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ANNUAL REPORT

Antimicrobial Resistance in Common Hospital Pathogens in Ontario: Annual Laboratory and Hospital Survey Report 2018

March 2020

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Background

Antimicrobial resistance poses a serious threat to patient safety and global public health, as current antimicrobials become less effective at treating resistant organisms. Health care-associated infections contribute to increased length of hospitalization, mortality and use of health care resources. In Canada, it is estimated that antimicrobial resistance causes 5,400 deaths and costs the health care system $1.4 billion per year.[1] Patients colonized with antimicrobial resistant organisms (AROs) are a major reservoir for health care-associated pathogens; screening and surveillance programs further our understanding of the burden of AROs and the impact of infection control programs in health care settings.

For nearly 20 years, the Institute for Quality Management in Healthcare (IQMH), formerly Quality Management Program – Laboratory Services (QMP-LS), administered an annual survey on antimicrobial resistance in common hospital pathogens to all licensed Ontario bacteriology laboratories and summarized the data in an annual report. In 2016, Public Health Ontario (PHO) and IQMH established a partnership to conduct an annual survey of AROs across all laboratories and hospitals for surveillance. As part of this collaboration, IQMH resumed laboratory survey administration, while PHO administered the hospital survey on infection control programs. Questions have evolved each year to capture the changing trends in AROs in Ontario.

The 2018 survey was distributed to all licensed microbiology labs and all public hospitals in Ontario. Participants were surveyed on screening and infection control programs, as well as the prevalence of AROs: methicillin-resistant *Staphylococcus aureus* (MRSA), vancomycin-resistant enterococci (VRE), extended spectrum beta-lactamases (ESBLs), carbapenemase-producing organisms (CPO) and *Clostridioides difficile* infections (CDI).

The objective of this report is to summarize the findings of the annual survey on antimicrobial resistance of common hospital pathogens from 2018.

Survey Methods

The laboratory survey was distributed by IQMH and included questions on the number of new patients identified with MRSA, VRE, ESBLs, CPO and CDI. This survey was made available to all 53 hospital-based laboratories in Ontario, 11 community-based private laboratories and 11 PHO reference laboratories across the province. All laboratories surveyed were licensed bacteriology laboratories and able to access the survey via the existing IQMH questionnaire platform in QView™. The infection control survey was also appended to the laboratory survey for hospital-based laboratories that were able to provide the infection control survey to onsite infection control staff.

Concurrently, the IPAC Research team at PHO distributed the infection control survey to all hospitals in Ontario using the PHO survey tool, Acuity4 Survey by Voxco. This survey invited infection control professionals to answer questions about their screening programs for MRSA, VRE, ESBLs, CPOs, CDI and infection control practices.

The surveys were distributed to all licensed microbiology labs and public Ontario hospitals and made available from February 25, 2019 through March 25, 2019. Extensions to complete the survey beyond the specified period were available upon request.

Data from both surveys were extracted, linked on unique identifiers and cleaned for duplicates and incomplete data entry. In most cases, no attempt was made to verify the submitted data and inaccuracies may be present. This survey is dependent on complete and accurate responses in order to provide useful information on AROs that may benefit laboratories practicing bacteriology. Data from the Canadian Institute for Health Information - Discharge Abstract Database accessed through IntelliHEALTH was used as the denominator data to calculate rates.[2] Data were analyzed using SAS 9.3 and Microsoft Excel. Easy Maps v2.0 tool[3] was used to generate the maps, displayed by Local Health Integration Network region (LHIN; Appendix B). Analyses were completed at PHO and coordination between IQMH and PHO was ensured during the development and dissemination of the final report.

Highlights of the survey results are presented in three sections for each organism: screening, infection control practices and laboratory data. Complete aggregate responses to the survey are provided in Appendix C: Detailed Responses to Bacteriology Questionnaire BACT-1902Q (MRSA, VRE, ESBLs, CPO and CDI data for 2018), available upon request.

Results

Survey Response

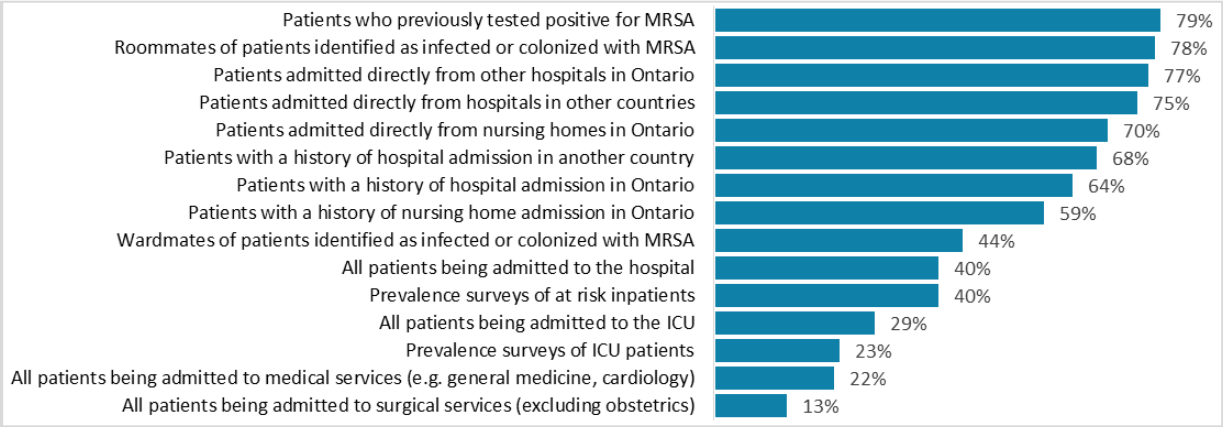
A total of 97/143 (68%) hospital corporations responded to the infection control survey questions. 73/75 (97%) currently licensed bacteriology laboratories responded to the survey. This included 51/53 (96.2%) hospital-based laboratories, 11/11 private community-based laboratories and 11/11 PHO laboratory sites. Non-respondents included one laboratory that transitioned from a microbiology laboratory to a core laboratory and another laboratory that underwent renovations in 2018.

Methicillin-resistant *Staphylococcus aureus* (MRSA)

Hospital Screening

All hospitals responded as having a screening program for MRSA (consistent with results from 2017). Hospitals were likely to screen patients who were previously positive for MRSA, roommates of patients positive for MRSA and patients admitted from other hospitals or nursing homes in Ontario (Figure 1).

Figure 1. Criteria used by hospitals for MRSA patient screening, 2018



Infection Control Practices

All hospitals responded that Additional Precautions are used to care for patients with MRSA. 95/97 (97.9%) hospitals responded that Additional Precautions are used for all colonized and infected patients. Two (2.1%) hospitals responded that Additional Precautions are used for patients with MRSA infections only.

Patients with MRSA are most commonly accommodated with a single room and dedicated toileting (92, 94.8%), followed by cohorting patients with MRSA and providing dedicated toileting (41, 42.3%) and cohorting patients with MRSA and providing shared toileting (27, 27.8%).

There were 77 (79.4%) hospitals that responded Additional Precautions for MRSA may be discontinued once three negative swabs have been taken, one week apart. Seven (7.2%) hospitals responded that patients with MRSA remain in Additional Precautions for the duration of their hospitalization.

11 (11.3%) hospitals responded that decolonization protocols may be applied to patients with MRSA; 67 (69.1%) hospitals responded they do not decolonize patients with MRSA. Six (6.2%) hospitals decolonize all patients with MRSA, three (3.1%) hospitals decolonize to facilitate patient placements and two (2.1%) decolonize as part of the pre-operative procedure for surgical patients. There were 19 (19.6%) hospitals that responded MRSA decolonization may be considered for a variety of other reasons, including on a case by case basis, patients with MRSA for prolonged durations and patients without wounds or indwelling devices.

Laboratory Data

14,371 new patients with MRSA isolated from any specimen site (i.e., colonizations or infections) were reported in 2018 (overall rate: 12.2 per 1,000 patients).

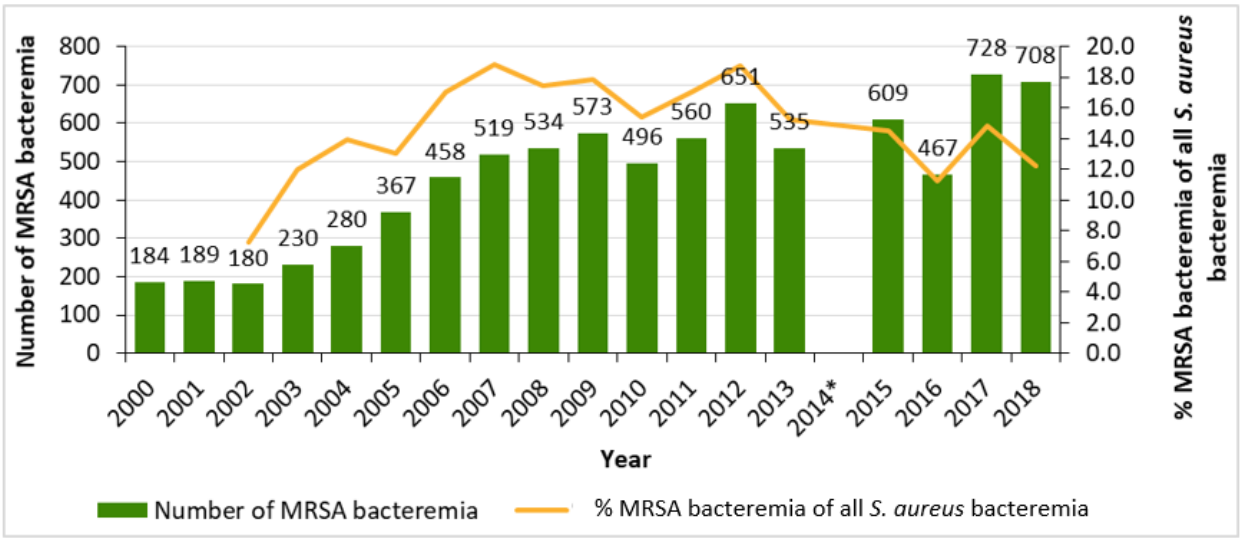
- 708 (4.9%) patient specimens were isolated from blood culture
- 4,528 (31.5%) patients with MRSA had specimens isolated from non-screening sites, excluding blood culture

The total number of patients with MRSA isolated from any specimen site increased 20% from 11,969 in 2017 to 14,371 in 2018. The proportion of patients with MRSA from blood culture decreased from 6.1% in 2017 compared to 4.9% in 2018.

In 2018, the total number of methicillin-susceptible *S. aureus* bacteremia reported was 5,101. Methicillin-resistant *S. aureus* bacteremia as a proportion of all methicillin-susceptible *S. aureus* bacteremia was 14.8% in 2017 and 12.2% (708/5,809) in 2018 (Figure 2).

Central West, North West, Erie St. Clair and Champlain LHINs had the highest rate of MRSA isolated from any specimen site in 2018 (Figure 3; see Table 1 for values).

Figure 2. MRSA bacteremia reported from hospital laboratories in Ontario, 2000–2018



*Survey was not conducted in 2014.

Figure 3. Rate of patients with MRSA from any specimen site (colonizations and infections) reported from hospital laboratories in Ontario by LHIN, 2018

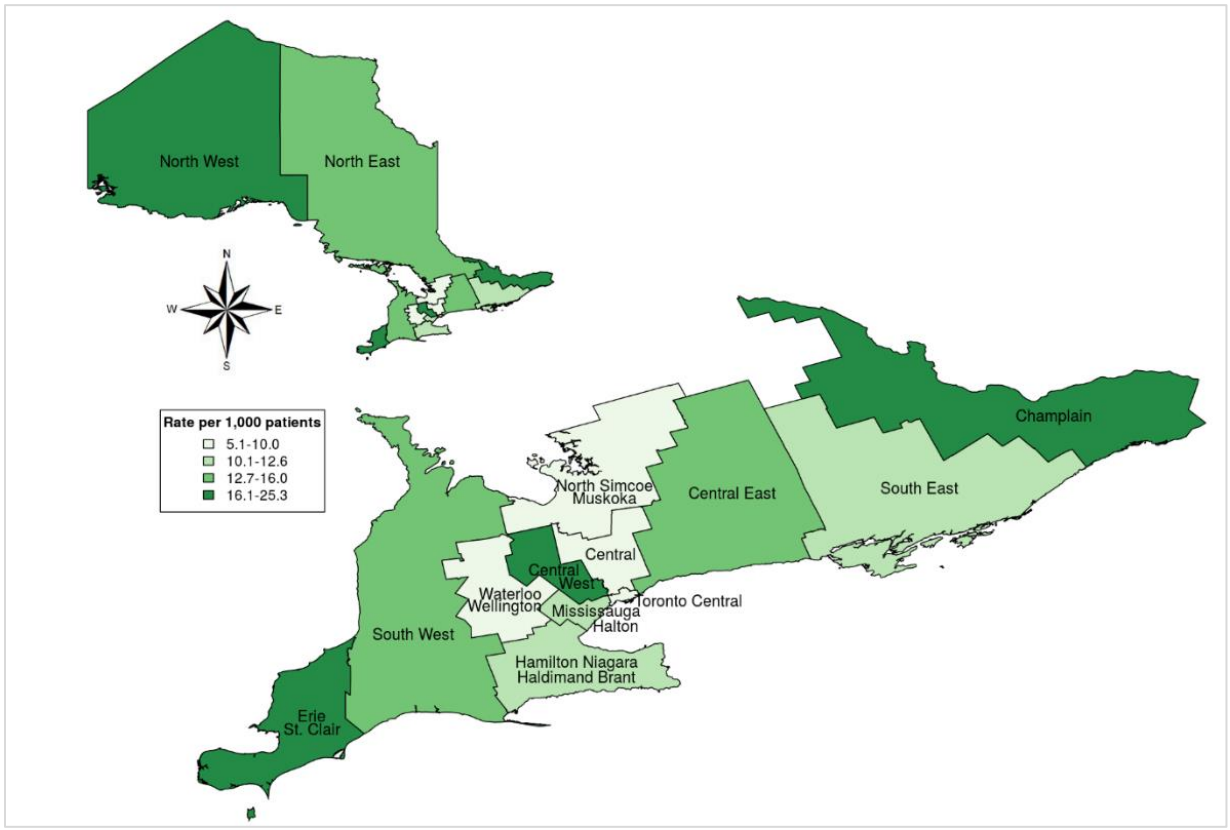


Table 1. Patients with MRSA from any specimen site (colonizations and infections) reported from hospital laboratories in Ontario by LHIN, 2017–2018

LHIN	2017 Patients with MRSA from any specimen site	2017 Rate per 1,000 patients	2018 Patients with MRSA from any specimen site	2018 Rate per 1,000 patients
Central	444	8.5	883	7.1
Central East	696	6.5	1,399	13.5
Central West	196	8.0	1,412	25.3
Champlain	1,257	14.1	1,814	16.6
Erie St. Clair	961	13.6	884	17.0
Hamilton Niagara Haldimand Brant	1,977	18.1	1,428	10.9
Mississauga Halton	406	7.6	1,026	12.1

LHIN	2017 Patients with MRSA from any specimen site	2017 Rate per 1,000 patients	2018 Patients with MRSA from any specimen site	2018 Rate per 1,000 patients
North East	938	16.6	838	14.0
North Simcoe Muskoka	317	8.5	335	8.2
North West	1,100	39.3	498	18.9
South East	512	8.9	460	10.1
South West	1,204	8.8	1,325	13.1
Toronto Central	1,486	7.7	1,774	9.9
Waterloo Wellington	475	9.6	295	5.1
Overall	11,969	11.3	14,371	12.2

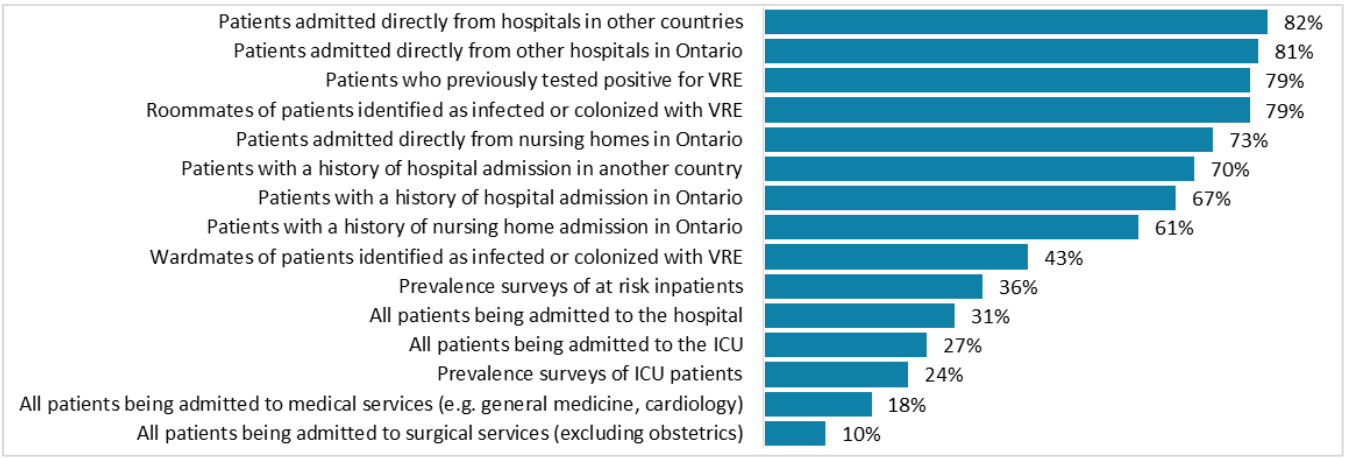
Vancomycin-resistant enterococci (VRE)

Hospital Screening

67/96 (69.8%) hospitals reported having a screening program for VRE in 2018, comparable to 74% of hospitals that reported having a screening program for VRE in 2017.

Hospitals with a screening program for VRE were likely to identify patients admitted directly from a hospital in another country, admitted directly from another hospital in Ontario or patients who previously tested positive for VRE (Figure 4).

Figure 4. Criteria used by hospitals for VRE patient screening, 2018



Infection Control Practices

67/97 (69.1%) hospitals responded that Additional Precautions are used to care for all patients colonized and infected with VRE; six (6.2%) hospitals responded that Additional Precautions are only used for patients with VRE infections. There were 21 (21.6%) hospitals that reported Additional Precautions are not used for patients with VRE, compared to 10% of hospitals that reported Additional Precautions were not used for patients with VRE in 2017.

71 (73.2%) hospitals accommodated patients with VRE in a single room with dedicated toileting, 30 (30.9%) hospitals cohort patients positive for VRE together and provide dedicated toileting and 18 (18.6%) hospitals cohort patients positive for VRE and provide shared toileting. There were 24 (24.7%) hospitals that responded special accommodations are not used for patients with VRE.

55/96 (57.3%) hospitals reported that Additional Precautions for patients with VRE may be discontinued once three negative swabs for VRE have been taken, one week apart. 17 (17.7%) hospitals responded that no conditions are considered before discontinuing Additional Precautions or Additional Precautions are not used for patients with VRE. Six (6.3%) hospitals reported patients with VRE remain in Additional Precautions for the duration of their hospitalization.

Laboratory Data

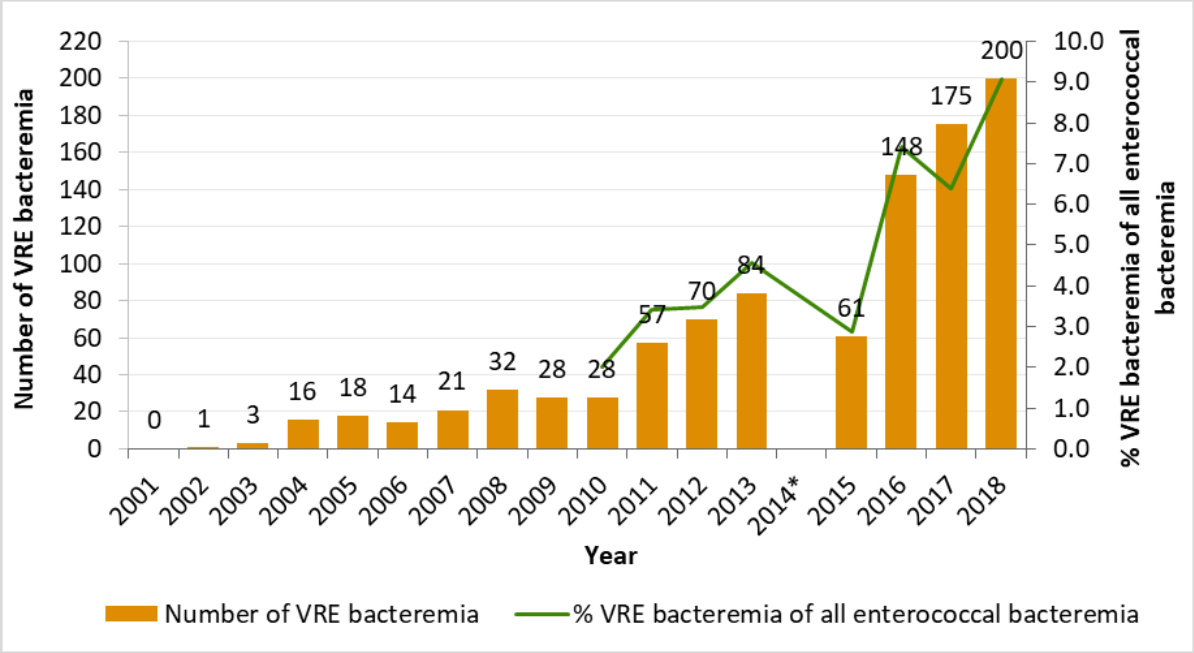
A total of 5,461 new patients with VRE isolated from any specimen site (i.e., colonizations and infections) were reported in 2018.

- 200/5,461 (3.7%) patients with VRE had specimens isolated from blood culture
- 477 (8.7%) patients with VRE had specimens isolated from non-screening sites, excluding blood culture
    - *E. faecium*: 441/477 (92.5%)
    - *E. faecalis*: 22/477 (4.6%)
    - Other enterococci: 14/477 (2.9%)

In 2018, the total number of vancomycin-susceptible enterococcal bacteremia was 2,004. The proportion of vancomycin-resistant enterococcal bacteremia of all vancomycin-susceptible enterococcal bacteremia was 6.4% in 2017 and 9.1% (200/2,204) in 2018 (Figure 5).

Laboratories in Champlain, South East and North West LHINs reported the highest rates of VRE isolated from clinical specimen sites in 2018 (Figure 6, see values in Table 2). Ontario laboratories reported 1,499 patients with VRE isolated from a clinical specimen site in 2017 (Table 2).

Figure 5. VRE bacteremia reported from laboratories in Ontario, 2001–2018



*Survey was not conducted in 2014

Figure 6. Rate of patients with VRE isolated from a clinical specimen in Ontario by LHIN, 2018

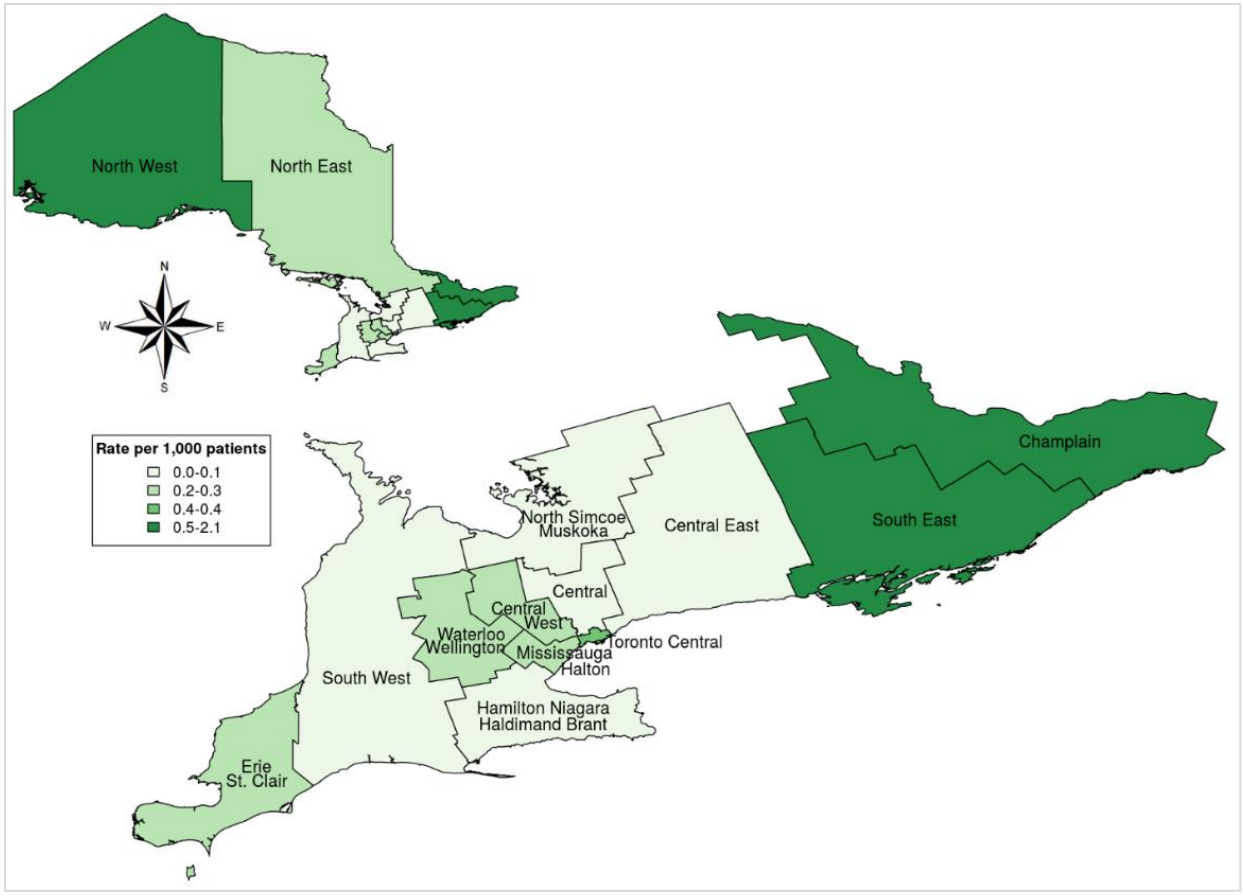


Table 2. Patients with VRE isolated from non-screening specimen sites in Ontario by LHIN, 2017–2018

LHIN	2017 Patients with VRE from non-screening specimen sites	2017 Rate per 1,000 patients	2018 Patients with VRE from non-screening specimen sites	2018 Rate per 1,000 patients
Central	14	0.5	2	0.0
Central East	70	0.7	11	0.1
Central West	24	0.3	15	0.3
Champlain	284	3.2	232	2.1
Erie St. Clair	74	1.0	18	0.3
Hamilton Niagara Haldimand Brant	32	0.3	7	0.1
Mississauga Halton	23	0.4	25	0.3

LHIN	2017 Patients with VRE from non-screening specimen sites	2017 Rate per 1,000 patients	2018 Patients with VRE from non-screening specimen sites	2018 Rate per 1,000 patients
North East	48	0.8	16	0.3
North Simcoe Muskoka	11	0.4	0	0.0
North West	494	16.8	12	0.5
South East	91	1.8	39	0.9
South West	207	0.6	7	0.1
Toronto Central	119	0.6	79	0.4
Waterloo Wellington	8	0.2	14	0.2
Overall	1,499	1.2	477	0.4

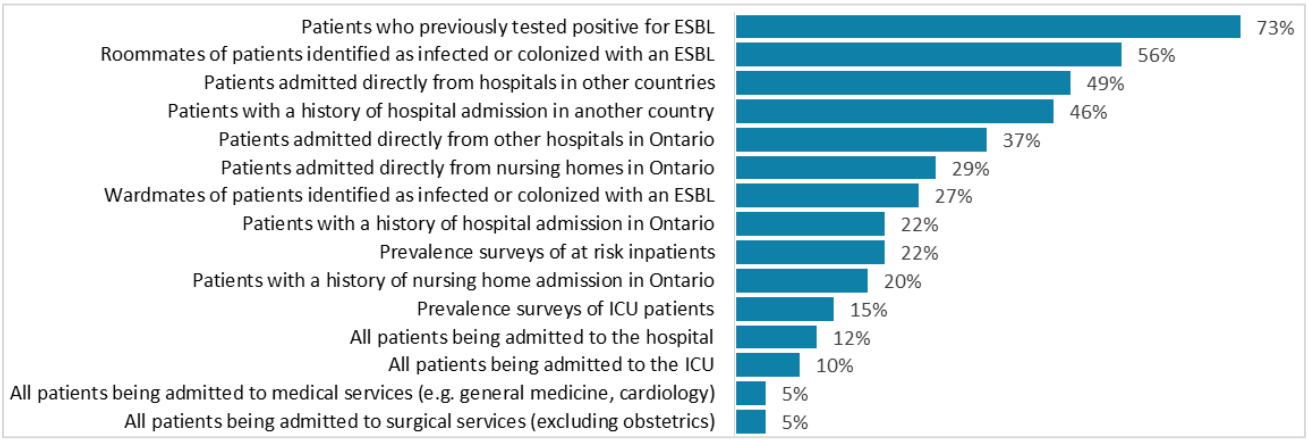
Extended Spectrum Beta-Lactamases (ESBL)

Hospital Screening

41/96 (43%) hospitals reported having a screening program for extended spectrum beta-lactamases (ESBLs) in 2018. In 2017, 47% of hospitals surveyed reported having an ESBL screening program.

Hospitals with a screening program for ESBLs were likely to identify patients who were previously positive for ESBLs, roommates of patients identified as infected or colonized with ESBLs and patients admitted from a hospital abroad or those with a history of hospitalization abroad (Figure 7).

Figure 7. Criteria used by hospitals for ESBL patient screening, 2018



Infection Control Practices

A total of 54/96 (56.3%) hospitals responded that Additional Precautions are used for all patients colonized and infected patients with ESBLs; six (6.3%) hospitals responded that Additional Precautions are only used for patients infected with ESBLs. There were 25 (26.0%) hospitals that reported Additional Precautions are not used for patients with ESBLs.

Patients with ESBLs were most commonly accommodated with a single room and dedicated toileting (63, 65.6%), followed by cohorting with other patients positive for ESBLs with dedicated toileting (24, 25%) and multi-patient rooms with dedicated or shared toileting (23, 23.9%). There were 29 (30.2%) hospitals that reported special accommodations are not used for patients with ESBLs.

34/95 (35.8%) hospitals responded Additional Precautions may be discontinued once three negative swabs for ESBL are taken, one week apart. 17 (17.9%) hospitals reported that patients who test positive for ESBLs remain on Additional Precautions for the duration of their hospitalization. There were 32 (33.7%) hospitals that responded Additional Precautions are not used for patients with ESBLs or there are no conditions considered for discontinuing Additional Precautions for patients with ESBLs.

Laboratory Data

There were 538,789 isolates of *E. coli*, 71,218 isolates of *Klebsiella* spp., 49,540 isolates of *Pseudomonas aeruginosa*, and 3,914 isolates of *Acinetobacter* spp. from any specimen site were reported by laboratories in 2018.

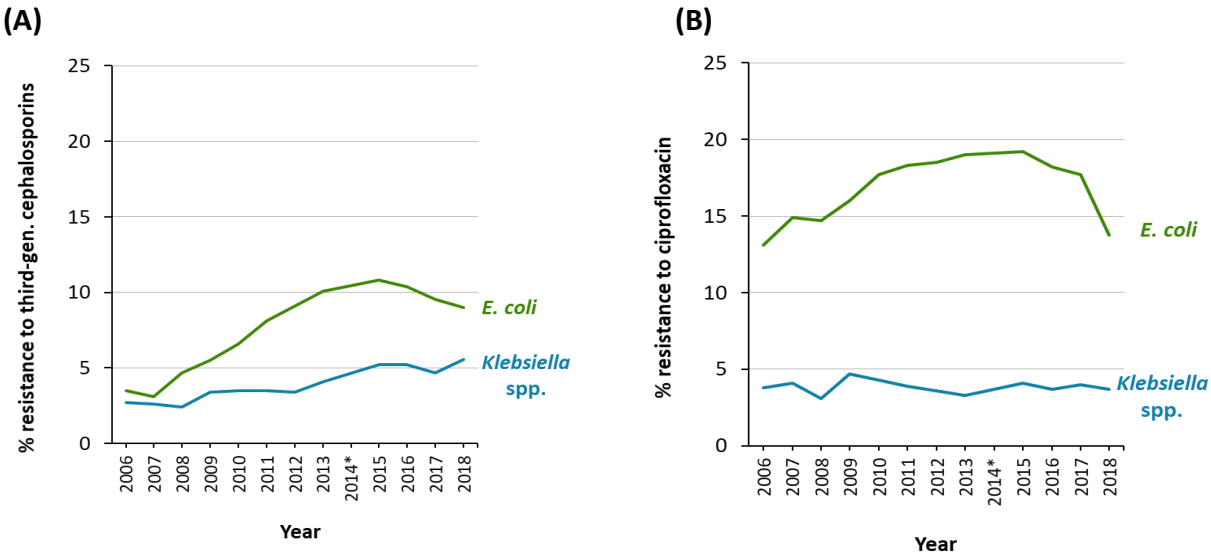
Resistance to third-generation cephalosporins among *E. coli* isolated from all specimen sites has decreased slightly since 2015 (Figure 8, panel A). Resistance to cephalosporins was 10.8% in 2015 and 9.6% in 2017 and 9.0% in 2018. Resistance to cephalosporins among *Klebsiella* spp. isolated from all specimen sites has remained consistent (5.2% resistant in 2015 and 2016, 4.7% resistant in 2017, 5.5% resistant in 2018).

Similarly, resistance among *E. coli* to ciprofloxacin has decreased slightly over time since 2013 (19.0% in 2013, 19.2% in 2015, 17.7% in 2017, 13.8% in 2018), whereas *Klebsiella* spp. resistance to ciprofloxacin has remained relatively stable around 4% for the last three years (Figure 8, panel B). Among *P. aeruginosa* isolates, resistance to ciprofloxacin has decreased over the last few years, from 13.6% in 2015, 12.7% in 2016, 9.0% in 2017 and 10.2% in 2018 (Figure 9). Resistance to ciprofloxacin in *Acinetobacter* spp. was 6.8% in 2015, 5.6% in 2016 and 5.2% in 2017 and 2018.

P. aeruginosa isolates resistant to meropenem has been consistent over the last three years, from 7.0% in 2016 to 7.8% in 2017, to 6.7% in 2018 (Figure 10). Resistance to cephalosporins among *Acinetobacter* spp. from any specimen type was 14.4% in 2017 and 11.0% in 2018 (Figure 10); 19.8% resistance in 2017 and 19.2% in 2018 from blood isolates only (Figure 11).

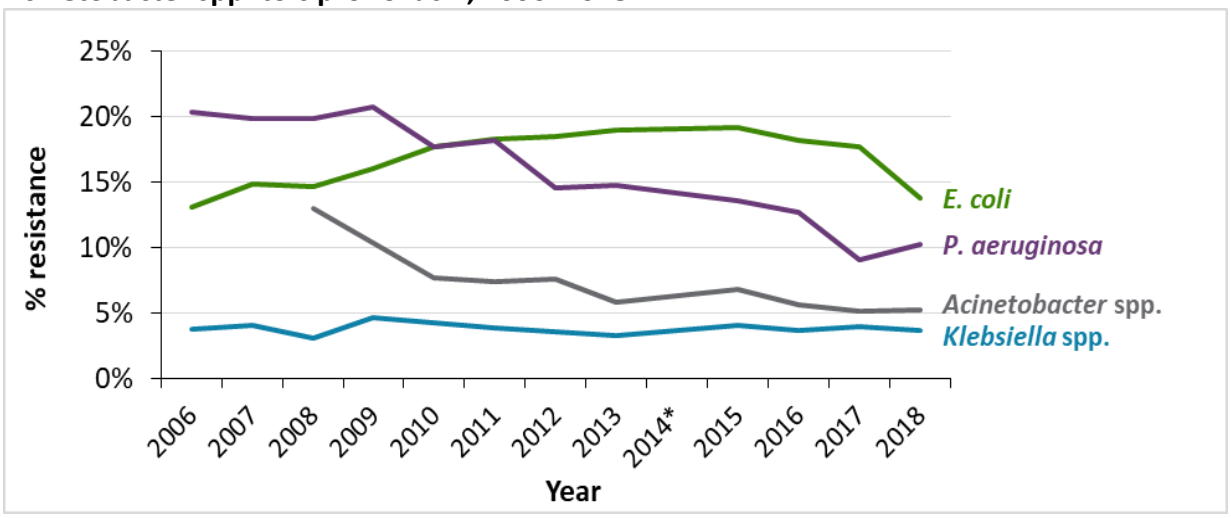
E. coli resistance from blood to third-generation cephalosporins was 7.7% in 2018, down from 13.9% resistance in 2017 (Figure 11). *E. coli* resistance in urine to third-generation cephalosporins was 10.0% in 2018, similar to 9.3% resistance in 2017. (Figure 12). Resistance to ciprofloxacin among *E. coli* isolated from blood was 20.8% in 2017 and decreased to 10.9% in 2018; resistance was 17.8% for *E. coli* isolated from urine in 2017 and 14.1% in 2018.

Figure 8. Percent resistance of all isolates of *E. coli* and *Klebsiella* spp. to (A) cephalosporins and (B) ciprofloxacin, 2006–2018



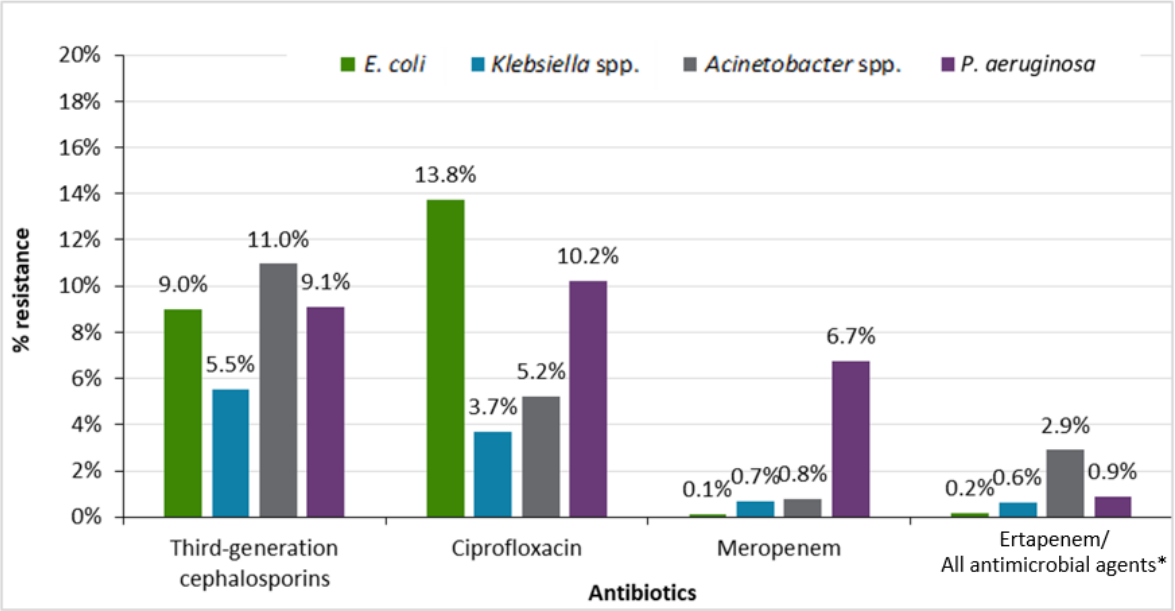
*Survey was not conducted in 2014.

Figure 9. Percent resistance of all isolates of *E. coli*, *Klebsiella* spp., *P. aeruginosa* and *Acinetobacter* spp. to ciprofloxacin, 2006–2018



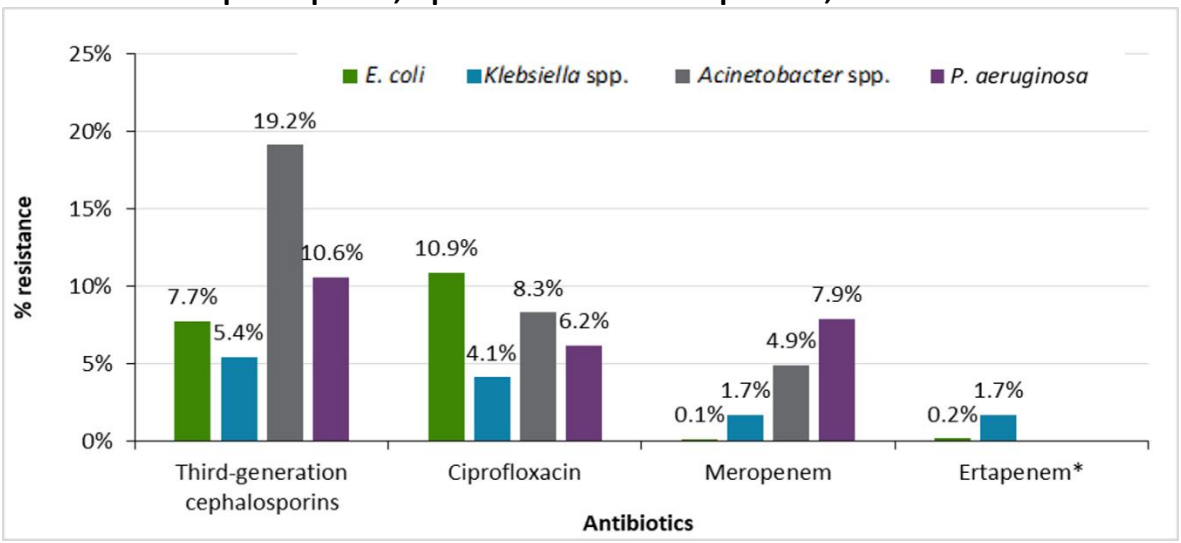
*Survey was not conducted in 2014

Figure 10. Percent resistance of all isolates of *E. coli, Klebsiella* spp., *Acinetobacter* spp., and *P. aeruginosa* to third-generation cephalosporins, ciprofloxacin and carbapenems, 2018



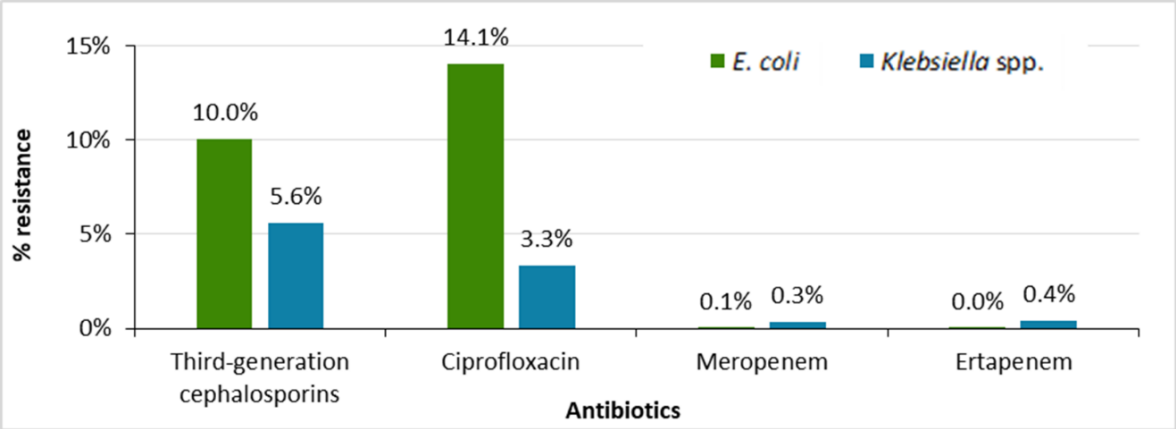
*Note: Resistance to ertapenem is shown for *E. coli* and *Klebsiella* spp. only. Resistance to all antimicrobial agents tested is shown for *P. aeruginosa* and *Acinetobacter* spp.

Figure 11. Percent resistance of *E. coli, Klebsiella* spp., *Acinetobacter* spp., and *P. aeruginosa* from blood to cephalosporins, ciprofloxacin and carbapenems, 2018



*Note: Resistance to ertapenem is shown for *E. coli* and *Klebsiella* spp. only.

Figure 12. Percent resistance of *E. coli* and *Klebsiella* spp. from urine specimens to cephalosporins, ciprofloxacin and carbapenems, 2018



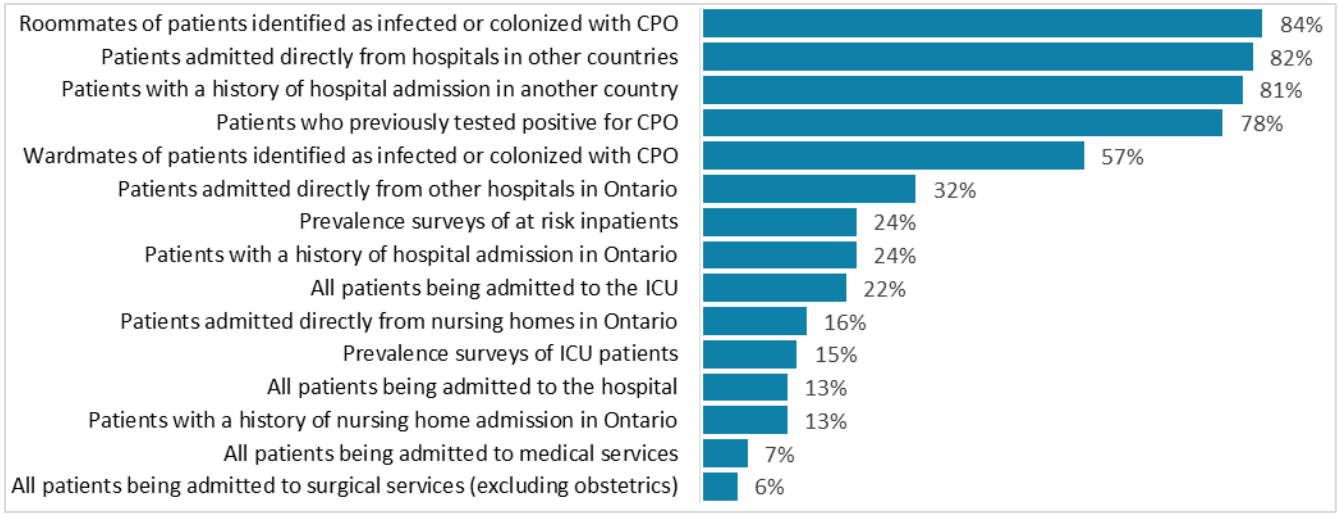
Carbapenemase-producing Organisms (CPO)

Hospital Screening

68/96 (71%) hospitals reported having a screening program for CPOs in 2018, equal to findings from the 2017 survey, where 71% of hospitals reported having a screening program for CPOs.

Hospitals with a screening program for CPOs were likely to identify patients who were roommates with patients positive CPOs, patients admitted directly from a hospital in another country and patients with a history of hospital admission abroad. 13% of hospitals reported screening all patients admitted to the hospital, increased from only 4% of hospitals in 2017 (Figure 13).

Figure 13. Criteria used by hospitals for CPO patient screening, 2018



Infection Control Practices

85/93 (91.4%) hospitals responded that Additional Precautions are used for all patients with CPO colonizations and infections. There were two (2.2%) hospitals that responded Additional Precautions are only used for patients with CPO infections.

The most commonly reported accommodation for patients with CPOs was a single room with dedicated toileting (87, 93.5%). There were 10 (10.8%) hospitals that reported patients with CPOs are cohorted with other patients positive for CPOs and provided with dedicated toileting.

53 (57.0%) hospitals reported environmental services are notified for additional CPO cleaning requirements, 51 (54.8%) hospitals reported that special attention is paid to cleaning sinks and drains, and 39 (41.9%) reported that twice a day cleaning is used for CPE. There were 23 (24.7%) hospitals that reported routine environmental cleaning for CPO is sufficient.

There were 56/89 (62.9%) hospitals that responded patients who test positive for CPOs remain in Additional Precautions for the duration of their hospitalization. 13 (14.6%) hospitals reported that Additional Precautions may be discontinued once three negative swabs have been taken, one week apart; seven (7.9%) reported that no conditions are considered before discontinuing Additional Precautions.

Laboratory Data

A total of 355 new patients with CPO isolated from any specimen site (colonizations and infections) were reported in 2018 (overall rate: 3.0 per 10,000 patients).

- 155 (43.7%) patient specimens were identified from non-screening sites
- 38 (10.7%) patient specimens were isolated from blood culture
- 328 (92.4%) patient specimens were reported from hospital laboratories; 27 (7.6%) were submitted from community-based laboratories

The most commonly reported carbapenemase was New Delhi metallo-beta-lactamase (NDM; 158, 44.5%), followed by oxacillinase (OXA; 85, 23.9%) and *Klebsiella pneumoniae* carbapenemase (KPC; 66, 18.6%); 46 (13.0%) were other carbapenemases.

Central West, Hamilton Niagara Haldimand Brant and Toronto Central LHINs had the highest rate of CPOs (Figure 14, see values in Table 3).

In 2017, laboratories reported 311 new patients with CPOs isolated from any specimen site (i.e., colonizations and infections, Table 3).

Figure 14. Rate of patients with CPOs from any specimen site (colonizations and infections) reported from hospital laboratories in Ontario by LHIN, 2018

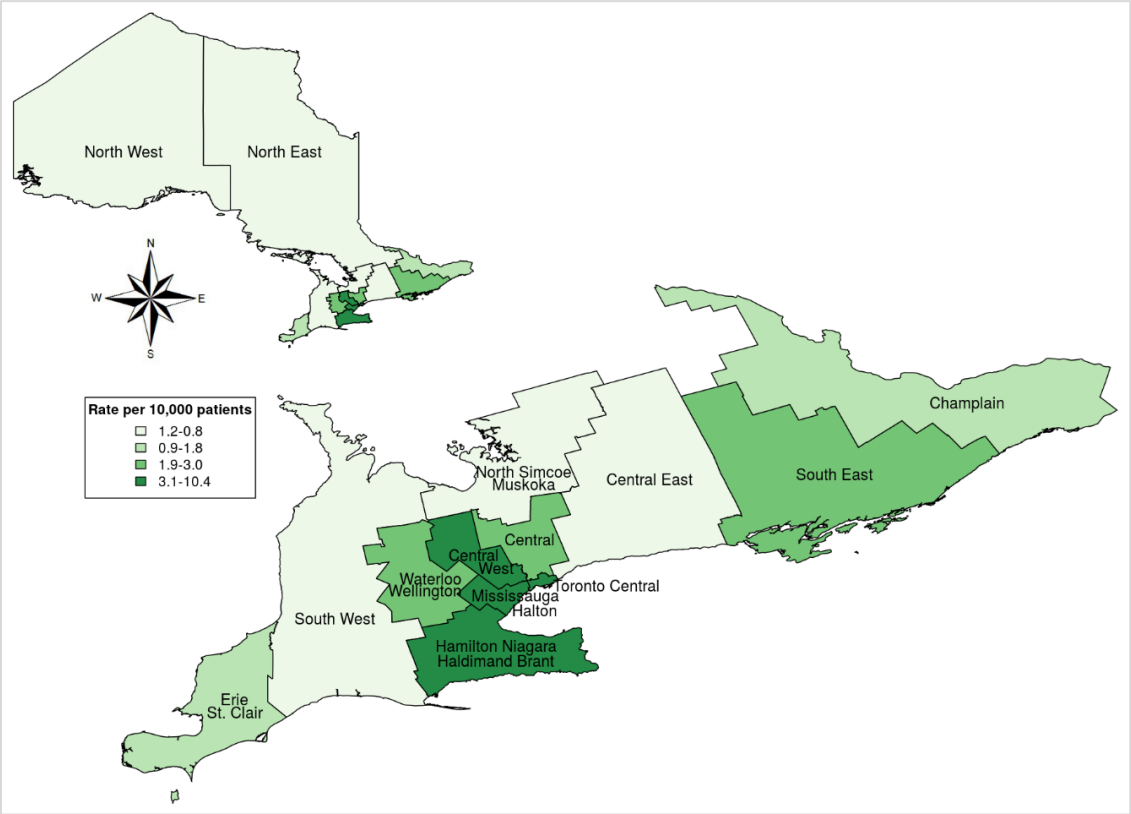


Table 3. Patients with CPOs from any specimen site (colonizations and infections) reported from hospital laboratories in Ontario by LHIN, 2017–2018

LHIN	2017 Patients with CPO from any specimen site	2017 Rate per 10,000 patients	2018 Patients with CPO from any specimen site	2018 Rate per 10,000 patients
Central	18	6.6	32	2.6
Central East	13	1.2	6	0.6
Central West	102	12.6	55	9.8
Champlain	7	0.8	17	1.6
Erie St. Clair	2	0.3	9	1.7
Hamilton Niagara Haldimand Brant	20	2.7	58	4.4
Mississauga Halton	27	5.1	26	3.1

LHIN	2017 Patients with CPO from any specimen site	2017 Rate per 10,000 patients	2018 Patients with CPO from any specimen site	2018 Rate per 10,000 patients
North East	13	2.2	1	0.2
North Simcoe Muskoka	0	0.0	3	0.7
North West	1	0.4	1	0.4
South East	5	0.9	9	2.0
South West	2	0.2	11	1.1
Toronto Central	98	5.1	89	5.0
Waterloo Wellington	3	0.8	11	1.9
Overall	311	3.0	328	2.8

Clostridioides difficile Infections (CDI)

Infection Control Practices

96/97 (99.0%) hospitals reported that Additional Precautions are used to care for patients with CDI.

All hospitals reported that patients with CDI are accommodated with a single room and dedicated toileting; 11 (11.3%) hospitals reported that patients may also be cohorted with other CDI positive patients and provided with dedicated toileting and seven (7.2%) hospitals reported multi-patient rooms and dedicated toileting is used to accommodate patients with CDI.

There were 85 (87.6%) hospitals that reported Additional Precautions may be discontinued once the patient has not had diarrhea for ≥48 hours and 78 (80.4%) hospitals that responded consultation with IPAC prior to discontinuing Additional Precautions is required. Five (5.2%) hospitals reported that patients positive for CDI remain in Additional Precautions for the duration of their hospitalization.

Laboratory Data

A total of 106,439 specimens were tested for CDI toxin by Ontario laboratories in 2018.

- 12,346 (11.6%) specimens were positive for CDI toxin from 9,090 patients (overall rate: 7.7 per 1,000 patients).

Laboratories in South West, Erie St. Clair and North East LHINs reported the highest proportion of specimens positive for CDI toxin in 2018 (Figure 16).

In 2017, 112,934 specimens were tested for CDI; 13,091 (11.6%) were positive for CDI toxin.

The Ontario Ministry of Health recommended turnaround time (TAT) from specimen collection to reporting is ≤24 hours. There were 52/57 (91.2%) laboratories that reported TATs within the recommended time (Figure 17). Four (7.0%) laboratories reported TAT between 24-48 hours and one (1.8%) laboratory reported TATs between 49-72 hours. 10/11 (90.9%) PHOL regional laboratories reported TATs of <24 hours.

Figure 15. CDI percent specimen test positivity based on laboratory location by LHIN, 2017–2018

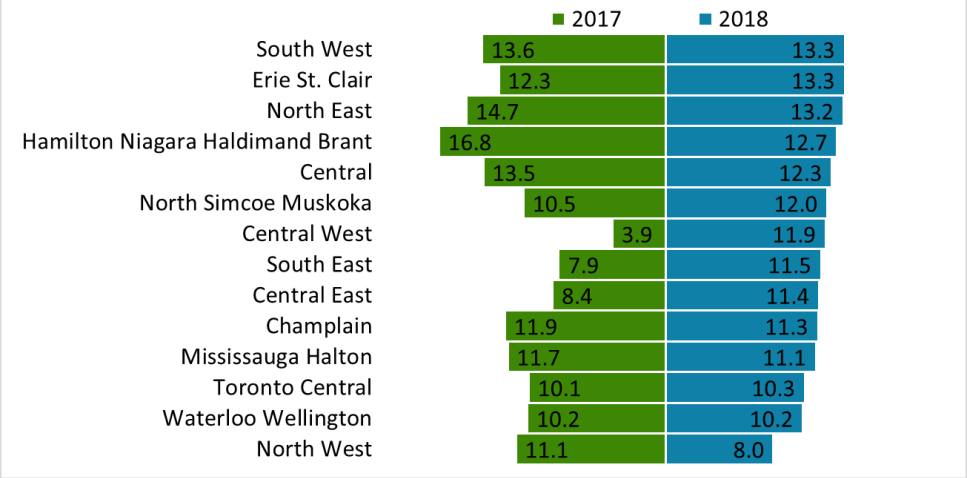


Figure 16. Rate of patients with CDI toxin in Ontario by LHIN, 2018

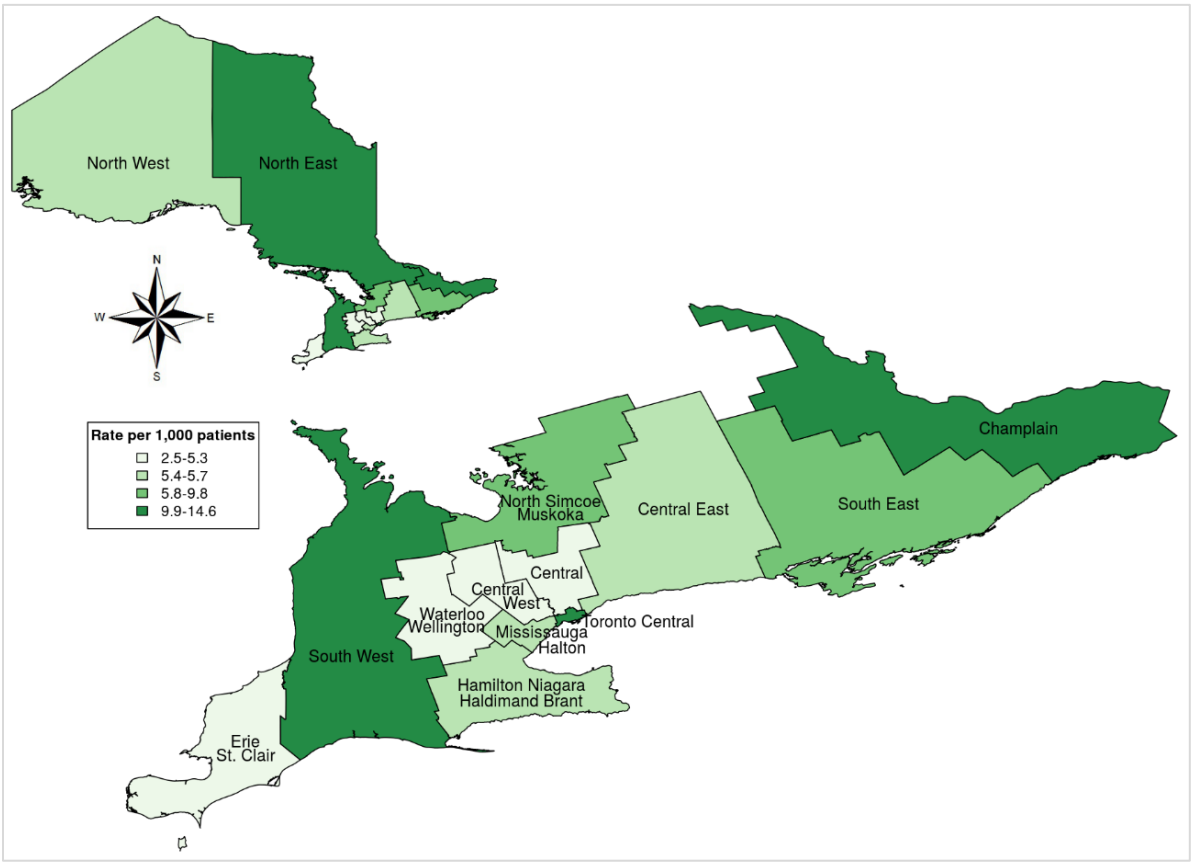
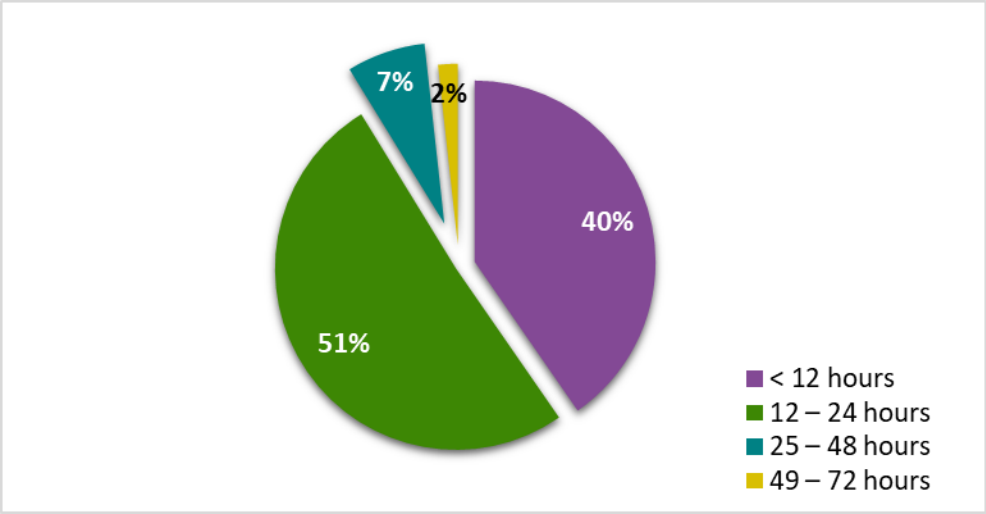


Table 4. Number and rate of CDI toxin positive patients, 2018

LHIN	Patients positive for CDI toxin	Rate per 1,000 patients
Central	572	4.6
Central East	590	5.7
Central West	250	4.5
Champlain	1,105	10.1
Erie St. Clair	275	5.3
Hamilton Niagara Haldimand Brant	740	5.6
Mississauga Halton	462	5.5
North East	591	9.9
North Simcoe Muskoka	332	8.1
North West	140	5.3
South East	428	9.4
South West	1018	10.0
Toronto Central	2442	13.6
Waterloo Wellington	145	2.5
Overall	9,090	7.7

Figure 17. Percent of hospitals that reported CDI turnaround times <12 hours, 12-24 hours, 25-48 hours and 49-72 hours in Ontario, 2018 (n=57)



Data Caveats

Data Collection

The survey was administered in two components. For hospital-based laboratories, instructions were provided to complete the laboratory survey and facilitate completion of the infection control practices with the relevant infection control personnel for the hospital or corporation. The hospital infection control survey was also distributed separately to all hospital corporations in Ontario. Each corporation was requested to complete the survey once on behalf of all corporate sites that followed the same infection control policies. Survey completion was greatest among hospital-based laboratories who were able to facilitate data entry for the infection control portion of the survey into IQMH's QView™ survey platform.

Different approaches to survey administration have been attempted in previous years. Strategies that have been implemented to improve responses include providing a pre-survey notification and follow-up reminder emails during the survey period. While efforts were made to ensure dissemination contact lists were up to date, we are cognizant that not all hospital infection control staff may have had an opportunity to respond to the online survey. We continue to explore opportunities to strengthen networks between PHO and hospitals, as well as streamline future surveys to encourage infection control personnel to provide important data on the prevalence of AROs.

Laboratory Data

Data on ESBLs and CDIs were requested at the specimen-level, thus duplicate specimens submitted for a single patient may be included.

For MRSA, VRE and CPOs, we assumed the number of new patients reported by a laboratory was assumed not to be duplicated by another testing laboratory; however, it is likely there were a number of patients who may have been identified and reported by multiple laboratories due to different hospital visits or admissions within the same year. This would contribute to overestimating the prevalence of AROs.

For both the laboratory and hospital surveys, several assumptions were made during the data cleaning process (Appendix A provides a detailed list of these assumptions). Further, results of this report may not be comparable to other surveillance systems due to different methods employed in collecting data and level of reporting implemented in each of the surveillance systems (i.e., provincial, national level).

Discussion

Health care-associated infections contribute to increased morbidity and mortality and greater burden on the health care system. From the 2018 survey results, we did not observe substantial changes to the overall prevalence of resistant organisms in Ontario. Similar to previous years, there was noticeable regional variation across the province among pathogens. Rates of MRSA were highest in the Central West, North West, Erie St. Clair and Champlain regions in 2018, whereas the rates of VRE have been highest in the Champlain, South East and North West regions in 2017 and 2018.

The abundance of travel and migration from the Indian subcontinent to the south central region of Ontario has been reflected in the higher prevalence of CPOs compared to other parts of the province for the last two years. As of May 2018, carbapenemase-producing *Enterobacteriaceae* was designated a disease of public health significance in Ontario. Case data are now captured in the integrated Public Health Information System (iPHIS) by all public health units. In the first year of reportable disease data,[4] 315 cases were reported by public health units, comparable to the number of cases reported in the current survey by laboratories. Efforts to collect data on all carbapenemase-producing organisms are important to understand the epidemiology of organisms that may emerge locally as a result of infections acquired abroad and transmitted among health care settings in Ontario.

Infection control practices vary widely throughout hospitals in Ontario. Best practice documents by the Provincial Infectious Diseases Advisory Committee on Infection Prevention and Control (PIDAC-IPC) provide guidance on the recommended approaches to infection control. Consistent approaches to MRSA and CDI infection control are more common (e.g., all hospitals responded that they have a screening program for MRSA), whereas screening and infection control of VRE, ESBL and CPOs continue to be inconsistent between hospitals in Ontario. The rate of CDI[5] has been decreasing in Ontario since 2012 and consistent infection control practices for CDI have been reported by hospitals (e.g., all hospitals reported using additional precautions for patients with CDI and providing single room accommodations with dedicated toileting). This is in contrast to diverging infection control policies for VRE and changing epidemiology of VRE, observed in the current survey results and highlighted in a study by Johnstone et al. that found increasing rates of VRE bloodstream infections were highly associated with discontinuation of screening programs and Contact Precautions for VRE.[6]

Conclusion

Surveillance programs of AROs in health care are necessary to understand the current landscape of resistance. Identifying regional variation of organisms can inform local decisions regarding the appropriate application of infection control policies. Strengthening the collaborations between public health, health care infection control and laboratories will be instrumental in improving existing surveillance initiatives and developing targeted infection control policies and antimicrobial stewardship programs.

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Appendix A: Assumptions and Data Cleaning Procedures

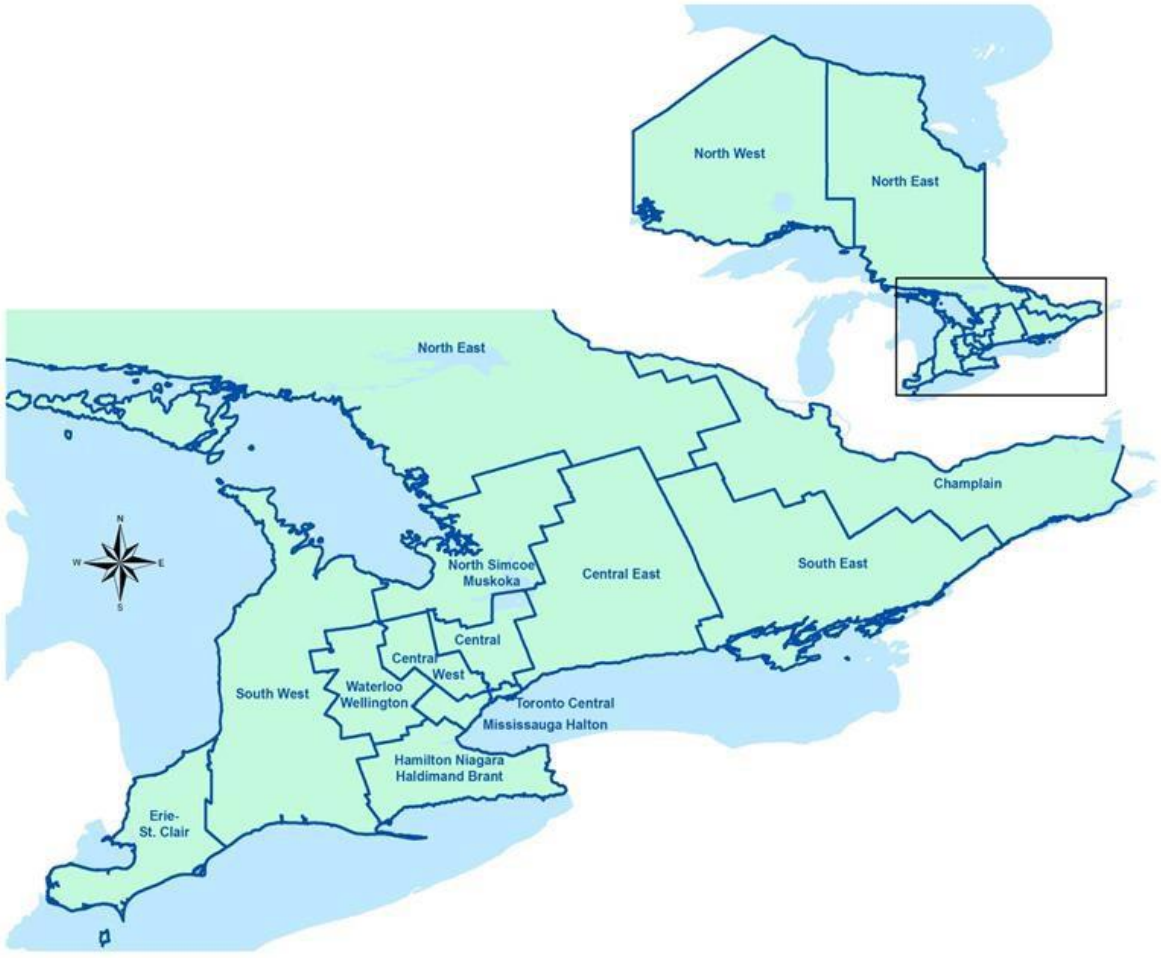
Laboratory Data

1. The numbers provided in the survey were assumed to be accurate.
2. Character values in numeric variables were changed to numeric values where possible. Responses such as “NA,” “not available,” “unable to determine” were changed to blanks.
3. For duplicated laboratories grouped with other laboratories, the numbers were assumed to be coming from different laboratories since separating the counts were not feasible.
4. The total number of isolates was used where the subtotals did not match the total number of isolates.
5. Interpretation of questions may vary between laboratories, especially when different laboratory personnel respond to the survey year to year. Every effort was made to use unambiguous wording in the survey.
6. Regionally stratified data were based on the location of the submitting laboratory.

Hospital Data

1. The hospital was assumed to have a screening program in place if the screening program question was not completed, but follow-up responses were indicative of a positive response.
2. Infection control practices submitted by the corporation were assumed to apply across all institutions under the corporation.

Appendix B: Map of Local Health Integration Networks (LHINs)



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