Community-wide Surveillance for Carbapenemase Producing Organisms (CPO)
Statistical Report for 2022 Quarter 4*

**Report contains cumulative data from January 2022 through December 2022.*

Surveillance Definitions (year updated):

REPORT DATE (2022)

For this report, the date of specimen collection is used for case counts by months.

Carbapenem Resistant Enterobacteriaceae (CRE) (2022)

Enterobacteriaceae that meets the following criteria:

- Resistant to ANY carbapenem antimicrobial (i.e., MIC of ≥ 4 mcg/ml for doripenem, meropenem, or imipenem OR ≥2 mcg/ml for ertapenem) OR
- Documented to produce carbapenemase

In addition:

- For bacteria that have intrinsic imipenem nonsusceptibility (i.e., *Morganella morganii, Proteus spp., Providencia spp*.), resistant to carbapenems other than imipenem is required.

Carbapenem Resistant *Pseudomonas aeruginosa* (CRPA) (2022)

Pseudomonas aeruginosa isolated from any body site* that meets the following criteria:

- Resistant to imipenem, meropenem, or doripenem based on current Clinical and Laboratory Standards Institutes Standards (CLSI) M100 standards (≥ 8 mcg/mL); AND/OR
- Demonstrates production of a carbapenemase by a recognized method (e.g., CarbaNP or Polymerase chain reaction (PCR) or other methods).
  **Excluding isolates from patients with cystic fibrosis (CF).*

Carbapenem Resistant *Acinetobacter* (CRA) (2022)

Acinetobacter isolated from any body site that meets the following criteria:

- Resistant to imipenem, meropenem, or doripenem based on current Clinical and Laboratory Standards Institutes Standards (CLSI) M100 standards (≥ 8 mcg/mL); AND/OR
- Demonstrates production of a carbapenemase by a recognized method (e.g., CarbaNP or PCR or other methods).

Carbapenem Resistant Organisms (CRO) (2017)

Any organisms meeting the above definitions for CRE, CRPA, and CRA are considered CRO.

Carbapenemase Producing Organisms (CPO) (2017)

Any organisms producing carbapenemase which is laboratory-confirmed are defined as CPO.

Multi-Drug Resistant Bacilli – Carbapenem Resistant (MDRB-CR) (SINCE 2010)

A case is defined as an infection with an MDRB-CR organism of one patient per hospitalization per year regardless of resident status. Infection with a second species of MDRB-CR organism in the same patient is counted as a separate case. Infections with those Gram-negative bacilli that are constitutively resistant to carbapenems, specifically *Stenotrophomonas, Aeromonas & Chryseobacterium,* are not counted as cases.

MDRB-CR organisms refer to Gram negative bacilli that are resistant to three or more classes of antibiotics, one of which must be Carbapenem.

DUPLICATES (SINCE 2010)

Duplicates are defined isolates from same patient, same organism, and same source within same year.

PATIENT'S RESIDENCY (SINCE 2010)

Patients from out of jurisdiction (OOJ) are included in the surveillance report as long as isolates meet the above surveillance definitions.

Major Findings:

Table 1: Reported CRO by Month, Washoe County, 2022

Month	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
CRE	2	4	5	3	7	3	8	6	11	4	5	4	62
CRPA	6	9	5	9	8	6	5	7	6	7	11	3	82
CRA	0	0	0	0	0	0	0	0	0	0	0	0	0
Unknown	0	0	0	0	0	0	0	0	1	0	0	0	1
Other CROs	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	8	13	10	12	15	9	13	13	18	11	16	7	145

Table 1-1: Descriptive Statistics for Reported CRO Cases, Washoe County, Quarter 4 2022

		Quarter 4		2022	
Characteristics		No.	Percent (%)	No.	Percent (%)
Age	Median	69 y	NA	68 y	NA
	Minimum	31 y	NA	<1 y	NA
	Maximum	84 y	NA	92 y	NA
Sex	Male	22	64.7%	75	51.7%
	Female	12	35.3%	70	48.3%
Race/Ethnicity	White, non-Hispanic	22	64.7%	117	80.7%
	White, Hispanic	5	14.7%	10	6.9%
	Asian	4	11.8%	6	4.1%
	Black	1	2.9%	5	3.4%
	American Indian/Alaskan Native	1	2.9%	2	1.4%
	Other	0	0.0%	3	2.1%
	Unknown	1	2.9%	2	1.4%
Washoe County Resident	Yes	30	88.2%	121	83.4%
	No	4	11.8%	24	16.6%
	Unknown	0	0.0%	0	0.0%
Specimen Type	Urine	23	67.6%	87	60.0%
	Respiratory	5	14.7%	19	13.1%
	Wound	3	8.8%	21	14.5%
	Rectal	0	0.0%	1	0.7%
	Invasive (e.g., blood, cerebrospinal fluid)	0	0.0%	6	4.1%
	Other	3	8.8%	4	2.8%
	Surgical	0	0.0%	4	2.8%
	Unknown*	0	0.0%	3	2.1%
Facility Type	Inpatient	19	55.9%	69	47.6%
	Outpatient	12	35.3%	65	44.8%
	Long Term Acute Care	1	2.9%	3	2.1%
	Intensive Care Unit	2	5.9%	8	5.5%
	Skilled Nursing Facility	0	0.0%	0	0.0%
Total**		34	100%	145	100%

*Initial result not received from testing hospital. **Represents number of testing events. A single person may count more than once if not considered a duplicate isolate (see definition of "Duplicates")

Carbapenemase Producing Organisms (CPO)

Table 2: Characteristics of Reported CPO Cases, Washoe County, Quarter 4 2022

Month/ Year Reported	Resistance Mechanism	Organism	Active Infection or Colonization	Source of Detection	# of Contacts Identified for Screening	Case notes
7/2022	Novel	*Klebsiella pneumoniae*	Active	Routine Reporting	1	Case has history of being transferred to multiple in-state healthcare facilities starting in March 2022. No travel or invasive procedures prior.
7/2022	OXA-48	Not isolated	Active	Hospital Screening	0	Case had previous international hospitalizations and had been hospitalized in two separate local facilities.
10/2022	KPC	*Klebsiella pneumoniae*	Active	Routine Reporting	0	Case had extensive medical history for past year and is ventilator dependent. No foreign travel or hospitalizations. No contacts identified.
11/2022	VIM	*Pseudamonas aeruginosa*	Active	Routine Reporting	0	Case was identified as being part of a multi-state outbreak related to use of over-the-counter eye drops. No travel history or foreign/domestic hospitalization history.

KPC-*Klebsiella pneumonia* carbapenemase, NDM-New Delhi Metallo-β-lactamase, VIM-Verona Integron-encoded Metallo-β-lactamase

CPO cases reported 2022 = 4; Contacts identified = 1; Case-contact ratio = 0.25
Cumulative CPO case counts (2017- 2022) =44; Contacts identified (2017- 2022) = 111; Case-contact ratio = 2.22

Carbapenem Resistant Enterobacteriaceae (CRE)

Table 3: Carbapenem Resistant Enterobacteriaceae, Washoe County, 2018-2022

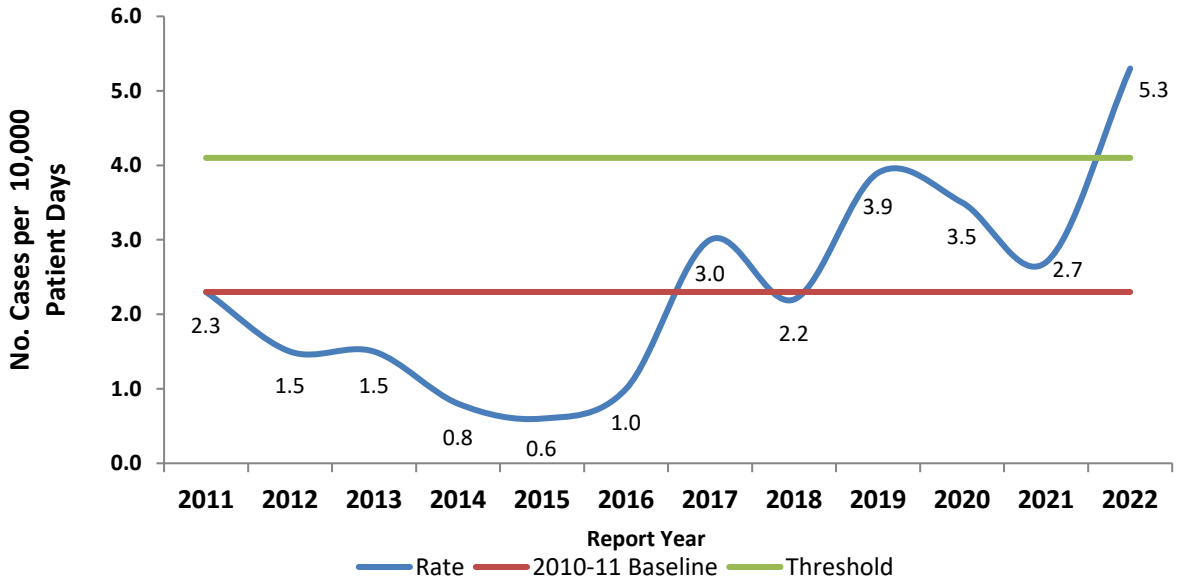
Year	Total N CRO	No. CRE	Proportion (%)	CRE Organisms													
				EC	EA	KP	E. coli	PM	CF	SM	CB	KO	PS	PR	MM	KA	Citro sp.
2018	135	43	31.9	17	4	9	7	2	1	0	2	1	0	0	0	0	0
2019	94	27	28.7	13	1	9	3	0	0	0	0	0	0	0	0	0	1
2020	90	48	53.3	27	2	8	6	0	2	0	0	1	0	0	0	0	1
2021	77	36	46.8	21	3	5	2	0	0	2	0	1	1	0	1	0	0
2022	145	62	42.8	39	0	6	3	1	1	2	0	0	0	1	2	7	0

EC-*Enterobacter cloacae*, EA-*Enterobacter aerogenes*, KP-*Klebsiella pneumoniae*, PM-*Proteus mirabilis*, CF-*Citrobacter freundii*, SM-*Serratia marcescen,* CB-*Citrobacter braakii*, KO-*Klebsiella oxytoca*, PS- *Providencia stuartii*, PR- *Providencia rettgeri*, MM- *Morganella morganii*, Citro sp.-*Citrobacter species*, KA- *Klebsiella aerogenes*

Reported Incidence of MDRB-CR (2022):

The reported incidence for January 2022 December 2022 was 5.3 cases per 10,000 patient days. Figure 1 illustrates the reported incidence rate of MDRB-CR from 2011 through 2022.

Figure 1. Reported Incidence (per 10,000 Patient Days) of MDRB-CR, Washoe County, 2011-2022



Note: Only data received by 02/10/2023 were included in this report.

(Beginning 2017, reporting criteria expanded from MDRB-CR to CRO. Cases for previous years might be under-reported)

Table 4: Reported MDRB-CR Cases by Month, Washoe County, 2010-2022

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
2010	6	2	2	3	1	7	7	4	6	6	7	5	56
2011	9	8	9	13	5	5	4	3	4	6	2	9	77
2012	3	2	4	5	3	4	3	5	3	8	3	7	50
2013	8	3	5	5	4	3	2	0	1	0	2	0	33
2014	2	5	3	1	0	0	1	3	2	0	1	0	18
2015	0	0	2	4	2	2	3	0	2	4	2	4	25
2016	2	2	3	0	3	2	2	7	5	2	1	3	32
2017*	4	8	8	7	12	15	8	6	8	8	8	10	102
2018	7	5	7	3	5	8	9	6	7	13	6	10	86
2019	11	9	11	6	10	9	9	13	3	9	3	6	99
2020	5	8	6	4	4	8	9	9	1	8	16	7	85
2021	8	7	6	7	3	0	10	8	2	6	4	5	66
2022	5	8	5	8	11	8	11	7	12	6	8	4	93
Total	70	67	71	66	63	71	78	71	56	76	63	70	822

*Beginning 2017, reporting criteria changed

Severity of Drug-Resistance among CRO (2022):

- Proportion of resistance to three classes of antibiotics: 82% (119/145)
- Proportion of resistance to four or more classes of antibiotics: 64% (93/145)
- Proportion pan-resistance*: 0.7% (1/145)

*Pan-resistance is defined as non-susceptible to all tested drugs at the clinical lab.

CPO Testing

Table 5: Pan-resistance Rate, Washoe County, 2010-2022

Year	Total N Cases	No. Pan-resistance	Proportion (%)	Organisms (No. pan-resistant)
2010*	54	1	1.9	*Acinetobacter* (1)
2011	76	11	14.5	*Acinetobacter* (7), *Pseudomonas aeruginosa* (4)
2012	50	14	28.0	*Acinetobacter* (14)
2013	28	8	28.6	*Acinetobacter* (8)
2014	17	1	5.9	*Pseudomonas aeruginosa* (1)
2015	0	0	undefined	-
2016	32	1	3.1	*Klebsiella pneumoniae* (1)**
2017	137	14	10.2	*Pseudomonas fluorescens* (1), *Pseudomonas aeruginosa* (2), *Acinetobacter* (11)
2018	130	5	3.8	*Acinetobacter* (2), *Pseudomonas aeruginosa* (2), *Klebsiella pneumoniae* (1)
2019	91	3	3.3	*Pseudomonas aeruginosa* (1), *Klebsiella pneumoniae* (2)
2020	89	2	2.2	*Citrobacter spp.* (1), *K. pneumoniae* (1)
2021	76	0	0.0	-
2022	145	1	0.7	*Pseudomonas aeruginosa* (1)

*may be under-reported retrospectively during January-May 2010 ** Pan-resistance reported by CDC

Table 6 and 7 may not equal the total isolates recorded. The Washoe County Health District is in the process of updating surveillance definitions and through end of 2022 continued to track intermediate results which are not consistently forwarded to the Nevada State Public Health Lab for susceptibility testing. Table 7 does not reflect the positive PCR test as the specimen was only able be identified through PCR for type of mechanism.

Table 6: Modified Carbapenem Inactivation Method (mCIM) Testing, Washoe County, 2018-2022

Year	Total N Tested	No. Positive								Positivity (%)
		Total	KP	PA	PP/PF	E. coli	EC	KO	SM	Organism not isolated	
2018	114	17	6	1	0	7	1	1	0	1	14.9
2019	77	6	6	0	0	0	0	0	0	0	7.8
2020	81	5	2	0	0	0	0	0	0	0	6.2
2021	71	5	0	2	1	1	1	0	0	0	7.0
2022**	109	3	1	1	0	0	1	0	0	0	2.8
Total	519	43	17	5	1	11	3	1	1	1	8.3

* PCR testing by NSPHL started May 24, 2017 ** One CPO is not included in Table 6 as they were identified by PCR testing and not mCIM.
KP-*Klebsiella pneumoniae*, PA-*Pseudomonas aeruginosa*, PP/PR-*Pseudomonas fluorescens/putida*, KO-*Klebsiella oxytoca*, SM-*Serratia marcescen*, EC-*Enterobacter cloacae*

Table 7: Polymerase Chain Reaction (PCR) Testing, Washoe County, 2018-2022

Year	Total N Tested	No. Positive								Positivity (%)
		Total	KP	PA	PP/PF	E. coli	KO	EC	Organism not isolated	
2018	20	17	6	1	0	7	1	1	1	85.0
2019	12	7	6	3	0	0	1	2	0	58.3
2020	7	5	4	0	0	1	0	0	0	71.4
2021	6	3	0	1	1	1	0	0	0	50.0
2022	6	4	1	1	0	0	0	1	1	66.7
Total	66	42	19	7	1	12	2	4	2	63.6

* PCR testing by NSPHL started May 24, 2017
KP-*Kleibsiella pneumoniae*, PA-*Pseudomonas aeruginosa*, PP/PR-*Pseudomonas fluorescens/putida, EC-Enterobacter cloacae, KO-Klebsiella oxytoca*

Antibiotic Susceptibility

Table 8. Antibiotic Susceptibility for CRE, CRPA and CRGNB 2022

Antimicrobial Class or Subclass	CRE (n=62)			CRPA (n=82)			CRGNB[1]		
	# Tested	# Susceptible	% Susceptible	# Tested	# Susceptible	% Susceptible	# Tested	# Susceptible	% Susceptible
Penicillins									
Ampicillin	78	2	3%	1	0	0%	0	0	0%
Piperacillin	0	0	0%	1	1	100%	0	0	0%
Cephems									
Cefazolin	92	3	3%	2	0	0%	0	0	0%
Cefepime	88	53	60%	137	81	59%	0	0	0%
Cefotaxime	2	0	0%	0	0	0%	0	0	0%
Cefotetan	5	0	0%	0	0	0%	0	0	0%
Cefoxitin	9	0	0%	0	0	0%	0	0	0%
Ceftazidime	51	7	14%	94	52	55%	0	0	0%
Ceftriaxone	97	16	16%	66	1	2%	0	0	0%
Cefuroxime	45	7	16%	0	0	0%	0	0	0%
Cephalothin	0	0	0%	0	0	0%	0	0	0%
β-Lactam/β-lactamase inhibitor combinations									
Amoxicillin-clavulanic acid	11	1	9%	0	0	0%	0	0	0%
Ampicillin-sulbactam	80	3	4%	1	0	0%	0	0	0%
Piperacillin-tazobactam	97	28	29%	142	96	68%	0	0	0%
Ticarcillin-clavulanic acid	0	0	0%	4	0	0%	0	0	0%
Fluoroquinolones									
Ciprofloxacin	95	69	73%	145	62	43%	0	0	0%
Levofloxacin	78	64	82%	117	45	38%	0	0	0%
Moxifloxacin	16	14	88%	0	0	0%	0	0	0%
Aminoglycosides									
Amikacin	50	50	100%	137	130	95%	0	0	0%
Gentamicin	99	94	95%	150	132	88%	0	0	0%
Tobramycin	95	89	94%	139	133	96%	0	0	0%
Sulfonamides									
Trimethoprim	0	0	0%	0	0	0%	0	0	0%
Trimethoprim-sulfamethoxazole	99	81	82%	65	3	5%	0	0	0%
Monobactams									
Aztreonam	41	5	12%	88	35	40%	0	0	0%
Tetracyclines									
Tetracycline	44	29	66%	66	0	0%	0	0	0%
Tigecycline	43	38	0%	0	0	0%	0	0	0%
Nitrofurans									
Nitrofurantoin	74	13	18%	0	0	0%	0	0	0%
Carbapenems									
Imipenem	17	0	0%	49	2	4%	0	0	0%
Meropenem	57	49	86%	144	43	30%	0	0	0%
Doripenem	0	0	0%	0	0	0%	0	0	0%
Ertapenem	83	5	6%	69	0	0%	0	0	0%

[1] *Pseudomonas aeruginosa* and *Acinetobacter* have intrinsic resistance to Ertapenem.

Surveillance changes in 2017

1. Surveillance is expanded from MDRB-CR to CRO surveillance. CRO is a reportable condition in Washoe County effective in 2017. WCHD begins investigating CPO cases.
2. The quarterly report contents are modified.
3. NSPHL starts implementing modified carbapenem inactivation method (mCIM) for screening carbapenemase and PCR testing for resistance mechanism among CRO. Details are described in surveillance protocol.
4. Washington state lab will be the regional lab for advanced testing and/or colonization screening if needed.
5. This surveillance is funded by CDC ELC grant and an epidemiologist has been assigned for this surveillance project in Washoe County.

Surveillance changes in 2018

1. There were no changes made to surveillance methods, but the report was improved by adding more tables.

Surveillance changes in 2019, 2020, and 2021

1. Updated definition for duplicate sample to be more clear on the timeframe of “year” to reflect this means calendar year.

Surveillance changes in Quarter 1 2022

1. CLSI standards for intermediate results were updated and Washoe County will no longer be requiring intermediate susceptibilities to be sent to NSPHL.

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