Illinois Carbapenem-Resistant Enterobacteriaceae (CRE) Surveillance Report, 2014

Introduction

Carbapenem-resistant Enterobacteriaceae (CRE) are extensively drug-resistant organisms (XDROs) that have few antibiotic treatment options and can cause deadly infections.[1] To prevent the spread of CRE, the Illinois Department of Public Health (IDPH) and Centers for Disease Control and Prevention's (CDC) Chicago Epicenter guided development of the XDRO registry, a web-based inter-facility communication and surveillance tool.[2] Starting November 2013, healthcare facilities and laboratories in Illinois were required to report CRE to the XDRO registry based on specific surveillance criteria (Appendix).

Two important elements of the CDC's Detect and Protect strategy for CRE control are tracking CRE trends and improving awareness of the regional CRE situation among healthcare providers and health departments.[3,4] To help address those two elements, this report summarizes the first full year of data from the XDRO registry and the CRE burden in Illinois.

Methods

All records with culture acquisition dates from November 1, 2013 – December 31, 2014 were retrieved from the XDRO registry on August 7, 2015. Records were excluded from analysis if they had been deleted from the registry by users due to data entry errors, amended laboratory results indicating that the isolates were not CRE, or similar reasons. Records deleted due to a patient's death were included in the analyses. Only isolates with culture dates from 2014 are summarized in this report.

For regional descriptive analyses, data were stratified based on six IDPH regions, except the City of Chicago was separated from the West Chicago Region. Regions were assigned based on the geographic location of the healthcare facility that reported the case. If a laboratory reported a case and specified the facility for which it was reporting, the specified facility's address was assigned to the case. If a laboratory did not specify the facility for which it was reporting or the facility was not registered with the IDPH system, that report was included in the "unknown" category.

To allow for a demographic summary of unique patients reported in 2014, records from January 1 – December 31, 2014 were de-duplicated by patient last name, first initial, and date of birth. If a patient had multiple reports, the one with the earliest culture date was accepted. To characterize CRE incidence, a second method of de-duplication was employed that attempted to account for a CDC-sponsored regional CRE point prevalence survey. Through this study, rectal screening and laboratory testing for CRE were periodically conducted at select acute care and long-term acute care hospitals in the Chicago area from January – June 2014. For this de-duplication method, records from November 1, 2013 – December

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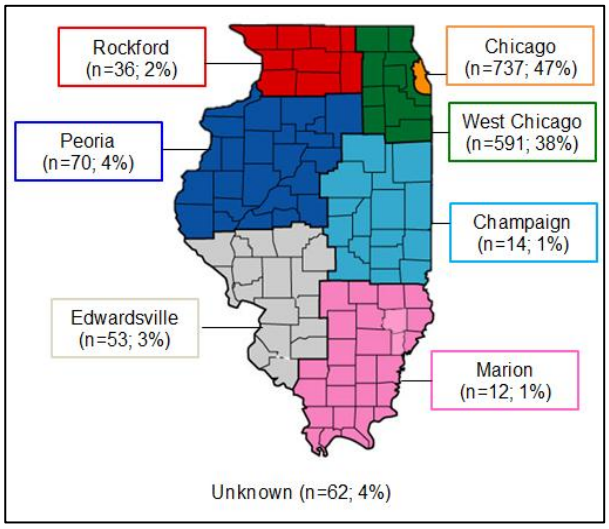
31, 2014 were de-duplicated as above, but rectal screening cultures and cultures with unknown specimen source were excluded so that trends could be examined based on clinical cultures only.

Results

In 2014, 136 facilities submitted 1575 CRE reports to the XDRO registry. About 85% of reports came from the Chicago and West Chicago regions, whereas CRE were rarely reported in the downstate regions (Figure 1). Most reports were submitted by acute care hospitals (57%), followed by long-term acute care hospitals (26%) and laboratories (15%) (Table). Eighty-seven isolates (6%) were marked as coming from outpatients, although this option was not available on the report form until April 2014. Statewide, *Klebsiella pneumoniae* was the predominant organism (85%), although some regions had higher proportions of *Escherichia coli* and *Enterobacter* spp. About 26% of isolates reportedly underwent molecular characterization of the mechanism of carbapenem resistance and 48% underwent phenotypic characterization (alone or in combination with another test type), while 28% of isolates were reported based on susceptibility testing results alone. Among isolates with a mechanism of resistance identified, *Klebsiella pneumoniae* carbapenemase (KPC) was most frequently reported (n=366, 91%), and the first reported CRE cases with OXA-48-like and IMP carbapenemases in Illinois were submitted to the registry (Box). CRE were largely identified from clinical cultures (80%), most of which were from urine (n=690, 44%), sputum (n=201, 13%) and wound (n=175, 11%). Rectal screening cultures accounted for 19% of the specimen sources and nearly all CRE screening was conducted in the Chicago and West Chicago regions (>99%). There was a median of 106 clinical cultures per month (by culture date) and a median of 23 screening cultures per month (Figure 2).

Figure 1. All reports submitted to the XDRO registry, by Illinois Department of Public Health Region, 2014 (N=1575)



Box. Emerging mechanisms of antibiotic resistance reported to the Illinois XDRO registry, 2014

One case of OXA-48-like-producing *K. pneumoniae* and one case of IMP-producing *K. pneumoniae* were reported to the XDRO registry in 2014. The OXA-48-like isolate was identified from blood in a patient who had foreign travel with medical care and multiple comorbidities. Hospice care was initiated and the patient expired. The IMP isolate was identified from the sputum of a patient with multiple comorbidities and a distant history of travel and medical care outside the United States.

Since 74% of the isolates in the XDRO registry from 2014 did not have mechanism testing, unusual resistance mechanisms such as OXA-48 and IMP may be under-recognized. Expanding the number of laboratories that are capable of molecular testing would improve surveillance of emerging resistance mechanisms.

Table. Characteristics of all CRE reports submitted to the XDRO Registry, by Illinois Department of Public Health Region, 2014

	City of Chicago (N=737)		West Chicago (N=591)		Rockford (N=36)		Peoria (N=70)		Champaign (N=14)		Edwardsville (N=53)		Marion (N=12)		Unknown (N=62)		TOTAL (N=1575)	
Characteristic	**n**	**(%)**	**n**	**(%)**	**n**	**(%)**	**n**	**(%)**	**n**	**(%)**	**n**	**(%)**	**n**	**(%)**	**n**	**(%)**	**n**	**(%)**
Reports submitted by facility type																		
Acute care hospital	391	(53)	350	(59)	21	(58)	58	(83)	14	(100)	52	(98)	12	(100)	0	(0)	898	(57)
Long-term acute care hospital	246	(33)	149	(25)	13	(36)	0	(0)	0	(0)	0	(0)	0	(0)	0	(0)	408	(26)
Laboratory	94	(13)	75	(13)	1	(3)	11	(16)	0	(0)	0	(0)	0	(0)	61	(98)	242	(15)
Other	6	(1)	17	(3)	1	(3)	1	(1)	0	(0)	1	(2)	0	(0)	1	(2)	27	(2)
Culture Type																		
Clinical	507	(69)	506	(86)	36	(100)	70	(100)	14	(100)	53	(100)	11	(92)	61	(98)	1258	(80)
Screening	222	(30)	78	(13)	0	(0)	0	(0)	0	(0)	0	(0)	1	(8)	0	(0)	301	(19)
Unknown	8	(1)	7	(1)	0	(0)	0	(0)	0	(0)	0	(0)	0	(0)	1	(2)	16	(1)
Organism																		
K. pneumoniae	662	(90)	506	(86)	26	(72)	40	(57)	10	(71)	38	(72)	1	(8)	51	(82)	1334	(85)
E. coli	26	(4)	38	(6)	1	(3)	16	(23)	1	(7)	4	(8)	6	(50)	11	(18)	103	(7)
Enterobacter spp.	24	(3)	26	(4)	5	(14)	8	(11)	2	(14)	8	(15)	4	(33)	0	(0)	77	(5)
Other	25	(3)	21	(4)	4	(11)	6	(9)	1	(7)	3	(6)	1	(8)	0	(0)	61	(4)
Lab detection method*																		
Molecular characterization	303	(41)	84	(14)	9	(25)	3	(4)	0	(0)	3	(6)	0	(0)	0	(0)	402	(26)
Phenotypic characterization	282	(38)	331	(56)	11	(31)	53	(76)	10	(71)	31	(59)	8	(67)	28	(45)	754	(48)
Susceptibility test ONLY	185	(25)	183	(31)	11	(31)	11	(16)	3	(21)	18	(34)	3	(25)	34	(55)	448	(28)
Unknown	7	(1)	10	(2)	5	(14)	4	(6)	1	(7)	1	(2)	1	(8)	0	(0)	29	(2)
Mechanism of resistance**																		
KPC	288	(95)	69	(82)	5	(56)	2	(67)	-	-	2	(67)	-	-	-	-	366	(91)
NDM-1	1	(<1)	10	(12)	0	(0)	0	(0)	-	-	0	(0)	-	-	-	-	11	(3)
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	14	(5)	3	(4)	4	(44)	1	(33)	-	-	1	(33)	-	-	-	-	23	(6)

* 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=402. Regions that had no molecular testing performed are indicated by dashes. KPC= *Klebsiella pneumoniae* carbapenemase; NDM-1=New Delhi metallo-β-lactamase

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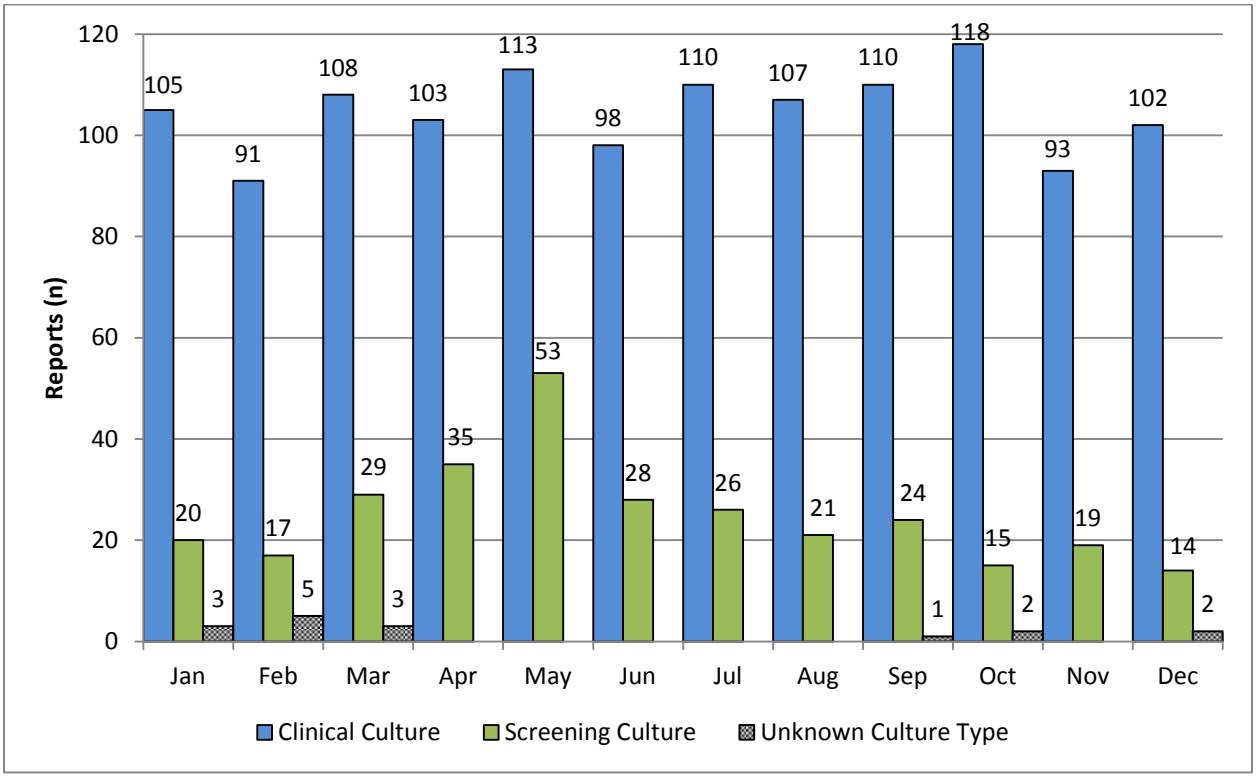
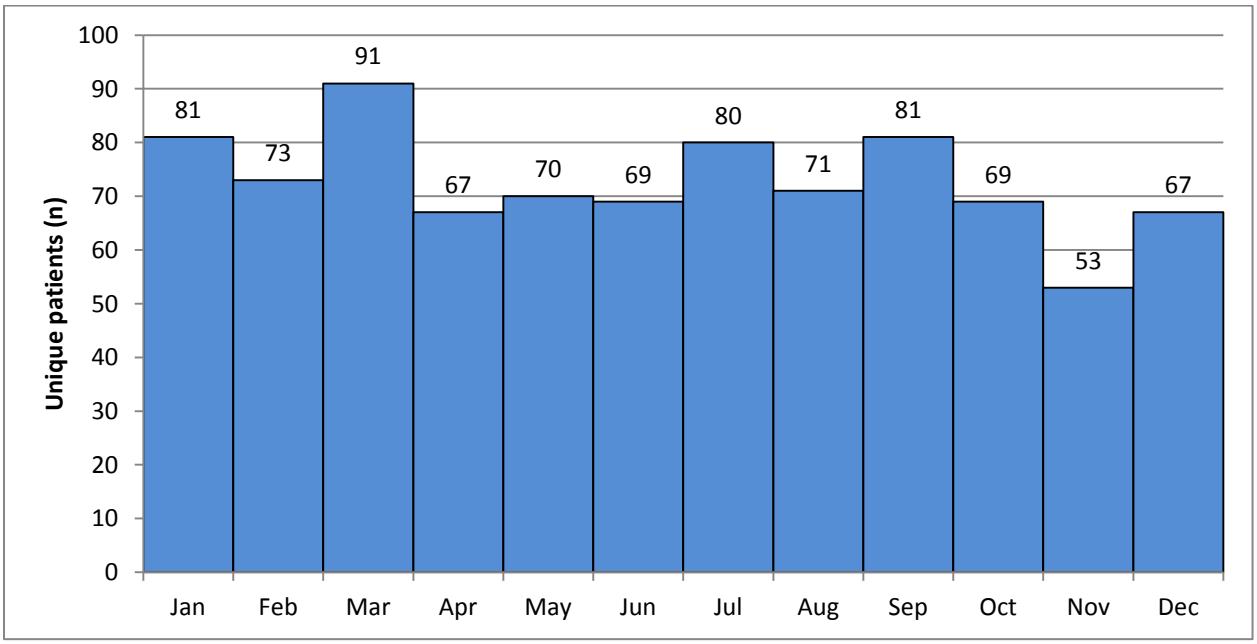
Figure 2. All reports submitted to the Illinois XDRO registry in 2014, by culture type and month of culture (N=1575)



There were 1085 unique patients reported in 2014; 50% were male and the median age was 65 years at the time of culture collection (range: 14 – 100 years). When considering only clinical cultures, 872 unique patients were first reported to the registry in 2014, for a median of 71 newly reported patients per month (Figure 3).

Figure 3. Unique patients reported to the Illinois XDRO registry in 2014, by month of earliest culture, clinical cultures only (N=872)



Discussion

Mandatory CRE reporting into the XDRO registry has improved CRE surveillance in Illinois, allowing the state to capture 1575 records for 1085 patients in its first full year of implementation. From all regions in the state, 136 laboratories and facilities across the spectrum of healthcare submitted reports. The point prevalence surveys conducted in the Chicago area have collected valuable data on CRE, including CRE carriage in acute care and long-term acute care hospitals and mechanisms of antibiotic resistance in the region. More importantly, the reports in the registry allow healthcare providers to search for CRE-positive patients admitted to their facilities so that appropriate and timely infection control measures can be initiated.

The data give an indication of the CRE burden in Illinois, although they are subject to several limitations. First, registry data were not validated and reports may have had data entry errors or there may have been underreporting of cases. In the first quarter of 2014, changes were made to the XDRO report form to enhance data quality, such as making report fields mandatory to reduce missing data and incorporating logic checks and pop-up explanations to further educate users on the surveillance definition. Additionally, some isolates in the registry may not be carbapenemase-producing CRE, as 28% of CRE isolates were reported based on susceptibility testing alone, without further confirmatory testing for carbapenemases. Only a small sample of 2014 CRE isolates were validated through further testing by an external laboratory as part of a short-term project. Results from this laboratory validation project were not available for the 2014 surveillance report, but may be included in the future.

The 85% of reports that came from the City of Chicago and West Chicago regions may reflect true, higher CRE burden than the rest of the state, but could also be a result of more advanced laboratory detection and better reporting compliance in those regions. Of note, data regarding rectal screening cultures from Chicago hospitals include results from the point prevalence survey that occurred across the first six months of 2014, which likely contributed to the increased number of screening isolates in the first half of the year. Also, a few long-term care facilities reported their own cases, but most relied on laboratories to report for them. Sixty-one isolates could not be assigned a region because the laboratory did not identify the ordering facility or the facility was not registered with the IDPH system.

Regarding monthly trends in reports submitted and unique patients reported, the numbers were fairly steady over the year. The number of patients with positive cultures in early 2014 may include more prevalent rather than incident cases than in later months because the registry had only recently launched in November 2013. Another influence may have been the CRE Detect and Protect educational campaign that IDPH started in March 2014 to promote implementation of CRE control measures at facilities. In an evaluation survey, 203 of 323 (63%) respondents from healthcare facilities and laboratories said that they had taken at least one infection control action as a result of participating in the campaign. Subsequent years of data will need to be considered to identify any trends in the number of patients with CRE.

This is the first annual Illinois CRE surveillance report; the data summarized here can serve as a baseline for tracking CRE trends and as a guide for regional CRE prevention efforts. The XDRO registry has

provided important statewide information on CRE epidemiology and is a unique system for CRE surveillance and inter-facility communication that relies on the participation of healthcare facilities and laboratories across the state. Continued reporting and data quality improvements are needed to ensure that the data collected are accurate and actionable and to help monitor Illinois' progress in CRE control.

Contact

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

References

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Appendix: 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