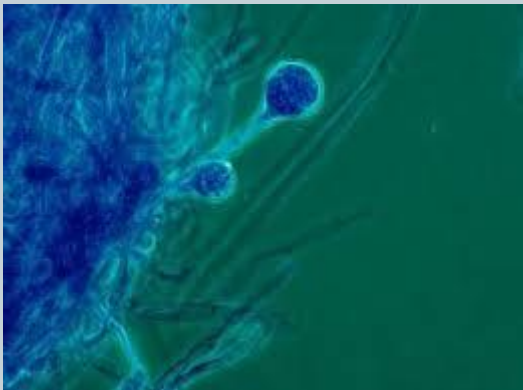


The Changing Epidemiology of Fungal Pathogens: Implications for Healthcare Associated Infections



HEALTHCARE ASSOCIATED
INFECTIONS/ANTIMICROBIAL RESISTANCE
PROGRAM
DIVISION OF DISEASE CONTROL
PHILADELPHIA DEPARTMENT OF HEALTH



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Medical Director
Healthcare Associated
Infections/Antimicrobial
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Lunch and Learn
September 23, 2020



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Disclosures



Spouse works for Incyte. I will not be discussing any Incyte products

Outline



- Estimated cost of fungal infections in the U.S.
- Focus on *Candida auris* (*C. auris*) as a healthcare associated infection (HAI)
- Brief update on emerging antifungal resistance of environmental *Aspergillus* spp., *Mucormycetes*
- Updates on the changing epidemiology of endemic mycoses
 - Histoplasmosis
 - Blastomycosis
 - Coccidioidomycosis
 - Cryptococcus



Estimated Cost of Fungal Diseases



>\$7.2 billion in 2017 in U.S. direct medical costs

- \$4.5 billion from 75,055 hospitalizations
- \$2.6 billion from 8,993,230 outpatient visits
- Likely an underestimation due to underdiagnosis and undercoding

	Total Cost (\$)	
Disease	Inpatient	Outpatient
Aspergillus infections Invasive/ABPA	1,221,559,161	33,274,501
Candida infections Invasive/ Non-invasive	1,431,098,112	1,575,757,507
Coccidioidomycosis	186,323,486	12,132,656
Cryptococcus	247,998,103	9,737,911
Histoplasmosis	176,360,051	39,772,029
Mucormycosis	124,631,863	718,510

Benedict K, Jackson B, Chiller T, Beer KD. *Clin Infect Dis* 2019; 68(11):1791-7

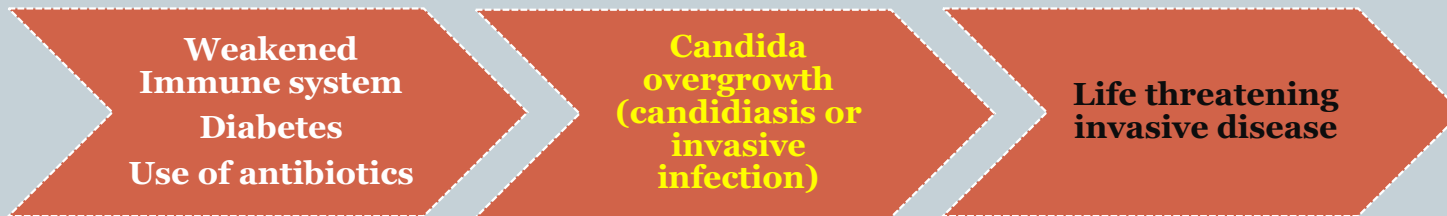


Candida Infections



- Genus Candida- more than 500 species, more than 20 species that can cause human infections
- Yeasts generally reside in the gut and on the skin of healthy people, as well as on mucous membranes

Colonization



Overall mortality rate with invasive candidiasis is ~30%

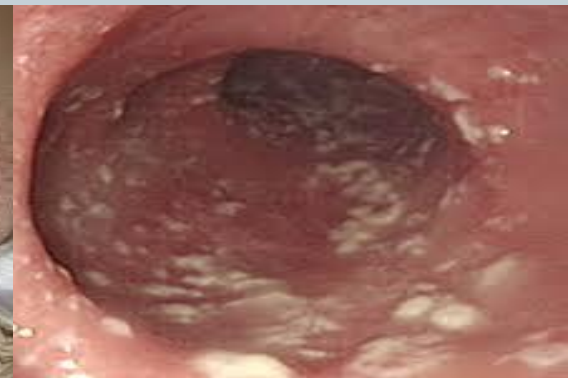
Candida Infections



- **Background:**

95% of Candida infections in the U.S. are caused by 5 species:

- *C. albicans*, *C. glabrata*, *C. parapsilosis*, *C. tropicalis*, and *C. krusei*
- *C. albicans* is the most common cause of candidiasis
- Can be a cause of HAIs



Candida auris (*C. auris*)



Emerging yeast:

- First described in 2009 when isolated from a patient with an ear infection in Japan
- Invasive disease in Korea in 2011
- Identified in U.S. in 2016
- Reasons for rapid emergence are unknown
- Nationally notifiable in 2019, 20 states by 2020
- Largest number of cases in NY and Illinois
 - As of June 2019- NY reported 801 patients with either colonization or infection
 - As of June 30, 2020- CDC confirmed 551 clinical cases in N.Y.
 - 3 patients reported in 2019 with pan-resistant *C. auris*



Morbidity and Mortality Weekly Report

Candida auris Isolates Resistant to Three Classes of Antifungal Medications — New York, 2019

Belinda Ostrowsky, MD¹; Jane Greenko, MS²; Eleanor Adams, MD²; Monica Quinn, MS³; Brittany O'Brien, MS⁴; Vishnu Chaturvedi, PhD^{4,5}; Elizabeth Berkow, PhD⁶; Snigdha Vallabhaneni, MD⁶; Kaitlin Forsberg, MPH⁶; Sudha Chaturvedi, PhD^{4,5}; Emily Lutterloh, MD^{3,5}; Debra Blog, MD^{3,5}; *C. auris* Investigation Work Group

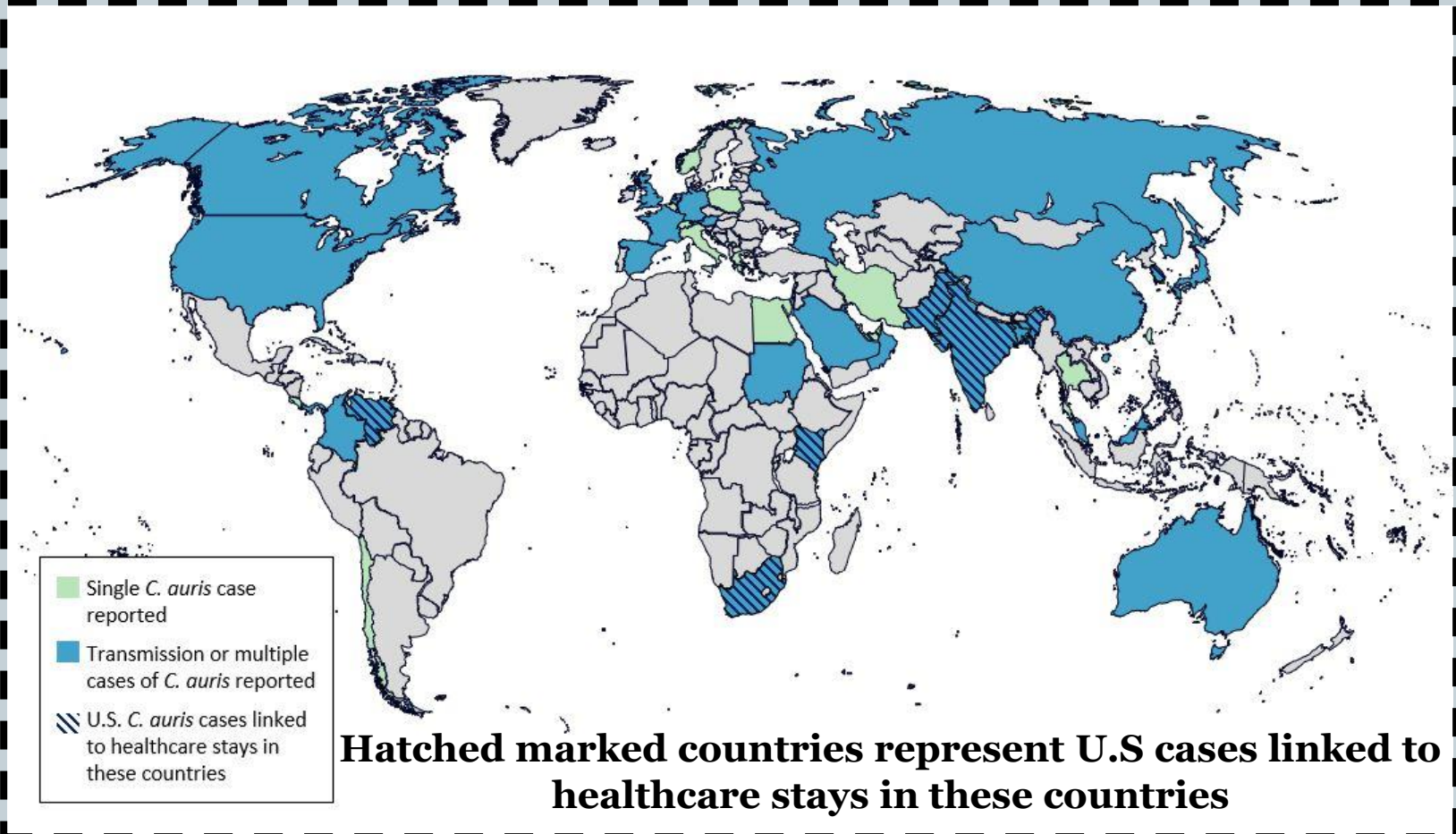


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C. auris Epidemiology



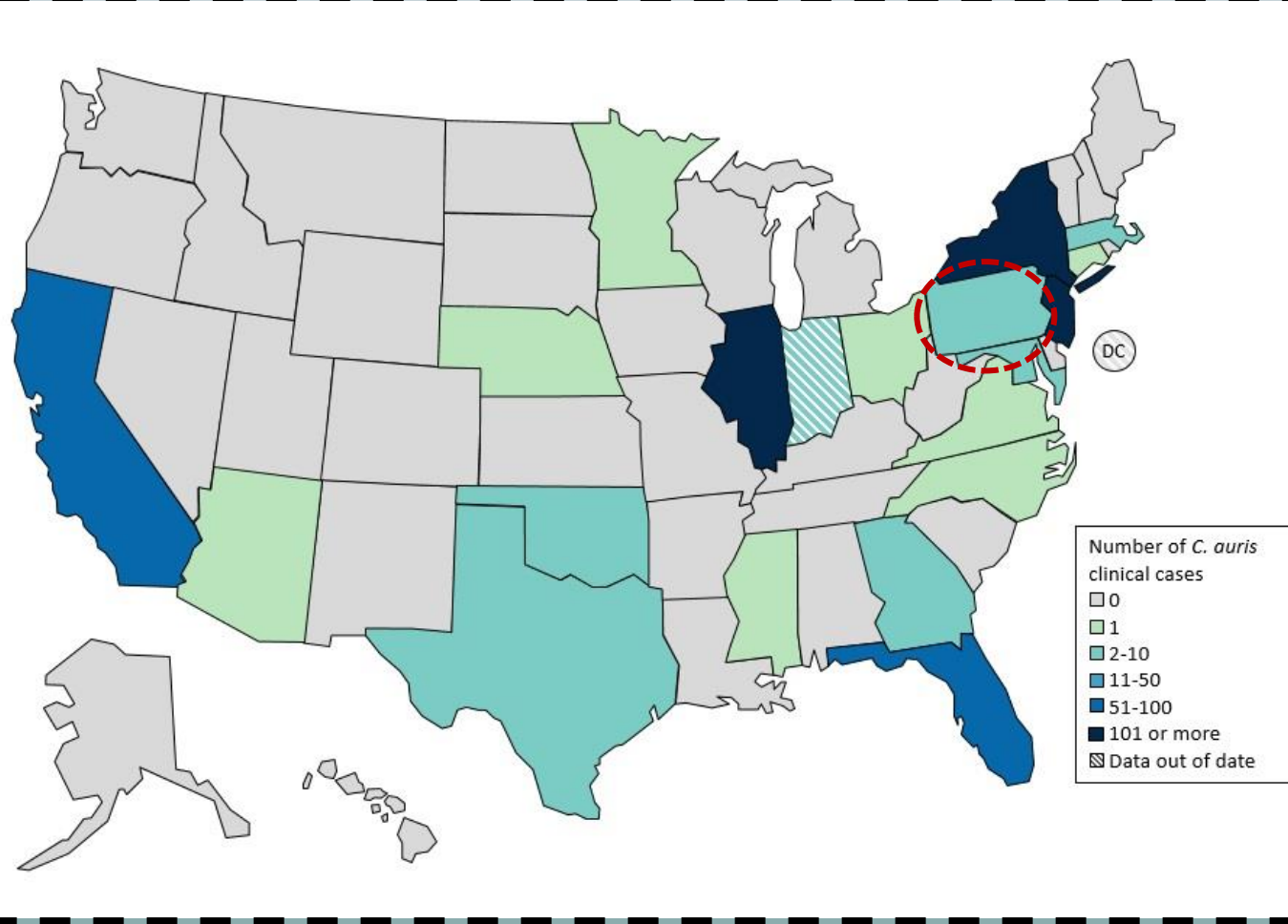
Countries from which *C.auris* cases have been reported, June 30, 2020



C. auris Epidemiology



Clinical cases of *Candida auris* reported by U.S. states, June 30, 2020



As of Aug 13, 2020:

1238 cases reported nationally

90% resistant to at least one antifungal

30% resistant to at least two antifungals

C. auris Health Alert



PENNSYLVANIA DEPARTMENT OF HEALTH
2020 – PAHAN – 522 – 08-18-ALT
ALERT: New Outbreak and Containment of *Candida auris*
in PA Healthcare Facilities



DATE:	08/18/2020
TO:	Health Alert Network
FROM:	Rachel Levine, MD, Secretary of Health
SUBJECT:	ALERT: New Outbreak and Containment of <i>Candida auris</i> in PA Healthcare Facilities
DISTRIBUTION:	Statewide
LOCATION:	n/a
STREET ADDRESS:	n/a
COUNTY:	n/a
MUNICIPALITY:	n/a
ZIP CODE:	n/a

This transmission is a "Health Alert": conveys the highest level of importance; warrants immediate action or attention.

HOSPITALS: PLEASE SHARE WITH ALL MEDICAL, PEDIATRIC, NURSING AND LABORATORY STAFF IN YOUR HOSPITAL; EMS COUNCILS: PLEASE DISTRIBUTE AS APPROPRIATE; FQHCs: PLEASE DISTRIBUTE AS APPROPRIATE
LOCAL HEALTH JURISDICTIONS: PLEASE DISTRIBUTE AS APPROPRIATE; PROFESSIONAL ORGANIZATIONS: PLEASE DISTRIBUTE TO YOUR MEMBERSHIP; LONG-TERM CARE FACILITIES: PLEASE SHARE WITH ALL MEDICAL, INFECTION CONTROL, AND NURSING STAFF IN YOUR FACILITY

- In March 2020, the first case of *Candida auris* was detected in a Pennsylvania resident with a history of healthcare exposures in another state. Public health containment measures and investigation did not identify further transmission.
- In June 2020, a second clinical case of *C. auris* was detected in Pennsylvania. An ongoing investigation has recently identified more than ten cases of *C. auris* colonization in two healthcare facilities in southeastern Pennsylvania, including a long-term acute care hospital (LTACH) and a skilled nursing facility (SNF), raising concerns about undetected *C. auris* transmission in healthcare facilities in southeastern Pennsylvania.
- Controlling the spread of multi-drug resistant organisms (MDROs), including *C. auris* is still of utmost importance during the COVID-19 pandemic. The Pennsylvania Department of Health (DOH) and the Philadelphia Department of Public Health (PDPH) are jointly providing guidance to request that:
 - Healthcare facilities develop and maintain *C. auris* action plans to assure measures are in place should a patient with *C. auris* be detected in, or transferred to, the facility;
 - Healthcare providers maintain vigilance for clinical illness that could be consistent with *C. auris*;
 - Healthcare facilities deliver education to staff and providers about *C. auris* and the infection prevention and control measures necessary to contain it;
 - Environmental health practices are reviewed for effectiveness against *C. auris*;
 - Laboratories implement methods to detect *C. auris* as outlined in this HAN.
- Suspected or confirmed cases of *C. auris* identified in Pennsylvania should be reported promptly to PDPH at 215-685-6748 or DOH by calling 1-877-PA-HEALTH, or your local health department.

- Issued jointly by PADOH and PDPH on Aug 18, 2020
- *C. auris* identified in southeastern PA and Philadelphia
- Three different healthcare setting types

<https://hip.phila.gov/HealthAlerts/SignUpHealthAlerts>

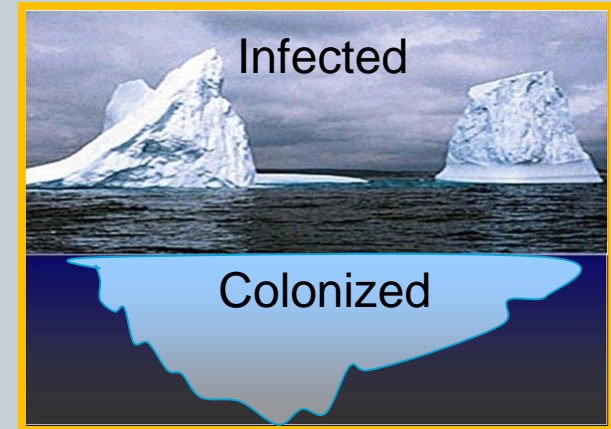
<https://han.pa.gov/>



C. auris as an HAI



- Patients can be colonized or infected
- Colonization persists for long time
- High mortality- **approx. 57%**
- Delays in laboratory diagnosis-
misidentification by detection systems
 - Requires MALDI-TOF
 - PCR
- Healthcare environment quickly becomes contaminated
- Contact transmission between patients, staff and environment

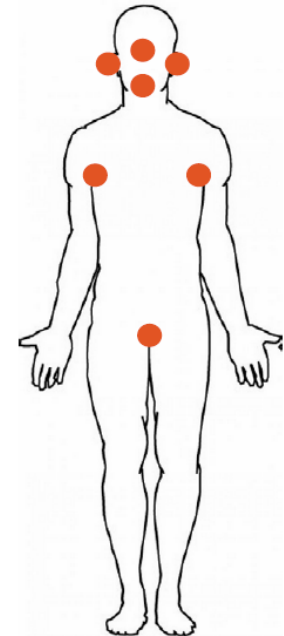


C. auris Colonization



Patients are often colonized indefinitely

- Persistent, for many months
- No currently known decolonization strategies
- Patients can be intermittently positive on colonization screening
- **CDC updating recommendations to not repeat testing to establish clearance of *C. auris***



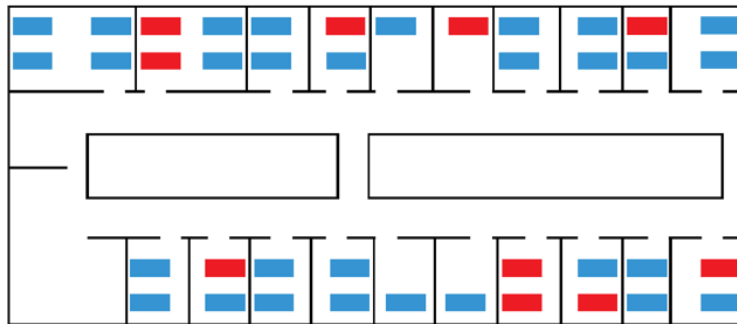
The percentage of those patients who are colonized with *C. auris* that will go on to develop invasive infection is not known



C. auris Screening



Recommendations for screening



Healthcare contacts



Healthcare abroad in past year

On site Infection Control Assessments



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C. auris Environmental Contamination



- ***C. auris* persists in the environment**

- Can survive over a month
- Some common disinfectants (quarternary ammonia compounds) do not work
- Few products have EPA claims for efficacy against *C. auris*
- If not available should use products effective against *C. difficile* (List K)



Antimicrobial Products Registered with EPA for Claims Against *C. auris*



Registration	Product Brand Name	Company
70627-72	Avert Sporicidal Disinfectant Cleaner	Diversey Inc.
67619-24	Blondie	Clorox Professional Products Company
67619-25	Dagwood	Clorox Professional Products Company
37549-1	Micro-Kill Bleach Germicidal Bleach Wipes	Medline Industries Inc.
70627-74	Oxivir 1	Diversey Inc.
70627-77	Oxivir 1 Wipes	Diversey Inc.
70627-60	Oxivir Wipes	Diversey Inc.
1677-237	Oxycide™ Daily Disinfectant Cleaner	Ecolab Inc.
1677-226	Virasept	Ecolab Inc.
9480-12	Wonder Woman Formula B Germicidal Wipes	Professional Disposables International
9480-10	Wonder Woman Formula B Spray	Professional Disposables International

As of February 2020

C. auris Infection Prevention



Colonized and/or infected patients should be put in contact precautions!

C. auris Infection Prevention



C. auris prevention

- Updated guidance on precautions in nursing homes
 - Enhanced Barrier Precautions

Candida auris:
Learn how you can stop it from spreading.

This drug-resistant fungus causes serious infections and spreads in healthcare facilities.

www.cdc.gov/fungal

<https://www.cdc.gov/hai/containment/PPE-Nursing-Homes.html>

STOP **ENHANCED BARRIER PRECAUTIONS** **STOP**
EVERYONE MUST:

Clean their hands, including before entering and when leaving the room.

PROVIDERS AND STAFF MUST ALSO:

Wear gloves and a gown for the following High-Contact Resident Care Activities.

Dressing
Bathing/Showering
Transferring
Changing Linens
Providing Hygiene
Changing briefs or assisting with toileting
Device care or use:
central line, urinary catheter, feeding tube, tracheostomy
Wound Care: any skin opening requiring a dressing

Do not wear the same gown and gloves for the care of more than one person.



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C. auris Infection Prevention



- Maintain excellent communication regarding *C. auris* colonization/infection status with referring facilities
 - Utilize a transfer form
 - Note status in electronic medical record
 - Verbal communication upon transfer
- See Philadelphia Department for Public Health (PDPH) Health Information Portal *C. auris* page (hip.phila.gov)
 - Transfer form
 - Reporting form
 - *C. auris* resources



PDPH Transfer Form



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The Philadelphia Department of Public Health (PDPH) and
the Centers for Disease Control and Prevention (CDC) recommend that:

This patient should immediately be placed
on **contact precautions**

This patient has been colonized or infected with *Candida auris*. *Candida auris* is a difficult to detect yeast that can cause life-threatening infections and has caused long-lasting outbreaks in healthcare facilities (HCFs). It is easily spread, hard to remove from the environment, and often very resistant to antifungal medications. Implementation of Transmission-Based Precautions is necessary to prevent outbreaks. Contact Precautions should be implemented by all HCFs, including long-term care facilities (LTCFs), as the primary option. LTCFs may be able to utilize Enhanced Barrier Precautions* for long-term management of these patients per CDC guidance and in consultation with the PDPH.

Contact Precautions and Recommendation Checklist:

- This patient should be placed in a private room, if possible.**
- Healthcare personnel interacting with patients on Contact Precautions, or their environment, are required to wear a gown and gloves, donning their PPE upon room entry and properly discarding before exiting
- Healthcare personnel should conduct diligent hand hygiene during and after contact with a *C. auris* patient or their environment; Ensure alcohol-based hand rub is readily available
- Disposable or dedicated patient-care equipment should be used whenever possible
- All disinfection should be completed with an Environmental Protection Agency (EPA) registered disinfectant effective against *Candida auris* or *Clostridium difficile*. Cleaning and disinfection should be performed according to the manufacturer's instructions for use. Examples include:
 - Shared equipment should be thoroughly cleaned/disinfected after contact with this patient (e.g. stethoscopes, X-ray machines, respiratory therapy equipment)
 - The patient's room should be cleaned/disinfected daily and terminally upon discharge
 - Transport vehicles/equipment should be terminally cleaned/disinfected after use
- Ensure written and verbal communication of isolation status for intra and inter-facility transfers

* More information on Enhanced Barrier Precautions can be found on CDC's website:
<https://www.cdc.gov/hai/containment/PPE-Nursing-Homes.html> Enhanced barrier precautions should only be used in the place of contact precautions under consultation with PDPH.

** If a patient cannot be placed in a private room, ensure roommates are at low risk of developing *Candida* infections (e.g., no immunocompromising conditions or antifungal therapies, no indwelling devices or open wounds), maintain separation of at least 3 feet, use privacy curtains to limit direct contact, clean/disinfect surfaces on a more frequent schedule, and have healthcare workers change PPE and perform hand hygiene when moving between roommates. Patients with *C. auris* who have uncontained secretions, excretions, acute diarrhea, or draining wounds should only be roomed with other *C. auris* patients

1



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2

Patient Name/ID: _____

Completing facility: _____ Date completed: _____

This patient was identified to have *Candida auris*: (select one)

- Infection
 This infection has been treated (patient is likely to be colonized and should be maintained on contact precautions)
 Treatment is ongoing
- Colonization

This case status is: (select one)

- Confirmed: *Candida auris* was isolated from a body site
 Under investigation: Laboratory results are pending and *Candida auris* is suspected

The organism was isolated from the patient's: (check all that apply)

- Skin Blood Urine Respiratory tract
 Wound Stool Other: _____

The Isolation/Transmission-based Precaution status at time of discharge:

- Contact Droplet Airborne Enhanced barrier

Other organisms requiring isolation: _____

Most recent topical antiseptic application (chlorhexidine gluconate [CHG]) if applicable:

Date: _____ Body Sites: _____

Additional Notes:

Resources

PDPH Health Information Portal: *Candida auris* <https://hip.phila.gov/HAIAR/CandidaAuris>
Infection Prevention and Control for *Candida auris* <https://www.cdc.gov/fungal/candida-auris/c-auris-infection-control.html>
Inter-facility IC Transfer Form <https://www.cdc.gov/hai/pdfs/toolkits/interfacility-ic-Transfer-Form-508.pdf>
PPE in Nursing Homes to Prevent MDROs <https://www.cdc.gov/hai/containment/PPE-Nursing-Homes.html#1>



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Reporting of *C. auris* in Philadelphia



<i>Candida auris</i> Report Form		Philadelphia Department of Public Health Division of Disease Control 1101 Market St., 12th Floor Philadelphia, PA 19107 Telephone: (215) 685-6748 Fax: (215) 238-6947 Form available at hip.phila.gov	
Department of Public Health CITY OF PHILADELPHIA LIFE • LIBERTY • AND YOU			
PATIENT DEMOGRAPHIC INFORMATION			
PATIENT'S NAME (LAST, FIRST)		D.O.B.	AGE (years)
			SEX <input type="checkbox"/> Male <input type="checkbox"/> Female <input type="checkbox"/> Other
RACE <input type="checkbox"/> African-American <input type="checkbox"/> White <input type="checkbox"/> Asian <input type="checkbox"/> Pacific Islander <input type="checkbox"/> Native-American <input type="checkbox"/> Unknown <input type="checkbox"/> Other			
HISPANIC <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> JUNK			
CURRENT ADDRESS <input type="checkbox"/> Private Residence <input type="checkbox"/> Healthcare/Assisted Living Facility		ZIP CODE	PATIENT TELEPHONE <input type="checkbox"/> Work <input type="checkbox"/> Cell <input type="checkbox"/> Home
FACILITY NAME, if residing in a healthcare/assisted living facility		WAS FACILITY NOTIFIED <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Unknown	PART OF OUTBREAK/CLUSTER <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Unknown
CLINICAL DATA			
HOSPITALIZED <input type="checkbox"/> Yes <input type="checkbox"/> No	HOSPITAL NAME	ADMIT DATE	DISCHARGE DATE
Admitted to Intensive Care Unit <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> JUNK			
Fatal <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Unknown			
Date of Death: ____/____/____			
REASON FOR TESTING <input type="checkbox"/> Screening/Surveillance <input type="checkbox"/> Signs/Symptoms of Infection		SIGNS/SYMPTOMS ONSET DATE, if infection: ____/____/____	
History of <i>C. auris</i> : <input type="checkbox"/> Y <input type="checkbox"/> N <input type="checkbox"/> JUNK			
Date of first positive: ____/____/____			
INFECTION(S) ASSOCIATED WITH CULTURE(S) (Check all that apply) <input type="checkbox"/> None <input type="checkbox"/> Candidemia (blood) <input type="checkbox"/> Respiratory Tract Infection			
<input type="checkbox"/> Urinary Tract Infection (UTI) <input type="checkbox"/> Organ Space/Abscess <input type="checkbox"/> Skin/Soft Tissue Infection or Wound <input type="checkbox"/> Other: _____			
UNDERLYING MEDICAL CONDITIONS (Check all that apply or attach problems list or pertinent sections of medical records)			
<input type="checkbox"/> Chronic Heart/Cardiovascular Disease <input type="checkbox"/> Kidney Disease; <input type="checkbox"/> Dialysis in Past Year		<input type="checkbox"/> Wound(s), specify: _____	
<input type="checkbox"/> Diabetes <input type="checkbox"/> Neurological, specify: _____		<input type="checkbox"/> Other, specify: _____	
<input type="checkbox"/> COPD <input type="checkbox"/> Immunosuppression, specify: _____		<input type="checkbox"/> None <input type="checkbox"/> Unknown	
RISK FACTORS			
IF AVAILABLE, HISTORY OF HEALTHCARE STAYS IN THE UNITED STATES IN THE PREVIOUS YEAR (List where the patient was transferred from first)			
Facility: _____	Admission/Discharge Dates: ____/____/____ - ____/____/____		
Facility: _____	Admission/Discharge Dates: ____/____/____ - ____/____/____		
Facility: _____	Admission/Discharge Dates: ____/____/____ - ____/____/____		
HISTORY OF INTERNATIONAL TRAVEL and/or MEDICAL CARE ABROAD IN PREVIOUS YEAR (Check all that apply)			
<input type="checkbox"/> International Travel <input type="checkbox"/> Medical Care Abroad <input type="checkbox"/> No <input type="checkbox"/> Unknown			
Dates of travel: ____/____/____ - ____/____/____			
If yes, location(s): _____			
SURGERY/PROCEDURE INVOLVING A SCOPING DEVICE IN THE PAST YEAR? <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Unknown			
If yes, date: ____/____/____			
<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>			
LABORATORY (Please attach culture and sensitivity results and any other applicable test results available)			
SPECIMEN COLLECTION DATE: ____/____/____		RESULT DATE: ____/____/____	
GENUS and SPECIES: <input type="checkbox"/> <i>Candida auris</i> <input type="checkbox"/> <i>Candida haemulonii</i>			
<input type="checkbox"/> Other: _____			
SPECIMEN TYPE (Check all that apply)		DIAGNOSTIC METHOD	
<input type="checkbox"/> Blood <input type="checkbox"/> Urine		<input type="checkbox"/> MALDI-TOF <input type="checkbox"/> VITEK 2 YST	
<input type="checkbox"/> Wound <input type="checkbox"/> Respiratory Secretions		<input type="checkbox"/> MALDI Biotyper <input type="checkbox"/> API 20c AUX	
<input type="checkbox"/> Skin <input type="checkbox"/> Ear		<input type="checkbox"/> BD Phoenix <input type="checkbox"/> MicroScan	
<input type="checkbox"/> Groin <input type="checkbox"/> Axilla		<input type="checkbox"/> Whole Genome Sequencing (WGS)	
<input type="checkbox"/> Other, specify: _____		<input type="checkbox"/> Other: _____	
RESISTANT/INTERMEDIATE TO AT LEAST ONE DRUG IN THE CLASS: (Check all that apply)			
<input type="checkbox"/> Azoles (e.g. Fluconazole)		<input type="checkbox"/> 5-fluorocytosine	
<input type="checkbox"/> Polyenes (e.g. Amphotericin B)		<input type="checkbox"/> Pandrug-Resistant	
<input type="checkbox"/> Echinocandins (e.g. anidulaf, caspo-, mica-fungin) <input type="checkbox"/> None			
<input type="checkbox"/> Allylamines (e.g. terbinafine, amorolfin, naftifine) <input type="checkbox"/> Unknown			



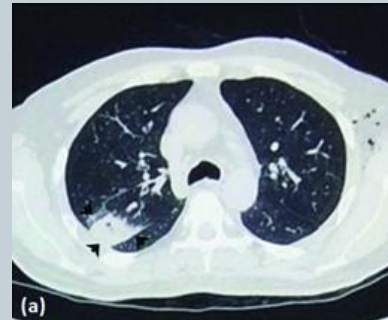
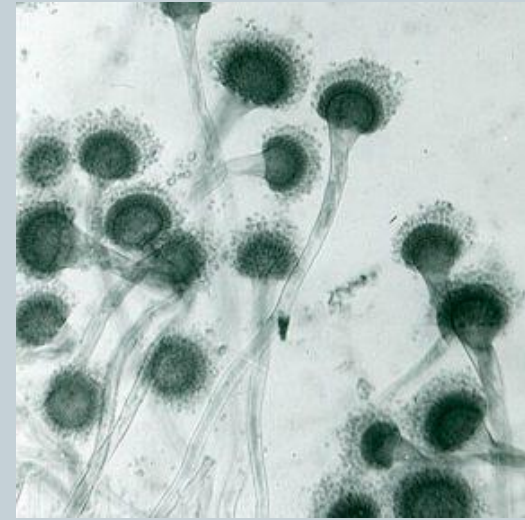
- Report all positive cultures of *Candida auris* and *Candida haemulonii* (*Candida auris* is frequently misidentified as *Candida haemulonii*)**
- Report cultures from all body sites (including but not limited to blood, wound, skin, ear, urine, rectum, and respiratory secretions) that were collected for diagnostic purposes as well as surveillance or screening purposes
- All positive test results should be reported to PDPH within 24 hours.** Please call PDPH at (215) 685-6748 [after-hours (215) 686-4514] to report a case of *Candida auris*
- A *Candida auris* case report form should also be filled out and faxed to PDPH at (215) 238-6947 after reporting the case via phone
- Isolates should be retained for one month. PDPH will follow up to coordinate further testing as needed.**



Updates on Antifungal Resistance of Environmental Aspergillus



- Genus *Aspergillus* includes several hundred mold species- found indoors and outdoors
- *A. fumigatus* is the major species associated with human disease
 - *A. niger*, *A. flavus*, *A. terreus*
 - People become ill from *Aspergillus* when they have a weak immune system, damaged lungs, or major allergies
 - *Aspergillus* spp. can cause infections in animals, birds, and plants and produce toxins that lead to food spoilage or are carcinogenic
- Aspergillosis refers to the group of diseases caused by *Aspergillus*
 - Invasive aspergillosis- high mortality rate, 25% to 90%
 - Chronic pulmonary aspergillosis- long term infection in patients with underlying lung disease

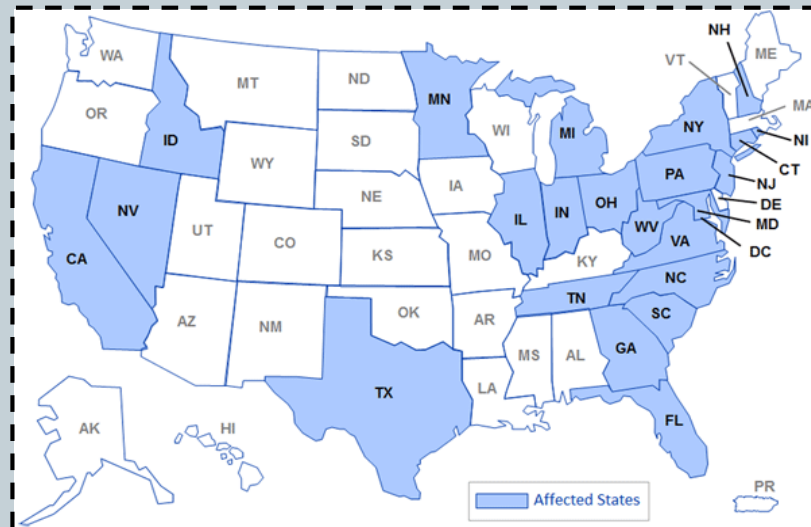


Aspergillus as a cause of HAIs



- HAIs may be sporadic or may be associated with dust exposure during building renovation or construction
- Occasional outbreaks of cutaneous infection have been traced to contaminated biomedical devices

Multistate Outbreak of Fungal Infection Associated with Injection of Methylprednisolone Acetate Solution from a Single Compounding Pharmacy – United States, 2012



753
cases

64
deaths

Updates on Antifungal Resistance of Environmental Aspergillus



- Current antifungal therapies for invasive and chronic aspergillosis syndromes may be unsuccessful
- Recent emergence of triazole-resistant *A. fumigatus*
 - Environmental usage of triazole fungicides
 - Not previous patient exposure to antifungals

Morbidity and Mortality Weekly Report

Multidrug-Resistant *Aspergillus fumigatus* Carrying Mutations Linked to Environmental Fungicide Exposure — Three States, 2010–2017

Karlyn D. Beer, PhD¹; Eileen C. Farnon, MD²; Seema Jain, MD³; Carol Jamerson⁴; Sarah Lineberger, MPH⁴; Jeffrey Miller, MD^{5,6};
Elizabeth L. Berkow, PhD¹; Shawn R. Lockhart, PhD¹; Tom Chiller, MD¹; Brendan R. Jackson, MD¹

- Four out of seven reported cases were from PA (years 2010, 2014, 2016, 2017)
- Two of these four patients died of their infections, one died of hydropneumothorax not related to her infection

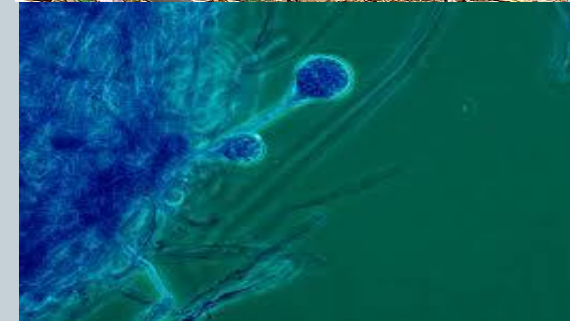


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Mucormycetes (Zygomycosis)



- Thermotolerant molds found in soil and decaying organic matter, most often *Rhizopus*
- Can cause life-threatening infection called mucormycosis or zygomycosis in people with weakened immune systems
- Climatic events, such as tornadoes and tsunamis, can lead to outbreaks as debris can become embedded in skin or eyes or lead to pulmonary infections
- Fungus can spread through the bloodstream leading to infections of brain, spleen, heart, and skin



Mucormycetes (Zygomycosis)



- **Can cause HAIs**
 - **often associated with healthcare facility construction or water damage**
 - **Can cause outbreaks**
- Prevention is vital
 - Avoid areas with dust ex. construction sites, excavation sites
 - N95 masking if unable to avoid
 - Avoid direct contact with water-damaged buildings and flood water
 - Avoid gardening, yard work if possible- wear gloves if can't avoid, wash hands, clothes if exposed
 - Antifungal prophylaxis



Mucormycetes (Zygomycosis)



- Early recognition of disease improves clinical outcome-histopathology and cultures
- Aggressive treatment: overall mortality is approximately 50%
 - Debridement
 - Antifungal therapy
 - Reduction of immunosuppression if possible
- Organism is typically drug resistant
 - Amphotericin B, posaconazole, isavuconazole are active
 - Fluconazole and voriconazole are not active



Dimorphic Fungi



- Dimorphic fungi
 - *Histoplasma capsulatum*
 - *Blastomyces dermatitidis*
 - *Coccidioides immitis/posadasii*
- Characterized by having two morphotypes or shapes
 - Exist as filamentous molds in the environment
 - At mammalian body temperature, they transition to a spherical yeast form
- Capable of causing disease in otherwise healthy humans
- Inhalation of spores initiates infection
- Organisms are prevented from leaving the lung by the patient's immune response → granulomas around the fungi



Updates on Endemic Mycoses



- **Expansion of endemic geographic locations**
 - Global climate change
- **Histoplasmosis: 12 states reportable**
 - Estimated U.S. direct medical cost- \$216 million in 2017
 - 82% from hospitalization- 5,000 hospitalizations
 - Number of death certificates-44
- **Burden of coccidioidomycosis: 27 states reportable**
 - At least 10% of the 15,000 U.S. residents infected with annually seek medical treatment for pneumonia
 - 1% of these patients requiring life-long antifungal therapy to avoid a fatal outcome, at a cost exceeding \$30,000/year

Benedict K, *Clin Infect Dis*, 2018

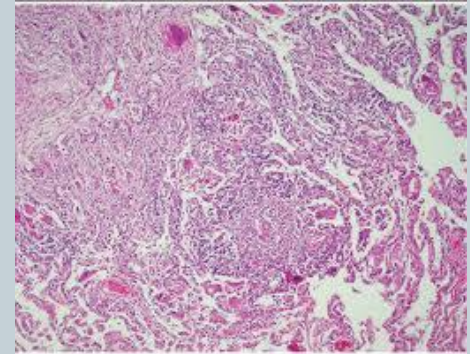


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Histoplasmosis



- Histoplasmosis is found worldwide
- In North America, it is endemic to the Mississippi and Ohio River Valleys
- Sporulates in bat and bird guano
- Disturbance of bat and bird roosts can lead to inhalation of spores and infection
- Most hosts are unaware of their infection because their immune systems control the infection with granuloma formation
 - Significant percentage seek treatment for pneumonia or flu-like symptoms
 - Small percentage require life-long antifungal therapy
- Higher incidence in immunocompromised humans and in areas where antiretroviral therapy is not available
 - Mortality in patients infected with HIV reaches 30%



Histoplasmosis



Histoplasmosis outbreak at Louisiana campsite: CDC partners with state health department to respond

"Fungal diseases [like histoplasmosis] have taken a back seat to bacterial and viral infections, to the point where many doctors don't think about fungi as a cause of illness. But statewide tracking of fungal diseases and outbreak findings show that we should be concerned about fungal diseases." — Jose Serrano, MPH, epidemiologist at the Louisiana Department of Health and lead investigator of the histoplasmosis outbreak



<https://www.cdc.gov/ncezid/dfwed/stories/louisiana-histoplasmosis-outbreak.html>

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Fungal Diseases

Histoplasmosis: Be Safe Around Bird or Bat Poop!

Histoplasmosis is a fungal infection that can affect anyone. Learning about histoplasmosis can help you stay healthy and recognize symptoms early if you do get the infection.

Histoplasmosis is caused by *Histoplasma*, a fungus that lives in the soil, particularly where there's a large amount of bird or bat poop. The infection ranges from mild to life-threatening. It can be misdiagnosed because its symptoms are similar to those of other illnesses. Here are some important things to know about histoplasmosis.

<https://www.cdc.gov/fungal/features/histoplasmosis.html>



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Blastomycosis



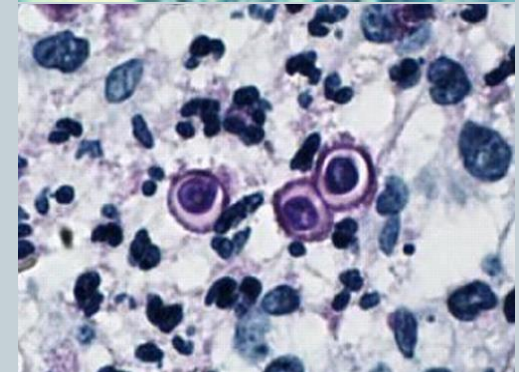
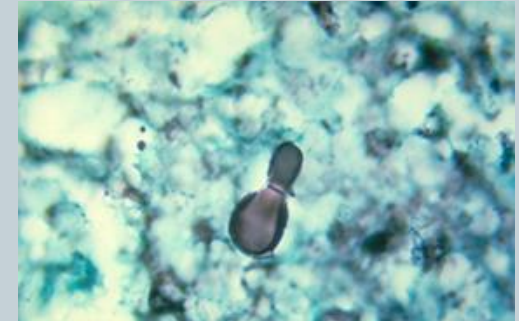
- Caused by the dimorphic fungus *Blastomyces dermatitidis*
- Found in moist soil and decomposing organic matter such as wood and leaves
- Endemic areas in the U.S.:
 - Mid-western, south-central, and south-eastern states
 - Particularly areas surrounding the Ohio and Mississippi River valleys, Great Lakes, and St. Lawrence River
- Wisconsin has one of the highest incidences of any state, with yearly rates ranging from 10 to 40 cases per 100,000 persons in some northern counties
- Blastomycosis is typically acquired via inhalation of airborne fungal spores
 - Primary cutaneous blastomycosis is uncommon, but can result from traumatic inoculation
- Outbreaks often involve activities that disrupt soil:
 - Construction/ excavation
 - Recreational activities near lakes or rivers such as hunting, fishing, or camping



Blastomycosis



- Influenza-like symptoms (50% asymptomatic)
- Acute pulmonary blastomycosis can progress to acute respiratory distress syndrome (ARDS)
- 25 to 40% of symptomatic cases will develop extrapulmonary infection
 - Cutaneous, osteoarticular, genitourinary, central nervous system disease
- Laboratory tests
 - Culture
 - Histopathology
 - Cytopathology
 - Antigen testing
 - Molecular assays
- Amphotericin B is drug of choice
 - Itraconazole is recommended for mild to moderate disease and step-down therapy



Coccidioidomycosis



- Coccidioides is endemic in arid zones of the Americas
- Most common in highly populated areas of Arizona and California
- Fungus has evolved to use soil rich in small desert rodent excrement as a substrate and has jumped hosts to humans, domesticated dogs and horses
- Soil disturbance, by natural causes or human activity, aerosolizes the spores and leads to infection
- Global climate change is certain to alter the distribution of this arid zone fungus
 - *C. immitis* has already been identified in eastern Washington State and Missouri, far outside of the traditionally defined area where it is endemic



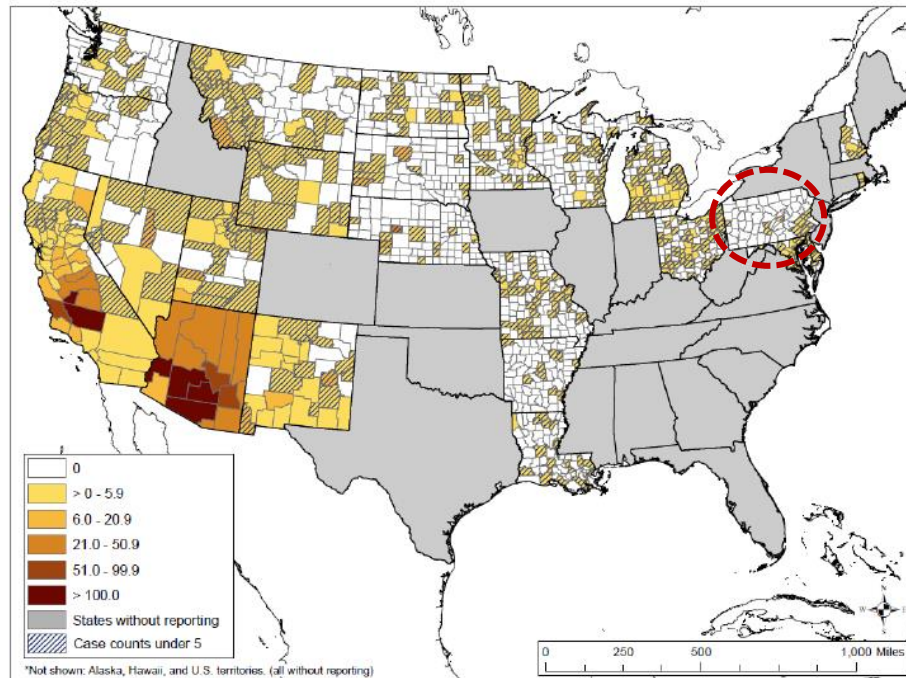
Coccidioidomycosis



Centers for Disease Control and Prevention

MMWR

Surveillance for Coccidioidomycosis — United States, 2011–2017



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Coccidioidomycosis



U.S. Volunteers Get Sick from Soil Fungus After Building Houses



Volunteers dug trenches at multiple worksites in Tijuana during a community house-building service trip.

Prevention Tips for Service Groups

CDC recommends that service groups consider the following prevention measures to help avoid exposure to the fungus that carries Valley fever.

- Allow trained construction workers to perform activities that generate a lot of dust, such as building foundations and digging trenches.
- Wet the soil before digging, to reduce the amount of dust in the air.
- Stay upwind of digging, when possible.
- NIOSH approved or FDA cleared [N95 or greater respirators](#) when performing activities that generate dust.

<https://www.cdc.gov/nceid/dfwed/stories/volunteers-cocci-mexico.html>



Conclusions



- Fungal diseases in the U.S are costly
- *C. auris* has emerged as a multi-drug resistant fungal pathogen causing HAIs, is now present in southeastern PA and is a reportable condition in Philadelphia
- Newly emerging azole resistant aspergillus is linked with environmental use of antifungals and is also present in PA including Philadelphia
- Epidemiology of endemic mycoses in the U.S. is evolving
- Ongoing fungal pathogen surveillance will be crucial to reducing transmission



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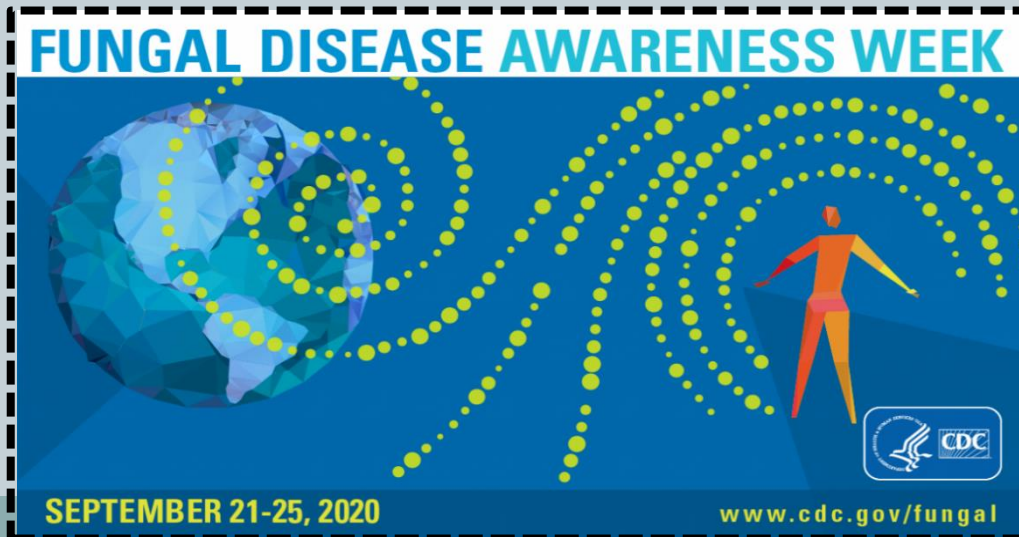


Thank you



- PDPH HAI/AR program
 - 215-685-4501
 - Signup to receive HAI/AR newsletter, “Healthcare Happenings” at <http://eepurl.com/gLX6GV>

Questions?



FREQUENT USE OF ANTIFUNGAL CREAMS CAN LEAD TO HARD-TO-TREAT INFECTIONS

FOR MORE INFORMATION VISIT:
WWW.CDC.GOV/FUNGAL/ANTIFUNGAL-RESISTANCE.HTML

COMMON ANTIFUNGALS INCLUDE:
Cruex
Lamisil
Lotrimin
Monistat
Mycelex
Mycostatin
Naftin
Nizoral
Nyata
Tinactin

ALWAYS SEE YOUR DOCTOR BEFORE USING ANTIFUNGALS

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