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, July 1–December 31, 2019

Case Definition:

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

- Extended-spectrum cephalosporin-resistant (ceftazidime, cefotaxime, or ceftriaxone) using the current Clinical and Laboratory Standards Institute clinical breakpoints (1); and
- 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 site (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 2019.

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 2,938,879 persons.
Source: National Center for Health Statistics bridged-race vintage 2019 file.

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 the first incident case per species in a patient during the year and for all incident cases from normally sterile sites. Inpatient and outpatient medical records were reviewed for information on patient demographics, clinical syndrome, outcome of illness, and relevant healthcare exposures.

A convenience sample of ESBL-E isolates (N=194) was collected from sites and submitted to CDC for additional testing including species confirmatory testing, reference antimicrobial susceptibility testing by using broth microdilution, phenotypic screening for ESBL production by using ceftazidime and cefotaxime alone and in combination with clavulanate, and molecular characterization.

Incidence rates for incident cases were calculated using the 2019 US 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 2/2/2022 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:

Table 1. Specimen Sources for ESBL-E Cases by Organism, 2019 (N=2612)

Organism	Total	Urine No.	Urine %	Blood[a] No.	Blood[a] %	Other Sterile Sites No.	Other Sterile Sites %
Escherichia coli	2169	2080	95.9	82	3.8	7	0.3
Klebsiella pneumoniae	405	363	89.6	39	9.6	3	0.7
Klebsiella oxytoca	38	38	100.0	0	0.0	0	0.0
Total	**2612**	**2481**	**95.0**	**121**	**4.6**	**10**	**0.4**

[a] Category includes cases with both a positive blood and urine specimen collected

Table 2: Incidence Rates of ESBL-E Cases by Sex, Race and Age, 2019 (N=2612)

Sex	No. of Cases	%	Incidence Rate[a]
Female	1953	74.8	256.72
Male	652	25.0	92.00
Unknown	7	0.3	-

Race	No. of Cases	%	Incidence Rate[a]
White	1335	51.1	139.23
Black or African American	499	19.1	117.45
Other[b]	116	4.4	135.37
Unknown	662	25.3	-

Age groups, years	No. of Cases	%	Incidence Rate[a]
0–18	100	3.8	29.66
19–49	585	22.4	93.76
50–64	623	23.9	221.76
65–79	805	30.8	459.21
≥80	499	19.1	958.39
Invasive cases[c]	162	6.3	11.02
All cases	2612	100.0	177.76

[a] Cases per 100,000 population for EIP areas (crude rates) estimated as the number of cases multiplied by two divided by population based on the 2019 US Census

[b] Other race includes Asian, American Indian or Alaska Native, Native Hawaiian or Other Pacific Islander, or ≥2 races reported

[c] 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. ESBL-E Cases by Race and Ethnicity, 2019 (N=2272)

Race/Ethnicity	No. of Cases	%
Hispanic, any race	397	17.5
Not known to be Hispanic[a] – White[b]	1034	45.5
Not known to be Hispanic[a] – Black or African American[c]	495	21.8
Not known to be Hispanic[a] – Asian[d]	82	3.6
Not known to be Hispanic – Other or multiple races[e]	37	1.6
Not known to be Hispanic[a,f]– Unknown race	227	10.0

[a] Records either indicated ethnicity was non-Hispanic, or ethnicity was not known
[b] 122 ESBL-E cases with unknown ethnicity
[c] 31 ESBL-E cases with unknown ethnicity
[d] 2 ESBL-E cases with unknown ethnicity
[e] American Indian or Alaska Native, Native Hawaiian or Other Pacific Islander, or ≥2 races reported; 1 ESBL-E case with unknown ethnicity
[f] Of cases with unknown race, 191 ESBL-E cases had unknown ethnicity

Table 4. Selected Characteristics of ESBL-E Cases, 2019 (N=2272)

Location of patient on the 3rd calendar day before incident specimen collection	No. of Cases	%
Private residence	1753	77.2
Long-term care facility	304	13.4
Acute-care hospital (inpatient)	132	5.8
Homeless	13	0.6
Long-term care acute care hospital	10	0.4
Other	3	0.1
Unknown	57	2.5

Location of incident specimen collection	No. of Cases	%
Outpatient setting or emergency department	1812	79.8
Acute care hospital	245	10.8
Long-term care facility	183	8.1
Long-term acute care hospital	9	0.4
Unknown	23	1.0

Infection types[a]	No. of Cases	%
Urinary tract infection	1668	73.4
Bacteremia[b]	177	7.8
Pyelonephritis	105	4.6
Other	79	3.5
None[c]	277	12.2
Unknown	131	5.8

[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, septicemia, bacteremia, or blood stream infection
[c] No infection types reported

Table 5. Selected Clinical Characteristics of ESBL-E Cases, 2019[a] (N=2272)

Charlson comorbidity index	No. of Cases	%
0	754	33.2
1	457	20.1
≥2	996	43.8
Unknown	65	2.9
Median (IQR)	1	0–3

Underlying conditions	No. of Cases	%
Diabetes mellitus	726	32.0
Neurologic condition, any	679	29.9
Cardiovascular disease[b]	649	28.6
Urinary tract problems/abnormalities	626	27.6
Chronic renal disease	426	18.8
Chronic pulmonary disease[c]	407	17.9
Gastrointestinal disease[d]	299	13.2
Skin condition	294	12.9
Malignancy (hematologic or solid organ)	245	10.8
Transplant (hematopoietic stem cell or solid organ)	44	1.9
Unknown	65	2.9

[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

Table 6. Selected Healthcare Exposures or Risk Factors of ESBL-E Cases, 2019[a] (N=2272)

Healthcare facility stay in the year before the date of incident specimen collection	**No. of Cases**	**%**
Acute care hospitalization	920	40.5
Long-term care facility residence	502	22.1
Long-term acute care hospitalization	19	0.8
Surgery in the year before the date of incident specimen collection	349	15.4
Specimen collected ≥3 days after hospital admission	122	5.4
Chronic dialysis	56	2.5

Selected medical device(s) in place in the 2 calendar days before the date of incident specimen collection	**No. of Cases**	**%**
Urinary catheter	396	17.4
Central venous catheter	105	4.6
Other[b]	168	7.4
None of the above healthcare exposures[c]	1021	44.9
Healthcare exposures are unknown	52	2.3
International travel in the 2 months prior to date of incident specimen	83	3.7

[a] Patients could have more than one prior healthcare 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 7. Outcomes of Incident ESBL-E Cases, 2019 (N=2272)

Outcomes	**No. of Cases**	**%**
Hospitalized on the day of or in the 29 days after the date of incident specimen collection	753	33.1
ICU admission in the 6 days after the date of incident specimen collection	125	5.5

Discharge location among hospitalized	**No. of Cases**	**%**
Private Residence	416/753	55.2
Long-term care facility	256/753	34.0
Died during hospitalization	58/753	7.7
Long-term acute care hospital	5/753	0.7
Other	11/753	1.5
Unknown	7/753	0.9
Died within 30 days of incident specimen collection date	55	2.4
Cases with an incident sterile site specimen	19/131	14.5
Cases with an incident urine specimen[a]	36/2141	1.7

[a] 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 8. Prior Antimicrobial Use 2019 [a] (N=2272)

Antimicrobial class	Antimicrobial agent[b, c]	No. of Cases	%
Cephems	Cefazolin, cefdinir, cefepime, cefixime, cefotaxime, cefoxitin, cefpodoxime, ceftaroline, ceftazidime, ceftizoxime, ceftriaxone, cefuroxime, cephalexin	355	15.6
Fluoroquinolones	Ciprofloxacin, delafloxacin, levofloxacin, moxifloxacin	150	6.6
Glycopeptides	Dalbavancin,[d] oritavancin, telavancin,[d] vancomycin IV, vancomycin PO	108	4.8
Penicillins	Amoxicillin, ampicillin, penicillin, nafcillin, oxacillin	74	3.3
ß-lactam combination agents	Amoxicillin/clavulanic acid, ampicillin/sulbactam, ceftazidime/avibactam, ceftolozane/tazobactam, imipenem/cilastatin,[d] meropenem/vaborbactam	50	2.2
Tetracyclines	Doxycycline, minocycline, tetracycline, tigecycline[d]	46	2.0
Carbapenems	Doripenem,[d] ertapenem, meropenem	32	1.4
Lincosamides	Clindamycin	25	1.1
Aminoglycosides	Amikacin, gentamicin, tobramycin	24	1.1
Fosfomycin	Fosfomycin	8	0.4
Macrolides	Azithromycin, clarithromycin, erythromycin	7	0.3
Folate pathway antagonists	Trimethoprim, trimethoprim/sulfamethoxazole	6	0.3
Lipopeptides	Daptomycin	4	0.2
Monobactams	Aztreonam	2	0.1

[a] Antimicrobial use was reported in the 30 days before the date of incident specimen collection

[b] Patients could have more than one antimicrobial reported

[c] 6 (0.3%) were isoniazid, methenamine, unknown, unspecified (reported as other and not shown in table)

[d] No prior antimicrobial use reported

Laboratory Characterization:

Table 9. Antimicrobial Susceptibility and Molecular Characteristics of ESBL-E Isolates Based on Testing Performed at CDC, 2019 (N=194)

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	158	153	96.8%	145	91.8%
Klebsiella pneumoniae [b]	35	33	94.3%	31	88.6%
Klebsiella oxytoca	1	1	100.0%	1	100.0%
Total	**194**	**187**	**96.4%**	**177**	**91.2%**

[a] Phenotypic screening for ESBL production was performed by using ceftazidime and cefotaxime alone and in combination with clavulanate according to CDC guidelines

[b] Includes *Klebsiella pneumoniae* and *Klebsiella variicola*

Summary:

Surveillance data from 2019 represent the first 6 months of population-based surveillance for ESBL-E through the Emerging Infections Program. The crude annual incidence rate of ESBL-E in 2019 was 177.76 cases per 100,000 persons. The incidence rate increased with age and was higher in women than in men and higher in persons of White race than in persons of other races. More ESBL-E were isolated from a urine source than from normally sterile body sites. Prior healthcare exposures were reported for over half of the cases, with hospitalization in the prior year, presence of indwelling medical devices, and prior long-term care facility residency being the most common exposures. Approximately one-third of the ESBL-E cases required hospitalization, and overall crude 30-day mortality was 2.4%, with a higher 30-day mortality observed in cases with a sterile-site specimen source compared to those with a urine specimen source. Among the 194 isolates submitted to CDC, 91.2% were ESBL-producing.

References:

1. Clinical and Laboratory Standards Institute (CLSI). Performance Standards for Antimicrobial Susceptibility Testing. 29th ed. CLSI supplement M100 (ISBN 978-1-68440-032-4). Clinical and Laboratory Standards Institute, 950 West Valley Road, Suite 2500, Wayne, Pennsylvania 19087 USA, 2019.

Citation:

Centers for Disease Control and Prevention. 2023. Emerging Infections Program, Healthcare-Associated Infections – Community Interface Surveillance Report, Multi-site Gram-negative Surveillance Initiative (MuGSI), Extended-spectrum β-lactamase -producing Enterobacterales Surveillance, 2019. Available at: https://www.cdc.gov/hai/eip/pdf/mugsi/2019-ESBL-Report-508.pdf

For more information, visit our web sites:

- Multi-site Gram-negative Surveillance Initiative (MuGSI) (https://www.cdc.gov/hai/eip/mugsi.html)
- Healthcare-Associated Infections - Community Interface Data Visualization (https://www.cdc.gov/hai/eip/haicviz.html)