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Institute for Quality Management in Healthcare

Antimicrobial Resistance in Common Hospital Pathogens in Ontario: Annual Laboratory and Hospital Survey Report 2020-2021

Annual Report

February 2023

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Institute for Quality Management in Healthcare

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Ontario

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Contents

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 cost the health care system $1.4 billion in 2018.[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.

As the survey was suspended for one year due to the SARS-CoV-2 pandemic, a survey to capture information about 2020 and 2021 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 (CPOs), *Clostridioides difficile* infections (CDI; formerly called *Clostridium difficile* infections) and *Candida auris*. The survey also included questions to better understand the impact of the pandemic on the screening and management of health care-associated infections in Ontario hospitals.

The objective of this report is to summarize the findings of the annual survey on antimicrobial resistance of common hospital pathogens from 2020/21.

Survey Methods

Information from two surveys was collected for this report: a laboratory survey and an infection control survey. The lab survey was distributed by IQMH to all 51 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. The laboratory surveys were administered concurrently to collect data from 2020 and 2021. Surveys included questions on the number of new patients identified with MRSA, VRE, ESBLs, CPO and CDI and questions on screening for *Candida auris* from clinical isolates and patients. In addition, questions were included to understand any impact of the pandemic on existing screening and management practices of health care-associated infections in Ontario hospitals.

Concurrently, 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, CPO, CDI and infection control practices over the 2 year period from 2020 to 2021. As with the lab survey, questions about *Candida auris* were also included with this survey.

The surveys were made available from February 22, 2022 to June 30, 2022.

Data from both surveys were extracted and linked on unique identifiers. Duplicates and incomplete data entries were also removed. Data from the Canadian Institute for Health Information - Discharge Abstract Database accessed through IntelliHEALTH on November 9, 2022 were used as denominator data to calculate MRSA, VRE, and CPO rates.[2] Population Estimates 2020-2021 from Statistics Canada, also accessed through IntelliHEALTH (received March 25, 2022), were used as denominator data for calculating CDI rates.[3] To allow comparison over time, historical Local Health Integration Network boundaries were assigned based on the location of the laboratories. Data were analyzed using SAS 9.4 and Microsoft Excel. ArcMap v10.3.1 software was used to generate the maps, displayed by Local Health Integration Network (LHIN).

Results

Highlights of the surveys' results have been combined and presented in three sections for a majority of the organisms: screening, infection control practices and laboratory data. Aggregated responses to the surveys are available upon request.

Survey Response

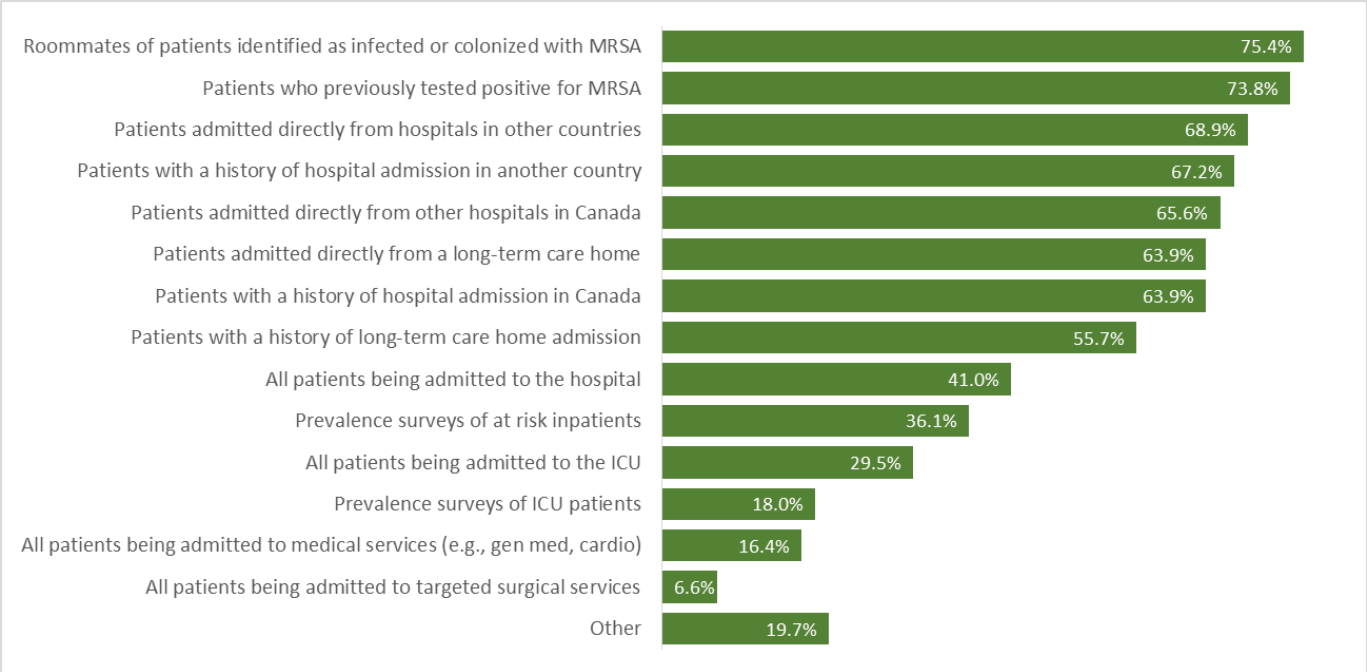
A total of 61/133 (45.9%) hospital corporations responded to the infection control survey questions. Of the currently licensed bacteriology laboratories, 67/73 (91.8%) responded to the 2020 survey and 66/73 (90.4%) responded to the 2021 survey. This included 46/51 (90.2%) in 2020 and 45/51 (88.2%) in 2021 hospital-based laboratories, 11/11 private community-based (both years) laboratories and 10/11 PHO laboratory (both years) sites.

Methicillin-resistant *Staphylococcus aureus* (MRSA)

Hospital Screening

All 61 hospital corporations responded as having a screening program for MRSA in 2020/21 which is consistent with results from 2019. Hospitals were most likely to screen patients who were roommates of patients positive for MRSA, patients previously positive for MRSA, and patients admitted from other hospitals in Canada or in other countries (Figure 1).

Figure 1. Criteria used by hospitals for MRSA patient screening, 2020/21



Infection Control Practices

All hospitals responded that Additional Precautions were used to care for patients with MRSA. Regarding which type of patient with MRSA (i.e., infected, colonized) was placed in Additional Precautions, 60/61 (98.4%) hospitals responded that Additional Precautions were used for all colonized and infected patients and one (1.6%) hospital specified that Additional Precautions were used only for infected patients.

There were 48/61 (78.7%) hospitals that responded Additional Precautions for MRSA are discontinued once three negative swabs were taken, one week apart. Five (8.2%) hospitals responded that patients with MRSA remain in Additional Precautions for the duration of their hospitalization.

Additionally, 8/61 (13.1%) hospitals responded that decolonization protocols are applied to patients with MRSA; 41 (67.2%) hospitals responded they do not decolonize patients with MRSA. Four (6.5%) hospitals decolonize all patients with MRSA, three (4.9%) hospitals decolonize as part of the pre-operative procedure for surgical patients, and one (1.6%) hospital reported decolonizing to facilitate patient placements. There were 12 (19.6%) hospitals that responded that MRSA decolonization may be considered for a variety of other reasons, including on a case-by-case basis, and when requested by a primary provider/physician.

Fourteen of the 61 hospitals (23%) reported changes to their MRSA screening and management practices due to the pandemic. Disruptions to practices included the halting of patient admission screening, the inability to place patients in single rooms, the stopping of contact precautions on positive patients and/or their contacts, pauses on the testing of contacts and the discontinuation of prevalence surveys. All reported disruptions of these MRSA screening and management practices had been reinstated at the time of survey with the exception of 3 hospitals that reported they were still unable to place patients in single rooms.

Laboratory Data

A total of 11,283 and 12,516 new patients with MRSA isolated from any specimen site (i.e., colonizations or infections) were reported by hospital-based laboratories in 2020 and 2021, respectively (overall rate: 12.9 and 13.5 per 1,000 patients in 2020 and 2021, respectively).

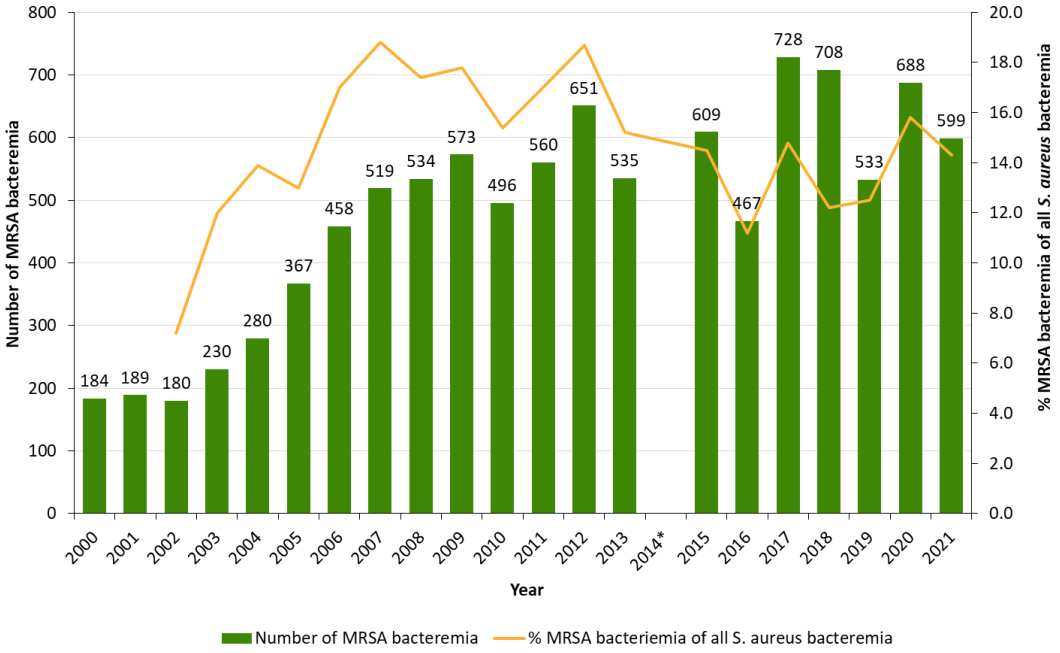
- 688 (6.1%) and 599 (4.8%) patient specimens were isolated from blood culture in 2020 and 2021, respectively.
- 3,925 (34.7%) and 4,295 (34.3%) patients with MRSA had specimens isolated from non-screening sites, excluding blood culture in 2020 and 2021, respectively.

The total number of new patients with MRSA isolated from any specimen site increased by 7.6% from 11,064 in 2019 to 12,516 in 2021. The proportion of patients with MRSA from blood culture was stable at 4.8% from 2019 to 2021.

In 2021, the total number of methicillin-susceptible *S. aureus bacteremia* reported was 3,584. Methicillin-resistant *S. aureus bacteremia* as a proportion of all *S. aureus bacteremia* was 12.5% (533/4,259) in 2019 and 14.3% (599/4,183) in 2021 (Figure 2).

North West, South East, North East and Hamilton Niagara Haldimand Brant regions had the highest rates of new patients with MRSA isolated from any specimen site in 2021 (Figures 3,4).

Figure 2. Number of MRSA bacteremia and percentage of all *S. aureus bacteremia* reported from hospital laboratories in Ontario, 2000–2021



*Survey was not conducted in 2014.

Figure 3. Rate of patients with MRSA isolated from any specimen site (colonizations and infections) per 1,000 patients reported from hospital laboratories in Ontario, by LHIN, 2021

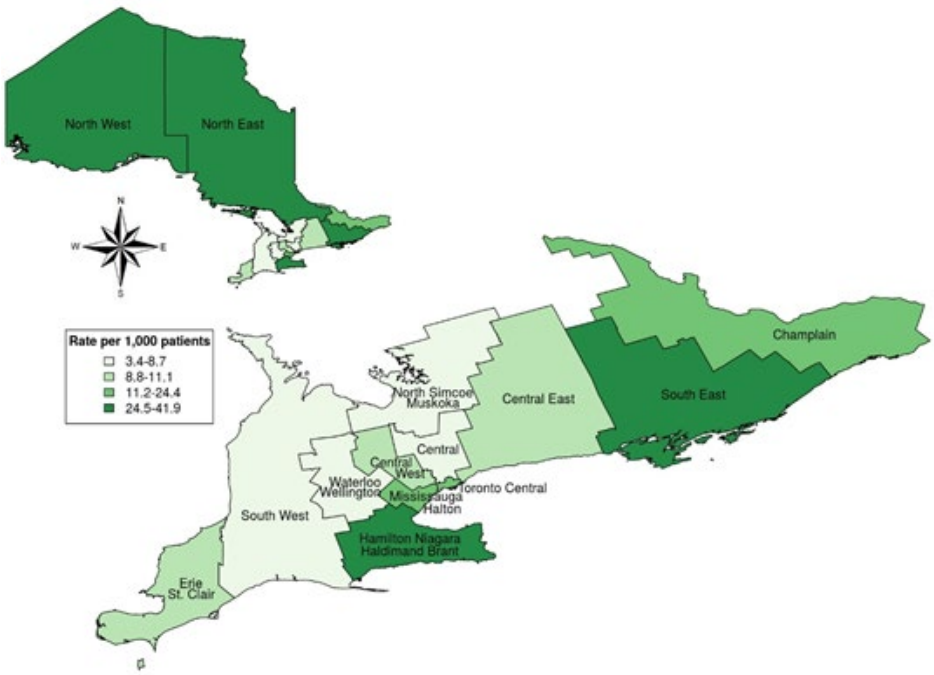
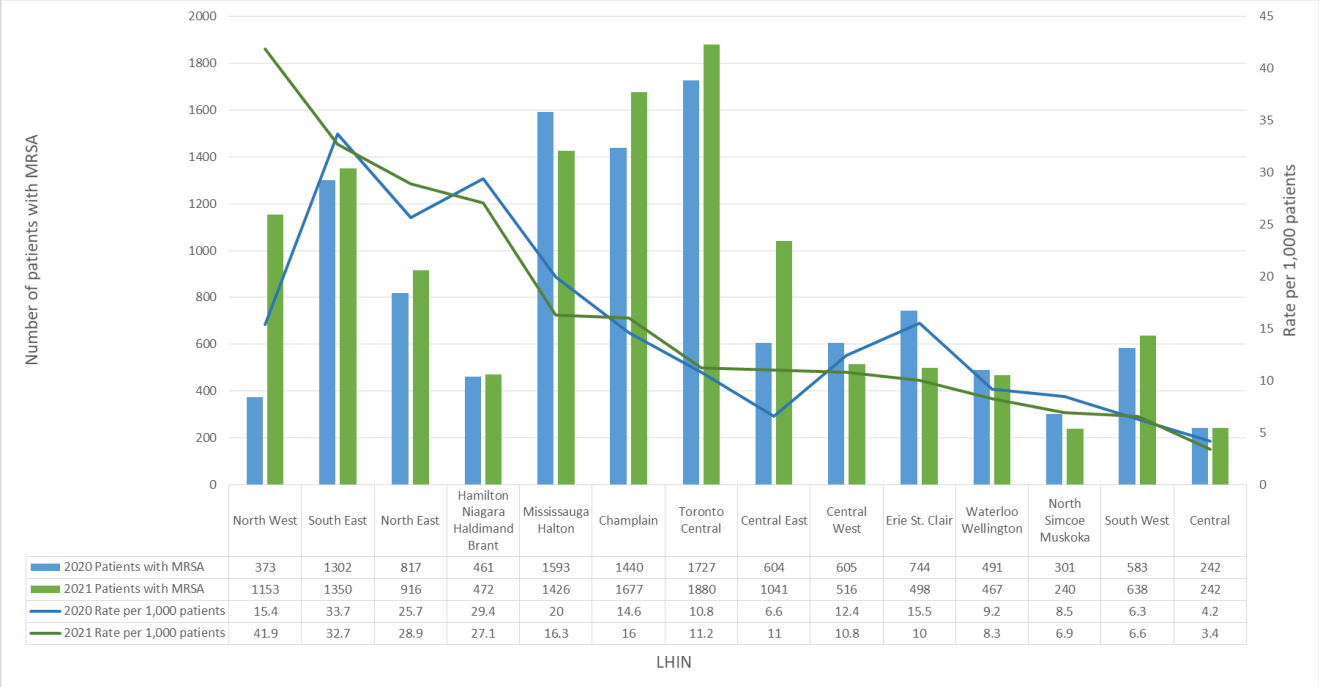


Figure 4. Number of patients with MRSA isolated from any specimen site (colonizations and infection) and rate per 1,000 patients reported from hospital laboratories in Ontario, by LHIN, 2020-2021



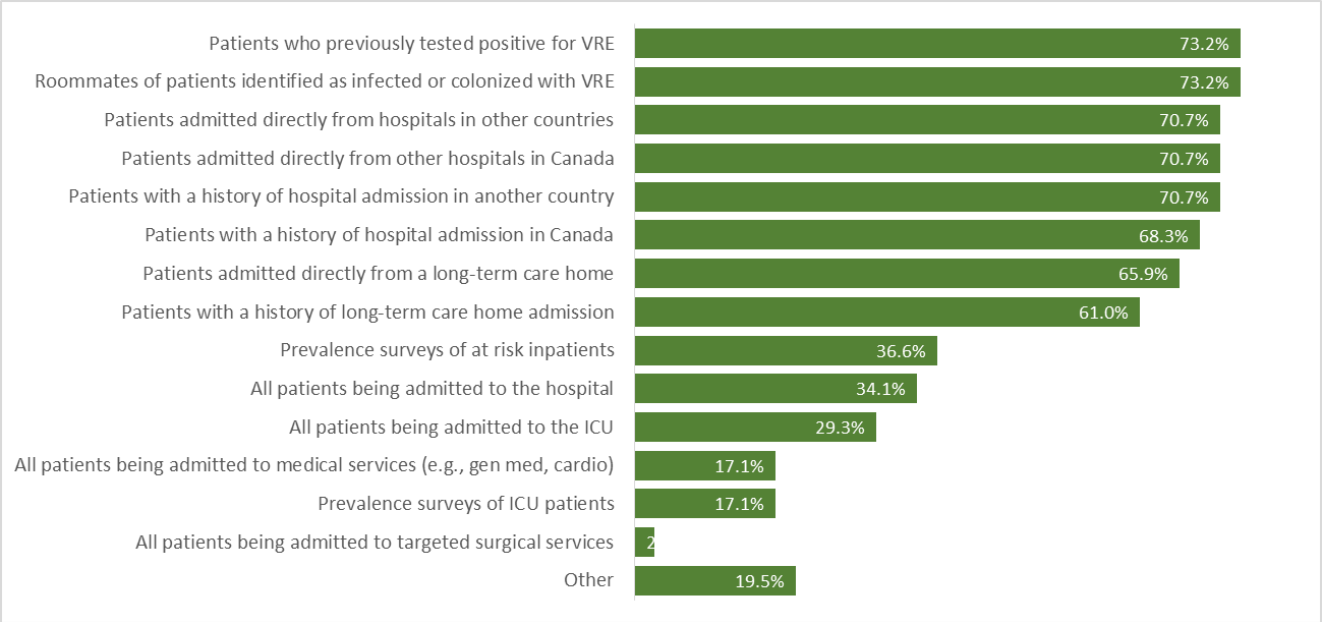
	North West	South East	North East	Hamilton Niagara Haldimand Brant	Mississauga Halton	Champlain	Toronto Central	Central East	Central West	Erie St. Clair	Waterloo Wellington	North Simcoe Muskoka	South West	Central
2020 Patients with MRSA	373	1302	817	461	1593	1440	1727	604	605	744	491	301	583	242
2021 Patients with MRSA	1153	1350	916	472	1426	1677	1880	1041	516	498	467	240	638	242
2020 Rate per 1,000 patients	15.4	33.7	25.7	29.4	20	14.6	10.8	6.6	12.4	15.5	9.2	8.5	6.3	4.2
2021 Rate per 1,000 patients	41.9	32.7	28.9	27.1	16.3	16	11.2	11	10.8	10	8.3	6.9	6.6	3.4

Vancomycin-resistant enterococci (VRE)

Hospital Screening

Of the 61 responding hospital corporations, there were 41 (67.2%) that reported having a screening program for VRE in 2020/21. This was lower than 78.4% of hospital corporations that reported having a screening program for VRE in 2019. Hospitals were most likely to screen patients who previously tested positive for VRE and those who were roommates of patients positive for VRE (Figure 5).

Figure 5. Criteria used by hospitals for VRE patient screening, 2020/21



Infection Control Practices

There were 40/61 (65.6%) hospitals that responded that Additional Precautions were used to care for all patients colonized and infected with VRE; two (3.3%) hospitals responded that Additional Precautions were only used for patients with VRE infections. There were 16 (26.2%) hospitals that reported Additional Precautions were not used for patients with VRE in 2020/21, compared to 17.8% of hospitals that reported Additional Precautions were not used for patients with VRE in 2019.

In hospitals reporting the use of Additional precautions for VRE, 26/45 (57.8%) reported Additional precautions are discontinued once three negative swabs for VRE have been taken, one week apart. Eight (17.8%) hospitals reported patients with VRE remain in Additional Precautions for the duration of their hospitalization.

There were 11/41 (26.8%) hospitals that reported halting patient admission screening for VRE due to the pandemic. Other disruptions to practices reported by hospitals included the inability to place patients in single rooms, the stopping of contact precautions on positive patients and/or their contacts, pauses on the testing of contacts and the discontinuation of prevalence surveys. Most reported disruptions to VRE screening and management practices were later reinstated, however one hospital reported they are still not able to screen for VRE upon patient admission and two hospitals reported they were still unable to place patients in single rooms.

Laboratory Data

A total of 3,702 and 3,344 new patients with VRE isolated from any specimen site (i.e., colonizations and infections) were reported by hospital laboratories in 2020 and 2021, respectively.

- In 2020, 238/3,702 (6.4%) and in 2021, 199/3,344 (6.0%) patients with VRE had specimens isolated from blood culture

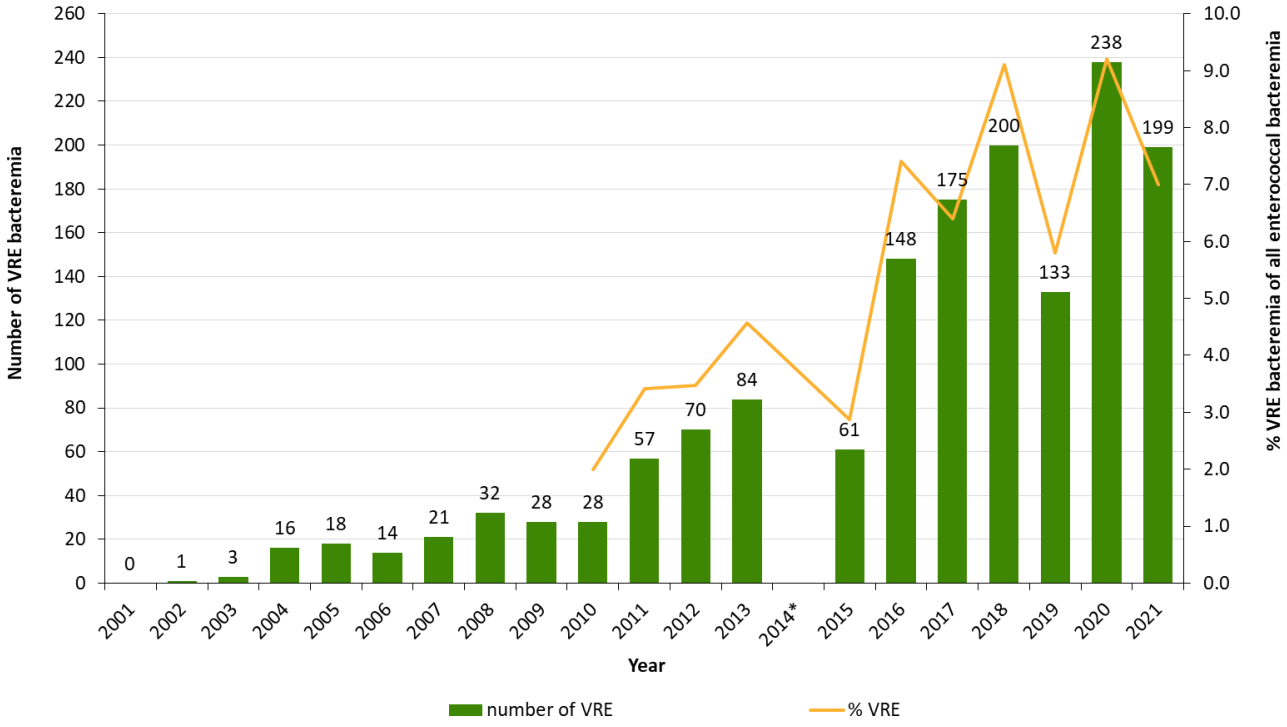
- *E. faecium*: (230/238; 96.6%; 2020) (191/199; 96.0%; 2021)
- *E. faecalis*: (1/238; 0.4%; 2020) (2/199; 1.0%; 2021)
- Other enterococci: (7/238; 2.9%; 2020) (6/199; 3.0%; 2021)

- In 2020, 918/3,702 (24.8%) and in 2021, 771/3,344 (23.1%) patients with VRE had specimens isolated from non-screening sites, excluding blood culture
  - *E. faecium*: (893/918; 97.3%; 2020) (737/771; 95.6%; 2021)
  - *E. faecalis*: (10/918; 1.1%; 2020) (28/771; 3.6%; 2021)
  - Other enterococci: (15/918; 1.6%; 2020) (6/771; 0.8%; 2021)

The total number of vancomycin-susceptible enterococcal bacteremia was 2,335 and 2,662 in 2020 and 2021, respectively. The proportion of vancomycin-resistant enterococcal bacteremia of all enterococcal bacteremia was 9.2% (238/2,573) in 2020 and 7.0% (199/2,861) in 2021 (Figure 6).

Hospital laboratories in Champlain and South East regions reported the highest rates of new patients with VRE isolated from all non-screening specimen sites (including blood cultures) in 2021 (Figures 7,8).

Figure 6. Number of VRE bacteremia and percentage of all enterococcal bacteremia reported from hospital laboratories in Ontario, 2001–2021



*Survey was not conducted in 2014

Figure 7. Rate of patients with VRE isolated from all non-screening specimen sites (including blood cultures) per 1,000 patients reported from hospital laboratories in Ontario, by LHIN, 2021

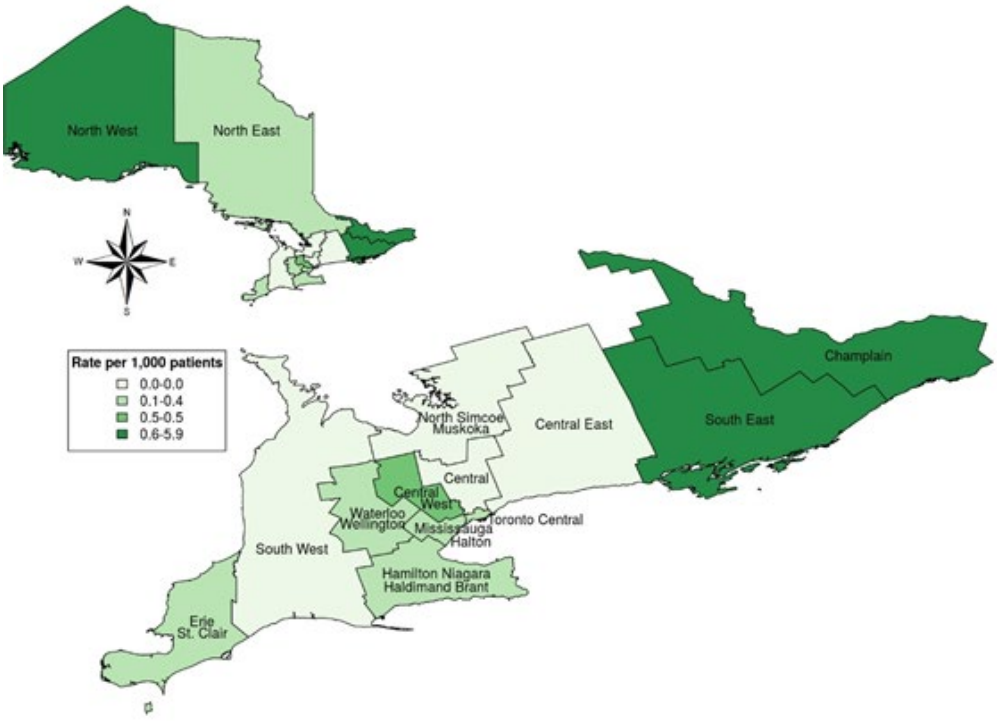
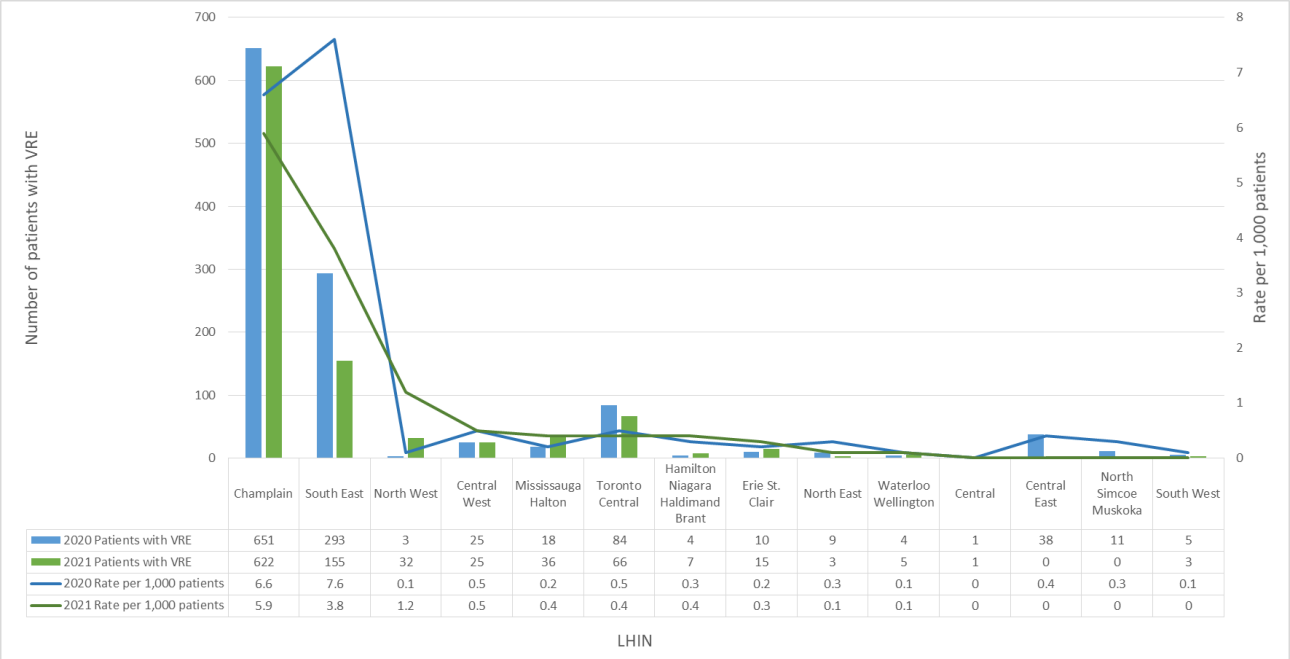


Figure 8. Number of patients with VRE isolated from all non-screening specimen sites (including blood cultures) and rate per 1,000 patients reported from hospital laboratories in Ontario, by LHIN, 2020-2021



	Champlain	South East	North West	Central West	Mississauga Halton	Toronto Central	Hamilton Niagara Haldimand Brant	Erie St. Clair	North East	Waterloo Wellington	Central	Central East	North Simcoe Muskoka	South West
2020 Patients with VRE	651	293	3	25	18	84	4	10	9	4	1	38	11	5
2021 Patients with VRE	622	155	32	25	36	66	7	15	3	5	1	0	0	3
2020 Rate per 1,000 patients	6.6	7.6	0.1	0.5	0.2	0.5	0.3	0.2	0.3	0.1	0	0.4	0.3	0.1
2021 Rate per 1,000 patients	5.9	3.8	1.2	0.5	0.4	0.4	0.4	0.3	0.1	0.1	0	0	0	0

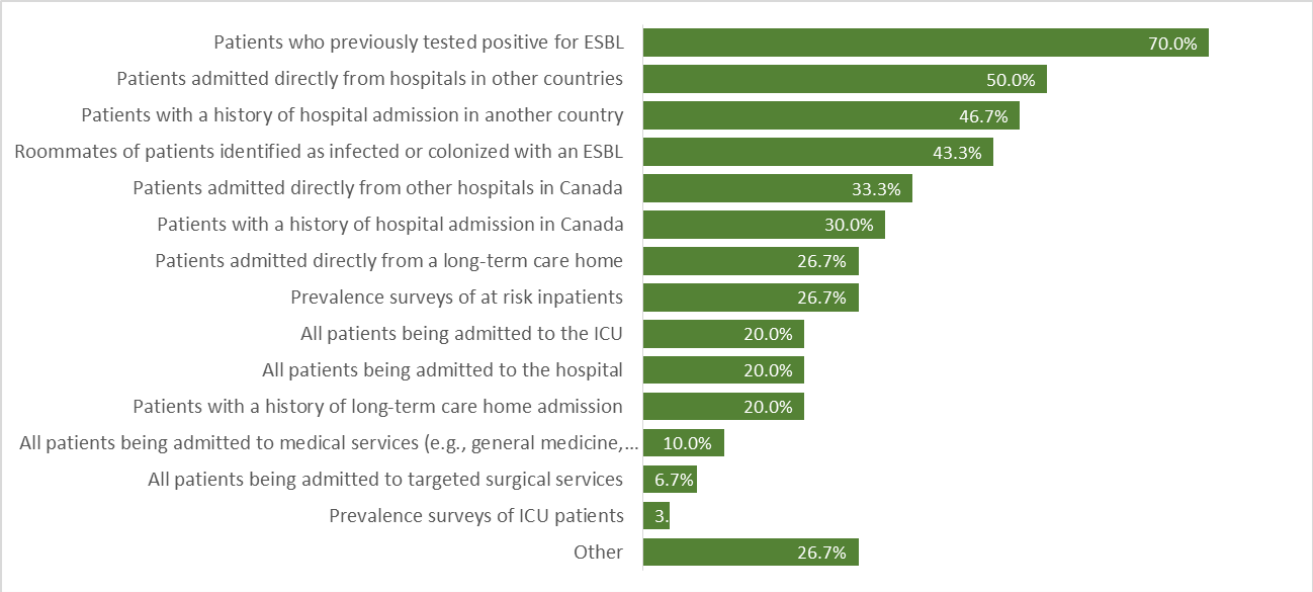
Gram-Negative Bacilli

Extended spectrum beta-lactamases (ESBL) Hospital Screening

Of the 61 responding hospital corporations, 30 (49.2%) reported having a screening program for extended spectrum beta-lactamases (ESBLs) in 2020/21. In 2019, 46.0% of hospitals surveyed reported having an ESBL screening program.

Hospitals with a screening program for ESBLs were most likely to screen patients who previously tested positive for ESBL, and admitted directly from a hospital abroad (Figure 9).

Figure 9. Criteria used by hospitals for ESBL patient screening, 2020/21



ESBL Infection Control Practices

A total of 29/61 (47.5%) hospitals responded that Additional Precautions were used for all patients colonized and infected patients with ESBLs; four (6.5%) hospitals responded that Additional Precautions were only used for patients infected with ESBLs. There were 20 (32.8%) hospitals that reported Additional Precautions were not used for patients with ESBLs.

In hospitals reporting the use of Additional precautions for ESBL, 19/41 (46.3%) reported Additional Precautions are discontinued once three negative swabs for ESBL have been taken, one week apart. Thirteen (31.7 %) hospitals reported that patients who test positive for ESBLs remain on Additional Precautions for the duration of their hospitalization.

There were 10/30 (33.3%) hospitals that reported halting patient admission screening for ESBLs due to the pandemic. Other disruptions to practices reported by hospitals included the inability to place patients in single rooms, the stopping of contact precautions on positive patients and/or their contacts, pauses on the testing of contacts and the discontinuation of prevalence surveys. Most reported disruptions to ESBL screening and management practices were later reinstated, however one hospital reported they are still not able to screen for ESBL upon patient admission and two hospitals reported they were still unable to place patients in single rooms at the time of survey.

Laboratory Data

In 2020, 331,112 isolates of *E. coli*, 69,797 isolates of *Klebsiella* spp., 35,997 isolates of *Pseudomonas aeruginosa,* and 2,173 isolates of *Acinetobacter* spp. from any specimen site were reported by laboratories. In 2021, 353,307 isolates of *E. coli*, 78,940 isolates of *Klebsiella* spp., 40,494 isolates of *Pseudomonas aeruginosa,* and 2,669 isolates of *Acinetobacter* spp. from any specimen site were reported by laboratories.

Resistance to third-generation cephalosporins among *E. coli* isolated from all specimen sites has been relatively stable (approximately 10.0% resistant) from 2016 to 2021 (Figure 10). Resistance to third-

generation cephalosporins among *Klebsiella* spp. isolated from all specimen sites has also been relatively stable, 5.5% in 2019, 6.2 % in 2020, and 6.6% in 2021).

On the other hand, resistance among *E. coli* isolates to ciprofloxacin increased from 17.3% in 2019 to 20.7% in 2020 and 19.6% in 2021 (Figure 11). *Klebsiella* spp. resistance to ciprofloxacin has remained stable at approximately 4.0% between 2006 and 2019 and then increased to 7.6% and 7.2% for 2020 and 2021, respectively. Among *P. aeruginosa* isolates, resistance to ciprofloxacin increased from 12.0% in 2019 to 18.0% in 2020 and to 16.4% in 2021. Resistance to ciprofloxacin in *Acinetobacter* spp. isolates decreased from 8.1% in 2019 to 5.8% in 2021.

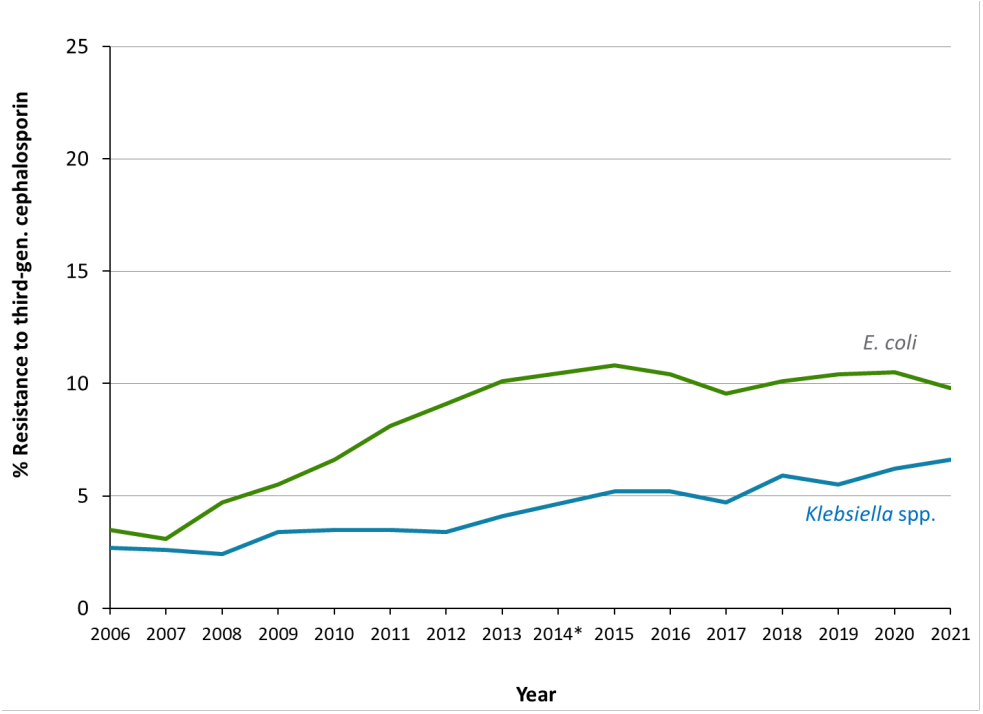
P. aeruginosa resistance from any specimen site to third-generation cephalosporins increased from 6.7% in 2019, 7.8% in 2020 to 8.1% in 2021; resistance to meropenem also increased from 6.5% in 2019, 7.6 % in 2020 and 8.3% in 2021 (Figure 12). *Acinetobacter* spp. resistance to third-generation cephalosporins fluctuated from 7.2% in 2019 to 11.3% in 2020 to 8.4% in 2021; resistance to meropenem decreased from 6.0% in 2020 to 2.9% in 2021.

Percent resistance of *P. aeruginosa* from blood to third-generation cephalosporins increased from 4.5% in 2019 to 6.4% in 2021; resistance to meropenem also increased from 4.3% 2019 to 9.0% in 2021 (Figure 13). Among *Acinetobacter* spp. isolates, percent resistance from blood to third-generation cephalosporins increased from 7.5% in 2019 to 12.5% in 2020 and 13.1% in 2021.

E. coli resistance from blood to third-generation cephalosporin and ciprofloxacin fluctuated from 11.6% and 17.4% in 2019 to 16.2% and 20.9% in 2020 to 13.4% and 19.1% in 2021, respectively (Figure 13). *Klebsiella* spp. resistance from blood to cephalosporin and to ciprofloxacin slightly increased in the past two years (4.6% and 4.1% in 2019 to 7.0% and 9.6% in 2020 to 8.4% and 10.5% in 2021, respectively).

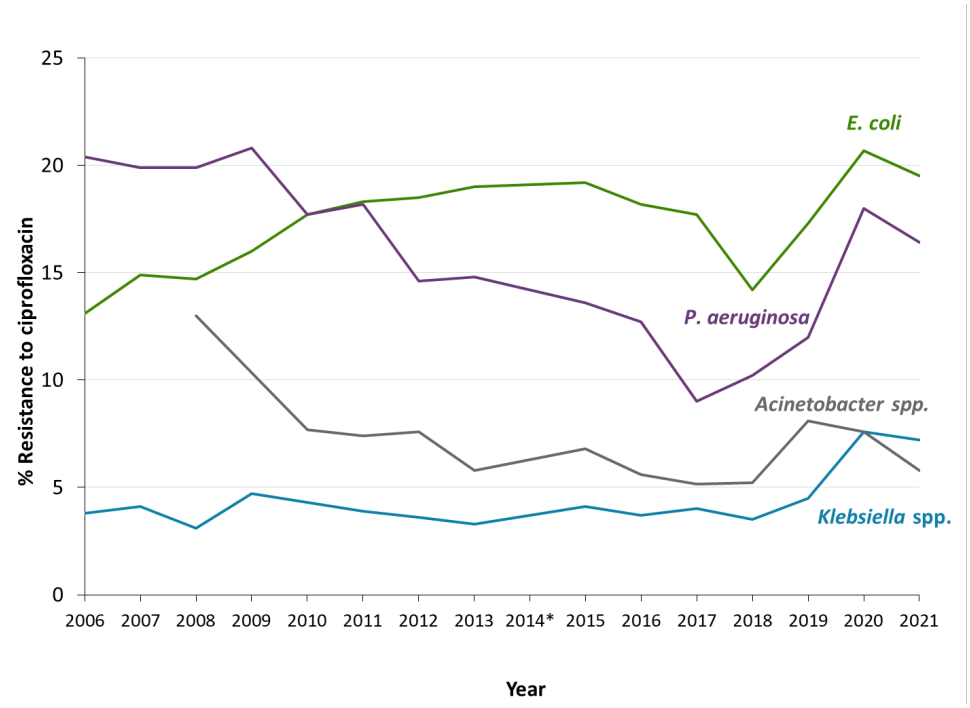
E. coli resistance in urine to third-generation cephalosporins increased from 8.9% in 2019 to 10.0% in 2021 (Figure 14). Resistance to ciprofloxacin also increased from 17.8% in 2019 to 19.9% in 2021 (Figure 14). Resistance to third-generation cephalosporins among *Klebsiella* spp. isolated from urine was similar, 5.3% in 2019 to 5.5% in 2021; resistance to ciprofloxacin was 4.6% for *Klebsiella* spp. isolated from urine in 2019, and 6.8% in 2021.

Figure 10. Percent resistance of all isolates of *E. coli* and *Klebsiella* spp. to third generation cephalosporins, 2006–2021



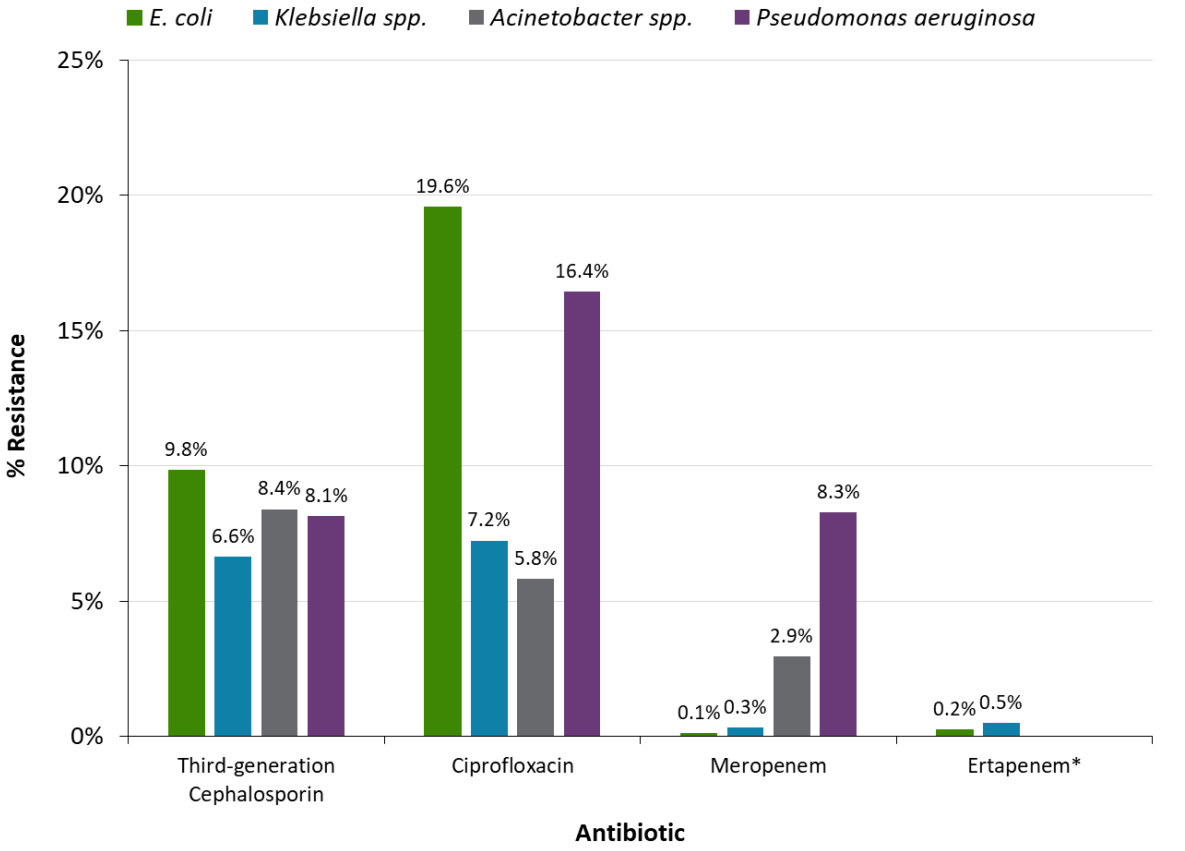
*Survey was not conducted in 2014.
**2018 results were updated based on data cleaning.

Figure 11. Percent resistance of all isolates of *E. coli* and *Klebsiella* spp., *P. aeruginosa*, and *Acinetobacter* spp. to ciprofloxacin, 2006-2021



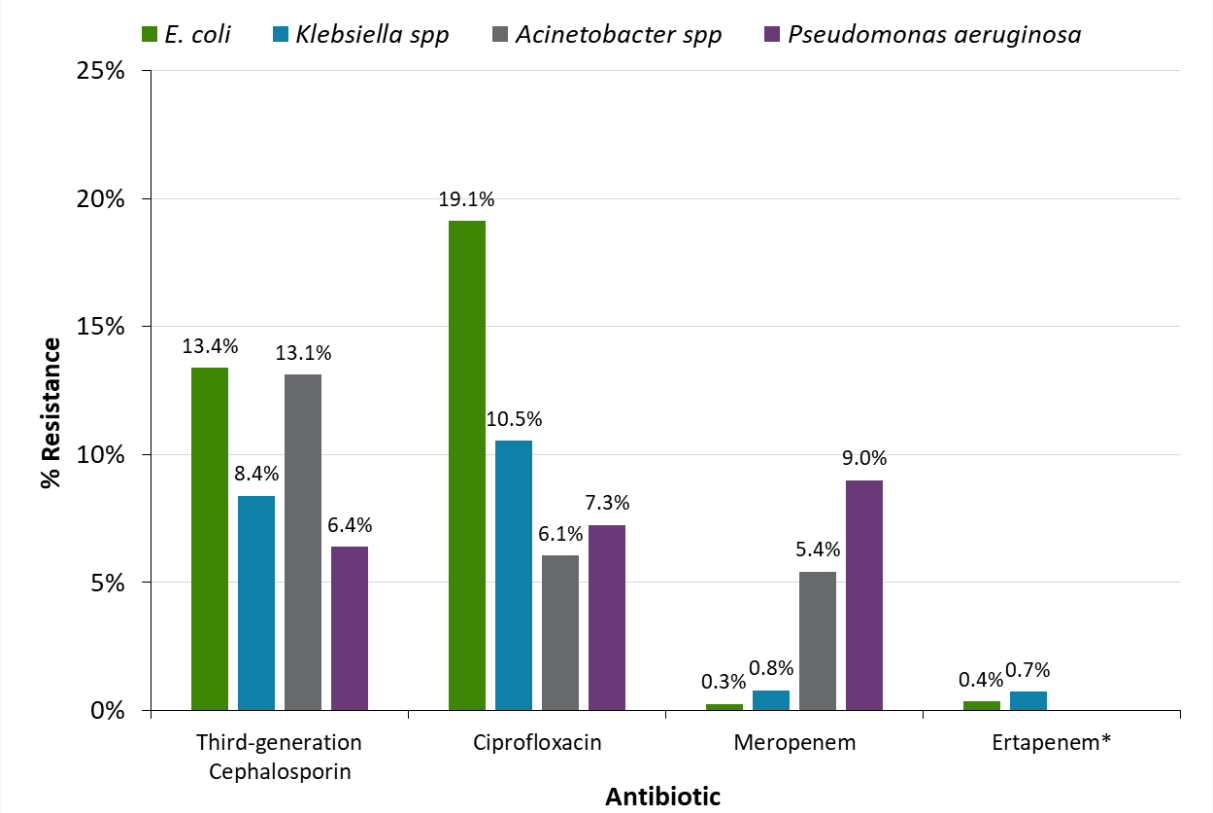
*Survey was not conducted in 2014. **2018 results were updated based on data cleaning

Figure 12. Percent resistance of all isolates of *E. coli, Klebsiella* spp., *Acinetobacter* spp., and *P. aeruginosa* to third-generation cephalosporins, ciprofloxacin and carbapenems, 2021



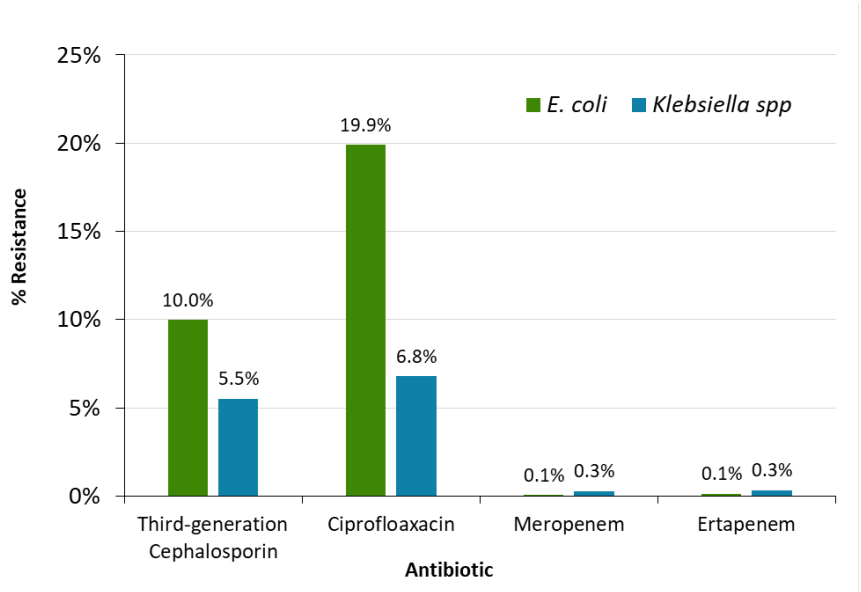
*Note: Resistance to ertapenem is shown for *E. coli* and *Klebsiella* spp. only.

Figure 13. Percent resistance of *E. coli*, *Klebsiella* spp., *Acinetobacter* spp., and *P. aeruginosa* from blood to third-generation cephalosporins, ciprofloxacin and carbapenems, 2021*



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

Figure 14. Percent resistance of *E. coli* and *Klebsiella* spp. from urine specimens to third generation cephalosporins, ciprofloxacin and carbapenems, 2021

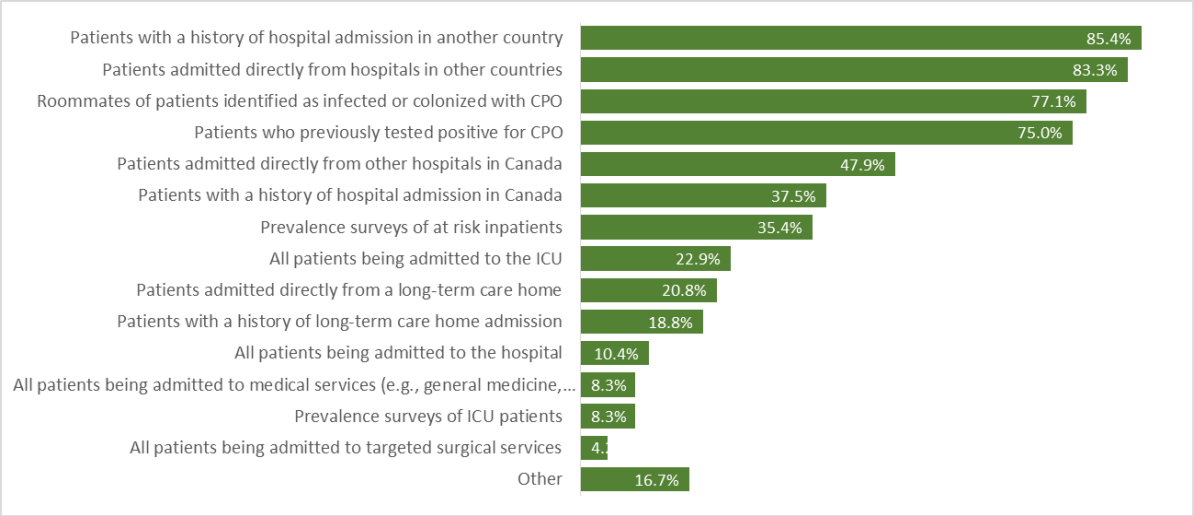


Carbapenemase-producing organisms (CPO)

Hospital Screening

Of the 61 responding hospital corporations, there were 48 (78.7%) that reported having a screening program for CPO in 2020/21. This is slightly higher than the findings from the 2019 survey, where 73.0% of hospitals reported having a screening program for CPOs. Hospitals were most likely to screen patients with a history of hospital admission in another country, patients admitted directly from a hospital in another country, those who were roommates with patients positive for CPO, and those patients who previously tested positive for CPO (Figure 15).

Figure 15. Criteria used by hospitals for CPO patient screening, 2020/21



Infection Control Practices

A total of 56/61 (91.8%) hospitals responded that Additional Precautions were used for all patients with CPO colonizations and infections. Two (3.3%) hospitals responded that Additional Precautions were only used for patients with CPO infections. There were three (4.9%) hospitals that reported Additional Precautions were not used for patients with CPOs.

There were 43/61(70.5%) hospitals that reported that special attention was paid to cleaning sinks and drains, 29 (47.5%) hospitals reported using twice-a-day cleaning, and 26 (42.6%) reported double cleaning of rooms (i.e. repeated cleaning after terminal/discharge and discontinuation of additional precautions) for CPO.

Of the 58 hospitals that provided conditions that must be in place before considering discontinuation of Additional Precautions, 40 (69.0%) hospitals responded patients who tested positive for CPOs remain in Additional Precautions for the duration of their hospitalization. Nine (15.5%) hospitals reported that Additional Precautions may be discontinued once three negative swabs have been taken, and 9 (15.5%) provided other information such as assessment on a case by case basis.

There were 4/48 (8.3%) hospitals that reported halting patient admission screening for CPOs due to the pandemic. Other disruptions to practices reported by hospitals included the discontinuation of

prevalence surveys. All reported disruptions to CPO screening and management practices were later reinstated.

Laboratory Data

A total of 289 and 309 new patients with CPO isolated from any specimen site (colonizations and infections) were reported in 2020 and 2021, respectively.

- 133 (46.0%) in 2020 and 139 (45.0%) in 2021 patient specimens were identified from non-screening sites
- 16 (5.5%) in 2020 and 31 (10.0%) patient specimens were isolated from blood culture
- 229 (79.2%) in 2020 and 256 (82.8%) in 2021 patient specimens were reported from hospital laboratories; 60 (20.1%) in 2020 and 53 (17.2%) in 2021 were submitted from community-based laboratories

The most commonly reported carbapenemase in 2021 was New Delhi Metallo-beta-lactamase (NDM; 123, 39.8%), followed by Oxacillinase (OXA; 73, 23.6%), *Klebsiella pneumoniae* carbapenemase (KPC; 70, 22.6%); Verona Integron-Encoded Metallo-beta-lactamase (VIM; 7, 2.3%); and, Imipenemase (IMP; 11, 3.6%) (Figure 19).

Among hospital-based laboratories, Central West, Toronto Central, Mississauga Halton and South East regions had the highest rates of new patients with CPOs per 10,000 patients in 2021 (Figure 16, 17). Overall rates decreased from 4.2 per 10,000 patients in 2019 to 2.1 per 10,000 patients in 2020 to 2.8 per 10,000 patients in 2021 (Figure 18).

Figure 16. Rate of patients with CPOs isolated from any specimen site (colonizations and infections) per 10,000 patients reported from hospital laboratories in Ontario, by LHIN, 2021

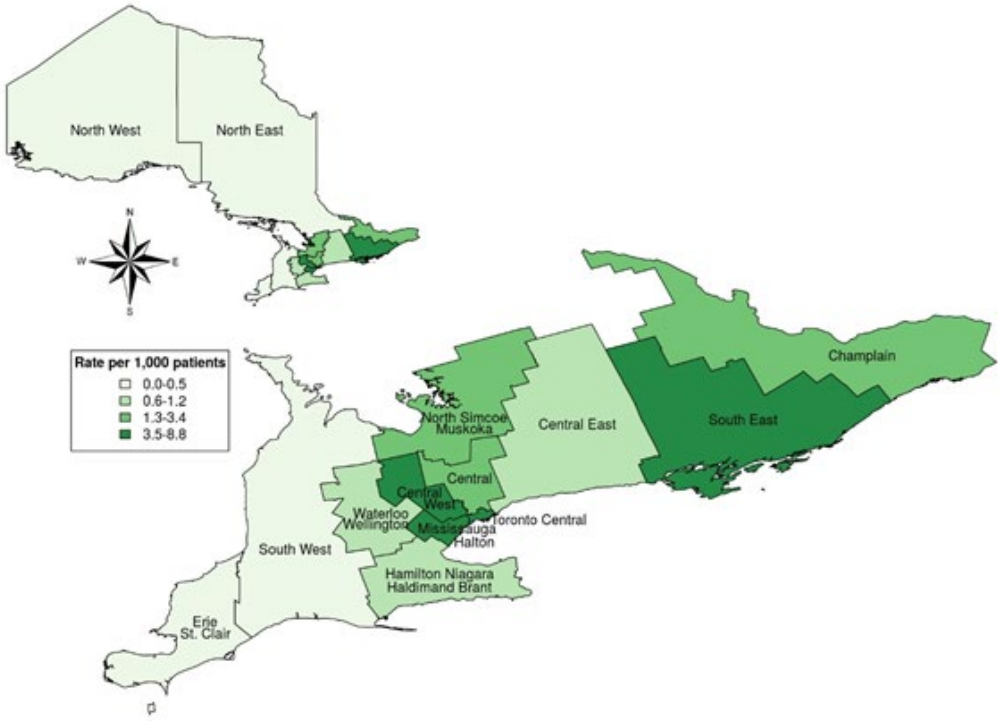
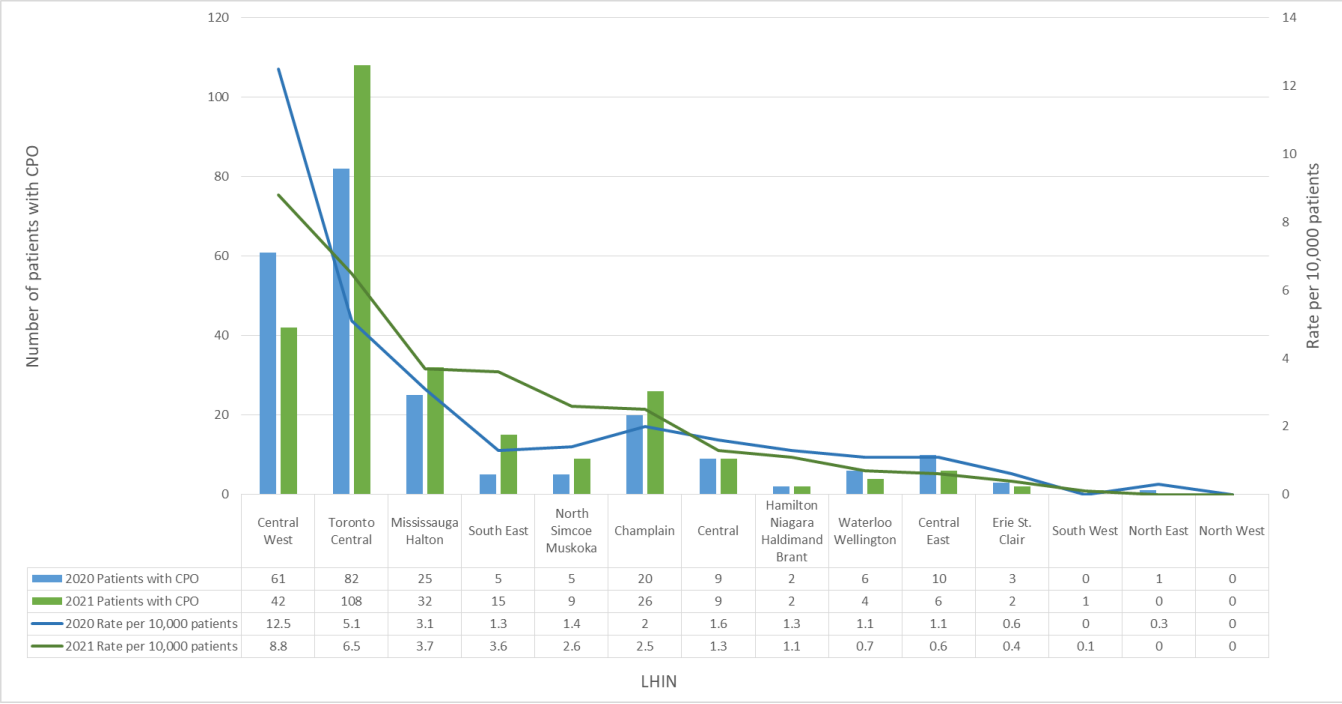


Figure 17. Number of patients with CPOs isolated from any specimen site (colonizations and infections) and rate per 10,000 patients reported from hospital laboratories in Ontario, by LHIN, 2020-2021



	Central West	Toronto Central	Mississauga Halton	South East	North Simcoe Muskoka	Champlain	Central	Hamilton Niagara Haldimand Brant	Waterloo Wellington	Central East	Erie St. Clair	South West	North East	North West
2020 Patients with CPO	61	82	25	5	5	20	9	2	6	10	3	0	1	0
2021 Patients with CPO	42	108	32	15	9	26	9	2	4	6	2	1	0	0
2020 Rate per 10,000 patients	12.5	5.1	3.1	1.3	1.4	2	1.6	1.3	1.1	1.1	0.6	0	0.3	0
2021 Rate per 10,000 patients	8.8	6.5	3.7	3.6	2.6	2.5	1.3	1.1	0.7	0.6	0.4	0.1	0	0

Figure 18. Number of patients with CPOs isolated from any specimen site (colonizations and infections) rate per 10,000 patients reported from hospital laboratories in Ontario, 2019-2021

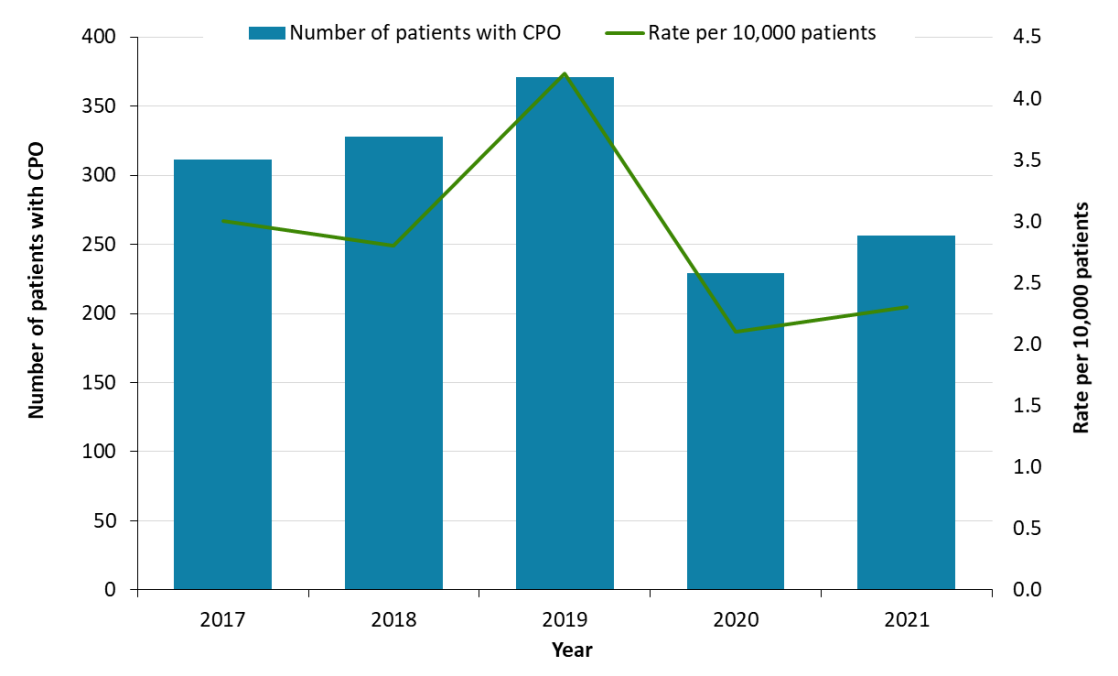
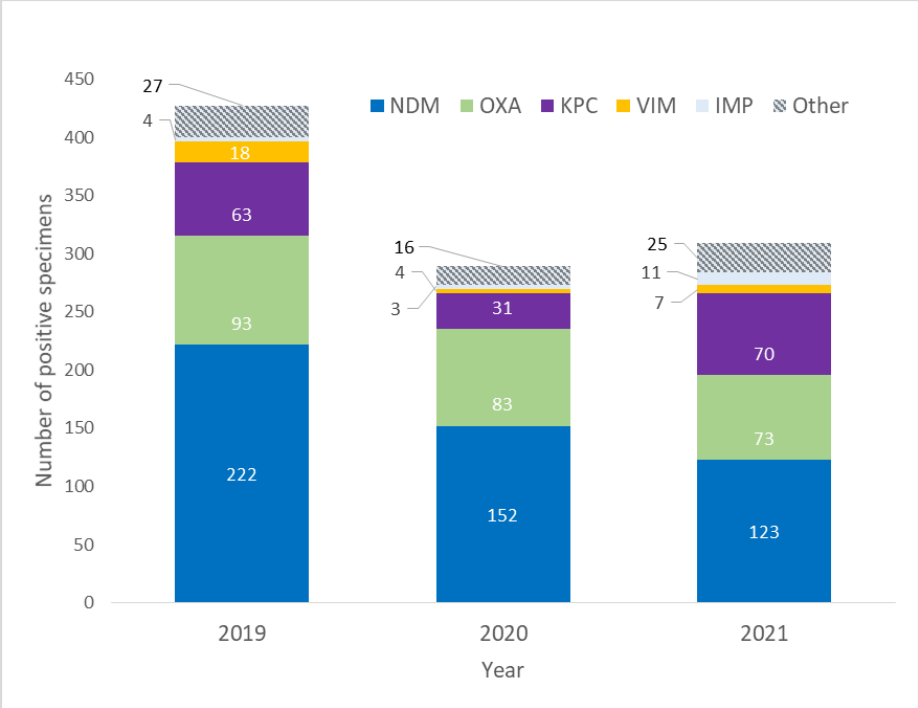


Figure 19. Number of CPO isolated from any specimen site (colonizations and infections) by carbapenemase and year, 2019-2021



Clostridioides difficile infections (CDI)

Infection Control Practices

All 61 hospitals reported that Additional Precautions are used to care for patients with CDI.

A total of 58/61(95.1%) hospitals reported cleaning and disinfection of patient rooms using a sporicidal agent. 53 (86.9%) hospitals reported twice a day cleaning and disinfection of patient rooms while 30 (49.2%) reported double cleaning of rooms (i.e. repeated cleaning after terminal/discharge and discontinuation of additional precautions) for CDI.

There were 48/61 (73.8%) hospitals that reported Additional Precautions may be discontinued once the patient has not had diarrhea for ≥48 hours and 1/61 (1.6%) hospital reported that patients positive for CDI remain in Additional Precautions for the duration of their hospitalization. Sixteen (24.6%) provided other information such as waiting until the patient has not had diarrhea for ≥72 hours or waiting until the patient had not had diarrhea for ≥48 hours following the completion of treatment to remove additional precautions. Of the 61 hospitals, only one (1.6%) reported any changes to their CDI screening and management practices due to the pandemic. The reported disruption to the practice of contact precautions on CDI positive patients was later reinstated.

Laboratory Data

A total of 81,615 and 86,401 specimens were tested for *C. difficile* toxin by Ontario laboratories in 2020 and 2021, respectively.

- In 2020, 8, 898 (10.9%) specimens were positive for *C. difficile* toxin from 7,534 people (overall rate 5.1 per 10,000 population). In 2021, 9,430 (10.9%) specimens were positive for *C. difficile* toxin from 7,863 people (overall rate: 5.3 per 10,000 population).
- The *C. difficile* percent specimen positivity rate has remained stable 2019 to 2021 at 10.9% each year.

Laboratories in Central, North East, and Waterloo Wellington regions reported the highest proportion of specimens positive for *C. difficile* toxin in 2021 (Figure 20). Additionally, Toronto Central, North West and Champlain regions reported the highest rates of patients with *C. difficile* toxin in Ontario in 2021 (Figure 21,22).

The Ontario Ministry of Health recommends turnaround time (TAT) from specimen collection to reporting is ≤24 hours. Due to limitations in understanding the interval between specimen collection and receipt at the laboratory, the survey asks laboratories about their average TAT from the time specimens are received to reporting test results. There were 48/50 (96.0%) and 47/49 (95.9%) laboratories that reported average TATs from specimen receipt at the laboratory to reporting <24 hours in 2020 and 2021, respectively (Figure 23; 2021). No laboratories reported average TAT between 25-48 hours in 2020 or 2021 and two (4.0%) laboratory reported TATs between 49-72 hours in both 2020 and 2021.

Figure 20. *C. difficile* percent specimen test positivity based on laboratory location by LHIN, 2020-2021

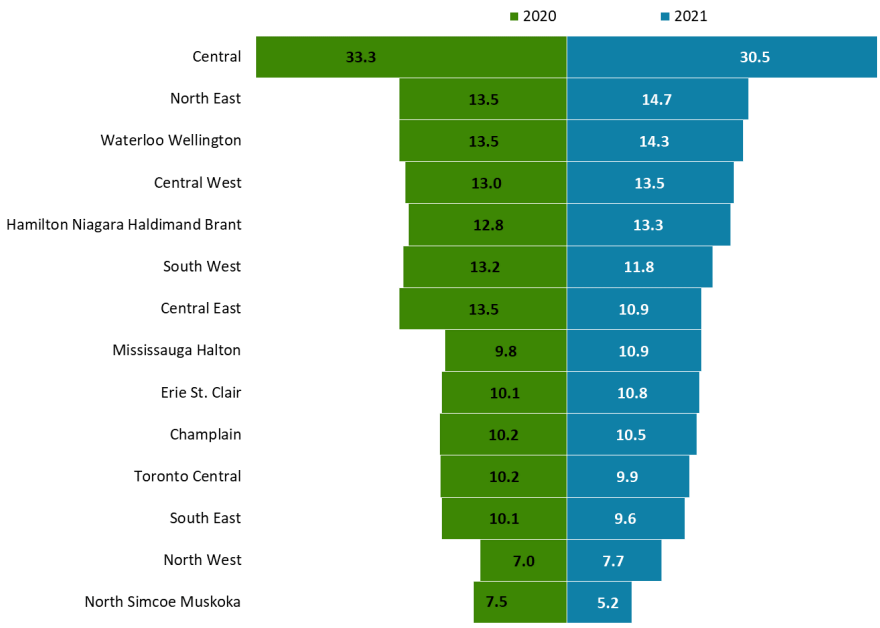


Figure 21. Rate of CDI per 10,000 population reported from all participating laboratories in Ontario, by LHIN, 2021

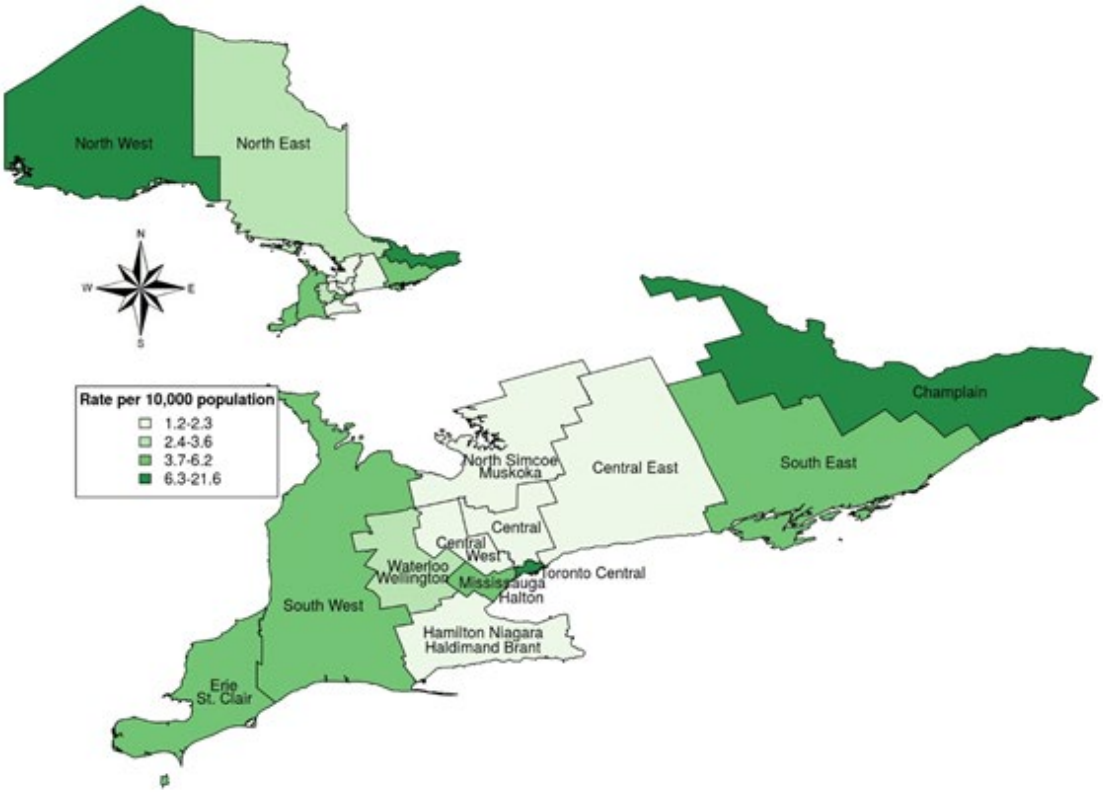
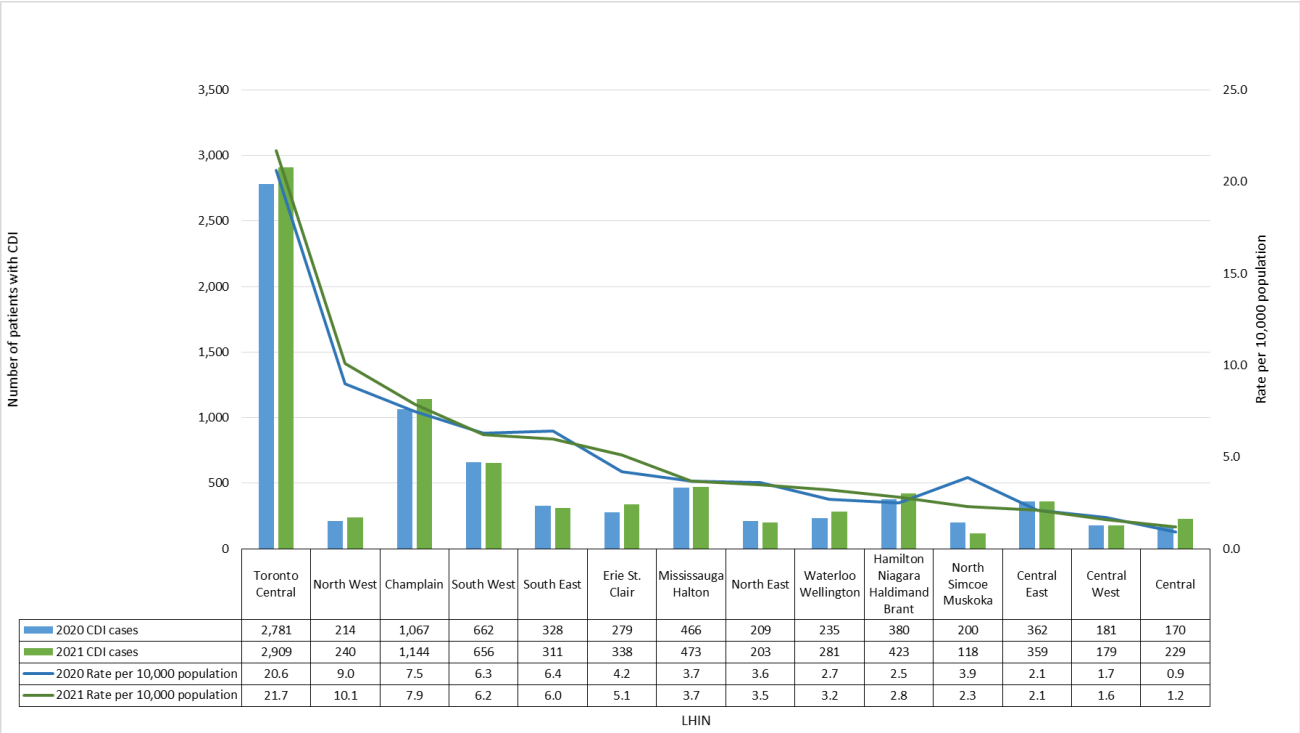


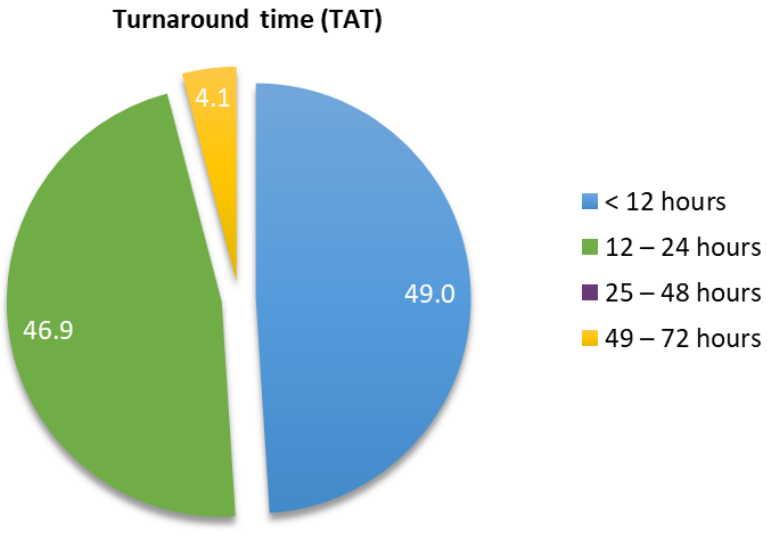
Figure 22. Number of CDI and rate per 10,000 population reported from all participating laboratories in Ontario, by LHIN, 2020-2021



	Toronto Central	North West	Champlain	South West	South East	Erie St. Clair	Mississauga Halton	North East	Waterloo Wellington	Hamilton Niagara Haldimand Brant	North Simcoe Muskoka	Central East	Central West	Central
2020 CDI cases	2,781	214	1,067	662	328	279	466	209	235	380	200	362	181	170
2021 CDI cases	2,909	240	1,144	656	311	338	473	203	281	423	118	359	179	229
2020 Rate per 10,000 population	20.6	9.0	7.5	6.3	6.4	4.2	3.7	3.6	2.7	2.5	3.9	2.1	1.7	0.9
2021 Rate per 10,000 population	21.7	10.1	7.9	6.2	6.0	5.1	3.7	3.5	3.2	2.8	2.3	2.1	1.6	1.2

LHIN

Figure 23. Percent of laboratories that reported average *C. difficile* testing turnaround times (from specimen receipt to reporting) between 0 to 72 hours in Ontario, 2021 (n=49)



Candida auris

Infection Control Practices

Hospitals were asked if they have an infection prevention and control policy that determines which patients should be screened for colonization with *C. auris.* A total of 11/61 (18.0%) hospitals reported having a screening policy, with several stating they screen patients who had been admitted to a hospital outside of Canada in the past year or patients transferred from health care facilities with recent *C. auris* transmission. 17/61 (27.9%) hospitals reported the primary reason for not having a *C. auris* screening policy was that they had not yet seen a case in their facility. 13 (21.3%) of hospitals reported that the risk level in their geographic area did not currently warrant a *C. auris* screening program. 11 (18.0%) hospitals reported they are currently planning for a future *C. auris* screening program, with several indicating that implementation has been delayed by the pandemic.

Laboratory Data

There were 16/47 (34.0%) laboratories that reported screening for *Candida auris* from clinical isolates. Specimen types collected by these laboratories included respiratory specimens (11/16 or 68.8%) and urine specimens (6/16 or 37.5%). Laboratories also reported using matrix-assisted laser desorption ionization-time of flight or MALDI-TOF (9/16 or 56.3%) and VITEK (2/16 or 12.5%) to identify *C. auris.*

A total of 5/48 (10.4%) laboratories reported screening for *Candida auris* from patients and of these, 4 (80%) labs reported collecting rectal swabs while 3 (60%) labs specified collecting from other anatomical sites including nasal, bilateral axillary and groin. All 5 laboratories indicated using culture method to identify *C. auris* from patients.

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. In past surveys, LHIN boundaries were self-reported by laboratory survey respondents. The data in this report has assigned LHIN boundaries based on postal codes of the laboratories, which potentially impacts comparisons across LHINs to previous reports. In addition, rates by LHIN were calculated excluding patient discharges from hospitals served by laboratories that did not respond to the laboratory survey. 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. In 2016, we began to provide pre-survey notification and follow-up reminder emails during the survey period. Collection of infection control data through the IQMH platform from hospital-based laboratories was an approach that started in 2018. While efforts were made to ensure dissemination contact lists were up to date, infection control staff may have changed. Additionally, the survey was conducted during the pandemic and some hospital infection control staff may not have participated due to pandemic-related duties. 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 that the number of new patients reported by a laboratory was not 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) provides a detailed list of these assumptions). Additionally, these surveys are dependent on complete and accurate responses in order to provide useful information on AROs that may benefit laboratories practicing bacteriology as well as infection control hospital staff. In most cases, no attempt was made to verify the submitted data therefore, inaccuracies may be present. Finally, 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, mortality and burden on the health care system. The hospital survey results describe some of the effects of the SARS-COV-2 pandemic on the screening and management of health care-associated infections in Ontario hospitals. While most disruptions to the use of additional contact precautions and use of prevalence surveys and contact-testing due to the pandemic have been reinstated, some hospitals did report ongoing interruptions to their screening programs and ability to place patients in single rooms.

From the 2020/21 survey results, we did not observe substantial changes to the overall prevalence rate of MRSA and VRE in Ontario. Similar to previous years, there was noticeable regional variation across the province among pathogens. Rates of MRSA were highest in the North West, South East, North East and Hamilton Niagara Haldimand Brant regions in 2021, whereas the rates of VRE remain the highest in the Champlain and South East regions in 2020 and 2021.

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.[4,5] As of May 2018, carbapenemase-producing Enterobacteriaceae (now termed as carbapenemase-producing Enterobacterales) 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 2021, 266 cases were reported by public health units in the reportable disease data[6] while 309 cases were reported in 2021 in the current survey by laboratories. A decrease in infection and colonization rates of CPE in 2020 compared with 2019 in Canadian acute care hospitals has also been reported by the Canadian Nosocomial Infection Surveillance Program.[7] The epidemiological data obtained from Ontario laboratories and hospital infection prevention and control programs helps in understanding the impact of CPO and informs recommendations to prevent the spread of CPO within our province.

While hospital-based rates of CDI have been decreasing since 2012[8], CDI prevalence rates from this survey were similar between 2019 and 2021. Community-associated cases may have contributed to this relatively stable trend. Differential trends in CDI rates were also observed in a study on the Epidemiology of *Clostridioides difficile* infection[9] which reported a decreasing rate of hospital-acquired CDI and an increasing rate of community-acquired CDI in Canada.

Percent resistance varies by antibiotic and by Gram-negative organism. However, an increase in percent resistance to ciprofloxacin was observed across all Gram-negative organisms from 2018 to 2021.

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 and all hospitals reported using additional precautions for patients with CDI), whereas screening and infection control of VRE, ESBL and CPOs continue to be inconsistent between hospitals in Ontario. Diverging infection control policies for VRE and changing epidemiology of VRE were observed in the current survey results and highlighted in a study by Johnstone et al. (2020) that found increasing rates of VRE bloodstream infections were highly associated with discontinuation of screening programs and Additional Precautions for VRE.[10]

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: Assumptions and Data Processing

Laboratory Data

1. Counts provided in the survey were assumed to be accurate.
2. The total number of isolates was used where the subtotals did not match the total number of isolates.
3. Interpretation of questions may vary between laboratories, especially when different laboratory personnel respond to the survey year to year.
4. Regionally stratified data were based on the location of the submitting laboratory.

Hospital Data

1. Infection control practices submitted by the corporation were assumed to apply across all institutions under the corporation.
2. Reinstatement of disruptions to screening and management practices due to the pandemic were assumed if respondents indicated an end date or 'unknown' to questions asking if practices were later reinstated.

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