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ANNUAL REPORT

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

April 2019

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Disclaimer

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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 health care resource use. Colonized patients with resistant organisms are an important reservoir for health care-associated pathogens and require routine surveillance to understand their changing epidemiology and effect of infection control programs.

In Canada, it has been estimated that the incidence of health care-associated infections is over 220,000 per year, resulting in more than 8,000 deaths. 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 collected in an annual report. In 2016, Public Health Ontario (PHO) and IQMH established a partnership to conduct annual surveillance of antimicrobial resistant organisms (AROs) in laboratories and hospitals. 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 changing trends in AROs in Ontario.

Report Objectives and Scope

The objective of this report is to provide information and share findings of the survey on antimicrobial resistance of common hospital pathogens, as reported by laboratories and hospitals in Ontario in 2017.

Participants were invited to report on the prevalence of AROs, laboratory information, screening practices and infection control programs related to methicillin-resistant *Staphylococcus aureus* (MRSA), vancomycin-resistant enterococci (VRE), extended spectrum beta-lactamases (ESBLs), carbapenemase-producing organisms (CPO) and *Clostridioides difficile* infections (CDI).

Methods

The surveys used to collect 2017 ARO prevalence data and infection control information were distributed to all licensed microbiology labs and public Ontario hospitals and available from February 26 through March 29, 2018.

IQMH developed and distributed the laboratory-focused survey, which included questions on number of new patients identified with AROs and laboratory practices. This survey was made available to all 53 hospital-based laboratories in Ontario, 13 community-based private laboratories and 11 PHO reference laboratories across the province. All laboratories surveyed are currently licensed bacteriology laboratories and accessed the survey via the existing IQMH questionnaire platform in QView™.

Concurrently, IPAC Regional Support Teams at PHO distributed an adapted survey to all hospitals in Ontario using the survey tool Acuity4 Survey by Voxco. The hospital survey invited infection control practitioners to answer questions about their screening programs for MRSA, VRE, extended spectrum beta-lactamase (ESBL)-producing organisms, CPOs, CDI, prevalence of colonized and infected patients and infection control practices.

Data from both surveys were extracted from their current interface, linked on unique identifiers and cleaned. 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 were analyzed using SAS 9.3 and Microsoft Excel. Analyses for both datasets 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 ARO: screening, prevalence and infection control practices.

Results

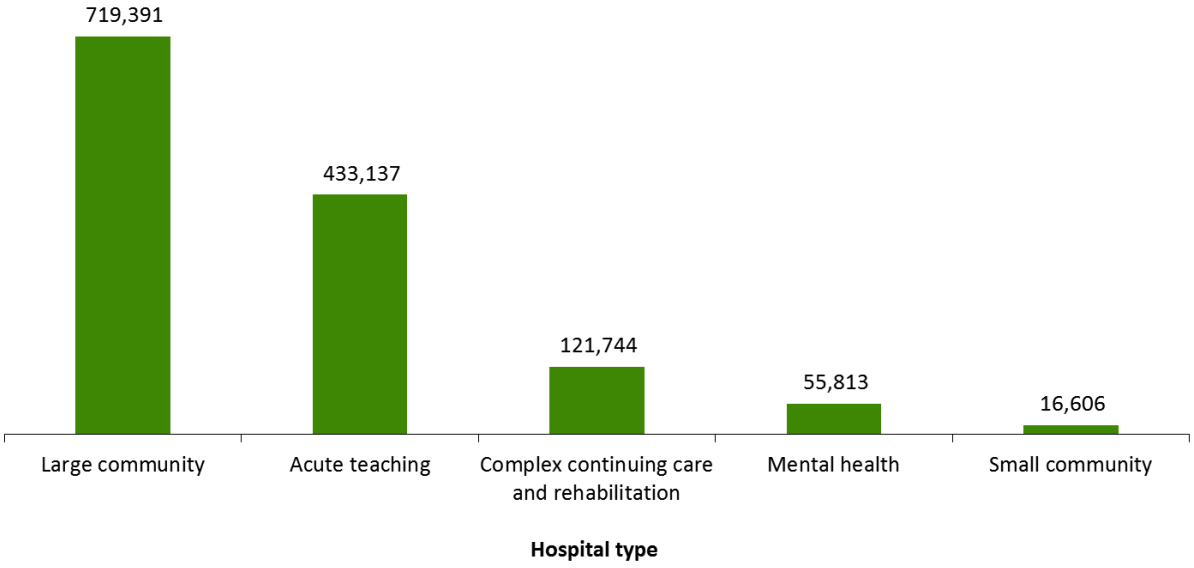
Survey Response

A total of 106/209 (51%) hospitals responded to the survey. Among the hospital respondents, 16 acute teaching hospital sites, 54 large community hospitals, 24 small community hospitals, eight complex continuing care and rehabilitation hospital sites and four mental health hospital sites were represented.

All 77 currently licensed bacteriology laboratories responded to the survey. This includes 53 hospital-based laboratories, 13 private community-based private laboratories and 11 PHO laboratory sites.

Among all 106 hospitals, 1,346,691 patients were admitted in 2017 (Figure 1). Patients admitted to large community hospital sites were the majority of all patients represented in this survey (53%), followed by patients admitted to acute teaching hospital sites, complex continuing care and rehabilitation hospital sites and small community hospitals.

Figure 1. Sum of patient admissions reported by 106 hospital respondents, by hospital type, 2017.



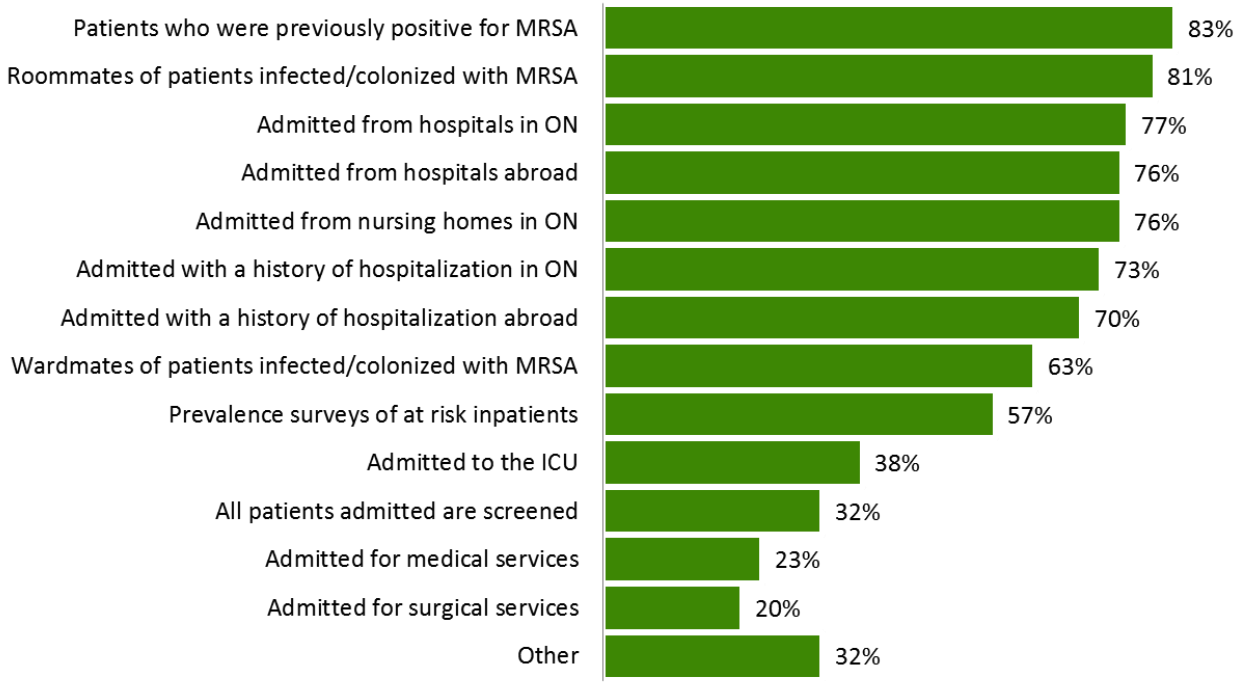
Methicillin-resistant *Staphylococcus aureus* (MRSA)

Hospital Screening

All 103 responding hospital sites reported having a screening program for MRSA (consistent with results from 2016).

Hospitals were likely to screen patients, who were previously positive for MRSA, roommates of patients positive for MRSA and patients admitted from another hospital in Ontario or nursing home (Figure 2).

Figure 2. Criteria used by hospitals for MRSA patient screening, 2017.



Prevalence

11,969 patients with MRSA isolated from any specimen site (i.e., any colonizations or infections) were reported. Of these patients, 728 (6.1%) had MRSA bacteremia. North West LHIN, Hamilton Niagara Haldimand Brant LHIN and North East LHIN had the highest rate of MRSA isolated from any specimen site in 2017 (Figure 3; see Table 1 for values).

728/4929 (14.8%) S. aureus bacteremia resistant to methicillin were reported in 2017 (Figure 4).

Figure 3. Rate of patients with MRSA from any specimen site (colonizations and infections) reported from hospital laboratories in Ontario, by LHIN, 2017.

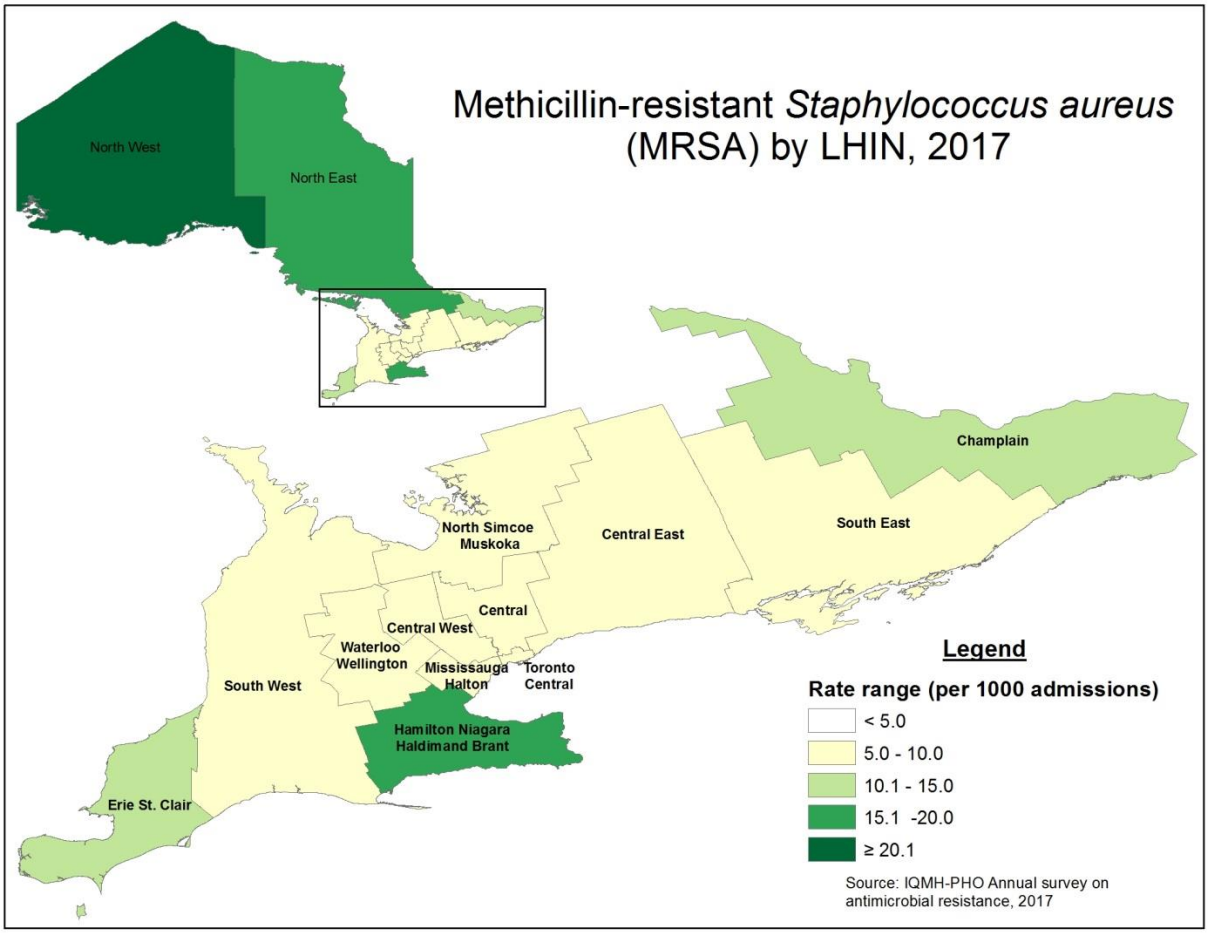
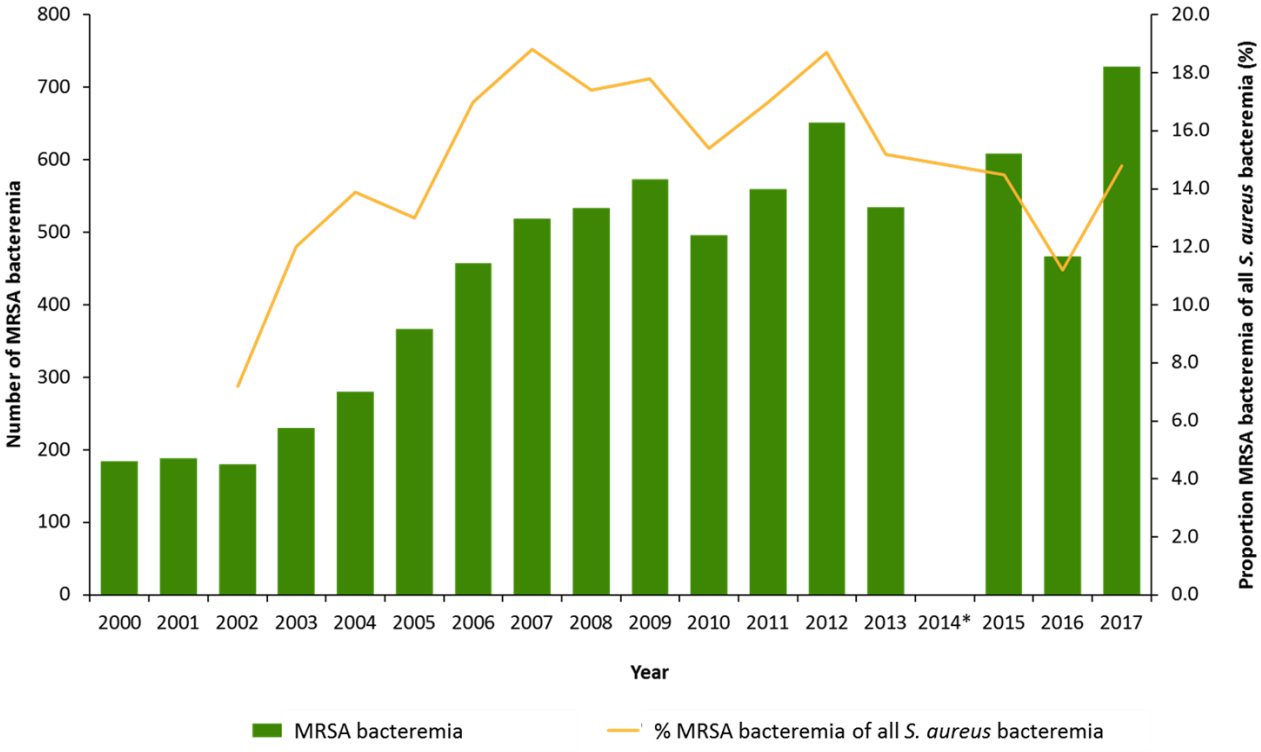


Table 1. Patients with MRSA from any specimen site (colonizations and infections) reported from hospital laboratories in Ontario, by LHIN, 2017.

LHIN	Number of MRSA from any specimen site (colonizations and infections)	Rate per 1,000 admissions
Central	444	8.5
Central East	696	6.5
Central West	196	8.0
Champlain	1,257	14.1
Erie St. Clair	961	13.6
Hamilton Niagara Haldimand Brant	1,977	18.1
Mississauga Halton	406	7.6
North East	938	16.6
North Simcoe Muskoka	317	8.5
North West	1,100	39.3
South East	512	8.9
South West	1,204	8.8
Toronto Central	1,486	7.7
Waterloo Wellington	475	9.6
Overall	**11,969**	**11.3**

Figure 4. MRSA bacteremia reported from hospital laboratories in Ontario, 2000 to 2017.



*Survey was not conducted in 2014.

Infection Control Practices

All hospital sites reported using additional precautions to care for patients with MRSA. 90/106 (85%) hospitals reported accommodating patients with dedicated toileting in single patient or multi-patient rooms. Only nine hospital sites reported cohorting patients with dedicated or shared toileting.

There were 68/106 (64%) hospitals that reported that routine environmental cleaning was sufficient for MRSA. Routine cleaning of patient equipment was reported by 52 (49%) hospitals. 37 (35%) hospitals reported doing using routine environmental cleaning and routine cleaning of patient equipment for MRSA. There were 30 (28%) hospital sites that reported using hospital-grade disinfectant to conduct additional cleaning of frequently touched surfaces.

74/106 (70%) hospitals reported that additional precautions for MRSA could be discontinued after three swabs taken one week apart were negative. There were seven (7%) hospitals that reported that patients remain with additional precautions for the duration of their hospitalization.

14/106 (13%) hospital sites responded that they decolonize patients with MRSA; however, several criteria and discretions were provided by each site that responded using decolonization.

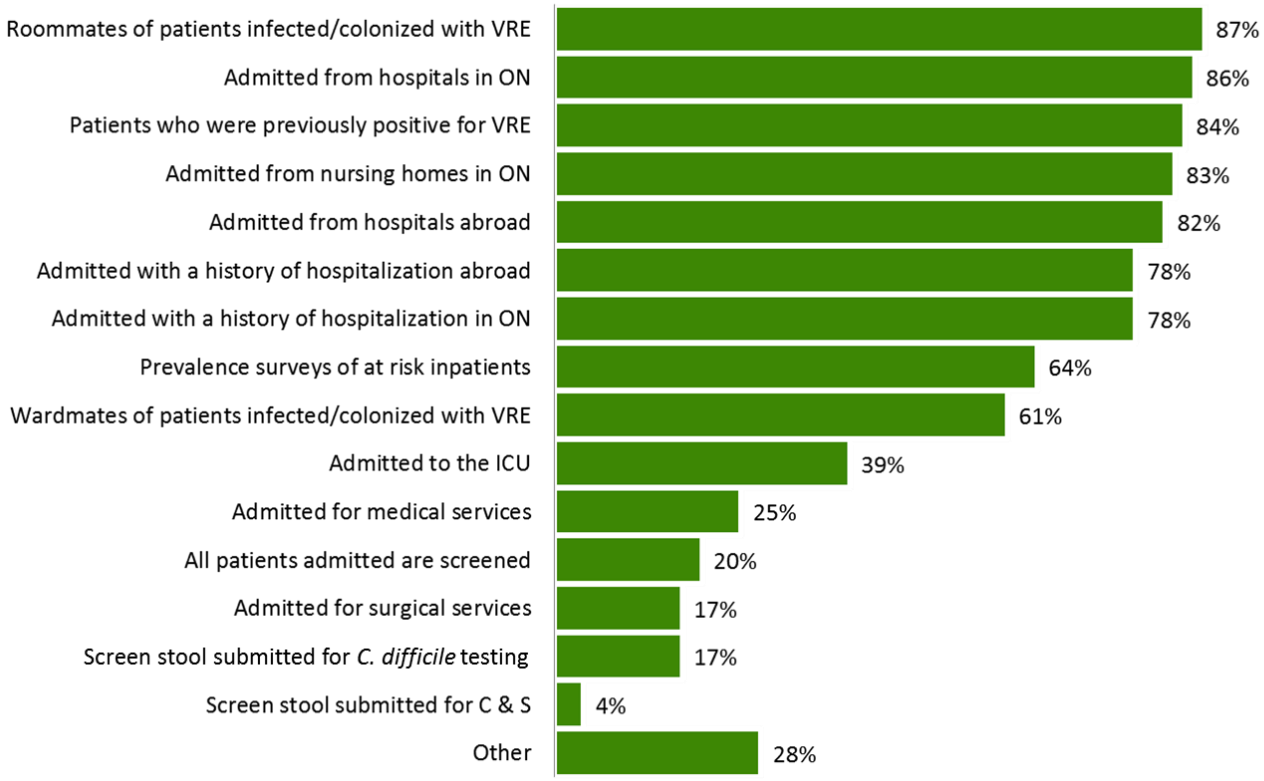
Vancomycin-resistant enterococci (VRE)

Hospital Screening

76/103 (74%) responding hospital sites had a screening program for VRE in 2017, comparable to 70% of hospitals that had a VRE screening program in 2016.

Hospitals with a screening program for VRE were likely to identify patients admitted from another hospital in Ontario or nursing home, roommates of a patient with VRE or patients previously positive for VRE (Figure 5). 15/76 (20%) hospital sites reported screening all patients admitted.

Figure 5. Criteria used by hospitals for VRE patient screening, 2017.



Prevalence

Ontario laboratories reported 1,499 patients with VRE isolated from a clinical specimen site (Figure 6; see Table 2 for values). The enterococcal species was specified for 756 patients; 644 (85%) patients were *E. faecium* and 112 (15%) were *E. faecalis*; the enterococcal species for the remaining 743 isolates was not specified. Of all 1,499 patients, 175 (11.7%) had VRE bacteremia. Laboratories in North West LHIN and Champlain LHIN had the highest rates of VRE isolated from clinical specimen sites in 2017.

175/2730 (6.4%) enterococcal bacteremia resistant to vancomycin were reported in 2017 (Figure 7).

Among acute teaching hospitals that do not have a screening program for VRE, the rate of VRE bacteremia was 0.46 per 1,000 patient admissions, compared to 0.21 per 1,000 patient admissions among acute teaching hospitals that reported having a screening program in 2017 (Figure 8).

Figure 6. Rate of patients with VRE isolated from a clinical specimen in Ontario, by LHIN, 2017.

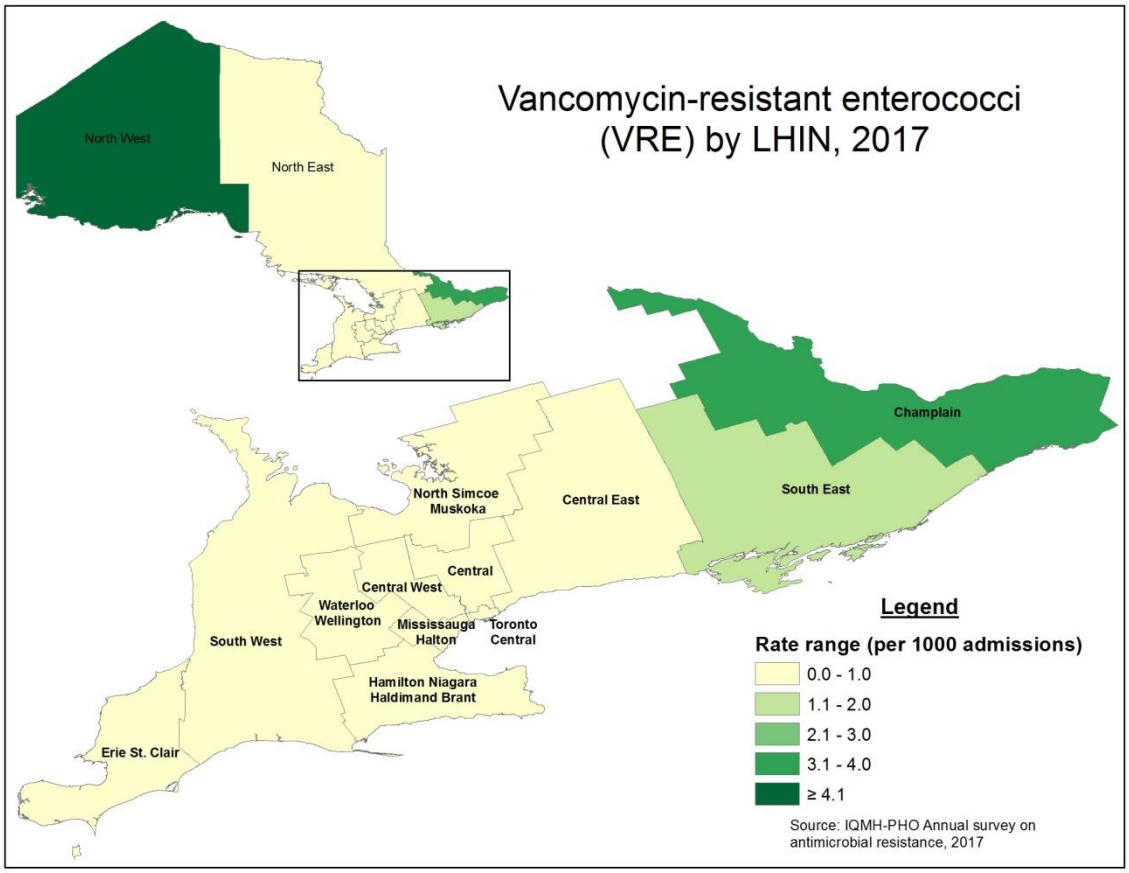
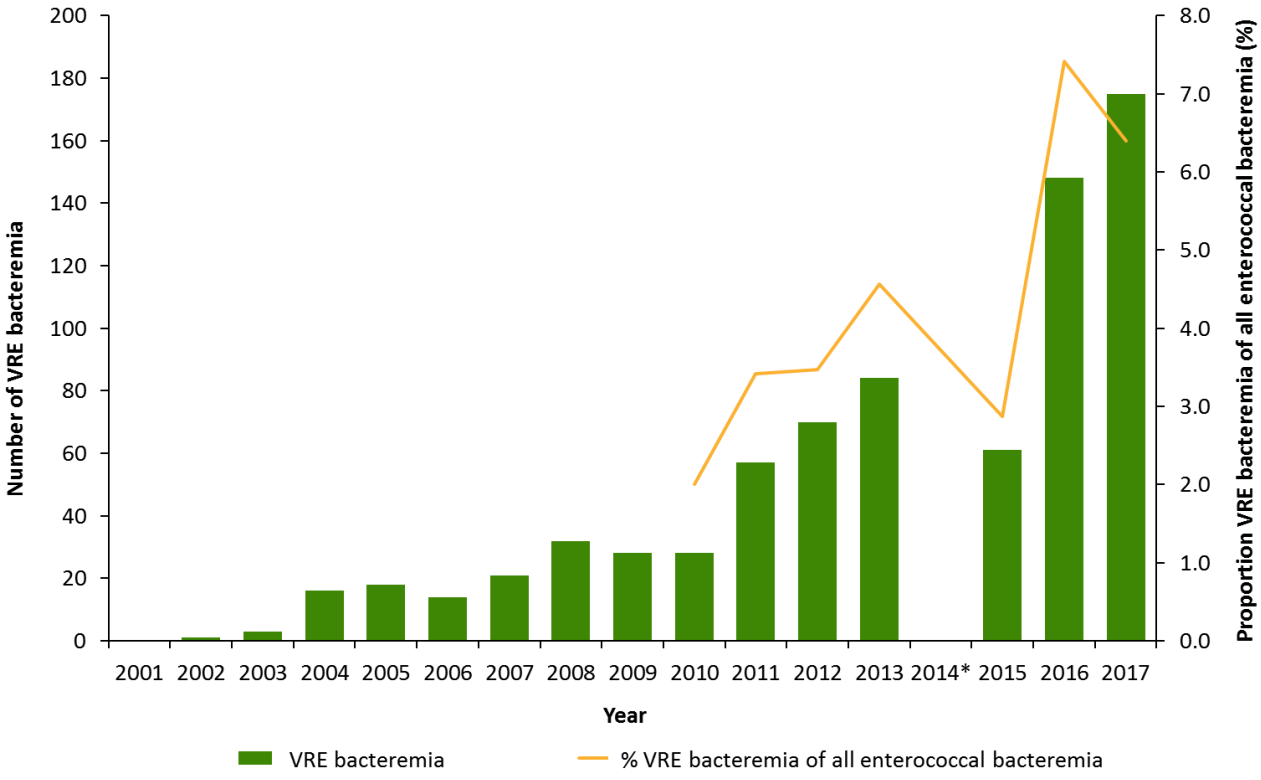


Table 2. Patients with VRE isolated from a clinical specimen in Ontario, by LHIN, 2017.

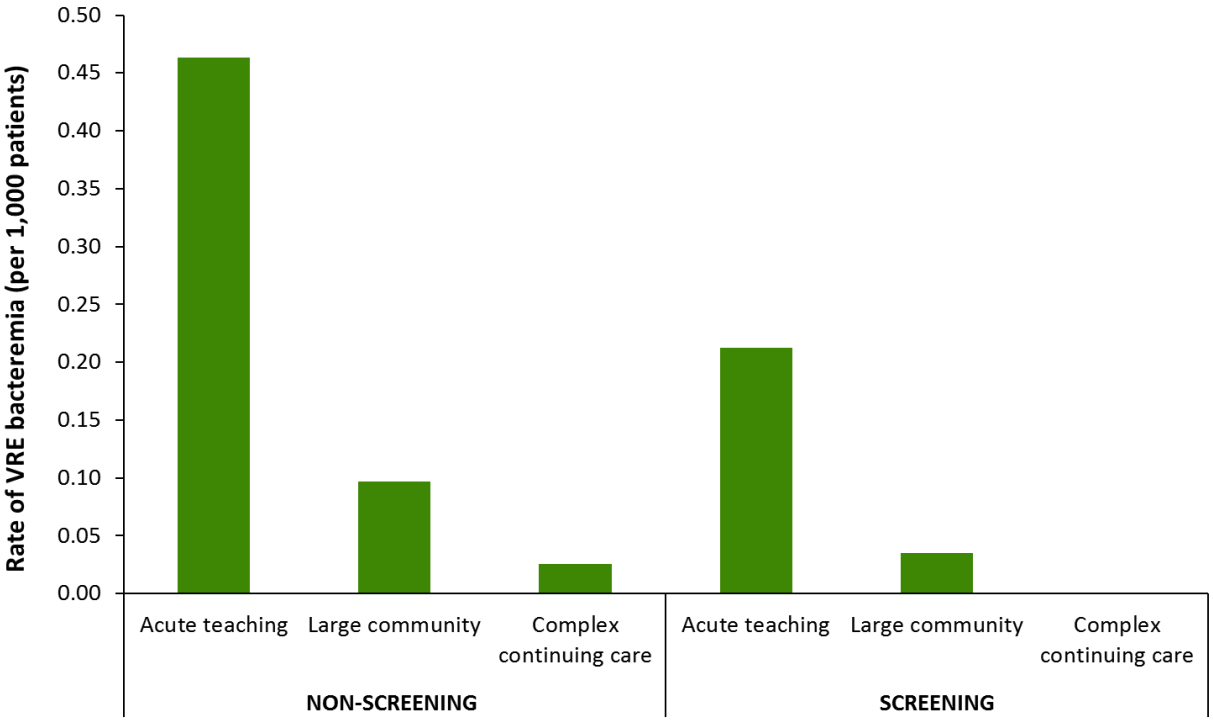
LHIN	Number of VRE clinical isolates	Rate per 1,000 admissions
Central	14	0.5
Central East	70	0.7
Central West	24	0.3
Champlain	284	3.2
Erie St. Clair	74	1.0
Hamilton Niagara Haldimand Brant	32	0.3
Mississauga Halton	23	0.4
North East	48	0.8
North Simcoe Muskoka	11	0.4
North West	494	16.8
South East	91	1.8
South West	207	0.6
Toronto Central	119	0.6
Waterloo Wellington	8	0.2
Overall	**1,499**	**1.2**

Figure 7. VRE bacteremia reported from laboratories in Ontario, 2001 to 2017.



*Survey was not conducted in 2014

Figure 8. Comparison of VRE bacteremia rate (per 1,000 patients) between non-screening and screening hospitals, by hospital type, 2017.



Infection Control Practices

Additional precautions for all patients with VRE colonizations and infections were used by 75/106 (71%) hospitals; eight (7%) hospitals reported using additional precautions for symptomatic VRE patients only. 11/106 (10%) hospitals reported they did not use any additional precautions for patients with VRE in 2017.

78/83 (94%) hospitals accommodated patients with VRE in single rooms with dedicated toileting; 14 (17%) hospital sites used multi-patient rooms with dedicated toileting and eight (10%) hospitals cohorted positive patients with dedicated or shared toileting.

82/106 (77%) hospitals reported using gowns and gloves when caring for patients with VRE. 64 (60%) hospitals reported using gowns, gloves and dedicated equipment when providing care to patients with VRE. 10 (9%) hospitals reported not using any PPE when administering care to patients with VRE.

49/83 (59%) hospitals reported that additional precautions could be discontinued once the patient has had three negative swabs for VRE one week apart. 18/83 (22%) hospital sites reported that no conditions were considered before discontinuing additional precautions. Only 4/83 (5%) hospital sites reported that VRE positive patients remain in additional precautions for the duration of hospitalization.

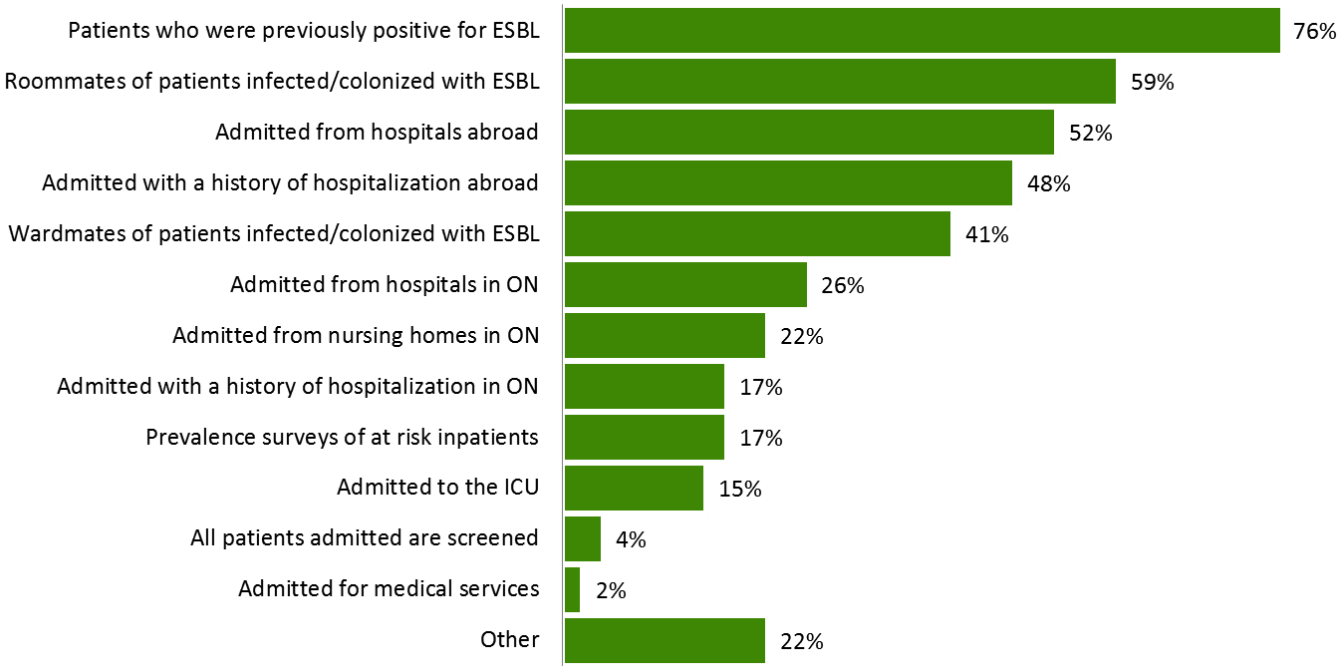
Extended spectrum beta-lactamases (ESBL)

Hospital Screening

46/103 (47%) responding hospital sites reported having a screening program for ESBL. In 2016, 32% of hospitals surveyed reported having an ESBL screening program.

Hospitals with a screening program for ESBLs were likely to identify patients by screening those who were previously positive for ESBLs, roommates of patients positive for EBSL and patients who were admitted from hospitals abroad or those who have a history of hospitalization abroad (Figure 9).

Figure 9. Criteria used by hospitals for ESBL patient screening, 2017.



Prevalence

In 2017, 478,663 clinical isolates of *Escherichia coli*, 78,282 isolates of *Klebsiella* spp., 43,147 clinical isolates of *Pseudomonas aeruginosa* and 2,962 clinical isolates of *Acinetobacter* spp. were reported by Ontario laboratories.

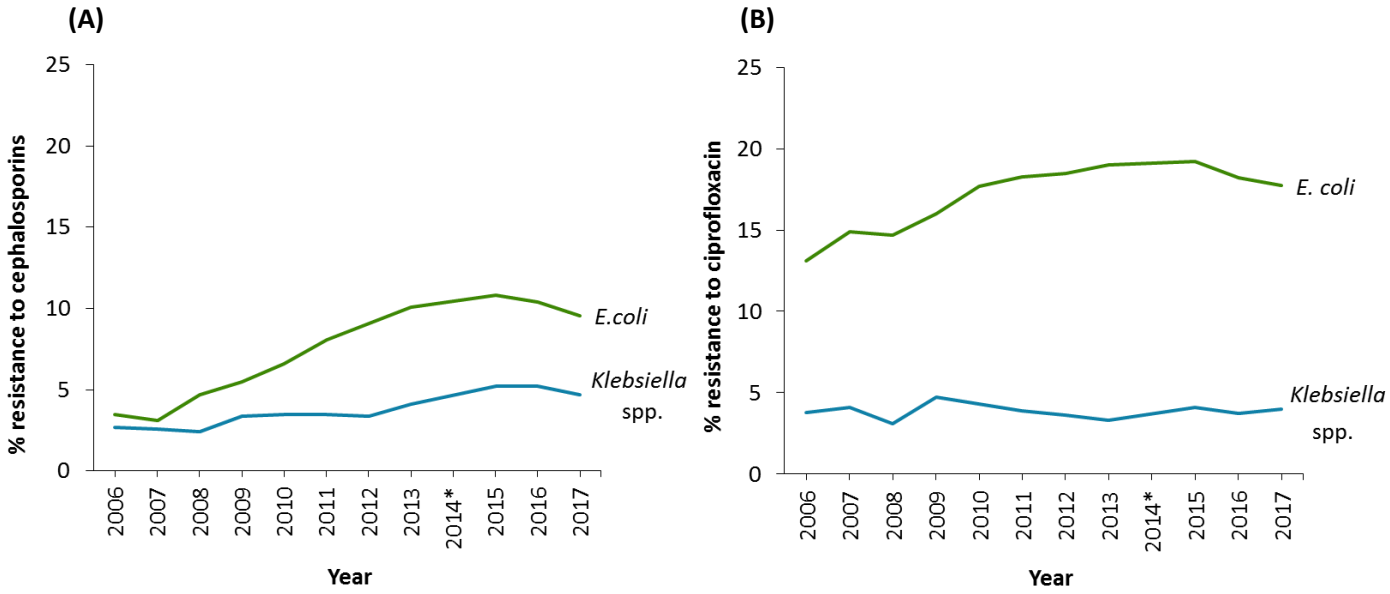
Resistance to third-generation cephalosporins among *E. coli* isolated from all specimen sites has decreased slightly since 2015 (Figure 10, panel A), but has remained relatively consistent since 2013. Resistance to cephalosporins was 10.1% in 2013, 10.8% in 2015 and 9.6% in 2017. Resistance to cephalosporins among *Klebsiella* spp. isolated from all specimen sites has remained consistent (5.2% in 2015 and 2016 and 4.7% resistant in 2017).

Similarly, resistance among *E. coli* to ciprofloxacin has decreased slightly over time since 2013 (19.0% in 2013, 19.2% in 2015 and 17.7% in 2017), whereas *Klebsiella* spp. resistance to cirprofloxacin has remained relatively stable around 4% for the last three years (Figure 10, panel B).

Among *P. aeruginosa* isolates, resistance to ciprofloxacin was 13.6% in 2015, 12.7% in 2016 and 9.0% in 2017 (Figure 11). *P. aeruginosa* isolates resistant to imipenem/meropenem has increased from 7.0% in 2016 to 7.8% in 2017. Resistance to cephalosporins among *Acinetobacter* spp. from any specimen type was 14.4%; 19.8% resistance from blood isolates only (Figure 12).

Resistance of *E. coli* isolated from blood and urine to third-generation cephalosporins was 13.9% and 9.3%, respectively (Figure 12 and Figure 13). Resistance to ciprofloxacin among *E. coli* isolated from blood was 20.8% and 17.8% for *E. coli* isolated from urine.

Figure 10. Percent resistance of *E. coli* and *Klebsiella* spp. isolated from any site to (A) cephalosporins and (B) ciprofloxacin, 2006–2017.



*Survey was not conducted in 2014.

Figure 11. Percent resistance of all isolates of *E. coli*, *Klebsiella* spp., *P. aeruginosa* and *Acinetobacter* spp. to cephalosporins, ciprofloxacin and carbapenems, 2017.

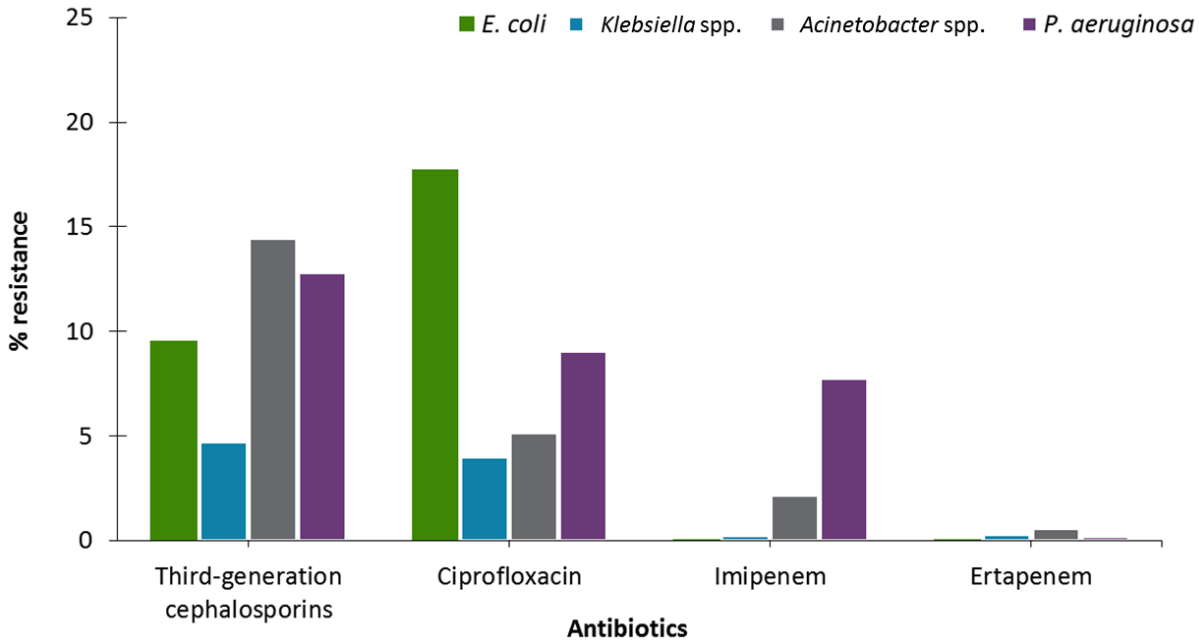


Figure 12. Percent resistance of *E. coli*, *Klebsiella* spp., *P. aeruginosa* and *Acinetobacter* spp. from blood to cephalosporins, ciprofloxacin and carbapenems, 2017.

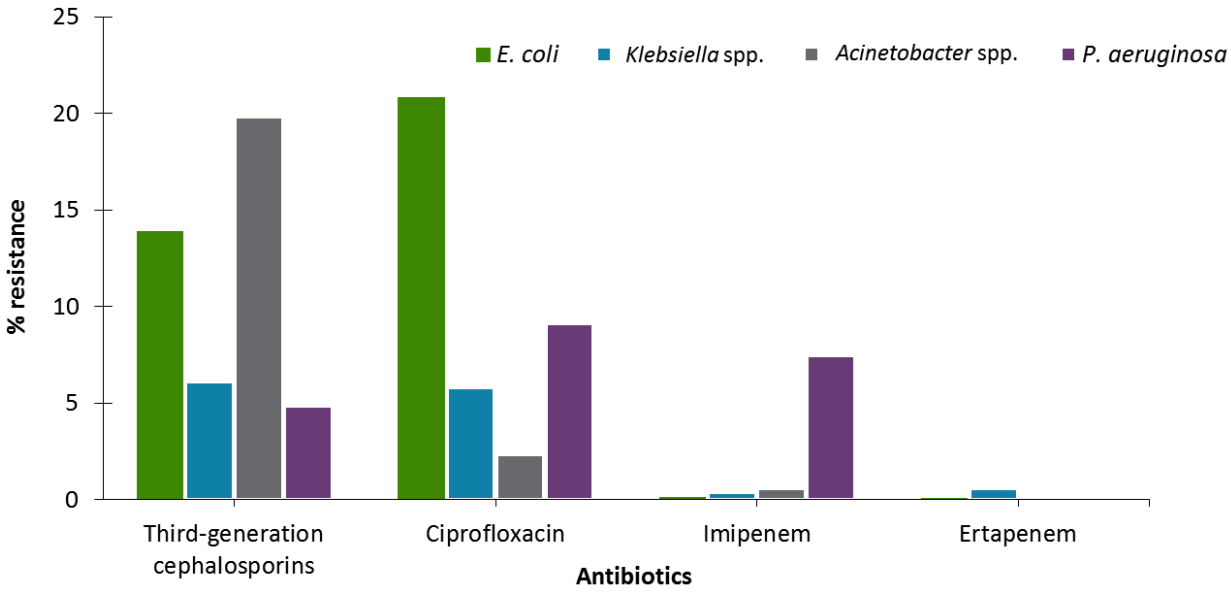
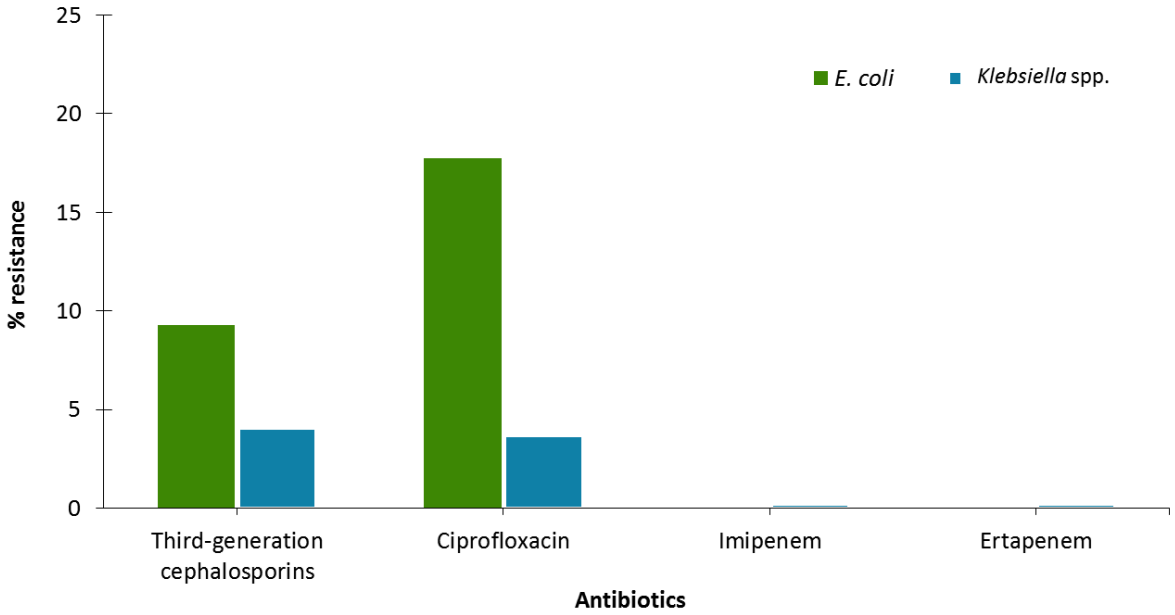


Figure 13. Percent resistance of *E. coli*, *Klebsiella* spp., *P. aeruginosa* and *Acinetobacter* spp. from urine specimens to cephalosporins, ciprofloxacin and carbapenems, 2017.



Infection Control Practices

66/106 (62%) hospital sites used additional precautions to care for all patients with ESBL colonizations or infections. Nine (8%) hospitals reported using additional precautions for symptomatic patients only (e.g., diarrhea). There were 25 (24%) hospitals that reported they do not use additional precautions for patients with ESBLs.

68/106 (64%) hospital sites reported using gowns and gloves for direct care of patients with ESBLs; 44 (41%) used dedicated equipment for patients with ESBLs.

73/106 (69%) hospital sites reported that routine environmental cleaning is sufficient for patients with ESBLs; 28 (26%) hospitals used routine cleaning of patient equipment and 20 (19%) hospitals perform additional cleaning of frequently touched surfaces using hospital-grade disinfectant.

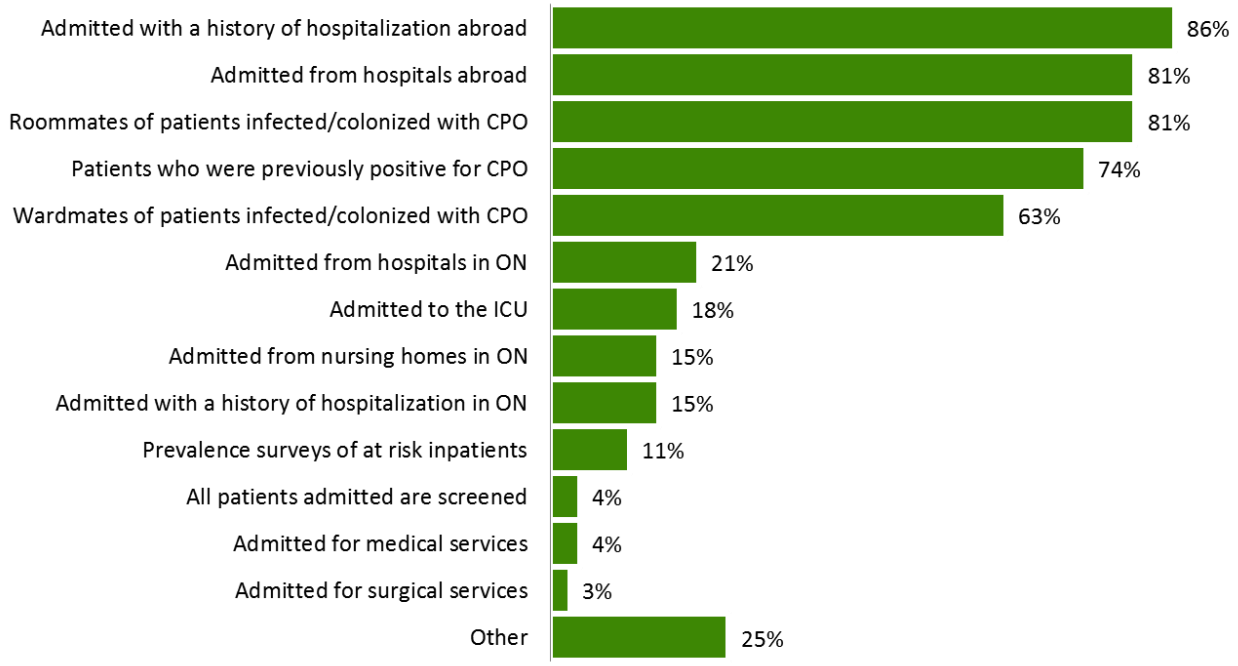
31/75 (41%) hospital sites reported that additional precautions could be discontinued after three negative swabs taken one week apart were negative. 13/75 (17%) hospitals reported that once a patient is positive for ESBL, they remain in additional precautions.

Screening

73/103 (71%) responding hospital sites reported having a screening program for CPOs in 2017, an increase from 51% of hospitals that reported having a screening program for CPOs in 2016.

Hospitals with a screening program for CPOs were likely to identify patients with a history of hospitalization abroad/patients admitted directly from a hospital abroad, those who were roommates of a patient positive for CPO and patients who were previously positive for CPO. Only 4% of hospitals screened all patients on admission; 21% of hospitals screen patients admitted from another hospital in Ontario (Figure 14).

Figure 14. Criteria used by hospitals for CPO patient screening, 2017.



Prevalence

Laboratories reported 311 new patients with CPOs isolated from any specimen site (i.e., colonizations and infections) in 2017 (Figure 15; see Table 3 for values). Central West and Toronto Central LHINs had the highest rate of CPOs per 1000 admissions; North Simcoe Muskoka LHIN did not report any patients with CPOs in 2017.

In 2016, there were no patients with CPO reported from North Simcoe Muskoka, North West or South East LHINs; a total of 150 patients with CPOs were reported by Ontario laboratories.

Figure 15. Rate of patients with CPOs from any specimen site (colonizations and infections) reported from hospital laboratories in Ontario, by LHIN, 2017.

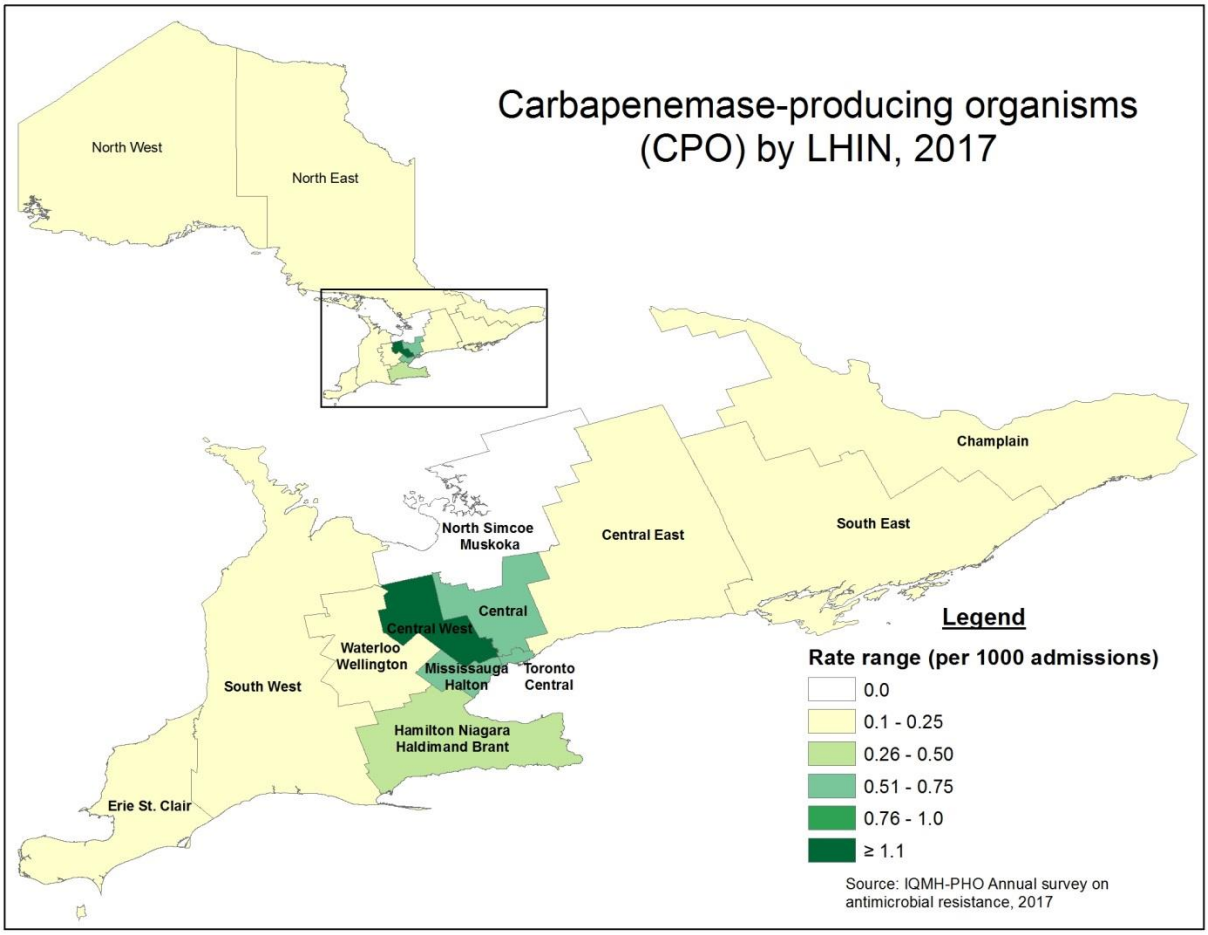


Table 3. Patients with CPOs from any specimen site (colonizations and infections) reported from hospital laboratories in Ontario, by LHIN, 2017.

LHIN	Number of CPO from any specimen site (colonizations and infections)	Rate per 1,000 admissions
Central	18	0.66
Central East	13	0.12
Central West	102	1.26
Champlain	7	0.08
Erie St. Clair	2	0.03
Hamilton Niagara Haldimand Brant	20	0.27
Mississauga Halton	27	0.51
North East	13	0.22
North Simcoe Muskoka	0	0.00

LHIN	Number of CPO from any specimen site (colonizations and infections)	Rate per 1,000 admissions
North West	1	0.04
South East	5	0.09
South West	2	0.01
Toronto Central	98	0.51
Waterloo Wellington	3	0.08
Overall	**311**	**0.30**

Infection Control Practices

96/106 (91%) hospital sites used additional precautions to care for all patients with CPO colonizations or infections in 2017. Two (2%) hospitals reported they used additional precautions for symptomatic patients only.

42/106 (40%) hospitals reported that hospital-grade disinfectant was used for additional cleaning of frequently touched and 51 (48%) hospital sites reported that special attention was paid to cleaning sinks and drains of patients with CPOs. There were 57 (54%) hospitals that indicated environmental services staff were notified of additional cleaning requirements for CPOs. 80 (75%) hospitals reported using gowns, gloves and dedicated equipment to care for patients with CPOs.

51/98 (52%) hospital sites reported that patients with CPOs remain in additional precautions for the duration of their hospitalization, whereas 16/98 (16%) hospitals reported that no conditions are considered prior to considering discontinuation of additional precautions. Notably, there were a few hospital sites that indicated policies for discontinuing additional precautions for CPOs are in development or have not been established yet.

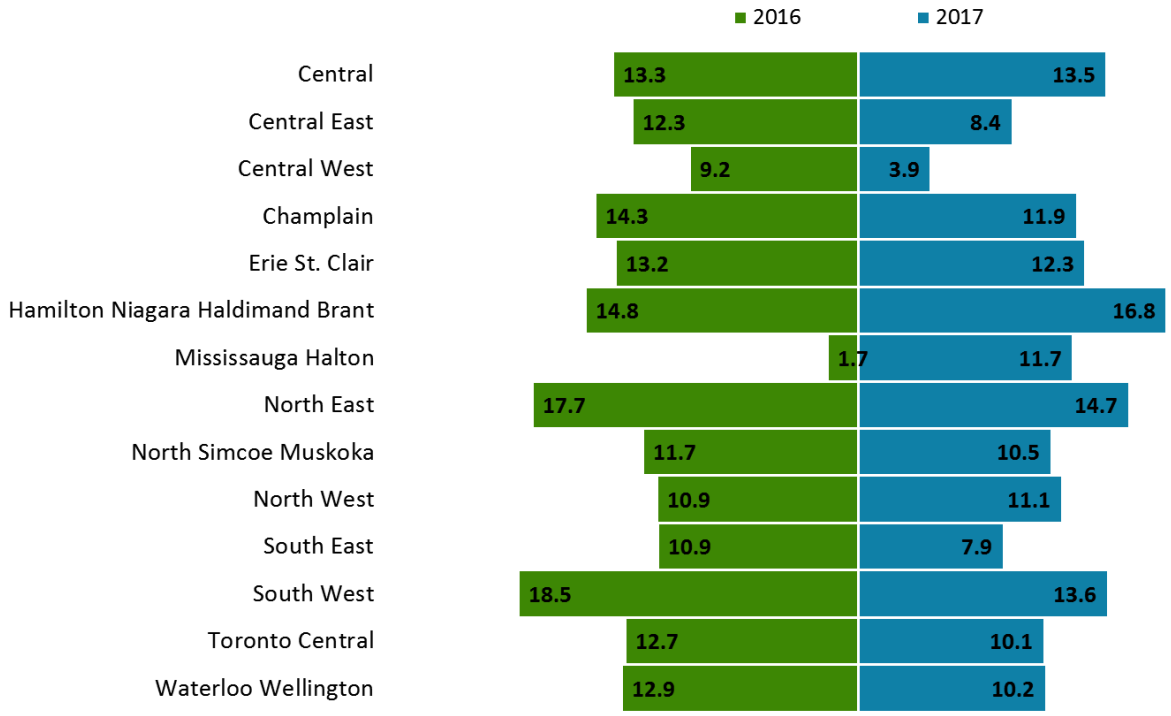
Clostridioides difficile Infections (CDI)

Prevalence

A total of 112,934 specimens were tested for CDI toxin by Ontario laboratories in 2017. Among all specimens tested, 13,091 (11.6%) were positive for CDI toxin. Laboratories in Hamilton Niagara Haldimand Brant, Central and North East LHINs reported the highest proportion of specimens positive for CDI toxin in 2017 (Figure 16).

In 2016, 135,716 specimens were tested for CDI. 14,663 (10.8%) specimens were positive for CDI toxin. South West, North East and Hamilton Niagara Haldimand Brant LHINs reported the highest proportion of specimens positive for CDI toxin in 2016.

Figure 16. CDI percent specimen positivity, by LHIN, 2016 and 2017.



Infection Control Practices

72/106 (68%) hospital sites reported using additional precautions to care for any patients with CDI. There were 25/106 (24%) hospital sites that indicated that they used additional precautions for symptomatic patients only (e.g., diarrhea).

99/106 (93%) hospital sites reported that single rooms with dedicated toileting were used to accommodate patients with CDI. 74 (70%) hospitals reported that patients require at least 48 hours without diarrhea prior to discontinuing additional precautions for CDI.

Turnaround time (TAT) from specimen collection to reporting a test result was within the 24-hour recommendation from the Ministry of Health and Long-Term Care for 42/46 (91%) hospital-based laboratories that responded with CDI laboratory information. 16 laboratories reported a TAT within 12 hours from specimen collection. Among PHO laboratories, 7/11 (64%) laboratories reported 24-hour TAT.

Data Caveats

Data Collection

We attempted to administer the surveys using a hybrid approach to link the ARO prevalence estimates provided by the laboratories to their respective hospital infection control practices.

This was a success for the hospital-based laboratories who were able to facilitate data entry for the infection control portion of the survey into IQMH's QView™ survey platform; however, QView™ surveys are only accessible to laboratory personnel, necessitating a separate survey to be administered via PHO's survey platform Acuity4 Survey by Voxco to all hospitals that do not have a laboratory onsite to collect data from infection control personnel.

While we made efforts 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.

Prevalence Estimates

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

Conclusions

Health care-associated infections contribute to increased morbidity and mortality and greater burden on the health care system. The overall prevalence of resistant organisms remains stable in Ontario; however, there is noticeable regional variation across the province among pathogens.

MRSA is highly prevalent in the North West, South Central and South West regions, whereas the rate of VRE is highest in the North West, South East and Champlain regions. The abundance of travel and migration from the Indian subcontinent to the south central region on Ontario is reflected in the higher prevalence of CPOs compared to other parts of the province. In fact, the changing epidemiology of CPOs over the last decade has prompted the addition of carbapenemase-producing *Enterobacteriaceae* (CPE) to the list of diseases of public health significance in Ontario requiring all cases of CPE colonization and infection to be reported to local public health for surveillance (CDI outbreaks and outbreak associated cases in hospitals have been provincially reportable since 2008). The rate of CDI is lower than it has been in Ontario historically, particularly in the last two years.

Infection control practices vary widely throughout hospitals in Ontario. Best practice documents by the Provincial Infectious Disease Advisory Committee (PIDAC) 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, 93% of hospitals reported that single rooms with dedicated toileting were used to accommodate patients with CDI), whereas screening and infection control of VRE, ESBL and CPOs are highly variable in hospitals in Ontario. This may be due to the time needed for hospital infection control policies to be developed and implemented widely. Screening programs for emerging organisms or low-prevalence health care settings require significant resources, but may be warranted to prevent spread and outbreaks — ensuring new patients with risk factors for acquiring AROs are captured. Nonetheless, several factors contribute to the implementation of infection control practices and data from surveillance initiatives can be used to monitor the effect of interventions.

Surveillance of AROs requires collaboration between public health, laboratories and infection control. Data can enable hospitals to compare their prevalence of AROs to the regional and provincial rates and may inform local decisions regarding the appropriate application of infection control practices.

Appendix A: Assumptions and Data Cleaning Procedures

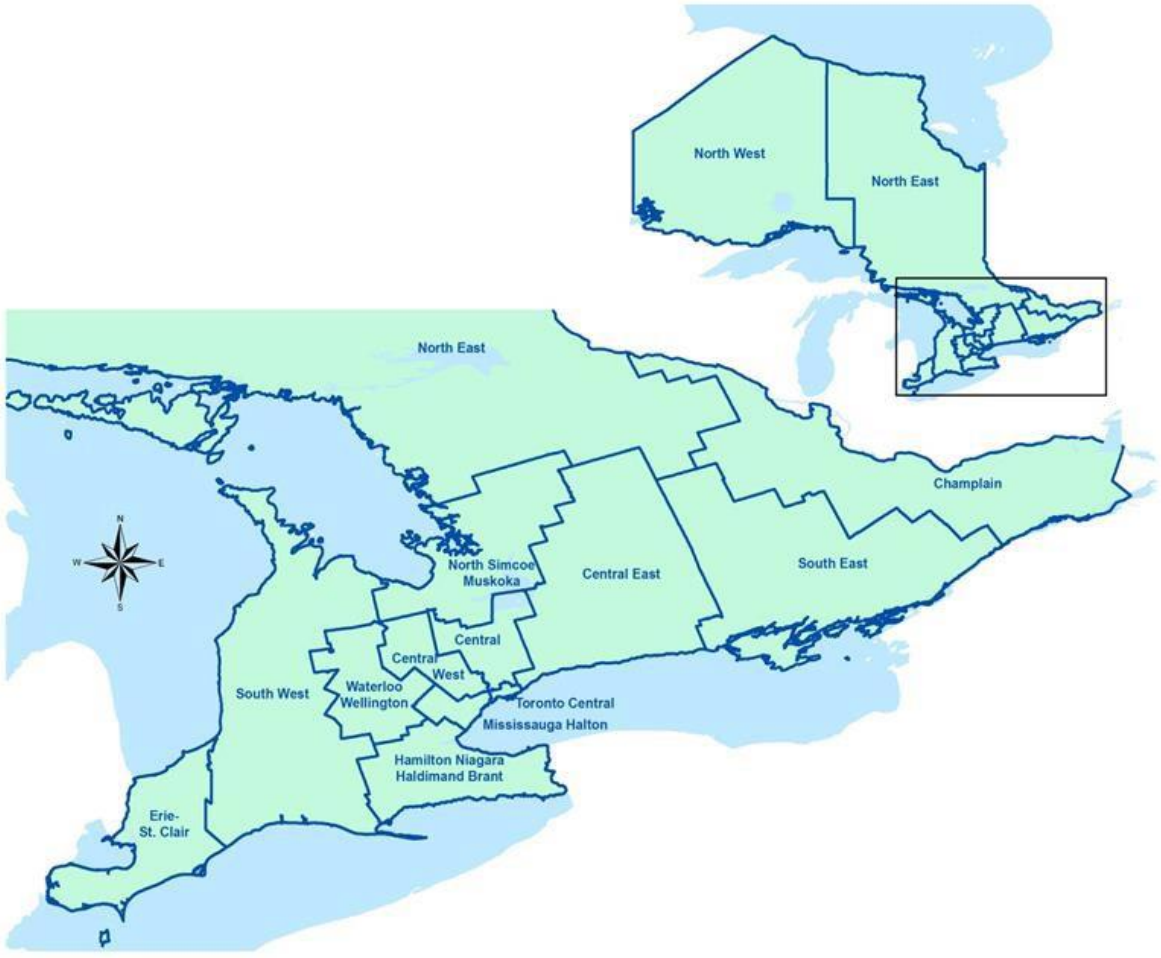
Laboratory Data

1. The numbers provided in the survey were assumed to be accurate.
2. To avoid duplicate entries, supplementary questionnaires received from laboratories, which send specimens to a centralized laboratory, were deleted from the dataset if data from their laboratories were already captured by the centralized laboratory. Information that was in the supplementary questionnaire that was not in the centralized laboratory questionnaire was manually added to the latter.
3. 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.
4. For duplicated laboratories grouped with other laboratories, the numbers were assumed to be coming from different laboratories since separating the counts were not feasible.
5. Where the subtotals did not match the total number of isolates, the total number of isolates was used.
6. If the screening question was not completed, but practices were specified in follow-up responses, the laboratory was assumed to conduct screening related to the ARO in question.
7. 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.
8. Regionally stratified data were based on the location of the submitting laboratory.

Hospital Data

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

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



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