BRITISH COLUMBIA ASSOCIATION OF MEDICAL MICROBIOLOGISTS

Antibiotic Resistant Organism (ARO) Surveillance in British Columbia 2012 Report

The Medical Microbiologists of British Columbia (BCAMM) have established a representative network for gathering surveillance information on AROs in British Columbia. Participating laboratories are from all Health Authorities (HA) in B.C. and include data for both in- and out-patients. This is the eleventh consecutive year for this report, with yearly cumulative data from 2002 to 2012. Limitations to data interpretation are included in the last section. The data this year includes previous participating sites with the exception of a large community laboratory which somewhat limits the interpretation of data trends.

This report presents aggregate MRSA and VRE data for the province (Tables 1 and 3), and aggregate MRSA and VRE data by HA (Tables 2 and 4). Where only a single site within a HA submitted data, this site is included with another HA to prevent identification of the facility.

The cumulative data from 2002 to 2007 showed a steady increase in the incidence of both MRSA and VRE. The most recent data included in this report continues to suggest a downward trend which began in 2009 in the number of new patients identified to have MRSA, however as noted, data is missing from a former participant.

Antibiotic resistance in Gram negative bacilli is an area of major concern. Eleven sites provided an estimate of the presence of resistance to extended spectrum cephalosporins (known as Extended Spectrum Beta-lactamases, or ESBLs). This data is presented in Table 5. Data on the presence of a broad range of resistance genes including carbapenemase genes found in Enterobacteriaceae is included.

The report is formatted so that individual sites and/or patients can not be identified. After BCAMM review, the report is made available to the Provincial Health Officer, BCCDC Epidemiology, PICNET, IPAC-BC and to others interested in surveillance for AROs. Further use or dissemination of this report should acknowledge the efforts of BCAMM and participants.

We acknowledge the contributions of Medical Microbiologists, General Pathologists, Infectious Disease specialists, laboratory technologists, epidemiologists and infection control practitioners without whom this report would not be possible. While it would be desirable to collect additional demographic or clinical data, or extend the surveillance project to other organisms, this effort is not possible without additional resources.

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Reviewed and approved by BCAMM and all participants

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MRSA reported by BCAMM ARO Surveillance Project

The MRSA data collected for 2012 continues to show a slight decrease compared to 2011 in the overall incidence of new cases of MRSA but the percentage of MRSA comprising the proportion of total *S. aureus* isolates remains relatively constant. The decreasing trend first seen in 2008 was small, but the trend has continued, suggesting that the increased awareness and attention to infection prevention and control is having an impact. This decrease was reported by participating laboratories in most HA.

The trend of new patients identified with MRSA and the approximate proportion of MRSA/total *S. aureus* over the years of this report, and detailed in Table 1, is summarized below:

2002 and 2003: Numbers fairly constant.
2004 to 2007: Steady increase in numbers, **peak year 2007**
2008: 3% decrease from 2007
2009: 13% decrease from 2007
2010: 29% decrease from 2007
2011: 32% decrease from 2007
2012: figure not calculated due to missing data

Table 1: MRSA in BC, collected by BC Association of Medical Microbiologists

Year	Total new MRSA patients[a]	Total *S.aureus* isolates[b]	Approx % MRSA/ Total *S. aureus*[b]	Approx % MRSA -Range[b,c]	Approx % MRSA - Median[b]
2002	2,504	27,641	9.1%	1.3 – 62.7%	NA
2003	3,122	29,991	10.4%	2 – 51%	NA
2004	5,063	33,079	14.4%	6 – 33%	12.3%
2005	8,923	39,471	22.6%	8 – 47%	21%
2006	10,069	43,694	23%	11 – 30%	20%
2007	11,413	50,226	22%	7 – 38%	23%
2008	11,031	52,604	19%	5 – 42%	23%
2009	9,890	48,126	16%	4-32%	23%
2010	**8,088**	**47,220**	**17%**	**4-24%**	**16%**
2011	**7,722**	**50,367**	**15%**	**4-25%**	**15%**
2012[d]	**6,725**	**39,639**	**17%**	**9-34%**	**19%**

[a] See limitation 1.
[b] See limitation 2.
[c] Numbers at high end of range are outliers and reflect local outbreaks.
[d] One community laboratory did not provide data for this report.

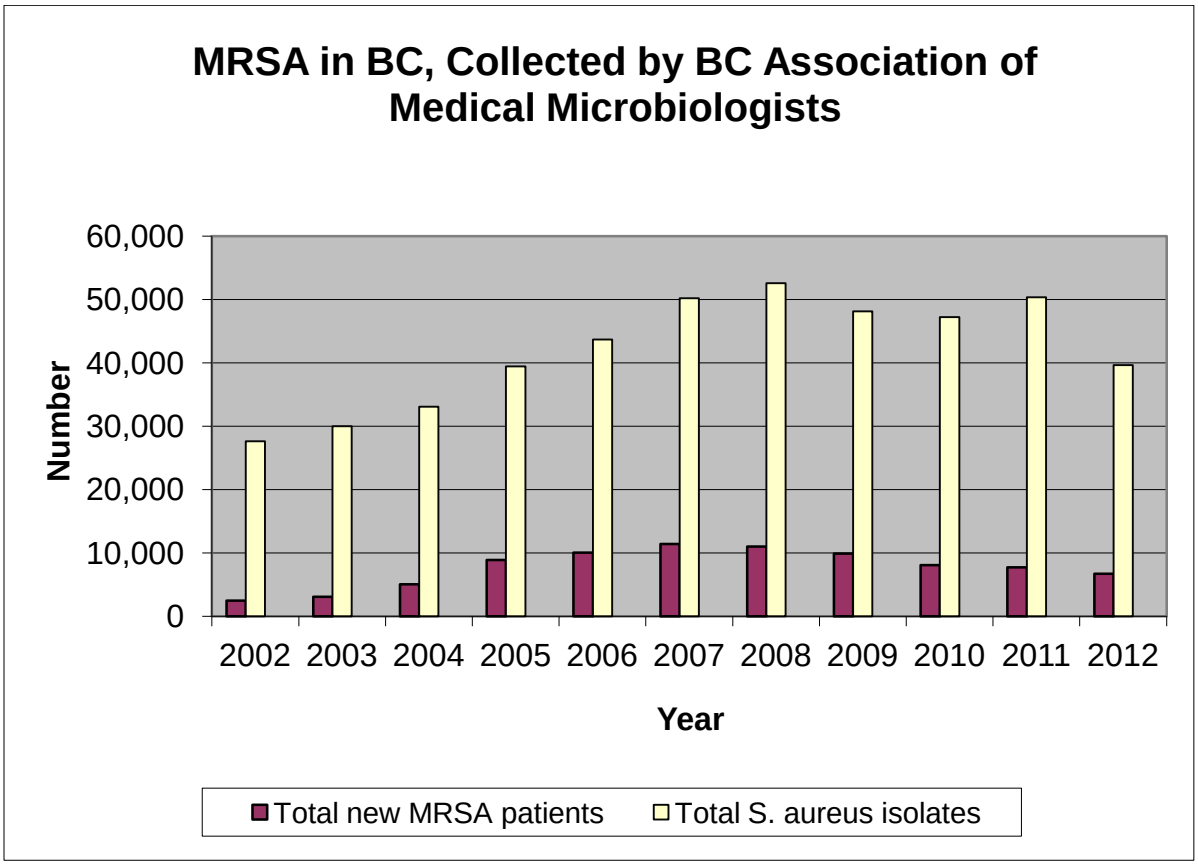
MRSA in BC, Collected by BC Association of Medical Microbiologists
60,000
50,000
40,000
30,000
20,000
10,000
0
Number
2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012
Year
Total new MRSA patients
Total S. aureus isolates

Table 2: MRSA by Health Region, collected by the BC Association of Medical Microbiologists

Region	2004		2005		2006		2007		2008	
	New MRSA patients	%MRSA/ All *S.aureus*	New MRSA patients	%MRSA/ All *S.aureus*	New MRSA patients	%MRSA/ All *S.aureus*	New MRSA patients	%MRSA/ All *S.aureus*	New MRSA patients	%MRSA/ All *S.aureus*
VCH/PHC/ PHSA	1,600	20%	2,263	25%	2,270	24%	1,990	23%	1,769	26%
VIHA South	535	15%	686	24%	314	18%	351	7%	217	5%
FHA	840	12%	2,023	27%	2,229	24%	2,375	31%	2,557	29%
IHA NHA	264	9%	601	15%	745	18%	1,203	21%	1,162	19%
Community Laboratories	1,824	13%	3,350	19%	4,511	24%	5,224	26%	5,326	20%

Region	2009		2010		2011		2012		2013	
	New MRSA patients	%MRSA/ All *S.aureus*	New MRSA patients	%MRSA/ All *S.aureus*	New MRSA patients	%MRSA/ All *S.aureus*	New MRSA patients	%MRSA/ All *S.aureus*	New MRSA patients	%MRSA/ All *S.aureus*
VCH/PHC/ PHSA	1,396	19%	1345	19%	1288	19%	1366	25%		
VIHA South	243	6%	287	8%	328	5%	292	9%		
FHA	2,226	25%	1312	14%	1162	13%	1453	18%		
IHA NHA	1,148	19%	1103	19%	1121	20%	1578	23%		
Community Laboratories	4,877	20%	4041	19%	3823	17%	2036*	13%		

*One community laboratory did not provide data for this report.

VRE Reported by BCAMM ARO Surveillance Project

The VRE data collected for 2012 shows an increase in the overall incidence of new cases of VRE after several years of declining total numbers. This is surprising given that many sites are moving to policies which decrease the surveillance intensity for VRE, based on local epidemiology and clinical significance in their patients. The VRE trend is not impacted as much as MRSA trends by the missing data since the reported incidence of VRE to date in out-patients has been very low.

The following summarizes the data of new patients identified with VRE, detailed in Table 3:

2002 and 2003: Number of new patients with VRE fairly constant.
2004 to 2008: Steady increase in numbers, large increases attributed to local institutional outbreaks, peak year 2008
2009: 11% decrease from 2008 in number of new patients with VRE
2010: 24% decrease from 2008 in the number of new patients with VRE
2011: Number of VRE cases back to numbers seen in 2008
There continues to be a wide range in the incidence of VRE as evidenced by the range of reported cases, from 5 patients with VRE (reported by one site) to a high of 758 patients (reported by one site). The number of patients with VRE reported by many sites still continues to be low, as reflected by the median number of 172 patients by all sites reporting. Ten sites reported more than 60 patients and five sites reported greater than 200 patients. This data is not significantly changed from that reported in 2011. Despite the increase in total number of patients identified with VRE, the prevalence of VRE as a percentage of all enterococci isolated in laboratories is still believed to be low. As in previous years, very few patients with VRE were identified by the community laboratory. The large majority of patients with VRE are colonized and the infection rates have remained very low.

Table 3: VRE in BC, collected by the BC Association of Medical Microbiologists

Year	Total new VRE patients[a]	Estimate of VRE as % of all Enterococci[b]	Range: # patients with VRE	Median # patients with VRE by site	Sites reporting >60 patients with VRE
2002	43	<1%			
2003	45*	<1%			
2004	150*	Estimate: no more than 1%			
2005	1,107*	Estimate: no more than 1%	0 – 656	7	5
2006	1,368*	Estimate: no more than 1%	0 – 550	18	7
2007	1,800	Estimate: no more than 1%	1 – 433	8	8
2008	2,588	Low[b]	1 – 514	44	8
2009	2,291	Low[b]	1 - 595	44	7
2010	**1,972**	**Low**	**5-570**	**97**	**5**
2011	**2,562**	**Low[b]**	**3-826**	**128**	**8**
2012[c,]**	**2,951**	**Low[b]**	**5-758**	**172**	**10**

[a] See limitation 1.
[b] See limitation 3. The increase in absolute numbers of VRE and the uncertainly of the denominator makes an estimate unreliable, but it is still considered to be very low.
[c] One community laboratory did not provide data for this report.
* Reflects local outbreaks.
** Surveillance policy change with less intense surveillance performed at one or more facilities..

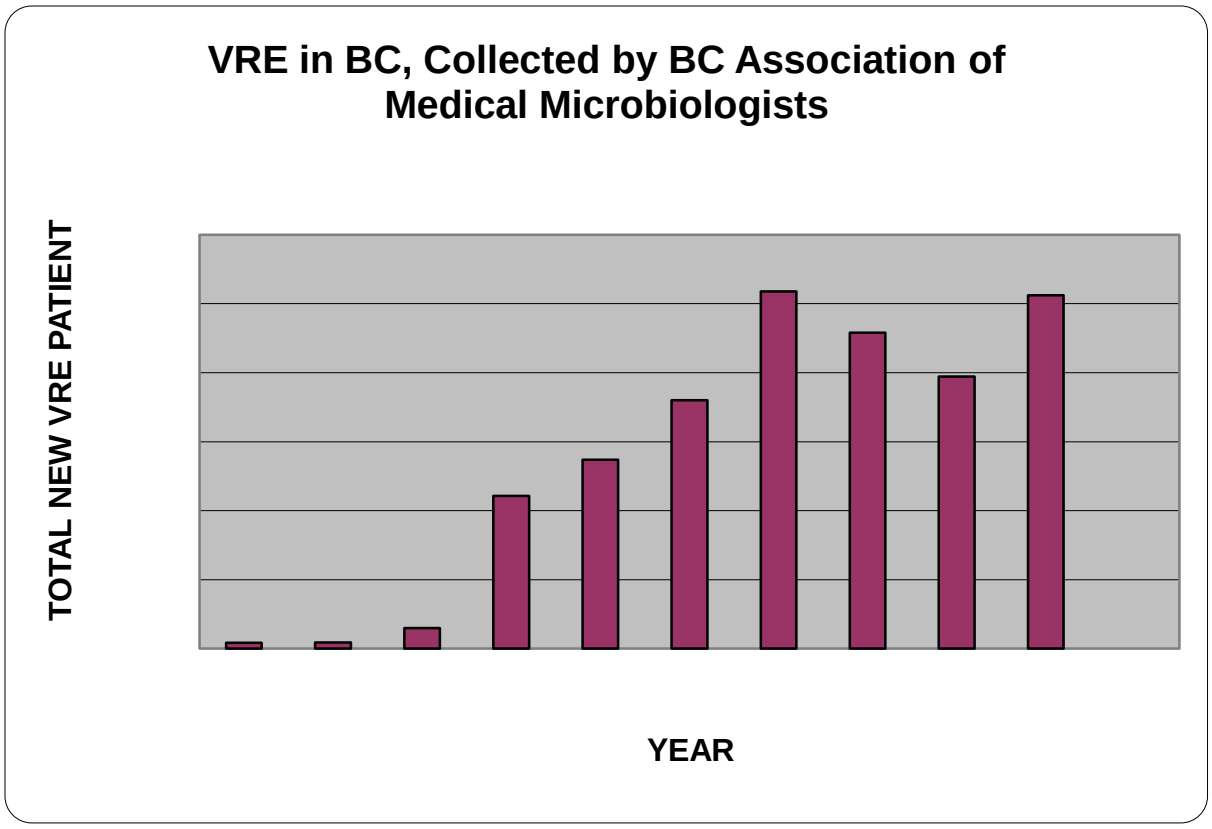

Table 4: VRE by Health Region, collected by the BC Association of Medical Microbiologists

	2005	2006	2007	2008	2009	2010	2011	2012
Region	**New VRE**	**New VRE**	**New VRE**	**New VRE**	**New VRE**	**New VRE**	**New VRE**	**New VRE**
VCH/PHC/ PHSA	914	873	913	832	1,131	995	1217	1186*
VIHA South	31	17	296	471	243	23*	10*	27*
FHA	150	354	436	878	796	697	886	1056
IHA NHA	8	110	149	41	47	217	399	643
Community Laboratories	4	14	6	67	74	30	50	39**

* Surveillance policy change with less intense surveillance performed at one or more facilities
** One community laboratory did not provide data for this report.

Streptococcus pneumoniae Reported by BCAMM ARO Surveillance Project

New to the report this year is data on the susceptibility of *S. pneumoniae*. Ten laboratories provided data on the patterns of susceptibility for approximately 1500 isolates recovered from both invasive and non-invasive isolates for three antibiotics.

Isolates of *S. pneumoniae* recovered from respiratory samples showed the following ranges in susceptibility:
Macrolide susceptibility from 48 to 93%
Penicillin susceptibility from 82 to 100%
Ceftriaxone susceptibility from 99 to 100%.

Isolates of *S. pneumoniae* recovered from potentially invasive or systemic infections are usually reported using two breakpoints to be considered susceptible to Beta-lactams, with a higher MIC breakpoint used to determine susceptibility of isolates from patients with non- meningeal infections and lower MIC breakpoint for isolates from patients with potential meningeal infection.

Using the non-meningeal breakpoints, susceptibility remains high with the following ranges in susceptibility:
Penicillin susceptibility from 92 to 100%
Ceftriaxone susceptibility from 99 to 100%

Using meningeal breakpoints, susceptibility was reported with the following ranges in susceptibility:
Penicillin susceptibility from 84 to 100%
Ceftriaxone susceptibility from 96 to 100%

Antibiotic Resistance in Enterobacteriaceae

Results of Phenotypic Testing to Detect Antimicrobial Resistance

ESBLs are extended spectrum beta-lactamases active against newer generation cephalosporins. Most BC laboratories screen for and confirm the presence of ESBL- producing *E. coli* and *Klebsiella pneumoniae* by phenotypic methods according to accepted guidelines. Testing guidelines to detect ESBLs using phenotypic tests are not well standardized for other organisms. Ten sites have reported an approximate percentage (computer systems may not readily track this data) of ESBL producers compared to total laboratory isolates of *E. coli* and *K. pneumoniae*. The estimated number of ESBL producing organisms appears stable. The percentage varies from 3 – 13% for *E. coli* and 0. – 6% for *K.pneumoniae.*

Table 5: Estimated Resistance in Enterobacteriaceae: ESBLs

Year	*E. coli* ESBL estimates	*Klebsiella pneumoniae* ESBL estimates
2007	0.7 to 5%	0 – 3%
2008	1 – 13%	0.3 – 6%
2009 All Laboratories	1-7.8%	0.3 – 6%
2010 All Laboratories	0.7 – 10%	0-8%
2011 All Laboratories	2.5-11%	<1 – 7%
2012 All Laboratories	3-13%	0-6%
2009 Community Laboratories	1- 1.7%	0.3 -1%
2010 Community Laboratories	0.7 – 2.5%	0.5 %
2011 Community Laboratories	3%	5%
2012 Community Laboratories	3%	1%

Results of Genotypic Testing to Detect Antimicrobial Resistance

Phenotypic testing methods cannot always identify and differentiate between specific resistance mechanisms, i.e., ESBLs, AmpC (also known as cephalosporinases) and carbapenemases; hence, genotypic methods were implemented at the BCCDC Public Health and Reference Laboratory in the fall of 2010. From October 2009 to December 31, 2013, about 1000 clinical Enterobacteriaceae and non-fermenter isolates, were submitted based on unusual phenotypic antibiotic susceptibility profiles that required confirmation. Duplicate isolates from the same source and collection dates were removed for this report. The phenotypic screening methods and decisions for submitting isolates were at the discretion of frontline medical microbiology laboratories.

ESBLs

The gene targets associated with ESBL looked for at the BC Public Health and Reference Laboratory are not comprehensive, but include SHV, TEM, CTX-M, and OXA-1. Amongst the isolates tested, the most common ESBL genes detected were SHV, TEM, CTX-M and OXA-1. Resistance mediated by ESBL resistance genes continues to be the most common resistance mechanism detected amongst all isolates.

AmpC

BC Public Health and Reference Laboratory tests for seven gene targets associated with AmpC resistance, including CMY-2, CMY-1/MOX, CMY-2/LAT, DHA, ACC, MIR/ACT and FOX. About 6% of all isolates are positive for any AmpC, and about 5% of all isolates are positive for CMY-2 gene.

Carbapenemase Producing Organisms, CPO (formerly known as CRE)

The BC Public Health and Reference Laboratory tests for KPC, NDM, IMP and VIM carbapenem resistance genes. The additional plasmid-encoded carbapenemase gene OXA-48 is tested for at the National Microbiology Laboratory (NML) in Winnipeg. NML also tests for the emerging chromosomally mediated SME gene. Between 2010-2013, about 1000 isolates were submitted for CPO PCR testing, and of these, 139 cases of CPO were identified with 7 cases harbouring multiple CPO genes. The most commonly identified CPO was NDM (79 cases) mostly from *Enterobacter cloacae* (18) and *K. pneumoniae* (46). Other NDM harbouring organisms included *E.coli* (13), *Citrobacter freundi* (5), *Morganella morganii*, *Acinetobacter baumanii* (2) and *P. aeruginosa* (1). OXA-48 was identified in 19 case-patients, and mostly from K. pneumoniae. There were 9 KPC positive case-patients (8 from *K. pneumoniae*) and 10 VIM (all *P. aeruginosa*). Twenty-six SME harbouring *S. marcescens* was also identified. There were 2 *P. aeruginosa* and 1 *Acinetobacter* that harboured IMP.

There was an increase in 2013 in NDM positive cases due to a combination of travel-related and non-travel related cases.

ARO Surveillance in British Columbia

Limitations:

1. **Number of MRSA and VRE patients:** The patient numbers submitted are those identified at each participating laboratory, each patient counted only once at each site. However, patients may be counted more than once if they submitted cultures to more than one of the participating laboratories. Anecdotally, one large tertiary center found on one annual review that only 2.5% were repeated reports.

2. **Number of isolates:** The number of isolates reported is generated by laboratory information systems. Laboratories use a variety of approaches to count isolates, some of which are chosen according to local need and some of which are dictated by the constraints of the laboratory information system. For example, some laboratories re-test every isolate on a patient (and thus re-count every isolate), while some laboratories have policies which require that the same isolate be re-tested (and thus re-counted) only every four or seven days, depending on the source of the isolate or the location of the patient. Some laboratories only count in-patient isolates. Thus any calculation using the number of isolates tested, e.g. #MRSA/total MRSA tested, is subject to a degree of error.

3. **Number of enterococci**: Denominator data for enterococci is not provided, as the degree of resistance would be largely over-estimated. This is due to the fact that enterococci are common colonizers or are present with other more virulent pathogens. Therefore they are not subject to susceptibility testing and are not counted in laboratory information systems. Alternatively stated, the search for VRE is much more vigilant than the testing and reporting of enterococci in general. The same is not as much of a problem for *S. aureus*, since when *S. aureus* is present in a specimen it is usually considered a pathogen, subjected to susceptibility testing, and is counted. Even with these limitations, it is still fair to estimate that VRE represent a very small percentage of all enterococci isolated in B.C.

4. **Community versus hospital incidence:** Further epidemiologic investigation is required to meaningfully separate the isolates arising from the community or arising in the hospital setting. Breaking the numbers down into those reported by community laboratories and those reported by in-patient settings would not necessarily reflect acquisition in the community, but could be provided if of interest.

5. **Time Period:** Centres may differ on the periods used for counting, some counting on calendar months and others using “periods” within a fiscal year. The data collected were requested for the 12 calendar months or “periods” which best reflect those months, or for the calendar year. This is not felt to introduce significant error into these statistics, as it will be the trend of these data that is most useful.

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ARO Surveillance in British Columbia: Participating Locations

We acknowledge and thank the Medical Microbiologists, General Pathologists, Infectious Disease specialists, laboratory technologists, and Infection Control Practitioners at:

Community-based Laboratories:

1. LifeLabs -Mainland, Vancouver Island, Sechelt, and Gibsons Laboratory locations

Hospital-based Laboratories:
Vancouver Coastal Health:

2. Lion's Gate Hospital, North Vancouver
3. Powell River General Hospital
4. Providence Health Care (St. Paul's Hospital and Mt. St. Joseph's), Vancouver
5. Richmond Hospital
6. Squamish General Hospital
7. St. Mary's Hospital, Sechelt
8. Vancouver Acute (VGH and UBCH sites)

Provincial Health:

9. Children's and Women's Hospital (Vancouver)
10. BCCDC Public Health and Reference Microbiology Laboratory (Vancouver)

Fraser Health:

11. Fraser Health East (Abbotsford Regional Hospital and Cancer Centre, Chilliwack General, Mission Memorial, and Fraser Canyon Hospitals)
12. Fraser Health North (Burnaby, Eagle Ridge, Royal Columbian, and Ridge Meadows Hospitals)
13. Fraser Health South (Surrey Memorial Hospital, Delta Hospital, Surrey Youth Outreach Clinic, Peace Arch Hospital, Langley Memorial Hospital)

Interior Health:

14. Kelowna General Hospital
15. Penticton Regional Hospital
16. Summerland Health Centre
17. South Okanagan Regional Hospital (Oliver)
18. Princeton General Hospital
19. Keremeos Diagnostic Centre
20. Royal Inland Hospital (Kamloops)
21. Vernon Jubilee Hospital

Northern Health:

22. University Hospital of Northern BC

Vancouver Island Health (South):

23. Victoria General Hospital
24. Royal Jubilee Hospital

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