PICNet
PROVINCIAL INFECTION CONTROL NETWORK OF BRITISH COLUMBIA
A program of the Provincial Health Services Authority

Methicillin-Resistant *Staphylococcus aureus* (MRSA) Surveillance Report

Fiscal Year 2011/2012

Prepared by:

Provincial Infection Control Network of British Columbia (PICNet)

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Glossary of Acronyms

BC	British Columbia
CA	Community-associated
CI	Confidence interval
CNISP	Canadian Nosocomial Infection Surveillance Program
FHA	Fraser Health Authority
FQ	Fiscal quarter
FY	Fiscal year
HA	Health authority
HAI	Healthcare-associated infection
HCA	Healthcare-associated
ICP	Infection control practitioner
IHA	Interior Health Authority
MRSA	Methicillin-Resistant *Staphylococcus aureus*
NHA	Northern Health Authority
PHC	Providence Health Care
PHSA	Provincial Health Services Authority
PICNet	Provincial Infection Control Network of British Columbia
SSC	PICNet's Surveillance Steering Committee
VCHA	Vancouver Coastal Health Authority
VIHA	Vancouver Island Health Authority

Summary

The provincial Methicillin-resistant *Staphylococcus aureus* (MRSA) surveillance program was implemented in 2011 to monitor the rates and trends of MRSA in BC acute care facilities. This annual surveillance report presents cases of MRSA newly identified in 79 acute care facilities across the province during the fiscal year (FY) 2011/2012 (April 1, 2011 - March 31, 2012).

A total of 2,414 cases of MRSA (either infections or colonizations) were newly identified among inpatients admitted to acute care facilities during FY 2011/2012, of which 1,196 were healthcare-associated (HCA) with the reporting facility (49.5%).

The provincial rate of MRSA cases associated with the reporting facility was 4.2 per 10,000 inpatient days [95% confidence interval (CI): 3.9-4.4] in FY 2011/2012. Compared with the annual rate of 4.4 (95% CI: 4.1-4.6) per 10,000 inpatient days in FY 2010/2011, the rate was relatively stable in FY 2011/2012 at the provincial level.

The rate of MRSA cases associated with the reporting facility varied greatly by health authority (HA). Compared with the annual rate for each HA in FY 2010/2011, the differences were not statistically significant for any of the HAs except VCHA, whose rate was significantly lower in FY 2011/2012 than in FY 2010/2011.

The rate of MRSA associated with the reporting facility was significantly higher in hospitals with more than 250 beds than in hospitals with 51-250 beds, in both FY 2011/2012 and FY 2010/2011. The rate was also higher in tertiary/referral hospitals and teaching hospitals, though in FY 2011/2012 the differences in the rates between each hospital type were not statistically significant. Compared with the annual rate in FY 2010/2011, there were no significant changes in the rates of MRSA in FY 2012/2011 for each hospital type.

It is worth noting that the large hospitals usually serve as tertiary hospitals with specialty care to the patients, and may also provide teaching or training to the medical and nursing students, and other healthcare professionals, these hospitals are more likely to admit patients with greater severity of illness, which may in turn increase the risk of acquiring multidrug-resistant organisms.

The rates in small facilities varied substantially from reporting period to reporting period due to the small numbers of MRSA cases and/or inpatient days. For those hospitals with reliable rates in the two fiscal years compared in this report, the rate was significantly lower in FY 2011/2012 than in FY 2010/2011 in one hospital, and higher in two hospitals.

Please note that a higher rate of MRSA associated with the reporting facility does not imply that the facility performed poorly in infection control or other performance measures. Instead, hospitals reporting higher rates may have more patients vulnerable to MRSA and/or may be more aggressively screening for MRSA. Some cases of HCA MRSA may in fact have been contracted in the community.

The rates presented in this report are not adjusted by known risk factors or variations in screening practices, and are therefore not directly comparable between facilities or between HAs.

This report provides a provincial overview of MRSA incidence in BC acute care facilities, which can be used as baseline information for intervention programs. The provincial surveillance program, along with public reporting of the results, ensures transparency and accountability in prevention and control of healthcare-associated infections in BC acute care facilities.

Introduction

Staphylococcus aureus (S aureus) is a type of bacterium that frequently lives on the skin and in the nose of healthy individuals without causing health problems. *S aureus* becomes a problem when it is a source of infection of the skin, lungs, blood, or other body systems. These bacteria can be spread from person to person through casual contact (such as unclean hands) or through the sharing of contaminated objects. The emergence of strains resistant to Methicillin and other antimicrobial agents, particularly the spread of Methicillin-resistant *Staphylococcus aureus* (MRSA) in healthcare settings, has become a major concern because MRSA infections are more difficult to treat than ordinary *S aureus* infections, and may result in higher mortality[1,2].

In healthcare facilities, surveillance is the generally accepted method of assessing the incidence of healthcare-associated infections and monitoring the effectiveness of infection control measures[3]. MRSA in BC hospitals is monitored by each health authority (HA). In 2011, the Provincial Infection Control Network of BC (PICNet), in collaboration with representatives from Interior Health Authority (IHA), Fraser Health Authority (FHA), Vancouver Coastal Health Authority (VCHA), Providence Health Care (PHC), Vancouver Island Health Authority (VIHA), Northern Health Authority (NHA), and Provincial Health Services Authority (PHSA), launched provincial surveillance for MRSA in BC acute care facilities. A provincial MRSA surveillance protocol, including a standard case definition for MRSA surveillance and a minimum dataset, was developed by PICNet's Surveillance Steering Committee (SSC). MRSA cases were divided into four groups according to the patients' current and previous healthcare encounter history: Healthcare-associated (HCA) with the reporting facility, HCA with another facility, Community-associated (CA), and Unknown (see Glossary for definitions). Aggregated facility data are submitted quarterly to PICNet by each HA. This report summarizes the MRSA cases identified in the fiscal year (FY) 2011/2012 (April 1, 2011 - March 31, 2012).

Please note that the MRSA cases in this report represent *inpatients that were admitted to acute care facilities and newly identified with MRSA either as an infection or colonization.* The rates of HCA MRSA in this report were not risk-adjusted; therefore, comparison of the rates between HAs or between healthcare facilities is not recommended. Many factors can affect the rate of HCA MRSA, such as the intensity of MRSA screening performed by the facility, the patients' exposure history to healthcare and antibiotics, environmental conditions, and the prevalence of MRSA in the community.

[1] Seller JL, et al (2011). The Journal of the American Medical Association
[2] Cosgrove SE, et al (2003). Clinical Infectious Diseases 36 :53-59
[3] Chaberny IF, et al (2007). Infection Control and Hospital Epidemiology 28:446-452

Surveillance results

Population under surveillance

All acute care facilities in BC except one participate in the provincial MRSA surveillance program. Table 1 summarizes the characteristics of the facilities during FY 2011/2012 and estimated general population in each HA in 2011. Please note, in this report PHC is analyzed separately from VCHA due to differences in case definition. All patients who were admitted to these facilities for acute care were under surveillance for MRSA.

Table 1. Summary of facilities participating in the provincial MRSA surveillance program by health authority, fiscal year 2011/2012

Health authority	IHA	FHA	VCHA[a]	PHC[b]	VIHA[c]	NHA	PHSA	Total
Total number of facilities	**22**	**14**	**9**	**2**	**12**	**18**	**2**	**79**
By hospital size[d]								
1-50 beds	16	3	6		5	17		47
51-250 beds	5	7	1	1	4	1	2	22
>250 beds	1	4	2	1	3			11
By hospital category								
Community hospital	16	7	5	1	9	9		47
Regional hospital	4	4	3		1	8		20
Tertiary/Referral hospital	2	3	1	1	2	1	2	12
By teaching status								
Non-teaching hospital	21	8	5		10	16		60
Teaching hospital	1	6	4	2	2	2	2	19
Total acute care beds[e]	**1,088[f]**	**2,422**	**1,247**	**538**	**1,478**	**552**	**249**	**7,574**
Total acute care admissions	**67,892[g]**	**130,329**	**66,934**	**17,377**	**66,804**	**28,718**	**24,978**	**403,032**
Total inpatient days	**413,287[g]**	**1,035,715**	**453,914**	**183,687**	**517,677**	**183,408**	**89,661**	**2,877,349**
Estimated general population in 2011[h]	**741,619**	**1,635,340**	**1,151,320**	**N/A**	**765,849**	**289,974**	**N/A**	**4,584,102**

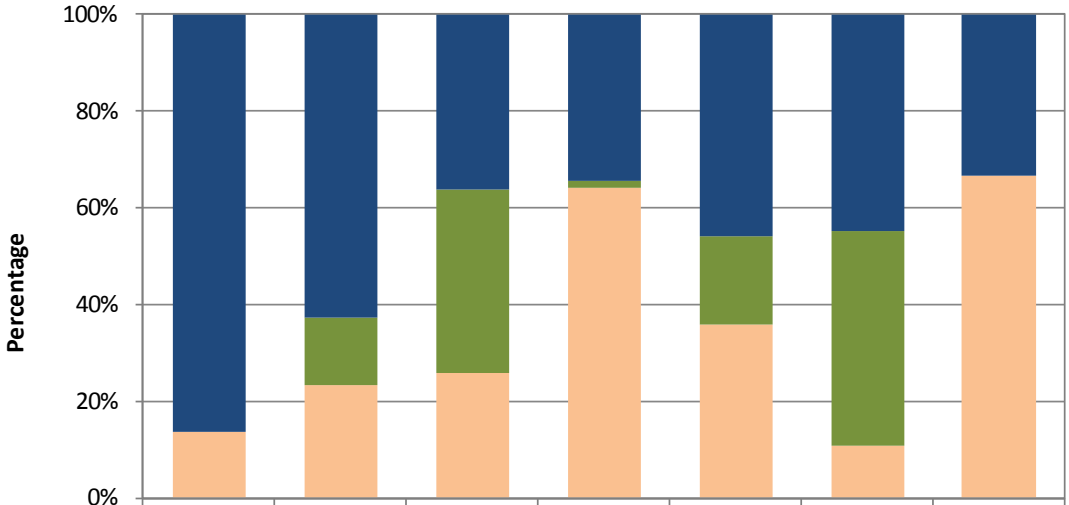
Notes:

a. Excludes PHC, which is listed separately in this report; the same hereinafter.
b. PHC is listed separately from VCHA due to a difference in the case definition; refer to "Limitations" in the "About the MRSA surveillance program".
c. Excludes St. Joseph's General Hospital, which did not participate in the provincial MRSA surveillance program in 2011/2012; the same hereinafter.
d. Based on the acute care beds in Q4 of FY 2011/2012. The number of beds may vary by quarter due to temporary closure of acute care beds by facilities.
e. Based on the average of quarterly counts of acute care beds in each health authority.
f. Includes nine facilities that did not have data available for Q1 and Q2 of FY 2011/2012 due to information system upgrades in progress.
g. Excluded from this report are nine facilities for Q1 and Q2 of FY 2011/2012 in IHA that did not have data available due to information system upgrades in progress.
h. BC Stats. Population projections (P.E.O.P.L.E. 36). http://www.bcstats.gov.bc.ca/

Overview of MRSA cases

A total of 2,414 cases of MRSA were newly identified in 79 acute care facilities during FY 2011/2012. According to the PICNet's MRSA surveillance protocol, 1,196 cases were defined as HCA with the reporting facility (49.5%), 457 cases were HCA with another facility (18.9%), and 761 cases were community-associated or of unknown association (31.5%). However, variations existed among the HAs in how the classification of MRSA cases were applied (Figure 1).

Figure 1. Proportion of newly identified MRSA cases by association and health authority, fiscal year 2011/2012



	IHA[a]	FHA	VCHA[b]	PHC[c]	VIHA	NHA	PHSA[d]
Healthcare-associated with reporting facility	86.4%	62.8%	36.3%	34.3%	45.8%	44.9%	32.8%
Healthcare-associated with another facility	0.0%	13.9%	37.9%	1.4%	18.2%	44.2%	N/A
Community-associated/ Unknown	13.6%	23.3%	25.8%	64.3%	36.0%	10.9%	65.5%
Total number of cases	162	771	581	370	325	147	58

Notes:

a. IHA assigns MRSA cases that were associated with another facility within IHA to the appropriate facilities, and the cases that were associated with the facilities outside of IHA as "healthcare-associated with another facility".

b. VCHA includes MRSA cases that were associated with the facilities outside of VCHA into "healthcare-associated with another facility".

c. PHC classified MRSA cases as either "PHC-associated" or "Not-PHC-associated". PHC-associated cases included MRSA cases that were associated with the reporting facility or another facility of PHC. The cases other than these were classified as Not-PHC-associated, which were grouped into the category "Community-associated/Unknown" in this report.

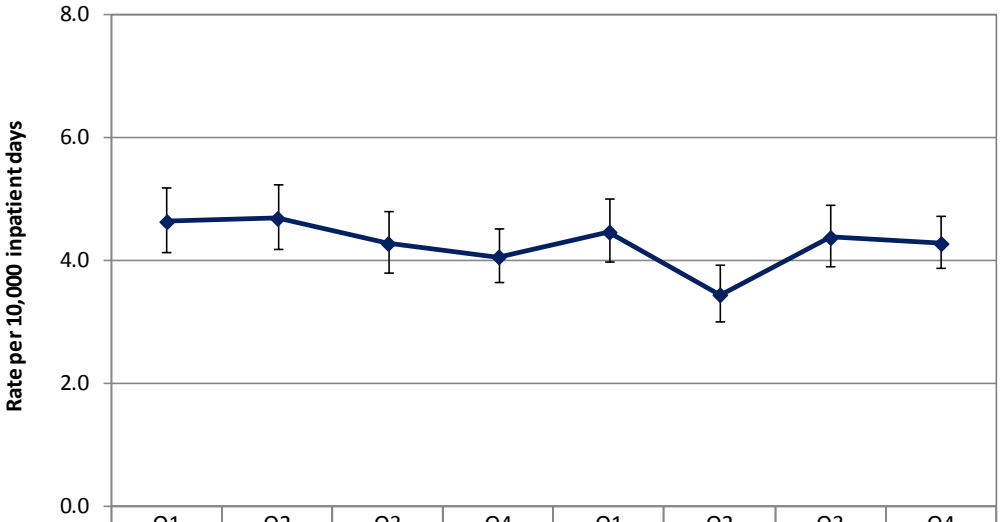
d. PHSA classified the MRSA cases other than those associated with the reporting facility as "Community-associated" or unknown, which were grouped into the category of "Community-associated/Unknown" in this report.

Provincial rate of MRSA associated with the reporting facility

The provincial rate of MRSA associated with the reporting facility was 4.2 per 10,000 inpatient days [95% confidence interval (CI): 3.9-4.4] in FY 2011/2012. Compared with the annual rate of 4.4 (95% CI: 4.1-4.6) per 10,000 inpatient days in FY 2010/2011, the rate was relatively stable at the provincial level.

The quarterly rates of MRSA were relatively stable for both fiscal years, with the exception of quarter 2 (Q2) of FY 2011/2012, which was significantly lower than most of other quarters (Figure 2).

Figure 2. Provincial rate of MRSA associated with the reporting facility by fiscal year and quarter



	Q1 2010/2011	Q2 2010/2011	Q3 2010/2011	Q4 2010/2011	Q1 2011/2012	Q2 2011/2012	Q3 2011/2012	Q4 2011/2012
Provincial rate of MRSA associated with reporting facility	4.6	4.7	4.3	4.1	4.5	3.4	4.4	4.3

Note: Bars in the line chart represent 95% confidence interval of the rates

* Data were aggregated by fiscal quarter for each HA except PHSA, which aggregated the data by calendar quarter (for start and end date of each quarter, see Fiscal Year in the Glossary). The same hereinafter.

Rate of MRSA associated with the reporting facility by health authority

The rate of MRSA associated with the reporting facility varied greatly by HA and fiscal quarter (Table 2). Compared with the annual rate for each HA in FY 2010/2011, the differences were not statistically significant (where 95% CI were not overlapped with each other) for any of the HAs except VCHA, where the rate was significantly lower in FY 2011/2012 than in FY 2010/2011.

Table 2. Rate of MRSA associated with the reporting facility per 10,000 inpatient days, by health authority

Health Authority	FY 2010/2011	FY 2011/2012				
	Annual Rate (95% CI)	Q1	Q2	Q3	Q4	Annual Rate (95% CI)
IHA	4.0 (3.5-4.6)[a]	3.3 [b]	2.7 [b]	3.1	4.1	3.4 (2.9-4.0)
FHA	4.7 (4.3-5.1)	5.2	3.9	5.1	4.6	4.7 (4.3-5.1)
VCHA	6.3 (5.6-7.1)	3.9	3.6	5.0	5.6	4.6 (4.1-5.3)
PHC	5.6 (4.6-6.8)	7.1	5.0	8.0	7.4	6.9 (5.8-8.2)
VIHA	2.6 (2.2-3.1)	2.9	3.0	3.1	2.6	2.9 (2.5-3.4)
NHA	N/A[c]	6.7	2.3	3.2	2.6	3.6 (2.8-4.6)
PHSA	1.8 (1.1-2.9)	2.7	2.3	1.8	1.8	2.1 (1.4-3.3)
Total	**4.4 (4.1-4.6)**	**4.5**	**3.4**	**4.4**	**4.3**	**4.2 (3.9-4.4)**

Notes:

a. Excludes four facilities in IHA for Q3 and Q4 of FY 2010/2011 due to unavailability of the data.
b. Excludes nine facilities in IHA for Q1 and Q2 of FY 2011/2012 due to unavailability of the data.
c. Data were not available because PICNet's MRSA surveillance protocol was not applied in the acute care facilities of NHA for FY 2010/2011; the same hereinafter.

Rate of MRSA associated with the reporting facility by facility type

The rate of MRSA associated with the reporting facility in those hospitals with more than 250 beds was significantly higher than in hospitals with 51-250 beds, and non-significantly higher than in hospitals with 50 or fewer beds in FY 2011/2012 (Table 3). The rate between hospitals with 50 or fewer beds and hospitals with 51-250 beds did not differ significantly for either fiscal year.

The annual rates for each hospital size did not change significantly from FY2010/2011 to FY 2011/2012.

Table 3. Annual rate of MRSA associated with the reporting facility per 10,000 inpatient days by hospital size

Hospital size	Annual Rate (95% CI)	
	FY 2010/2011	FY 2011/2012
1-50 beds	3.1 (2.5-3.8)	3.8 (3.1-4.6)
51-250 beds	3.8 (3.4-4.2)	3.7 (3.4-4.1)
>250 beds	5.1 (4.7-5.4)	4.5 (4.2-4.8)
Total	**4.4 (4.1-4.6)**	**4.2 (3.9-4.4)**

Note: see notes under Table 1 and Table 2.

Although the rate of MRSA associated with the reporting facility was significantly lower in the community hospitals than in the regional or tertiary/referral hospitals in FY 2010/2011, the differences between these rates in FY 2011/2012 were not statistically significant (Table 4).

The annual rates for each hospital category did not change significantly from FY2010/2011 to FY 2011/2012.

Table 4. Annual rate of MRSA associated with the reporting facility per 10,000 inpatient days by hospital category

Hospital category	Annual Rate (95% CI)	
	FY 2010/2011	FY 2011/2012
Community hospital	3.0 (2.6-3.5)	4.1 (3.6-4.8)
Regional hospital	4.5 (4.0-5.0)	3.9 (3.5-4.4)
Tertiary/Referral hospital	4.8 (4.5-5.2)	4.3 (4.0-4.6)
Total	**4.4 (4.1-4.6)**	**4.2 (3.9-4.4)**

Note: Please refer to the Glossary for the definition of each hospital category.

Teaching hospitals had a higher rate of MRSA associated with the reporting facility than non-teaching hospitals for both fiscal years, although the difference in FY 2011/2012 was not statistically significant (Table 5).

Compared with the rate in FY 2010/2011, there was also no significant change in the rate in FY 2011/2012 for both teaching and non-teaching hospitals.

Table 5. Annual rate of MRSA associated with the reporting facility per 10,000 inpatient days by teaching status of hospital

Teaching status	Annual Rate (95% CI)	
	FY 2010/2011	FY 2011/2012
Non-teaching hospital	3.6 (3.2-4.0)	3.8 (3.5-4.3)
Teaching hospital	4.8 (4.5-5.1)	4.3 (4.0-4.6)
Total	**4.4 (4.1-4.6)**	**4.2 (3.9-4.4)**

Note: Please refer to the Glossary for the definition of teaching hospital.

Rate of MRSA associated with the reporting facility by acute care facility

Table 6 below presents the rates of MRSA associated the reporting facility by hospital, listed in alphabetical order. The 95% CI of the rate is provided to show the reliability of the rate. The wide range of 95% CI for some facilities is due to the small numerators (i.e., number of cases of MRSA associated with the reporting facility) and/or denominators (inpatient days). The wider the range of CI, the less confidence there is in the rate, because there is a greater margin for error. The rates in facilities with a wide CI may vary substantially from reporting period to reporting period, as slight changes in case numbers – even one case – can considerably affect the rate. Those facilities for which the difference between the upper limit and lower limit of 95% CI was greater than twice the rate are denoted in the table below with the letter 'E', indicating that the rate may not be reliable.

Example In a facility with 30 acute care beds, if there were two cases of MRSA associated with the facility and 8,000 inpatient days in FY 2010/2011, and three cases of MRSA associated with the facility and 6,000 inpatient days in FY 2011/2012, the rates would be 2.5 and 5.0, respectively. As demonstrated in this example, the rate has doubled, although the number of cases has increased only by one case. For this reason, those rates with small numerators and/or denominators are flagged with the letter 'E' in the table below.

For those hospitals with reliable rates in the two fiscal years analyzed, the rate was significantly lower in FY 2011/2012 than in FY 2010/2011 in Vancouver General Hospital, and higher in Mount Saint Joseph Hospital and Shuswap Lake General Hospital.

Please note that the rates in this table represent HCA MRSA newly identified only among inpatients in each acute care facility and are not risk-adjusted. Therefore the rates are not comparable between individual facilities, nor are in any way a measure of the "performance" of the facility. Please refer to the "Discussion" section, and "Limitations" in the "About the MRSA surveillance program" section.

Table 6. Annual rate of MRSA associated with the reporting facility per 10,000 inpatient days by facility

Acute care facility	Facility type[a]	Annual rate (95%CI)	
		FY 2010/2011	FY 2011/2012
100 Mile District Hospital	S,C,N	13.9 (7.3-26.4)	7.8 (3.3-18.3)
Abbotsford Regional Hospital	L,T,Y	2.9 (2.0-4.1)	2.8 (2.0-4.0)
Arrow Lakes Hospital[b]	S,C,N	0.0	0.0
BC Children's Hospital	M,T,Y	2.9 (1.6-5.4)	2.4 (1.2-4.7)
BC Women's Hospital	M,T,Y	1.1 (0.5-2.4)	2.0 (1.1-3.5)
Bella Coola General Hospital	S,C,N	0.0	0.0
Boundary Hospital[b]	S,C,N	15.6 (5.3-45.9)[E]	14.2 (4.8-41.7)[E]
Bulkley Valley District Hospital	S,R,N	N/A[d]	7.8 (3.3-18.2)
Burnaby Hospital	L,R,Y	6.6 (5.3-8.3)	5.4 (4.2-6.9)
Campbell River & District General Hospital	M,C,N	4.4 (2.5-7.7)	3.5 (1.8-6.7)

Acute care facility	Facility type[a]	Annual rate (95%CI)	
		FY 2010/2011	FY 2011/2012
Cariboo Memorial Hospital and Health Centre	S,C,N	2.0 (0.6-7.4)[E]	1.0 (0.2-5.7)[E]
Chetwynd General Hospital	S,C,N	N/A[d]	0.0
Chilliwack General Hospital	M,C,Y	2.4 (1.4-4.1)	3.6 (2.4-5.5)
Cormorant Island Community Health Centre	S,C,N	40.9 (13.9-119.6)[E]	12.6 (2.2-70.9)[E]
Cowichan District Hospital	M,C,N	3.3 (2.0-5.6)	3.3 (1.9-5.5)
Creston Valley Hospital[c]	S,C,N	5.0 (1.7-14.7)[E]	3.6 (0.6-20.6)[E]
Dawson Creek Hospital	S,R,N	N/A[d]	1.2 (0.3-4.4)[E]
Delta Hospital	M,C,N	1.3 (0.4-3.8)[E]	5.3 (3.0-9.2)
Dr. Helmcken Memorial Hospital & Health Centre	S,C,N	0.0	5.6 (1.0-31.5)[E]
Eagle Ridge Hospital	M,C,N	2.5 (1.4-4.5)	2.6 (1.5-4.4)[E]
East Kootenay Regional Hospital[c]	M,R,N	12.7 (9.1-17.9)	6.3 (3.2-12.5)
Elk Valley Hospital[c]	S,C,N	9.9 (4.2-23.2)	15.1 (5.9-38.7)[E]
Fort Nelson General Hospital	S,C,N	N/A[d]	14.0 (6.0-32.8)
Fort St. John General Hospital	S,R,N	N/A[d]	4.1 (1.9-8.9)
Fraser Canyon Hospital	S,C,N	2.8 (0.5-15.6)[E]	13.2 (5.6-30.8)
G.R. Baker Memorial Hospital	S,R,Y	N/A[d]	1.5 (0.4-5.5)[E]
Golden & District General Hospital[c]	S,C,N	8.7 (2.4-31.8)[E]	0.0
Invermere & District Hospital[c]	S,C,N	14.6 (5.7-37.5)[E]	7.3 (1.3-41.0)[E]
Kelowna General Hospital	L,T,Y	4.5 (3.5-5.7)	2.6 (1.9-3.7)
Kitimat General Hospital	S,R,N	N/A[d]	4.1 (1.4-12.1)[E]
Kootenay Boundary Regional Hospital[b]	M,R,N	9.0 (4.9-16.6)	4.1 (1.7-9.5)
Kootenay Lake Hospital[b]	S,C,N	1.7 (0.3-9.8)[E]	0.0
Lady Minto Gulf Islands Hospital	S,C,N	3.3 (0.9-11.9)[E]	6.1 (2.4-15.8)[E]
Lakes District Hospital	S,C,N	N/A[d]	0.0
Langley Memorial Hospital	M,R,Y	3.4 (2.3-4.9)	3.5 (2.4-5.1)
Lillooet Hospital and Health Centre	S,C,N	0.0	0.0
Lion's Gate Hospital	L,R,Y	5.9 (4.5-7.7)	4.6 (3.4-6.2)
Mackenzie and District Hospital	S,C,N	N/A[d]	23.1 (6.4-84.0)[E]
Matsqui Sumas Abbotsford	S,C,N	0.0	1.1 (0.2-6.0)[E]
McBride and District Hospital	S,C,N	N/A[d]	0.0
Mills Memorial Hospital	S,R,N	N/A[d]	3.1 (1.3-7.3)
Mission Memorial Hospital	S,C,N	5.3 (2.4-11.6)	4.2 (1.8-9.7)
Mount Saint Joseph Hospital	M,C,Y	3.3 (1.9-5.7)	9.4 (6.7-13.0)
Nanaimo Regional General Hospital	L,R,N	3.0 (2.1-4.3)	4.1 (3.1-5.5)
Nicola Valley Health Centre	S,C,N	10.3 (3.5-30.2)[E]	3.0 (0.5-17.1)[E]
Northern Haida Gwaii Hospital	S,C,N	N/A[d]	0.0
Peace Arch Hospital	M,R,N	3.9 (2.7-5.6)	3.4 (2.3-5.0)
Penticton Regional Hospital	M,R,N	2.2 (1.3-3.9)	2.5 (1.5-4.3)

Acute care facility	Facility type[a]	Annual rate (95%CI)	
		FY 2010/2011	FY 2011/2012
Port Hardy Hospital	S,C,N	0.0	3.2 (0.6-18.3)[E]
Port McNeill and District Hospital	S,C,N	0.0	0.0
Powell River General Hospital	S,C,N	10.7 (6.0-19.2)	4.9 (2.1-11.4)
Prince Rupert Regional Hospital	S,R,N	N/A[d]	4.4 (1.7-11.2)[E]
Princeton General Hospital	S,C,N	11.7 (3.2-42.6)[E]	6.4 (1.1-36.4)[E]
Queen Charlotte Islands Hospital	S,C,N	N/A[d]	0.0
Queen Victoria Hospital and Health Centre	S,C,N	0.2 (0.0-1.1)[E]	3.4 (0.6-19.1)[E]
Queen's Park Care Centre	M,C,N	2.0 (0.8-4.6)	4.0 (2.4-6.7)
Richmond Hospital	M,R,Y	3.5 (2.3-5.2)	3.4 (2.3-5.0)
Ridge Meadows Hospital	M,R,N	4.3 (3.0-6.4)	6.4 (4.7-8.7)
Royal Columbian Hospital	L,T,Y	4.5 (3.6-5.7)	4.9 (3.9-6.0)
Royal Inland Hospital	M,T,N	4.5 (3.3-6.2)	5.1 (3.8-6.9)
Royal Jubilee Hospital	L,T,Y	2.3 (1.6-3.1)	2.9 (2.2-3.9)
RW Large Hospital	S,C,N	0.0	0.0
Saanich Peninsula Hospital	M,C,N	2.2 (1.0-5.2)	0.4 (0.1-2.4)[E]
Shuswap Lake General Hospital	S,C,N	1.5 (0.8-2.8)	6.1 (3.3-11.3)
South Okanagan General Hospital	S,C,N	6.1 (2.4-15.8)[E]	1.4 (0.3-8.1)[E]
Squamish General Hospital	S,C,N	2.0 (0.4-11.2)[E]	12.0 (5.8-24.7)
St. John Hospital	S,C,N	N/A[d]	1.5 (0.3-8.7)[E]
St. Mary's Hospital	S,C,N	5.9 (3.1-11.3)	0.7 (0.1-3.9)[E]
St. Paul's Hospital	L,T,Y	6.2 (5.0-7.6)	6.3 (5.1-7.7)
Stuart Lake Hospital	S,C,N	N/A[d]	6.3 (1.1-35.9)[E]
Surrey Memorial Hospital	L,T,Y	7.4 (6.3-8.7)	6.3 (5.3-7.4)
Tofino General Hospital	S,C,N	0.0	12.5 (3.4-45.4)[E]
UBC Hospital	S,R,Y	1.0 (0.2-5.4)[E]	0.0
University Hospital of Northern BC	M,T,Y	N/A[d]	3.9 (2.7-5.6)
Vancouver General Hospital	L,T,Y	7.5 (6.5-8.7)	5.3 (4.5-6.3)
Vernon Jubilee Hospital	M,R,N	2.5 (1.5-4.2)	1.3 (0.6-2.7)
Victoria General Hospital	L,T,Y	1.9 (1.3-2.8)	1.5 (1.0-2.4)
West Coast General Hospital	M,C,N	3.0 (1.4-6.6)	3.6 (1.8-7.5)[E]
Wrinch Memorial Hospital	S,R,N	N/A[d]	0.0

Notes:

a. Letter in the facility type represents: S: hospital with 1-50 beds, M: hospital with 21-250 beds, L: hospital with >250 beds, C: Community hospital, R: Regional hospital, T: Tertiary/Referral hospital, N: Non-teaching hospital, Y: Teaching hospital.
b. The data were not available from Q3 of FY 2010/2011 to Q2 of FY 2011/2012 due to information system upgrades in progress.
c. The data were not available for Q1 and Q2 of FY 2011/2012 due to information system upgrades in progress
d. Data were not available because the PICNet's MRSA surveillance protocol was not applied in FY 2010/2011.
E. Indicates an estimated rate that the difference between the upper limit and lower limit of 95% CI was greater than twice the rate, thus the rate may not be reliable.

Discussion

This first annual MRSA surveillance report presents cases of MRSA (either infection or colonization) newly identified among inpatients admitted to 79 acute care facilities across BC. At the provincial level, the rates of newly identified MRSA cases associated with the reporting facility were relatively stable in FY 2010/2011 and FY 2011/2012 for six of seven HAs (including PHC, which was listed separately from the other healthcare facilities of VCHA in this report). The exception was VCHA (excluding PHC), where the rate was significantly lower in FY 2011/2012 than in FY 2010/2011.

The spread of MRSA in hospital and community settings has been widely recognized as a serious health problem[4,5]. Infections with MRSA were found to contribute to more serious outcomes for patients, and were more costly than infections with Methicillin-susceptible *Staphylococcus aureus* (MSSA)[6]. According to results from hospitals participating in the Canadian Nosocomial Infection Surveillance Program (CNISP), the overall incidence of MRSA increased from 0.6 per 10,000 patient days in 1995 to 12.4 in 2009[7]. Outbreaks of MRSA were not uncommon in Canadian hospitals in the past decade[8].

Recent studies have demonstrated reductions in HCA invasive MRSA infections in the United States[9,10] and England[11], especially central line-associated MRSA bloodstream infections in intensive care units (ICUs)[12,13] following the implementation of preventive interventions. However, the overall prevalence of MRSA continuously increased among inpatients[10,14,15]. Our surveillance results show that the rates of HCA MRSA in BC acute care facilities were relatively stable between FY 2009/2010 and FY 2011/2012, but because the surveillance data did not distinguish MRSA infections from MRSA colonizations, further analysis was not possible.

The rate of HCA MRSA differed considerably by hospital, even among acute care facilities within the same HA. Generally the rates were higher in the large, tertiary/referral, and teaching hospitals. This was consistent with the findings of other reports[16,17]. Because the large hospitals usually serve as tertiary hospitals with specialty care to the patients, and may also provide teaching or training to the medical and nursing students, and other healthcare professionals, these hospitals are more likely to admit patients with greater severity of illness, which may in turn increase the risk of acquiring multidrug-

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resistant organisms. The severity of underlying medical conditions in the patients, higher antibiotic use, and frequency of invasive procedures have been proposed as the main reasons for this difference[18]. Studies have found that patient referral patterns also have an effect on the spread of hospital-acquired MRSA[19,20]. Tertiary/referral hospitals have a higher number of shared patients, and admit more patients that recently stayed in other hospitals[19]. Consequently, they are more likely to admit patients that still carry pathogens acquired during their previous hospital stay. On the other hand, the pathogen population in the small hospitals may fluctuate in size or be extinguished from period to period, which may impede both acquisition and spread of drug resistance[21].

Currently all hospitals participating in the provincial surveillance program routinely perform MRSA screening among inpatients, but the screening intensity and target population varies between hospitals, from universal screening of all patients on admission to screening patients with specific risk factors or those admitted to certain wards (e.g. ICU) only. This may partially explain the differences in the rates of MRSA among the hospitals. Studies found that about 1.5% of the general population may carry MRSA without experiencing any clinical symptoms[22], and MRSA colonization can persist for more than four years[23]. The more intensively the patients are screened, the more MRSA cases, especially colonizations, are likely to be identified.

MRSA colonization is a strong risk factor for subsequent infection in both community and hospital settings[24]. The data showed that detection of MRSA colonization may benefit both the colonized patient and other hospitalized patients located near the MRSA colonized patient[10]. Through active screening combined with placing patients colonized or infected with MRSA on contact precautions, MRSA infection rates have been documented to be significantly reduced in ICU patients, a variety of surgical populations, or even hospital-wide in hospitals with endemic MRSA[10,11].

It is worth noting that different approaches and terminology have been used to classify MRSA since it was first identified as a pathogen in healthcare-associated infections[25]. For surveillance purposes, this report classified HCA MRSA and CA MRSA based on epidemiological risk factors, such as encounter history with a healthcare facility, receipt of surgery or dialysis, or presence of indwelling devices. The criteria for this classification approach do not include the molecular characteristics of MRSA strains, which have also been used to categorize the MRSA as either HCA or CA . Typically, the isolates from cases of CA MRSA have distinct molecular features from that of HCA MRSA[26]. However, the epidemiology of MRSA has changed dramatically in the past decade. The MRSA strains that traditionally caused CA infections are now frequently identified in the healthcare setting[25,27,28], and the typical HCA strains have migrated into the community[29,30]. Molecular typing found that the typical CA MRSA strain

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US300 has been the predominant clone in both the communities and the hospitals in San Francisco, USA[31], and is significantly more common in paediatric patients[32]. Recent data also showed that the classic strains of CA MRSA, which were typically susceptible to most anti-*staphylococcal* antibiotics, are now resistant to several antibiotics[30,33]. The blurring of boundaries in the molecular type of MRSA between healthcare setting and community, and expanding drug resistance of CA MRSA strains, present new challenges in classifying MRSA for both surveillance and treatment purposes.

The main objectives of this report are to provide a provincial overview of MRSA that can be used to monitor provincial rates and patterns of MRSA over time, and to provide baseline information for intervention programs. Reliable and consistent surveillance data enable the effective monitoring of rate changes and trend analysis. The provincial surveillance program, along with public reporting of the results, also ensures transparency and accountability in prevention and control of healthcare-associated infections in BC acute care facilities.

The data displayed in this report comprise newly identified MRSA cases only, and should not be interpreted as a performance indicator of the facility. Higher rates of MRSA do not imply that a facility performed poorly in infection control or other performance measures. Instead, hospitals reporting higher rates may have more patients vulnerable to MRSA, and/or may be more aggressively screening for MRSA. HCA MRSA was defined based on the patient's history of encounter with healthcare services in the past twelve months. The MRSA cases classified as associated with the reporting facility mean merely that the patient was admitted to or has received treatment in the reporting facility. Strains of both HCA MRSA and CA MRSA can circulate in the community[34]; thus MRSA cases classified as HCA were not necessarily acquired in that facility, or even due to healthcare services. Some of them may in fact have been contracted in the community.

The rates of MRSA in this report were not adjusted for known risk factors and/or screening practices, therefore comparison of rates between HAs or facilities should be avoided. As discussed above, the rate of MRSA was correlated with the surveillance methods used to identify infections and persons at risk, underlying medical complexity of patients, as well as the control practices in each hospital. Other limitations described below (see "Limitations of the data" in the "About this report" section) also affect the rate of MRSA. Due to unique challenges in the populations served and environment faced by each facility, each HA is at the best position to respond to MRSA in its region and in its affiliated healthcare facilities.

Acknowledgements

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About the MRSA surveillance program

Purpose of MRSA surveillance

The provincial MRSA surveillance program is a collaboration between PICNet and all the health authorities in BC, and involves the voluntary participation of 79 of BC's 80 acute care facilities in the province. The main purpose of this MRSA surveillance program is to collect data on MRSA incidence (either infection or colonization) to monitor the rates and trends of healthcare-associated MRSA in BC acute care facilities, and to provide the baseline information for MRSA intervention programs.

Population under surveillance

The population under surveillance consists of inpatients in acute care facilities in BC. This includes patients admitted to the emergency department awaiting placement (e.g. patients admitted to a service who are waiting for a bed), patients in alternative level of care beds, patients in psychiatric beds, and patients in labour and delivery beds.

Excluded are outpatient visits to acute care facilities, patients in extended care beds housed in acute care facilities, and patients with short-term emergency room admissions.

Data collection and reporting

The provincial MRSA surveillance protocol, including case definition and core data elements, was developed by the PICNet Surveillance Steering Committee (SSC) to standardize data collection with minimum burden to the HA. Each HA incorporated the core data elements into their MRSA surveillance form and database. Data on individual MRSA cases are collected daily by infection control practitioners (ICP) and managed at each HA. Every quarter, the HAs aggregate their MRSA cases by facility and MRSA classification, and submit the data to PICNet along with facility-specific denominators. PICNet then consolidates the aggregated data for provincial analysis and reporting. At the end of each fiscal year, the HAs provide updates on their quarterly data submission. Data updates submitted after the data submission due dates may not be reflected in this report, but will be presented in future reports.

Limitations of the data

The data quality and the results are subject to at least the following limitations:

First, the intensity of MRSA screening varies from hospital to hospital, which greatly affects the identification of MRSA. Those hospitals which conduct more intense screening of patients (such as all patients admitted to the facility) may find more MRSA cases than those which screen patients in specific situations only. The laboratory methods used in identifying MRSA and antibiotics tested may also differ by hospital.

Second, MRSA colonization and MRSA infection were not distinguished in the surveillance. Only newly identified MRSA cases, either colonizations or infections, were reported. Not included were infections developed after colonizations; infections and/or colonizations identified in different body sites or from another strain of MRSA; re-infections; or re-colonizations. This report may therefore underestimate the magnitude of MRSA in BC acute care facilities.

Third, variation exists in how MRSA is classified among the HAs. A twelve-month look-back period and three calendar days after admission (with the day of admission counted as the first day) to classify MRSA associated with the reporting facility is employed by all HAs except PHC, which uses more than seventy-two hours after admission and a four-week look-back period. For MRSA identified less than three calendar days after admission to be classified as HCA with the reporting facility, the current case definition requires that the previous admission in the past twelve months must be a period of greater than or equal to three days in the healthcare facility. There are variations in this classification: FHA, VCHA and VIHA employ an admission of more than forty-eight hours in the past twelve months; PHC employs more than twenty-four hours; and PHSA employs any admissions. In addition, IHA assigned the cases that were associated with another IHA facility to the appropriate facilities, and the cases that were associated with the facilities out of IHA as "associated with another facility". PHSA classifies all MRSA cases other than those associated with the reporting facility as "Community-associated" or "Unknown", including those cases associated with another facility. PHC classifies the HCA MRSA cases that were associated with the facilities within PHC only, and all others as "Not PHC-associated." Furthermore, the ability to determine healthcare encounter history relies on the patient information system used in each hospital and HA. Some misclassification of MRSA is inevitable.

Lastly, the data for MRSA cases were collected by ICPs using data collection forms designed by each HA, while the denominators were collected from the health authorities' information systems. Definition and inclusion criteria of the data fields may vary among HAs. Furthermore, double-reporting may occur if the MRSA case was identified in a number of HAs. Both MRSA cases and denominator data were aggregated by HA at the facility level by fiscal quarter with the exception of PHSA, which aggregated the data by calendar quarter. Excluded from this report were the data for NHA in FY 2010/2011 because a standard case definition for MRSA surveillance was not in place in NHA prior to April 1, 2011. The data for some facilities in IHA were not available for certain periods due to information system upgrades.

The provincial MRSA surveillance program has been in place for only one year (FY 2010/2011 data were collected retrospectively). PICNet and each HA and their healthcare facilities have been continuingly working together to enhance surveillance and reporting mechanisms to monitor MRSA and other HAIs in an effort towards improving healthcare quality and patient safety.

Glossary

Acute care facility

Acute care facilities are healthcare facilities in which patients are treated for brief but severe episodes of illness, for the sequelae of an accident or other trauma, or during recovery from surgery. In this report, acute care facility refers to acute care hospitals in BC.

Colonization

Colonization is the presence of MRSA on tissue without observable clinical symptoms or immune reaction. Common sites of colonization include the nostrils, belly button, underarms, groin, etc.

Community-associated (CA) (Not healthcare-associated)

- An MRSA case (as defined above) identified three calendar days or less after admission to an acute care facility, with the first day counted as the day of admission,

  AND

- There was no exposure to any healthcare facility, either as an inpatient or an outpatient, within the last 12 months.

Confidence Interval (CI)

A confidence interval gives an estimated range of values that is likely to include an unknown population parameter to indicate the reliability of an estimate. The 95% CI of the rate and proportion in this report are calculated using Wilson score intervals.[35]

Fiscal Quarter and Calendar Quarter

Fiscal quarter (FQ) is a specified period within a budget or financial year. There are four FQs in a fiscal year. Start and end dates of each FQ vary from year to year. Calendar quarter is a period of three consecutive months starting on the first day of January, April, July or October. Below are the start and end dates of each quarter for the fiscal year from 2009/2010 to 2011/2012:

Start and end date of quarters for this report

Fiscal year	Quarter code	Fiscal quarter		Calendar quarter	
		Start date	End date	Start date	End date
2010/2011	**Q1**	01-Apr-2010	24-Jun-2010	01-Apr-2010	30-Jun-2010
	Q2	25-Jun-2010	16-Sep-2010	01-Jul-2010	30-Sep-2010
	Q3	17-Sep-2010	09-Dec-2010	01-Oct-2010	31-Dec-2010
	Q4	10-Dec-2010	31-Mar-2011	01-Jan-2011	31-Mar-2011
2011/2012	**Q1**	01-Apr-2011	23-Jun-2011	01-Apr-2011	30-Jun-2011
	Q2	24-Jun-2011	15-Sep-2011	01-Jul-2011	30-Sep-2011
	Q3	16-Sep-2011	08-Dec-2011	01-Oct-2011	31-Dec-2011
	Q4	09-Dec-2011	31-Mar-2012	01-Jan-2012	31-Mar-2012

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Fiscal Year (FY)

A term used to differentiate a budget or financial year from the calendar year. The fiscal year in BC runs from April 1 of the prior year through March 31 of the next year. For example: FY 2010/2011 is from April 1, 2010 to March 31, 2011.

Healthcare-associated with the reporting facility

- An MRSA case identified greater than three calendar days after the patient was admitted to the reporting acute care facility, with the first day counted as the day of admission.

  OR

- An MRSA case identified three calendar days or less after admission to your acute care facility, with the first day counted as the day of admission, AND the patient was admitted to the same acute care facility for a period of greater than 3 calendar days within the last 12 months.

Healthcare-associated with another facility:

- An MRSA case identified 3 calendar days or less after admission to the reporting acute care facility, with the first day counted as the day of admission,

  AND

- The case had an encounter with another healthcare facility, either as an inpatient (including Acute Care and Long Term Care), OR as an outpatient (including emergency care, ambulatory care, and outpatient clinics), within the last 12 months.

Health Authority (HA)

A Health Authority manages and delivers healthcare services. There are five regional Health Authorities which govern, plan, and coordinate services regionally within sixteen health service delivery areas, and a Provincial Health Services Authority which coordinates and/or provides provincial programs and specialized services (please note, in this report, PHC is analyzed separately from VCHA due to differences in case definition).

The six HAs in BC are:

- Interior Health Authority (IHA)
- Fraser Health Authority (FHA)
- Northern Health Authority (NHA)
- Vancouver Coastal Health Authority (VCHA)
  (PHC is part of VCHA, but in this report is analyzed separately.)
- Vancouver Island Health Authority (VIHA)
- Provincial Health Services Authority (PHSA)

Hospital category

The hospital category in this report is based on the healthcare services that the hospital provides and the population to be served, including:

- **Tertiary/Referral hospital** refers to a major hospital that provides a wide range of acute in-patient and out-patient specialist services together with the necessary support systems for the patients across the health authority. Patients will often be referred from smaller hospitals for

major operations, consultations with specialist and sub-specialists and when sophisticated intensive care facilities are required.

- **Regional hospital** typically provides healthcare services to the patients in its region, with a large numbers of beds for intensive care and long-term care, and also providing specialist and sub-specialist services, such as surgery, plastic surgery, childbirth, bioassay laboratories, and so forth.
- **Community hospital** offers an appropriate range of integrated health and social care designed to meet the needs of local people. Medical care is predominantly provided by general practitioners working with consultant medical colleagues.

Infection

Infection refers to the invasion of bacteria into tissue with the manifestation of clinical symptoms of infection, such as increased white blood cell counts, fever, lesions, furuncles, drainage from a break in skin continuity, or erythema. Infections require treatment.

Isolate

A bacterial or fungal strain that has been isolated in the laboratory from specimens collected from the patients.

Inpatient day

An accounting unit used by healthcare facilities and healthcare planners. Each day represents a unit of time during which the services of the institution or facility are used by a patient; e.g. 50 patients in a hospital for 1 day would represent 50 inpatient days.

Methicillin-Resistant *Staphylococcus aureus* (MRSA)

Methicillin-resistant *Staphylococcus aureus* (MRSA) is a type of staph bacteria that is resistant to certain antibiotics called beta-lactams. These antibiotics include Methicillin and other more common antibiotics such as oxacillin, penicillin, and amoxicillin. PICNet's MRSA surveillance program focuses on newly identified MRSA cases, which must meet ALL of the following criteria:

- Laboratory identification of MRSA, including *Staphylococcus aureus* cultured from any specimen that tests oxacillin-resistant by standard susceptibility testing methods; or by a positive result for penicillin binding protein 2a (PBP2a); or molecular testing for mecA. Positive results of specimens tested by other validated polymerase chain reaction (PCR) tests for MRSA may also be included
- The patient must be admitted to an acute care facility
- The MRSA must be newly identified at the time of hospital admission or identified during hospitalization, either as infection or colonization

This includes:

- MRSA infection or colonization identified for the first time during their hospital admission
- Patients identified in the emergency department and then admitted to the reporting acute care facility

- Patients that have been identified as being positive for MRSA in outpatient clinics (including ambulatory care) or other healthcare facilities were admitted to the reporting acute care facility with MRSA

This DOES NOT include:

- Patients that were previously identified as being positive for MRSA in the reporting acute care facility or other acute care facilities before current admission
- Cases identified in the emergency department or outpatient clinics but are not admitted to the reporting acute care facility
- Cases re-admitted with MRSA
- MRSA cases transferred from another acute care facility

Nosocomial infection

Infection associated with admission to the reporting healthcare facility.

Rate for MRSA associated reporting facility per 10,000 inpatient days

$$\text{Rate per 10,000 inpatient days} = \frac{\text{Number of MRSA associated with the reporting facility within a defined period}}{\text{Sum of inpatient days during the same period}} \times 10{,}000$$

A defined period can be a quarter or several quarters, or a year (annual rate).

Statistical significance

In statistics, a result is called statistically significant if it is unlikely to have occurred by chance. In this report, the difference is considered as statistically significant if the 95% confidence intervals of the two rates, proportions, percentages, or means do not overlap (i.e., the lower limit of one confidence interval is greater than the upper limit of the other confidence interval).

Teaching hospital

A teaching hospital combines assistance to patients with teaching to medical and nurse students, and other healthcare professionals, and is often linked to a medical school, nursing school, or university. A teaching hospital can be a community hospital, or regional hospital, or tertiary/referral hospital.

Trend test

Trend test is an aspect of statistical analysis that tries to determine whether there is a statistically significant trend upwards or downwards over a period of time or among specific ordinal categories. This report uses Mantel-Haenszel Chi-square test for linear trend at a statistically significant level of $p < 0.05$.

Unknown association

A MRSA case where there is insufficient information on healthcare exposure history to classify as a healthcare-associated case or community-associated.

Surveillance Steering Committee

The Provincial Infection Control Network of British Columbia (PICNet) is a provincially supported professional collaborative that provides guidance and advice on healthcare-associated infection prevention and control in British Columbia. Under the aegis and accountability framework of the Provincial Health Services Authority, PICNet connects healthcare professionals from across the province to develop and create guidelines and tools, with a focus on surveillance, education, and evidence-based practice.

PICNet's **Surveillance Steering Committee** provides guidance to PICNet's surveillance programs and assists the PICNet Management Office in implementation within the participating Health Authorities.

- Dr. Ghada Al-Rawahi, BC Association of Medical Microbiologists
- Jun Chen Collet, Provincial Health Services Authority
- Tara Donovan, Fraser Health Authority
- Leslie Forrester, Vancouver Coastal Health Authority
- Bruce Gamage (Co-Chair), PICNet
- Dr. Guanghong Han, (Co-Chair), PICNet
- Deanna Hembroff, Northern Health Authority
- Dr. Bonnie Henry, BC Centre for Disease Control
- Anthony Leamon, Vancouver Island Health Authority
- Dr. Elisa Lloyd-Smith, Providence Health Care
- Anne Marie Locas, Interior Health Authority

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