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# Highlights, Discussions and Orientations 2012-2013

# Healthcare-Associated Infections Provincial Surveillance Program

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## Context

The ministère de la Santé et des Services sociaux (MSSS) mandated the Institut national de santé publique du Québec (INSPQ) with the provincial surveillance of healthcare-associated infections (HAI), as outlined in the 2003–2012 Programme national de santé publique (Public Health Plan), revised in 2008 [1] as well as in the 2006–2009 and 2010–2015 versions of the Plan d'action sur la prévention et le contrôle des infections nosocomiales (Action Plan for Preventing and Controlling HAIs) [2,3] aimed at reducing the transmission of HAIs in Québec's healthcare facilities.

The INSPQ set up a structured surveillance program to support public health administrations and local infection prevention and control teams in general and specialized healthcare facilities. The program includes a set of standardized tools and educational activities focusing on infections categorized as "priorities" by the MSSS and by the INSPQ's Comité des infections nosocomiales du Québec (CINQ) and the Groupe de travail sur la Surveillance provinciale des infections nosocomiales (SPIN).

Surveillance findings are published yearly. Experts serving on the various SPIN committees drafted the 2012–2013 highlights, discussions and recommendations based on this year's findings. They were then submitted to the CINQ and the MSSS for approval and published.

Québec

## Methicillin-Resistant *Staphylococcus aureus* Bloodstream Infections

There has been a gradual decrease in methicillin-resistant *Staphylococcus aureus* bloodstream infections (MRAS BSIs) reported between the inception of the *S. aureus* bloodstream infection surveillance program (SPIN-BACT -*S.aureus*) and 2011–2012. In 2012–2013, the incidence rate was stable at 0.29/10,000 patient-days, same as last year (4). This translates to 147 healthcare-associated MRSA BSIs in 2012–2013 compared with 144 in 2011–2012. In France, the Réseau de Surveillance des bactéries multirésistantes (BMR-Raisin) network reported an incidence rate of MRSA BSIs of 0.45/10,000 patient -days for 2011 [5], whereas Public Health England cited an incidence rate of 0.12/10,000 patient-days for the 2012–2013 fiscal year in some of its hospitals (Trust hospitals) [6]. The incidence rate for the first surveillance year in Québec (2006–2007) was 0.54/10,000 patient-days [7].

The proportion of methicillin resistance in reported *S. aureus* BSIs declined steadily, from 31.6% in 2003 to 15.4% in 2012–2013. The proportion of methicillin resistance in HA *S. aureus* BSIs dropped from 35.9% in 2006–2007 to 20.0% in 2012–2013. Two-thirds (67.6%) of MRSA BSIs are healthcare-associated in nature. In the United States, MRSA accounted for 54.6% of all healthcare-associated (HA) central line–associated bloodstream infections (CLABSIs) in 2009–2010 [8].

The incidence rate of HA methicillin-susceptible *S. aureus* (MSSA) has remained relatively stable over the years. This points to an improvement in the measures used to prevent MRSA transmission, given that any improvement in the prevention of HA BSIs would results in a corresponding decrease in MSSA BSIs. The surveillance of MRSA acquisition in Québec hospitals will provide more precise data, since BSIs represent only a portion of MRSA-related infections. In comparison, the Canadian MRSA surveillance program reported an MRSA acquisition rate of 14.25/10,000 patient-days in 2011 for Québec and Ontario, whereas the infection rate in these new cases was 2.44/10,000 patient-days. This includes all infections, but only in patients who are newly detected carriers [9]. Despite the fact that BSIs represent only a subset of MRSA infections, they significantly impact hospitalized individuals: according to Canadian surveillance program data between 2008 and 2010, 28.4% of patients with an MRSA BSI are admitted to intensive care and 23.4% die within 30 days of their first positive blood culture [10].

The decrease in HA MRSA BSIs in recent years was largely driven by the lower incidence rate in teaching hospitals with 250 beds or more. The trend continued this past year, with incidence rates for these facilities dropping from 0.36/10,000 patient-days in 2011–2012 to 0.28 in 2012–2013. However, there was a significant increase in incidence rates in teaching hospitals with fewer than 250 beds, which rose from 0.32/10,000 patient-days in 2011–2012 to 0.66 in 2012–2013. The incidence rate in teaching hospitals with fewer than 250 beds is significantly higher than in non-teaching hospitals with fewer than 250 beds and teaching hospitals with 250 beds or more. This increase can be explained by a higher incidence rate for three of the six facilities in this category. One facility in particular saw its incidence rate shoot up from 0.25 to 1.12/10,000 patient-days. Moreover, four HA MRSA BSIs were reported in one of the pediatric facilities, yielding an incidence rate of 1.10/10,000 patient-days, despite the fact that there had been no cases declared by the two pediatric facilities since 2006.

There are five regions in Québec that reported MRSA incidence rates higher than 15%, two of which topped the 20% mark. In several regions, a significant proportion of MRSA BSIs are acquired in the community. The incidence rate of MRSA BSIs in Québec was 3.96 per 100,000 population in 2012–2013, which is very close to the previous year's rate of 3.98 per 100,000 population. The rates in Québec in 2003 and 2004 were higher, at 7.67 and 8.28 per 100,000 population, respectively. For comparison's sake, England reported a decrease in its rate, at 1.7 per 100,000 population in 2012–2013 [9].

Central lines remain the most common infection site for MRSA BSIs. Surgical sites and skin and soft tissues were next on the list in 2011–2012, while pneumonia and urinary tract infections came in second and third in 2012–2013. Given that catheters are the source of 23% of MRSA BSIs, the introduction of best practices in terms of insertion and maintenance will help further reduce MRSA BSIs incidence rate.

## Vancomycin-Resistant Enterococcus Infections

A number of changes have occurred in the surveillance of vancomycin-resistant enterococcus (VRE) infections since 2011:

- Transition from laboratory surveillance to surveillance by infection control and prevention (ICP) teams in 2011–2012 using the former INSPQ portal;
- Change from a September 2011–September 2012 annual report to a report based on financial periods (September 2011–April 2012);
- Migration to a new data capture system for surveillance purposes;
- Introduction, after the end of the 2012–2013 fiscal year, of a HA VRE infection rate to be calculated retrospectively using the data from this past year.

### VRE INFECTION INCIDENCE RATES

Considering that the decision was made to introduce these rates after the end of the 2012–2013 surveillance period, certain limitations need to be highlighted:

- We made the assumption that the infections that occurred in the 41 patients not known to be VRE carriers and who belonged to categories 1a and 1b were all HA (patients must have acquired the strain from a HA source).
- These incidence rates of HA VRE infections for 2011–2012 and 2012–2013 do not include HA infections that occurred in patients belonging to categories 2b, 2c, 3 and 4, or HA infections that occurred in 66 patients who were known VRE carriers and who developed an infection.
- The rate of HA infection was 0.08/10,000 patient-days. Teaching hospitals reported a rate three times higher (0.12) than non-teaching hospitals (0.04). For comparison's sake, the Canadian Nosocomial Infection Surveillance Program (CNISP) [9] reported an infection rate of 0.68/10,000 patient-days for the 2011 surveillance year.
- A total of 112 VRE infections were declared in the province (HA and community-associated).
- There were 17 primary BSIs (6 of which were catheter -related) and 11 secondary BSIs for a total of 28 BSIs. In contrast, 25 BSIs were reported in Québec in 2011–2012.
- Ontario reported 56 VRE BSIs for the 2011 surveillance year [11].
- Urinary tract infections, skin and soft tissue infections and surgical site infections ranked as the most common infections.
- Overall lethality within 30 days for all types of infection was 18.8% (stable compared with 2011–2012).

### VRE COLONIZATION ACQUISITION RATE

The acquisition rate of HA VRE colonization is calculated based on the total number of newly detected cases of VRE (infection or colonization), which source is related to a hospitalization in the reporting facility (categories 1a + 1b).

The acquisition rate is contingent on the VRE screening policy in place in the reporting facility and must therefore be interpreted in light of the average number of screening tests performed per admission.

To determine the average number of screening tests performed in reporting facilities, the ICP teams were required to provide the total number of screening tests conducted and, wherever possible, differentiate between number or tests performed upon admission and during hospitalization (> 48 hours after admission). They were allowed, as appropriate, to use Gestlab* and VRE screening tests conducted for patients registered in the emergency room and those admitted (an approximation of the number of screening tests upon admission and during hospitalization, respectively). Some facilities were not able to provide anything more than the combined total number of screening tests performed for patients upon admission and during hospitalization.

The acquisition rate of HA VRE colonization in all facilities increased from 6.97/10,000 patient-days in 2011–2012 to 8.26 in 2012–2013. It is nevertheless important to note that the VRE colonization acquisition rate is almost twice

*Gestlab: management system for laboratory statistical compilations

as high in teaching hospitals (10.82/10,000 patient days) compared to non-teaching hospitals (5.63/10,000 patient days). For the purpose of comparison, the CNISP program reported 7.18 cases of VRE colonization per 10,000 patient-days in its network of hospitals for the 2011 surveillance year [9].

In terms of screening tests, 70 of 89 facilities were able to indicate the number of screening tests done upon admission, and 66 were able to indicate the number of screening tests done during hospitalization. Almost all teaching facilities (24/26) were able to provide this information. The average number of VRE screening tests upon admission is therefore 1.00, with only a slight variation between teaching (1.02 VRE screenings/admission) and non-teaching facilities (0.98 VRE screenings/admission). However, non-teaching hospitals screen more patients upon admission and fewer patients during hospitalization and the opposite is true in teaching hospitals.

In conclusion, the incidence rate of VRE infection continues to be low and stable, although the lethality rate is high. The 18.5% increase in VRE colonization acquisition rate shows that colonization control remains a challenge for healthcare facilities in Québec, especially teaching facilities. It would be interesting to start measuring the prevalence of VRE colonization/infection in reporting facilities to improve the indicators for comparison purposes.

## *Clostridium difficile*–Associated Diarrhea

The mandatory provincial surveillance program for *Clostridium difficile*–associated diarrhea (CDAD) has completed its ninth year of surveillance. In total, 95 facilities, including two pediatric facilities and six rehabilitation facilities, participated in the surveillance program.

This year's report is the first to publish annual incidence rates on the basis of an administrative year (April to March). Previous analyses ran from August to August, making it necessary to recalculate incidence rates from past years. This new analysis window was chosen to ensure consistency with other surveillance programs. Any comparisons involving earlier annual incidence rates must take into account the seasonality of the infection. Because the winter peak does not always occur at the same time every year, some surveillance years may contain two winter peaks while others may contain one or even none, which may have a major impact on calculated annual incidence rates in the future.

The number of cases of HA CDAD and the province-wide incidence rate have both risen slightly, by about 10%, since 2008–2009. The situation levelled off, however, in 2012–2013. Teaching hospitals with 100 beds or more continue to exhibit the highest incidence rate, irrespective of the proportion of admitted patients aged 65 years or older. In total, 10 facilities saw a significant improvement in their incidence rate compared with the previous year, whereas 15 facilities saw a significant increase.

It should be noted that the threshold value (75th percentile) was exceeded in period 11. This can be attributed to a strong winter peak combined with a dip in the threshold value. The threshold is calculated based on incidence rates from the previous five years. The very low rates in 2008–2009 and 2009–2010 contributed to lowering this value to unprecedented levels. Despite the slight increase in incidence rates since 2010–2011, the current incidence rate and the number of cases continue to be well below the incidence rates that the province experienced during the 2003–2005 outbreak.

The proportion of deaths, colectomies, readmissions and transfers to an intensive care unit has remained stable.

The provincial surveillance of *C. difficile* strains was conducted in collaboration with the Laboratoire de santé publique du Québec (LSPQ). In 2012–2013, the NAP1/027 strain (Pulsovar A) and its variants (Pulsovars A1 and A2-5) still accounted for more than 50% of the isolated strains. Given the natural mutation rate of *C. difficile*, it is logical to include the variants when calculating the prevalence of Pulsovar A.

This surveillance program is now well established and gathers essential data for hospitals throughout the province, and there are no major foreseen changes. Minor tweaks include the use of new categories to identify the presumed origin of acquisition in 2013–2014. Inter-facility comparison could be improved by taking certain factors into account, such as the proportion of the NAP1 strain and the type of *C. difficile* screening test used. With the development of new typing techniques (MLVA, MLST) also comes the need to reconsider the choice of pulsed-field gel electrophoresis as an analytical technique. The SPIN-CD group will take a closer look at these questions in the coming year and will publish a manuscript specifically on this topic.

## Hospital-Wide Healthcare -Associated Bloodstream Infections

During the 2012–2013 surveillance period for hospital-wide healthcare-associated bloodstream infections (BSIs) (SPIN-BACTOT), 2,797 HA BSIs were reported in hospitalized patients, for an overall rate of 6.1/10,000 patient-days. The 2012–2013 rate is significantly lower than the 2008–2012 rate. This decrease is more striking and significant for catheter-related bloodstream infections (CRBSIs), which can be explained by the concerted effort made by hospitals to minimize their rates, specifically by ensuring compliance to the central line insertion bundle.

A decrease in incidence rates in facilities that participated to SPIN-BACTOT at least once between 2008–2009 and 2011–2012 was nevertheless observed for all BSI sources, even though, to the best of our knowledge, there are no specific surveillance measures or programs in place targeting the infections monitored under this program. The facilities' participation, coupled with the dissemination of BSI rates in various healthcare environments, could very well contribute to lowering the BSI incidence rate.

BSIs secondary to urinary tract infection occur as frequently as CRBSIs. This rise in the predominance of BSIs secondary to urinary tract infection over the past two years undoubtedly reflects the even sharper decrease, proportionately speaking, in CRBSIs, as a result of the efforts by many Québec facilities to promote best practices to lower CRBSI incidence rates. A similar approach to applying best practice bundles to prevent urinary tract infections, such as those that will be put forward by the INSPQ in the coming months, could lead to a similar drop in the rate of BSIs secondary to urinary tract infection.

The rate of BSIs is three times higher in adult intensive care units (ICUs) than in non-ICU settings. Rates are also higher in ICUs in adult teaching hospitals compared to ICUs in adult non-teaching hospitals. These differences reflect a more complex population and a greater prevalence of underlying medical conditions in teaching hospitals. Furthermore, even if CRBIS incidence rates are lower in non-ICUs, their frequency in absolute numbers remains important.

It will be interesting to see how the adoption of the new definitions published by the National Healthcare Safety Network (NHSN) [12] will affect the number of reported

cases, especially those associated with surgical site infections (SSIs), which are no longer included if they occur more than 90 days after the procedure. A preliminary analysis of the data from 2007 to 2012 shows that 66 of 1,214 cases (5.4%) of BSIs secondary to an SSI arose after 90 days. The impact of this change in definition should therefore be limited, although this percentage is higher for implant-related infections (63/379 or 16.6%).

Enterobacteriaceae are the most frequently isolated family of pathogens, followed by *S. aureus*, especially among patients with a CRBSI or a BSI associated with hemodialysis. *S. aureus* is the microorganism most frequently associated with overall mortality. Overall, 17% of *S. aureus* isolated were methicillin-resistant (MRSA) and nearly 8% of enterococci were resistant to vancomycin. Although there are no programs in the U.S. focused on hospital-wide BSIs, it is interesting to compare data on proportions of resistant bacteria observed in Québec with the higher proportions reported by the U.S. NHSN. Data from 2009–2010 on CRBSIs within this surveillance network showed a 54.6% proportion of MRSA, as well as an 82.8% proportion of VRE *(E. faecium)* [13].

MRSA control measures followed in several hospitals in Québec [14] have likely contributed to the relatively constant decline in the proportion of MRSA BSIs since the program was started. It will be interesting to track the progress of VRE BSIs in the coming years, following the publication of Québec guidelines on VRE control [15]. BSIs caused by carbapenem-resistant enterobacteriaceae continue to be relatively rare in Québec. It is key, however, to monitor closely any changes in this regard, given their clinical significance and steady progression in North America.

The all-cause 30-day mortality rate is 18%. More than 45% of these deaths occurred within seven days of bacteremia onset.

HA BSIs are responsible for significant morbidity and mortality in acute-care facilities in Québec. Recent data show that surveillance in itself reduces the incidence of CRBSIs in intensive care units [16,17]. Current data suggest that a similar impact can also be observed for hospital-wide BSIs. The surveillance program for hospital-wide healthcare-associated BSIs allows facilities that do not have a hospital-wide surveillance program to establish a comprehensive profile of the most serious infections, determine the source (e.g., surgical site infections, catheter-associated urinary tract infections, post-procedure infections) and set infection prevention and control program priorities at the local level. This is the reason the Table nationale de prévention des infections nosocomiales (National Table for the Prevention of HAIs) stressed the importance of making this a mandatory program in 2013–2014, as set out in the MSSS's 2010–2015 action plan [18].

## Central Line–Associated Bloodstream Infections in Intensive Care Units

Two new intensive care units (ICUs) joined the central line-associated bloodstream infections (CLABSIs) surveillance program (SPIN-BACC) in 2012–2013, bringing the total number of participating units to 67. CLABSIs incidence rates remained stable for most types of ICUs compared with previous years (2008–2012) [19,20] except for ICUs in adult teaching hospitals where a significant decrease was observed. The incidence rate is now between 0.84/1,000 central-line days in ICUs in adult teaching hospitals and 5.36/1,000 central-line days in neonatal units.

The microorganisms associated with CLABSIs are, in descending order of frequency, coagulase-negative staphylococci (44%), *Candida sp*. (16%), *S. aureus* (10%) and *Enterococcus sp*. (7%). The proportion of methicillin-resistant *S. aureus* (MRSA) decreased slightly compared with last year to 22.7%. This resistance is still higher than in 2010–2011 when only 10% of *S. aureus* were resistant to methicillin. No cases of CLABSI caused by VRE were reported this year, while 19% of Gram-negative bacteria showed resistance to at least one fluoroquinolone. No carbapenemase-producing enterobacteriaceae were identified.

A survey of insertion and maintenance bundle of measures to prevent CLABSI in ICUs was done in Québec [21], which showed that most ICUs have implemented the recommended preventive measures. However, only a minority of ICUs conduct audits to check compliance with recommended measures. There is therefore room for improvement. Our study also showed that, in adult ICUs (in teaching and non-teaching hospitals) where audits were used to monitor compliance to central line insertion bundles, there was a greater reduction in the CLABSI incidence rate between 2007–2008 and 2012–2013 than in units where no such program had been implemented.

A working group on the implementation of best practice bundles is currently working on recommendations to further reduce the incidence of HAIs. It will be interesting to monitor CLABSI incidence rates while these measures are being implemented to see whether better results can be achieved.

To allow for continuous benchmarking of our data against data from other organizations, it is essential that neonatal ICUs monitors BSIs and denominators (e.g., central-line days) by NHSN birth weight categories. Our analysis of SPIN-BACC data showed a correlation between CLABSI rates in neonatal ICUs and the proportion of children with intestinal insufficiency (e.g., necrotizing enterocolitis, short bowel syndrome) most likely attributable to digestive translocation and bacterial overgrowth in the gastrointestinal tract. This raises the question as to whether or not CLABSIs associated with enterobacteriaceae and enterococci in neonatal patients with intestinal insufficiency should be analyzed separately, similar to what is currently done for BSI associated with mucosal barrier injury in neutropenic patients? This question remains to be answered.

In conclusion, the CLABSI surveillance program will continue in ICUs with little or no change. Definitions will need to be harmonized in the coming year to ensure consistency in the terminology used in the various BSI surveillance programs in Québec as well as adherence to the changes and clarifications issued by the NHSN in July 2013.

## Vascular Access–Related Bloodstream Infections in Hemodialysis Patients

In this second year of mandatory surveillance for vascular access–related BSIs in hemodialysis patients (VARBIs), 42 units participated in the surveillance program, similar to last year. With a total of 218 BSIs, the incidence rate remained stable at 0.42 per 100 patient-periods, all types of vascular access combined. Of these, 79% were catheter-related [22].

Breaking down the results by vascular access type again confirms the gradual increase in the risk of BSIs, depending on whether hemodialysis is done via an arteriovenous (AV) fistula, a synthetic fistula, a permanent catheter or a temporary catheter (Table 1).

**Table 1** VARBSI Incidence Rate and Relative Risk by Type of Vascular Access

| Type of vascular access | VARBSI incidence rate/ 100 patient-periods | Relative risk |
|---|---|---|
| AV fistula | 0.19 | 1 |
| Synthetic fistula | 0.26 | 1.4 |
| Permanent catheter | 0.55 | 2.9 |
| Temporary catheter | 5.06 | 26.6 |

The VARBSI incidence rate for temporary catheters was 9.2 times higher than for permanent catheters ($p<0.05$), which itself was 2.1 times greater than for synthetic fistulas ($p<0.05$). The incidence rate for patients with a synthetic fistula was not significantly different from that related to an AV fistula.

Although overall incidence rates have been stable since 2008, it is interesting to note a significant decrease in BSIs associated with catheters, whether temporary or permanent, from 0.26 BSIs per 1,000 catheter-days in 2008–2012 to 0.22 in 2012–2013 ($p=0.03$). This reduction may be attributed to the combination of two elements: a significant decrease in the proportion of temporary catheters (0.7% versus 0.9% in 2008–2012, $p<0.001$) and the downward trend associated with both types of catheter.

As catheter-associated BSIs declined by a significant margin, the incidence rate of infections associated with AV fistulas rose from 0.14 in 2008–2012 to 0.19 BSI cases per 100 patient-periods in 2012–2013. This increase was not significant, however. Most of these episodes (80%) involved the use of the buttonhole technique. The lack of a specific denominator for this practice, however, prevents us from drawing a clear conclusion about the risk of infection associated with the use of this technique, although the literature tends to show an increase in risk with the buttonhole technique [23]. Since April 1, 2013, denominators have been compiled by dividing the AV fistula category in two: one with the buttonhole technique and one without. It is hoped that this will help shed more light on this issue.

Although catheters have a more significant association with BSIs than fistulas [24], the proportion of catheter use is growing, at 55.1% compared with 53.1% in 2008–2012. Among our American neighbours, this proportion is only 20% [25].

The BSI rate was recalculated based on 100 patient-months for international benchmarking purposes, which gave an incidence of 0.45/100 patient-months. If the proportion of fistulas and catheters in Québec were closer to that in South-Eastern France (i.e., 26% catheters), the standardized provincial rate based on vascular access type could potentially be lowered to 0.32 BSIs per 100 patient -months (157 BSIs). This hypothetical figure is still higher than the rate of 0.13 observed in the 36 dialysis units that are part of the Centre de Coordination et de lutte Contre Les Infections Nosocomiales du Sud-Est (CCLIN Sud -Est surveillance network)[26]. In the U.S., the only recent data available were from 17 hemodialysis units, where best practice bundles were implemented. The BSI rates decreased from 0.73 to 0.43 BSIs per 100 patient-months [27], which is comparable to rates observed in Québec.

The 30-day overall lethality rate is 11%. This is significantly higher ($p=0.003$) when the infection is contracted during hospitalization (28%) than when it is acquired in an ambulatory care setting (8%).

Among microorganisms isolated, *S. aureus* remains predominant at 54%, and methicillin-resistant strains account for 7%. This latter proportion decreased significantly compared with 2011–2012 ($p=0.002$). There were no reported case of vancomycin-resistant enterococcus or multiresistant Gram-negative rods.

In conclusion, BSIs associated with vascular access in hemodialysis patients remain an issue of concern and are potentially preventable. The study carried out in 2011 on prevention measures recommended in Québec hemodialysis units made it possible to identify potential avenues to reduce infections [28]. Inspired by several sets of guidelines [24,29,30] and existing best practices [27,31,32], CINQ is about to finalize a best practice bundle for healthcare facilities to prevent infections specific to hemodialysis. It will be interesting to see the impact of these measures in the years to come.

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# Highlights, Discussions and Orientations 2012-2013


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