

Methicillin Resistant *Staphylococcus Aureus* (MRSA)

2010 Alberta Health and Wellness Report

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ISBN 978-0-7785-8327-1

October 2011

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Executive Summary

Methicillin resistant *Staphylococcus aureus* (MRSA) is one of a number of nosocomial infections found in acute care settings, but also in other facilities and in the community. MRSA first came under lab surveillance in Alberta in June 2005. Since then, Alberta Health and Wellness (AHW), in partnership with Alberta Health Services, has developed guidelines and standards to both manage and prevent infections like MRSA, and continues to monitor infection activity through lab surveillance of first clinical isolates.

In summary:

- Total MRSA cases and rates in Alberta have been steady for the last four years.
- Rates of infection are highest in the elderly (70 years and older) and in babies (under 1 year).
- Rates for those under 20 years of age have more than doubled between 2006 and 2010 (26 cases per 100,000 to 68 cases per 100,000).
- In 2010, those who were 50 years and older made up the largest proportion of cases in the South, Calgary and Central health zones, while 20 to 49 year olds were the largest age group in the Edmonton and North zones.
- In 2010, MRSA rates in the Central and North health zones were higher than the provincial average of 115.7 cases per 100,000 persons.
- MRSA can be further typed by the lab to the strain level: CMRSA 1 through CMRSA 10
 - The majority of cases reported have been typed as CMRSA 10 since 2006, and this increased sharply between 2006 and 2007.
 - Since 2006, cases of CMRSA 7 and CMRSA 8 have increased, while CMRSA 3 & 6 have decreased.
 - In 2010, rates of CMRSA 7 and CMRSA 10 were highest for those under 1 year of age (31.5 cases per 100,000 and 84.6 cases per 100,000, respectively); CMRSA 2 was highest in those 70 years and older (228.2 cases per 100,000).

Background

Staphylococcus aureus is a bacterium, which commonly lives in the nose and on the skin of healthy people. Many people that harbour these bacteria have no symptoms but some develop infections and need treatment.

MRSA is the term for *Staphylococcus aureus* (*S.A.*) bacteria that have become resistant to semi-synthetic penicillins such as cloxacillin and methicillin. It can also acquire resistance to other classes of antibiotics. MRSA infections can be more difficult to treat and drugs commonly used for treatment of other strains of *S.A.* are not always effective. The *S.A.* bacteria are spread primarily through direct person-to-person contact with a colonized or clinically infected individual (see *Glossary in the Appendix*).

Traditionally, MRSA is seen in people who are taking antibiotics and those individuals who are receiving medical care. MRSA, like *S.A.*, may also live on the skin, in the nose, or around the rectum of a person. More recently, MRSA has been found in people who have no contact with the health care system. This is referred to as community-associated MRSA (CA-MRSA). In the community, MRSA most commonly causes skin and soft tissue infections (e.g. boils or abscesses on arms, legs or elsewhere). These are treatable with drainage and antibiotics. In rare cases, MRSA can cause severe invasive infections such as pneumonia and bloodstream infections such as septicemia. These severe infections require urgent medical treatment. Infection occurs when bacteria get past normal body defences and cause disease.

MRSA were first reported in the hospital in 1961 by bacteriologist professor Patricia Jevons in England¹. In America, the first reports of MRSA were in hospitals in Boston in 1968¹. In Canada, in 1981, MRSA acquired in the community was first reported by Low *et al*².

The preliminary results from a Canadian Nosocomial Infection Surveillance Program (CNISP) study on MRSA between January 1995 and December 1999 found 4,507 patients infected or colonized with MRSA from the 22 to 34 hospital sites participating. Through this study, the rate of MRSA was found to have increased from 0.46 per 1,000 admissions in 1995 to 4.12 per 1,000 admissions in 1999 ($p < 0.05$)³. Colonization occurs when bacteria are present on or in the body without causing illness.

An updated CNISP report included data up to and including 2003 from 38 hospital sites (mostly tertiary-care teaching hospitals; and a few community hospitals) involved in the MRSA surveillance program in nine Canadian provinces. The results found that MRSA rates continued to increase from 4.12 cases per 1,000 admissions in 1999 to 5.10 cases per 1,000 admissions in 2003, a significant increase ($p=0.002$)⁴.

In 2007, a preliminary surveillance report on MRSA in patients from 47 Canadian acute-care sentinel hospitals found that the MRSA rate was 8.62 per 1,000 admissions⁵.

A 2004 investigation of an outbreak of MRSA (Canadian strain type, CMRSA 10) in the Calgary Health Region found that the highest risk was for people with histories of illicit drug use, homelessness or recent incarceration⁶. Factors that contribute to transmission of MRSA include environmental (e.g., overcrowded living conditions), social (e.g., belong to specific drug using networks, limited health care access), individual (e.g. pre-existing cut, abrasion or wound) and

behavioural (e.g., sharing drug paraphernalia). The transmission factors have been termed the “five C’s”:

- cleanliness,
- crowding,
- contact,
- sharing contaminated items, and
- compromised skin⁷.

Later, an Alberta report of the Provincial Outbreak Investigation between June 1, 2005 and February 28, 2006 (EI 2005-286) found that the majority of patients infected with MRSA were infected with the typically healthcare-associated strain CMRSA 2 (38.5 per cent) or the usually community-associated strain CMRSA 10 (36.7 per cent)⁸.

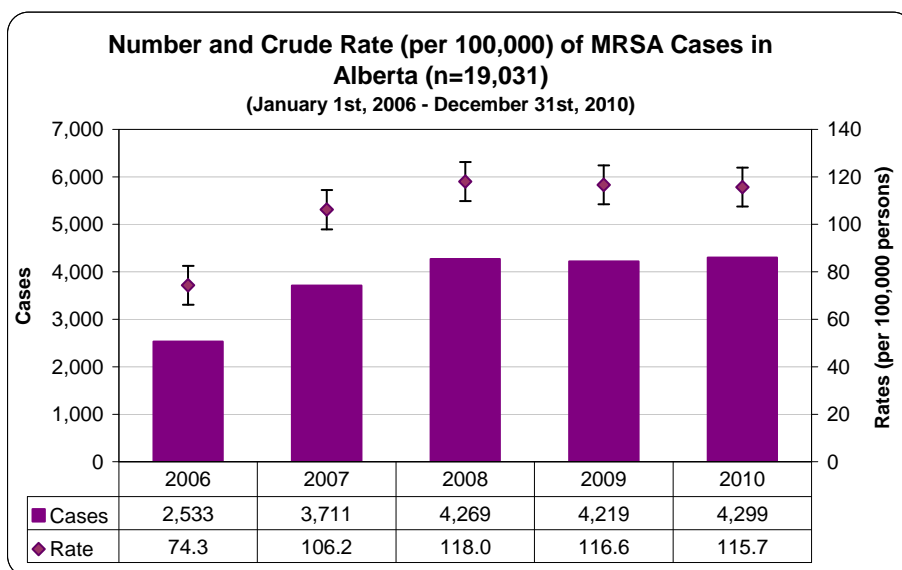
Alberta Health and Wellness provides information on prevention and management of community associated MRSA⁷ and Provincial MRSA IPC Guidelines and Standards for Prevention and Management of MRSA on their public website⁹.

In Alberta, the Provincial Public Health Laboratory (ProvLab) has collected lab information on MRSA cases since June 2005. These MRSA cases are reported to AHW weekly. In February 2010, to enhance surveillance of MRSA, ProvLab changed typing procedures; ProvLab replaced pulsed-field gel electrophoresis (PFGE) with spa typing – the internationally preferred method for MRSA typing – as the primary molecular typing method of first clinical isolates of MRSA. The first clinical isolate is an under-estimation of the number of MRSA cases in Alberta, as colonized individuals are not captured.

SUMMARY - MRSA in Alberta, 2006-2010

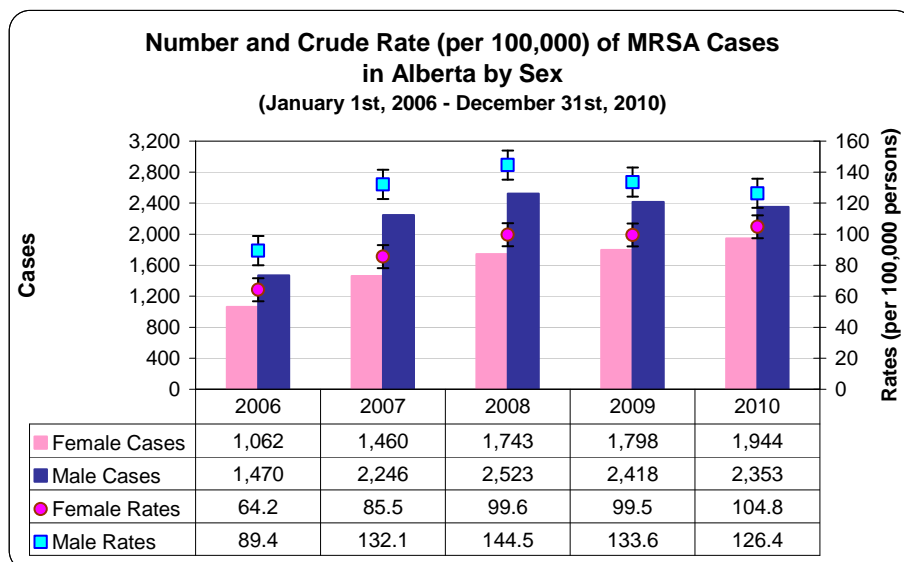
This section presents an annual overview of MRSA in Alberta for the years 2006 to 2010. The source of all data is the AHW MRSA dataset based on first clinical isolates identified through Provincial Public Health Laboratory (ProvLab) and reported weekly to AHW. Population figures used in the denominators are from the AHW Interactive Health Data Application.

Figure 1



The number of reported MRSA cases had increased from 2,533 cases (rate of 74 cases per 100,000 persons) in 2006 to 4,269 cases (118 cases per 100,000 persons) in 2008. From 2007 to 2010, MRSA rates remained at similar levels. In 2010, there were 4,299 cases at a rate of 116 cases per 100,000 persons (Figure 1).

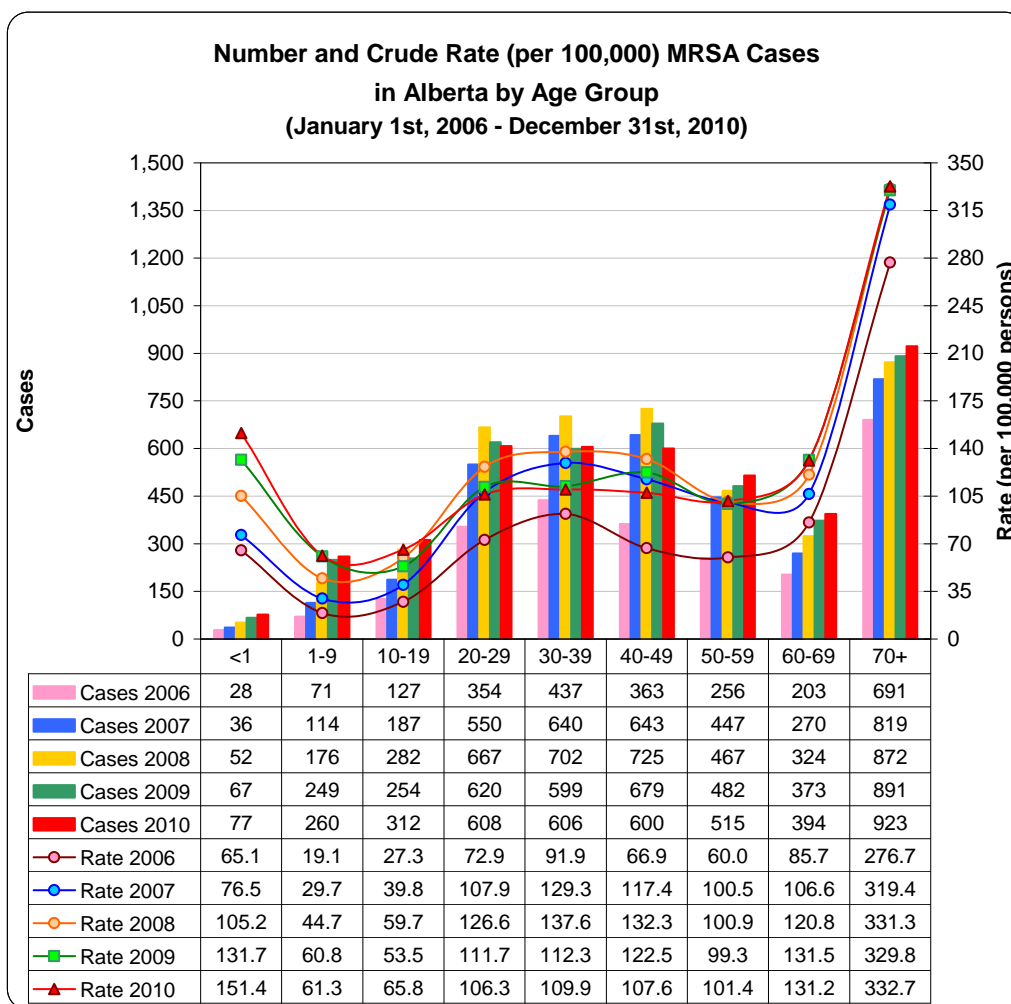
Figure 2



The MRSA rate for males continues to be higher than those for females for the past five years. In 2006, the MRSA male rate was 89 cases per 100,000 males, increasing to 145 cases per 100,000 males in 2008, and then decreasing to 126 cases per 100,000 males in 2010. The MRSA female rate continued to increase from 64 cases per 100,000 females in 2006 to 105 cases per 100,000 females in 2010 (Figure 2).

Overall, MRSA rates for the age group of 70 years and older were the highest. Their rates increased from 277 cases per 100,000 persons in 2006 to 333 cases per 100,000 persons in 2010. The lowest MRSA rates were in the one to nine years of age group, ranging from 19 cases per 100,000 children in 2006 to 61 cases per 100,000 children in 2010 (Figure 3).

Figure 3



Children under 1 year of age had the second highest MRSA rates with 132 and 151 cases per 100,000 in 2009 and 2010, respectively.

From 2006 to 2010, MRSA rates for persons under 20 years of age have more than doubled between 2006 and 2010, increasing from 26 to 68 cases per 100,000, respectively. MRSA rates in

the 20 to 69 years age group increased from 1,613 cases (74 cases per 100,000) in 2006 to 2,885 cases (125 cases per 100,000) in 2008, then decreased to 2,723 cases (109 cases per 100,000) in 2010. For persons from 70 and older, in the same period of time, their MRSA rates have increased slowly from 691 cases or 277 cases per 100,000 persons in 2006 to 923 cases or 333 cases per 100,000 persons in 2010.

Figure 4

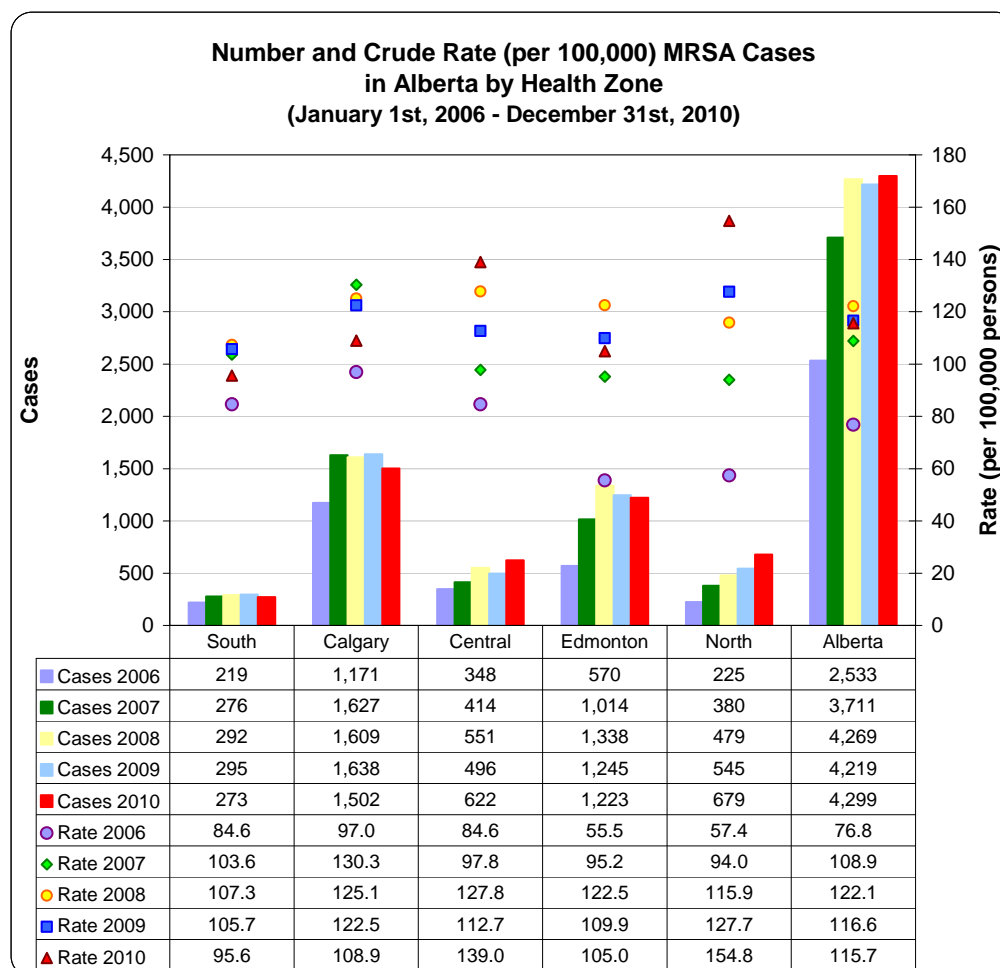


Figure 4 shows that the rate of MRSA has continued to change within the province by health zone in the past five years (2006-2010).

- The MRSA rates in the North health zone have increased from 57 cases per 100,000 persons in 2006 to 155 cases per 100,000 persons in 2010, or increasing 2.7 times within five years. Also, its rate was the highest MRSA rate in the province in 2010.
- The second highest MRSA rate in 2010 was 139 cases per 100,000 persons in the Central health zone. In these two health zones, North and Central, the rates of MRSA in 2010 were higher than the provincial rate (116 cases per 100,000).
- The MRSA rates for the Edmonton health zone more than doubled from 56 cases per 100,000 persons in 2006 to 123 cases per 100,000 persons in 2008.
- In the Calgary health zone, the MRSA rates increased from 97 cases per 100,000 persons in 2006 to 130 cases in 2007 then decreased to 109 cases per 100,000 persons in 2010.

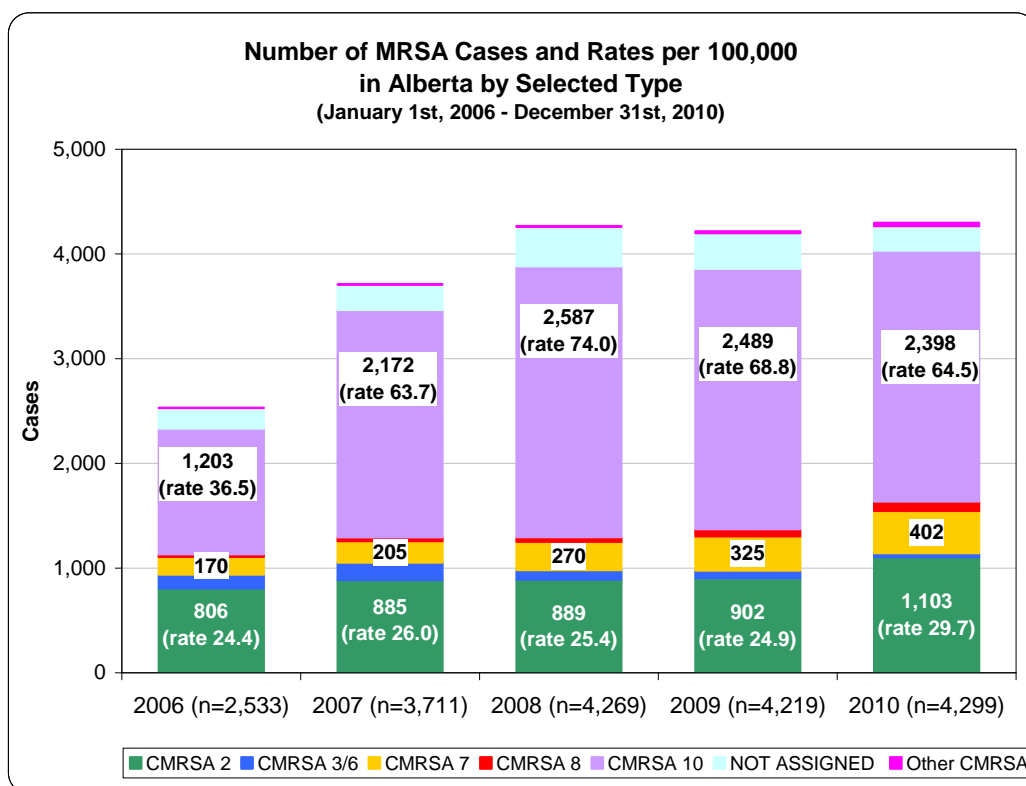
- Edmonton, Calgary, and South health zones, had lower MRSA rates than the provincial rate in 2010.

Figure 5 breaks down the reported MRSA cases in Alberta from 2006 to 2010 into the following CMRSA types:

CMRSA 1 to CMRSA 6 strains are typical healthcare-associated MRSA with multi-drug resistant phenotypes.

CMRSA 7 to CMRSA 10 are typically labelled community-associated strains and have been associated with community-related outbreaks in Canada. CMRSA 7 has caused community outbreaks in aboriginal populations. Community-associated MRSA strains are generally more susceptible to many classes of antimicrobials and often carry a toxin (Panton-Valentine leukocidin, PVL) not typically found in healthcare-associated MRSA strains.

Figure 5



Not all MRSA strains typed in Alberta will have an assigned PFGE profile using the National Microbiology Laboratory (NML)/CNISP nomenclature. The non-assigned profiles refer to strains with new PFGE patterns, i.e., unique profiles that are not the same as any of the NML prototype strains.¹⁰

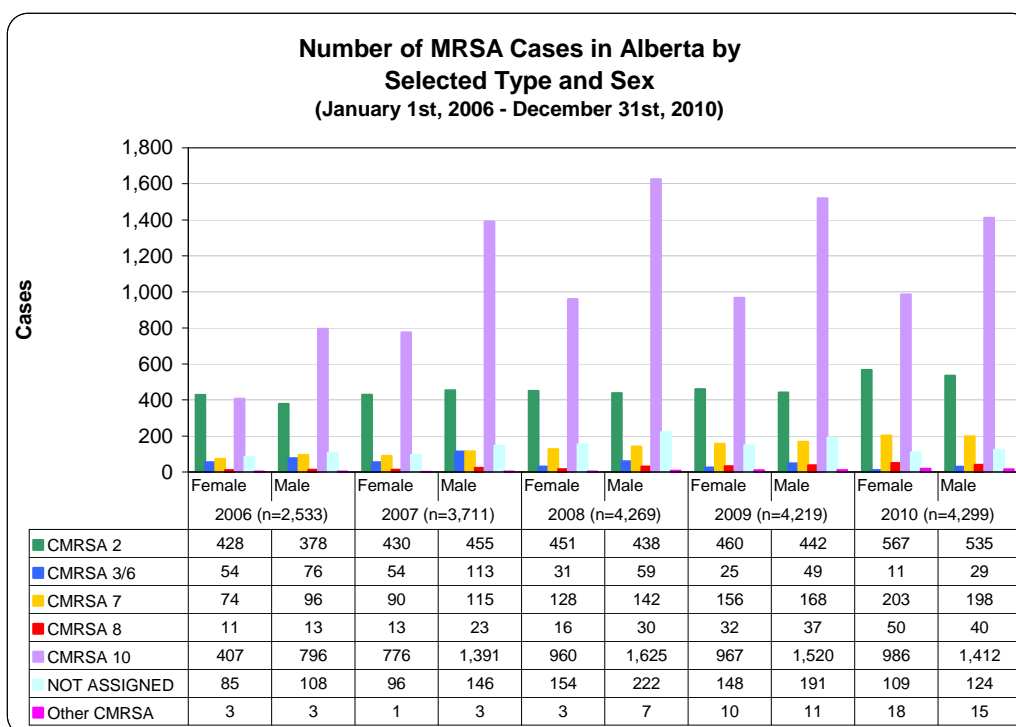
The classification of community-associated MRSA and healthcare-associated MRSA is imprecise as it is often impossible to accurately identify the point of transmission. As hospital strains move into

the community and community strains spread within hospitals it may be increasingly difficult to define strains as healthcare-associated MRSA or community MRSA.

Figure 5 shows two CMRSA types which stood out among cases since 2006:

- CMRSA 2 cases made up 31.8 per cent of total cases in 2006, then decreased to 20.8 per cent in 2008 and rose to 25.7 per cent in 2010. The CMRSA 2 rates varied from 24 cases per 100,000 persons in 2006 to 26 cases per 100,000 in 2010.
- CMRSA 10 cases were higher, starting with 47.5 per cent of total cases in 2006, then increased to 60.6 per cent in 2008, then decreased to 55.8 per cent in 2010. The CMRSA 10 rates increased from 37 cases in 2006 to 74 cases per 100,000 in 2008.

Figure 6



Overall, Figure 6 shows that females had fewer cases reported than those for males in almost all CMRSA types from 2006 to 2010 except CMRSA 2.

MRSA in Alberta, 2010

This section examines MRSA in Alberta in greater detail for the 2010 calendar year.

In 2010, the lowest MRSA infection rate was 61 cases per 100,000 children aged one to nine years, and the highest rate of MRSA was 333 cases per 100,000 among persons aged 70 years and older. Children less than one year of age had the second highest MRSA rate with 151 cases per 100,000 babies (Figure 7).

Figure 7

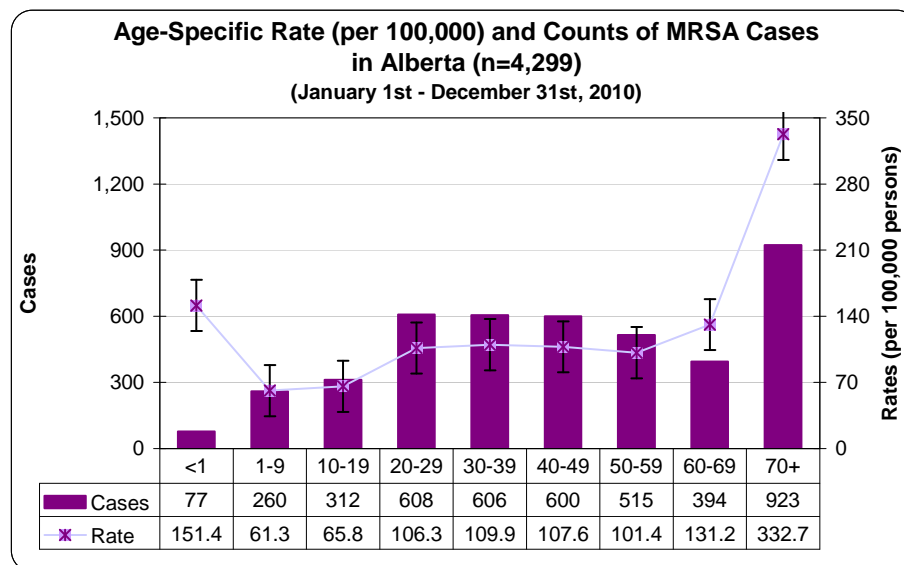
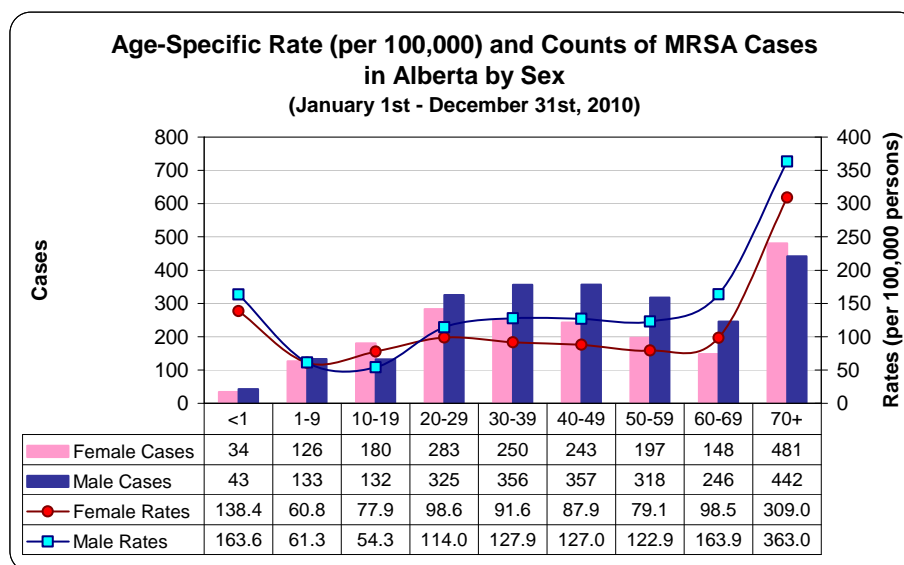


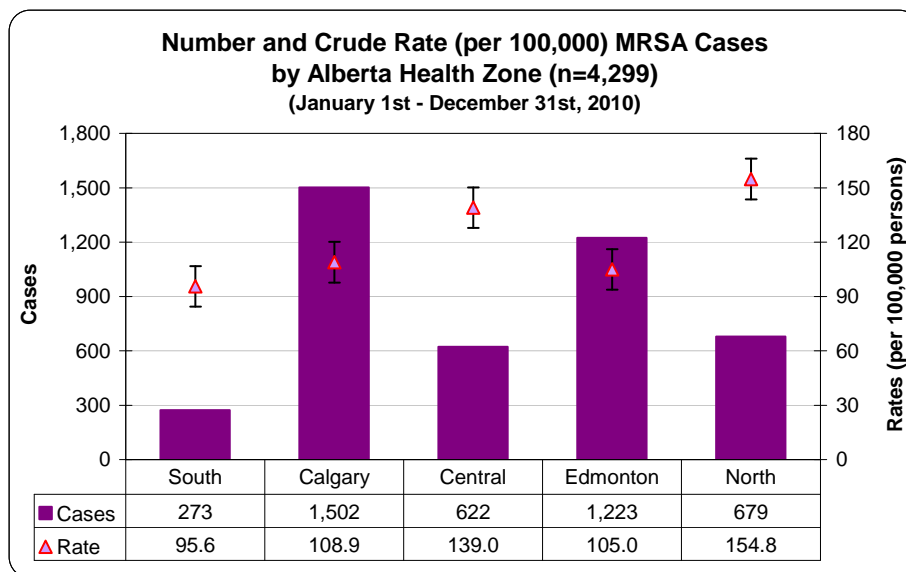
Figure 8



In 2010, overall, MRSA rates for males were higher than those for females, except children 10 to 19 years. In that age group, the MRSA rate for males was 54 cases per 100,000 males compared to 88

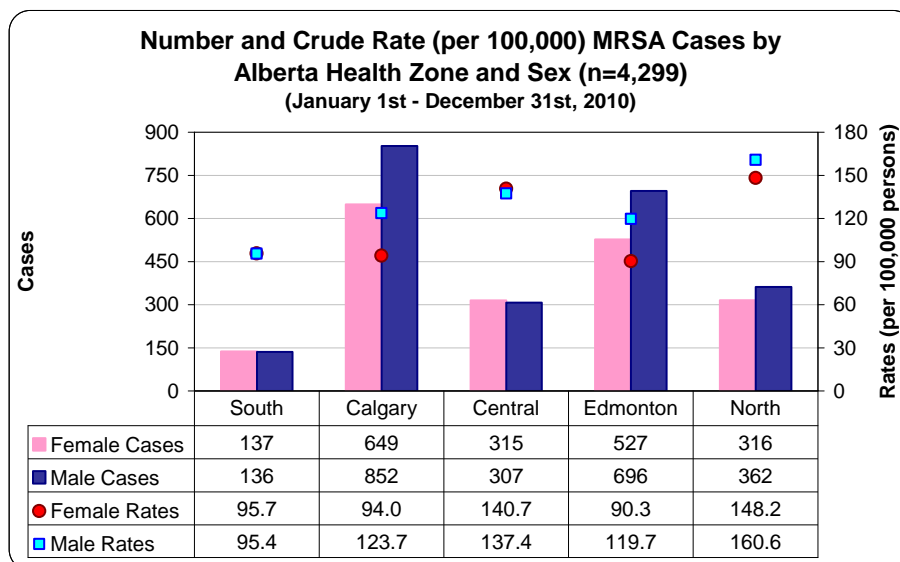
cases per 100,000 females. Both males and females aged 70 years or older had MRSA rates about double or more compared to those from other age groups (Figure 8).

Figure 9



In 2010, MRSA rates differed among health zones. The North zone had the highest rate (155 cases per 100,000 persons) while the South zone had the lowest rate with 96 cases per 100,000 persons. The MRSA rates in Calgary and Edmonton health zones were similar to each other (109 cases vs. 105 cases per 100,000 persons, respectively) (Figure 9).

Figure 10

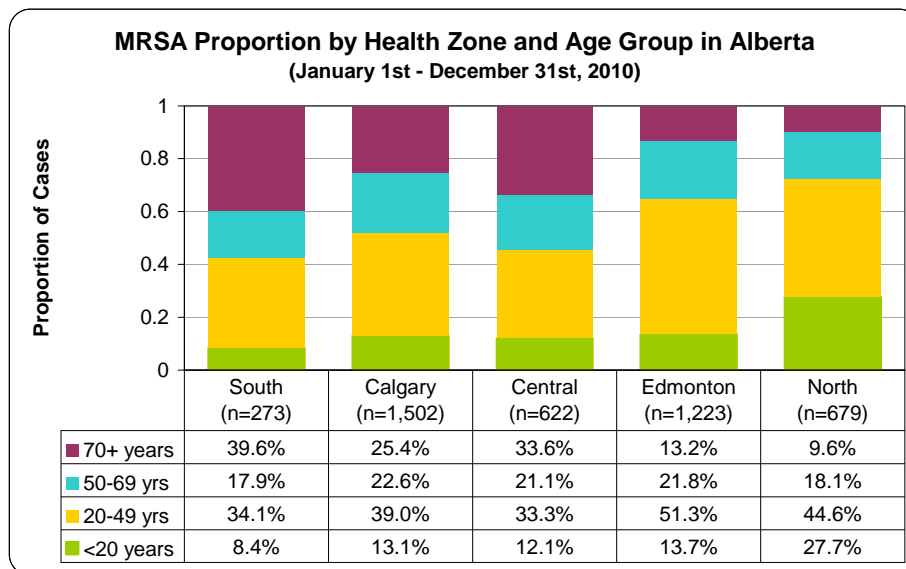


There was also a discrepancy of MRSA rates between females and males in Calgary and Edmonton health zones (female rate was about 76 per cent of male rate – Figure 10) which was not apparent in the other zones.

Figure 11 showed that within health zones in 2010, the number of MRSA cases increased with age. There were more cases for the South, Calgary, and Central zones, but not for Edmonton and North zones.

The highest proportions of MRSA cases for South, Central, and Calgary health zones were in those 50 years of age and older (Figure 11). The highest proportions of MRSA infection for Edmonton and North zones were in the age group of 20 to 49 years with 51 per cent (627/1,223 cases) and 45 per cent (303/679 cases), respectively. The North zone had 28 per cent of cases younger than 20 years of age.

Figure 11



Of the 4,299 MRSA cases in 2010, CMRSA 2 (typically Hospital Associated) accounted for 26 per cent (1,103/4,299 cases), CMRSA 10 (typically Community Associated) 56 per cent (2,398 /4,299 cases), and the other MRSA strains made up the remaining 18 per cent of cases.

For CMRSA 2, those 70 years and older had the highest rate and percentage of CMRSA 2 cases (228/100,000 or 71.7 per cent). Among these cases, with information gathered from patient location codes there were:

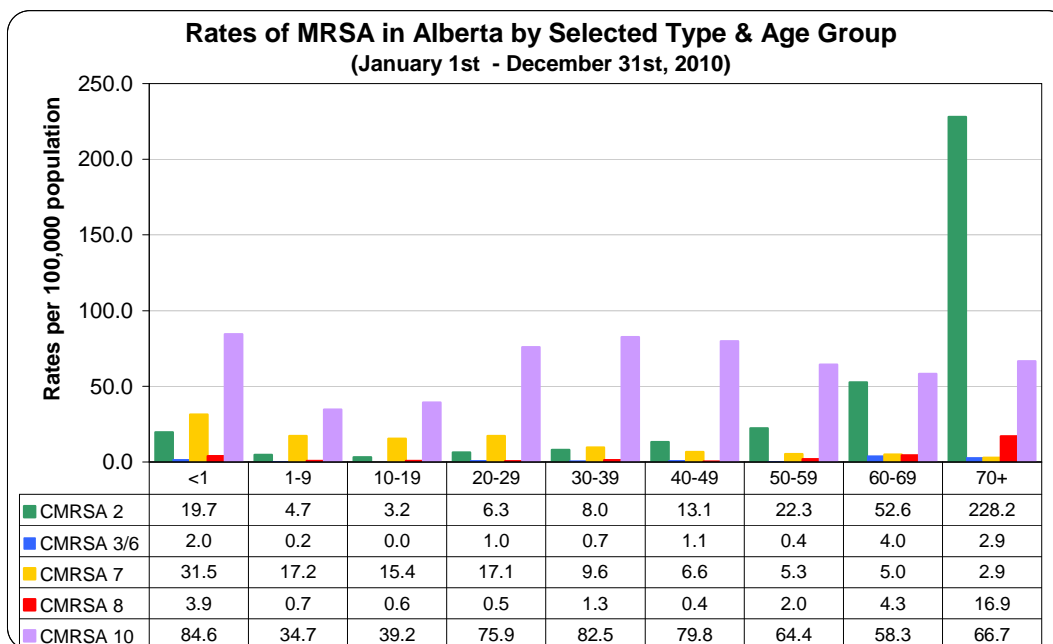
- 83.3 per cent (659/791 cases) from healthcare settings (i.e. clinic, drop in centre, hospital, emergency, inpatient, outpatient, dialysis, and IV therapy),
- 13.4 per cent (106/791 cases) from long term care,
- 3.3 per cent from other or unknown.

In 2010, the break down of 93 CMRSA 2 cases from long term care showed that just over half of the cases (55/93 cases) were from the major cities in southern Alberta. The distributions were as follows:

- 32.3 per cent (30/93 cases) in Calgary,
- 17.2 per cent (15/93 cases) in Lethbridge,
- 10.8 per cent (10/93 cases) in Medicine Hat, and
- 39.7 per cent (37/93 cases) in 21 other municipalities of Alberta.

The rates of MRSA per 100,000 persons by age groups and MRSA types for 2010 are shown below in Figure 12.

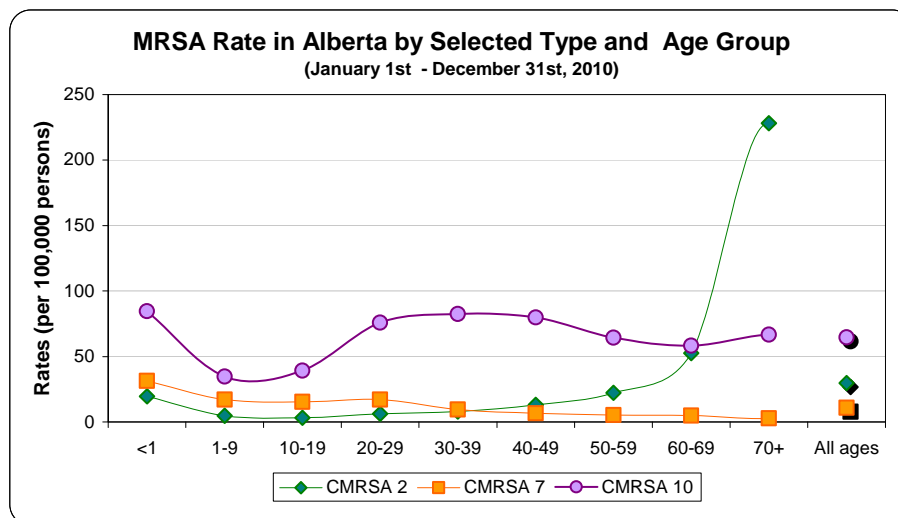
Figure 12



For the 2,398 CMRSA 10 cases, the highest proportion was in the 30 to 39 years age group with 19 per cent (455/2,398), followed by the second highest of the 18.5 per cent (455/2,398) in 40 to 49 year olds.

The provincial rate for CMRSA 10 was 65 cases per 100,000 persons. Children between one and nine years of age had the lowest rate (35 cases per 100,000 persons). The highest rate was 85 cases per 100,000 persons in those less than one year (Figure 13).

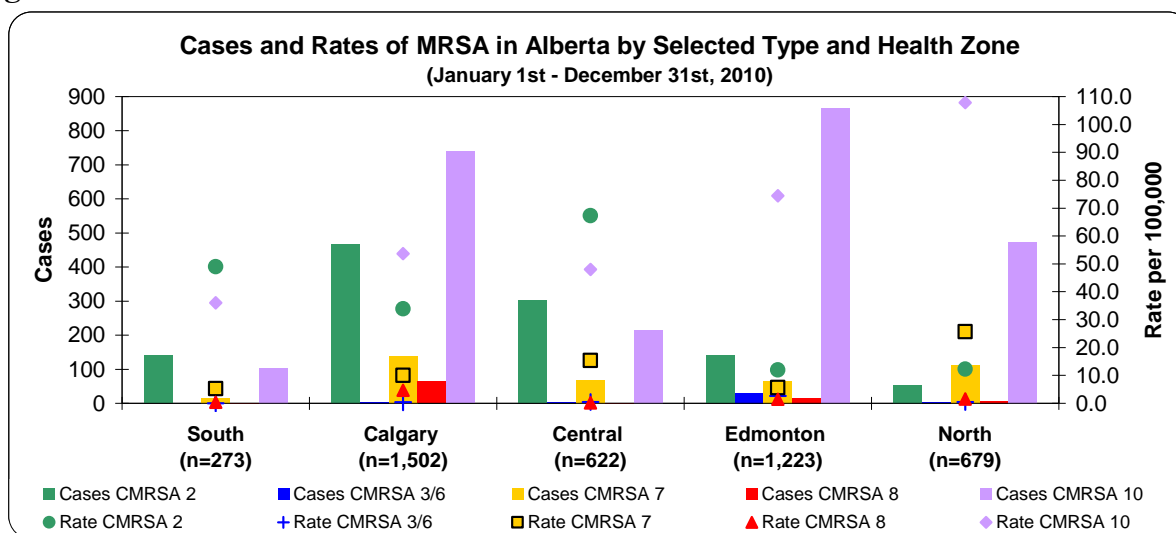
Figure 13



In 2010, the provincial rate for CMRSA 2 was 30 cases per 100,000 persons. All groups of patients aged less than 60 years had rates below its provincial rate, the rate of the age group of 60 to 69 was higher, while the age group of 70 and older was significantly higher. Persons 70 years of age and older had the highest rate of 228 cases per 100,000 persons, which was 7.7 times greater than the provincial rate (228.2 vs. 29.7 cases) or almost 71.3 times greater than the lowest rate of CMRSA 2 in the age group 10 years to 19 years (228.2 vs. 3.2). In other words, people aged 70 years or more, have a much higher risk of the CMRSA 2 infection than younger people.

In comparison, younger persons had higher rates of CMRSA 7 than older people. For people younger than 30 years, the rates of CMRSA 7 were higher than the provincial average rate (17.1 cases vs. 10.8 cases).

Figure 14



In 2010, the rates and number of cases of CMRSA by types differed among the health zones (see Figure 14 and Table 1).

- The highest rate of CMRSA 2 was 67 cases per 100,000 persons in Central.
- The highest rate of CMRSA 10 was 108 cases per 100,000 persons in North.
- CMRSA 7 was highest in North with about 26 cases per 100,000 persons.

Table 1: MRSA Rates (per 100,000) in Alberta by Selected Type and Health Zone, 2010

Health Zone	CMRSA 2	CMRSA 3/6	CMRSA 7	CMRSA 8	CMRSA 10	NOT ASSIGNED	OTHER CMRSA	ALL TYPES
South	49.0	0.0	5.3	0.4	36.1	4.9	0.0	95.6
Calgary	33.9	0.4	10.1	4.6	53.7	4.9	1.4	108.9
Central	67.3	0.4	15.4	0.2	48.1	6.7	0.9	139.0
Edmonton	12.0	2.7	5.7	1.5	74.4	8.1	0.7	105.0
North	12.3	0.5	25.8	1.6	107.8	6.4	0.5	154.8
ALBERTA	29.7	1.1	10.8	2.4	64.5	6.3	0.9	115.7

Figure 15

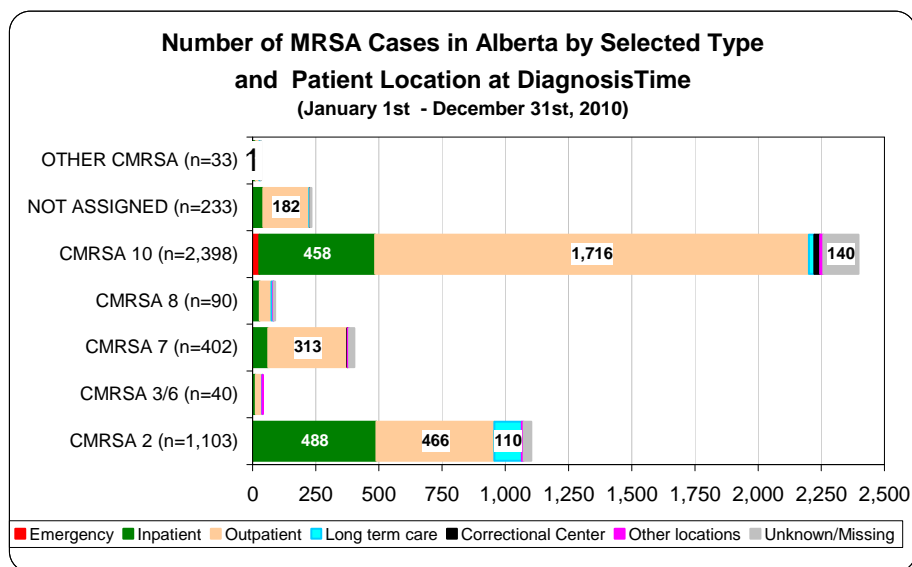


Figure 15 and Table 2 show the patient locations of MRSA infected cases in 2010 (n=4,299):

- 64.3 per cent outpatients,
- 26.4 per cent inpatients (includes emergency),
- 3.4 per cent from long term care, and
- 5.9 per cent from other patient locations (includes correctional centres).

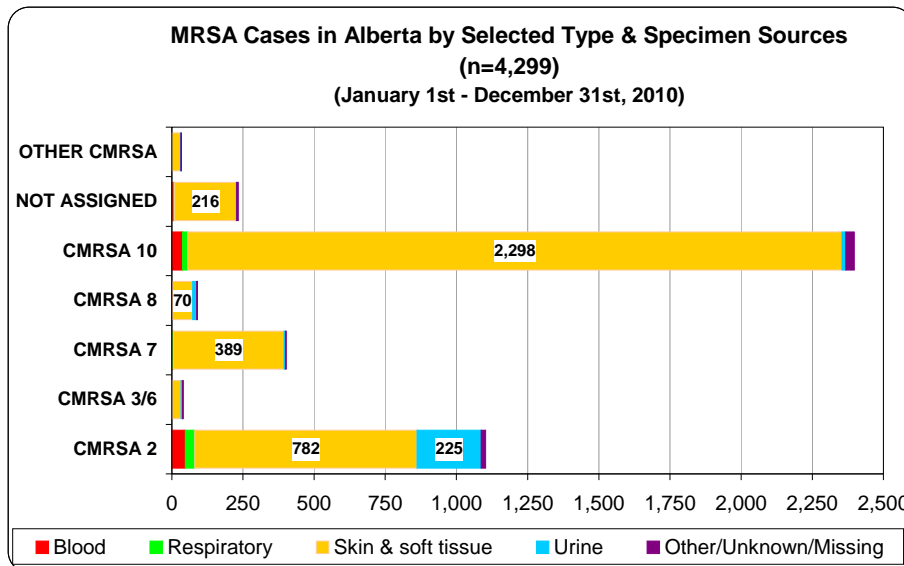
The break down of MRSA cases by type and the four groups of patient locations at time of diagnosis (inpatient & emergency, outpatient, long term care, and others) is shown below in Table 2.

Table 2: MRSA Proportions in Alberta by Selected Type and Patient Location, 2010

Patient Location	CMRSA 2 (n=1,103)	CMRSA 3/6 (n=40)	CMRSA 7 (n=402)	CMRSA 8 (n=90)	CMRSA 10 (n=2,398)	NOT ASSIGNED (n=233)	OTHER CMRSA (n=33)	ALL CMRSA (n=4,299)
Inpatient & Emergency	44.4%	32.5%	15.4%	32.2%	20.2%	18.0%	36.4%	26.4%
Outpatient	42.2%	62.5%	77.9%	51.1%	71.6%	78.1%	45.5%	64.3%
Long term care	10.0%	2.5%	0.0%	8.9%	0.9%	1.3%	12.1%	3.4%
Others	3.4%	2.5%	6.7%	7.8%	7.3%	2.6%	6.1%	5.9%
TOTAL	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Figure 16 shows the majority of MRSA infections were found in the skin and soft tissue specimens (88.8 per cent or 3,816/4,299 cases). Urine specimens accounted for the next largest proportion of cases (6.2 per cent or 267/4,299 cases). Other specimen sources included blood (2.3 per cent or 97/4,299 cases), respiratory (1.4 per cent or 59/4,299 cases), and other specimens/unknown (1.4 per cent).

Figure 16



APPENDIX

Glossary

Carrier:

An individual who is found to be persistently colonized (culture positive) for a particular organism, at one or more body sites, but has no symptoms of infection.

Colonization:

Occurs when bacteria are present on or in the body without causing illness. MRSA can colonize the nose, skin and moist areas of the body.

Infection:

Occurs when bacteria get past the person's normal defenses and cause disease (e.g., skin bacteria getting into the bloodstream via an intravenous catheter). Infections with MRSA may be minor, such as pimples and boils, but serious infections may also occur, such as surgical wound infections and pneumonia.

Methicillin Resistant *Staphylococcus aureus*:

Staphylococcus aureus isolates that carry the *mecA* gene, or that produce PBP 2a (the *mecA* gene product), should be reported as oxacillin / methicillin resistant. If MIC tests are performed, isolates with an oxacillin MIC > 4 µg/ml are resistant to oxacillin / methicillin.

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