



Novel Multi-Drug Resistant Organisms (N-MDROs): How to Detect, Report, and Contain

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Basics of Infection Prevention Course

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Objectives

- Review novel and targeted multi-drug resistant organisms (MDROs)
- Describe the epidemiology of and response efforts to these MDROs
- Discuss the role of infection preventionists in detecting, reporting, and containing novel & targeted MDROs

Multi-drug resistant organisms (MDROs)

Antibiotic resistance—when germs (bacteria, fungi) develop the ability to defeat the antibiotics designed to kill them—is one of the greatest global health challenges of modern time.

New National Estimate*

Each year, antibiotic-resistant bacteria and fungi cause at least an estimated:



2,868,700
infections



35,900 deaths



*Clostridioides difficile*** is related to antibiotic use and antibiotic resistance:



223,900
cases



12,800 deaths

New Antibiotic Resistance Threats List

Updated urgent, serious, and concerning threats—totaling 18

5 urgent threats

2 new threats

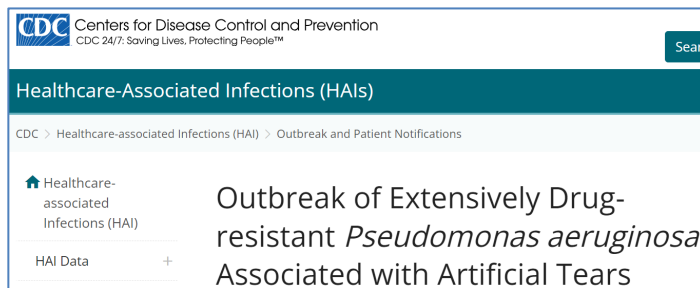
NEW!
Watch List with **3** threats

1. CDC 2019 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>

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 staff who did not perform hand hygiene
 - medical equipment that have not been correctly cleaned
- Some (CRPA) via contaminated water sources or products



The screenshot shows the CDC website interface. At the top, it says "CDC Centers for Disease Control and Prevention" with the tagline "CDC 24/7: Saving Lives. Protecting People™" and a search bar. Below this is a teal header for "Healthcare-Associated Infections (HAIs)". The breadcrumb trail reads "CDC > Healthcare-associated Infections (HAI) > Outbreak and Patient Notifications". A main heading reads "Healthcare-associated Infections (HAI)" with a home icon. Below this, there is a section titled "HAI Data" with a plus sign. The main content area displays the text: "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

Figure 1D: High risk cases.

High-risk cases were defined as any of the following: assistance for activities of daily living, ventilator-dependent, incontinent, wounds with unmanageable drainage, or unable to maintain hygiene.

67%
of N-MDRO cases
were considered "High Risk" patients



Figure 1E: High-risk setting.

High risk settings for N-MDRO transmission are SNFs or long-term acute care hospitals (LTACs). (6 months prior to culture collection date).

53%
of N-MDRO cases
have stayed in a high risk setting 6 months prior to
culture collection date



What “Novel” (or “Targeted”) MDRO Means

- MDROs that are:
 - Pre-endemic
 - Difficult to treat
 - Easy to spread
- Varies by region



LACDPH MDRO Tier Designation - 2023

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 endemic	<ul style="list-style-type: none"> Carbapenemase-producing <i>Pseudomonas</i> spp.⁵ NDM-producing Enterobacterales
4	Pathogens/resistance mechanisms endemic in Los Angeles County and/or less epidemiologically concerning	<ul style="list-style-type: none"> KPC-producing Enterobacterales <i>C. auris</i> OXA-23-like-producing <i>Acinetobacter</i> spp. Vancomycin-resistant <i>Staphylococcus aureus</i> Other MDROs not previously listed



Increasing
DPH
follow-up

1. Resistant (R) to all drugs tested at public health laboratories (including CDC)

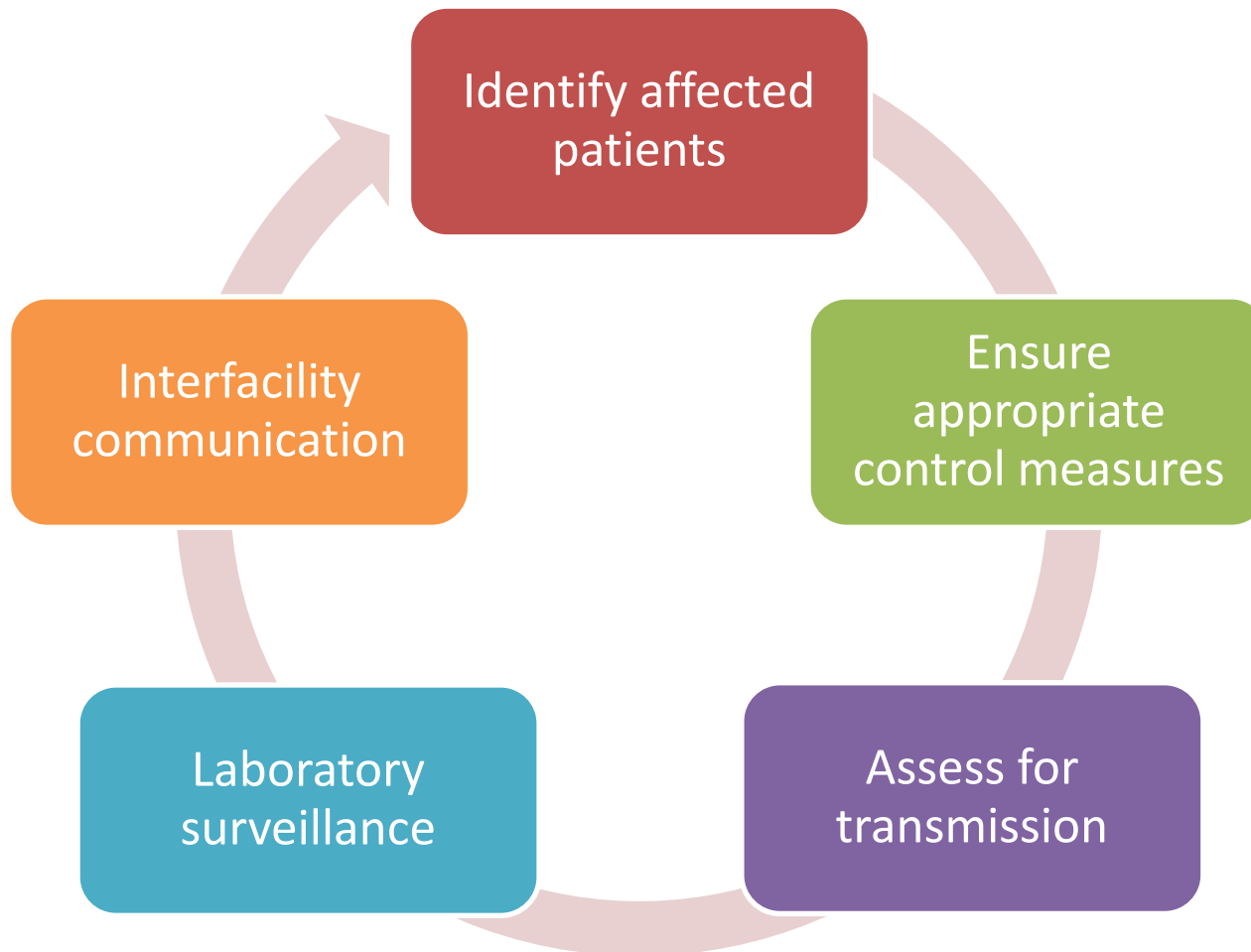
2. Including echinocandin- or pan-resistant *C. auris*

3. Including NDM-, IMP-, VIM-, and KPC-producing *Acinetobacter* spp.

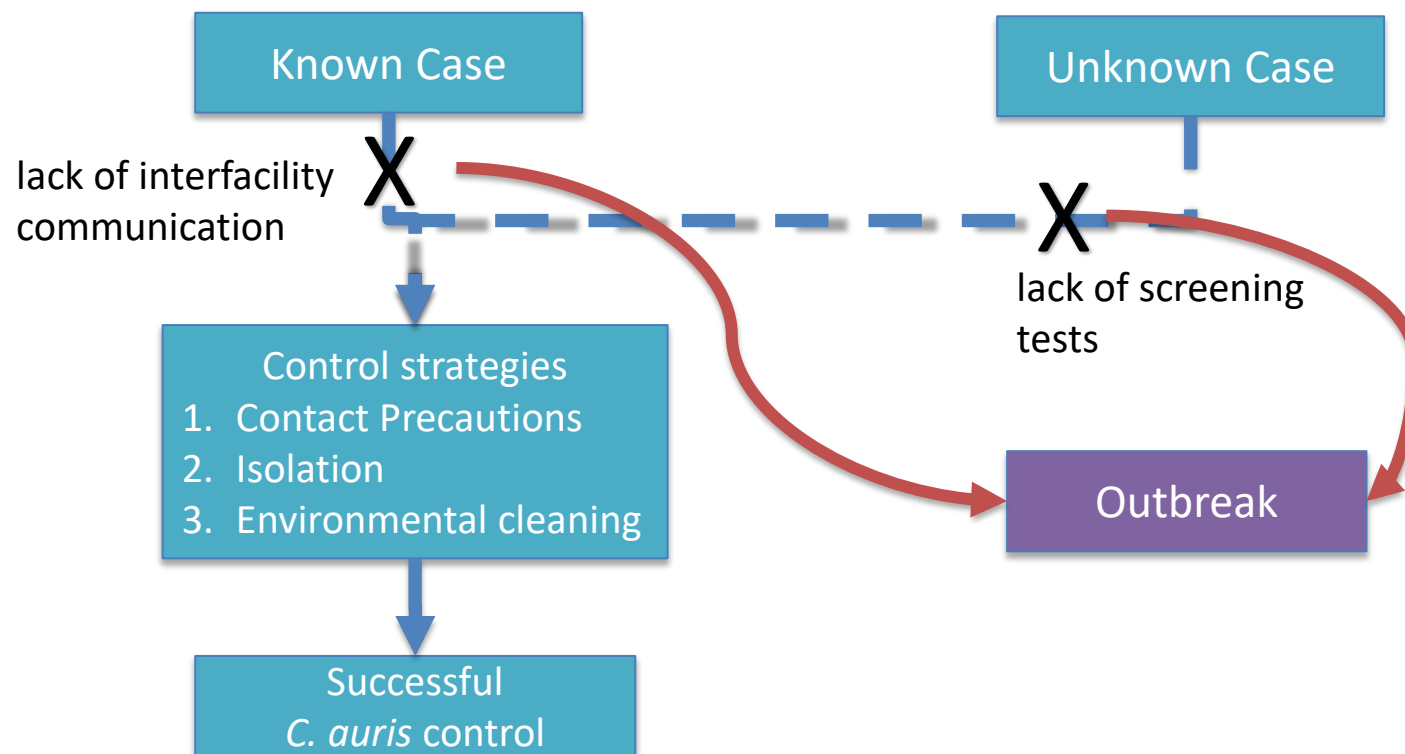
4. Including IMP-, VIM-, and OXA-like producing Enterobacterales

5. Including VIM-, IMP-, NDM-, KPC-, and OXA-like producing *Pseudomonas* spp.

MDRO Containment and Prevention Approach



Common causes of *C. auris* outbreaks in LA County healthcare facilities (2020-2023)



Need for a Coordinated Approach to Stop Spread

Facilities work together to protect patients.

Common Approach *(Not enough)*

- Patients can be transferred back and forth from facilities for treatment without all the communication and necessary infection control actions in place.

Independent Efforts *(Still not enough)*

- Some facilities work independently to enhance infection control but are not often alerted to antibiotic-resistant or *C. difficile* germs coming from other facilities or outbreaks in the area.
- Lack of shared information from other facilities means that necessary infection control actions are not always taken and germs are spread to other patients.

Coordinated Approach *(Needed)*

- Public health departments track and **alert** health care facilities to antibiotic-resistant or *C. difficile* germs coming from other facilities and outbreaks in the area.
- Facilities and public health authorities share information and implement shared infection control actions to stop spread of germs from facility to facility.





HOW TO DETECT





RARE CPOs



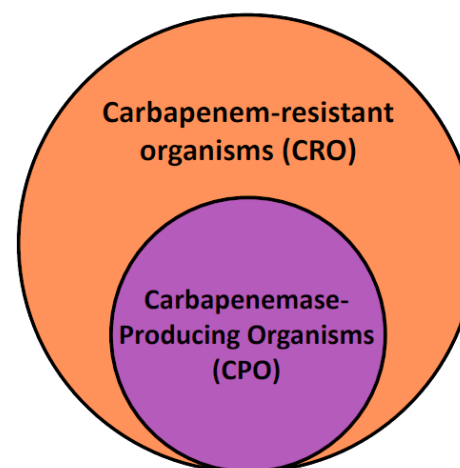
CPO vs Carbapenem-resistant Organisms (CROs)

- **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)
- Regardless of having a carbapenemase or not

- **CPO= carbapenemase-producing organism**

- Organism that produces a carbapenemase enzyme
 - KPC, IMP, NDM, OXA, VIM
- This is one way organisms become CR
- *Examples: KPC-producing CRE, VIM-producing CRPA*





CPOs Epidemiology in LA County (2017-2022)





Laboratory testing for CROs and CPOs

- Labs must perform specific testing to look for CPOs
- Approximately 30% of LA County hospitals do this testing

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:

```
*****
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.
```



LACDPH CPO Surveillance Recommendations

- Admission screening for patients:
 - With recent international healthcare exposure
 - Admitted from high-risk facilities¹
 - Admitted from facilities with outbreaks
- Clinical testing
 - Encourage carbapenemase testing for CROs²

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

2. https://www.cdph.ca.gov/Programs/CHCQ/HAI/CDPH%20Document%20Library/CPO_webinar_102722.pdf

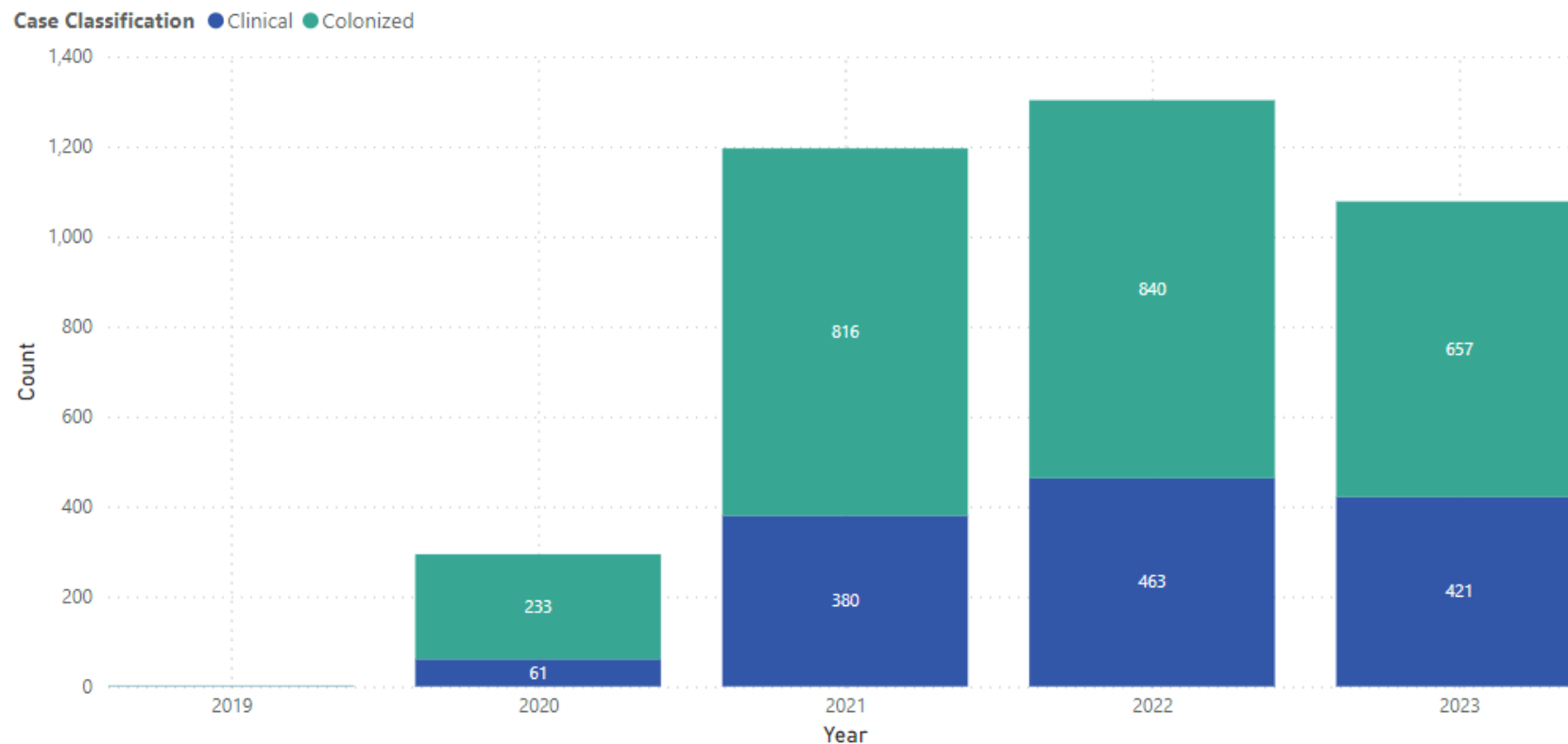


CANDIDA AURIS





Candida auris Epidemiology in LAC (2019-2022)





C. auris Susceptibility Profile in LA County

Table 9. Minimum Inhibitory Concentrations (MICs) and resistance (R) of clinical C. auris isolates to antifungal agents, Los Angeles County isolates, June 2020-Sept 2021 (N=36)

Antifungals		% R	Minimum Inhibitory Concentration (µg / mL) MIC at or above tentative breakpoint values in red*														
Class	Drug		0.03	0.06	0.12	0.25	0.5	1	2	4	8	16	32	64	128	256	>256
Polyenes	Amphotericin B (n = 35)	2.8%				3 (8.6%)	25 (71.4%)	6 (17.1%)	1 (2.9%)								
Echinocandins	Anidulafungin (n = 35)	0.0%	1 (2.9%)	6 (17.1%)	8 (22.9%)	9 (25.7%)	9 (25.7%)	1 (2.9%)	1 (2.9%)								
	Caspofungin (n = 35)	0.0%	4 (11.4%)	10 (28.6%)	13 (37.1%)	7 (20.0%)	1 (2.9%)										
	Micafungin (n = 31)	0.0%	1 (3.2%)	9 (29.0%)	13 (41.9%)	6 (19.4%)	2 (6.5%)										
Azoles	Fluconazole (n = 35)	100%											1 (2.9%)	3 (8.6%)	25 (71.4%)	6 (17.1%)	
	Itraconazole [†] (n = 35)	N/A			4 (11.4%)	11 (31.4%)	19 (54.3%)	1 (2.9%)									
	Posaconazole [†] (n = 35)	N/A		8 (22.9%)	14 (40.0%)	11 (31.4%)	2 (5.7%)										
	Voriconazole [†] (n = 35)	N/A						5 (14.3%)	28 (80.0%)	2 (5.7%)							
	Isavuconazole [†] (n = 35)	N/A		2 (5.7%)	17 (48.6%)	14 (40.0%)	2 (5.7%)										

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)



LACDPH *C. auris* Surveillance Recommendations

- Admission screening for patients:
 - Admitted from high-risk facilities¹
 - Admitted from facilities with outbreaks
- Clinical testing
 - Consider additional passive surveillance
 - E.g., identifying all yeast to the species level from sterile sites
 - Recommend to perform antifungal susceptibility testing (AST), especially when *C. auris* causing infection

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



HOW TO REPORT



LACDPH MDRO Reporting Requirements

1 MDRO Reporting Overview

Organism	Disease categories	Criteria	Who reports
<i>Candida auris</i> (<i>C. auris</i>)	<i>C. auris</i>	<i>Candida auris</i>	Lab and provider
Carbapenem-resistant Enterobacterales (CRE)*	CRE	Enterobacterales that are resistant to one or more carbapenems (independent of any carbapenemase testing)	Provider only
	CP-CRE	<ul style="list-style-type: none"> • Carbapenemase positive (CP)-CRE by phenotypic or molecular test OR • Carbapenemase unknown (no carbapenemase test performed) 	Lab only
Carbapenemase-producing <i>Acinetobacter baumannii</i>	CP- <i>Acinetobacter</i> spp.	<i>Acinetobacter</i> spp. positive for carbapenemase by phenotypic or molecular test	Lab only
Carbapenemase-producing <i>Pseudomonas aeruginosa</i>	CP- <i>P. aeruginosa</i>	<i>P. aeruginosa</i> positive for carbapenemase by phenotypic or molecular test	Lab only
Vancomycin-resistant <i>Staphylococcus aureus</i> (VRSA)	VRSA	<i>S. aureus</i> with a vancomycin MIC ≥ 16	Lab only
Pan-resistant organisms (Suspect PDR)	Suspect PDR	Gram negative bacteria that are non-susceptible to all antibiotics tested	Lab only

**E. coli*, *Klebsiella oxytoca*, *Klebsiella pneumoniae*, *Enterobacter* spp.

Hospitals should report results for all CRE (including CP-CRE) in NHSN





MDRO Reporting Portal

LACDPH MDRO Reporting Portal

Laboratories and providers in Los Angeles County (LAC) may submit reports of multi-drug resistant organisms (MDROs) [reportable](#) to the Department of Public Health (DPH) using this survey. We will collect information as relevant to the organism being reported. Additional guidance on reporting instructions can be found on our [CRE](#) and [novel MDRO](#) websites.

You may save and continue your work at any time. At the end of the survey, you will receive a record ID number and option to send yourself a confirmation email. You will not be allowed to modify answers once submitted.

If you have any questions or concerns, please email us at hai@ph.lacounty.gov.

Organism Reported

Which organism is being reported?
** must provide value*

- Carbapenem-resistant Enterobacteriales (CRE)
- Carbapenem-resistant Pseudomonas aeruginosa (CRPA)
- Carbapenem-resistant Acinetobacter baumannii (CRAB)
- Candida auris (C. auris)
- Vancomycin-resistant Staphylococcus aureus (VRSA)
- Pan-resistant gram-negative organism
- Other (specify)

reset

Facility Information

Where are you reporting from?
** must provide value*

- Hospital
- Skilled Nursing Facility
- Reference Laboratory
- Other (specify)

reset






Labs can report via REDCap if ELR not set up: redcap.link/LACMDROPortal



HOW TO CONTAIN



LAC Novel MDRO Response

- Upon receipt of a Tier 1-3 MDRO, LACDPH will work with HCFs to:
 -  Conduct initial assessment of affected facility to ensure patient is on appropriate level of precautions (Contact vs. Enhanced Standard)
 -  Determine patient status and risk for transmission
 -  Identify whether transmission may have occurred
 -  Educate facility staff on how to prevent transmission
 -  Ensure communication of patient infection/colonization status



Assessment

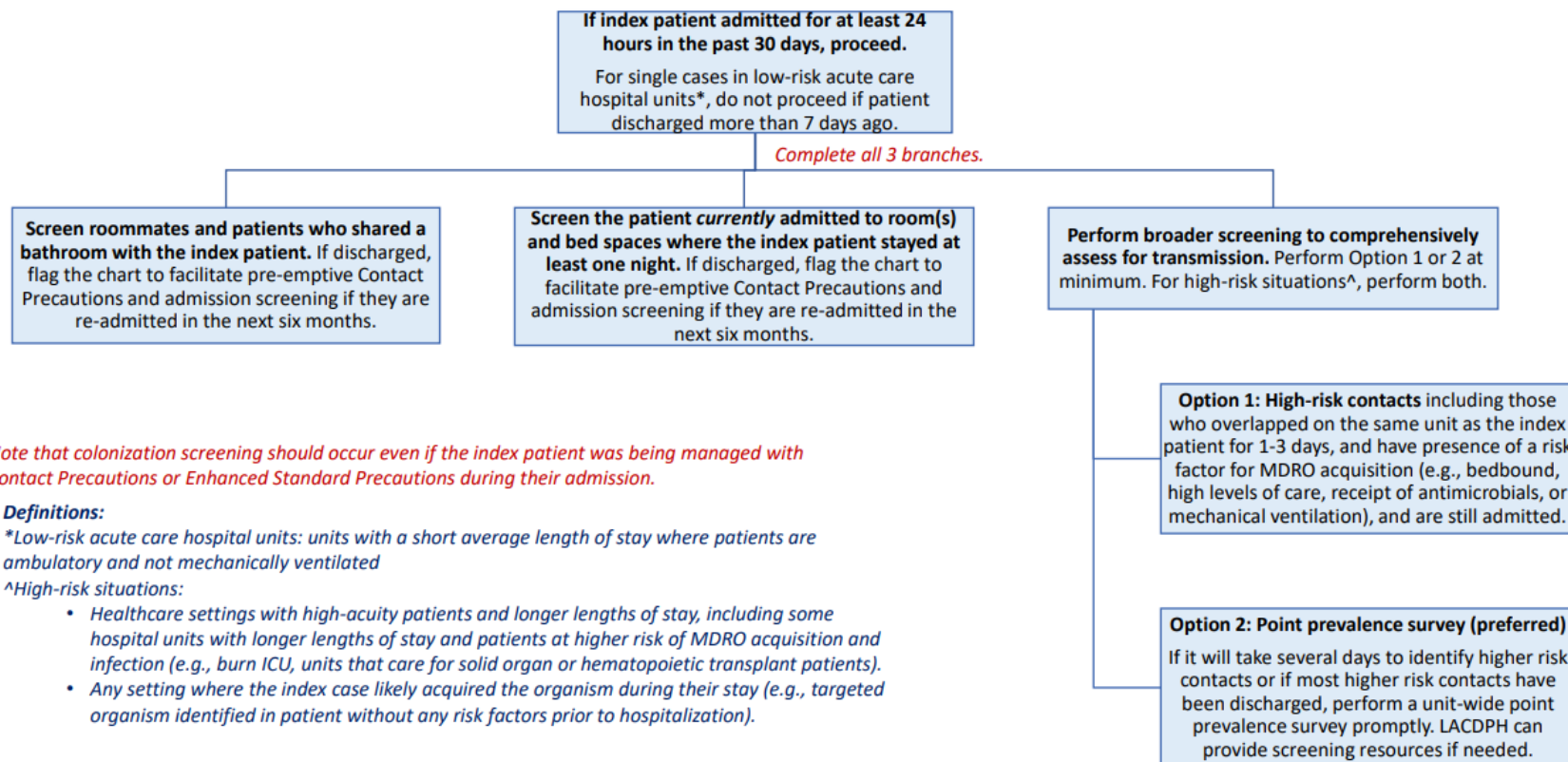
- Determine whether patient was on appropriate TBP
- What type of unit(s) was the patient on?
- Is staff adherence to infection control practices high?
- Are staff using appropriate disinfectants?
- What is your baseline MDRO rate?



Screening

- Work to identify additional colonized cases
- Generally, identify those at highest risk for transmission
 - Shared same room/unit
 - Shared same staff
 - Had same procedure
- Regardless of whether patients were on Contact Precautions or not

Screening algorithm (example)



Note that colonization screening should occur even if the index patient was being managed with Contact Precautions or Enhanced Standard Precautions during their admission.

Definitions:

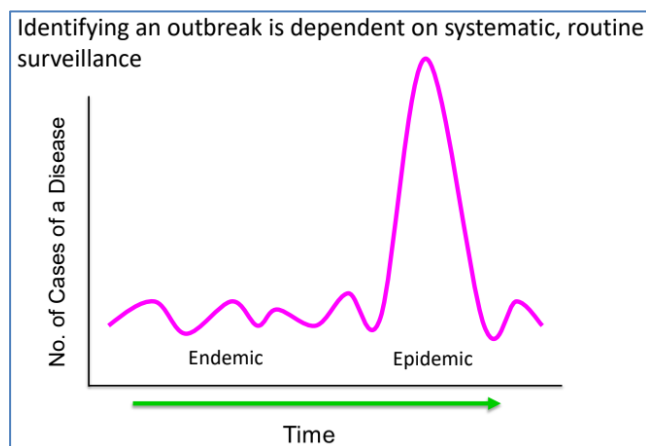
*Low-risk acute care hospital units: units with a short average length of stay where patients are ambulatory and not mechanically ventilated

^High-risk situations:

- Healthcare settings with high-acuity patients and longer lengths of stay, including some hospital units with longer lengths of stay and patients at higher risk of MDRO acquisition and infection (e.g., burn ICU, units that care for solid organ or hematopoietic transplant patients).
- Any setting where the index case likely acquired the organism during their stay (e.g., targeted organism identified in patient without any risk factors prior to hospitalization).

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”





HOW TO PREVENT





Key MDRO Prevention Measures

- Identify residents who are infected or colonized with MDROs
- Implement appropriate transmission-based precautions
 - Hospitals: Contact Precautions
 - Dialysis: Standard Precautions
- Have good baseline infection control practices:
 - ✓ Hand hygiene
 - ✓ PPE
 - ✓ Environmental cleaning & disinfection
- Communicate MDRO status upon transfer^{1,2}
- Conduct regular MDRO surveillance

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

Slide courtesy of CDPH

It Takes a TEAM to Detect, Report, Contain, and Prevent Novel MDROs

- Infection Preventionists
- Laboratorians
- Clinicians
- Pharmacists
- Nurses





Actions for Infection Preventionists

- Identify colonized and infected residents in the facility
 - Conduct screening when transmission is suspected
- Ensure appropriate precautions are strictly adhered to
- Maintain adherence to basic infection control practices
- Work with EVS to ensure thorough cleaning & disinfection practices
- Educate staff on
- Flag medical records for future admissions



Actions for Case Managers

- Review medical records for MDROs
- Understand MDRO status upon admission
 - Determine whether screening indicated
 - Determine type of transmission based precautions
- Clearly communicate patient's current status



Actions for Microbiologists

- Determine if your lab can identify novel MDROs
 - Our Public Health Lab can provide guidance and/or free testing services, if needed
- Consider admission screening for CPOs and *C. auris*
- Immediately alert clinical and infection prevention staff when novel MDROs are suspected/identified
- Ensure lab reports easy to read, and suppress unnecessary information

Actions for Clinicians & Pharmacists

- Ensure timely, appropriate antibiotic therapy for infections
- Look for novel agents but ensure they are **ONLY** used when needed
 - Public Health can assist with expanded AST for CRE if needed
- Track facility and community antibiotic resistance rates
 - LA County Regional Antibioqram – now a dashboard!
<http://publichealth.lacounty.gov/acd/AntibiogramData.htm>

Antibiogram Dashboard of Los Angeles County Hospitals
Last refreshed: September 27, 2022

Year: 2020

Organism: All

Antimicrobial Agent: All

Facility Type: Select all

Region: County-Wide

Total Hospitals Reporting¹ in 2020: **81**

Hospitals Reporting Selected Organism-Antimicrobial Agent(s): **81**

Antimicrobial Agent	Organism	Region	Isolates Tested ²	Hospitals Reported	Susceptibility (%) ² (IQR)	Change in Susceptibility (%) ³
Amikacin	Acinetobacter baumannii	County-Wide	1,888	51	35% (25%, 67%)	-16%
Amikacin	Citrobacter freundii	County-Wide	2,614	59	100% (100%, 100%)	-0%
Amikacin	Citrobacter koseri	County-Wide	929	45	100% (100%, 100%)	-0%
Amikacin	Enterobacter cloacae complex	County-Wide	6,523	66	99% (100%, 100%)	0%
Amikacin	Enterobacter spp.	County-Wide	161	11	99% (100%, 100%)	-0%
Amikacin	Escherichia coli	County-Wide	170,120	79	99% (99%, 100%)	-0%
Amikacin	Klebsiella (Enterobacter) aerogenes	County-Wide	4,856	65	99% (100%, 100%)	-1%
Amikacin	Klebsiella oxytoca	County-Wide	4,304	63	98% (100%, 100%)	-1%
Amikacin	Klebsiella pneumoniae	County-Wide	31,708	79	97% (92%, 99%)	0%
Amikacin	Morganella morganii	County-Wide	3,470	65	97% (99%, 100%)	1%

Click here to reset filters



Actions for Nurses

- Assist with screening upon admission (e.g., ask if a resident has received medical care outside the US in the past 12 months)
- Wear a gown and gloves when caring for residents with MDROs
- Perform hand hygiene ALWAYS: use alcohol-based hand rub or wash hands with soap and water before and after contact with the patient or their environment
- Discontinue devices (i.e., catheters) as soon as no longer necessary
- Alert the receiving facility when you transfer an MDRO-positive resident







Actions for Dialysis Centers

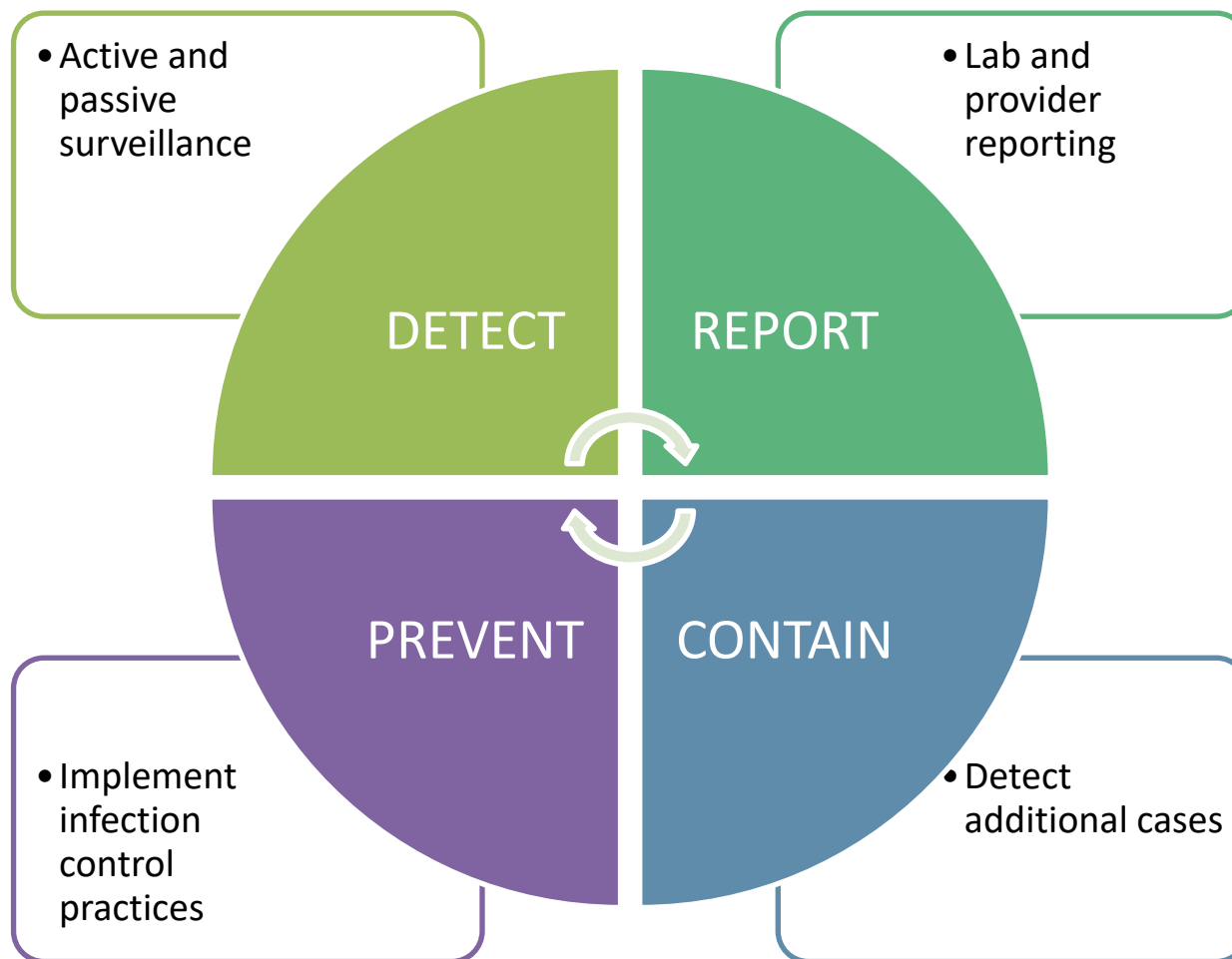
- Educate staff about MDROs and prevention measures
- Audit and improve adherence to basic control measures:
 - Hand hygiene
 - Wearing gowns and gloves
 - Cleaning and disinfecting reusable equipment
- Receive and send patient's MDRO status



Inter-facility Communication is VITAL

LOS ANGELES COUNTY HEALTHCARE FACILITY TRANSFER FORM		Place patient label here.
Please use this form for ALL transfers to admitting facility. This form is NOT meant to be used as criteria for admission.		
Patient Name (Last, First):		
Date of Birth:	MRN:	Transfer Date:
Receiving Facility Name:		
	Currently in Isolation Precautions? <input type="checkbox"/> Yes If Yes, check: <input type="checkbox"/> Contact <input type="checkbox"/> Droplet <input type="checkbox"/> Airborne Check all PPE (personal protective equipment) to be considered:  <input type="checkbox"/>  <input type="checkbox"/>  <input type="checkbox"/>	<input type="checkbox"/> No isolation precautions
	Organisms Does the patient have any MDROs (multi-drug resistant organisms) or other lab results for which the patient should be in isolation? Please include any infection, colonization, history, or "rule-out" communicable diseases.	
<i>C. difficile</i> <input type="checkbox"/> Date: _____		
CRE (Carbapenem-resistant Enterobacteriaceae such as: <i>Klebsiella</i> , <i>Enterobacter</i> or <i>E. coli</i>) <input type="checkbox"/> Date: _____		
MDR gram negatives (such as: <i>Acinetobacter</i> , <i>Pseudomonas</i> , etc.) <input type="checkbox"/> Date: _____		
ESBL (extended-spectrum beta lactam resistant such as: <i>E. coli</i> , <i>Klebsiella</i>) <input type="checkbox"/> Date: _____		
VRE (vancomycin-resistant <i>Enterococcus</i>) <input type="checkbox"/> Date: _____		
MRSA (methicillin-resistant <i>Staphylococcus aureus</i>) <input type="checkbox"/> Date: _____		
Other: _____ <input type="checkbox"/> Date: _____ <small>Such as: lice, scabies, disseminated shingles, norovirus, flu, TB, etc.</small>		
Please include lab results with antimicrobial susceptibilities, medication documentation with antibiotic therapy end dates, and any additional info.		
CONTACT INFORMATION		
Sending Facility Name:		
Contact Name:	Contact Phone:	
Contact Signature: _____	Date: _____	
Available at http://www.ph.lacounty.gov/acd/HCPmaterials.htm Finalized and approved by the Los Angeles County Healthcare-Associated Infections and Antimicrobial Resistance Committee on 12-13-16.		

MDRO CONTAINMENT AND PREVENTION





Remember...

- **When in doubt, always contact us!**
 - HOU Email: hai@ph.lacounty.gov
 - HOU website: publichealth.lacounty.gov/acd/HOU/index.htm
- **Additional Resources:**
 - LACDPH MDRO Website:
<http://publichealth.lacounty.gov/acd/Diseases/MDRO.htm>
 - CDPH Antimicrobial Resistance Website:
<https://www.cdph.ca.gov/Programs/CHCQ/HAI/Pages/AntimicrobialResistanceLandingPage.aspx>
 - CDC *C. auris* Infection Control Website:
<https://www.cdc.gov/fungal/candida-auris/c-auris-infection-control.html>
 - CDC CRE website: <https://www.cdc.gov/hai/organisms/cre/index.html>



Questions?





- What are your challenges or concerns with MDROs?