



From Genome to Action: Detecting CPO Outbreaks in Oregon

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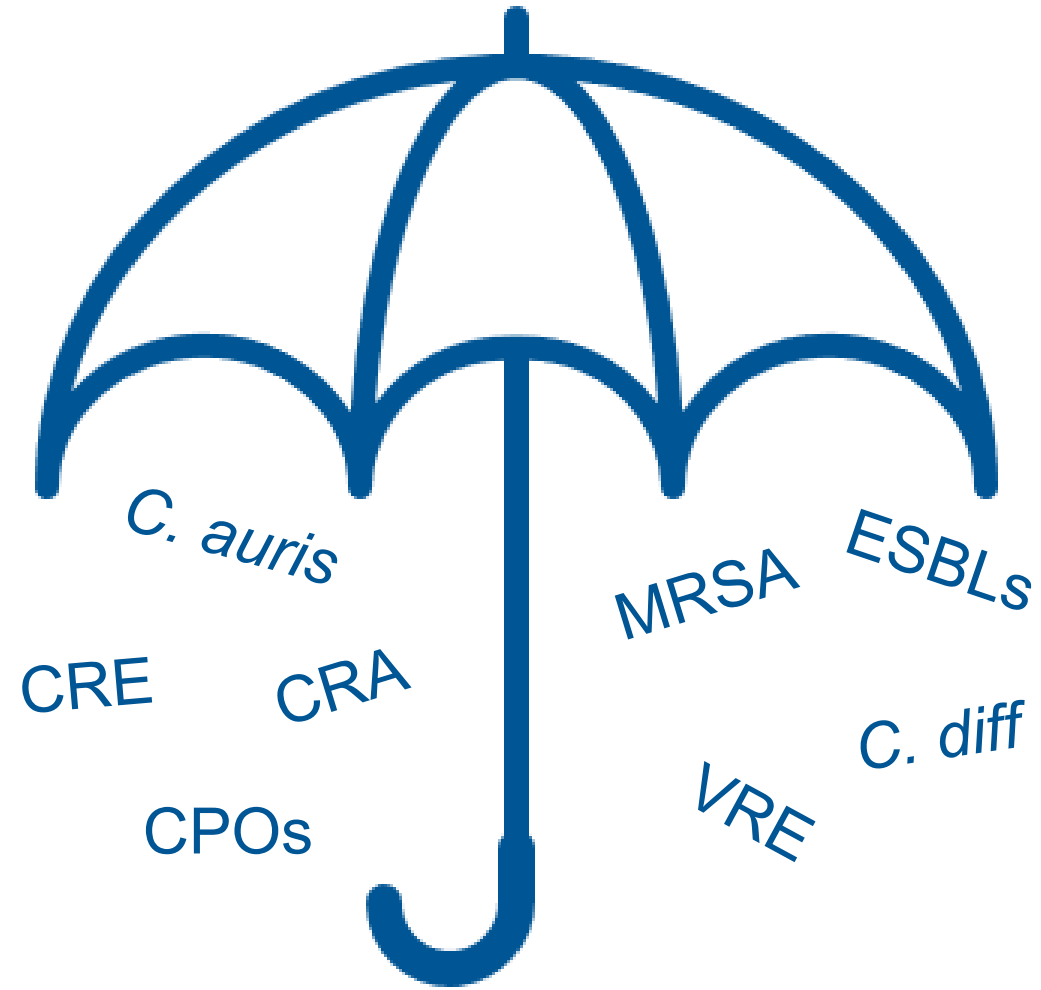




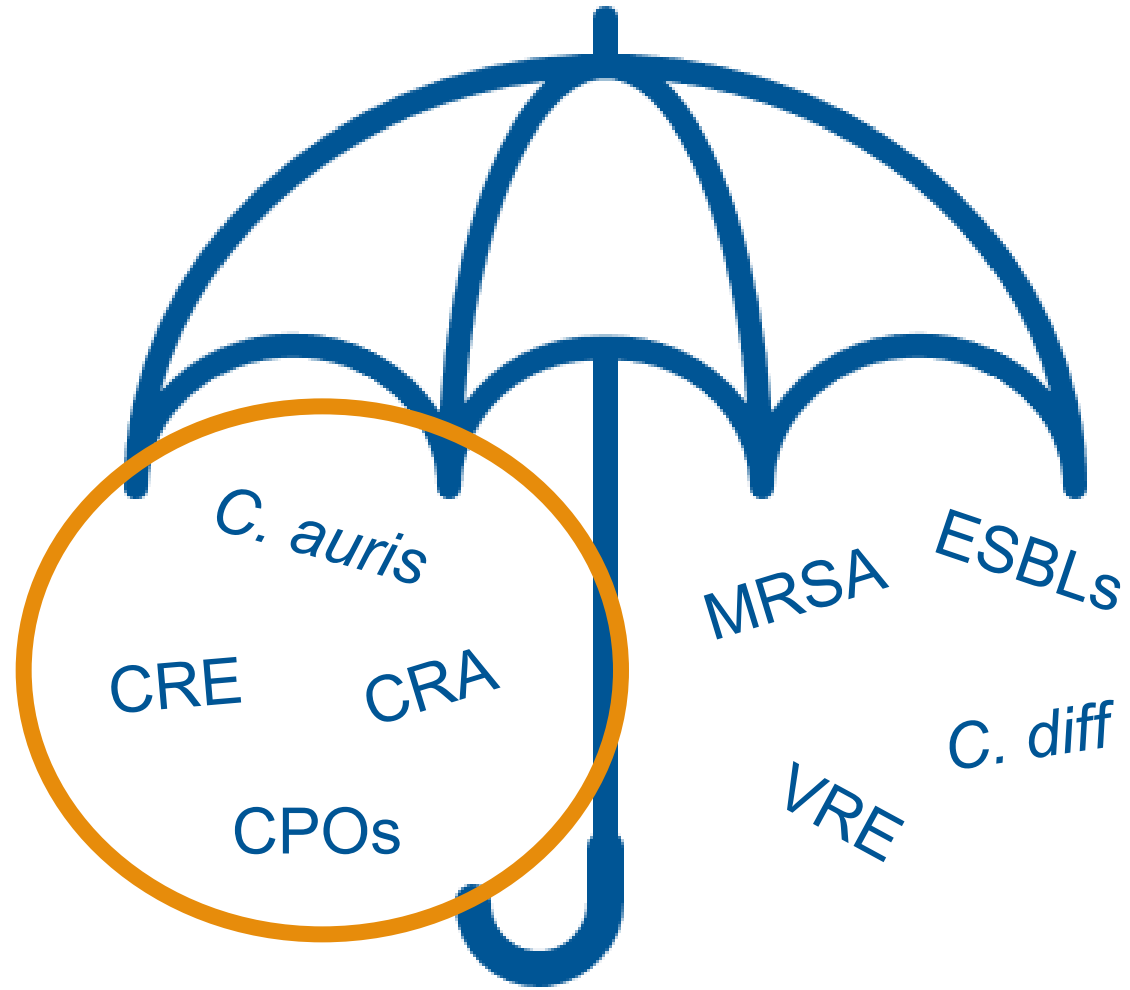
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What are CPOs?

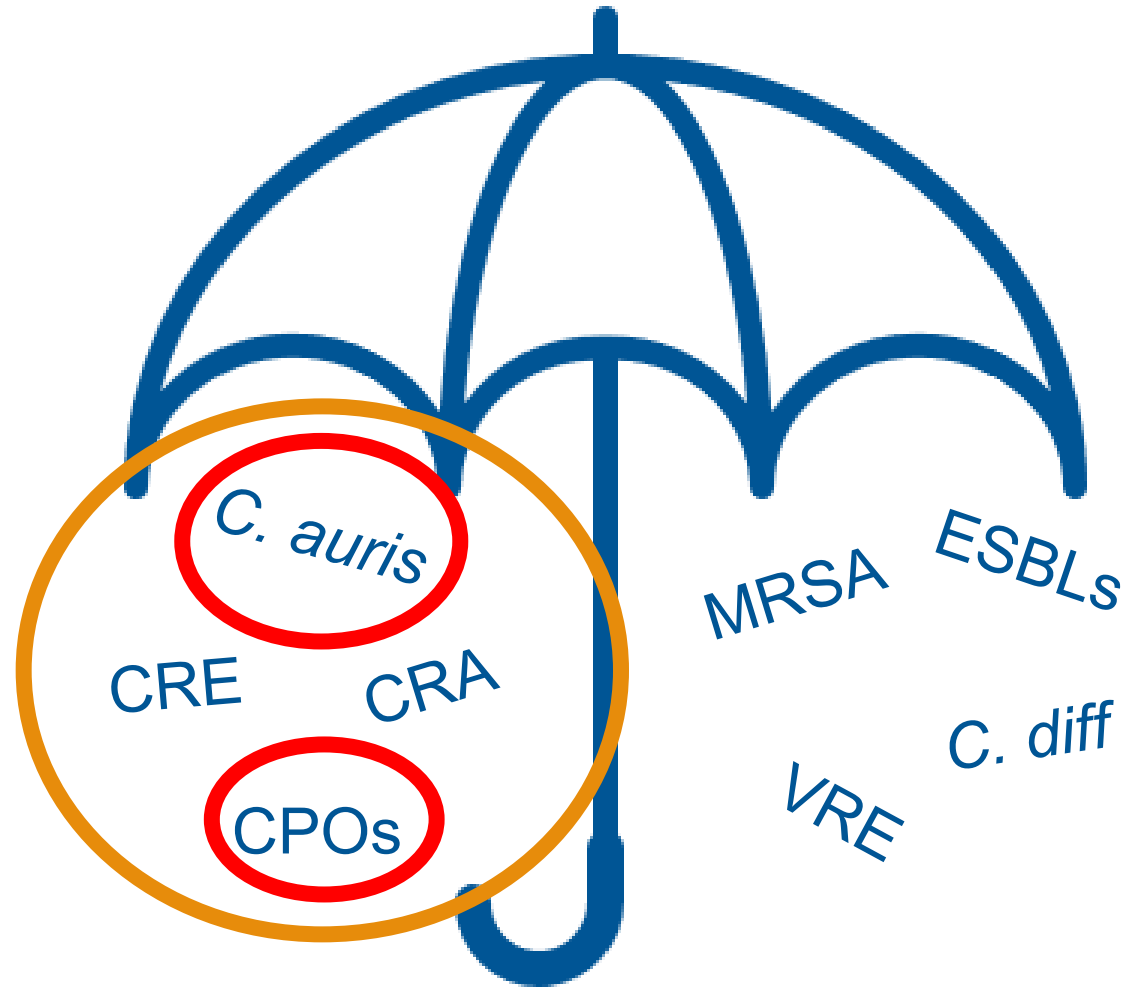
Many types of multidrug-resistant organisms (MDROs)



Public health focuses mainly on **reportable MDROs**, high-priority MDROs, and outbreaks of any MDRO



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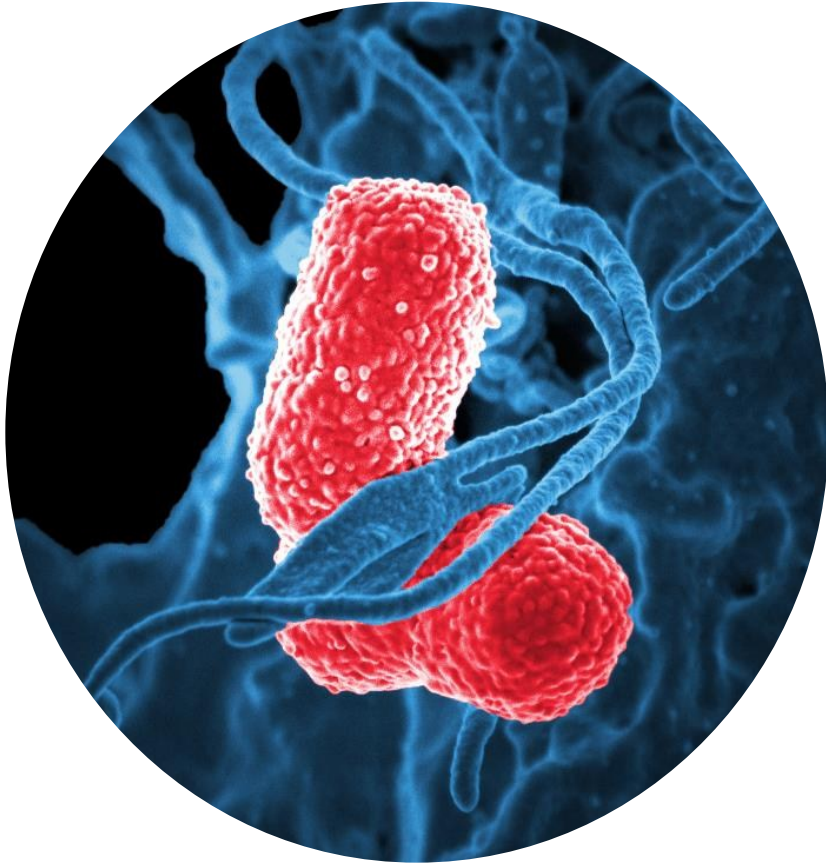


Public health focuses mainly on reportable MDROs, high-priority MDROs, and outbreaks of any MDRO



Two most common (but still rare) high-priority MDROs:

Carbapenemase-producing organisms (CPOs)



Carbapenem-resistant *Klebsiella pneumoniae*
source: CDC

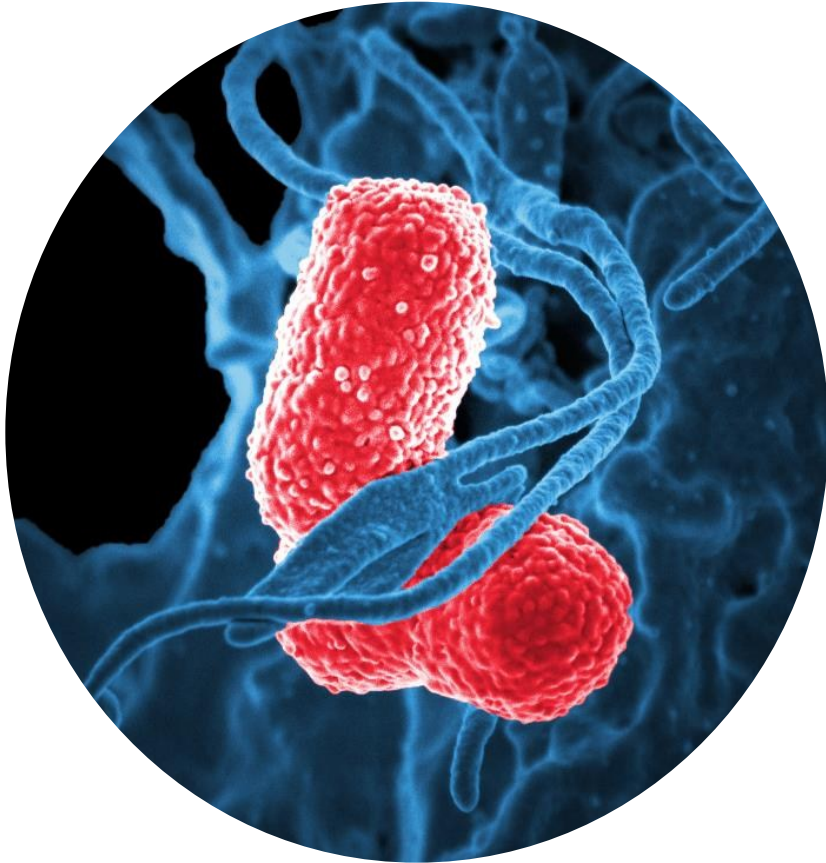
Candida (Candidozyma) auris



Candida auris
source: CDC

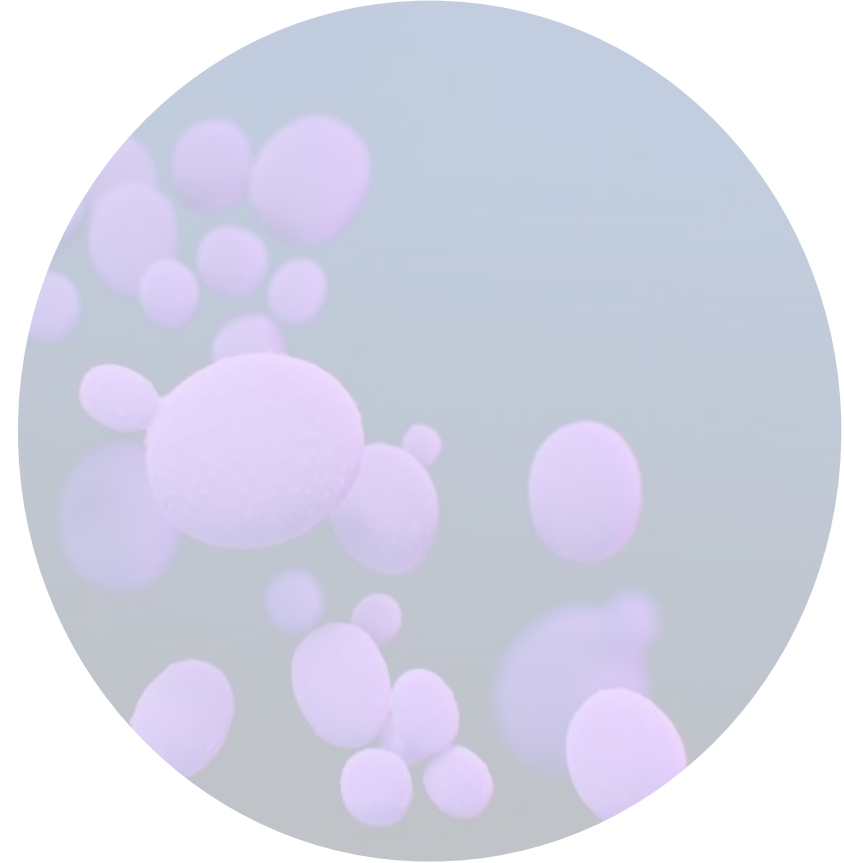
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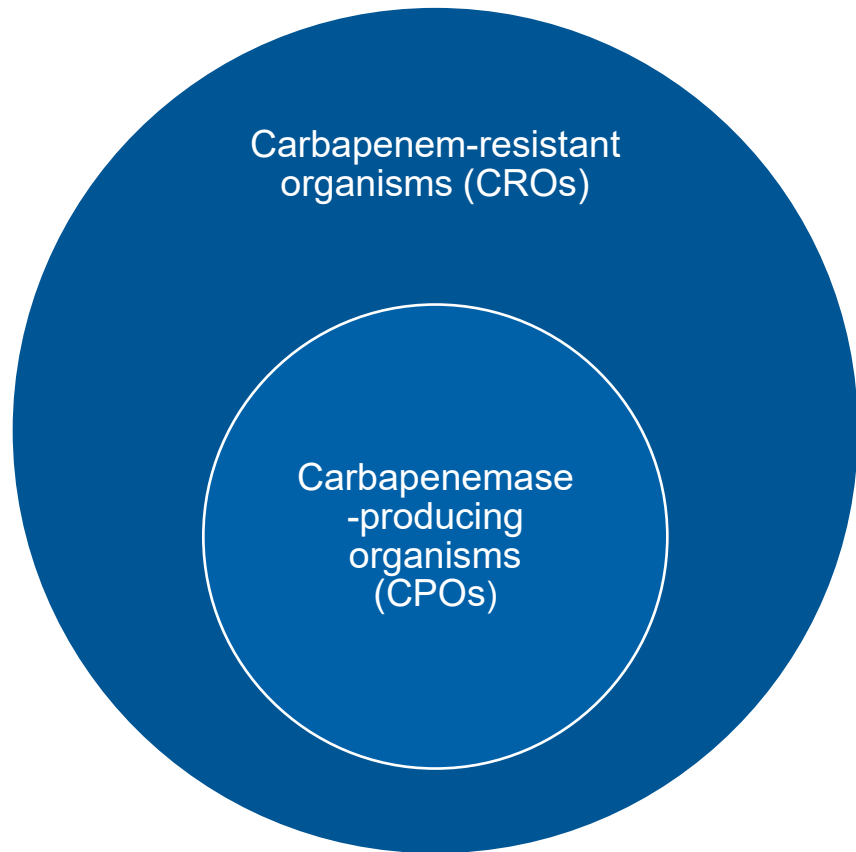
Carbapenem-resistant *Klebsiella pneumoniae*
source: CDC

Candida (Candidozyma) auris



Candida auris
source: CDC

Carbapenemase producing organisms (CPO) are a type of carbapenem-resistant organism (CRO)



- Carbapenems are a class of antibiotics
 - Ertapenem, Meropenem, Imipenem
 - “Last line of defense”
 - Often used to treat resistant infections
 - Can be difficult to treat
- Organisms that develop carbapenem resistance:
 - Gram negative bacteria
 - *Enterobacterales*: *E. coli*, *Enterobacter*
 - *Acinetobacter* species
 - *Pseudomonas aeruginosa*

Carbapenemase producing organisms (CPO) are a type of carbapenem-resistant organism (CRO)

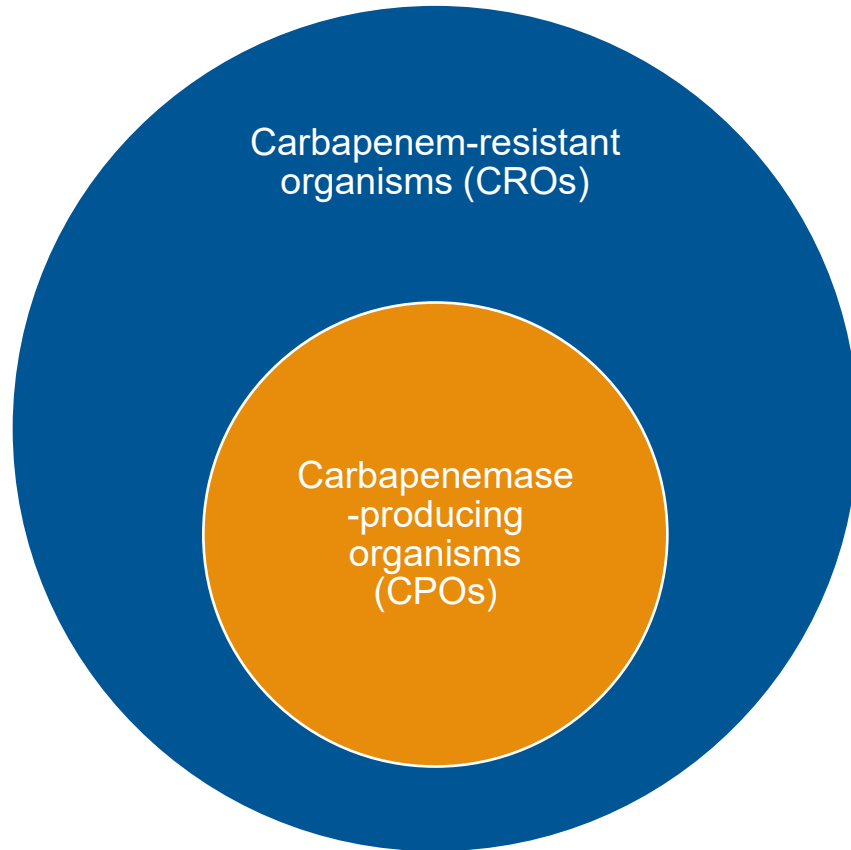
- Carbapenemases are

- enzymes that degrade carbapenem antibiotics

- one of the ways bacteria can be resistant to carbapenem antibiotics

- easily spread among bacteria

- Most common: KPC, NDM, OXA-48, VIM, IMP

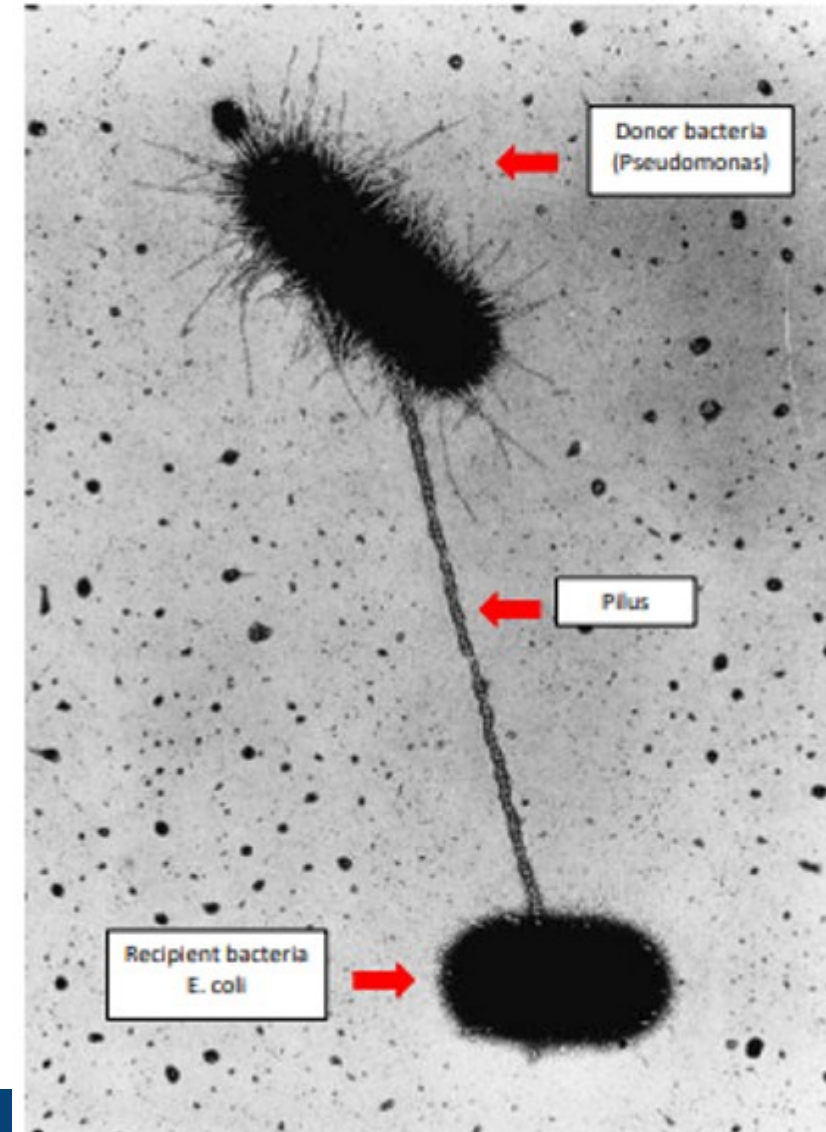


Carbapenemases can spread antibiotic resistance among bacteria

- Carbapenemases exist on plasmids
- Easily shared among bacteria
- Leads to rapid spread of antibiotic resistance

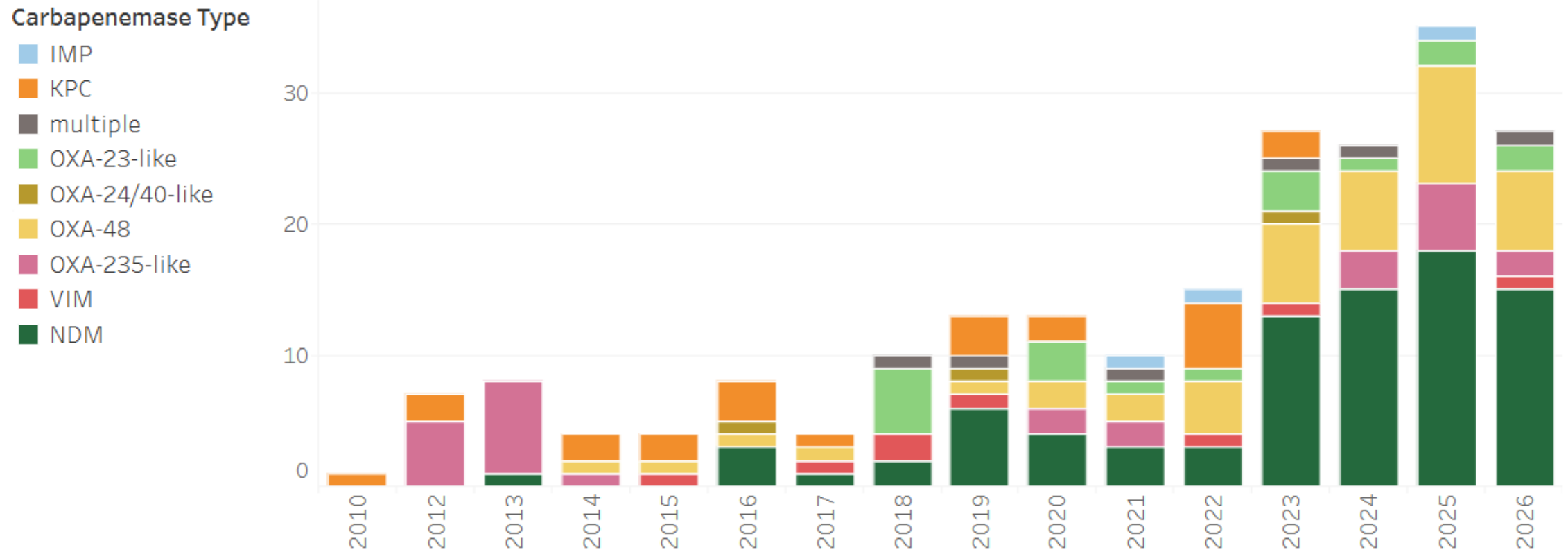
Cell-to-Cell Exchange – Horizontal Gene Transfer

Donor bacteria extends its pilus and upon contact with another cell, both cells form a channel (pore) between the two cells. The plasmid (mobile DNA instructions for antibiotic resistance) is transferred from the donor bacterium to the recipient.



Bacterial Conjugation

CPOs are rare, but increasing in Oregon



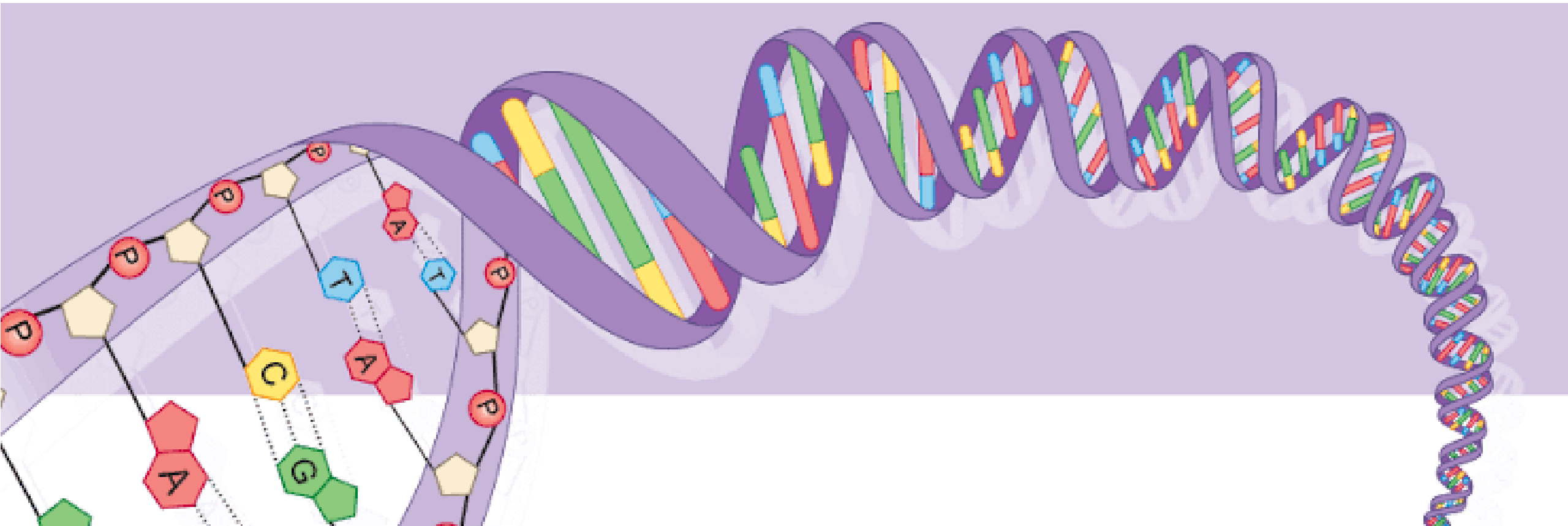


The 5 W's of WGS in Oregon

(who, what, when, where, and why)

Whole Genome Sequencing (WGS)

- A technological tool to identify the unique sequence of DNA bases in an organism



Who does WGS for Oregon?

Oregon State Public Health Lab (OSPHL)



Antimicrobial Resistance Laboratory Network (ARLN)



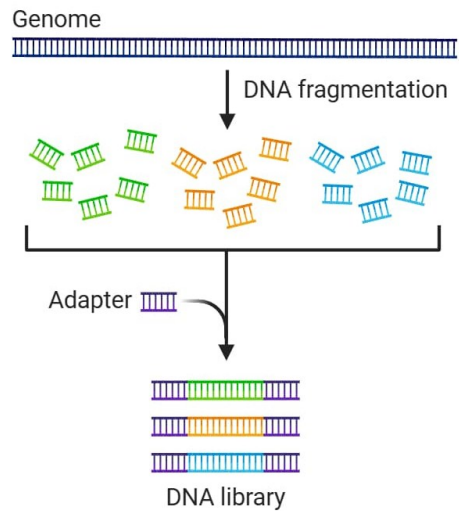
What is sequenced?

- All CPO isolates undergo WGS either at OSPHL or ARLN

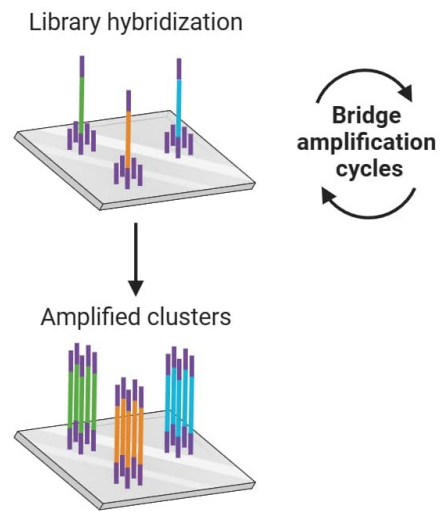
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Steps of WGS

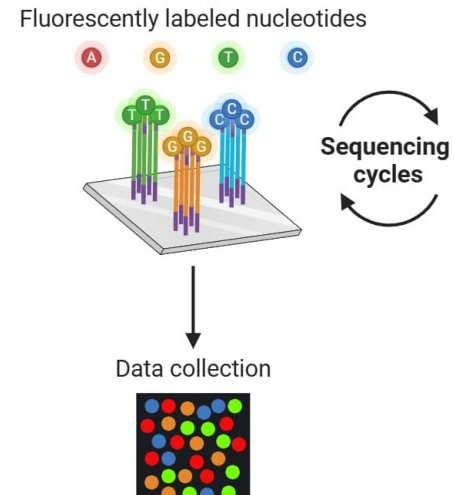
① Library preparation



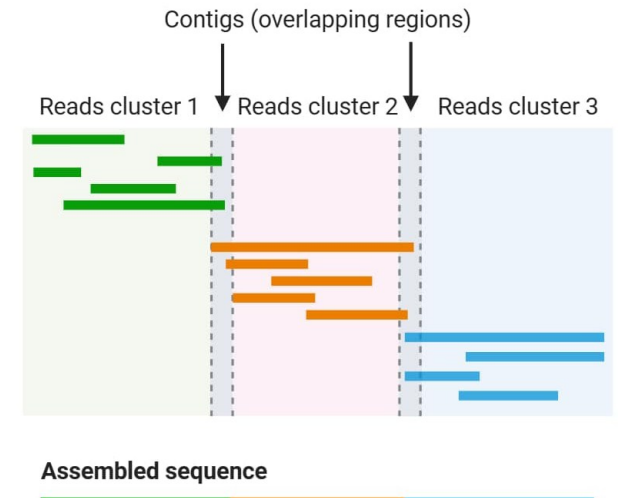
② DNA library bridge amplification



③ DNA library sequencing



④ Alignment and data analysis



When are isolates sequenced

- Sequencing began in 2017 with foodborne bacteria
- Retroactive sequencing of all CP-CRA, NDM isolates since 2023
- All isolates are sequenced moving forward
- Most isolates are sequenced within 10 days of arrival at OSPHL
 - Anonymized and uploaded to international database: NCBI Pathogen Finder

Why WGS?

- identify rare carbapenemase genes not detected by phenotypic or molecular based testing
- discover of novel/emerging carbapenemases
- support epidemiological investigation
- Identify isolates that are closely related

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- International database
- Anonymized data

An official website of the United States government [Here's how you know](#)

NIH National Library of Medicine
National Center for Biotechnology Information

Health > Pathogen Detection > Isolates Browser

Search

Filters

Matched Isolates

Page 1 of 146373 Records per Page 20 Choose columns Download Hide plus AMR genotypes Expand all

#	Scientific name	Collection date	Host	Strain	Isolate identifiers	Isolate	Location
1	Legionella pneumophila	2026-09-10	Homo sapiens	MDH-26-000053	MDH-26-000053 SRS30922774	PDT003410753.1	USA
2	Candidozyma auris	2026	Homo sapiens		CA-OCPHL-CAU-00859 SRS30924419	PDT003410751.1	USA
3	Candidozyma auris	2026	Homo sapiens		CA-OCPHL-CAU-00862 SRS30924422	PDT003410749.1	USA
4	Candidozyma auris	2026	Homo sapiens		CA-OCPHL-CAU-00864 SRS30924432	PDT003410747.1	USA
5	Candidozyma auris	2026	Homo sapiens		CA-OCPHL-CAU-00861 SRS30924420	PDT003410750.1	USA
6	Candidozyma auris	2026	Homo sapiens		CA-OCPHL-CAU-00876 SRS30924446	PDT003410739.1	USA
7	Candidozyma auris	2026	Homo sapiens		CA-OCPHL-CAU-00873 SRS30924442	PDT003410742.1	USA
8	Candidozyma auris	2026	Homo sapiens		CA-OCPHL-CAU-00871 SRS30924440	PDT003410743.1	USA
9	Candidozyma auris	2026	Homo sapiens		CA-OCPHL-CAU-00842 SRS30924450	PDT003410736.1	USA
10	Candidozyma auris	2026	Homo sapiens		CA-OCPHL-CAU-00858 SRS30924448	PDT003410737.1	USA

Oregon MDROs tend to be closely related to out-of-state or international isolates

119 from 107 patients isolates sequenced (09/2026) – 50% of cases

```
graph TD; A[119 from 107 patients isolates sequenced (09/2026) – 50% of cases] --> B[79% (n=94) clustered with isolates from other US states or abroad]; B --> C[18% (n=21) did not cluster with any other Pathogen Finder isolates]; C --> D[3% (n=4) matched with known Oregon cases]; D --> E[• 1 instance of household transmission, isolates collected years apart  
• 3 outbreaks with 2 cases each, without clear epi links];
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Examples of WGS Application

Example 1:

WGS found that 75% of CRA carry carbapenemases



Prior to 2023 CRA was not reportable in Oregon

Select laboratories participated in regional or sentinel surveillance from 2011-2023



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Based on this study, CRA was made reportable and all isolates are now required to be sent to public health for carbapenemase testing

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Example 2: WGS found suspected Cefiderocol Resistance in NDM+ isolates

Cefiderocol is one of only a small number of antibiotics that can treat CPOs

Suspected Cefiderocol resistance found NDM CPOs

Important information for clinicians treating CPO infection

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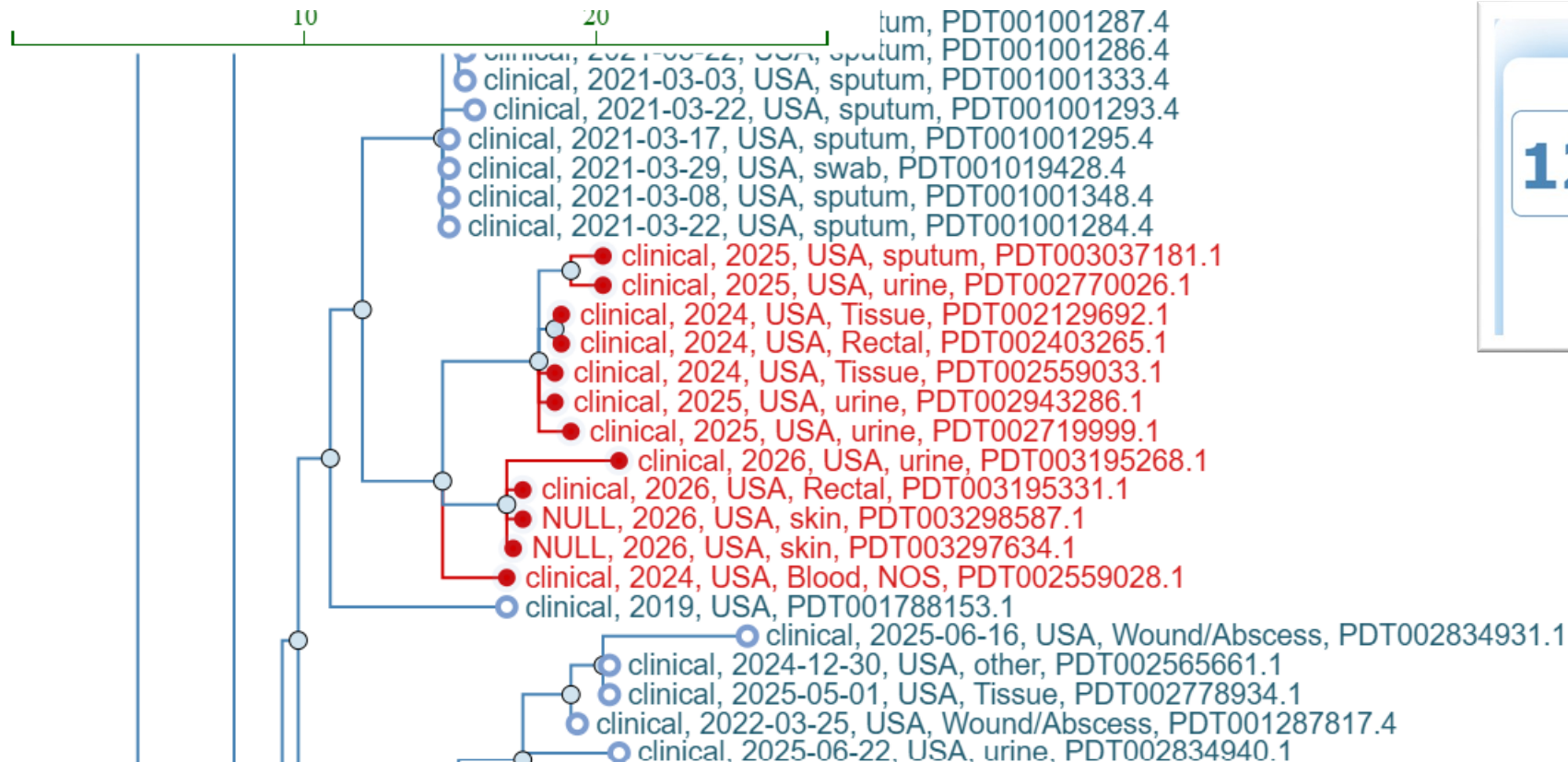
Examples 3-6: Outbreak identification & investigation

- Identification of OXA-235 CRAB outbreak; including a cat
- NDM outbreak in a skilled nursing facility
- Linking cases without usual CPO risk factors

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- **Identification of OXA-235 CRAB outbreak; including a cat**
- NDM outbreak in a skilled nursing facility
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10-case multi-facility outbreak of OXA-235+ CRAB



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Isolates Selected ✕ Clear

Distance between selected isolates :

minimum = 0 SNPs, maximum = 21 SNPs,
average = 10 SNPs

Target creation date range :

2024-04-02 to 2026-07-24

Examples 3-6: Outbreak identification & investigation

- Identification of OXA-235 CRAB outbreak; including a cat
- **NDM outbreak in a skilled nursing facility**
- Linking cases without usual CPO risk factors

9-case NDM+ *E. coli* outbreak at a single SNF

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Isolates Selected [✕ Clear](#)

Distance between selected isolates :

minimum = 0 SNPs, maximum = 15 SNPs,
average = 7 SNPs



Examples 3-6: Outbreak identification & investigation

- Identification of OXA-235 CRAB outbreak; including a cat
- NDM outbreak in a skilled nursing facility
- **Linking cases without usual CPO risk factors**

Closely related isolates with no known epi links



2

Isolates Selected [✕ Clear](#)

Distance between selected isolates :

**minimum = 2 SNPs, maximum = 2 SNPs,
average = 2 SNPs**

Target creation date range :

2024-07-17 to 2026-07-17

Thank you!

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MDRO Epidemiologist

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