Wastewater surveillance for *C. auris*: a novel tool for early detection in the community?

Alessandro Rossi, Ph.D., D (ABMM)

CLIA Director and ID Chief

Utah Public Health Laboratory

Utah Department of
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C. auris, a growing threat

It causes serious infections. *C. auris* can cause bloodstream infections and even death, particularly in hospital and nursing home patients with serious medical problems. More than 1 in 3 patients with invasive *C. auris* infection (for example, an infection that affects the blood, heart, or brain) die.

It's often resistant to medicines. Antifungal medicines commonly used to treat *Candida* infections often don't work for *Candida auris*. Some *C. auris* infections have been resistant to all three types of antifungal medicines.

It's becoming more common. Although *C. auris* was just discovered in 2009, it has spread quickly and caused infections in more than a dozen countries.

It's difficult to identify. *C. auris* can be misidentified as other types of fungi unless specialized laboratory technology is used. This misidentification might lead to a patient getting the wrong treatment.

It can spread in hospitals and nursing homes. *C. auris* has caused outbreaks in healthcare facilities and can spread through contact with affected patients and contaminated surfaces or equipment. Good hand hygiene and cleaning in healthcare facilities is important because *C. auris* can live on surfaces for several weeks.

https://www.cdc.gov/fungal/diseases/candidiasis/pdf/Candida_auris_508.pdf

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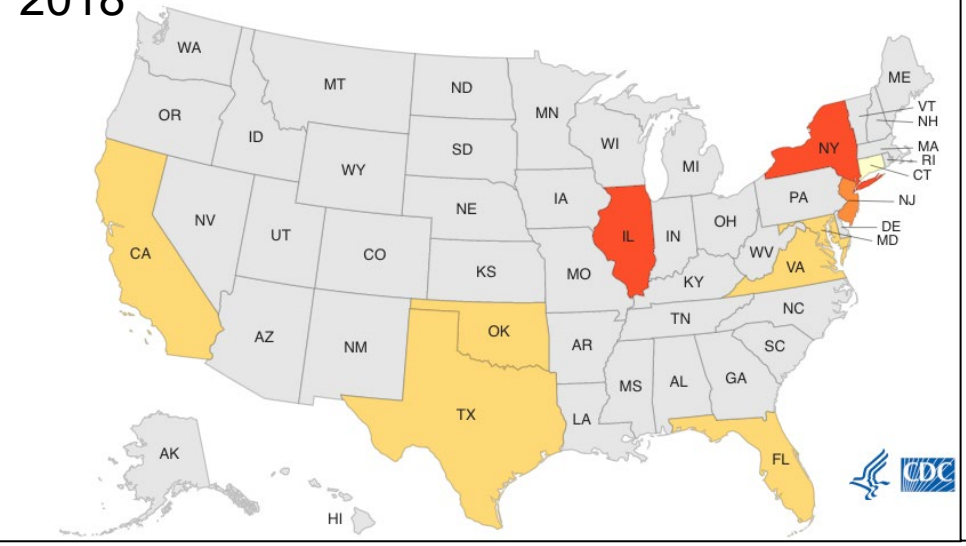
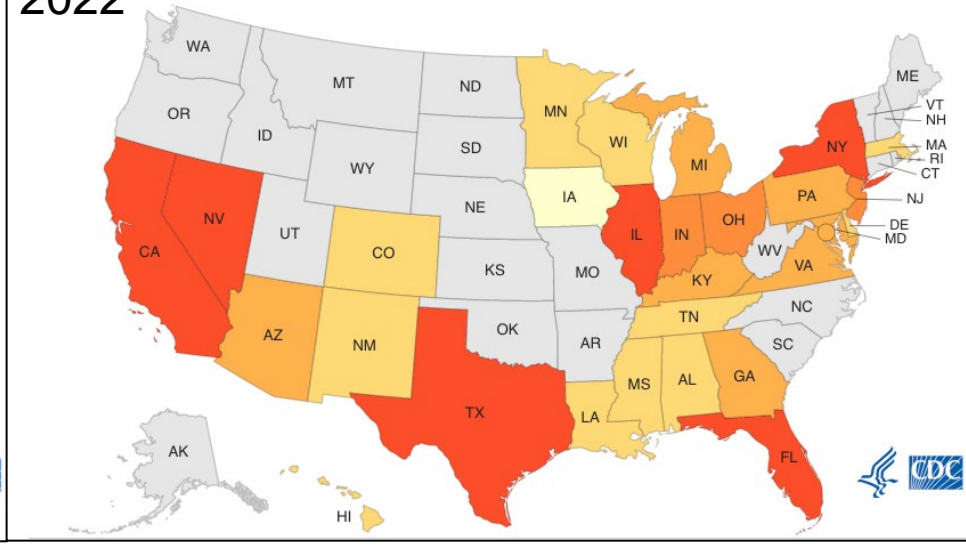
C. auris, a growing threat

2018



2022



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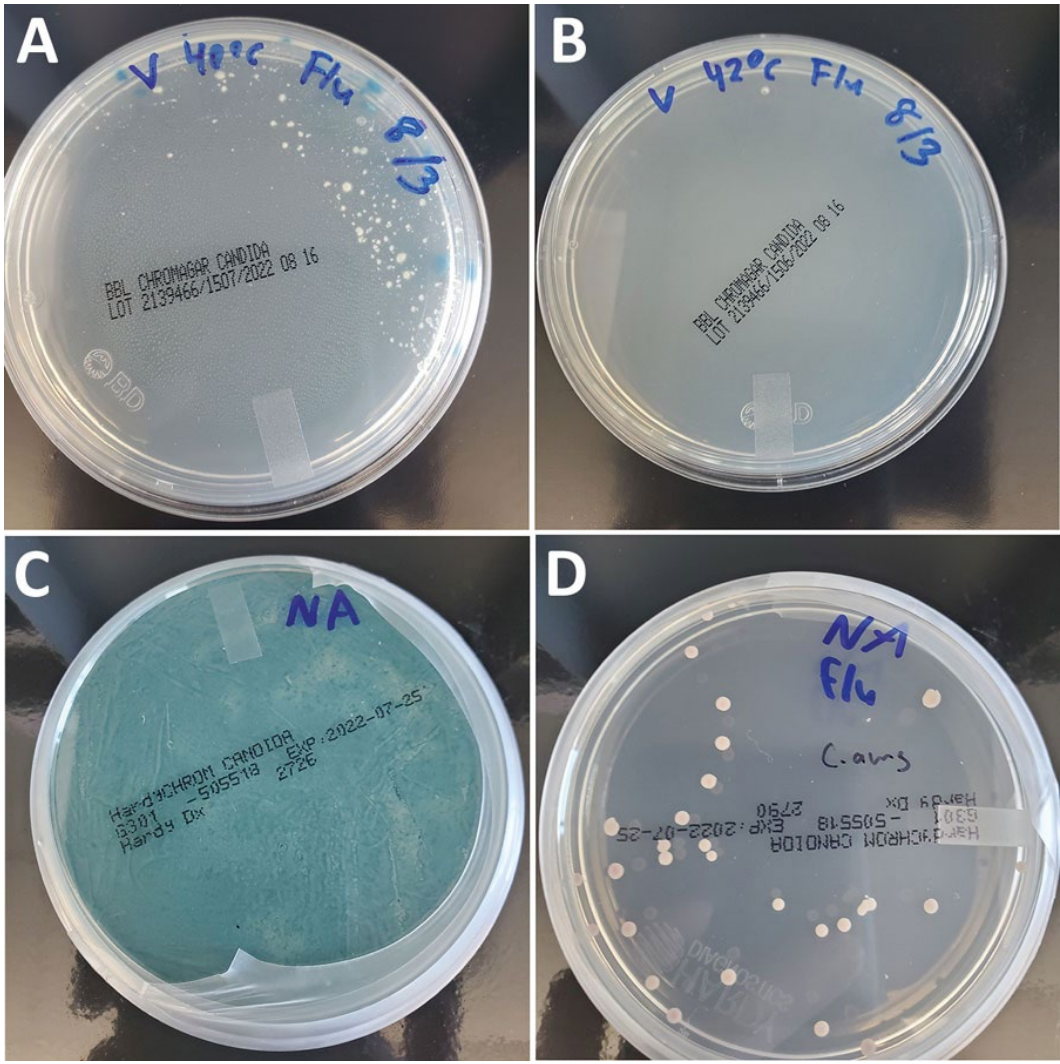
Culture-based detection of *C. auris* in wastewater

- Pellet 50 mL wastewater
- 1 mL 0.9% Saline
- 100 µl into Salt Sabouraud Dulcitol Broth (SSDB)

+ 8-32 µg/mL fluconazole

- 2 to 7 days at 42˚C
- Plate on HardyCHROM™ Candida
- MALDI-TOF identification



Candida auris discovery through community wastewater surveillance during healthcare outbreak, Nevada, USA, 2022. Emerging Infectious Diseases, 2023;29(2):422-425

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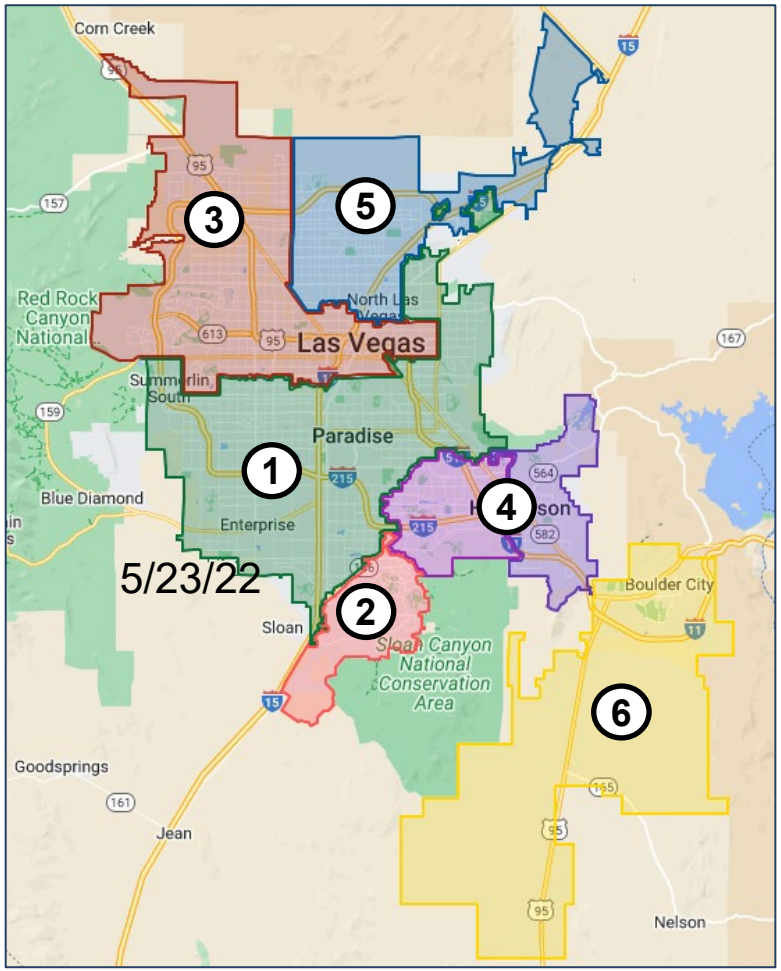
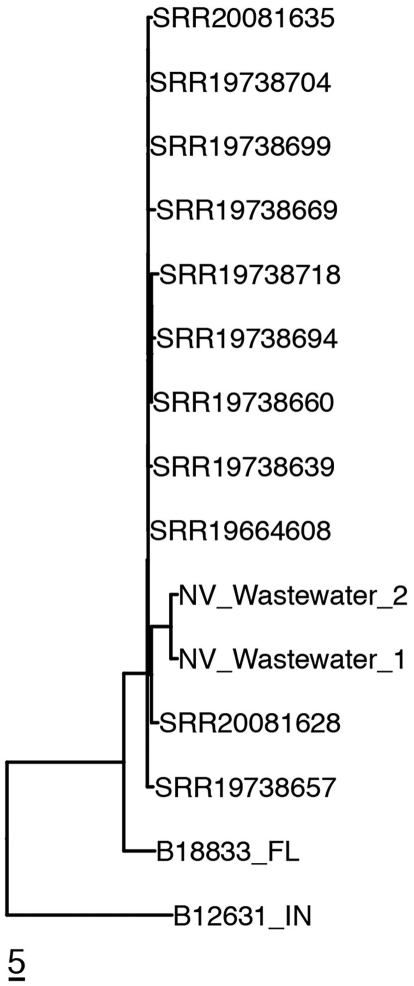
Genetic relatedness of clinical and wastewater *C. auris* isolates

Map, courtesy of Casey Barber (SNWA)





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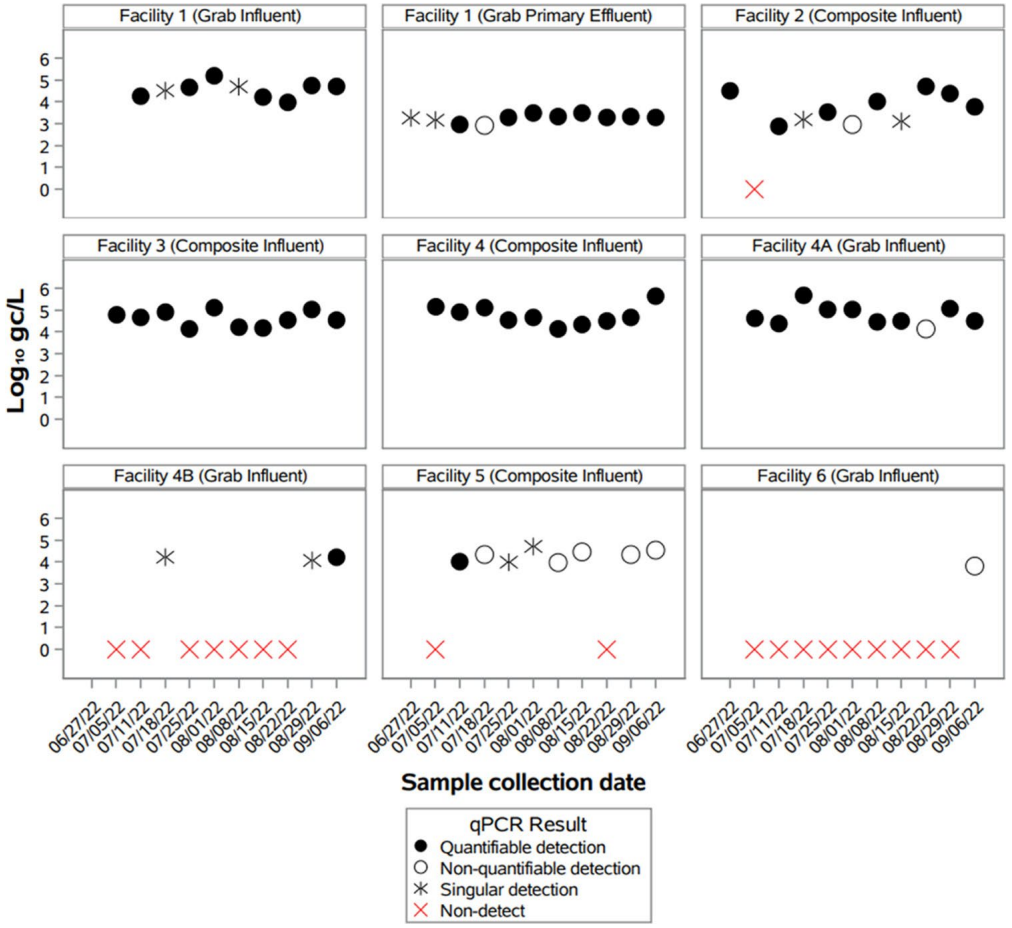
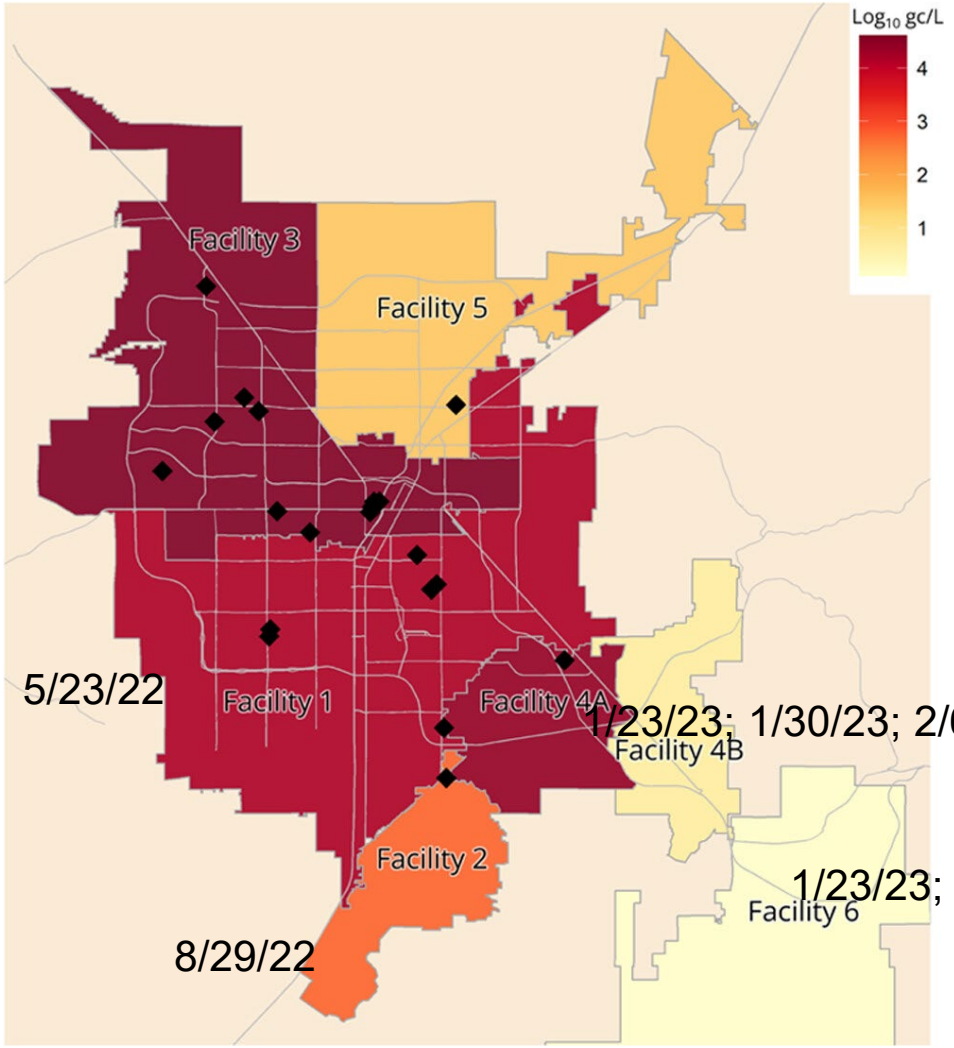
Prospective monitoring by culture/PCR

Sample source	Sample Source2	Starting Volume	Expected Concentration of C. auris	Observed Concentration of C. auris
Utah	Influent Wastewater	50 mL	7.6 $\log_{10}$ gc/L (1000 CFU/mL)	7.6 $\log_{10}$ gc/L
Utah	Influent Wastewater	50 mL	6.6 $\log_{10}$ gc/L (100 CFU/mL)	6.7 $\log_{10}$ gc/L
Utah	Influent Wastewater	50 mL	5.6 $\log_{10}$ gc/L (10 CFU/mL)	6 $\log_{10}$ gc/L
Utah	Influent Wastewater	50 mL	0 $\log_{10}$ gc/L (0 CFU/mL)	0 $\log_{10}$ gc/L



Barber et al. Environ. Sci. Technol. 2023, 57, 4, 1755–1763

Culture-based detection of *C. auris* in NV wastewater



Ongoing efforts to improve the culture method:

1) Inclusion of additional selective agents (explored cyclosporin A)
2) Filter large quantity of wastewater (in process)

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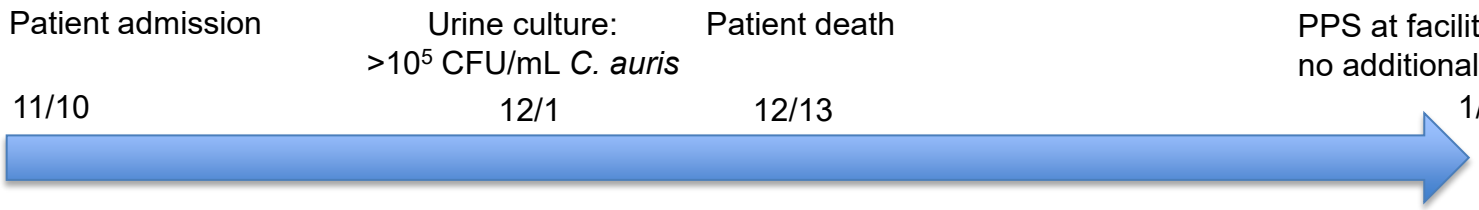
Barber et al. Environ. Sci. Technol. 2023, 57, 4, 1755–1763

1st documented *C. auris* case in St. George, UT



	11/8	11/15	11/29	12/6	12/13	1/9
WWTP PCR:	ND	ND	<LoQ*	<LoQ	<LoQ	<LoQ

1/24
$10^{4.91}$ gc/L
1/31
$10^{5.51}$ gc/L
2/7*
<LoQ

St George's sewershed size: 92,047 people

*LoQ: ≥ 2 replicates at < 33.03 Ct
For average ESV ($10^{3.92}$ gc/L)

*Cedar City WWTPs PCR Neg.

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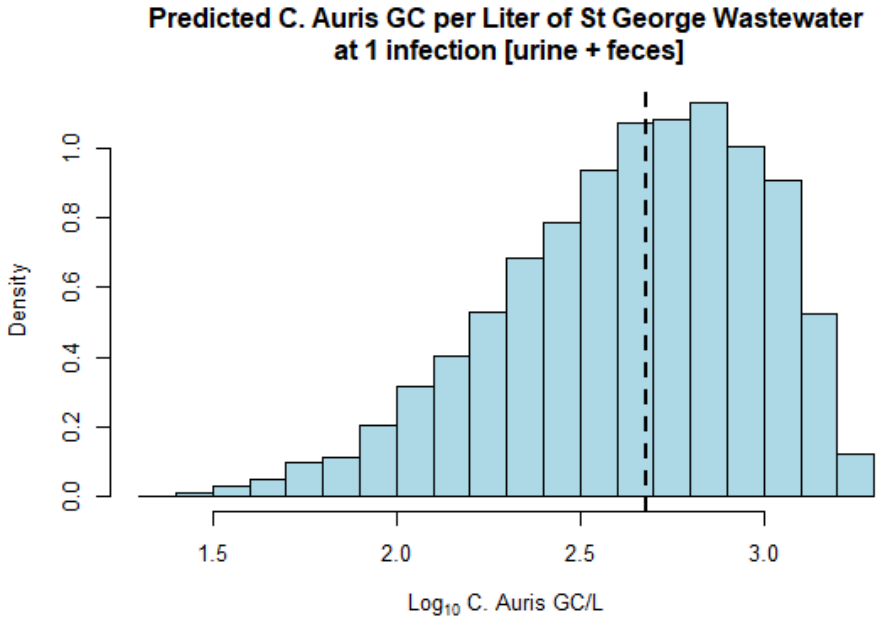
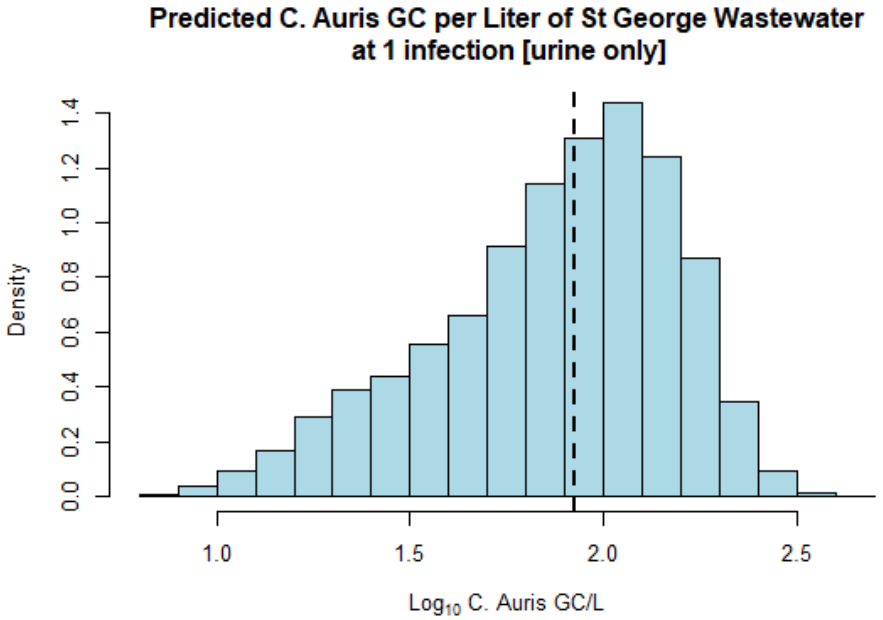
Sensitivity of *C. auris* wastewater surveillance?

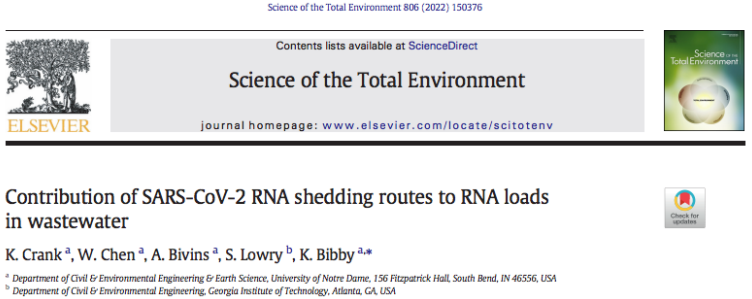




- St George's sewershed size: 92,047 people
- Average flow: 11.14899 MGD (millions of gallons per day)
- ITS: 3-40 copies/genome

- *C. auris* in urine: 10^5 CFU/mL
- *C. auris* in feces: 10^7 CFU/mL
- Monte Carlo simulation (n=10,000)

Model provided by Dr. Katherine Crank (SNWA)


Science of the Total Environment 806 (2022) 150376

Contents lists available at ScienceDirect

Science of the Total Environment

journal homepage: www.elsevier.com/locate/scitotenv

ELSEVIER

Contribution of SARS-CoV-2 RNA shedding routes to RNA loads in wastewater

K. Crank [a], W. Chen [a], A. Bivins [a], S. Lowry [b], K. Bibby [a,*]

[a] Department of Civil & Environmental Engineering & Earth Science, University of Notre Dame, 156 Fitzpatrick Hall, South Bend, IN 46556, USA
[b] Department of Civil & Environmental Engineering, Georgia Institute of Technology, Atlanta, GA, USA

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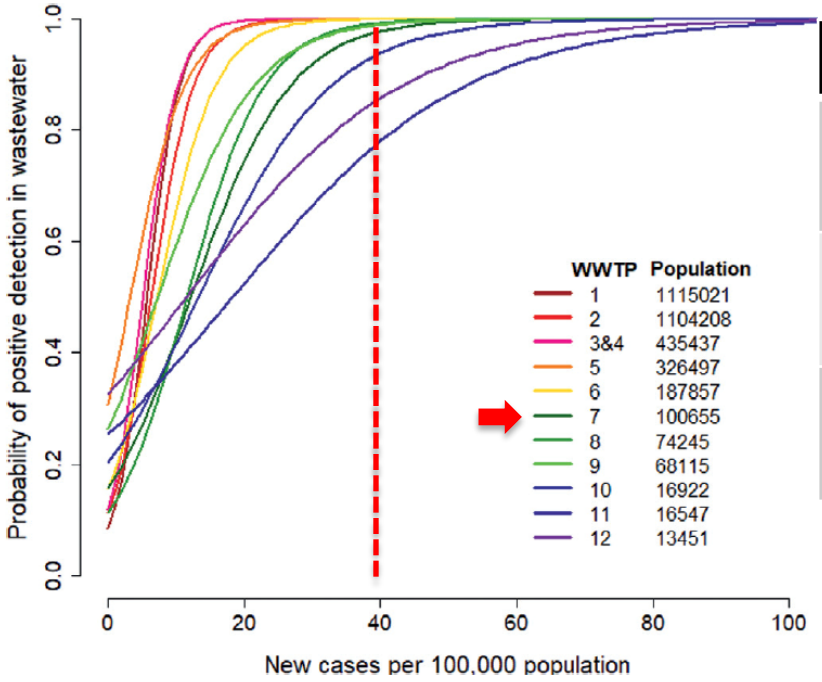

Li et al. JES. 2023;125:843-850

SARS-CoV-2	*C. auris*
Single copy target per genome (1)	Multicopy target per genome (40)
Shedding=10^8 gc/individual/day	Shedding=10^8 gc/individual/day
Sensitivity= 40 new cases/100K population	Sensitivity=1 new case/100K population

Persistent detection after initial introduction

- Are there still colonized individuals in St. George who have not been detected and/or other sporadic introductions (e.g. travelers)?
- Can *C. auris* colonize the sewer system indefinitely (e.g. biofilms)?

Conclusions

- We have shown that *C. auris* isolates can be recovered from wastewater samples allowing high-resolution molecular epidemiology analyses.
- The culture method is currently not robust enough for routine surveillance, and optimization is still underway.
- Early detection could be potentially achieved through PCR-based wastewater surveillance in areas where *C. auris* is not yet established.
- A better understanding of shedding levels in human excreta and the biology of *C. auris* in wastewater systems will be essential for the development of WBE approaches for this organism.

Acknowledgements

- Jorge Chavez (APHL AR Fellow)
- Nathan Lacross (Utah Wastewater Surveillance Program)
- Kelly Oakeson and NGS/Bioinformatics team (UPHL)
- Daniel Gerrity, Katherine Crank, Casey Barber (Southern Nevada Water Authority)
- Andrew Gorzalski (Nevada State PHL)

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