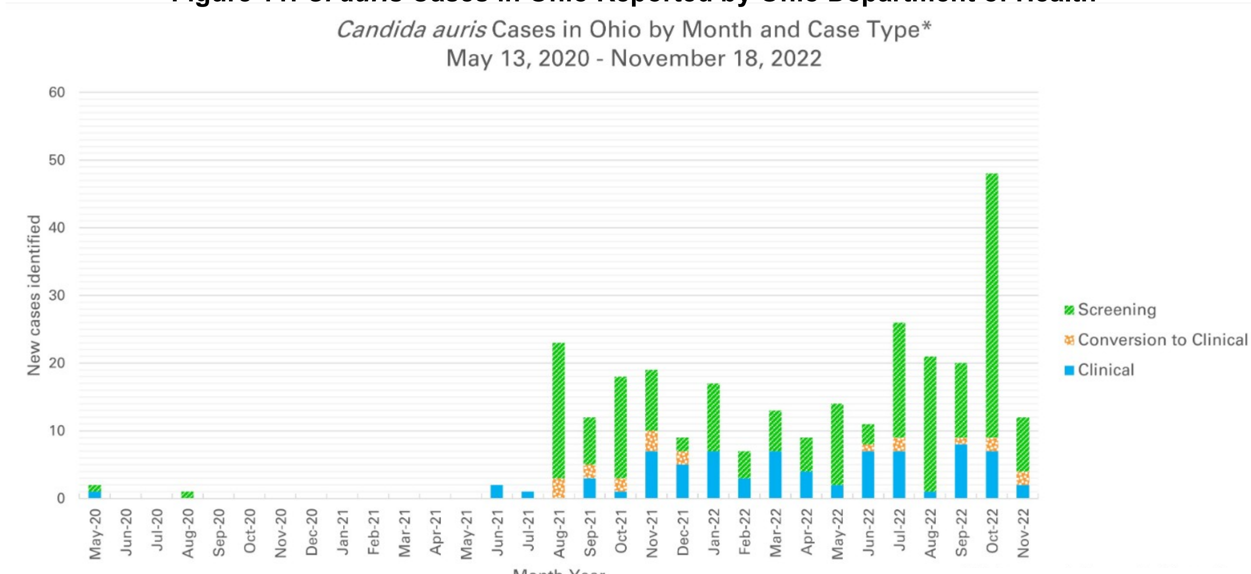
Patients who do have not symptoms, but result positive after a skin screening, and then subsequently develop symptoms of infection and result positive from a clinical specimen (e.g. blood, wound drainage, etc.) are counted as **two** separate cases of *C. auris* in Ohio. Cases that are reported as clinical cases first and then test positive during a screening are considered **one** case of *C. auris* for reporting purposes in Ohio.

Figure 10: *C. auris* Cases in Ohio Reported by Ohio Department of Health



Note: For up to date Ohio *C. auris* case counts please visit ODH website: https://odh.ohio.gov/know-our-programs/antibiotic-resistance/Antimicrobial-Threats/Candida_auris

Figure 11: *C. auris* Cases in Ohio Reported by Ohio Department of Health



** Source: Ohio Disease Reporting System
All data is provisional and subject to change

Candida Auris' Impact on the Southwest Ohio Region.

Southwestern (SW) Ohio currently has the highest number of reported *C. auris* cases in the state. From 2020 through the end of 2022, 253 cases of *C. auris* have been reported in this region. These cases include both colonized and clinical cases of *C. auris.*

Out of all the *C. auris* cases reported in SW Ohio, about 90% of them were reported in facilities within the Cincinnati and Hamilton County health jurisdictions (Figure 12). Cincinnati and Hamilton County are home to several large hospital networks and see a variety of patients from nearby counties and states.

In total, 24 healthcare facilities (hospitals, nursing homes, and specialty long-term care centers) across the SW region have reported cases of *C. auris* over the last three years. These facilities are stretched across eight different health jurisdictions.

Figure 14 shows the approximate number of *C. auris* cases in each of the 24 facilities affected by *C. auris*. Facilities following Ohio Department of Health screening recommendations were noted to have detected higher numbers of colonized patients.

Figure 12: Number of Candida Auris Cases in SW Ohio by Health Juristiction, 2020-2022 (n=253)

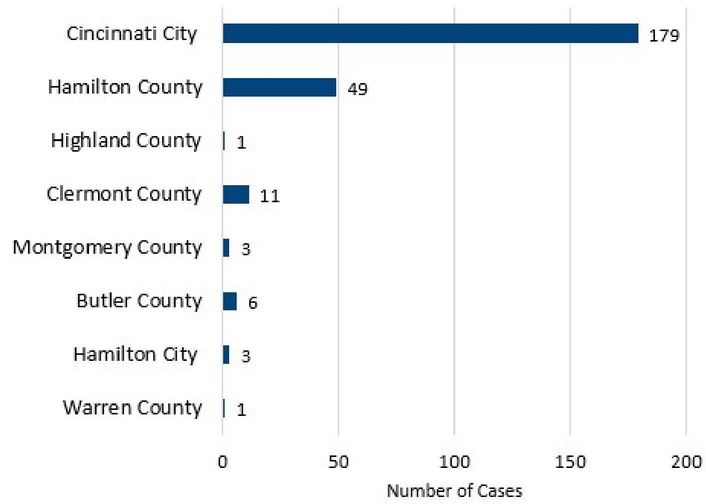


Figure 13*: Candida Auris* Cases Reported in SW Ohio by Case Type, 2020-2022 (n=253)

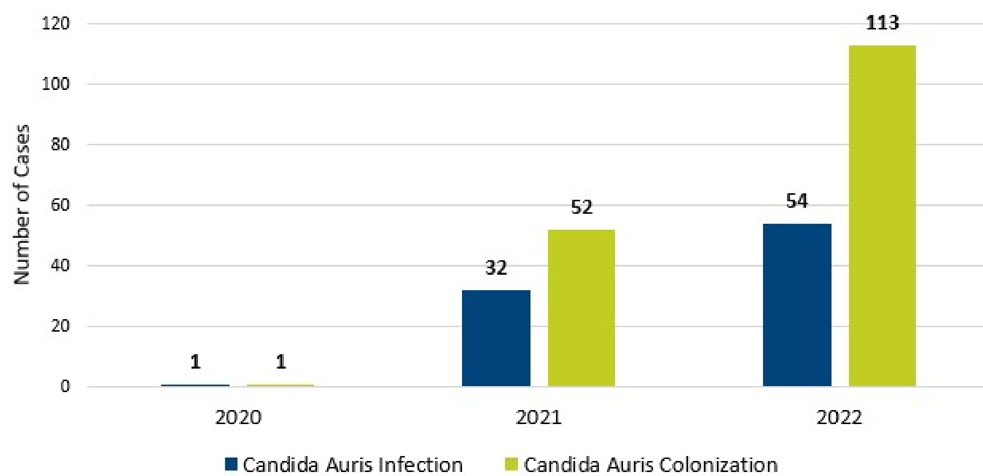
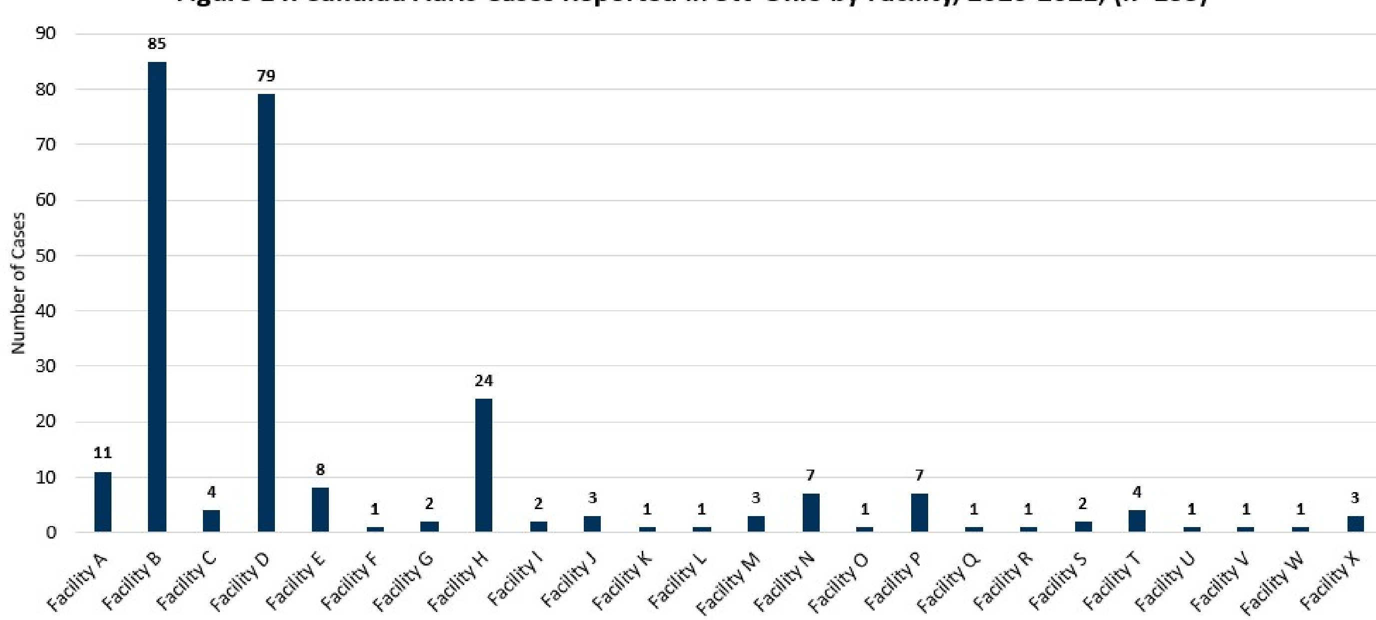


Figure 14: *Candida Auris* Cases Reported in SW Ohio by Facility, 2020-2022, (n=253)



** Source: Ohio Disease Reporting System
All data is provisional and subject to change

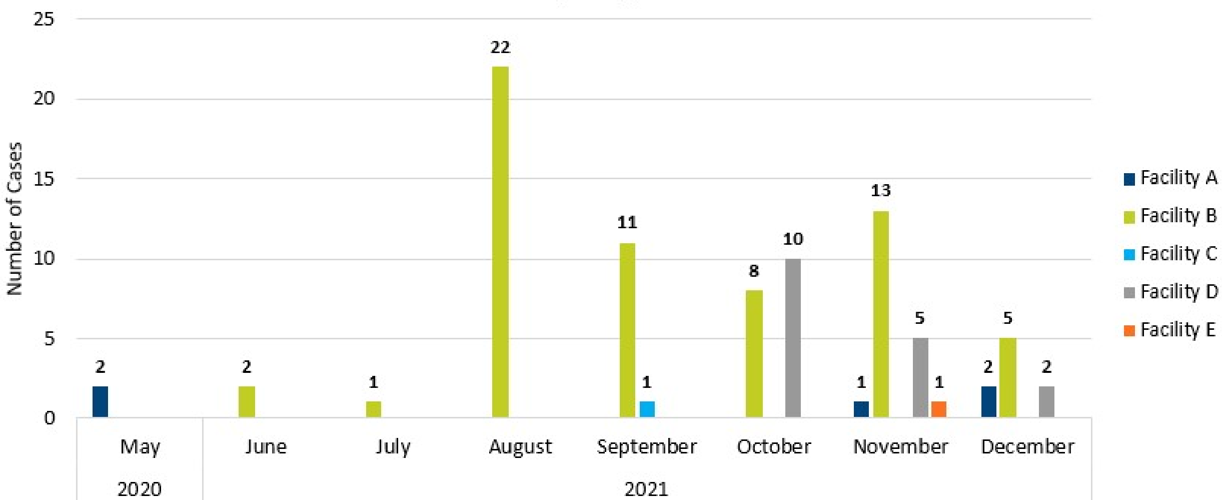
Timeline of *Candida Auris* in Southwestern Ohio

The first case of *C. auris* in Ohio was diagnosed by a healthcare facility in Cincinnati in May of 2020. This facility is known as "Facility A" (Figure15). After the first clinical case was identified, facility A followed ODH recommended screenings, resulting in the identification of one colonized case of *C. auris*.

In June 2021, over a year after the first case in facility A was identified, one *C. auris* clinical case was identified in a different healthcare facility, known as "facility B". This facility began screening patients at high risk for *C. auris* exposure and began screening upon admission to the facility. Facility B was considered the location of Cincinnati's first *C. auris* outbreak. During the summer months between June and August 2021, facility B identified and reported five additional clinical cases of *C. auris* and 19 colonized cases of *C. auris* while conducting point prevalence in units where cases were identified.

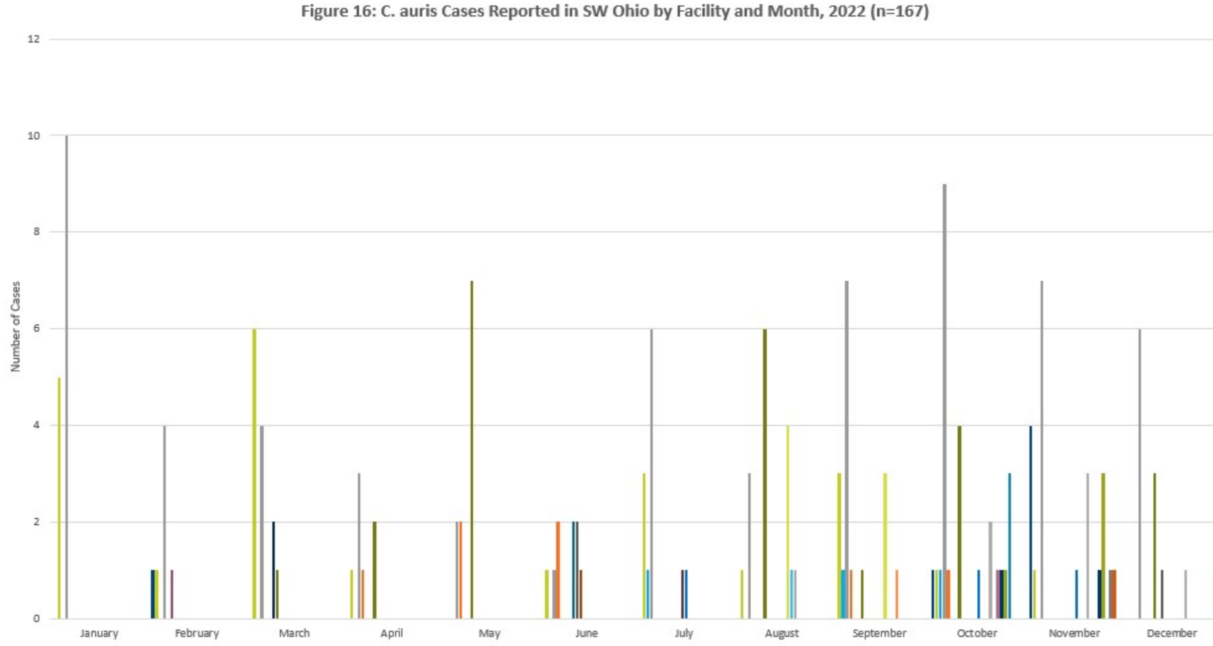
In September of 2021, another facility, "facility C", identified and reported one colonized case of *C. auris.* In October 2021, "facility D" began to report colonized cases of *C. auris,* as they screened new admissions. Unlike facility A's cases, the cases reported in facility D could be directly linked to exposures that occurred in facility B, which meant that cases were beginning to spread across multiple healthcare facilities. Before the end of 2021, one additional healthcare facility, "E", in Cincinnati would also begin to report patients diagnosed with clinical cases of *C. auris*.

Figure 15: *C. auris* Cases Reported in SW Ohio by Facility and Month, 2020-2021 (n=86)



By the end of 2022, an additional 54 clinical cases of *C. auris* and 113 colonized cases of *C. auris* were identified and reported by a **total** of 24 different facilities across the southwest region of Ohio. (Figure 16)

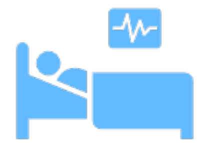
Figure 16: C. auris Cases Reported in SW Ohio by Facility and Month, 2022 (n=167)



** Source: Ohio Disease Reporting System
All data is provisional and subject to change

Why are Antimicrobial Resistance (AR) Diseases Spreading So Quickly in Southwest Ohio?

Regional Hub for Advanced Level Healthcare Services: Cincinnati is renowned for its many regionally and nationally recognized health organizations, health research studies, hospitals, children's healthcare and specialty units. It follows that patients who have serious conditions who are not responding to commonly diagnosed infections would be referred for care in one of Cincinnati many hospitals and subsequently diagnosed with AR diseases, such as *C. auris.* An early outbreak of *C. auris* in 2021 was linked to an outbreak in Northern Kentucky. It was believed at the time there was possibly a "reservoir" of undiagnosed colonized cases in the region. State officials coordinated screening recommendations for all long-term care facilities with high acuity units in order to determine the underlying scope of the problem. Unfortunately, very few facilities did perform the free screenings at the time.



Patient Vulnerability: As more cases and outbreaks were being reported across the nation, it was becoming clearer that the patients most vulnerable to AR diseases were those patients who spent the longest periods of time in healthcare settings, such as skilled nursing facilities, who have many patients with chronic health conditions requiring one or more medical devices. Many times, these patients require multiple antibiotics over extended periods of time. Such patients often also have multiple healthcare facilities in their 3 -to-12-month medical histories prior to the AR diagnosis.

Ease of Spread: *C. auris* among other AR diseases are not easily killed by common disinfectants, such as those that were used daily during the COVID-19 pandemic. *C. auris* lives on surfaces for weeks in settings where infected patients have been. When the proven effective disinfectants were not in use at the height of the pandemic and PPE shortages called for re-use of some items like masks and gowns, *C. auris* was able to spread insidiously to new patients in common rooms, from room to room, carried by equipment and staff, and facility to facility when colonized patients were transferred without notice to the receiving facilities. Audits conducted at affected facilities also provided insight into how large a role staff and staff turnover played, as hand hygiene was cited often as lacking, even in units where AR patients were receiving treatment.

Identification: Some AR diseases are evolving faster than laboratory technology and treatment development can study and research AR. *C. auris* detection, for example, may have been missed in the past due to some laboratories not having the ability to distinguish it from other *Candida* organisms. Also related to identification, some facilities just aren't looking for *C. auris* and have declined to do the recommended screening from the state and local health officials even after notification a patient or resident who stayed in their facilities was infected with *C. auris.* Reasons given for not screening as recommended have included the burden of screening on staff (due to staffing shortages related to COVID-19 illness and staff turnover), the burden of having patients/residents in contact precautions and isolation, and the difficulty in transferring a patient or resident to another facility once they are diagnosed with *C. auris*. It was noted in feedback from regional healthcare providers that even some facilities where a patient had previously been a long-term resident would not take the resident back after they had been detected with *C. auris.*

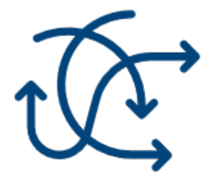
Healthcare Worker Shortage: Like much of the U.S, there was also a shortage of essential healthcare workers in Southwest Ohio, exacerbated by requirements for healthcare workers to be current in their COVID -19 vaccinations. The high turnover rate of healthcare workers especially created an overall less educated workforce with regards to *C. auris* and other AR diseases. Facilities in general were less and less prepared to prevent disease transmission just the CDC and ODH recommended that all facilities with high-risk patient conduct point prevalence screenings. Failure to follow recommendations from local and state health officials in response to AR cases and outbreaks was often blamed on staffing shortages.

Public Health Challenges: The experience and expertise needed to stay ahead of the fast spreading and often complicated cases of AR infection traceback also was a challenge for local health jurisdictions in Southwest Ohio who at the same time were affected by staff illness and COVID-19 pandemic work. Infected patients frequently transferred into and out hospitals and long-term care facilities located in multiple different jurisdictions, creating new clusters in facilities where no prior screening had taken place, resulting in more work and effort for the strained local health departments' staff as well.

Communication Challenges with *C. auris* Reporting: Slow disease reporting to local and state officials, delays public health investigation. The lack of education or lack of communication at any level of the healthcare system can exacerbate the insidious spread of *C. auris* in healthcare settings. Containment of disease depends on communication when a patient infected with *C. auris* is transferred to a new facility. It is important that facilities receiving patients have proper notification when patients must be in contact precautions. Ideally, the receiving facility is made aware of a patient's *C. auris* status prior to transfer so the patient can be isolated when received and *C. auris* can be contained. Unfortunately, in some situations patients were not received with advance knowledge of the condition; they were not isolated, and the result was a new outbreak in the receiving facility. Lack of communication has been blamed on incompatible medical records systems, positive lab results not being entered into the medical record by the diagnosing facility, medical records not being "flagged" for *C. auris* when the lab result was present, and facilities not communicating specific conditions to the receiving facility during transfer.

As a result of outbreaks and the growing concern for *C. auris* spread, some Southwest Ohio facilities began screening all new patients on admission. These facilities are identifying the majority of new *C. auris* colonizations in Southwest Ohio. As new cases are reported, public health carries the burden of determining the patient's often extensive healthcare facility history, responsibility to notify each of those facilities (often multi-jurisdictional), and advise screening recommendations wherever the patient was not in adequate precautions. When diagnosing facilities report new admissions with *C. auris,* they are expected to notify the facility that transferred the patient to them, but those facilities receiving the notification did not always comply with pubic health recommendations upon receiving the information.

***C. auris* Response Delays:** Jurisdictional confusion over some reported cases of *C. auris* resulted in delayed public health investigation and recommendations in Southwest Ohio. Unlike other reportable diseases in Ohio, *C. auris* cases are reported to the public health department based on where the diagnosing facility is located, not where the patient's home address is. The case is also counted in the diagnosing facility's health jurisdiction. While this helps explain the substantially higher numbers of cases in Cincinnati and Hamilton County health jurisdictions, it also created a significantly disproportionate burden upon the affected health departments' staff during a time when state and national public health authorities required continued focus on COVID-19.



As previously mentioned, public health has not been immune to staffing shortages and turnover during the COVID-19 response and also had difficulty competing with well-paid remote contractual contact tracing companies. With each turnover of staff comes a new training period with the expected on-the-job learning necessary to understand the complex and extensive *C. auris* investigations.

What is Cincinnati Health Department Doing to Combat Antimicrobial Resistance?

The Cincinnati Health Department (CHD) works closely with a variety of partners including the Ohio Department of Health (ODH), Cincinnati healthcare facilities, and other local public health departments. CHD works with these partners to identify outbreaks and conduct disease investigations. In partnership with ODH and CDC, CHD is providing free *C. auris* screening resources for facilities with high-risk patients. CHD also provides infection control consultations and assessments for healthcare facilities during outbreaks or upon request.

CHD is directly involved with several local and regional health workgroups with hospitals and long-term care facilities. CHD works with these workgroups in order to share valuable education on antimicrobial resistance and infection control for specific AR diseases. CHD has presented education on AR and *C. auris* to a variety of audiences, including healthcare providers, local infection prevention groups, skilled nursing groups, and other key community stakeholders.

CHD designed a survey for long-term care facility staff in Cincinnati specifically regarding *C. auris*. It included questions on their general knowledge and about how their facility has responded to *C. auris* cases. Most importantly this survey included a write-in section requesting feedback specific to what CHD could do to support them moving forward. The results of the survey informed the creation of several training opportunities as well as the creation of binders filled with resources, education and Ohio reporting procedures that were designed for healthcare providers. These binders provide existing staff with general knowledge of *C. auris* prevention and containment, as well as training materials for new staff.

Actions for Healthcare Providers to Combat Antimicrobial Resistance

1. Preventing Infections: [15-16]

- Follow infection prevention and control guidance (including screening when necessary).
- Ask patients if they recently received care at another facility or travelled out of the country.
- Encourage patients to receive all of their recommended vaccines. Additionally, provide education on:
  - Preventing infections
  - Keeping wounds clean
  - Managing chronic conditions
  - Seeking medical care if infections do not improve
  - Antibiotic and antifungal use

- Alert receiving facilities when transferring patients who are colonized or infected with AR diseases.
- Stay informed of current outbreaks within the state and regional area.

2. Improve Antibiotics and Antifungal Use: [15-16]

- Follow all clinical and treatment guidelines.
- Implement antibiotic stewardship practices to ensure appropriate antibiotic use.
- Consider fungal infections for patients with respiratory infections that do not respond to antibiotic treatments.
- Conduct appropriate diagnostic testing to guide dosage and duration of antibiotic and antifungal therapy.

3. Be Alert and Take Action: [15-16]

- Be aware of infection and resistance patterns in healthcare facilities and within the community.
- Ensure you are notified immediately when an AR pathogen is identified by the lab.
- Report AR disease to CHD and sent specimens to ODH when prompted.
- Keep patients and family members informed if they have AR infections.
- Ensure all cleaning and disinfection products are effective against the targeted microbe.

If you or your facility has any questions or would like to know more about what Cincinnati Health Department's Communicable Disease Prevention and Control Unit is doing presently in Cincinnati to order to prevent the spread of antimicrobial resistance, please call 513-357-7462 and our team will be happy to share what we know with you.

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References:

1. Lobanovska, M., & Pilla, G. (2017). Penicillin's Discovery and Antibiotic Resistance: Lessons for the Future?. *The Yale journal of biology and medicine*, *90*(1), 135–145.
2. Centers for Disease Control and Prevention, 2022, *About Antimicrobial Resistance*. Accessed December 2022. https://www.cdc.gov/drugresistance/about.html
3. Cleveland Clinic. (2021) Antibiotic Resistance. *The Cleveland Clinic*. Accessed January 2023. https://my.clevelandclinic.org/health/articles/21655-antibiotic-resistance
4. Centers for Disease Control and Prevention, 2022. *How Antimicrobial Resistance Happens.* Accessed December 2022. https://www.cdc.gov/drugresistance/about/how-resistance-happens.html
5. Centers for Disease Control and Prevention. 2019. *2019 AR Threats Report.* Accessed November 2022. https://www.cdc.gov/drugresistance/biggest-threats.html
6. Asif, M., Alvi, I. A., & Rehman, S. U. (2018). Insight into *Acinetobacter baumannii*: pathogenesis, global resistance, mechanisms of resistance, treatment options, and alternative modalities. *Infection and drug resistance*, *11*, 1249–1260. https://doi.org/10.2147/IDR.S166750
7. Heinlen, L., & Ballard, J. D. (2010). Clostridium difficile infection. *The American journal of the medical sciences*, *340*(3), 247–252. https://doi.org/10.1097/MAJ.0b013e3181e939d8
8. Centers for Disease Control and Prevention, 2020, *Tracking CRE in the United States*. Accessed March 2023. https://www.cdc.gov/hai/organisms/cre/trackingcre.html
9. Unemo, M. Shafer, W. (2014). Antimicrobial Resistance in *Neisseria gonorrhoeae* in the 21st Century: Past, Evolution, and Future. *American Society for Microbiology, Vol.27, No.3. https://journals.asm.org/doi/10.1128/CMR.00010-14*
10. Massachusetts Department of Public Health. (2023). Department of Public Health Announces First Cases of Concerning Gonorrhea Strain. Accessed March 2023. https://www.mass.gov/news/department-of-public-health-announces-first-cases-of-concerning-gonorrhea-strain
11. Centers for Disease Control and Prevention. 2022. *Special Report: COVID-19 U.S Impact on Antimicrobial Resistance.* Accessed February 2023. https://www.cdc.gov/drugresistance/pdf/covid19-impact-report-508.pdf
12. Ohio Department of Health. Ohio Infectious Disease Manual Candida Auris, 2022. Columbus, Ohio. Available online at: https://odh.ohio.gov/know-our-programs/infectious-disease-control-manual/section3/section-3-candida-auris
13. Centers for Disease Control and Prevention, 2019, *General Information about Candida Auris*. Accessed December 2022. https://www.cdc.gov/fungal/candida-auris/candida-auris-qanda.html
14. Ohio Department of Health. 2022. Candida Auris. Accessed January 2023. https://odh.ohio.gov/know-our-programs/antibiotic-resistance/antimicrobial-threats/candida_auris#:~:text=Candida%20auris%20(C.,or%20from%20person%20to%20person.
15. Centers for Disease Control and Prevention, 2022. *Healthcare Providers: Actions to Combat Resistance.* Accessed December 2022. https://www.cdc.gov/drugresistance/healthcare-providers.html
16. Centers for Disease Control and Prevention, 2022. *Health Departments: Actions to Combat Resistance.* Accessed December 2022. https://www.cdc.gov/drugresistance/health-departments.html

Appendix A: Timeline of Notable Antimicrobial Resistance Events from 1910-2022