Emerging Infections Program (EIP) Network Report
Healthcare-Associated Infections Community Interface Activity
Multi-site Gram-negative Surveillance Initiative
Extended-spectrum β-lactamase (ESBL)-producing Enterobacterales (ESBL-E) Surveillance, 2023

Case Definition:

An extended-spectrum beta-lactamase-producing Enterobacterales (ESBL-E) case was defined as isolation of *Escherichia coli*, *Klebsiella pneumoniae, Klebsiella oxytoca,* or *Klebsiella variicola* with the following criteria:

- Extended-spectrum cephalosporin-resistant (ceftazidime, cefotaxime, or ceftriaxone) using the current Clinical and Laboratory Standards Institute (CLSI) clinical breakpoints[1];
- Carbapenem non-resistant (i.e., susceptible or intermediate) (doripenem, imipenem, meropenem, or ertapenem) using the current Clinical and Laboratory Standards Institute clinical breakpoints[1];
- Isolated from a normally sterile body specimen (e.g., blood, cerebrospinal fluid, pleural fluid, pericardial fluid, peritoneal fluid, joint/synovial fluid, bone, internal body site, muscle) or urine;
- Identified in residents of the surveillance area in 2023.

Surveillance Catchment Areas:

Colorado (1 county Denver area); Georgia (2 county Atlanta area); Maryland (1 county Baltimore area); New Mexico (1 county Albuquerque area); New York (1 county Rochester area); Tennessee (4 county Columbia area).

Population:

The surveillance area represents 2,936,451 persons.
Source: U.S. Census Bureau, Population Division, Vintage 2023 Special Tabulation.

Methods:
Case finding was active, laboratory-based, and population-based. Clinical laboratories that serve residents of the surveillance area were routinely contacted for case identification through a query of minimum inhibitory concentration (MIC) values from automated testing instruments. When possible, the MIC values obtained directly from the automated testing instruments were used to determine if an isolate met the phenotypic case definition. An incident ESBL-E case was defined as the first ESBL-E isolate meeting the case definition from a patient during a 30-day period.

A standardized case report form was completed for each incident case through review of medical records. Inpatient and outpatient medical records were reviewed for information on patient demographics, clinical syndrome, outcome of illness, and relevant healthcare exposures.

Race/ethnicity was considered missing if a patient had unknown ethnicity (regardless of reported race) or if a patient had unknown race and was not Hispanic or Latino. New for 2023 data, Bayesian Improved Surname Geocoding (BISG) was used to impute missing race/ethnicity [2]. BISG applies Bayes' Theorem to calculate a patient's probability of identifying with each racial/ethnic group given their surname and home census tract or county. Probabilities for patients with known race/ethnicity were set to 1 for their reported race/ethnicity group and 0 for all other racial/ethnic groups. Race/ethnicity-stratified case counts were calculated by summing the probabilities for each racial/ethnic group.

A convenience sample of ESBL-E isolates (N=336) was collected from EIP sites and submitted to CDC for additional testing, including species confirmatory testing, reference antimicrobial susceptibility testing by broth

microdilution, phenotypic screening for ESBL production by using ceftazidime and cefotaxime alone and in combination with clavulanate, and molecular characterization.

Incidence rates for cases were calculated using the 2023 U.S. Census estimates of the surveillance area population as the denominator. Assessment of vital status in patients admitted to a hospital occurred at the time of discharge from the acute care hospital. For patients in a long-term care facility, long-term acute care facility, or in an outpatient dialysis center, vital status was assessed 30 days after culture collection. For all other patients, vital status was assessed using medical records from the healthcare facility encounter associated with the culture.

ESBL-E surveillance data underwent regular data cleaning to ensure accuracy and completeness. Patients with complete case report form data as of 2/10/2025 were included in this analysis. Because data can be updated as needed, analyses of datasets generated on a different date may yield slightly different results.

Results:

Note: The numbers of cases and denominators used for incidence rate calculations and case descriptions vary from table to table.

Tables 1 and 2 include all incident cases identified in 6 EIP sites (n=5908).

Tables 3–8 include 3643 incident cases with completed case report forms (n=3592) or with unavailable charts (n=51) from 5 EIP sites. This differs from the total number of incident cases (n=5908) for 2 reasons: 1) a case report form was completed for the first incident case per species per person during 2023 (except invasive cases, for which a case report form is always completed); and 2) case report forms were not completed for cases in 1 of the EIP sites.

Table 1. Specimen Sources for ESBL-E Cases by Organism, 2023 (N=5908)

Organism	Total	Urine No.	Urine %	Blood[a] No.	Blood[a] %	Other sterile specimens No.	Other sterile specimens %
Escherichia coli	4627	4346	93.9	238	5.1	43	0.9
Klebsiella oxytoca	170	156	91.8	11	6.5	3	1.8
Klebsiella pneumoniae[b]	1111	1001	90.1	97	8.7	13	1.2
Total	**5908**	**5503**	**93.1**	**346**	**5.9**	**59**	**1.0**

[a] Category may include cases with both a positive blood and urine specimen collected.
[b] Category includes 1 case further identified as *Klebsiella variicola* (from urine source).

Table 2: Incidence Rates of ESBL-E Cases by Sex, Age, and Race/ethnicity, 2023 (N=5908)

Sex	No. of Cases	%	Incidence Rate[a]
Female	4261	72.1	280.7
Male	1643	27.8	115.8
Missing Value	4	0.1	-

Age group, years	No. of Cases	%	Incidence Rate[a]
0–18	185	3.1	28.2
19–49	1380	23.4	111.2
50–64	1242	21.0	230.2
65–79	2069	35.0	523.6
≥80	1032	17.5	980.5

Race/Ethnicity[b]	No. of Cases[c]	%	Incidence Rate[a]
Hispanic or Latino, any race	1089	18.4	189.5
Not Hispanic or Latino – Asian or Native Hawaiian/Other Pacific Islander[d]	213	3.6	211.9
Not Hispanic or Latino - Asian only[e]	177	3.0	178.7
Not Hispanic or Latino - Native Hawaiian/Other Pacific Islander only[e]	1	<0.1	67.9
Not Hispanic or Latino – Black or African American	1487	25.2	191.8
Not Hispanic or Latino – White	2952	50.0	213.5
Not Hispanic or Latino – American Indian or Alaska Native or Multiracial	168	2.8	162.7
Not Hispanic or Latino – American Indian or Alaska Native only[e]	63	1.1	168.9
Not Hispanic or Latino – Multiracial only[e]	35	0.6	53.1

Total	No. of Cases	%	Incidence Rate[a]
Invasive cases[e]	471	8.0	16.0
All cases	5908	100	201.2

[a] Cases per 100,000 population for EIP site surveillance areas (crude rates).
[b] Race/ethnicity was imputed for cases with missing race/ethnicity (26.8%, n=1585) using BISG, as described in the methods section. The number of cases reported (i.e., non-missing) by race/ethnicity were 959 (Hispanic or Latino, any race), 178 (not Hispanic or Latino – Asian and/or Native Hawaiian/Other Pacific Island), 575 (Not Hispanic or Latino – Black or African American), 2513 (Not Hispanic or Latino – White), and 98 (Not Hispanic or Latino – American Indian or Alaska Native or Multiracial).
[c] Subcategories may not add to total due to rounding.
[d] Case-patients with reported race/ethnicity of both "Not Hispanic or Latino – Asian" and "Not Hispanic or Latino – Native Hawaiian/Other Pacific Islander" were categorized as "Not Hispanic or Latino - Multiracial". This is consistent with the United States Census Bureau denominator data. However, the BISG method does not distinguish between these two racial/ethnic groups, so a small proportion of case-patients with missing race/ethnicity who are multiracial ("Not Hispanic or Latino – Asian" and "Not Hispanic or Latino – Native

Hawaiian/Other Pacific Islander") may have been imputed as "Non-Hispanic or Latino – Asian or Native Hawaiian/Other Pacific Islander

[e] Case counts include reported (i.e., non-missing) data only. Missing data for these racial/ethnic groups were not separately imputed because BISG combines each of these groups with another racial/ethnic group.

[f] Invasive cases include cases with a sterile incident specimen source or an incident urine specimen with a subsequent non-incident sterile specimen collected on the date of incident specimen collection or in the 29 days after.

Table 3. Selected Characteristics of ESBL-E Cases, 2023 (N=3643)

Location of patient on the 3rd calendar day before incident specimen collection	**No. of Cases**	**%**
Private residence	3029	83.1
Long-term care facility	338	9.3
Acute-care hospital (inpatient)	194	5.3
Homeless[a]	22	0.6
Long-term acute care hospital	9	0.2
Unknown or another location	51	1.4

[a]Includes patients documented as experiencing homelessness at the time of positive culture. A patient experiencing homelessness is defined as an individual who lacks permanent housing

Location of incident specimen collection	**No. of Cases**	**%**
Outpatient setting or emergency department	3068	84.2
Acute care hospital	359	9.9
Long-term care facility	177	4.9
Long-term acute care hospital	8	0.2
Unknown	31	0.9

Infection types[a]	**No. of Cases**	**%**
Urinary tract infection	2863	78.6
Bacteremia[b]	367	10.1
Pyelonephritis	179	4.9
Other	168	4.6
None[c]	213	5.8
Unknown	129	3.5

Note: Table includes data from five EIP sites with case report forms available.

[a] Patients could have more than one type of infection reported.

[b] Bacteremia includes cases with a positive blood specimen (incident or non-incident) or a documented diagnosis of sepsis, bacteremia, or blood stream infection.

[c] No infection types reported.

Table 4. Selected Clinical Characteristics of ESBL-E Cases, 2023 (N=3643)

Charlson comorbidity index	No. of Cases	%
0	1245	34.2
1	781	21.4
≥2	1572	43.2
Unknown	45	1.2
Median (Interquartile range)	1	0–3

Underlying conditions[a]	No. of Cases	%
Diabetes mellitus	1136	31.2
Neurologic condition, any	1102	30.2
Urinary tract problems/abnormalities	1074	29.5
Cardiovascular disease[b]	966	26.5
Chronic pulmonary disease[c]	835	22.9
Chronic renal disease	724	19.9
Gastrointestinal disease[d]	513	14.1
Skin condition	487	13.4
Malignancy (hematologic or solid organ)	375	10.3
Transplant (hematopoietic stem cell or solid organ)	60	1.6
Unknown	45	1.2

SARS-CoV-2 testing	No. of Cases	%
Positive test for SARS-CoV-2 during hospitalization and on or before the date of incident specimen collection[e]	31/844	3.7

Note: Table includes data from five EIP sites.

[a] Patients could have more than one underlying condition reported.

[b] Defined as myocardial infarction, congestive heart failure, congenital heart disease, stroke, transient ischemic attack, or peripheral vascular disease.

[c] Defined as cystic fibrosis or any chronic respiratory condition resulting in symptomatic dyspnea.

[d] Defined as diverticular disease, inflammatory bowel disease, peptic ulcer disease, short gut syndrome, or liver disease.

[e] Among patients in the hospital on the date of incident specimen collection. Excludes patients who were admitted to the hospital after the date of incident specimen collection. A positive SARS-CoV-2 test was defined as any positive viral test for SARS-CoV-2, including antigen and nucleic acid amplification tests. Serologic tests were excluded.

Table 5. Selected Healthcare Exposures or Risk Factors of ESBL-E Cases, 2023[a] (N=3643)

Exposure	No. of Cases	%
Healthcare facility stay in the year before the date of incident specimen collection – any healthcare facility stay	1514	41.6
Healthcare facility stay in the year before the date of incident specimen collection – acute care hospitalization	1417	38.9
Healthcare facility stay in the year before the date of incident specimen collection – long-term care facility residence	577	15.8
Healthcare facility stay in the year before the date of incident specimen collection – long-term acute care hospitalization	34	0.9
Surgery in the year before the date of incident specimen collection	582	16.0
Specimen collected ≥3 days after hospital admission	170	4.7
Chronic dialysis	68	1.9
Selected medical device(s) in place in the 2 calendar days before the date of incident specimen collection – urinary catheter	517	14.2
Selected medical device(s) in place in the 2 calendar days before the date of incident specimen collection – central venous catheter	151	4.1
Selected medical device(s) in place in the 2 calendar days before the date of incident specimen collection – other[b]	228	6.3
None of the above healthcare exposures[c]	1853	50.9
Healthcare exposures are unknown	48	1.3
International travel in the 12 months prior to date of incident specimen	127	3.5

Note: Table includes data from five EIP sites.

[a] Patients could have more than one prior healthcare exposure or risk factor reported.

[b] Other medical devices: endotracheal or nasotracheal tube, tracheostomy, gastrostomy tube, nephrostomy tube, nasogastric tube.

[c] Defined as having no healthcare exposures in the year before specimen collection, no selected medical devices in place in the 2 days before specimen collection, and specimen collected before calendar day 3 after hospital admission if hospitalized.

Table 6. Outcomes of Incident ESBL-E Cases, 2023 (N=3643)

Outcomes	No. of Cases	%
Outcome – hospitalized on the day of or in the 29 days after the date of incident specimen collection[a,b]	1114	30.6
Outcome – ICU admission in the 6 days after the date of incident specimen collection[a]	157/1114	14.1
Hospitalized patient discharged to – private residence	668/1114	60.0
Hospitalized patient discharged to – long-term care facility	307/1114	27.6
Hospitalized patient discharged to – died during hospitalization	103/1114	9.2
Hospitalized patient discharged to – long-term acute care hospital	12/1114	1.1
Hospitalized patient discharged to – other/unknown	24/1114	2.2
Died within 30 days of incident specimen collection date	94	2.6
Cases with an incident sterile site specimen	37/269	13.8
Cases with an incident urine specimen[c]	57/3374	1.7

Note: Table includes data from five EIP sites.

[a] Patients could have more than one outcome.

[b] Data include 170 cases considered to be hospital-onset.

[c] One incident ESBL-E case had a subsequent non-incident blood specimen collected on the date of incident specimen collection or in the 29 days after.

Table 7. Prior Antimicrobial Use among ESBL-E Cases, 2023[a] (N=3643)

Antimicrobial class	Antimicrobial agent [b, c]	No. of Cases	%
Any antimicrobial class	Any antimicrobial agent	1022	28.1
Cephems	Cefadroxil, cefazolin, cefdinir, cefepime, cefiderocol[d], cefixime[d], cefotaxime, cefoxitin, cefpodoxime, ceftaroline, ceftazidime, ceftizoxime, ceftriaxone, cefuroxime, cephalexin	530	14.5
Fluoroquinolones	Ciprofloxacin, delafloxacin[d], levofloxacin, moxifloxacin, ofloxacin	169	4.6
Glycopeptides	Dalbavancin[d], oritavancin[d], telavancin[d], vancomycin (intravenous or oral)	161	4.4
Penicillins	Amoxicillin, ampicillin, penicillin, nafcillin, oxacillin	81	2.2
ß-lactam combination agents	Amoxicillin/clavulanic acid, ampicillin/sulbactam, ceftazidime/avibactam, ceftolozane/tazobactam[d], meropenem/vaborbactam[d]	116	3.2
Tetracyclines	Doxycycline, eravacycline[d], minocycline, omadacycline[d], tetracycline, tigecycline[d]	88	2.4
Carbapenems	Doripenem[d], ertapenem, meropenem, imipenem/cilastatin[d]	60	1.6
Lincosamides	Clindamycin	21	0.6
Ansamycins	Rifaximin, rifampin	18	0.5
Aminoglycosides	Amikacin, gentamicin, tobramycin	24	0.7
Fosfomycins	Fosfomycin	7	0.2
Macrolides	Azithromycin, clarithromycin, erythromycin[d], fidaxomicin	15	0.4
Folate pathway antagonists	Trimethoprim, trimethoprim/sulfamethoxazole	145	4.0
Lipopeptides	Daptomycin, polymyxin B[d], polymyxin E[d]	13	0.4
Monobactams	Aztreonam	6	0.2

Note: Table includes data from five EIP sites.

[a] Antimicrobial use documented in the 30 days before the date of incident specimen collection.

[b] Patients could have more than one antimicrobial reported.

[c] 27 (0.74%) were methenamine, unknown, or unspecified (not shown in table).

[d] No prior use of these antimicrobials reported.

Laboratory Characterization:

Table 8. Antimicrobial Susceptibility and Molecular Characteristics of ESBL-E Isolates Based on Testing Performed at CDC, 2023 (N= 336)

Organism	Isolates Submitted to CDC	Isolates meeting case definition, No.	Isolates meeting case definition, %	ESBL-producing organisms,[a] No.	ESBL-producing organisms,[a] %
Escherichia coli	245	237	96.7	225	91.8
Klebsiella pneumoniae	91	82	90.1	80	87.9
Total	**336**	**319**	**94.9**	**305**	**90.8**

Note: No *Klebsiella oxytoca* or *Klebsiella variicola* isolates were submitted to CDC for characterization in 2023 as a part of the convenience sample.

[a] Phenotypic screening for ESBL production was performed by using ceftazidime and cefotaxime alone and in combination with clavulanate according to CLSI guidance.[1]

Summary:

Surveillance data from 2023 represent the fifth calendar year and fourth full year of population-based surveillance for ESBL-E through the Emerging Infections Program (surveillance was conducted for six months in 2019). The crude annual incidence rate of ESBL-E in 2023 was 201.2 cases per 100,000 persons. This is a 16.8% increase from the crude ESBL-E incidence rate reported in 2022 [3]. The incidence rate increased with increasing age, was higher in females than in males, and highest in persons who were Not Hispanic or Latino–White, or Not Hispanic or Latino–Asian or Native Hawaiian/Other Pacific Islander than in persons of other race or ethnicities. More ESBL-E were isolated from a urine source than from normally sterile body sites. Prior healthcare exposures were reported for approximately 50% of the cases, with the most common exposure being any healthcare facility stay in the prior year. Approximately 30% of the ESBL-E cases were hospitalized, and overall crude 30-day mortality was 2.6%, with a higher 30-day mortality percentage observed in cases with a sterile site specimen source compared to those with a urine specimen source. Among the 336 isolates submitted to CDC, 90.8% were ESBL-producing.

References:

1. CLSI. Performance Standards for Antimicrobial Susceptibility Testing. 33rd ed. CLSI supplement M100. Wayne, PA: Clinical and Laboratory Standards Institute; 2023.

2. Elliott MN, Morrison PA, Fremont A, McCaffrey DF, Pantoja P, Lurie N. Using the Census Bureau's Surname List to Improve Estimates of Race/Ethnicity and Associated Disparities. RAND website. Available at: Using the Census Bureau's Surname List to Improve Estimates of Race/Ethnicity and Associated Disparities | RAND (https://www.rand.org/pubs/external_publications/EP20090611.html#document-details) Accessed January 12, 2026.

3. Centers for Disease Control and Prevention. 2024. Emerging Infections Program, Healthcare-Associated Infections – Community Interface Surveillance Report, Multi-site Gram-negative Surveillance Initiative (MuGSI), Extended-spectrum β-lactamase -producing Enterobacterales Surveillance, 2022. Available at: https://www.cdc.gov/healthcare-associated-infections/media/pdfs/2022-ESBL-Report-508.pdf

Citation:

Centers for Disease Control and Prevention. 2026. Emerging Infections Program, Healthcare-Associated Infections – Community Interface Surveillance Report, Multi-site Gram-negative Surveillance Initiative (MuGSI), Extended-spectrum β-lactamase -producing Enterobacterales Surveillance, 2023. Available at: https://www.cdc.gov/healthcare-associated-infections/media/pdf/2023-ESBL-Report-508.pdf

For more information, visit our websites:

- Multi-site Gram-negative Surveillance Initiative (MuGSI) (https://www.cdc.gov/hai/eip/mugsi.html)
- Healthcare-Associated Infections - Community Interface Activity (HAIC) Data on the Antimicrobial Resistance & Patient Safety Portal (https://arpsp.cdc.gov/profile/eip?tab=eip)