

Multi-drug Resistant Organisms (MDROs)

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LACDPH SNF Symposium
2023





Objectives

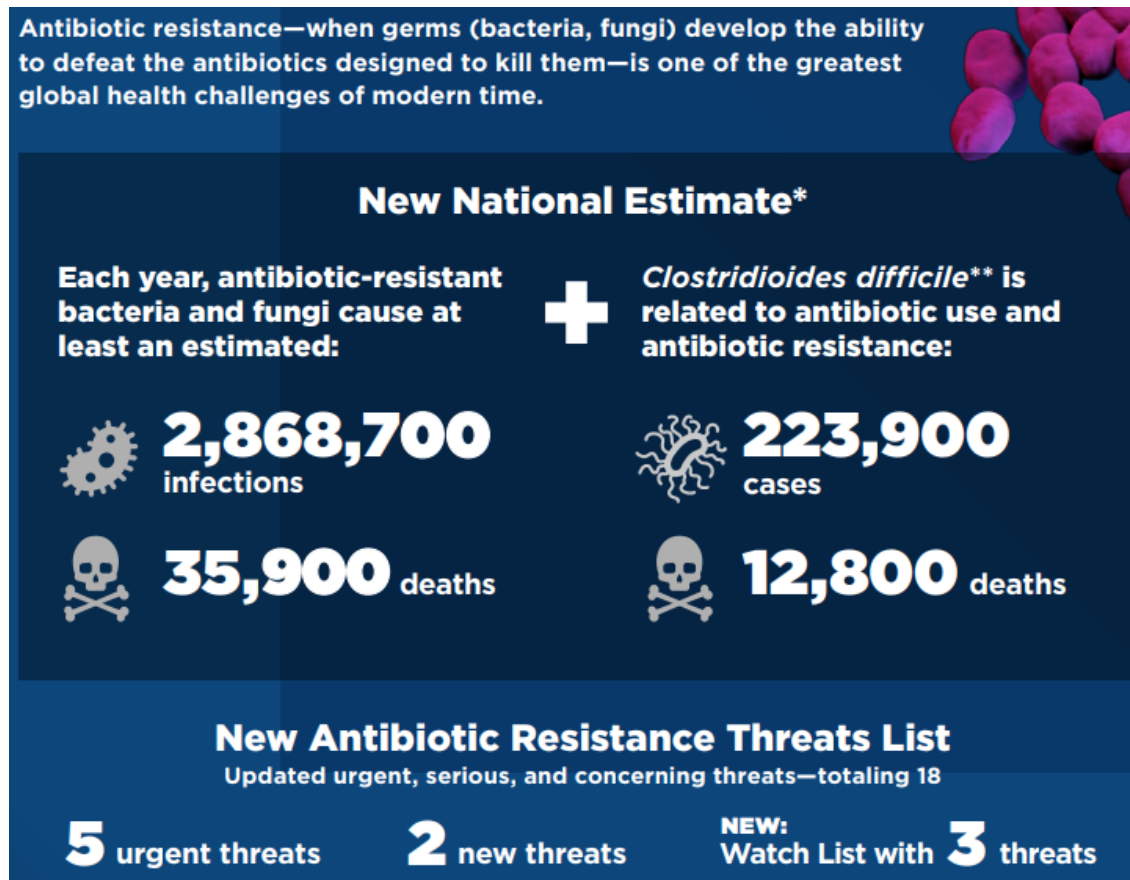
- Describe common multi-drug resistant organisms (MDROs)
- Explain infection control practices
- Outline MDRO investigation and control steps



Background and Epidemiology of MDROs



Multi-drug resistant organisms (MDROs)



1. CDC AR Threats Report: <https://www.cdc.gov/drugresistance/biggest-threats.html>

2. COVID-19 Impact on AR: <https://www.cdc.gov/drugresistance/pdf/covid19-impact-report-508.pdf>



Reportable MDROs for LA County (SNF reporting highlighted)

- Carbapenem-resistant Enterobacterales (CRE)
- Carbapenemase-producing organisms (CPOs), including:
 - CP-CRE
 - CP- *Acinetobacter baumannii*
 - CP- *Pseudomonas aeruginosa*
- *Candida auris*
- Vancomycin-resistant *Staphylococcus aureus*
- Pan-resistant organisms

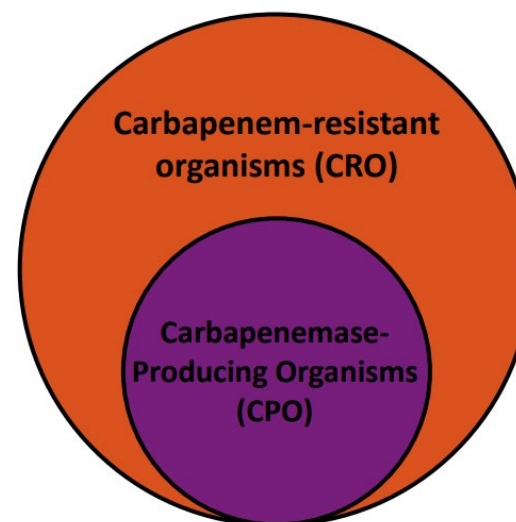
- Report via LACDPH MDRO Reporting Portal: redcap.link/LACMDROPortal

1. http://publichealth.lacounty.gov/acd/docs/MDRO_HOO_Compliance_Instructions.pdf

CPO vs Carbapenem-resistant Organisms (CROs)

- **CRO= carbapenem-resistant organism**
 - Organism that is resistant (R) to carbapenem antibiotics
 - Meropenem, doripenem, ertapenem, imipenem
 - Includes carbapenem-resistant (CR)-
 - Enterobacterales (CRE)
 - *Acinetobacter baumannii* (CRAB)
 - *Pseudomonas aeruginosa* (CRPA)
 - This is regardless of having a carbapenemase or not

- **CPO= carbapenemase-producing organism**
 - Organism that produces a carbapenemase enzyme
 - Five main types= KPC, IMP, NDM, OXA, VIM
 - This is one way organisms become CR
 - Examples: KPC-producing CRE, VIM-producing CRPA, NDM-producing CRAB



<http://publichealth.lacounty.gov/acd/docs/CDCMidAtlanticWebinarSimplifyingCROs.pdf>

Identifying CRO vs CPO on a lab report

CRO

Pseudomonas aeruginosa, Carbapenem resistant		
Amikacin	25 mm	S
Ampicillin		
Ampicillin + Sulbactam		
Aztreonam	11 mm	R
Cefazolin		
Cefepime	>=64 ug/mL	R
Ceftazidime	>=64 ug/mL	R
Ceftriaxone		
Ciprofloxacin	31 mm	S
Ertapenem		
Extended Spectrum Beta Lactamase		
Gentamicin	<=1 ug/mL	S
Levofloxacin	0.5 ug/mL	S
Meropenem	>=16 ug/mL	R
Piperacillin + Tazobactam	12 mm	R
Tobramycin	<=1 ug/mL	S

CPO

Example A:

```

Specimen Source: URINE CULTURE
Collection Date: 03/10/2017 Receipt Date: 03/10/2017
Accession#: 27710687
ORG#1 >100,000 COLONIES/ML
ORG#1 THIS ISOLATE DEMONSTRATES CARBAPENEMASE PRODUCTION
ORG#1 VERIFIED BY MODIFIED HODGE TEST (CARBAPENEMASE PRODUCTION)
ORG#1 MULTIPLE DRUG RESISTANT ORGANISM
ORG#1 ADDITIONAL SENSITIVITIES BY DISK METHOD
ORG#1 COLISTIN 10ug : S , POLYMYXIN B 300ug : S
  
```

Example B:

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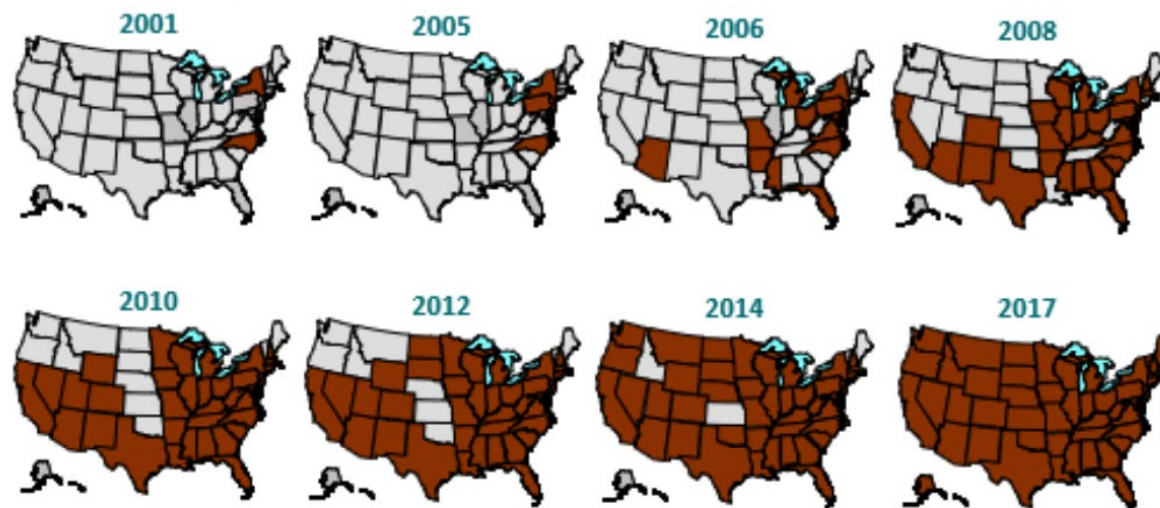
*****
POSITIVE for Klebsiella pneumoniae.
POSITIVE for KPC resistance gene.
Presumptive carbapenem resistant organism.
*****Comment*****
Preliminary identification performed using
Verigene nucleic acid test. Mixed infections
may not be detected by this method. Rare
cross-reactivity with organisms other than that
identified may occur for both identification
and resistance marker testing.
  
```

1. http://publichealth.lacounty.gov/acd/docs/LAC_CarbapenemaseTestingExplanation2021.pdf

Why are CPOs and CROs concerning?

- Infections with CPOs and CROs can be difficult to treat
- The carbapenemase carried by CPOs can be passed to other bacteria, potentially spreading antibiotic resistance

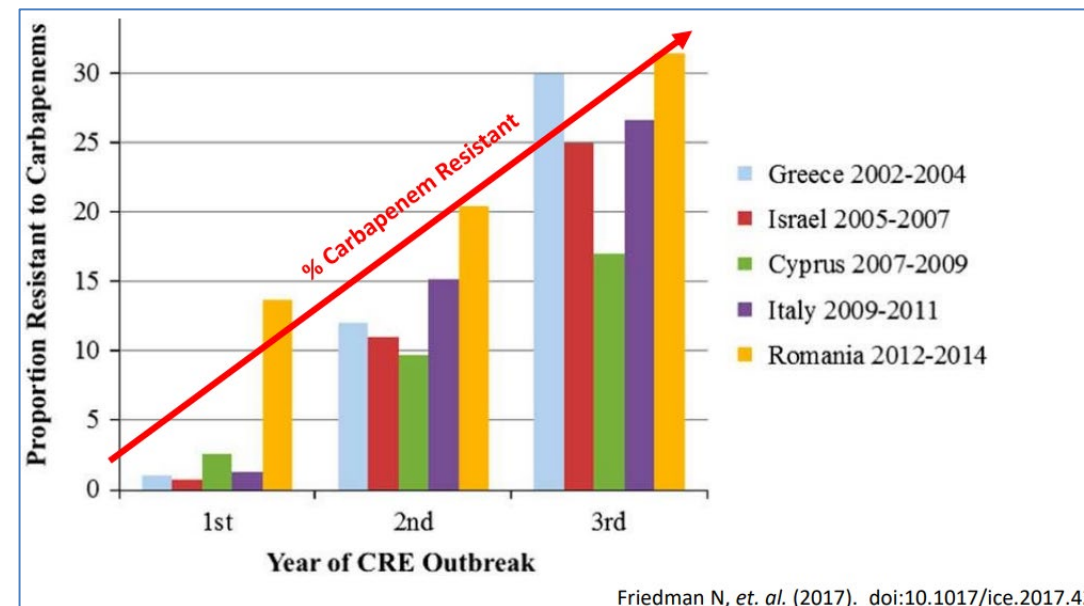
KPC-CRE found in the US spread from 2 states in 2001 to 50 states, DC, and PR by 2017



■ States with *Klebsiella pneumoniae* carbapenemase (KPC)-producing Carbapenem-resistant Enterobacteriales (CRE) confirmed by CDC

[Tracking CRE in the United States](https://www.cdc.gov/hai/organisms/cre/trackingcre.html)

(www.cdc.gov/hai/organisms/cre/trackingcre.html)



Friedman N, et. al. (2017). doi:10.1017/ice.2017.42

Why is *Candida auris* important?

- **HARDY:** it can survive in the environment and can spread quickly without the use of an appropriate disinfectant
 - Can survive quaternary ammonium cleaners
- **CAN BE DIFFICULT TO TREAT:** some strains are resistant to most of the commonly used antifungal treatments available
 - Echinocandin and amphotericin resistance has been seen
 - ***Note the SoCal strain of C. auris is fairly susceptible to most antifungal agents (only resistant to fluconazole).***
- **PREVENT INFECTIONS:** 5-10% of colonized persons will develop an infection



<https://phil.cdc.gov/Details.aspx?pid=23239>

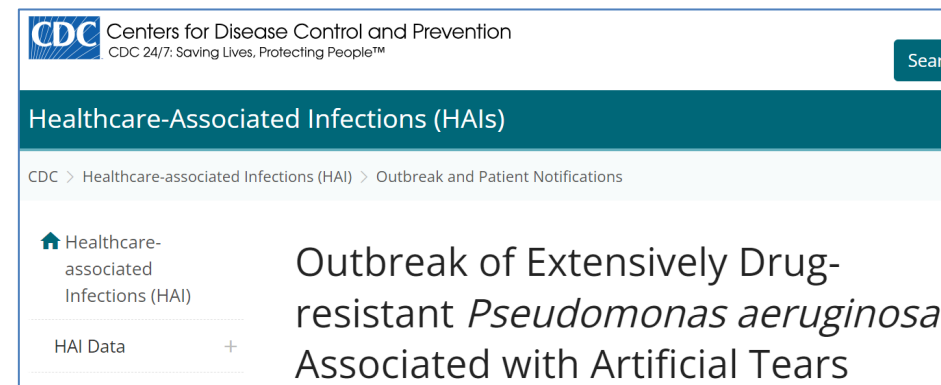
What is “concerning *C. auris*”?

<u>Identification</u>			<u>Candida auris</u>
<u>Analyte/Drug</u>	<u>Value</u>	<u>Units</u>	<u>Results/Interpretation</u>
Amphotericin B (E-Test)	0.5	µg/mL	No CLSI Interpretation
Anidulafungin	4	µg/mL	No CLSI Interpretation
Caspofungin	2	µg/mL	No CLSI Interpretation
Fluconazole	256	µg/mL	No CLSI Interpretation
Isavuconazole	0.12	µg/mL	No CLSI Interpretation
Itraconazole	0.5	µg/mL	No CLSI Interpretation
Micafungin	4	µg/mL	No CLSI Interpretation
Posaconazole	0.12	µg/mL	No CLSI Interpretation
Voriconazole	2	µg/mL	No CLSI Interpretation

C. auris that is resistant to echinocandins (pink highlight) or pan-resistant (to all drugs)

How are MDROs transmitted?

- Person-to-person contact with infected or colonized people
 - contact with wounds or stool
- Contact can occur with contaminated surfaces, such as via
 - hands of healthcare workers who did not perform proper hand hygiene
 - medical equipment and devices that have not been correctly cleaned
- Some (CRPA) via contaminated water sources or contaminated products



The screenshot shows the CDC website interface. At the top left is the CDC logo with the text "Centers for Disease Control and Prevention" and "CDC 24/7: Saving Lives, Protecting People™". A search bar is on the top right. Below the header is a teal navigation bar with the text "Healthcare-Associated Infections (HAIs)". Underneath is a breadcrumb trail: "CDC > Healthcare-associated Infections (HAI) > Outbreak and Patient Notifications". The main content area features a home icon next to "Healthcare-associated Infections (HAI)", a plus sign next to "HAI Data", and a large heading: "Outbreak of Extensively Drug-resistant *Pseudomonas aeruginosa* Associated with Artificial Tears".

<https://www.cdc.gov/hai/outbreaks/crpa-artificial-tears.html>



Who is at risk for acquiring MDROs?

- Patients/residents at highest risk, especially those with
 - One or more devices (e.g., ventilators, catheters)
 - Long courses of antibiotics
 - Weakened immune systems
 - History of healthcare received outside the United States
 - Frequent or long-term exposure to healthcare facilities

Where to find C. auris and CPO Screening

List of Laboratories with <i>C. auris</i> Testing Capacity			
Updated 12/5/22			
Reference Lab	Screening Method*	Test (Order Code)	Contact
ARUP	Fungal Culture	<ul style="list-style-type: none"> Fungal culture, yeast (0060149) Yeast ID - MALDI Bruker; sequencing if no ID (0060163) 	www.aruplab.com 1-800-522-2787
Genetic Technological Innovations	PCR	<ul style="list-style-type: none"> <i>Candida auris</i> surveillance (RT-PCR) (87481) 	www.gtilaboratories.com
GENETWORx	PCR	<ul style="list-style-type: none"> <i>C. auris</i> surveillance (PCR)(87481) 	www.genetworx.com POC Laura Smith, (610)-726-1205
InnerHealth	PCR	<ul style="list-style-type: none"> <i>Candida auris</i> RT-PCR surveillance (Order code C.AURIS) 	www.InnerHealthLab.com 1-949-272-3618 POC: Mike MFinl@innerhealthlab.com
LabCorp	Fungal Culture	<ul style="list-style-type: none"> Fungal culture, yeast (182776) Yeast ID – MALDI Vitek MS; sequencing if no ID (182212) 	www.labcorp.com
Mayo	PCR	<ul style="list-style-type: none"> <i>Candida auris</i> surveillance (PCR) (CAURS 607883) Yeast ID – MALDI Bruker; sequencing if no ID (FUNID 8223) 	www.mayocliniclabs.com 800-533-1710
Premier Lab Solutions	PCR	<ul style="list-style-type: none"> <i>Candida auris</i> surveillance (PCR) (6146) 	www.premierlabsolutions.com 602-441-2808
Quest	PCR & Fungal Culture	<ul style="list-style-type: none"> RT-PCR (10153) Fungal culture, yeast (20541) Yeast ID - MALDI Vitek MS or Bruker; sequencing if no ID (39507) 	www.questdiagnostics.com 866-697-8378
Soft Cell Labs, Inc.	NAAT, qPCR	<ul style="list-style-type: none"> <i>Candida auris</i> RT-PCR 15002 	www.softcelllabs.com ; 435-628-2215 POC Josh MacDonald; josh@softcellbio.com
Spectrum Molecular Diagnostics Laboratory	PCR	<ul style="list-style-type: none"> <i>Candida auris</i> PCR surveillance (78901) 	POC Rick Ferguson, 714-928-3162 rferguson@spectrumdxlabs.com 949-264-6102 www.spectrumdxlabs.com

List of Laboratories with Carbapenemase Testing Capacity					
Updated 2/1/23					
Laboratory	Test Type ¹	Test Code	Test Name	Specimen Type	Results
Isolates of Diagnostic Specimens					
ARUP	Phenotypic ²	2001503	Antimicrobial Susceptibility – Carbapenemase Production; Disk Diffusion / Chromogenic Assay	Actively growing Enterobacteriaceae, <i>Pseudomonas aeruginosa</i> in pure culture	Carbapenemase detected, no genes
Mayo Clinic Laboratories	Phenotypic ²	CARNP	Carbapenemase Detection-Carba NP Test	Enterobacteriaceae, <i>Pseudomonas aeruginosa</i> isolates	Carbapenemase detected, no genes
Quest	Phenotypic ²	18869	Carbapenemase Detection, Phenotypic; modified disk diffusion	Enterobacteriaceae, <i>Pseudomonas aeruginosa</i> isolates	Carbapenemase detected, no genes
ARUP	Genotypic ³	2014277	Antimicrobial Susceptibility – Carbapenemase Gene Detection by PCR	Actively growing Enterobacteriaceae, <i>Pseudomonas aeruginosa</i> , or <i>Acinetobacter baumannii</i> in pure culture	KPC, NDM, OXA-48, VIM, IMP
Mayo Clinic Laboratories	Genotypic ³	OXVRP	OXA-48-like (blaOXA-48-like) and VIM (blaVIM) in Gram-Negative Bacilli, Molecular Detection, PCR	Gram-negative bacilli isolates	OXA-48-like, VIM
Mayo Clinic Laboratories	Genotypic ³	KPNRP	KPC (blaKPC) and NDM (blaNDM) in Gram-Negative Bacilli, Molecular Detection, PCR	Gram-negative bacilli isolates	KPC, NDM
Colonization Screening					
ARUP	PCR ³	2014284	Antimicrobial Susceptibility – Surveillance Carbapenemase Gene Detection by PCR	Rectal swab	KPC, NDM, OXA-48, VIM, IMP
Mayo Clinic Laboratories	PCR ³	KNSRP	KPC (blaKPC) and NDM (blaNDM) Surveillance, PCR	Rectal swab	KPC, NDM
Mayo Clinic Laboratories	PCR ³	OVS RP	OXA-48-like (blaOXA-48-like) and VIM (blaVIM) Surveillance, PCR	Rectal swab	OXA-48-like, VIM

Key MDRO Prevention Measures

- Identify residents who are infected or colonized with MDROs
 - On admission and during stay
- Have good baseline infection control practices:
 - ✓ Hand hygiene
 - ✓ PPE
 - ✓ Environmental cleaning & disinfection
- Assess each resident over time and modify
- Communicate to other facilities about people with known MDROs at transfer^{1,2}

LOS ANGELES COUNTY
HEALTHCARE FACILITY TRANSFER FORM

Please use this form for all transfers of residents leaving the facility. This form is NOT meant to be used as a notice of admission.

Patient Name (Last, First, Middle) _____
Date of Birth: _____ Sex: _____ Transfer Date: _____
Sending Facility Name: _____

Consent to transfer (patient/next of kin) Yes No
If Yes, check:
 Contact Transfer Discharge
Check all MDRO personal protective equipment to be considered:
 Hand hygiene PPE Environmental cleaning & disinfection

From the patient, have any MDRO (prior drug resistant organisms) or other lab results for which the patient should be considered? (Include results for methicillin, vancomycin, rifampin, or "other") (attachable)
MDRO: _____ Status: Yes No
MDRO: _____ Status: Yes No
MDRO: _____ Status: Yes No
MDRO: _____ Status: Yes No
MDRO: _____ Status: Yes No
MDRO: _____ Status: Yes No
MDRO: _____ Status: Yes No
MDRO: _____ Status: Yes No
MDRO: _____ Status: Yes No
MDRO: _____ Status: Yes No

Please include lab results, with antimicrobial susceptibilities, available documentation with antibiotic therapy and dates, and any additional info.

CONTACT INFORMATION
Sending Facility Name: _____
Contact Name: _____ Contact Phone: _____
Contact Signature: _____ Date: _____

Available at <http://www.ph.lacounty.gov/healthcare-transfer>
Revised and approved by the Los Angeles County Healthcare Facility Transfer and Admission Practices Committee on 07/01/08

1. <http://publichealth.lacounty.gov/acd/InterfacilityTransfers.htm>

2. http://publichealth.lacounty.gov/acd/docs/LACDPH_TransferringGuidanceforMDROs.pdf

MDRO Infection Control Measures

	<i>C. auris</i>	<i>Acinetobacter</i>	Other MDRO (e.g., CRE)	<i>C. diff</i>	SARS-CoV-2
Good hand hygiene – ABHS preferred	X	X	X	Soap & water preferred	X
Transmission-based Precautions, single room if possible	X	X	X	X	+ respirator, eye protection
Thorough environmental cleaning and disinfection	Use List P agent	X	X	Use List K agent	Use List N agent (List P/List K agent OK)
Routine adherence monitoring	X	X	X	X	X
Cohorting of patients and healthcare personnel	X	X	X	X	X
Lab surveillance	X	X	X	X	X
Screening of high-risk contacts	X	X	X		X

*Including *Clostridioides difficile* (*C. diff*); ABHS=alcohol-based hand sanitizer; CRE=carbapenem-resistant Enterobacteriaceae



MDRO Investigations in LA County

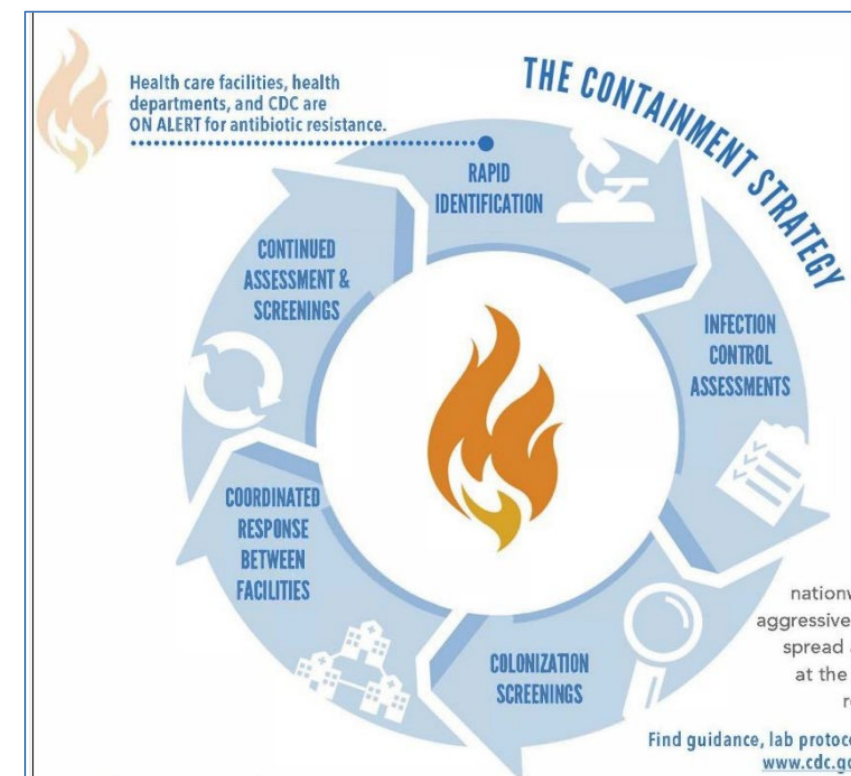


Novel and Targeted CPOs in LAC

LAC Pathogens by Tier

Tier	Description	Pathogens Included
1	Pathogens/resistance mechanisms never or very rarely detected in Los Angeles County (novel MDROs)	<ul style="list-style-type: none"> Novel organism and/or resistance mechanism Pan-resistant gram-negative organism¹
2	Pathogens/resistance mechanisms not commonly detected in Los Angeles County (targeted MDROs)	<ul style="list-style-type: none"> Concerning <i>C. auris</i>² Uncommon carbapenemase-producing <i>Acinetobacter</i> spp.³ Uncommon carbapenemase-producing Enterobacterales⁴
3	Pathogens/resistance mechanisms commonly detected in Los Angeles County but not <u>endemic</u>	<ul style="list-style-type: none"> Carbapenemase-producing <i>Pseudomonas</i> spp.⁵ NDM-producing <u>Enterobacterales</u>
4	Pathogens/resistance mechanisms endemic in Los Angeles County and/or less epidemiologically concerning	<ul style="list-style-type: none"> KPC-producing <u>Enterobacterales</u> <i>C. auris</i> OXA-23-like-producing <i>Acinetobacter</i> spp. Vancomycin-resistant <i>Staphylococcus aureus</i> Other MDROs not previously <u>listed</u>

1. CDC MDRO Containment Guidance: <https://www.cdc.gov/hai/mdro-guides/containment-strategy.html>
2. LACDPH NMDRO Tiers: http://publichealth.lacounty.gov/acd/docs/LACDPH_MDRO_TiersExternalGuidance.pdf



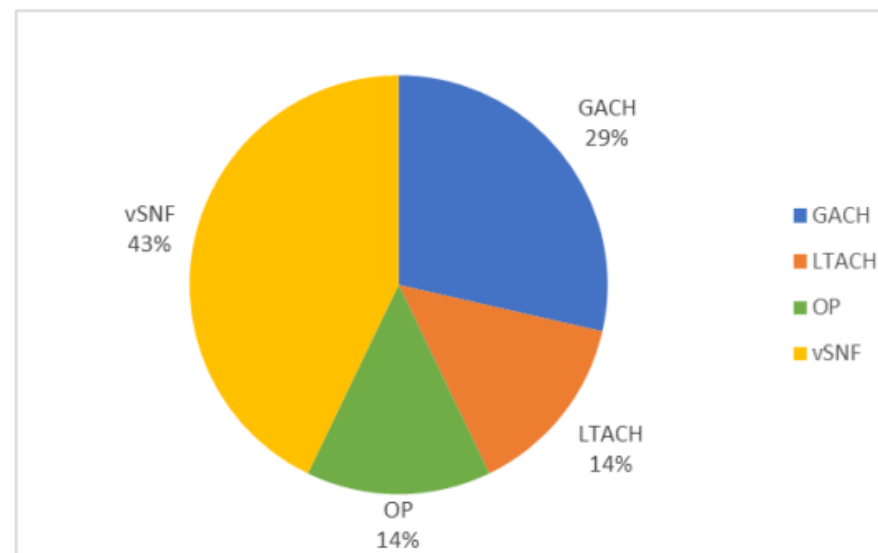
MDRO Outbreaks in LA County, 2022

Table 8. MDRO outbreaks by disease, 2022 (n=7)

MDRO	No. of outbreak	No. of cases	Cases per outbreak (average)	Cases per outbreak (range)
<i>C. auris</i>	6	45	7.5	4-14
CPPA	1	4	4	4

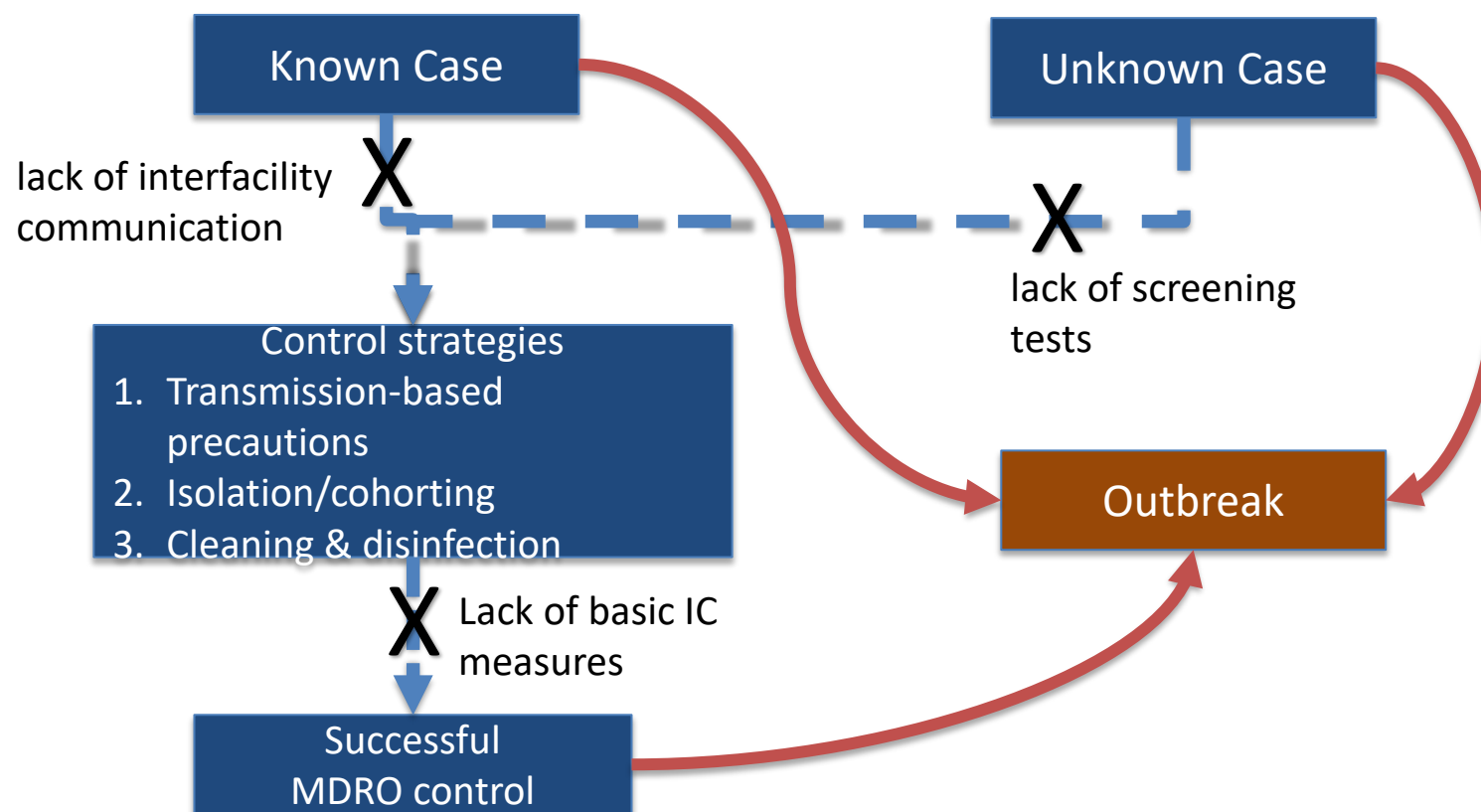
CPPA: carbapenemase-producing *P. aeruginosa*

Figure 2. MDRO Outbreaks by Setting Type, 2022 (n=7)



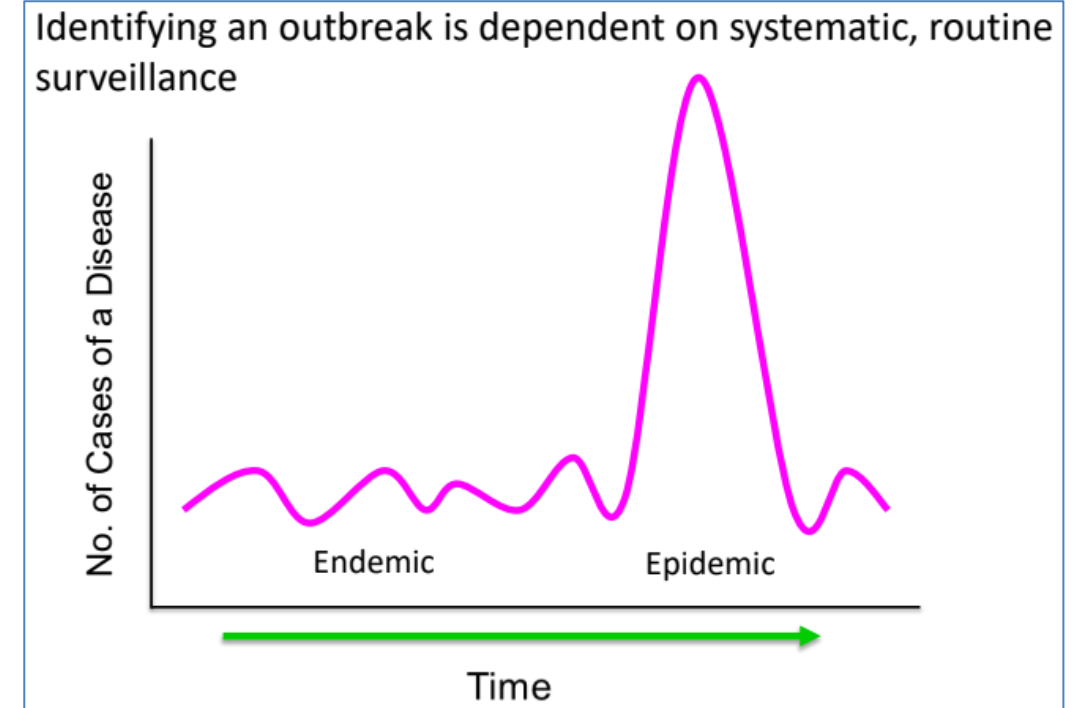
GACH= general acute care hospital; LTACH= long-term acute care hospital; OP= outpatient; vSNF= skilled nursing facility that provides ventilator care

Common causes of MDRO outbreaks in LA County



Determining when to open an outbreak

- Understand if this is “above the baseline”
 - Outbreak= the occurrence of more cases of disease than expected in a given area or group over a particular period of time
 - Cluster= the occurrence of many cases in a given area or group without regard to whether it is more than expected
- Determine if there are “epidemiological links”
 - Same exposure? What?



What to expect from LACDPH during an Investigation

What we will do:

- Reach out to provide guidance, resources, sample policies & templates
- Be available to answer any questions or concerns
- Recommend screening if transmission is suspected. Can provide testing via Public Health for wider screenings.
- Site visits to observe and improve IPC practices

What we will NOT do:

- Close facilities to admissions
- Conduct point prevalence surveys solely for the reason that you have *C. auris*/MDRO-positive residents admitted
- Open outbreaks unless transmission is above the baseline

What LACDPH expects of SNFs

1. Incorporate basic MDRO prevention practices
2. Conduct regular MDRO surveillance to assess when intervention needed
 - Include both colonized and infected cases
3. Implement a system to ensure adherence to IC measures
 - Audit and feedback as a team
4. Educate staff, patient, and visitors about MDROs and how to prevent transmission
5. Receive and communicate MDRO status during transfers
 - Flag medical records to initiate TBP upon future admissions

Investigation Steps for new HAI-MDRO

1

- Implement immediate control measures

2

- Determine if this needs to be reported to LACDPH/CDPH (see [Title 17](#) and [AFL 23-08](#))

3

- Determine possible cause/exposure
- Identify any epidemiologically-linked contacts (e.g., roommates)

4

- Screen epi-linked contacts for colonization (swab type depends on MDRO)
- LACDPH can assist with CPO and *C. auris* point prevalence surveys

5

- If additional cases found, report to LACDPH
- Implement additional control measures as needed

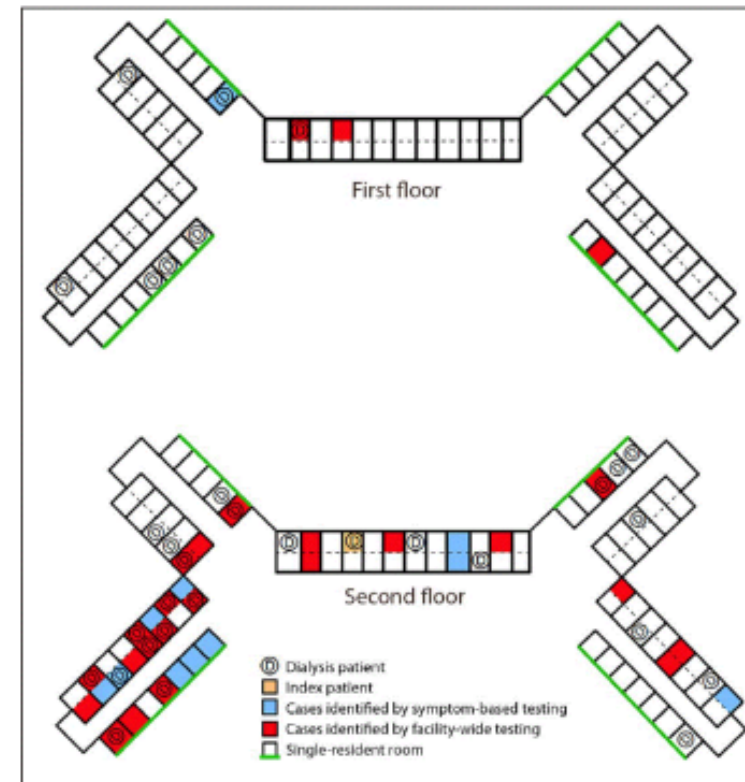
Understanding Colonization vs. contamination vs. infection

- **Colonization** is when microorganisms **live on us without causing disease**.
 - Coagulase negative staph, *Staph aureus*, *Candida*, etc.
 - May or may not be eradicable.
 - Ex. Skin swab grows Coag neg staph.
- **Contamination** is when colonizing bacteria show-up in cultures, but are not causing disease.
 - Does not require treatment.
 - Can be confused for infection & causes over-treatment.
 - Ex. *Candida* in urine culture.
- **Infection** is **when microbes invade** otherwise sterile sites and cause disease. Treatment usually provided.
 - Central line infection
 - UTI



Basic Elements of a MDRO Tracking Line List

- Room/bed #
- Resident name, DOB, gender
- Admission date(s)
- Organism(s) identified
- Specimen source
- Specimen collection date
- Signs and symptoms; date of onset
- Diagnoses





Sample scenarios



Sample Scenario #1

Situation

1. Resident in bed 201A tests positive for *C. auris* 15 days after admission
2. Has had ventilator since admission; located in subacute unit (SAU) with 2 roommates
3. All residents in room 201 were on enhanced standard precautions
4. SAU has been using an EPA List P agent for environmental cleaning and for shared equipment

What do you do?

Answers

- Report *C. auris* to LACDPH
- Swab roommates for *C. auris* colonization
- Isolate or cohort *C. auris*
- Verify compliance with HH, PPE, cleaning & disinfection protocols
- Educate staff and visitors
- Use transfer form when resident is discharged
- Flag resident's medical record

Sample Scenario #2

Situation

- IP notices 3 CRAB cases in September
- All from sputum
- All from long-term residents

What do you do?

Answers

- Determine if 3 CRAB is above the baseline
- If yes, reach out to LACDPH for further guidance
- Cohort cases together, if possible
- Verify compliance with HH, PPE, cleaning & disinfection protocols



Resources



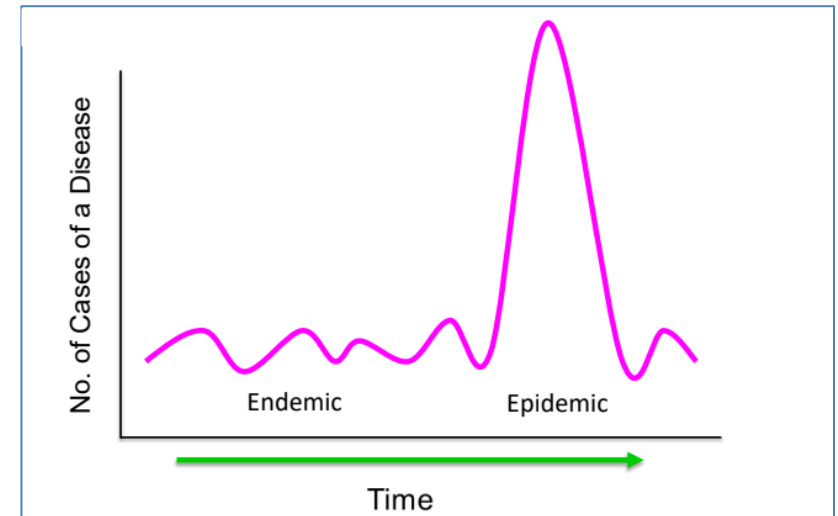


MDRO Resources

- CDPH CRE Quicksheet:
https://www.cdph.ca.gov/Programs/CHCQ/HAI/CDPH%20Document%20Library/CRE_QuicksheetOct2019.pdf
- CDPH CRAB, CRPA Quicksheet:
https://www.cdph.ca.gov/Programs/CHCQ/HAI/CDPH%20Document%20Library/CRO_Quicksheet_Oct2020.pdf
- LACDPH AR website: <http://publichealth.lacounty.gov/acd/AntibioticResistance.htm>
- CDC CRE website: <https://www.cdc.gov/hai/organisms/cre/cre-facilities.html>
- LACDPH *C. auris* website: <http://publichealth.lacounty.gov/acd/Diseases/CandidaAuris.htm>
- CDC *C. auris* website: <https://www.cdc.gov/fungal/candida-auris/c-auris-infection-control.html>
- CDPH SNF MDRO Cohorting Guidance:
<https://www.cdph.ca.gov/Programs/CHCQ/HAI/CDPH%20Document%20Library/MDROCohortingSNF.pdf>

LAC Multi-Drug Resistant OrgAnism Point-Prevalence SURvEy (MEASURE)

- Goal
 - Understand prevalence of CPOs in multiple healthcare facilities
 - Create a new “baseline”
 - Not to open outbreaks
- Participation
 - Single day point prevalence survey (PPS)
 - Free testing and supplies
 - On-site DPH assistance to pack and ship
 - Remove DPH assistance for MDRO infection control





FOR QUESTIONS
Contact us at hai@ph.lacounty.gov

