

Illinois Carbapenem-Resistant *Enterobacteriales* (CRE) Surveillance Report, November 2013 – December 2020

Introduction

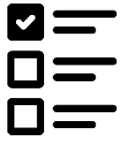
Carbapenem-resistant *Enterobacteriales* (CRE) are highly resistant bacteria that have a high attributable mortality [1], are difficult to treat, and pose hardship to patients and health care facilities [2]. The Illinois Department of Public Health, in partnership with the Centers for Disease Control and Prevention (CDC) Prevention Epicenter Program in Chicago, developed the Extensively Drug-Resistant Organism (XDRO) registry for surveillance and control of XDROs. Since November 2013, health care facilities and laboratories in Illinois have been required to report all CRE-colonized patients to the XDRO registry. Facilities use the XDRO registry (via manual query or automated alerts) to identify patients with a prior history of CRE colonization and to implement infection control precautions.

To support CRE prevention efforts in Illinois, this report examines the trends and patterns of CRE reported to the XDRO registry from November 1, 2013 through December 31, 2020.

Key Points

- ❖ Clinical CRE cases and incidence rates have consistently decreased from 2015 through 2020.
- ❖ KPC remains the most common carbapenemase reported; however, reports of NDM-1 positive isolates increased to a peak of 168 in 2019.
- ❖ After the XDRO registry began allowing the reporting of multiple mechanisms beginning in 2017, cases with multiple mechanisms identified increased from one in 2017 to 15 in 2019.
- ❖ The XDRO registry assists CRE prevention efforts in Illinois through improving interfacility communication and allowing for the timely implementation of infection control precautions.
- ❖ Public health is working to increase infection prevention capacity and CRE prevention through patient screenings, health care worker trainings, and onsite infection control assessments.

Methods



Surveillance Criteria and Case Definition

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 health care facilities are required to report CRE:

- Hospitals
- Hospital-affiliated clinical laboratories
- Independent or free-standing laboratories
- Long-term care facilities
- Long-term acute care hospitals (LTACHs)

Surveillance criteria

Facilities shall report CRE (e.g., *E. coli*, *Klebsiella* species, *Enterobacter* species, *Proteus* species, *Citrobacter* species, *Serratia* species, *Morganella* species, or *Providentia* species) based on at least one of the following laboratory test results:

- Molecular test (e.g., polymerase chain reaction (PCR)) specific for carbapenemase gene;
- Phenotypic test (e.g., Modified Hodge, modified Carbapenem Inactivation Method (mCIM)) specific for carbapenemase production; or
- For *E. coli* and *Klebsiella* species only (excluding *K. aerogenes*): 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).

Case Definitions and Inclusion Criteria

- All CRE reports from November 1, 2013 through December 31, 2020 submitted to the XDRO registry were included in this summary.
- *CRE Case* – the first positive specimen, by specimen collection date, of a given mechanism-organism pairing, per patient from November 1, 2013-December 31, 2020. If the first positive specimen of that organism and mechanism is a screening specimen, the first subsequent positive clinical specimen is also included as a case.
- *Clinical Case* – a CRE case from a specimen obtained from an individual in the course of clinical care (e.g., blood, respiratory, or wound specimens).
- *Screening Case* – a CRE case from a specimen source used for screening (rectal or skin swab).



Deduplication

- Patients were de-duplicated over the entire reporting period by patient last name, first initial, and date of birth. The report with the earliest culture date per patient was included.
- For case-level analyses, the first report by culture date of a given mechanism-organism combination per person was included; the first clinical case of a given combination was also included if it followed the screening case (see case definition above).



Rate Calculations

Acute Care Hospital Rates

- CRE rates at acute care hospitals were calculated as the number of cases per 100,000 patient days.
- Cases were only included if the culture was reported by an acute care hospital and was not classified by the reporter as belonging to an outpatient.
- Facility-wide inpatient-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 CDC, as described in [3].
- Incidence rates were calculated only for cases identified at acute care hospitals due to the lack of patient stay information for other facility types.

Geographic Analyses

- For geographic analyses, cases were classified according to the location of the facility that collected the specimen, regardless of whether it was reported by the facility, a laboratory, or public health.
- As the Chicago area has a higher known prevalence of CRE, along with more resources invested in both case detection and CRE-specific prevention activities, incidence rates for acute care hospitals were calculated separately for facilities inside and outside of Cook County.

Surveillance Data

Box 1. XDRO reporting

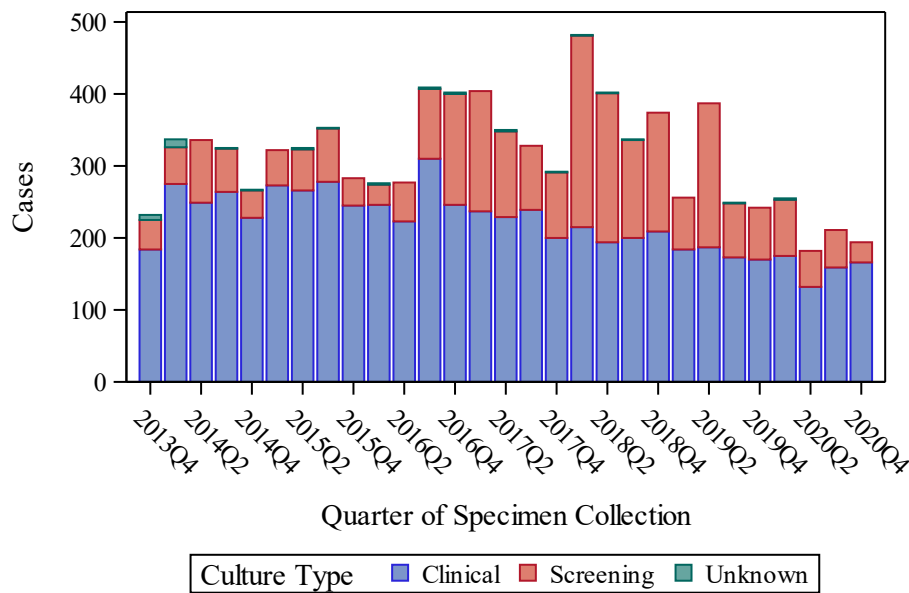
- ❖ Between November 1, 2013 and December 31, 2020, 11,721 CRE reports were submitted to the XDRO Registry.
- ❖ Reports have decreased over time since 2016, with a particularly steep 33% drop from 2019 to 2020, likely due in part to the COVID-19 pandemic and decreased colonization screening.
- ❖ Most reports came from short-term acute care hospitals (6,810, 59%) and long-term acute care hospitals (1,566, 13%).
- ❖ Reports by laboratories and public health accounted for 2,708 (7%) reports. A majority of these reports reflected specimens collected from residents of long-term care facilities (2,708, 63%) and from outpatients (557, 21%).

Table 1. CRE reports¹ by reporting facility type

Facility	Year of Specimen Collection								Total
	2013	2014	2015	2016	2017	2018	2019	2020	
<i>Acute care hospital</i>	179 (74%)	1,034 (66%)	1,230 (72%)	1,033 (58%)	944 (54%)	983 (47%)	876 (56%)	602 (57%)	6,881 (59%)
<i>Long-term acute care hospital</i>	40 (16%)	281 (18%)	148 (9%)	201 (11%)	313 (18%)	251 (12%)	184 (12%)	153 (15%)	1,571 (13%)
<i>Long-term care</i>	3 (1%)	19 (1%)	18 (1%)	72 (4%)	88 (5%)	213 (10%)	85 (5%)	25 (2%)	523 (4%)
<i>Laboratory</i>	21 (9%)	223 (14%)	318 (19%)	444 (25%)	373 (21%)	311 (15%)	242 (16%)	179 (17%)	2,111 (18%)
<i>Local health department</i>	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	134 (6%)	44 (3%)	11 (1%)	189 (2%)
<i>IDPH</i>	0 (0%)	1 (0.1%)	5 (0.3%)	34 (2%)	25 (1%)	178 (9%)	125 (8%)	78 (7%)	446 (4%)

¹Includes all reports submitted by facilities, labs, and public health according to the requirement to report the first CRE isolate obtained from any source during each unique patient/resident encounter. A single case may be reported multiple times across patient/resident encounters.

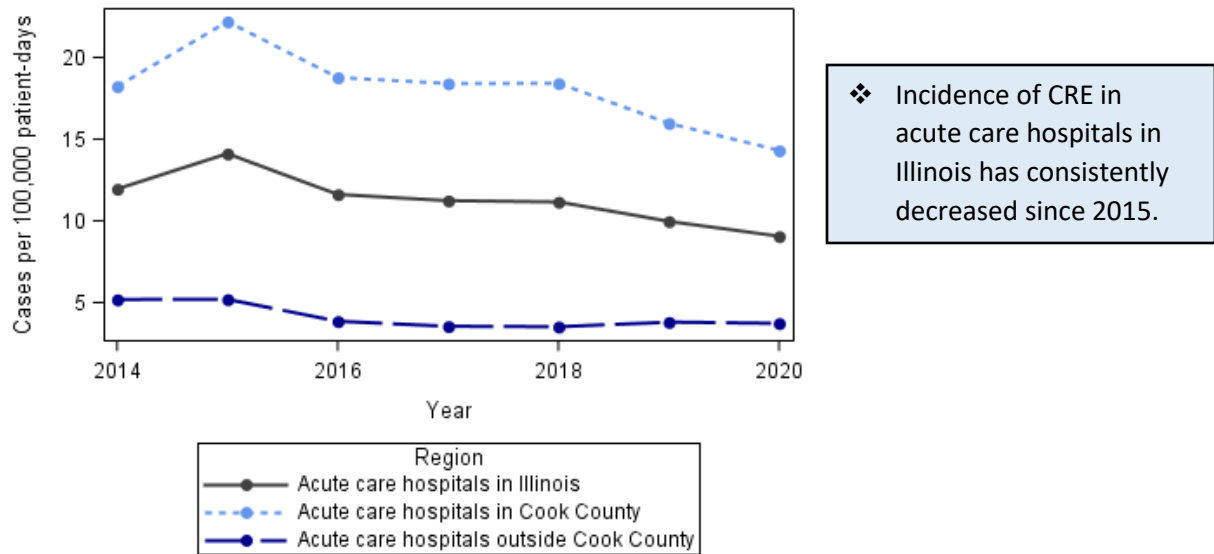
Figure 1. CRE cases¹ reported to the Illinois XDRO registry by date of earliest specimen collection, 11/1/2013-12/31/2020



- ❖ A total of 9,089 cases² of CRE were reported to the XDRO registry between November 1, 2013 and December 31, 2020.
- ❖ Of reported cases, 2,695 (30%) were screening cases and 6,356 (70%) were clinical cases.

²Cases include 201 (2.2%) colonized to clinical cases.

Figure 2. Incidence of clinical CRE cases among inpatients in acute care hospitals, 2014-2020.



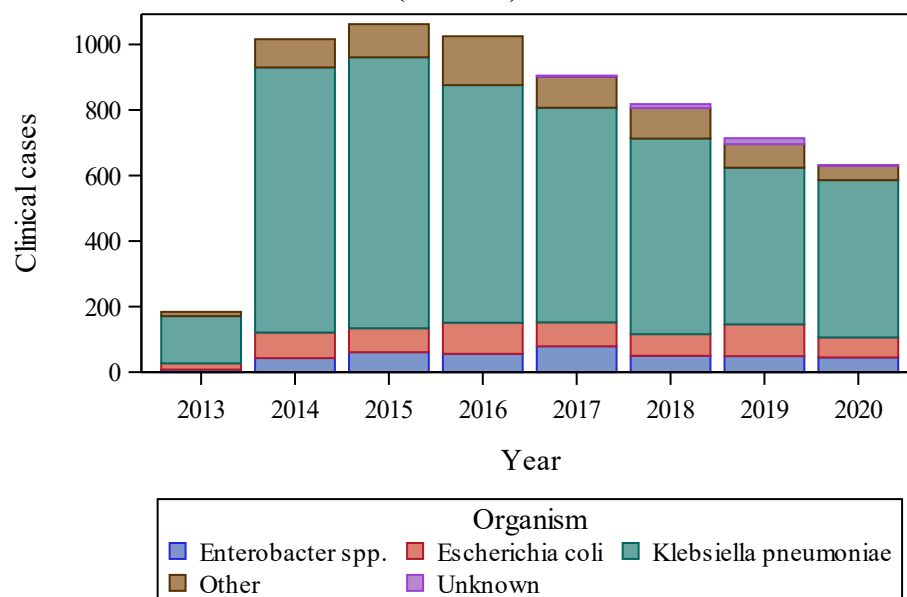
- ❖ Incidence of CRE in acute care hospitals in Illinois has consistently decreased since 2015.

Box 2. Patient characteristics

- ❖ Between November 1, 2013 and December 31, 2020, 7,156 unique individuals were reported to the registry with a CRE case.
- ❖ The median age among individuals with CRE cases was 65 years (interquartile range: 54-75), and 93 (1%) of 7,155 patients were less than 5 years old.
- ❖ Of the 7,154 patients with gender recorded, 3,421 (48%) were female.
- ❖ Only 2,442 (34%) of 7,156 patients had complete information for race and ethnicity.
 - Of these, 1,108 (45%) were non-Hispanic Black, 893 (37%) were non-Hispanic White, 291 (12%) were Hispanic or Latino, 67 (3%) non-Hispanic Asian or Pacific Islander, and 83 (3%) were non-Hispanic Other.
 - Due to the high proportion of missing data, this is likely not representative of all cases in the registry

Organisms Characteristics

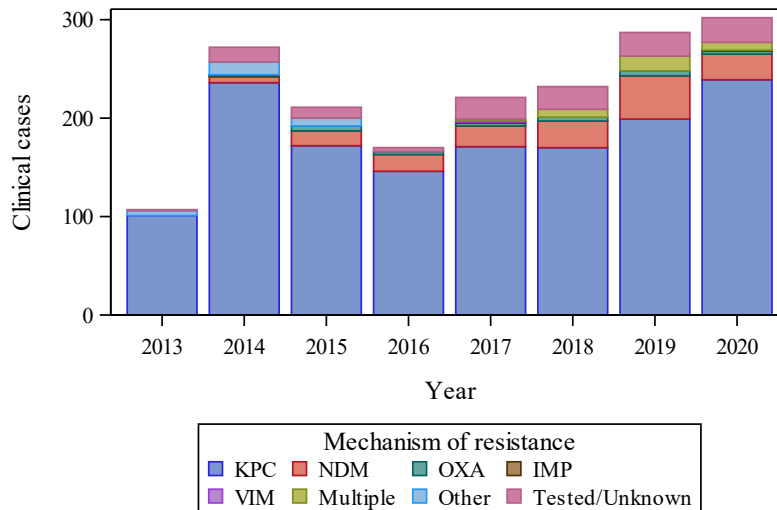
Figure 3. Frequencies of organisms identified among incident clinical CRE cases,³ by year of culture (N=6,356)



- ❖ Across all years, the most common organism was *Klebsiella pneumoniae* (4,715/6,356, 74%).
- ❖ The decrease in clinical CRE cases between 2015 and 2020 primarily reflects a decrease in clinical cases of *Klebsiella pneumoniae*, from 827 cases in 2015 to 480 cases in 2020.

³ Cases include subsequent specimens of a different mechanism/organism pairing from 5,532 total patients with one or more clinical cases.

Figure 3. Frequencies of mechanism of resistance identified among incident clinical CRE cases with mechanism testing performed, by year of culture (N=1,802)

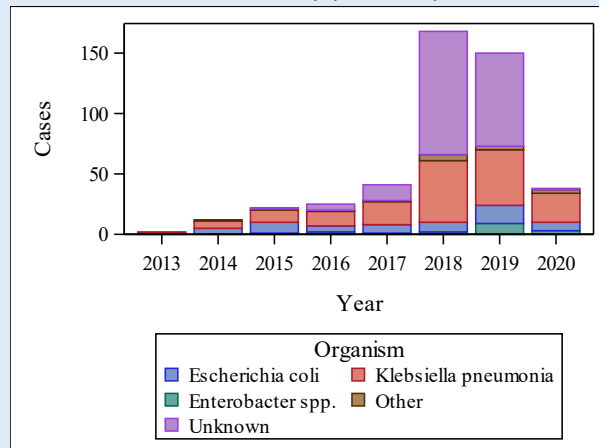


- ❖ Among clinical cases with a known mechanism, the most common was KPC (1,434/1,802, 80%).
- ❖ After the XDRO registry began allowing the reporting of multiple mechanisms beginning in 2017, cases with multiple mechanisms identified increased from one in 2017 to 15 in 2019.
 - The most common mechanism combination identified was KPC and NDM-1, accounting for 69% (22/32) of cases with multiple mechanisms.

Box 2. NDM-1

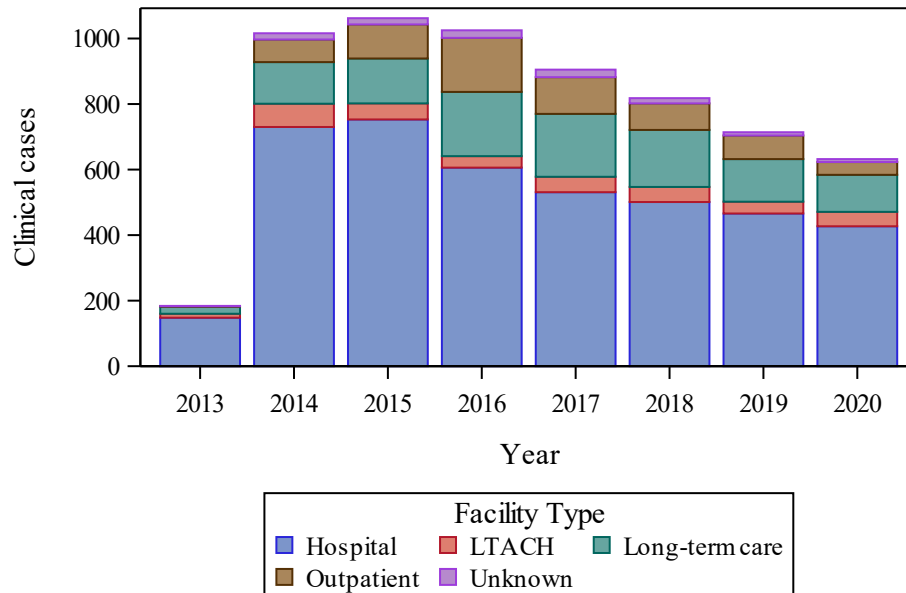
- ❖ Between 2013 and 2020, 458 cases of NDM-1 positive CRE were reported to the XDRO registry, of which 183 (40%) were clinical cases.
- ❖ Reports of NDM-1 positive cases peaked in 2018, with 168 cases reported that year.
- ❖ Of 169 NDM-1 positive CRE cases where the organism was identified, 101 (60%) were associated with *Klebsiella pneumoniae*.
- ❖ In 2014-2015, *Escherichia coli* comprised 43% (9/21) of cases with an identified organism, decreasing to 22% (33/148) in the following years.

Figure 4. Incident NDM-1 CRE cases, by year of specimen collection (N=458).



Facility and Specimen Characteristics

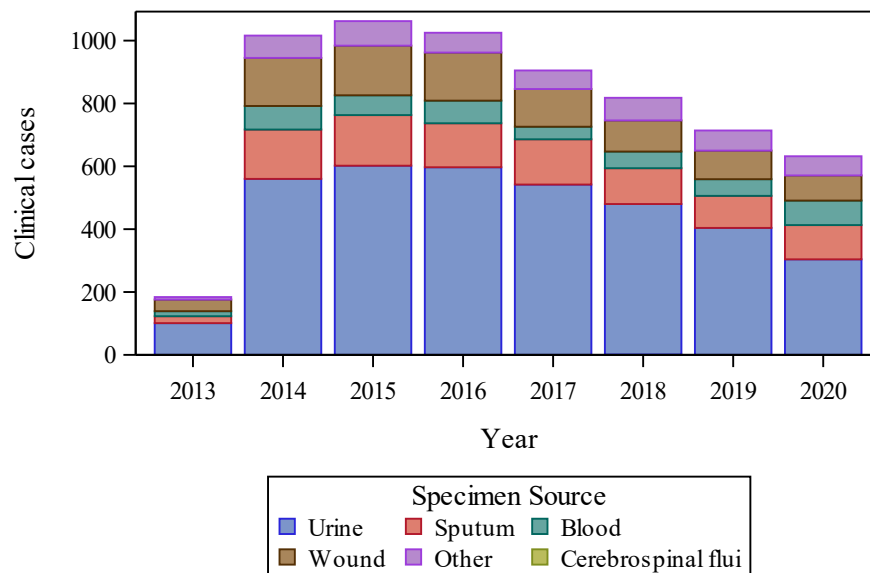
Figure 5. Facility type⁴ where the specimen was obtained for incident clinical CRE cases, by year of culture (N=6,356)



❖ Most cases were identified in patients in acute care hospitals (4162/6356, 65%).

⁴ Hospital = short-term acute care hospital, LTACH = long-term acute care hospital

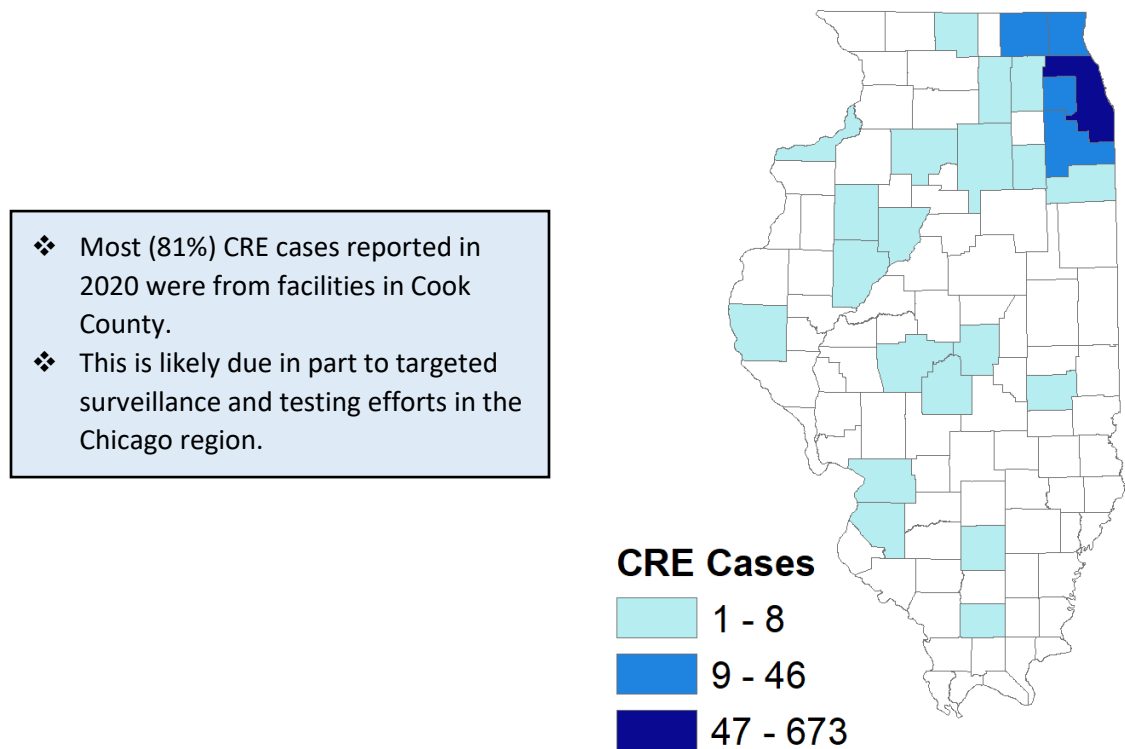
Figure 6. Specimen source for incident clinical CRE cases, by year of culture (N=6,356)



❖ A majority of clinical CRE cases were identified from urine specimens (3,589/6,315, 56%); the next most common specimen sources were sputum (949, 15%) and wounds (891, 14%).

❖ In 2020, the proportion of cases associated with urine specimens decreased to 48%.

Figure 7. CRE cases by county, 2020 (N=841).



Discussion

Following the introduction of the XDRO Registry in 2013, Illinois has seen a decrease in reported clinical CRE isolates from 2015 to 2020. This decrease is likely due in part to increased infection prevention control efforts in health care facilities along with the efforts of public health and community partners. The CDC Chicago Prevention and Intervention Epicenter and Illinois MDRO Task Force, a statewide advisory group of infection control experts, microbiologists, and stakeholders, worked with state and local public health agencies to apply CDC MDRO containment strategies and to increase infection control capacity in Illinois. Through these partnerships, public health efforts included expanding automated alerts to notify facilities of patients with XDROs on admission, encouragement of manual querying, point prevalence surveys of targeted facilities, and onsite infection control assessments and improvements.

In 2020, the COVID-19 pandemic dramatically changed both the patient population in Illinois health care facilities and the capacity of those facilities to address non-COVID-19 priorities, including detection, reporting, and response activities for CRE. Despite a temporary drop in CRE reports in April of 2020 during the first wave of COVID-19 in Illinois, the 18% decrease in clinical CRE cases between 2019 and 2020 is in line with previous years. Screening cases decreased 54% between 2020 and 2019, reflecting a decrease in health system and public health capacity to conduct admission screenings, contact

screenings, and point prevalence surveys. Additionally, CDC-funded Chicago PROTECT, which supported periodic point prevalence surveys at facilities across the Chicago region, ended in 2019. This decrease in point prevalence surveys may lead to future increases in clinical cases due to potential spread of unidentified infections and highlights the importance of renewed attention to control efforts to mitigate MDRO transmission as health systems address COVID-19.

While overall CRE cases decreased over the reporting period, an increase was seen in cases of CRE with an NDM-1 carbapenemase. This increase primarily reflected rising cases of *K. pneumoniae* with NDM-1. This is consistent with a previously published genomic analysis of NDM isolates in the Chicago region, which identified increases in NDM-1-containing *K. pneumoniae* in 2016-2019 tied to intrafacility transmission within ventilator skilled nursing facilities and subsequent spread to other long-term care facilities within their patient transfer networks [4].

While the XDRO registry has greatly increased understanding of XDRO infections in Illinois, it is subject to several limitations. Prior to 2017 multiple mechanisms could not be included in a single report. Facilities may have reported only one mechanism-organism combination, which limits the ability to identify trends before this change. Additionally, the high proportion of missing values for non-mandatory fields, particularly race and ethnicity, precluded interpretation of these data. Further efforts are necessary to increase record completeness and allow for analysis of these data.

IDPH and its partners continue to develop the XDRO Registry to increase its utility and improve the XDRO response in Illinois. Current efforts include expanding the facilities receiving automated alerts of admitted patients in the registry, along with extending this feature to long-term care facilities. As health care facilities address the challenges of the COVID-19 pandemic, IDPH will further support a renewed focus on XDRO containment through increasing screenings, offering trainings for infection prevention personnel, and performing onsite infection control assessments.

IDPH and XDRO Resources

- Additional information on reporting requirements for XDRO can be found at: <http://dph.illinois.gov/topics-services/prevention-wellness/patient-safety-quality/cre/reporting> and <https://www.xdro.org/index.html>.
- Surveillance reports are also available for *C. auris* and Carbapenem-Resistant *Acinetobacter baumannii* at: http://www.healthcarereportcard.illinois.gov/contents/view/State_Reports_of_Current_Interest.
- For questions about this report or assistance with reporting, contact DPH.XDRORegistry@illinois.gov.

References

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