

## SURVEILLANCE REPORT

# Carbapenemase-producing *Enterobacteriaceae* in Ontario, May 1, 2018 – April 30, 2019

## Introduction

Carbapenemase-producing *Enterobacteriaceae* (CPE) are a family of organisms that are resistant to nearly all available antibiotics and are of particular concern in health care settings.<sup>1</sup> In some studies, invasive CPE infections have been associated with mortality rates as high as 40-50%.<sup>2</sup> Data from Canadian CPE surveillance suggest that incidence remains low among acute care hospitals; however, hospital outbreaks have been documented with large variation in rates among regions including Alberta, Quebec and Ontario.<sup>3-7</sup>

From 2012 to 2017, Public Health Ontario conducted hospital-based, voluntary CPE surveillance to understand the changing epidemiology of CPE in Ontario.<sup>8-9</sup> The Ministry of Health and Long-Term Care updated the Health Protection and Promotion Act and its regulations for reporting diseases of public health significance (DOPHS) to include CPE colonization and infection, effective May 1, 2018. The aim of this amendment to legislation was to strengthen data quality and promote public health infrastructure necessary to monitor and prevent the establishment of CPE.

## Objective

The objective of this surveillance report is to summarize the first year of CPE data extracted from iPHIS after its designation as a disease of public health significance in Ontario, May 1, 2018 – April 30, 2019.

## Results

### Case Characteristics

- There were 315 confirmed CPE cases reported from May 1, 2018 through April 30, 2019 ([Figure 1](#)):
  - 29 patients reported had >1 carbapenemase isolated
  - The overall rate of CPE in Ontario was 1.9 per 100,000 population
- The highest reported rates of CPE were in Peel Public Health (6.4 per 100,000), Brant County Health Unit (4.6 per 100,000) and Haldimand-Norfolk Health Unit (3.6 per 100,000) ([Figure 2](#)).
  - 27/35 (77.1%) public health units reported at least 1 case of CPE during the reporting period.

- 177/315 (56.2%) patients were ≥65 years old, 128/315 (40.6%) patients were 18-64 years old, 10/315 (3.2%) patients were <18 years old ([Figure 3](#)).
- 188/315 (59.7%) cases were colonizations, 95/315 (30.2%) cases were infections, 32/315 (10.2%) cases were unspecified ([Figure 4](#)).

## Laboratory Information

- 2 species accounted for 70.5% of isolates causing CPE infection: *E. coli* accounted for 48/95 (50.5%) and *Klebsiella pneumoniae* accounted for 19/95 (20.0%).
  - 10/95 (10.5%) CPE infections had positive blood isolates.
- New Delhi metallo-β-lactamase (NDM)-producing carbapenemase was the most frequently reported carbapenemase (168/333, 50.4%), followed by Oxacillinase-48 (OXA-48) (81/333, 24.3%) and *Klebsiella pneumoniae* carbapenemase (KPC) (60/333, 18.0%) ([Figure 5](#)).

## Risk Factors

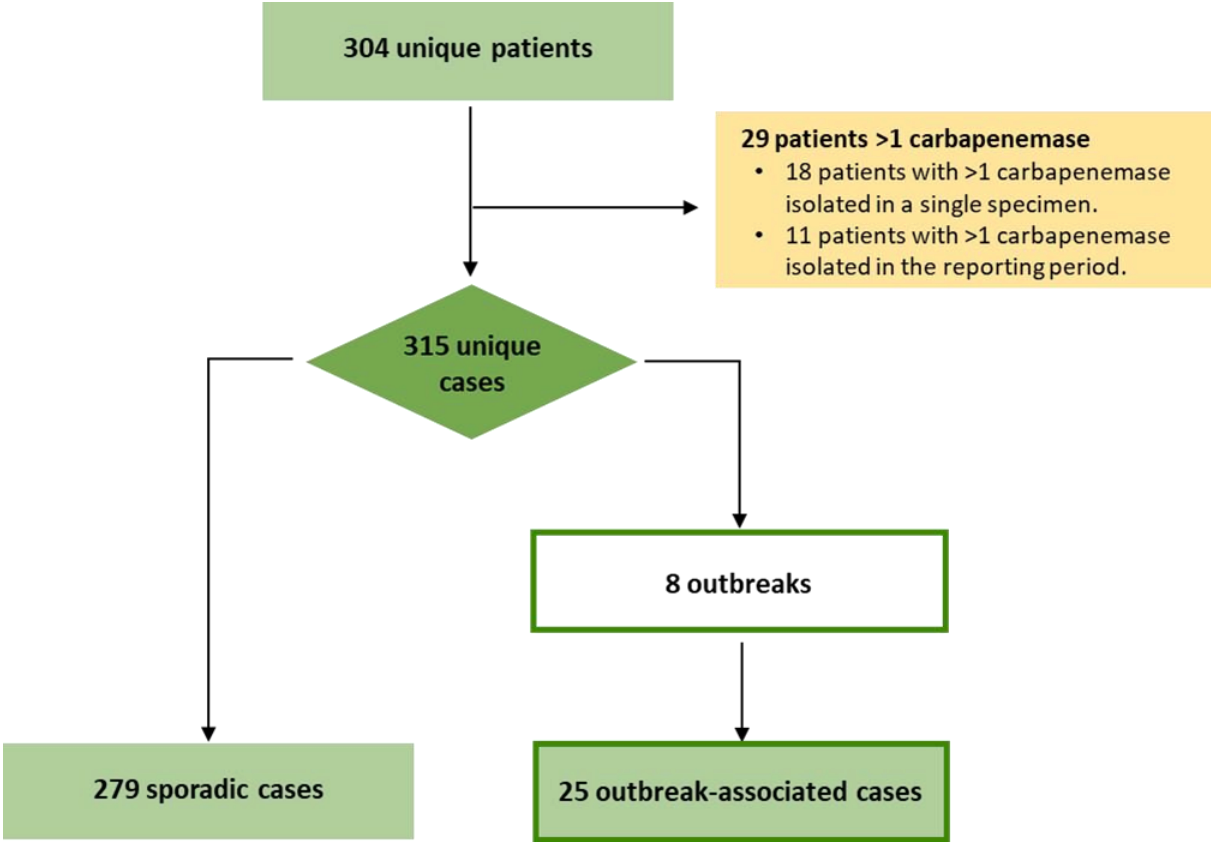
- Among the 289 cases with a risk factor reported ([Table 1](#)):
  - 155/289 (53.6%) reported inpatient hospitalization in Canada in the 12 months
  - 151/289 (52.2%) reported travel outside of Canada in the 12 months
  - 92/289 (31.8%) reported receiving health care outside of Canada in the last 12 months
- Among the 92 cases who reported receiving health care outside of Canada, 45/92 (48.9%) cases received health care in India and 12/92 (13.0%) cases received health care in Pakistan ([Table 2](#)).
- Among the 36 cases who reported travel outside of Canada without receiving health care, 14/36 (38.9%) cases traveled to India and 5/36 (13.9%) cases traveled to Pakistan ([Table 3](#)).

## Outbreaks

- There were 8 outbreaks reported from May 1, 2018 through April 30, 2019 ([Table 4](#)):
  - 25 outbreak-associated cases were reported in total
  - 3 outbreaks of NDM, 3 outbreaks of KPC, and 2 outbreaks of OXA-48 were reported
  - Median outbreak duration: 15 days (range: 2-45 days)
  - Median number of cases per outbreak: 3 cases (range: 2-5 cases)
  - 9/25 (36.0%) outbreak-associated cases were reported by Toronto Public Health

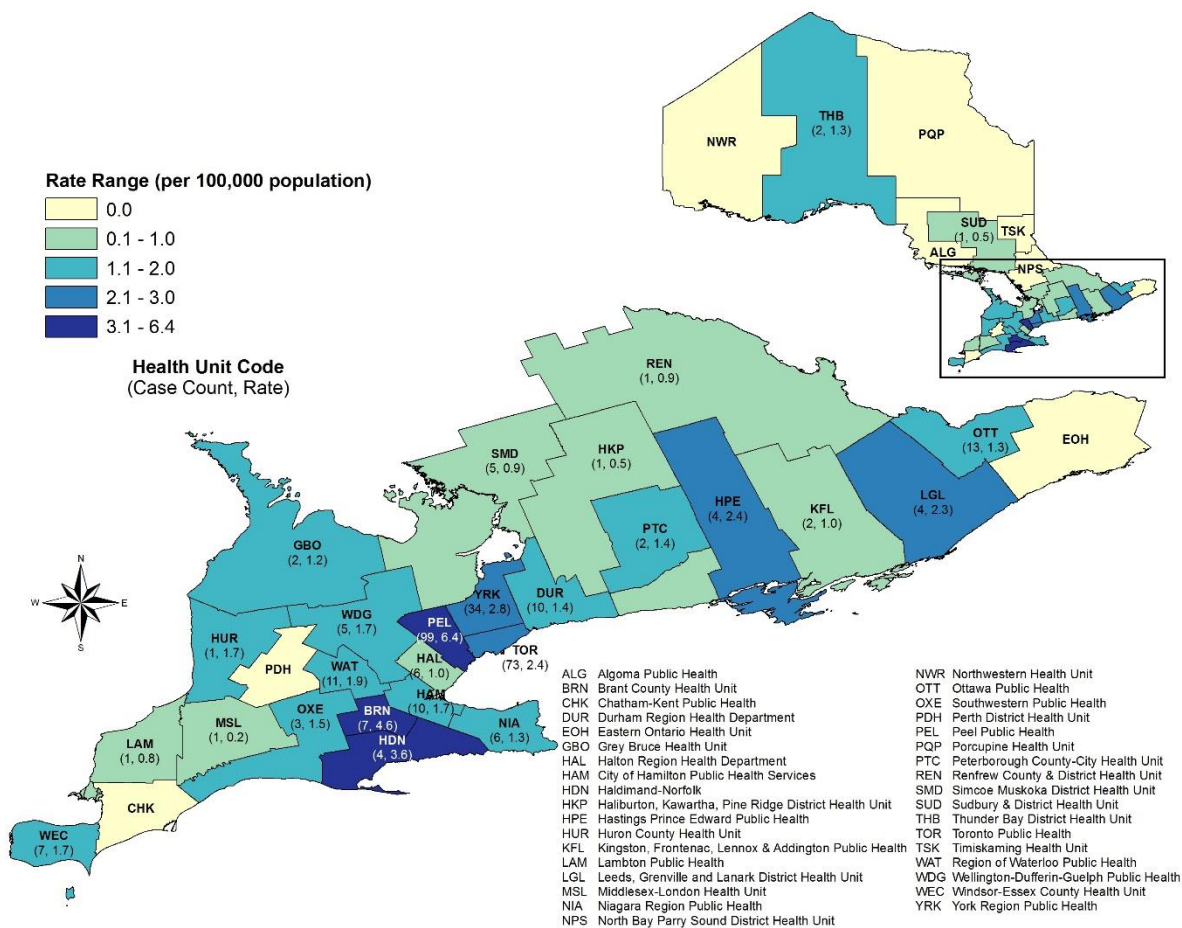
# Epidemiological Summary

Figure 1. Total number of confirmed CPE cases reported in Ontario, May 1, 2018 – April 30, 2019.



# Geographic Distribution

**Figure 2. CPE cases and rates by public health unit in Ontario, May 1, 2018 – April 30, 2019 (n=315).**



## Case Characteristics

Figure 3. CPE cases by age and sex in Ontario, May 1, 2018 – April 30, 2019 (n=315).

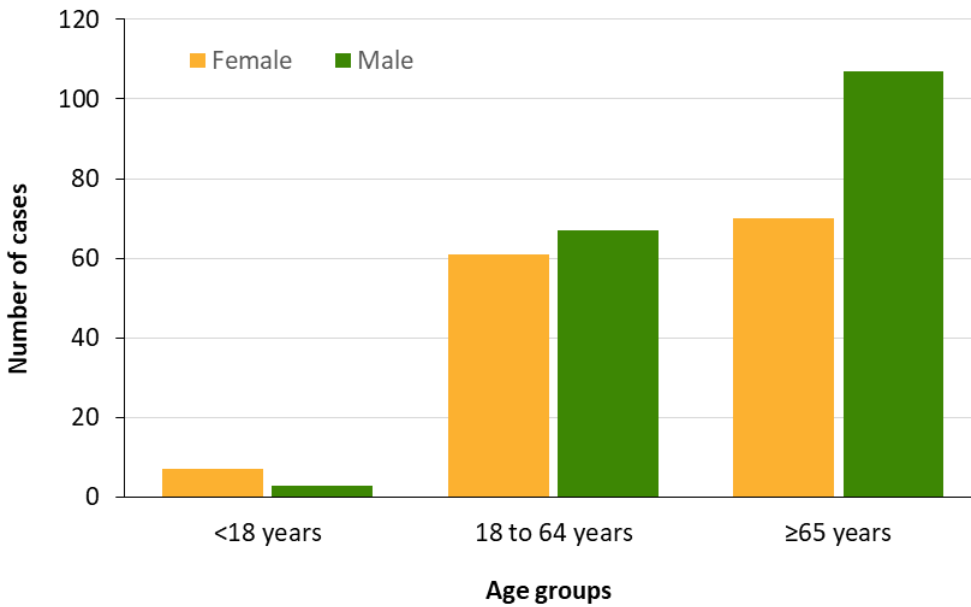
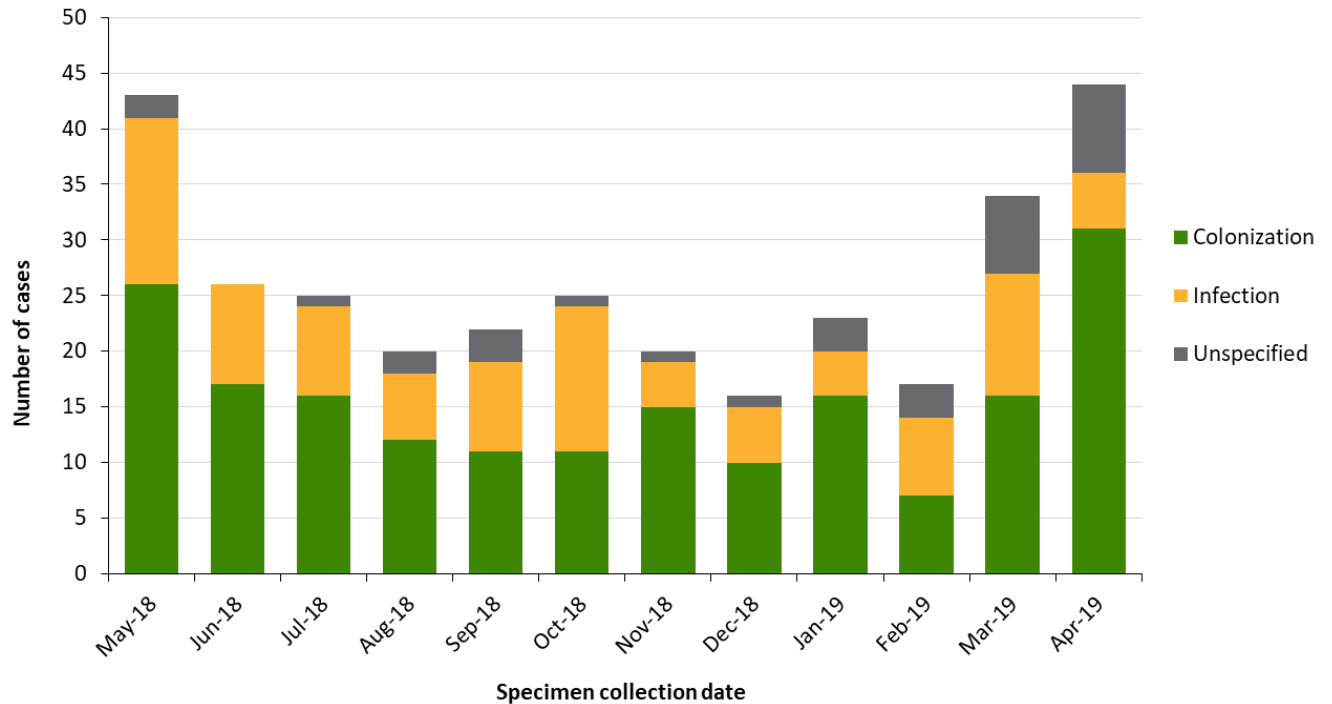


Figure 4. CPE cases stratified by disease status in Ontario, May 1, 2018 – April 30, 2019 (n=315).



## Risk Factors

**Table 1. Risk factors for CPE cases in Ontario, May 2018-April 2019 (n=289).**

Risk Factors	Cases	Proportion (%)
Chronic illness/underlying medical conditions	241	83.4%
Inpatient hospitalization in Canada in the last 12 months	155	53.6%
Travel outside of Canada in the last 12 months	151	52.2%
Medical/surgical procedure in Canada in the last 12 months	102	35.3%
Healthcare received outside of Canada in last 12 months	92	31.8%
ICU admission in Canada in the last 12 months	55	19.0%
Endoscopic procedure in Canada in the last 12 months	41	14.2%
Previous colonization with CPE	31	10.7%
Known contact with a confirmed case	15	5.2%
Other	84	29.1%
<b>Total number of cases with a reported risk factor †</b>	<b>289</b>	<b>-</b>

† Only cases reporting at least one risk factor were included in the denominator. Cases may report more than one risk factor.

## Health Care Received Outside of Canada

**Table 2. Most frequent countries of travel for cases who received health care outside of Canada (n=92).**

Health Care Received Outside Canada by Country	Cases	Proportion (%)
India	45	48.9%
Pakistan	12	13.0%
Bangladesh	3	3.3%
Egypt	3	3.3%
Sri Lanka	3	3.3%
U.S.A	3	3.3%
<b>Total number of cases who travelled and received healthcare †§</b>	<b>92</b>	<b>-</b>

†The denominator includes only cases with a response.

§ The total proportion does not add up to 100% due to travel to >1 country

## Travel Outside of Canada without Health Care

**Table 3. Most frequent countries of travel for cases who did not receive health care outside of Canada (n=36).**

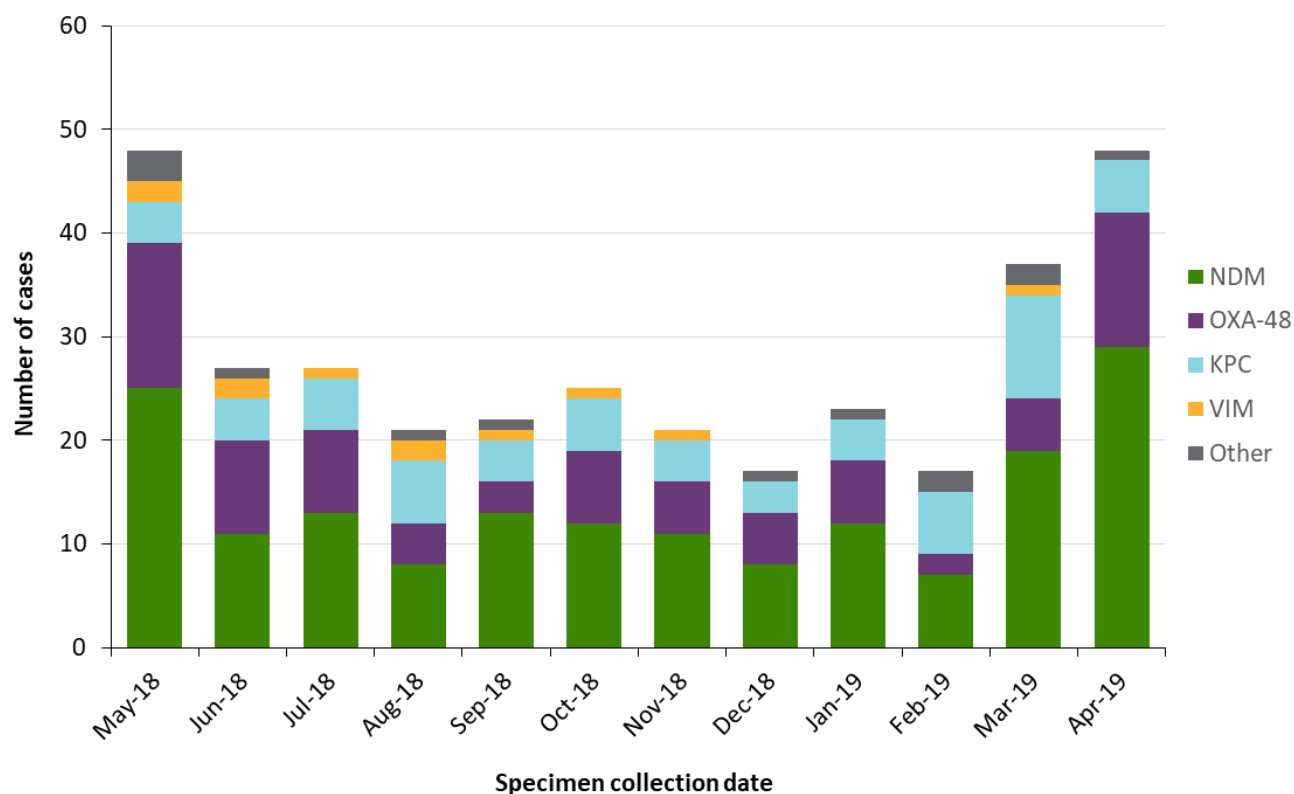
Country of Travel	Cases	Proportion (%)
India	14	38.9%
Pakistan	5	13.9%
China	2	5.6%
Egypt	2	5.6%
Thailand	2	5.6%
Australia	2	5.6%
U.S.A	2	5.6%
<b>Total number of cases who travelled and did not receive health care</b>	<b>36</b>	<b>-</b>

†The denominator includes only cases with a response.

§ The total proportion does not add up to 100% due to travel >1 country.

## Laboratory Information

**Figure 5. CPE cases by carbapenemase in Ontario, May 1, 2018 – April 30, 2019 (n=333)**



\*Other includes GES, IMI, SME; †cases may have  $\geq 1$  carbapenemase.

## Outbreaks

Table 4. CPE outbreaks by public health unit and carbapenemase in Ontario, May 1, 2018 – April 30, 2019 (n=8).

Public Health Unit	Number of Outbreaks	Carbapenemase			Cases per outbreak Median (Range)	Outbreak Duration in Days Median (Range)
		NDM	KPC	OXA-48		
Toronto Public Health	4	1	2	1	2 (2-3)	8.5 (2-16)
City of Hamilton Public Health Services	2	1	1	-	4 (4-5)	33 (21-45)
Haldimand-Norfolk Health Unit	1	1	-	-	4	29
Windsor-Essex County Health Unit	1	-	-	1	3	14
<b>TOTAL</b>	<b>8</b>	<b>3</b>	<b>3</b>	<b>2</b>	<b>3 (2-5)</b>	<b>15 (2-45)</b>



# Technical Notes

## Purpose

The Ministry of Health and Long-Term Care updated the Health Protection and Promotion Act and its regulations for reporting diseases of public health significance (DOPHS) to include carbapenemase-producing *Enterobacteriaceae* (CPE) colonization and infection, effective May 1, 2018.

This report summarizes the first year of epidemiological data extracted from the integrated Public Health Information System (iPHIS), the electronic reporting system for reportable diseases in Ontario. Public health units utilize the [Ontario Investigation Tool](#) to collect and enter CPE data into iPHIS. Data for both individual cases and outbreak data were extracted from iPHIS on July 17, 2019. Extracted data included demographics, personal health information, laboratory specimen results and risk factors.

The purpose of this section is to provide technical information for the CPE Surveillance Report. Technical information includes an in-depth explanation of analytic methods used in the report, and a description of data limitations. Data from this report are not directly comparable to estimates produced in previous reports.

## Data Sources

### Case data:

- The data for this report were based on information entered in the Ontario Ministry of Health, integrated Public Health Information System (iPHIS) database as of **July 17, 2019**.
- iPHIS is a dynamic disease reporting system which allows ongoing updates to data previously entered. As a result, data extracted from iPHIS represent a snapshot at the time of extraction and may differ from previous or subsequent reports.

### Ontario population data:

- Population Projections 2017–18, Ontario Ministry of Health, IntelliHEALTH Ontario. Data extracted on January 24, 2018.

### iPHIS data caveats:

- The data only represent cases reported to public health and recorded in iPHIS. As a result, all counts will be subject to varying degrees of underreporting due to a variety of factors, such as disease awareness and medical care seeking behaviours (which may depend on severity of illness, clinical practice), and reporting behaviours. Changes in [laboratory testing](#) may also affect case counts over time.
- Only provincial case classifications, as listed in the Ontario Ministry of Health [surveillance case definitions](#) are included in the report counts. Cases are excluded if they do not meet the provincial case classifications in place at the time that the case was reported.
- Cases are presented based on 'specimen collection date'. If not available, the Reported Date was used.

- Orientation of case counts by geography is based on the diagnosing health unit (DHU). DHU refers to the case's public health unit of residence at the time of illness onset and not necessarily the location of exposure. Cases for which the DHU was reported as MOHLTC (to signify a case that is not a resident of Ontario) have been excluded from the analyses.
- Risk factors were based on information reported in iPHIS and may not be fully captured for every case. See the [Risk Factors](#) subsection for details.
- Cases for which the Disposition status was reported as ENTERED IN ERROR, DOES NOT MEET DEFINITION, DUPLICATE-DO NOT USE, or any variation on these values have been excluded.

## Case Counts

CPE case counts are based on the earliest specimen collection date. Case counts of CPE include:

- Carbapenemase-Producing Enterobacteriaceae-Infection
- Carbapenemase-Producing Enterobacteriaceae-Colonization
- Carbapenemase-Producing Enterobacteriaceae-Unspecified

Where multiple cases with the same carbapenemase are entered in iPHIS for a client, only the first case is included.

## Rates

To calculate public health unit CPE rates, the number of CPE cases per diagnosing health unit was divided by the health unit specific population and multiplied by 100,000. The CPE rate for Ontario was calculated by dividing the total number of confirmed CPE cases by the total Ontario population and multiplied by 100,000.

## Risk Factors

- For each risk factor, proportions were calculated as the number of 'yes' responses divided by the total number of respondents who reported any risk factor.
- Where cases indicated receipt of health care outside of Canada in the last 12 months but did not indicate travel outside of Canada in the last 12 months, it was assumed that the case travelled outside Canada in the last 12 months.
- Due to changes during initial iPHIS configuration for CPE reporting, risk factor variables that captured the same or similar concepts were combined for analysis purposes, outlined below. Risk factor definitions are provided in the [CPE iPHIS User Guide](#).

The following fields were combined to create the risk factor *"Inpatient hospitalization in Canada in the last 12 months"*:

- Hospitalization in Canada in the last 12 months (available from May 2018 to January 2019)

- Previous hospitalization at the reporting hospital in the last 12 months (available January 2019 onwards)
- Other inpatient hospitalization in Canada in the last 12 months (available January 2019 onwards)

The following fields were combined to create the risk factor “*Health care received outside of Canada in the last 12 months*”:

- Medical/surgical procedure outside of Canada in the last 12 months (available from May 2018 onwards)
- Hospitalization outside of Canada in the last 12 months (available from May 2018 onwards)

## Outbreak Duration

Outbreak duration was defined as the number of days from the outbreak report date and the date the outbreak was declared over.

## Data Limitations

- Asymptomatic individuals colonized with CPE are only identified if they are tested for CPE at a health care facility. Colonized cases are more likely to have chronic underlying medical conditions that predispose them to health care. Asymptomatic cases in the community may be underrepresented.
- Changes to hospital CPE screening practices may affect case counts over time.
- Diagnosing health units investigate and collect data on cases; however, loss to follow-up may occur, particularly for patients discharged from health care facilities.
- Missing data may affect the reliability of conclusions drawn from the available data.

## References

1. Centers for Disease Control and Prevention. Carbapenemase producing carbapenem-resistant *Enterobacteriaceae* (CP-CRE) 2018 case definition [Internet]. Atlanta, GA: Centers for Disease Control and Prevention; [cited 2019 Jul 11]. Available from: <https://wwwn.cdc.gov/nndss/conditions/carbapenemase-producing-carbapenem-resistant-enterobacteriaceae/case-definition/2018/>
2. Centers for Disease Control and Prevention. Facility guidance for control of carbapenem-resistant *Enterobacteriaceae* (CRE) – November 2015 update CRE toolkit [Internet]. Atlanta, GA: Centers for Disease Control and Prevention; [cited 2019 Jul 5]. Available from: <https://www.cdc.gov/hai/organisms/cre/cre-toolkit/index.html>
3. Public Health Agency of Canada. Canadian Antimicrobial Resistance Surveillance System 2017 report. Executive summary [Internet]. Ottawa, ON: Her Majesty the Queen in Right of Canada; 2018 [cited 2019 Jul 5]. Available from: <https://www.canada.ca/en/public-health/services/publications/drugs-health-products/canadian-antimicrobial-resistance-surveillance-system-2017-report-executive-summary.html>
4. Public Health Agency of Canada. Carbapenem-resistant gram-negative bacilli in Canadian acute-care hospitals: surveillance report January 1, 2010 to December 31, 2012. Ottawa, ON: Government of Canada, 2014 [cited 2019 Jul 5]. Available from: <https://www.canada.ca/en/public-health/services/infectious-diseases/carbapenem-resistant-gram-negative-bacilli-canadian-acute-care-hospitals-surveillance-report-january-2010-december-2012.html>
5. Leung V, Loo VG, Frenette C, Domingo M-C, Bourgault A-M, Mulvey MR, et al. First Canadian outbreak of *Enterobacteriaceae*-expressing *Klebsiella pneumoniae* carbapenemase type 3. *Can J Infect Dis Med Microbiol*. 2012;23(3):117–20. Available from: <http://downloads.hindawi.com/journals/cjidmm/2012/725151.pdf>
6. Kohler PP, Melano RG, Patel SN, Shafinaz S, Faheem A, Coleman BL, et al. Emergence of carbapenemase-producing *Enterobacteriaceae*, South-Central Ontario, Canada. *Emerg Infect Dis*. 2018;24(9):1674–82. Available from: [https://wwwnc.cdc.gov/eid/article/24/9/18-0164\\_article](https://wwwnc.cdc.gov/eid/article/24/9/18-0164_article)
7. Ontario Agency for Health Protection and Promotion (Public Health Ontario); Institute for Quality Management in Healthcare. Antimicrobial resistance in common hospital pathogens in Ontario: annual laboratory and hospital survey report 2017 [Internet]. Toronto, ON: Queen's Printer for Ontario; 2019 [cited 2019 Sep 19]. Available from: <https://www.publichealthontario.ca/-/media/documents/aro-survey-2017.pdf>
8. Ontario Agency for Health Protection and Promotion (Public Health Ontario). Surveillance report: carbapenemase-producing *Enterobacteriaceae* (CPE) January 2016-December 2016 [Internet]. Toronto, ON: Queen's Printer for Ontario; 2017 [cited 2019 Sep 19]. Available from: <https://www.publichealthontario.ca/-/media/documents/surveillance-reports/cpe/surveillance-report-cpe-2016.ashx?la=fr>
9. Ontario Agency for Health Protection and Promotion (Public Health Ontario). Carbapenemase-producing *Enterobacteriaceae* January-December 2015 [Internet]. Toronto, ON: Queen's Printer

for Ontario; 2016 [cited 2019 Sep 19]. Available from: <https://www.publichealthontario.ca/-/media/documents/surveillance-reports/cpe/surveillance-report-cpe-2015.pdf?la=en>

10. Ontario. Ministry of Health and Long-Term Care. Infectious diseases protocol. Appendix A: Disease-specific chapters. Chapter: Carbapenemase-producing *Enterobacteriaceae* (CPE) infection or colonization [Internet]. Toronto, ON: Queen's Printer for Ontario; 2019 [cited 2019 Sep 19]. Available from: [http://www.health.gov.on.ca/en/pro/programs/publichealth/oph\\_standards/docs/CPE\\_chapter.pdf](http://www.health.gov.on.ca/en/pro/programs/publichealth/oph_standards/docs/CPE_chapter.pdf)
11. Ontario. Ministry of Health and Long-Term Care. Infectious diseases protocol. Appendix B: Provincial case definitions for diseases of public health significance. Disease: Carbapenemase-producing *Enterobacteriaceae* (CPE) infection or colonization [Internet]. Toronto, ON: Queen's Printer for Ontario; 2019 [cited 2019 Sep 19]. Available from: [http://www.health.gov.on.ca/en/pro/programs/publichealth/oph\\_standards/docs/CPE\\_cd.pdf](http://www.health.gov.on.ca/en/pro/programs/publichealth/oph_standards/docs/CPE_cd.pdf)

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