AHS has 17 performance measures which are used to monitor how the health system is performing. There are two safety performance measures informed by IPC: healthcare provider hand hygiene compliance and hospital-acquired *Clostridium difficile* infection rates. Performance measures are reported quarterly and are publicly available on the AHS website.

### Provincial Surveillance Program

IPC has developed an integrated provincial surveillance program and has established an AHS IPC Surveillance Action Plan for 2017-2020.

Surveillance protocols are developed by the Data Quality Working Group led by surveillance epidemiologists. The working group also includes surveillance analysts, Infection Control Professionals, and IPC physicians. Protocols are approved by the IPC Surveillance Committee and confirmed by the Provincial IPC Committee. Data Quality Forum meets online to improve inter-rater reliability and maintain data quality. Attendance ranges from 60-80 IPC staff each month.

There are six provincial IPC surveillance protocols in place across AHS and Covenant Health. These include: Methicillin-resistant *Staphylococcus aureus*, Vancomycin-resistant enterococci infections, carbapenemase-producing organisms, *Clostridium difficile* infections, central line-associated bloodstream infections, and surgical site infections.

Where available these protocols align with national surveillance allowing comparison between Alberta’s health system performance and the rest of Canada. A provincial online IPC surveillance platform enables the collection and reporting of surveillance data from every acute care facility in the province.
IPC staff and physicians create interim reports for clinical areas and units that are monitoring or analyzing a potential problem. A real-time data extraction system was introduced in 2012/13 to support this unit- and site-based reporting and intervention.

Provincial quarterly reports and zone and site rates are reviewed and approved by the Provincial IPC Surveillance Committee. Reports are distributed broadly to AHS and Covenant Health leaders and clinical stakeholders to inform practice and enhance patient safety. To increase availability to all stakeholders, the surveillance reports are posted on AHS Insite.

In 2016/17, an internal data sharing portal was established to communicate up-to-date IPC surveillance results to AHS and Covenant Health staff. The reports include Adverse Outcomes following *Clostridium difficile* infection, *Clostridium difficile* infection incidence rates, Methicillin-resistant *Staphylococcus aureus* incidence rates, incidence rate denominators, and timeliness of data reporting. The reports are updated twice daily at 5 AM and 1 PM. Information sheets accompany these reports and provide further detail on the surveillance indicators.

**Data Quality**

The IPC program uses the data quality framework from the Canadian Institute for Health Information to provide provincial surveillance data which are accurate, timely, comparable, usable, and relevant. The Data Quality Working Group is a key component of this and is responsible for developing, reviewing, and interpreting indicator protocols and identifying education needs for the province. The group conducts an annual review of the IPC provincial protocols compared to national and international protocols from the Canadian Nosocomial Infection Surveillance Program and the National Healthcare Safety Network. In addition to this work, provincial projects provide measures of data quality and system performance; a report on this work was accepted for publication in the Canadian Journal of Infection Control, 2016.

To further assist Infection Control Professionals with data entry and education, a surveillance case example library was created in the summer of 2016 and future work will incorporate this into education tools.

**IPC Surveillance Projects**

The IPC surveillance team regularly receives new requests for data linkages and support.

The team assisted various local surveillance initiatives including data linkages for the surveillance of surgical site infections following spinal fusion procedures, provision of denominator data to Calgary zone for use with their local protocol on surgical site infection surveillance following cerebrospinal shunt procedures, and an evaluation of the preprinted *Clostridium difficile* infection order set at the Royal Alexandra Hospital in Edmonton.

Other projects included solid organ transplant surveillance and surveillance for *Mycobacterium chimaera* following cardiovascular procedures.
Antibiotic-resistant Organisms

IPC surveillance focuses on antibiotic-resistant organisms identified in the hospital setting and includes all new laboratory confirmed cases of Methicillin-resistant *Staphylococcus aureus*, Vancomycin-resistant enterococci, and carbapenemase-producing organisms. IPC surveillance is also performed for all bloodstream infections that are associated with an antibiotic-resistant organism.

Infection Control Professionals across the province communicate about surveillance actions through the online IPC surveillance system. Invitations sent through the system can alert on new status updates for patients with antibiotic-resistant organisms to Infection Control Professionals at acute care facilities where these patients have had previous admissions. Until the development of a provincial Clinical Information System is completed, this informal communication allows Infection Control Professionals to review specific patient histories and initiate or discontinue flagging in local hospital information systems.

Each quarter, the Provincial Laboratory for Public Health (ProvLab) provides the IPC surveillance team with a list of patients with newly confirmed carbapenemase-producing organisms from the National Microbiology Laboratory, so that isolates meeting criteria for national surveillance through the Canadian Nosocomial Infection Surveillance Program can be identified. Using that list, the IPC surveillance team reviews these patient histories in Netcare for new acute care facility admissions, and on a quarterly basis sends invitations to site Infection Control Professionals so they can be aware of the patient’s colonization with carbapenemase-producing organisms and create an electronic flagging alert.

Information transfer is an Accreditation Canada required organizational practice, and this internal communication supplements the standardized forms and processes used during patient inter- and intra-facility transfer. In 2016/17, work continued to standardize hospital information system alerts and integrate Meditech antibiotic-resistant organism alert processes in South, Central, and North zones.

The IPC surveillance team collaborates with partners, including the AHS Analytics program and the Provincial Laboratory for Public Health (ProvLab), to provide more detailed information on patients with newly acquired infections through linkages to existing database information.

**Discontinuing Additional Precautions**

The process by which persons identified as being colonized with an antibiotic-resistant organism and no longer requiring the use of Additional Precautions in clinical care is not well described in the literature. Evidence to guide practice is not robust, resulting in global practice recommendations that range from never discontinuing isolation to requiring a variable number of negative screens. An evidence informed algorithm to guide discontinuation of Additional Precautions was developed by an IPC working group, approved by the IPC physicians, and began to be implemented in 2015/16. Full implementation of this process occurred in 2016/17, and future work planned by the IPC surveillance team will evaluate this practice change.
Methicillin-resistant *Staphylococcus aureus*

The provincial Methicillin-resistant *Staphylococcus aureus* rate is trending down for hospital-acquired infections with healthcare-associated infections increasing in the last three years and community-acquired infections remaining stable (Figure 1). This downward trend in hospital-acquired rates could reflect any or all of the IPC prevention efforts, data quality initiatives, improved standardization of surveillance efforts, or temporal changes as Methicillin-resistant *Staphylococcus aureus* rates appear to be decreasing across North America. Currently AHS is below the Canadian Nosocomial Infection Surveillance Program benchmark of 1.29 per 10,000 patient-days.

Figure 1: Provincial Methicillin-resistant *Staphylococcus aureus* Infection Rates by Case Classification Type, 2011/12 to 2016/17

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>HA</td>
<td>1.12</td>
<td>0.85</td>
<td>0.70</td>
<td>0.52</td>
<td>0.43</td>
<td>0.48</td>
</tr>
<tr>
<td>HCA</td>
<td>0.46</td>
<td>0.37</td>
<td>0.33</td>
<td>0.24</td>
<td>0.33</td>
<td>0.50</td>
</tr>
<tr>
<td>CA</td>
<td>0.78</td>
<td>0.72</td>
<td>0.77</td>
<td>0.70</td>
<td>0.80</td>
<td>0.79</td>
</tr>
</tbody>
</table>

HA - Hospital-acquired / HCA - Healthcare-associated / CA - Community-acquired
**Vancomycin-resistant Enterococci**

Changes in admission screening for Vancomycin-resistant enterococci occurred in 2015/16, based on recommendations of the Calgary Consensus Conference. At that time, all AHS facilities discontinued routine screening for Vancomycin-resistant enterococci, with the exception of select high-risk units in Calgary and Edmonton. The effect of changing admission screening is being monitored and evaluated through ongoing surveillance, which is now focused on infections caused by these organisms. Action will be taken as needed if there is a significant increase in infections.

The provincial Vancomycin-resistant enterococci infection rate remains low for 2016/17 (Figure 2) and below the 2015 Canadian Nosocomial Infection Surveillance Program benchmark rate of 0.34 per 10,000 patient-days.

*Figure 2: Provincial Vancomycin-resistant Enterococci Infection Rates by Facility Type 2011/12 to 2016/17*
Carbapenemase-producing Organisms

Carbapenemase-producing organisms are resistant to broad-spectrum antibiotics. Due to limited treatment options, infections are associated with increased morbidity and mortality. Rates remain low in Alberta; cases are generally associated with travel and receiving medical care in other countries.

An outbreak in the Edmonton zone began in the last fiscal quarter of 2015/16 and continued into the first quarter of 2016/17. The provincial rate stabilized following this outbreak and remains similar to the Canadian Nosocomial Infection Surveillance Program benchmark of 0.05 cases per 1,000 admissions (Figure 3).

Figure 3: Provincial Carbapenemase-producing Organism Rates by Facility Type, 2013/14 to 2016/17

Carbapenemase-producing organisms remain rare in Alberta, but have resulted in two localized outbreaks in the province since 2013. In 2016, a provincial working group was formed, with IPC leadership and medical expertise from IPC physicians in Edmonton and Calgary zones, to review patient management practices, outbreak management responses, and surveillance definitions so that IPC recommendations would be standardized across the province. Participants included Infection Control Professionals from all zones, medical microbiologists from the Provincial Laboratory for Public Health (ProvLab), and the manager for Alberta Health, Infectious Disease Surveillance.
Bloodstream Infections with an Antibiotic-resistant Organism

Bloodstream infections are an important cause of morbidity and mortality in severely ill patients, contributing to increased length of stay and a higher cost of care. Hospital-acquired bloodstream infections with antibiotic-resistant organisms are indicative of preventable infections; these infections are monitored to understand underlying trends and promote targeted interventions for safer patient care. The provincial rates for bloodstream infections with antibiotic-resistant organisms are stable (Figure 4).

Figure 4: Provincial Hospital-Acquired Bloodstream Infections with Antibiotic-resistant Organisms Rates by Organism, 2013/14 to 2016/17

<table>
<thead>
<tr>
<th>Organism</th>
<th>2013/14</th>
<th>2014/15</th>
<th>2015/16</th>
<th>2016/17</th>
</tr>
</thead>
<tbody>
<tr>
<td>HA BSI with MRSA</td>
<td>0.18</td>
<td>0.19</td>
<td>0.14</td>
<td>0.19</td>
</tr>
<tr>
<td>HA BSI with VRE</td>
<td>0.07</td>
<td>0.10</td>
<td>0.04</td>
<td>0.08</td>
</tr>
<tr>
<td>HA BSI with CPO</td>
<td>0.00</td>
<td>0.01</td>
<td>0.01</td>
<td>0.00</td>
</tr>
<tr>
<td>HA BSI with ESBL</td>
<td>0.15</td>
<td>0.17</td>
<td>0.22</td>
<td>0.13</td>
</tr>
</tbody>
</table>


---

IPC Annual Report to Alberta Health
Central Line-Associated Bloodstream Infection

Central lines are large bore and long intravenous catheters inserted into the largest veins of the body, usually located in or near the neck. All intravenous lines carry a risk of introducing infection into the bloodstream but central lines have a higher risk due to the catheter design, duration of use, and the population of generally more severely ill patients who require them.

Quarterly reporting in adult critical care units began in April 2011 with broad distribution to medical and operational leaders through the Critical Care Strategic Clinical Network. Follow-up occurs on each individual case to understand contributing factors and improve care.

IPC and clinical stakeholders created and validated an electronic method for collection of line-day data from the critical care data management system. In 2015/16, surveillance was expanded to pediatric intensive care, with line-days obtained electronically. In 2016/17, the terminology “central venous catheter bloodstream infection” surveillance changed to “central line-associated bloodstream infection” surveillance to align with terminology changes in the Canadian Nosocomial Infection Surveillance Program.

The overall provincial rate trended down in 2016/17; however, rates in large urban and regional facilities increased (Figure 5). The adult central line-associated bloodstream infection rate is below the Canadian Nosocomial Infection Surveillance Program benchmark of 0.77 per 1,000 line-days.

Figure 5: Provincial Central Line-Associated Bloodstream Infection Rates by Facility Type, 2011/12 to 2016/17

<table>
<thead>
<tr>
<th>Year</th>
<th>Tertiary ICU Rate</th>
<th>Large Urban ICU Rate</th>
<th>Regional ICU Rate</th>
<th>Provincial Adult ICU Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011/12</td>
<td>1.06</td>
<td>0.77</td>
<td>0.16</td>
<td>0.85</td>
</tr>
<tr>
<td>2012/13</td>
<td>1.16</td>
<td>0.26</td>
<td>0.30</td>
<td>0.75</td>
</tr>
<tr>
<td>2013/14</td>
<td>0.28</td>
<td>0.14</td>
<td>0.00</td>
<td>0.20</td>
</tr>
<tr>
<td>2014/15</td>
<td>0.34</td>
<td>0.79</td>
<td>0.71</td>
<td>0.54</td>
</tr>
<tr>
<td>2015/16</td>
<td>0.79</td>
<td>0.42</td>
<td>0.27</td>
<td>0.60</td>
</tr>
<tr>
<td>2016/17</td>
<td>0.42</td>
<td>0.68</td>
<td>0.61</td>
<td>0.53</td>
</tr>
</tbody>
</table>

ICU - Intensive Care Unit / CLABSI - Central line-associated bloodstream infection
**Clostridium difficile Infection**

The toxin produced by *Clostridium difficile* is the most common cause of infectious diarrhea in healthcare settings. It is often associated with antimicrobial use. Most cases are mild and resolve with discontinuation of antibiotics and/or targeted treatment; however, some cases can lead to severe colitis, protracted or relapsing illness, colectomy, and death. In recent years, treatment-resistant *Clostridium difficile* infections have become more common.

In April 2011, provincial surveillance for patients in acute care facilities was implemented with provincial, zone and site-specific reporting of incident new or re-infected *Clostridium difficile* infection cases. Quarterly reporting began in August 2011 and since July 2013, rates of hospital-acquired *Clostridium difficile* infections have been included as one of the publicly reported AHS Performance Measures.

Consistent definitions are applied to differentiate between hospital-acquired, healthcare-associated and community-acquired onset. Hospital-acquired *Clostridium difficile* infections are identified in patients where symptom onset begins 72 hours after acute care admission. Patients classified with healthcare-associated infection have multiple acute care exposures or are admitted from continuing care facilities.

The 2016/17 AHS target for hospital-acquired *Clostridium difficile* infection is to maintain at or below a baseline of 3.3 per 10,000 patient-days (Figure 6). The hospital-acquired *Clostridium difficile* infection rate is below the Canadian Nosocomial Infection Surveillance Program benchmark of 4.48 per 10,000 patient-days.

**Figure 6: Provincial Clostridium difficile Infection Rates by Case Classification, 2011/12 to 2016/17**

<table>
<thead>
<tr>
<th>Year</th>
<th>HA Rate (per 10,000 patient-days)</th>
<th>HCA Rate (per 1,000 admissions)</th>
<th>CA Rate (per 1,000 admissions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011/12</td>
<td>4.33</td>
<td>0.26</td>
<td>1.31</td>
</tr>
<tr>
<td>2012/13</td>
<td>4.08</td>
<td>0.24</td>
<td>1.33</td>
</tr>
<tr>
<td>2013/14</td>
<td>4.31</td>
<td>0.33</td>
<td>1.83</td>
</tr>
<tr>
<td>2014/15</td>
<td>3.48</td>
<td>0.27</td>
<td>1.72</td>
</tr>
<tr>
<td>2015/16</td>
<td>3.57</td>
<td>0.34</td>
<td>1.85</td>
</tr>
<tr>
<td>2016/17</td>
<td>3.37</td>
<td>0.38</td>
<td>1.80</td>
</tr>
</tbody>
</table>

HA - Hospital-acquired / HCA - Healthcare-associated / CA - Community-acquired
Surveillance data also include adverse outcomes due to *Clostridium difficile* infection occurring within 30 days of diagnosis and reviewed by IPC physicians. Adverse outcomes are reported quarterly to AHS and Covenant Health leaders and to clinical stakeholders, and are posted on AHS Insite.

Multi-disciplinary *Clostridium difficile* infection working groups have been established in all zones and resources continued to develop in 2016/17. Multi-modal approaches focus on environmental cleaning, antimicrobial stewardship, personal protective equipment, and descriptive epidemiology.

The IPC surveillance team has collaborated with Alberta Health, AHS Analytics, and AHS Laboratory Process Excellence Department to determine the burden of *Clostridium difficile* infection in all Alberta continuing care facilities using a lab-event surveillance approach (Figure 7). There is no national continuing care benchmark.

Figure 7: Provincial *Clostridium difficile* Infection Rates in Continuing Care, 2011/12 to 2015/16
Clostridium difficile Infection

In fall 2015, North zone surveillance data revealed a significant increase in the number of hospital-acquired Clostridium difficile infections and the first Clostridium difficile infection outbreak in the zone was declared. An increase in the severity of the disease, the number of patient relapses, and adverse patient outcomes was also noted.

In response, a North zone Clostridium difficile infection task force was created to investigate and address this change. During 2016/17 the task force completed two key investigations: a patient safety review and a human factors evaluation.

The patient safety review identified system deficiencies that may have contributed to the increased number and severity of Clostridium difficile infections. Factors included environmental cleaning and shared equipment, antimicrobial stewardship, clinical patient and outbreak management, and communication and education. Recommendations to improve care and patient safety were bundled into a Clostridium difficile toolkit including preprinted patient care orders, tiered management documents, implementation of the Bristol stool chart, and an adult diarrhea management algorithm. A data collection tool was adapted to support ongoing monitoring of factors that may contribute to a healthcare-acquired infection.

A human factors evaluation was done on the tiered documents that describe patient management practices, communication responsibilities, and required actions for managing sporadic cases, clusters, or outbreaks of Clostridium difficile infection. Because there are many users with very specific tasks, it is critical that roles and responsibilities can be clearly understood when using the documents. The Human Factors team worked in partnership with the North zone IPC Senior Clinical Coordinator to complete a redesign of the documents while incorporating user feedback from focus groups to validate the content, design and usability.

Continuous surveillance, heightened healthcare worker awareness and engagement, as well as increased consistent IPC follow-up are essential elements in ongoing management of Clostridium difficile in the North zone. Many of the learnings and tools have led to practice changes across AHS.
Surgical Site Infection Surveillance

On April 1, 2012, a provincial surveillance protocol for surgical site infections following total hip or knee replacement procedures was implemented, which includes a partnership with the Alberta Bone and Joint Health Institute to provide validated provincial procedure data. Patients are followed for 90 days following surgery to determine if an infection develops.

Surgical site infections are stratified by patient risk score and are classified as superficial, deep incision or organ/space. For reporting purposes deep incision and organ/space infections are combined and named “complex”. Both provincial and local surveillance protocols are accommodated in the provincial surveillance data entry platform. Provincial surveillance occurs for surgical site infections following orthopedic, cardiac, and vascular procedures while local surveillance initiatives are identified according to priorities identified in each zone.

Twice annually, all patients who have a total hip or total knee replacement procedure are matched to the Discharge Abstract Database and key healthcare diagnosis codes are used to find additional patients for investigation who may not have been identified by Infection Control Professionals. This additional case-finding process standardizes patient case review across the province and the report of this provincial process was accepted for publication in Infection Control and Hospital Epidemiology, 2016.

Surgical site infection rates following total hip replacement procedures have remained stable, and rates following total knee replacement procedures have decreased since surveillance began in 2012/13 (Figures 8 and 9). The variation in surgical site infection rates in North zone may be related to the small volume of procedures performed. Provincial rates are below the national benchmark rates.

Figure 8: Complex Surgical Site Infection Rate Following Total Hip Replacement by Zone, 2012/13 to 2016/17
Surgical Site Infections

Surgical site infections in cerebrospinal shunt procedures are monitored at Foothills Medical Centre and Alberta Children’s Hospital in Calgary and at the University of Alberta Hospital and Stollery Children’s Hospital in Edmonton as part of the Canadian Nosocomial Infection Surveillance Program. At Foothills Medical Centre, IPC worked closely with the Division of Neurosurgery to initiate a formal reporting program following surgical site infections in cerebrospinal shunt procedures following the implementation of an 11-step intraoperative bundle. The bundle was originally initiated in 2013 but not fully embedded in practice until 2015. The first formal report was issued in August 2016 and showed a decrease in surgical site infection rates, which has been sustained up to Dec 31, 2016.