Illinois Carbapenem-Resistant Enterobacteriaceae (CRE) Surveillance Report, 2015

Introduction

Carbapenem-resistant Enterobacteriaceae (CRE) are extensively drug-resistant organisms (XDROs) that have few antibiotic treatment options and can cause deadly infections.[1] In Illinois, mandatory reporting of CRE to the Illinois Department of Public Health (IDPH) via the XDRO registry has been in place since November 2013 (Appendix 1). IDPH is using these data to track the state's CRE burden, and has created this surveillance report to promote awareness of the regional CRE situation among health care facilities, laboratories, and health departments.

Methods

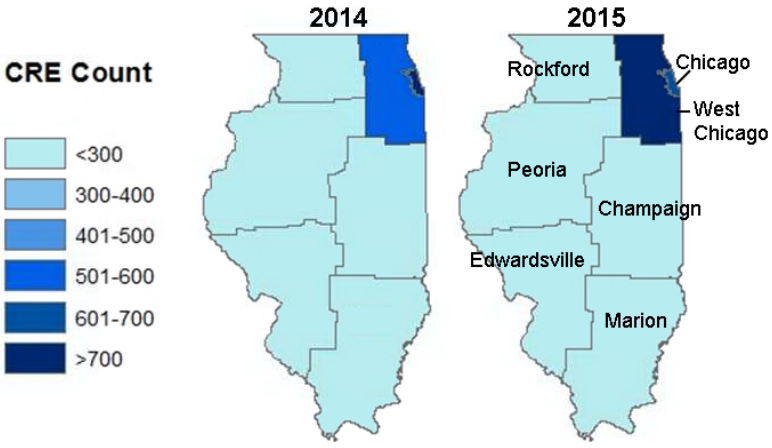
Records with culture acquisition dates from November 1, 2013 – December 31, 2015 that were submitted to the XDRO registry through June 30, 2016 were included. Methods for stratifying data based on IDPH regions, characterizing unique patients, and evaluating CRE incidence are the same as those described in the 2014 report.[2] However, for analyses at the report level in 2015, if a patient had multiple CRE-positive cultures reported for the same admission, only the first culture was included. This is in accordance with the Illinois rule that only the first positive culture per patient encounter is required to be reported. Because this report de-duplication method differs slightly from that in the 2014 report, the 2014 data were re-analyzed to allow for comparison between years (Appendix 2).

CRE rates at acute care hospitals were calculated as the number of cases per 100,000 patient-days. Cases were defined as the first CRE clinical culture, by date of culture acquisition, per patient from November 1, 2013 – December 31, 2015. Cases were included only if the culture was reported by an acute care hospital and was not marked as coming from an outpatient location. Facility-wide patient-days were obtained from data reported by hospitals to the National Healthcare Safety Network (NHSN), a nationwide surveillance system for health care-associated infections (HAIs) administered by the Centers for Disease Control and Prevention.

Results

In 2015, 122 facilities submitted 1585 CRE reports to the XDRO registry. Facilities from all regions submitted reports, with nearly 87% coming from the Chicago and West Chicago regions (Figure 1). Most reports were submitted by acute care hospitals (60%), followed by laboratories (20%) and long-term acute care hospitals

Figure 1. CRE reports submitted to the XDRO registry by Illinois Department of Public Health Region, 2014 and 2015



(LTACHs; 19%) (Table), with 156 of reported isolates (10%) marked as coming from outpatients. The median time from culture collection date to report date was eight days, but less than 70% of reports were submitted within two weeks of culture collection.

Klebsiella pneumoniae remained the predominant organism (84%) across the state, although some regions had higher proportions of *Escherichia coli* or *Enterobacter* spp. About 21% of isolates reportedly were tested for the presence of a carbapenemase gene and 55% underwent phenotypic testing for carbapenemase production (alone or in combination with another test type), while 29% of isolates were reported based on susceptibility testing results alone. Among isolates found to carry a carbapenemase gene, *Klebsiella pneumoniae* carbapenemase (KPC) was most frequently reported (n=287, 87%), with 21 New Delhi metallo-β-lactamase (NDM) and five OXA-48-like cases also submitted to the registry.

CRE were largely identified from clinical cultures (83%); the top clinical specimen sources were urine (n=779, 49%), sputum (n=195, 12%) and wound (n=181, 11%). Rectal screening cultures accounted for 16% of specimens, nearly all of which came from the Chicago and West Chicago regions (97%). There was an average of 110 clinical cultures and 21 screening cultures reported per month (by culture date) within 2015 (Figure 2).

There were 1183 unique patients reported in 2015; 52% were male and the median age was 65 years at the time of culture collection (interquartile range: 21 years). When restricting to clinical cultures, 899 unique patients were first reported to the registry in 2015, for a median of 73 newly reported patients per month (Figure 3).

The 2015 CRE rate at acute care hospitals was 9.1 cases per 100,000 patient-days, with the lowest monthly rate (7.8 per 100,000 patient-days) occurring in October and the highest (12.0 per 100,000 patient-days) in August (Figure 4). The 2015 rate was slightly higher than the 2014 rate of 8.5, but this difference was not statistically significant (p>0.05).

Figure 2. CRE reports submitted to the Illinois XDRO registry, by culture type and date of culture acquisition, 11/1/13 – 12/31/15 (N=3293)

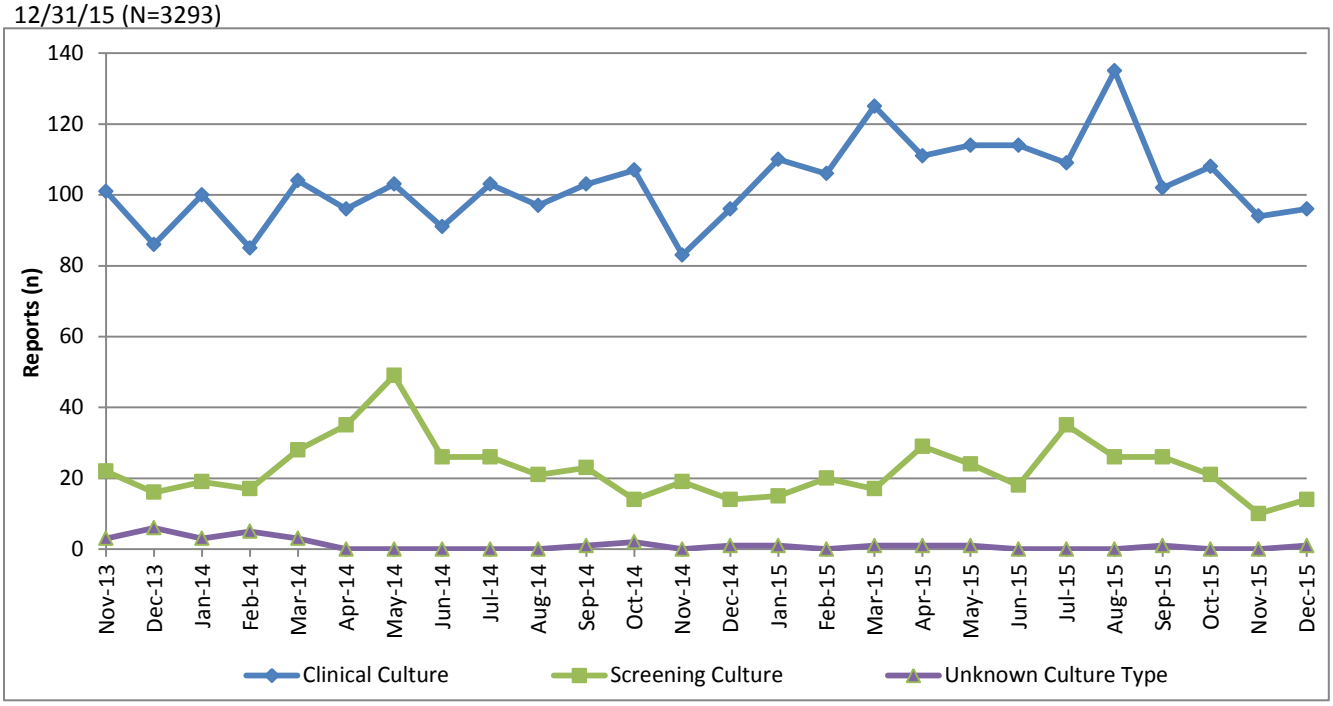


Table. Characteristics of CRE reports submitted to the XDRO Registry, by Illinois Department of Public Health Region, 2015

	City of Chicago (N=637)		West Chicago (N=737)		Rockford (N=23)		Peoria (N=58)		Champaign (N=16)		Edwardsville (N=38)		Marion (N=16)		Unknown (N=60)		TOTAL (N=1585)	
Characteristic	**n**	**(%)**	**n**	**(%)**	**n**	**(%)**	**n**	**(%)**	**n**	**(%)**	**n**	**(%)**	**n**	**(%)**	**n**	**(%)**	**n**	**(%)**
Reports submitted by facility type																		
Acute care hospital	406	(64)	407	(55)	15	(65)	50	(86)	16	(100)	37	(97)	16	(100)	0	(0)	947	(60)
Long-term acute care hospital	115	(18)	174	(24)	8	(35)	0	(0)	0	(0)	0	(0)	0	(0)	0	(0)	297	(19)
Laboratory	113	(18)	142	(19)	0	(0)	7	(12)	0	(0)	0	(0)	0	(0)	55	(92)	317	(20)
Other	3	(<1)	14	(2)	0	(0)	1	(2)	0	(0)	1	(3)	0	(0)	5	(8)	24	(2)
Culture Type																		
Clinical	517	(81)	606	(82)	23	(100)	57	(97)	16	(100)	33	(87)	16	(100)	57	(95)	1324	(84)
Screening	117	(18)	131	(18)	0	(0)	1	(2)	0	(0)	5	(13)	0	(0)	1	(2)	255	(16)
Unknown	3	(<1)	0	(0)	0	(0)	1	(2)	0	(0)	0	(0)	0	(0)	2	(3)	6	(<1)
Organism																		
K. pneumoniae	521	(82)	636	(86)	17	(74)	35	(60)	7	(44)	32	(84)	15	(94)	46	(77)	1309	(83)
E. coli	25	(4)	39	(5)	0	(0)	5	(9)	8	(50)	4	(11)	0	(0)	10	(17)	91	(6)
Enterobacter spp.	48	(7)	34	(5)	6	(26)	9	(16)	1	(6)	1	(3)	1	(6)	2	(3)	102	(6)
Other	43	(7)	28	(4)	0	(0)	9	(16)	0	(0)	1	(3)	0	(0)	2	(3)	83	(5)
Lab detection method*																		
Molecular characterization	174	(27)	131	(18)	3	(13)	2	(3)	0	(0)	5	(13)	2	(12)	14	(23)	331	(21)
Phenotypic characterization	334	(52)	413	(56)	1	(43)	51	(88)	7	(44)	19	(47)	11	(69)	23	(38)	867	(55)
Susceptibility test ONLY	177	(28)	220	(30)	10	(43)	5	(9)	9	(56)	17	(45)	4	(25)	25	(42)	467	(29)
Mechanism of resistance**																		
KPC	152	(87)	116	(89)	1	(33)	1	(50)	-	-	3	(60)	2	(100)	12	(86)	287	(87)
NDM-1	9	(5)	10	(8)	0	(0)	0	(0)	-	-	0	(0)	0	(0)	2	(14)	21	(6)
OXA-48-like	2	(1)	3	(2)	0	(0)	0	(0)	-	-	0	(0)	0	(0)	0	(0)	5	(2)
Other/Unknown	11	(6)	2	(2)	2	(67)	1	(50)	-	-	2	(40)	0	(0)	0	(0)	18	(5)

* Isolates with a molecular test for carbapenemase or phenotypic test for carbapenemase production are counted here if tests were conducted alone or in combination with another test type, so "Lab detection method" column totals may not add to 100%

** Mechanism of resistance applies only to reports with molecular test, N=331. Regions that had no molecular testing performed are indicated by dashes. KPC= *Klebsiella pneumoniae* carbapenemase; NDM-1=New Delhi metallo-β-lactamase

Figure 3. New CRE patients reported to the Illinois XDRO registry by date of earliest clinical culture, all facility types, 11/1/13 – 12/31/15 (N=1945)

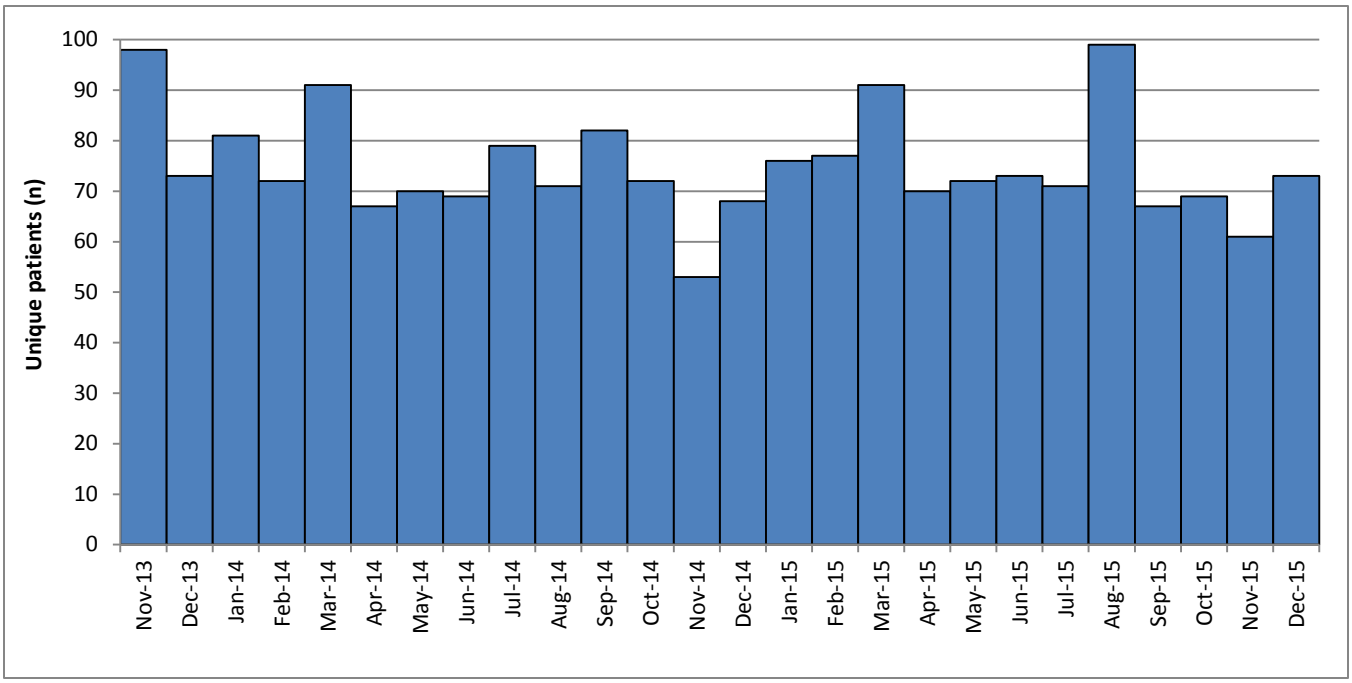
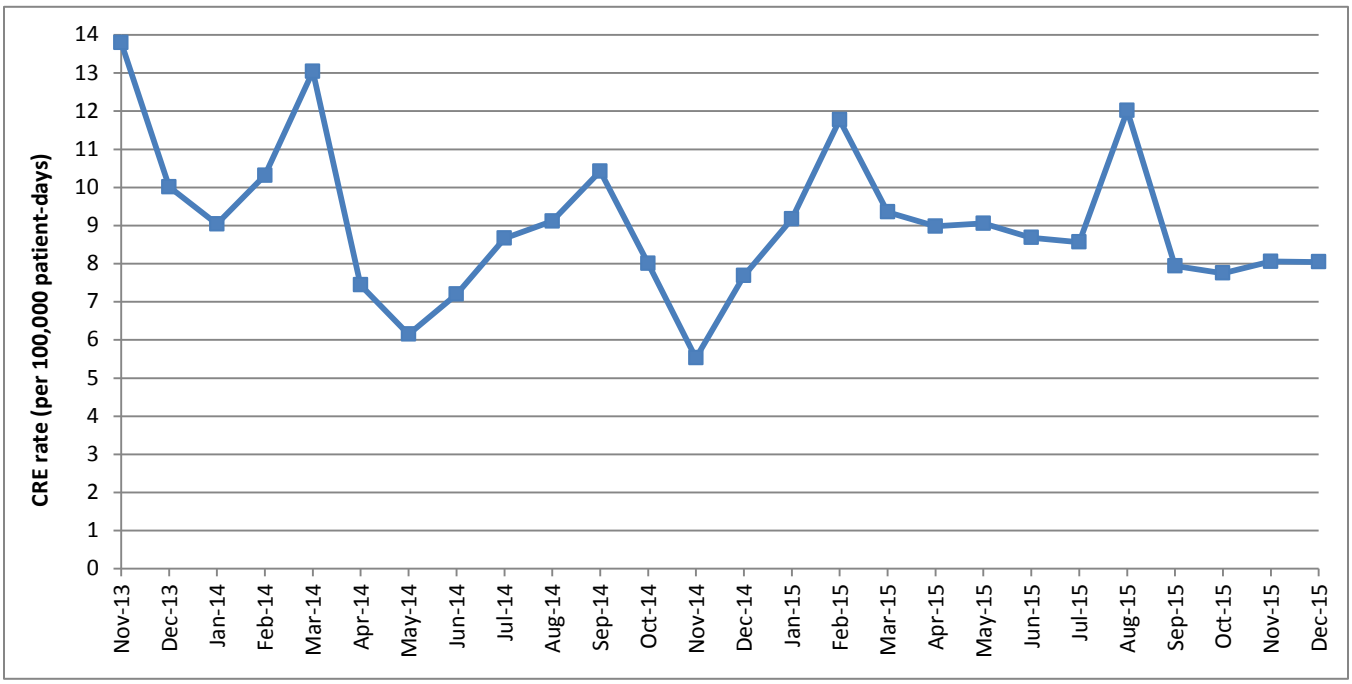


Figure 4. CRE rates (new cases per 100,000 patient-days), Illinois acute care hospitals, 11/1/13 – 12/31/15



Discussion

Mandatory CRE reporting to the XDRO registry continues to provide important surveillance data. IDPH and its public health partners are using the data to track CRE trends and detect clusters in the state, and the newly calculated CRE rates give an overall view of the CRE burden experienced by acute care facilities. Rates could not be calculated for LTACHs and long-term care facilities because denominator data were limited or not available. As more facilities join and report to NHSN, their denominator data may become available for use in future reports.

From 2014 to 2015, Chicago saw an 11% decrease (n=75) in reports submitted, while West Chicago saw a 27% increase (n=158). Part of the decrease in Chicago was due to fewer screening cultures reported by LTACHs, whereas the opposite occurred in West Chicago. Additionally, some of the increase in West Chicago may have been due to improved reporting compliance by reference laboratories, better information provided by laboratories regarding which facility they were reporting for, and more long-term care facilities registering with the IDPH system so that those reports were not placed in the "unknown" category. Reporting in the Edwardsville region decreased as well, by 27% (n=14), but remained relatively steady in other downstate regions. Although most CRE reports came from Chicago and West Chicago, every region had at least 10 reports in 2014 and 2015. Because there is potential for CRE to spread in all areas of the state, health care facilities and health departments need to be prepared to respond to a case or cluster.

CRE reporting has also been critical to the registry's function as an inter-facility communication tool. A new component of the registry alerts a hospital when a patient previously reported as CRE-positive has been admitted to that facility. This automated alert system provides near real-time notification to the hospital to facilitate rapid infection control action. During a pilot in 2015, ten hospitals were connected and received 100 alerts for 56 unique patients. The success of such a system relies on accurate and timely submission of CRE reports by healthcare facilities and laboratories, especially as automated alerting is being expanded to hospitals across the state. CRE are required to be reported within seven days after the test result is finalized, but about 30% of positive cultures were reported more than two weeks after the collection date. There may have been instances of lag time between getting positive test results from the laboratory and submitting the report to the XDRO registry, but the overall timeliness of reporting could be improved.

The limitations of the XDRO data were described in the previous report.[2] To evaluate the validity of CRE reported to the XDRO registry, a laboratory validation project tested a small sample of CRE isolates identified by local laboratories in 2015.[3] Of the 194 isolates submitted, 158 (81%) met the Illinois surveillance definition for CRE, showing that a majority of laboratories were correctly identifying CRE. Reasons for not meeting the definition included that the local laboratory did not follow project submission criteria (e.g., organisms other than *E. coli* and *Klebsiella* were submitted based on susceptibility testing results), the laboratory may have submitted the incorrect organism from a culture for testing, or that the isolate may have lost its resistance over time or after repeated subculture.

IDPH will continue to provide support for XDRO registry reporting, monitor CRE rates, and identify targets for quality improvement. Collaborations with partners such as the CDC Chicago Prevention and Intervention Epicenter and Illinois CRE Task Force will also continue, and XDRO registry data will help track the state's progress toward a regional approach to CRE control.

Contact

For questions about this report, please contact the IDPH XDRO Registry team at DPH.XDROregistry@illinois.gov.

References

1. Centers for Disease Control and Prevention. Vital signs: making health care safer. Available from: http://www.cdc.gov/vitalsigns/HAI/CRE/index.html. Accessed September 30, 2016.

2. Illinois Department of Public Health. Illinois carbapenem-resistant Enterobacteriaceae (CRE) surveillance report, 2014. Available from: http://dph.illinois.gov/topics-services/prevention-wellness/patient-safety-quality/cre/reporting. Accessed September 30, 2016.

3. Beron AJ, et al. Laboratory validation of carbapenem-resistant Enterobacteriaceae (CRE) reported to the Illinois XDRO registry. Abstract (7039). *Council of State and Territorial Epidemiologists Annual Conference*, Anchorage, AK, 2016.

Appendix 1: Illinois CRE Surveillance and Reporting Requirements

Reporting requirements

The first CRE isolate obtained from any source during each unique patient/resident encounter, including those obtained for active surveillance or clinical decision making that meets the surveillance criteria must be reported to the XDRO registry within seven calendar days after the test result is finalized. The following healthcare facilities are required to report CRE:

1. Hospitals;
2. Hospital-affiliated clinical laboratories;
3. Independent or free-standing laboratories;
4. Long-term care facilities; and
5. Long-term acute care hospitals (LTACHs)

Surveillance criteria

Facilities shall report carbapenem-resistant Enterobacteriaceae (e.g., *E. coli*, *Klebsiella* species, *Enterobacter* species, *Proteus* species, *Citrobacter* species, *Serratia* species, *Morganella* species, or *Providentia* species) based on laboratory test results:

1. Molecular test (e.g., polymerase chain reaction (PCR)) specific for carbapenemase;
2. Phenotypic test (e.g., Modified Hodge) specific for carbapenemase production; or
3. For *E. coli* and *Klebsiella* species only: nonsusceptible to one of the following carbapenems: doripenem, meropenem, or imipenem and resistant to all of the following third generation cephalosporin that were tested: ceftriaxone, cefotaxime, and ceftazidime.

Source: Control of Communicable Diseases (77 Ill. Adm. Code 690), added at 37 Ill. Reg. 12063, effective July 15, 2013

Appendix 2: Characteristics of CRE reports submitted to the XDRO Registry, by Illinois Department of Public Health Region, 2014 (Revised Table)

	City of Chicago (N=712)		West Chicago (N=579)		Rockford (N=29)		Peoria (N=58)		Champaign (N=14)		Edwardsville (N=52)		Marion (N=11)		Unknown (N=19)		TOTAL (N=1474)	
Characteristic	**n**	**(%)**	**n**	**(%)**	**n**	**(%)**	**n**	**(%)**	**n**	**(%)**	**n**	**(%)**	**n**	**(%)**	**n**	**(%)**	**n**	**(%)**
Reports submitted by facility type																		
Acute care hospital	385	(54)	340	(59)	19	(66)	49	(84)	14	(100)	52	(100)	11	(100)	0	(0)	870	(59)
Long-term acute care hospital	231	(32)	121	(21)	9	(31)	0	(0)	0	(0)	0	(0)	0	(0)	0	(0)	361	(24)
Laboratory	92	(13)	103	(18)	0	(0)	8	(14)	0	(0)	0	(0)	0	(0)	18	(95)	221	(15)
Other	4	(1)	15	(3)	1	(3)	1	(2)	0	(0)	0	(0)	0	(0)	1	(5)	22	(1)
Culture Type																		
Clinical	488	(69)	499	(86)	29	(100)	58	(100)	14	(100)	52	(100)	10	(91)	18	(95)	1168	(79)
Screening	218	(31)	72	(12)	0	(0)	0	(0)	0	(0)	0	(0)	0	(0)	0	(0)	291	(20)
Unknown	6	(1)	8	(1)	0	(0)	0	(0)	0	(0)	0	(0)	1	(9)	1	(5)	15	(1)
Organism																		
K. pneumoniae	644	(90)	498	(86)	20	(69)	35	(60)	10	(71)	37	(71)	2	(18)	12	(63)	1258	(85)
E. coli	23	(3)	37	(6)	1	(3)	11	(19)	1	(7)	4	(8)	5	(45)	7	(37)	89	(6)
Enterobacter spp.	20	(3)	24	(4)	4	(14)	7	(12)	2	(14)	8	(15)	3	(27)	0	(0)	68	(5)
Other	25	(4)	20	(3)	4	(14)	5	(9)	1	(7)	3	(6)	1	(9)	0	(0)	59	(4)
Lab detection method*																		
Molecular characterization	290	(39)	78	(13)	5	(17)	2	(3)	0	(0)	3	(6)	0	(0)	0	(0)	378	(26)
Phenotypic characterization	279	(39)	317	(55)	10	(34)	46	(79)	10	(71)	32	(62)	7	(64)	6	(32)	707	(48)
Susceptibility test ONLY	173	(24)	190	(33)	9	(31)	8	(14)	3	(21)	16	(31)	3	(27)	13	(68)	415	(28)
Unknown	5	(1)	10	(2)	5	(17)	3	(5)	1	(7)	1	(2)	1	(9)	0	(0)	26	(2)
Mechanism of resistance**																		
KPC	277	(96)	65	(83)	3	(60)	2	(100)	-	-	2	(67)	-	-	-	-	349	(92)
NDM-1	0	(0)	8	(10)	0	(0)	0	(0)	-	-	0	(0)	-	-	-	-	8	(2)
OXA-48-like	0	(0)	1	(1)	0	(0)	0	(0)	-	-	0	(0)	-	-	-	-	1	(<1)
IMP	0	(0)	1	(1)	0	(0)	0	(0)	-	-	0	(0)	-	-	-	-	1	(<1)
Other/Unknown	13	(4)	3	(4)	2	(40)	0	(0)	-	-	1	(33)	-	-	-	-	19	(5)

* Isolates with a molecular test for carbapenemase gene or phenotypic test for carbapenemase production are counted here if tests were conducted alone or in combination with another test type, so "Lab detection method" column totals may not add to 100%

** Mechanism of resistance applies only to reports with molecular test, N=378. Regions that had no molecular testing performed are indicated by dashes. KPC= *Klebsiella pneumoniae* carbapenemase; NDM-1=New Delhi metallo-β-lactamase