Community Acquired Methicillin Resistant *Staphylococcus Aureus* (CA MRSA) In Alberta

(EI) #286 Provincial Outbreak Investigation
June 1, 2005 – February 28, 2006

Data Analysis Report

Public Health Division
Alberta Health and Wellness
October 2006

For additional copies or more information contact:

Disease Control and Prevention
Alberta Health and Wellness
23rd Floor, Telus Plaza North Tower
10025 Jasper Avenue
PO Box 1360 STN MAIN
Edmonton, Alberta T5J 2N3
CANADA

Phone: 1 (780) 644-7108
Fax: 1 (780) 422-6663

Provincial Health Office
Alberta Health and Wellness
24th Floor, Telus Plaza North Tower
10025 Jasper Avenue
PO Box 1360 STN MAIN
Edmonton, Alberta T5J 2N3
CANADA

Phone: 1 (780) 415-2823
Fax: 1 (780) 427-7683

Table of Contents

BACKGROUND 1

INTRODUCTION 3

LITERATURE REVIEW 4

METHODS 7
- Case Definition 7
- Variable Definitions 7
- Data Flow 7
- Data Analysis 8

RESULTS 9
- MRSA in Alberta 9
- CMRSA 10 9
- Geographical Distribution 10
- Age and Gender Distribution 13
- Specimens Collected by Month 14
- Clinical Specimen Site 14
- Severity of Illness 15
- Special Populations 15
  - Children 15
  - Calgary Remand Centre 16
  - Linked Cases 17
  - CMRSA 10 Cases 17
- CMRSA 10 Non - Cases 19
- CMRSA 10 Lost to Follow - up Cases 20

DISCUSSION 21
- CMRSA 10 in Alberta 21
  - Geographic Distribution 21
  - Age and Gender 23
  - Specimen Site 23
  - Severity of Illness 23
  - Children 24
  - Incarceration 24
  - Remand Centre 24
  - Linked Cases 24
- CMRSA 10 Cases 25
- CMRSA 10 Non - Cases 26
- CMRSA 10 Lost to Follow - up Cases 26
- Completion of CMRSA 10 Case Reports 27
- Strengths 27
- Limitations 27
- Conclusions 29

REFERENCES 31

APPENDIX A: VARIABLES AND COMMUNITY DATA FORM 33

APPENDIX B: MRSA ISOLATE SUBMISSION FORM 39

APPENDIX C: MRSA TYPING NOMENCLATURE 40

Background

Staphylococcus aureus is a common bacterium that colonizes the skin and anterior nares. Approximately 30 per cent of the healthy population are asymptomatic carriers. The bacteria are spread primarily through direct person to person contact with a colonized or clinically infected individual[1]. *S. aureus* can cause mild local skin infections but can also cause boils and more serious invasive infections in some cases.

Methicillin resistant S*taphylococcus aureus* (MRSA) is the term for *S. aureus* bacteria that have become resistant to semi - synthetic penicillins such as cloxacillin and methicillin. MRSA can also acquire resistance to multiple classes of antibiotics and multi - drug resistant strains have become widespread[2]. In comparison with infections due to methicillin sensitive *Staphylococcus aureus* (MSSA), infections due to MRSA are associated with significantly higher mortality and costs[3]. One study designed to evaluate the impact of asymptomatic MRSA colonization on the development of subsequent MRSA infection found that MRSA colonization at admission increased the risk of subsequent MRSA infection (19 - 25 per cent), compared with MSSA colonization (two per cent)[4]. MRSA has traditionally been seen in people who are taking antibiotics and in those receiving hospital or medical care. In the last several years MRSA has begun to appear in people with no association to the health care system.

An increased number of MRSA associated skin infections in individuals with a history of illicit drug use, recent incarceration or homelessness were reported May to July 2004 within the Calgary Health Region (CHR). Pulse field gel electrophoresis (PFGE) identified the strain involved in the majority of the infections as the USA 300 strain, known in Canada as CMRSA 10*****; the same strain linked to community onset soft tissue infections outbreaks in the U.S. This was the first reported outbreak of CMRSA 10 in Canada[5]. Outbreaks have been previously documented in populations such as aboriginal communities, prisoners, drug - using and homeless populations.

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) and behavioural (e.g., sharing drug paraphernalia)[6]. The transmission factors have been termed the five C's: cleanliness, crowding, contact, sharing contaminated items and compromised skin[13].

MRSA infections are more difficult to treat than MSSA infections and common first - line drugs for treatment are less effective. This may lead to a delay in initiating correct treatment and can prolong the course of infection[6].

Of particular concern is the potentially severe nature of CMRSA 10 infection and the possibility CMRSA 10 could be spreading to other populations within and outside of the CHR. In the initial CHR outbreak, 93 per cent presented with moderate to severe skin infections, five per cent presented with musculoskeletal infections and one case presented with a rapidly progressing hemorrhagic pneumonia and died of respiratory failure. Also of note, 28 per cent required outpatient intravenous therapy and 18 per cent required hospitalization due to their infection. In addition, 35 per cent of the cases in the CHR cluster met the traditional definition of nosocomial - acquired infection, raising the concern of this strain spreading in the hospital setting[1].

***** Note: the terms CMRSA 10 and CA MRSA look similar; however, CMRSA 10 refers to a unique PFGE typing designation assigned by the National Microbiology Laboratory (NML) in Canada (Appendix C) and CA MRSA refers to Community Acquired or Community Associated MRSA.

A subsequent prevalence study of the CMRSA 10 outbreak was completed by the CHR to:

(1) Measure prevalence of colonization and/or infection with the CMRSA 10 strain of MRSA and

(2) determine demographic, environmental, social, behavioural factors associated with colonization and/or infection.

The study found that residence in community group - living, residence - in - jail, cocaine (crack) use, borrowing used needles or injection equipment and observed levels of hygiene were not significantly associated with colonization with CMRSA 10. The study also found that prevalence of colonization and/or infection with CMRSA 10 was 5.5 per cent (published nasal colonization studies three to 10 per cent)[6].

Alberta Health and Wellness (AHW), the Provincial Public Health Laboratory (PPHL) and regional health authorities (RHAs) set up the Community Acquired MRSA in Alberta Exposure Investigation (EI) #286 to investigate the epidemiology of CMRSA 10 in Alberta due to:

- the high rate of MSSA colonization and the theoretical transmission risk of MRSA virulence factors,
- increased CMRSA 10 prevalence,
- increased infection with CMRSA 10 in an “at risk” population, and
- possible spread into hospital settings.

Introduction

The provincial outbreak investigation of community acquired methicillin resistant *Staphylococcus aureus* (CA MRSA) in Alberta started June 1, 2005 (prospective phase).

Public Health investigation of CA MRSA in Alberta (EI) #286 was carried out for the following reasons (per *Community Acquired MRSA in Alberta Exposure Investigation (EI) #286 Provincial Outbreak Investigation Protocol*, July 29, 2005):

1. There was evidence of spread of the CMRSA 10 strain outside of the CHR.

2. It was important to determine the extent of the outbreak provincially.

3. The chief medical officer of health (CMOH), through AHW, has responsibility to investigate provincial outbreaks.

4. There was a risk of CMRSA 10 spread into the general population and hospitals. Further, there was a risk that CMRSA 10 may become endemic, resulting in significant socioeconomic consequences.

5. Outbreak information can guide preventative public health measures for at risk populations. For example, information on hand hygiene, wound care, and advice to seek medical attention could be distributed to at risk populations.

6. Surveillance data would assist hospital infection prevention and control (IPC) personnel to direct resources towards early identification and isolation of infectious patients.

7. Timely epidemiologic information for clinicians may improve care of those with CA MRSA though earlier identification, collection of appropriate specimens and prompt initiation of appropriate therapy.

8. Improved IPC practices may be of benefit to control the outbreak and prevent ongoing transmission within the community.

Literature Review

Community acquired methicillin resistant *Staphylococcus aureus* (CA MRSA) is an increasingly prevalent pathogen among patients without established risk factors for MRSA infection. CA MRSA strains are genetically different than hospital acquired MRSA (HA MRSA), can cause severe infection, generally have greater antibiotic susceptibility and are well adapted for survival and spread within the community[7]. The Classification of CA MRSA and HA 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 HA MRSA or CA MRSA.

Common molecular characteristics of isolates associated with CA MRSA are detailed below.

- Carriage of the virulence factor Panton - Valentine Leukocidin (PVL) determinant that is associated with primary skin infections and pneumonia[1].
- Staphylococcal Chromosomal Cassette (SCCmec) Type IV element (a mobile genetic element that codes Methicillin resistance)[1].
    - The mec A gene is located on a mobile element, SCCmec, on the chromosome of MRSA[8].
    - To date there have been several types of SCC types identified. SCC Type I to SCC Type III have been associated with hospital acquired strains that tend to be more multi - resistant to antibiotics. SCC Type IV and V have been associated with community - acquired strains that tend to be more susceptible to antibiotics than hospital acquired strains[9].
    - It is theorized that the smaller size of the SCCmec Type IV may serve as an evolutionary advantage by making them more amenable to horizontal spread among a bacterial population[9].
    - It is thought that acquisition of the SCCmec IV element by methicillin sensitive *Staphylococcus aureus* (MSSA) in the community has given rise to the emerging CA MRSA strains[10].
    - Commensal staphylococcal strains may act as a reservoir for antibiotic resistance islands that may be transferred to *S aureus*. The SCCmec Type IV was prevalent in isolates of Staphylococcus epidermidis from the 1970's, and was rarely described in *S aureus* isolates prior to 1990. Three other SCCmec elements that contain genes encoding biosynthetic enzymes for capsular polysaccharides have been identified in MSSA, S. epidermidis and S. hominis strains[10]. Extensive horizontal spread is suggested due to the similarity of SCCmec Type IV and those found in S. epidermidis[6].

It also has been postulated that the combination of the mec A gene and the PVL gene have created a super adaptable *S. aureus* strain capable of rapidly spreading through the community[14].

It is inferred that CA MRSA can penetrate intact skin. There may be a risk from *S. aureus* even in immune competent people with intact skin and this risk may be greater with the increased toxins in the newer CA MRSA strains. Although infections usually occur as a result in a break in the skin's integrity, they may also occur from hematogenous spread from a distant source[10].

Additional characteristics of CA MRSA that promote penetration of *S. aureus* into host tissues that are being investigated include[10]:

- An increased ability to adhere to epithelial cells than other MRSA strains.
- A higher tolerance to salt than nosocomial MRSA strains enhances the ability to survive as skin flora.
- Collagen - adhesin protein (CNA), encoded by the cna gene, is a virulence factor associated with S. aureus adherence to epithelium and may have a role in colonization or invasion of airways. CNA is a microbial surface component that recognizes adhesive matrix molecules the majority of S. aureus strains do not express.
- PVL contact with neutrophils, monocytes, macrophages and erythrocytes results in pore formation and cell lysis by osmotic rupture thus promoting tissue necrosis.

Most frequently involving skin and soft tissue infections, spread of CA MRSA is primarily through direct person - to - person contact with a colonized or clinically infected person. Self infection (from nares to a break in the skin) is also common[1]. People with draining skin lesions or purulent infections are more infectious and have been associated with epidemic spread[1]. CA MRSA outbreaks are often detected as clusters of abscesses or "spider bites" and have occurred in various settings including: sports participants (football players, wrestlers, fencers), correctional facilities (prisons, jails), military recruits, daycare and other institutional centres, newborn nurseries and in men who have sex with men (MSM)[13]. These patients are often healthy individuals with no known risk factors for HA MRSA acquisition[13].

The unique toxins and virulence factors associated with CA MRSA can inflict severe clinical syndromes such as septic shock, complicated skin and soft tissue infections and necrotizing pneumonia. Influenza or influenza like prodromes may precede necrotizing pneumonia due to MRSA. Outbreaks have been reported in the United States, Canada, Europe, Finland, Saudi Arabia, India, Asia, Australia, and New Zealand. An outbreak in Minnesota and North Dakota (1997 - 1999) resulted in four paediatric deaths from infection that progressed to pneumonia and septicaemia in previously healthy children[14].

MRSA has been observed sporadically as a community acquired pathogen in Canada over the past decade[15]. According to information collected by the Canadian Nosocomial Infection Surveillance Program (CNISP), 85 per cent of MRSA in Canada is hospital acquired, but CA MRSA strains have occasionally been seen in hospitals, particularly in aboriginals residing in western provinces[16]. One of the earliest Canadian reports of CA MRSA was in an Alberta First Nations community. A retrospective 1990 - 1992 survey of teaching hospitals in the Canadian prairies identified First Nations patients as accounting for 62 per cent of those who were MRSA positive on admission to hospital[17]. In east central Saskatchewan the emergence of a community associated MRSA strain, CMRSA 7 (USA 400 strain), was documented from 1999 - 2002. In that study, a large cluster of cases emerging after 2000 were primarily identified from patients presenting at local health clinics or nursing stations from surrounding communities. Most (73 per cent) of the community health centre cases were from persons under 18 years of age[15].

The number of CA MRSA cases is on the rise in several locations in Canada[18]. An environmental scan of the territories and western provinces confirmed CA MRSA emergence as follows:

1. CA MRSA is being seen across British Columbia and there has been a marked increase in infection over the past year. While there are concentrations in some high risk

populations, infections are occurring among members of the general public with no identified risk factors. In some British Columbia areas CMRSA 10 is identified as the predominant PFGE group pattern[19].

2. In 2005, Yukon identified two cases requiring hospitalization of severe CMRSA 10 infections through positive blood culture. A third case had positive cultures for CMRSA 10 taken from infected skin lesions. Illicit drug use was a factor[20].
3. Saskatchewan has been conducting targeted MRSA surveillance for the past several years. The strain identified is predominantly CMRSA 7 and a high proportion of the cases are in aboriginal people. It is thought the CMRSA 7 strain moved from Minnesota to Manitoba and from there to mid Saskatchewan in an area north of major habitation[21]. The MRSA strain is now widespread in the province[22].
4. Manitoba routinely conducts PFGE of MRSA isolates received at the Cadham Provincial Laboratory (since 1995)[23]. Forty per cent of the isolates strain typed were designated CA MRSA and were comprised of at least two types - predominantly type C (CMRSA 7) and type E (CMRSA 1). Manitoba has found large clusters of CA MRSA in both non - aboriginal and aboriginal populations in northern Manitoba and in neighbouring communities in North Saskatchewan[23].

Recognized risk factors for CA MRSA infections include: previous positive MRSA cultures (history of colonization or past history of MRSA infection), host factors (young age, minority populations, chronic skin disease) and environmental factors (high prevalence of CA MRSA in community, contact with colonized pet/person, contact sports, overcrowding). When CA MRSA is identified in a community, antibiotic choice should be re - evaluated. Some experts advise when community rates of MRSA rise to 10 - 15 per cent, alternative empiric therapy should be considered[8].

Virulent strains of CA MRSA can quickly become predominant in a given area. A recent study (2004) of CA MRSA isolates in a children's hospital in Texas reported that the percentage of community acquired *S. aureus* isolates that were methicillin resistant increased from 33 per cent to 71.5 per cent from 2000 - 2002 and to 76.4 per cent in 2004. Sixty - two percent of these cases required hospitalization. The study demonstrated a greater increase for CA MRSA than for community acquired methicillin sensitive *Staphylococcus aureus* (CA MSSA) (2.2 fold versus 1.7 fold increase). Of note, musculoskeletal and pulmonary infections were the most common invasive infections caused by CA MRSA, whereas osteomyelitis, septic arthritis, bacteremia and lymphadenitis were found to be among the most common invasive infections caused by CA MSSA (invasive infections were defined as infections in the bloodstream, lymph nodes, mastoids, CNS, bones or joints, muscle, lungs or pleural fluid). Extensive infections of the epidural space overlying the spinal cord and other invasive infections were also found with greater frequency than had been apparent in the years preceding the surveillance study[24].

There is evidence that CA MRSA is becoming an important health problem associated with high morbidity and mortality. The changing epidemiology is similar to the emergence of penicillase - mediated resistance in *S. aureus* decades ago[12]. Within six years of staphylococcal resistance to penicillin, 25 per cent of hospital strains were resistant and within a further 10 to 20 years, 25 per cent of community strains were penicillin resistant. It is theorized that as MRSA rates increase in hospitals, a similar trend will be noted regarding community acquired MRSA[25].

There are several important clinical implications of the increase in CA MRSA including: treatment failure, infections caused by MRSA may be more difficult or expensive to treat, and the increasing prevalence of MRSA will increase Vancomycin use, adding to the problem of antibiotic resistance[12].

Methods

Case Definition[26]

For the purpose of (EI) #286 an individual is considered to have CA MRSA when the CMRSA 10 isolate is:

Identified by the Provincial Public Health Laboratory (PPHL) as CMRSA 10
AND
Present in a clinical isolate (exclude screening specimens)
AND
Meets one of the following conditions:

Present at admission to hospital
OR
Develops within 72 hours of hospital admission
OR
Isolate obtained from a community lab specimen
OR
Isolate referred by the office of the medical examiner.

The patient will be excluded from (EI) #286 if the follow - up investigation finds that the one of the following conditions are met:

Patient is a hospital transfer
OR
Patient is from Long Term Care (Facility/Institution)
OR
Patient previously identified as MRSA positive (within past 12 months)
OR
Patient hospitalized within the past 12 months.

Variable Definitions

To improve data accuracy, a variables and community data form was developed (Appendix A).

Data Flow

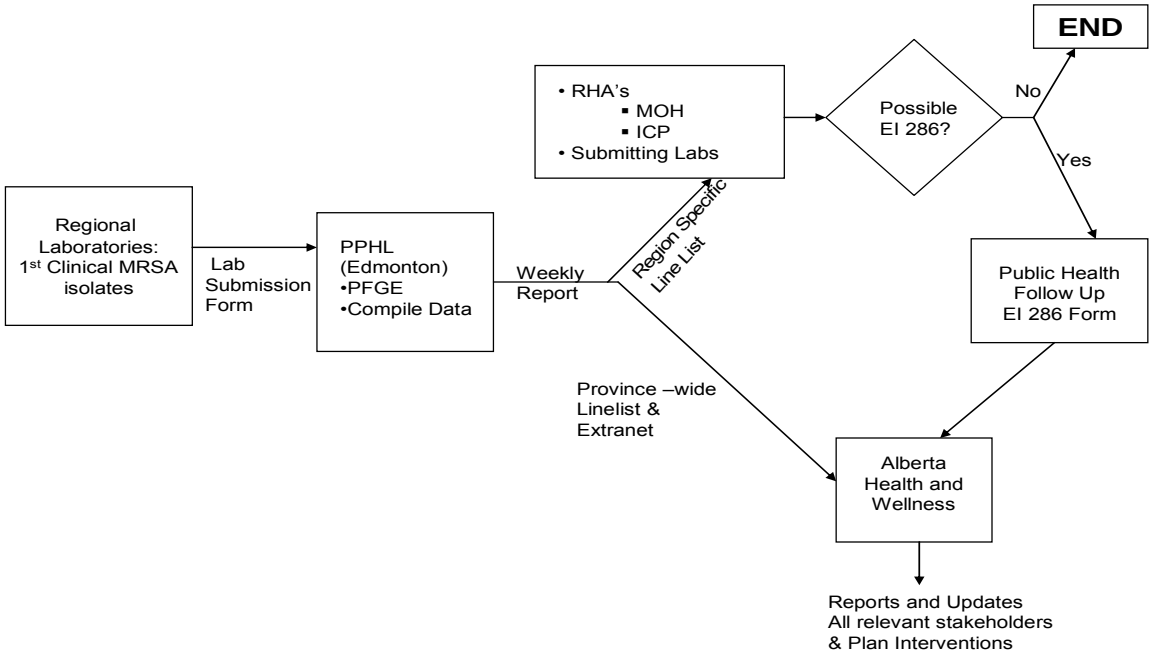
All first clinical MRSA isolates are submitted from the Alberta regional laboratories to the PPHL (Appendix B). The specimens (or data) are sent to the PPHL for PFGE and further laboratory analysis. The PPHL then creates RHA specific lists of individuals with MRSA. AHW receives a list of all of the MRSA cases in Alberta. Excel line lists were initially used to access the laboratory data and this was then replaced by the PPHL electronic viewing system.

At the provincial level all of the laboratory data was appended to an Access database that was created specifically for this outbreak investigation. Upon receipt of their line list from the PPHL, each RHA was to complete a case report form for all CMRSA 10 infected individuals and return the completed form to AHW. Upon receipt of the

completed case report form at AHW, each form was reviewed by the infection control professional and was then manually entered into the Access database.

The data received at AHW was routinely checked and verified to ensure data accuracy and consistency. Data was extracted for analytic purposes. The analytic software used was Statistical Package for Social Sciences (SPSS).

The following flowchart displays the dataflow for (EI) #286.



Data Analysis

Determination of Alberta cases was made based upon the city of residence of the individual infected with MRSA. If the city of residence was not reported the region that submitted the MRSA isolate was used as the RHA of residence. Individuals who were tested in Alberta, that do not live in the province, were excluded from analysis.

Surrogates for homelessness and incarceration were used if this data was not available (e.g., lost to follow - up cases). If the address on the laboratory submission was no fixed address or a homeless shelter, the individual was classified as homeless. If the isolate was submitted from a correctional facility, history of incarceration was classified as *yes*.

All rates included in this report use denominators that are based on the mid year population. This data may be stratified by age, gender, RHA or sub - RHA. Sub - RHAs were used in the geographic analysis of CMRSA 10. This allows for a more accurate determination of where cases of CMRSA 10 are occurring within an RHA. Specific sub - RHAs have been developed to meet the needs of the RHAs for both administrative and analytical purposes[27].

Results

MRSA in Alberta

Between June 1, 2005 and February 28, 2006 there were 1,321 individuals identified as MRSA positive, of which 1,282 (97 per cent) were Alberta residents. The remaining 39 individuals (three per cent) were primarily from Western Canada, British Columbia (15 cases), Saskatchewan (11 cases), Northwest Territories and Yukon (five cases), Manitoba (two cases) and Eastern Canada (six cases). The majority of Alberta residents infected with MRSA were infected with either CMRSA 2 (38.5 per cent) or CMRSA 10 (36.7 per cent).

Table 1.1 MRSA Types in Alberta Residents, June 1, 2005 - February, 28 2006

CMRSA Type	Number of Cases	Proportion of Cases (per cent)
CMRSA 10	**471**	**36.7**
CMRSA 1	1	0.1
CMRSA 2	493	38.5
CMRSA 4	3	0.2
CMRSA 5	1	0.1
CMRSA 6	66	5.1
CMRSA 7	88	6.9
CMRSA 8	18	1.4
NOT ASSIGNED	141	11.0
Total	**1282**	**100**

CMRSA 10

There were 471 individuals infected with CMRSA 10 between June 1, 2005 and February 28, 2006. Of these 471 individuals, AHW received 468 case reports. There are three categories of case definitions for CMRSA 10 infected individuals: meets the case definition, does not meet the case definition and lost to follow - up. Until a case report is received at AHW, the category for the infected individual is unknown.

Of the 468 case reports received, 176 (37.6 per cent) met the case definition, 88 (18.8 per cent) did not and 204 (43.6 per cent) were lost to follow - up. The case status for the remaining three individuals infected with CMRSA 10 is unknown.

Table 1.2 CMRSA 10 in Alberta by Regional Health Authority and Case Definition, June 1, 2005 - February 28, 2006

Regional Health Authority	Meets Case Definition	Does not Meet Case Definition	Lost to Follow - up	Unknown	Total Number of CMRSA 10
Chinook Health Region	3	2	2	0	7
Palliser Health Region	6	1	1	0	8
Calgary Health Region	80	39	131	1	251
David Thompson Regional Health Authority	9	5	6	1	21
East Central Health	0	0	1	1	2
Capital Health	63	33	43	0	139
Aspen Regional Health Authority	3	2	3	0	8
Peace Country Health	3	1	10	0	14
Northern Lights Health Region	9	5	7	0	21
Total	**176**	**88**	**204**	**3**	**471**

The basic demographics and other data for all 471 individuals infected with CMRSA 10 will be presented first. This will be followed by the results for individuals infected with CMRSA 10 that meet the case definition (cases), those that do not meet the case definition and those that are lost to follow - up.

Geographical Distribution

All of the RHAs have 10 or more MRSA cases from a first clinical isolate. Nearly half of all MRSA cases were identified in the Calgary Health Region. For the two urban regions (Calgary and Capital) between 40 to 50 per cent of identified CMRSA isolates are CMRSA 10. In addition, 21 of the 24 MRSA cases in Northern Lights Health Region are CMRSA 10, accounting for 87.5 per cent of their cases. The proportion of MRSA cases in an RHA that are CMRSA 10 varies widely from less than 10 per cent to over 85 per cent.

Table 1.3 MRSA and CMRSA 10 in Alberta by Regional Health Authority, June 1, 2005 - February 28, 2006

Regional Health Authority	Number of MRSA Cases	Number of CMRSA 10 Cases	Proportion of Cases that are CMRSA 10 (per cent)
Chinook Health Region	66	7	10.6
Palliser Health Region	46	8	17.4
Calgary Health Region	604	251	41.6
David Thompson Regional Health Authority	170	21	12.4
East Central Health	25	2	8.0
Capital Health	289	139	48.1
Aspen Regional Health Authority	27	8	29.6
Peace Country Health	31	14	45.2
Northern Lights Health Region	24	21	87.5
Total	**1282**	**471**	**36.7**

The Alberta provincial rate of CMRSA 10 is 14.9 cases per 100,000. The rates of CMRSA 10 are highest in the Northern Lights Health Region (28.5 cases per 100,000) and in the Calgary Health Region (21.4 cases per 100,000). Both the Northern Lights and Calgary Health Regions have rates of CMRSA 10 that are significantly higher than the provincial rate (Figure 1.1). The colouring of the error bars in Figure 1.1 represent whether or not the difference in the RHA rate is significantly different from the provincial rate. The colour legend for both Figure 1.2 and 1.1 is the same.

The distance between the point estimate of the rate and the coloured bars is one standard error. The distance from the point estimate of the rate to the top or bottom of the coloured bar is two standard errors. In general, those RHAs with a smaller population will tend to have a larger standard error than RHAs with a larger population.

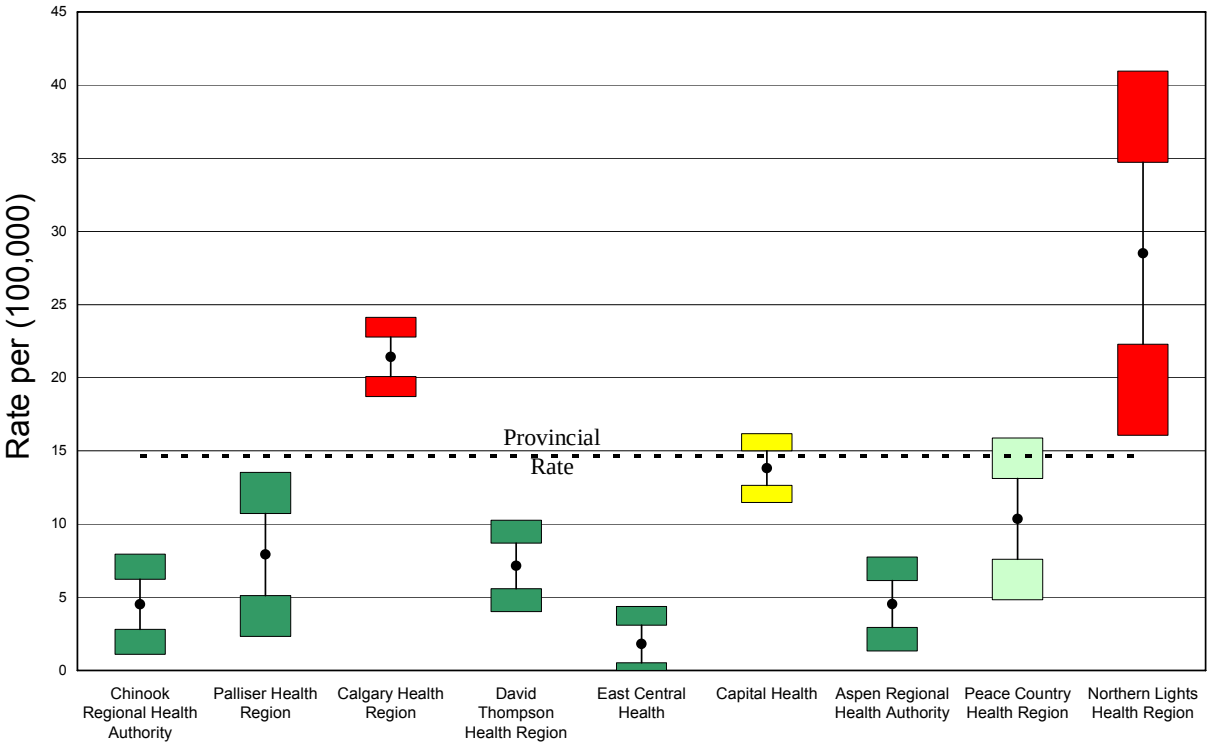
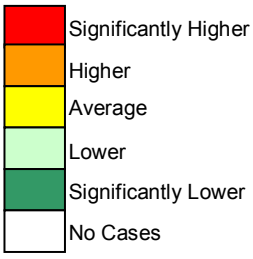


Figure 1.1 Regional Health Authority Specific Rates of CMRSA 10 and Alberta Provincial Rate, June 1, 2005 - February 28, 2006 (n=471)



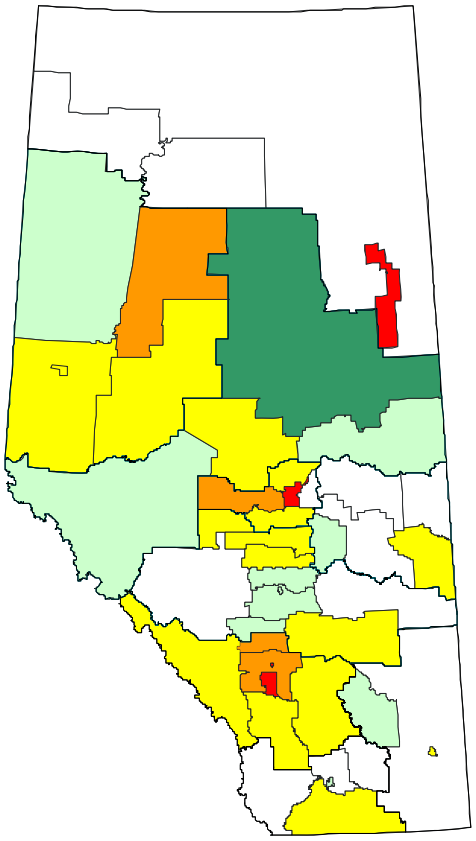


Figure 1.2 Rates of CMRSA 10 Cases compared to the Provincial Rate by Sub - Regional Health Authority, Alberta, June 1, 2005 – February 28, 2006 (n=454)

The rates of CMRSA 10 in the sub - RHAs are highly variable. The rate in Capital Health overall is not significantly higher than the Alberta rate, but the rate in the city of Calgary (25.9 cases per 100,000) remains higher than the Alberta rate.

Age and Gender Distribution

The median age of an individual infected with CMRSA 10 in Alberta is 35 years (age range: 11 months to 91 years). The age distribution is slightly skewed to the right, with 75 per cent of cases less than 44 years at diagnosis. This is significantly younger than for HA CMRSA types (CMRSA 2 was used as a surrogate for HA MRSA types) (Wilcoxon rank sum test statistic p=0.001).

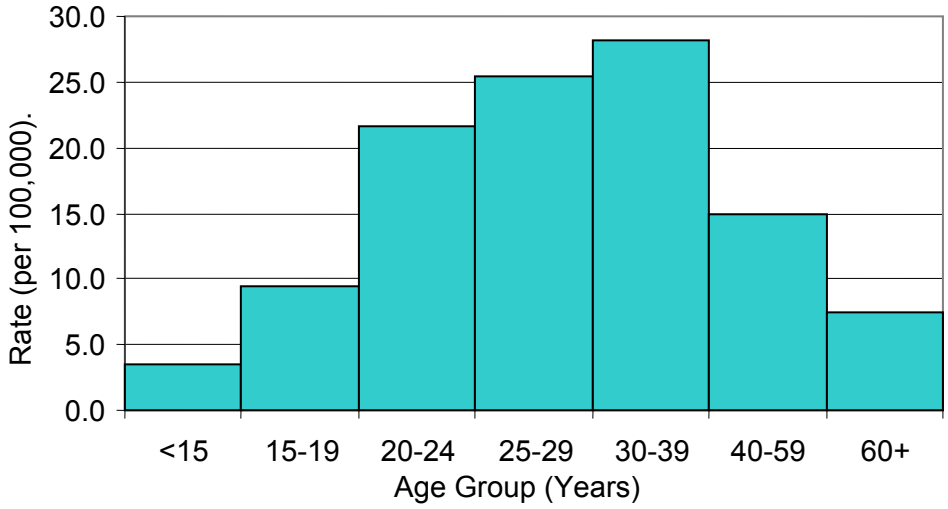


Figure 1.3 Age Distribution of CMRSA 10 Cases in Alberta, June 1, 2005 - February 28, 2006 (n=470)

There are more males than females infected with CMRSA 10 in Alberta. Sixty - six per cent of CMRSA 10 cases are males. The risk of CMRSA 10 infection is 1.9 (95 per cent; CI: 1.5 - 2.4) times greater for males than for females.

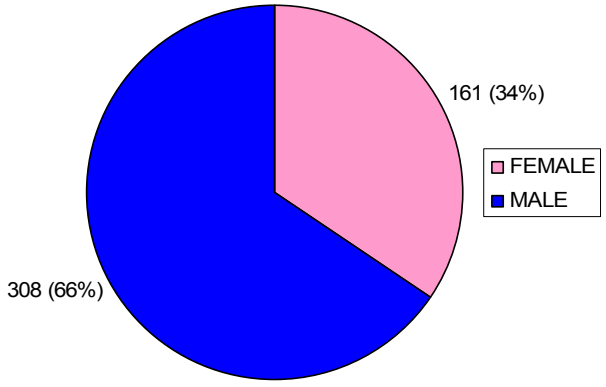


Figure 1.4: Gender Distribution of all CMRSA 10 Cases in Alberta, June 1, 2005 - February 28, 2006 (n=469)

Specimens Collected by Month

Based on the specimen collection date, the number of individuals infected each month with CMRSA 10 has increased between June 1, 2005 and March 31, 2006. On average, 3.1 additional cases were reported each month.

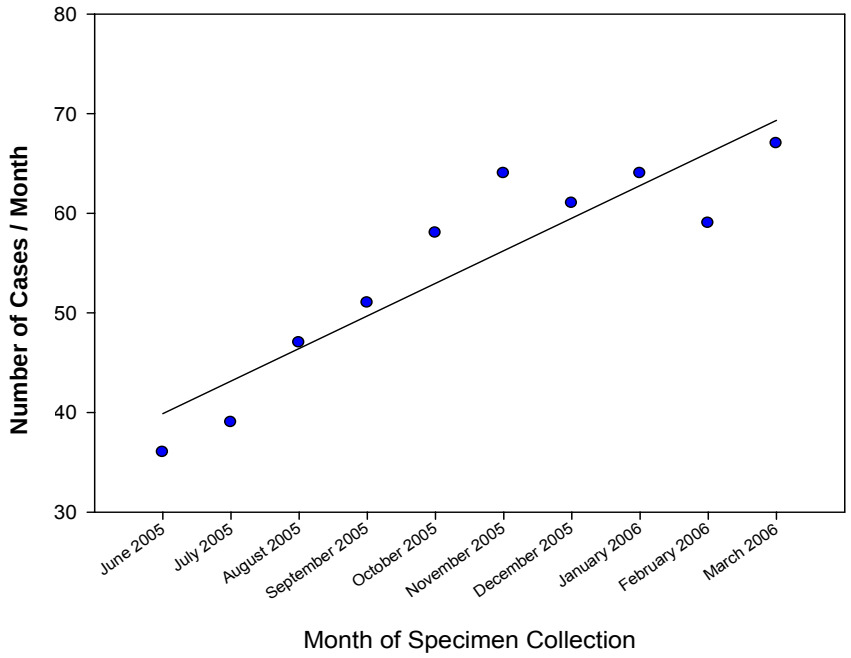


Figure 1.5 Distribution of CMRSA 10 Cases Over Time in Alberta, June 1, 2005 - March 31, 2006 (n=547)

Clinical Specimen Site

The majority of CMRSA 10 specimens were collected from soft tissue (434 cases, 92.1 per cent). There were 11 bacteremias and 12 respiratory specimens. There were seven surgical site infections and seven cases where the specimen collection site was reported as other or unknown.

Table 1.4 Specimen Collection Site for CMRSA 10 cases in Alberta, June 1, 2005 - February 28, 2006

Specimen Site	Number of Cases	Proportion of Cases (per cent)
Skin & Soft Tissue	434	92.1
Respiratory	12	2.5
Blood	11	2.3
Surgical Incision	7	1.5
Other	3	0.6
Unknown	4	0.8
Total	**471**	100.0

It is difficult to determine the portal of entry for the CMRSA 10 cases. Many case reports for individuals with skin and soft tissue infections report a small boil, pimple or red bump on the skin prior to a lesion or abscess forming. This information was not routinely collected, but was frequent among the comments on many of the case reports.

Severity of Illness

For those cases of CMRSA 10 that have a case report completed and not lost to follow - up (264 individuals), there are 49 individuals (18.6 per cent) that report being hospitalized as a direct result of their CMRSA 10 infection. The proportion of individuals that were hospitalized as a result of their infection that do not meet the case definition is higher (28.4 per cent, 25/88) than those who meet the case definition (9.7 per cent, 17/176) (Fischer's exact, p=0.0001).

Five deaths were reported among individuals that were infected with CMRSA 10 between June 1, 2005 and February 28, 2006. One of the deaths was related to CMRSA 10 pneumonia, two were bloodstream infections and two causes of death are unknown. Three fatal infections were nosocomially acquired in Alberta hospitals, though one patient was not an Alberta resident. Another death was related to CMRSA 10 infection (although the exact cause of death was not reported) and the death of the fifth individual appears not to be directly related to the CMRSA 10 infection.

Special Populations

Children

There were 62 children, under 15 years of age, infected with MRSA. Of these 62 children, 18 were infected with CMRSA 10, accounting for 29 per cent of children infected with MRSA. The proportion of children with CMRSA 10 is not higher than for other MRSA types. In fact, 15 of the 88 cases (17 per cent) of CMRSA 7 were among those less than 15 years of age. There were 13 cases of CMRSA 2

among children less than 15 years of age, accounting for 2.6 per cent of these cases.

Table 1.5 MRSA Cases in Children Less Than 15 Years of Age in Alberta, June 1, 2005 - February 28, 2006

MRSA Type	Number of Pediatric MRSA Cases	Total Number of MRSA Cases	Proportion of Pediatric Cases by MRSA Type
CMRSA 2	13	493	2.6
CMRSA 7	15	88	17.0
CMRSA 8	1	18	5.6
CMRSA 10	18	471	3.8
NOT ASSIGNED	15	141	10.6
All MRSA Types	**62**	**1211**	**5.1**

More than half of the children that tested positive for CMRSA 10 were between one and four years of age (10 / 18) and two children were less than one year of age at diagnosis. The remaining six children were between five and 14 years of age. All of the children had soft tissue infections and eight (44 per cent) reported having an abscess. Three CMRSA 10 infected children were hospitalized as a result of their infection.

The reported risk factors for MRSA acquisition varied widely and there was no common risk for all of the children. Some children had no risk factors, while others had multiple risk factors. There were four individuals that were lost to follow - up, and of the remaining 14 cases, there were four cases (28.5 per cent) with no known risk factors for CMRSA 10. Two cases had previous antibiotic use and two others had either direct contact with a health care setting or a health care worker. Three cases report travel (one case to California, one case to British Columbia and the other to both California and British Columbia). Two cases reported had a parent infected with MRSA prior to symptom onset in the child. Two cases attended daycare or preschool and it was assumed that all of the children five to 14 years of age (five cases) attended school.

Calgary Remand Centre

There were 73 cases of CMRSA 10 identified at the Calgary Remand Centre between June 1, 2005 and February 28, 2006. Of these cases, 69 (94.5 per cent) were soft tissue infections and the other four infection sites were unknown. The basic demographics were as follows: 70 per cent of cases were males (51 / 73), the mean age of infected individuals was 32.0 years of age and the ages of these individuals were normally distributed.

Fifty - eight cases identified at the Calgary Remand Centre were lost to follow - up (79.5 per cent), while 13 (17.8 per cent) met the case definition and two cases (2.7per cent) did not meet the case definition. Upon review of the few case reports, it was difficult to generalize about CMRSA 10 infected individuals identified at this institution.

Linked Cases

Approximately 10 per cent of individuals infected with CMRSA 10 report a link to an individual previously infected with MRSA (29/264). The MRSA type of the contact is not reported on any of the case reports, though nine of the linked individuals were in the database and had CMRSA 10. In addition, many case reports indicated that family members also had skin infections that were never tested, which preceded the reported MRSA infection.

CMRSA 10 Cases

The distribution of the 176 individuals infected with CMRSA 10 that meet the case definition (cases) was consistent with the distribution of all individuals infected with CMRSA 10 in the province. The greatest number of cases was in the Calgary Health Region, followed by Capital Health.

Table 1.6 CMRSA 10 Cases that Meet the Case Definition in Alberta, By Regional Health Authority, June 1, 2005 - February 28, 2006

Regional Health Authority	Number of CMRSA 10 Cases that Meet the Case Definition	Number of Cases with No Risk Factors for CMRSA 10	Proportion of Cases with No Known Risk Factor (per cent)
Chinook Health Region	3	1	33.3
Palliser Health Region	6	4	66.7
Calgary Health Region	80	17	21.3
David Thompson Regional Health Authority	9	2	22.2
East Central Health	0	0	0
Capital Health	63	30	47.6
Aspen Regional Health Authority	3	2	66.7
Peace Country Health	3	1	33.3
Northern Lights Health Region	9	2	22.2
Total	**176**	**59**	**33.5**

Fifty - nine (33.5 per cent) persons infected with CMRSA 10 that meet the case definition have no known risk factor for CMRSA acquisition. The proportion of cases with no known risk factor for CMRSA 10 acquisition is highest in Palliser and Aspen Health Regions (4/6 and 2/3 cases) followed by Capital Health (30/63). The Calgary Health Region has only 17 of 80 cases (21 per cent) with no known risk factor for CMRSA 10. The proportion of cases from the Calgary Health Region with no known risk factors is significantly lower than for Capital Health (X^2 = 11.0 Mantel–Haenszel corrected, p=0.001).

Table 1.7 Known Risk Factors for CMRSA 10 Among Cases in Alberta

Risk Factor*	Number of Cases (n=176)	Proportion of Cases (per cent)
Homeless	27	15.3
Incarceration	37	21.0
Drug Treatment Program (Detox)	18	10.2
Illicit Drug Use	48	27.3
Travel Outside of the RHA	64	36.4
Resident of a Group Setting (not a Correctional Facility)	10	5.7
Involved in Contact Sports	14	8.0
Recent Antibiotics	35	19.9
Contact of a Hospitalized Patient	10	5.7
Contact with Healthcare Facility	25	14.2

** see Appendix A for the variable definitions for risk factors*

There were several risk factors for which data was collected (Table: 1.7). The three most common risk factors were: travel outside of the RHA (36.4 per cent), history of illicit drug use (27.3 per cent) and incarceration (21.0 per cent). Thirty - seven (21.0 per cent) of the CMRSA 10 cases report travel as the sole risk factor for CMRSA 10 acquisition. Of the 64 travel cases, there were several that had traveled to multiple jurisdictions. The most common travel site was the United States, followed by travel within Alberta. There were 23 cases that do not report the location of travel.

Table 1.8 CMRSA 10 Cases With Recent Travel Outside RHA of Residence

Travel Location	CMRSA 10 cases that meet the Case Definition with Travel (n=64)
Alberta	13
British Columbia	7
Saskatchewan	3
Manitoba	3
Ontario	2
Quebec	1
United States	10
International	2
Location not stated	23

There were CMRSA 10 cases with multiple risk factors. Eighty - six cases (48.9 per cent) had at least two known risk factors for CMRSA 10 acquisition. In addition, there were 35 cases (19.9 per cent) that had at least two of the following risk factors: drug treatment (detox), history of illicit drug use, homelessness and history of incarceration. Of the 35 cases, 23 (65.7 per cent) were from the Calgary Health Region.

Incarceration was significantly more common in persons infected with CMRSA 10 that met the case definition in the Calgary Health Region than in Capital Health (Fischer's exact test, p=0.003). In the Calgary Health Region, 22 of the 80 cases (27.5 per cent) had a history of incarceration. In contrast, Capital Health reported five cases with a history of incarceration.

Comparisons between CMRSA 10 cases with no known risk factors for CMRSA 10 acquisition and those with risk factors indicate no significant differences for basic demographic data (i.e., age and gender distributions were not significantly different).

CMRSA 10 Non - Cases

The low proportion of individuals infected with CMRSA 10 that did not meet the case definition indicated that CMRSA 10 continues to be primarily a community acquired infection. Of the 88 individuals infected with CMRSA 10 that did not meet the case definition, 64 (72.7 per cent) were hospitalized in the previous 12 months. Fourteen individuals (15.9 per cent) were previously identified as MRSA positive, with four of the 14 cases also having been previously hospitalized in the past year. Four persons did not meet the case definition as they were hospital transfers and there were three more individuals that were long - term care residents. Nineteen individuals that did not meet the case definition had a recent antibiotic use (in the past two months).

Table 1.9 CMRSA 10 Non - Cases by Exclusion Criteria, June 1, 2005 - February 28, 2006

Exclusion Criteria	Number Excluded
Hospitalization in the previous twelve months	64
Previous MRSA Positive	14
Hospital Transfer	4
Long - Term Care Resident	3
Screening Specimen	7

The basic descriptive epidemiology of the CMRSA 10 cases that met the case definition and those who did not was very similar. Neither the age nor gender distribution was significantly different between those that met the case definition and those that did not.

CMRSA 10 Lost to Follow - up Cases

The largest proportion of individuals who were infected with CMRSA 10, 43.6 per cent (204/471) were lost to follow - up. Contact attempts by the RHA nurses were made three times in 32 cases (15.7 per cent) and another 68 cases (33.3 per cent) were contacted twice. The remaining 104 cases (51.0 per cent) were contacted once. There were 15 cases where the physician that submitted the MRSA isolate was contacted.

Those with CMRSA 10 that were considered lost to follow - up were not significantly different in age or gender distribution than those persons infected with CMRSA 10 that did and did not meet the case definition. The geographical distribution of persons infected with CMRSA 10 that were lost to follow - up was consistent with where the rate of CMRSA 10 was the highest. The rate of lost cases to follow - up was highest in the Calgary Health Region (11.2 cases per 100,000), followed by the Northern Lights Health Region (9.5 cases per 100,000). The proportion of CMRSA 10 infection individuals that were lost to follow - up was significantly higher in the Calgary Health Region compared to Capital Health (X^2 =5.9, p=0.01).

Table 1.10 CMRSA 10 and Lost To Follow - up Cases in Alberta by Regional Health Authority, June 1, 2005 - February 28, 2006

Regional Health Authority	Number of CMRSA 10 Cases	Number of Lost to Follow - up Cases	Proportion of CMRSA 10 Cases that are Lost to Follow - up (per cent)
Chinook Health Region	7	2	28.6
Palliser Health Region	8	1	12.5
Calgary Health Region	251	131	52.2
David Thompson Regional Health Authority	21	6	28.6
East Central Health	2	1	50.0
Capital Health	139	43	30.9
Aspen Regional Health Authority	8	3	37.5
Peace Country Health	14	10	71.4
Northern Lights Health Region	21	7	33.3
Total	**471**	**204**	**43.3**

Analysis of risk factors for those individuals infected with CMRSA 10 that were lost to follow - up is incomplete. There was no significant difference in history of homelessness (in the previous year) between those that were lost to follow - up and those that were cases and non - cases of CMRSA 10. Individuals lost to follow - up were significantly more likely to have been incarcerated than those that met the case definition and those that did not . (X^2 = 6.1 Mantel –Haenszel corrected, p=0.01)

Discussion

CMRSA 10 in Alberta

Geographic Distribution

The proportion of clinical infections with MRSA that were the result of CMRSA 10 in Alberta was not previously known. Although the previous outbreak of CMRSA 10 in the Calgary Health Region[1] was an indication of transmission in an urban setting, it was not known if this more pathogenic strain of MRSA would be found in all of the RHAs in Alberta.

Analysis of case counts over time (June 1, 2005 - February 28, 2006) indicated that the number of new CMRSA 10 cases identified each month had increased over the seven month investigation period. Although CMRSA 10 rates appear to be increasing for most RHAs, particularly in the Calgary and Capital Health

Regions, these increases were not equal across RHAs. The outbreak investigation did not commence until several months after the initial outbreak was reported in the Calgary Health Region. During this time CMRSA 10 infections may have spread throughout the province, alternately CMRSA 10 may have been present in other areas of the province and were simply detected first in the Calgary Health Region.

There was regional variation as to where CMRSA 10 infections were being detected. The two urban centres had the greatest number of cases, but the CMRSA 10 infection rate was significantly higher than the provincial rate in the Northern Lights and Calgary Health Regions. The high infection rate in the Calgary Health Region maybe the result of a detection bias as it was anecdotally reported that individuals with soft tissue infections were routinely tested due to increased physician awareness in the community. One support for this hypothesis was that despite nearly double the number of clinical cases of MRSA identified, the proportion of clinical MRSA infections that were CMRSA 10 in Capital Health was higher than the proportion in the Calgary Health Region. Unfortunately, with the information currently available, it is not possible to determine if a detection bias exists. In the Northern Lights Health Region, the small population size makes it difficult to determine if the risk of CMRSA 10 acquisition is higher in this region. The young and highly mobile population of the region makes determining the likely source of infection nearly impossible. There is no apparent cause for the high rate of CMRSA 10 in this region.

The seven rural regions had highly variable rates of CMRSA 10. In all rural health regions, except Northern Lights, the rate of CMRSA 10 was lower than the provincial average. In contrast, the rate in the Northern Lights Health Region was more than three times the provincial average. All of the RHAs had at least one case of CMRSA 10.

The regional distribution of cases by sub - RHA is of interest. It appeared that the areas most affected by CMRSA 10 were: the city of Calgary, the area immediately south of Calgary, the city of Edmonton, the city of Fort McMurray and the Peace River area. There were a small number of cases in the area around Anzac (in the Northern Lights Health Region) that caused the rate in that area to be significantly higher than the provincial rate of CMRSA 10, though the true risk in this area was not likely greater than for the rest of the province.

The southern part of the Calgary Health Region (including Okotoks, High River and Claresholm) had a rate of CMRSA 10 that was significantly higher than the provincial rate; indicating that despite the prevalence of CMRSA 10 in the inner city population in Calgary, there were also cases in the suburban and outlying areas of Calgary.

The four cases of CMRSA 10 in Peace River all appeared to be related to the Peace River Correctional Centre, accounting for the higher than expected rate of CMRSA 10 in this area. In the Northern Lights Health Region there were 19 individuals infected with CMRSA 10 with a reported address, and of these 19 cases, 15 were from the city of Fort McMurray. The population of Fort McMurray is young and there are many males that come to and from this city for work in the oil and gas industry. It was not clear from the small number of cases whether

these cases were long - term or temporary residents of Fort McMurray, or whether they acquired CMRSA 10 in the city or were simply diagnosed there.

Age and Gender

The young urban male is the typical person infected with CMRSA 10 in Alberta. Those who have been diagnosed with CMRSA 10 infections are significantly younger than those with CMRSA 2, a typical hospital acquired strain. This is expected as the majority of CMRSA 10 infections appear to be community acquired.

The significantly higher proportion of males that are infected with CMRSA 10 is of interest and the exact implication or cause is unknown. Poor hygiene and crowding are associated with CMRSA 10[28] and these two characteristics are common in correctional facilities and homeless shelters. The hypothesis that this may account for the higher proportion of males is reasonable, but unfortunately not verifiable with the data currently available.

The socioeconomic status of individuals infected with CMRSA 10 has not been estimated for this outbreak investigation. Previous literature suggests low socioeconomic status is associated with MRSA infections[29]. Marginalized and disadvantaged individuals are more common in urban centres. This may account for some of the higher rate of CMRSA 10 infections in urban settings.

Specimen Site

The CMRSA 10 isolates were most commonly collected from soft tissue wounds. This is consistent with previous literature that indicates CA MRSA infections are most likely to be soft tissue infections[1]. The most common site of soft tissue infection was the buttock area, which is a more common site of infection in MRSA soft tissue infection than MSSA soft tissue infections[30]. The reason for the high proportion in MRSA infections in the buttock area is unknown.

Several individuals infected with CMRSA 10 reported a pimple or small red bump at the site of infection. It is unclear if the “pimple” preceded the CMRSA 10 infection or if the CMRSA 10 bacteria were able to penetrate intact skin.

Severity of Illness

Approximately 15 per cent of individuals infected with CMRSA 10 were hospitalized as a result of their infection. A greater proportion of individuals infected with CMRSA 10 that do not meet the case definition are hospitalized due to the current CMRSA 10 infection than those that do meet the case definition. This is likely the result of a greater propensity for underlying illness among those who have known risk factors for MRSA acquisition such as previous hospitalization or being a resident of a long term care facility than the general population.

The five deaths related to CMRSA 10 infection are of particular concern due to the possibility of nosocomial acquisition of CMRSA 10 in three of the cases. These are the first reported deaths linked to nosocomial acquisition of CMRSA 10 in Alberta though previous reports suggest that CMRSA 10 (USA 300) has been found in hospitals in the United States[3131]. Since CMRSA 10 is usually community acquired and can be a severe infection, it is of concern that this organism could be circulating in hospitals.

Children

There were 62 MRSA infections among children less than 15 years of age. Thirteen of the 62 MRSA infections were CMRSA 2, indicating that most of the cases were likely community acquired. There were 18 CMRSA 10 infections among children. The small number of children infected with CMRSA 10 made any generalization of the risk factors impossible. Only two of the children were reported as attending daycare. Schools and daycares had previously been reported as sites of MRSA outbreaks[32]. The information from the case reports of the 18 children infected with CMRSA 10 did not identify whether any of them acquired it from or transmitted it to the school or daycare setting.

Incarceration

There were cases reported from correctional facilities throughout the province. Apart from the Calgary Remand Centre, the number of individuals infected with CMRSA 10 in each setting was small and may not have been consistently reported to AHW. There is consistent testing of all open wounds on those entering correctional facilities in the province[33].

Previous history of incarceration was reported on the case report form for this outbreak investigation, but the location of incarceration was not. This makes it difficult to model the location or time of acquisition of CMRSA 10.

Remand Centre

There was a significant proportion of individuals infected with CMRSA 10 reported from the Calgary Remand Centre. There were 73 individuals where CMRSA 10 infection was detected while they were at the Calgary Remand Centre. A likely reason for the high number of cases in the seven month period was the testing practice of the Calgary Remand Centre. A specimen was collected from any individual that presented at the facility with evidence of a soft tissue infection or wound. This testing upon arrival indicates that many of these infections were being acquired outside of the Calgary Remand Centre; what remains unclear is the transmission rate within the facility.

The demographics of CMRSA 10 infected individuals from the Calgary Remand Centre were as expected for correctional facility populations. Approximately 10 per cent of incarcerated individuals were females[33], yet 30 per cent of CMRSA 10 infected individuals from the Calgary Remand Centre were females. As the number of CMRSA 10 infected females was very small, it was difficult to determine if the risk was greater for incarcerated females than for the general female population.

Upon review of the few case reports, it was difficult to generalize about individuals identified at this particular institution or to determine whether cases acquired infection within the institution or had transmitted infection to others.

Linked Cases

It was expected that the number of CMRSA 10 infected individuals that reported a link to another MRSA case was underreported. Individuals identified as CMRSA 10 positive were asked if they had contact with another case of MRSA.

Many cases reported that they had a family member or a close contact with a boil/soft tissue infection but it was not confirmed to be MRSA. This anecdotal evidence supported the possible transmission of CMRSA 10 within families and close contacts.

CMRSA 10 Cases

For all individuals infected with CMRSA 10, a case report was expected to be completed even if the individual was lost to follow - up. Of the 468 case reports completed, 37.6 per cent met the case definition. Individuals were questioned about known risk factors for CMRSA 10 acquisition and these risk factors were analyzed to determine if any trend in the data could be seen.

The most common risk factor was travel outside of the RHA of residence, but the value of this as a true risk factor was unclear. No one travel location was consistently reported and those locations where travel was reported were common destinations. It appeared as though travel may not be a true risk factor for CMRSA 10 acquisition.

A history of illicit drug - use was reported by over a quarter of individuals infected with CMRSA 10. The lifestyle associated with drug - use may lend itself to the transmission of MRSA soft tissue infections. Many of the individuals with a history of illicit drug - use also reported a history of incarceration and homelessness.

A history of incarceration was common amongst the cases of CMRSA 10. Incarceration was a risk factor for CMRSA 10 acquisition due to poor hygiene practices and crowding. The nearly 25 per cent of cases who report a history of incarceration raised the following questions:

1. Which institution was the individual housed in?
2. How long was the individual incarcerated?
3. What is the transmission and colonization rate in correctional facilities in Alberta?

These questions should be addressed in future studies to help determine appropriate public health interventions in this population.

Previous literature had reported outbreak and clusters of CMRSA 10 in sports teams[34]. There were only 14 CMRSA 10 cases identified that played contact sports and none of these cases were linked to other team members or to each other. This was an unexpected result and the reason for so few cases among those that play contact sports was unknown.

Previous reports suggested that sex trade workers and those who trade sex for drugs were more likely to acquire CMRSA 10[7]. Based on the data collected, it is difficult to determine if sexual transmission of CMRSA 10 was occurring. Information on sexual practices was not collected. Those with multiple sexual partners, men who have sex with men (MSM) and sex trade workers (STW) were all reported to be at higher risk of MRSA. This information would be helpful to better characterize the transmission dynamics of CMRSA 10 in the community.

There were several cases for which no risk factor for CMRSA 10 was reported. This may be due to a combination of factors. Cases may have been unwilling to disclose

sensitive information about themselves, such as illicit drug use. There was also likely risk factors for CMRSA 10 acquisition that have not yet been determined. These factors may be more common in non - marginalized populations in society.

In Capital Health nearly half of cases report no known risk factors for CMRSA 10 acquisition. This is different from Calgary Health Region where most cases have at least one known risk factor for CMRSA 10 acquisition. This does not indicate that marginalized and at risk populations in Capital Health are not affected, simply that infections in this population have not yet been detected with any significant frequency. The increased awareness of CMRSA 10 in the Calgary Health Region may account for increased MRSA testing in this population. In addition, the high number of individuals infected with CMRSA 10 with no known risk factors indicated that CMRSA 10 was circulating in the general population.

CMRSA 10 Non - Cases

The basic demographics of individuals infected with CMRSA 10 was similar between those that did or did not meet the case definition. The case definition was quite conservative and it was likely, upon review of some of the 64 cases excluded for previous hospitalization, that some of the cases were community acquired. There were at least two cases that were excluded due to hospitalization for the normal delivery of a newborn. Even with the conservative case definition there were very few cases excluded; reinforcing the notion that CMRSA 10 is predominantly a community acquired infection.

CMRSA 10 Lost to Follow - up Cases

There were several factors that contributed to the high proportion of cases that were lost to follow - up. First was the period of time between when the isolate was obtained and when public health follow - up occurred. Second was the large number of CMRSA 10 infected individuals with no address or contact information reported on the laboratory requisition.

The large proportion of individuals infected with CMRSA 10 that were lost to follow - up made generalizing results from this outbreak investigation difficult. However, the basic demographics of the lost to follow - up cases and those for which a case report was completed was not significantly different. This helps support the study results to be generalizable to those infected with CMRSA in Alberta.

The proportion of cases that were lost to follow - up was higher in the Calgary Health Region. This correlates with more CMRSA 10 infected individuals with multiple risk factors (especially a history of incarceration) compared to Capital Health. Capital Health reported fewer cases with multiple risk factors and also fewer individuals infected with CMRSA 10 that were lost to follow - up.

The significantly higher proportion of incarcerated individuals that were lost to follow - up compared to those for which a case report was completed was of concern. Incarceration maybe a risk factor or it may be a confounder to another risk factor for CMRSA 10 acquisition that has yet to be determined.

Completion of CMRSA 10 Case Reports

Regional public health follow - up on individuals infected with CMRSA 10, using the MRSA Case Report, was found to be labor intensive and time consuming. Each RHA was asked to provide an estimate of time spent on completion of an MRSA Case Report when the case was found and when the case was lost to follow - up.

Four regions responded as follows:

On average it took 40 minutes (regional responses: 30 - 45, 30, 30, 60) to complete an MRSA Case Report form when the individual was found and contacted (167 case reports x 40 = 111 hrs) and 35 minutes (regional responses: 15 - 20, 30, 30 and 60) when the case was lost to follow - up (122 case reports x 35 = 71 hrs).

One RHA detailed the work as comprised of four stages:

1. Identify and document new cases:
   (a) PPHL report accessing, sorting, arranging print format, printing and determining new cases compared with last report.
   (b) Complete MRSA Case Report Form - set up the case file and fill out the form with demographic information from the PPHL report and Net Care file, find associated lab reports and attach to the follow - up form and search Net Care file for exclusion criteria (previous hospital admissions, etc.)
   (c) Add new cases to master list.
2. Make calls (maximum three attempts) and conduct interviews.
3. Write up notes and fax to AHW.
4. Log completion on master list and file completed files.

One RHA sent letters to cases that were not contactable by phone requesting the individual to contact the Communicable Disease Unit.

Strengths

This population based outbreak investigation was the first of its kind in Canada. This investigation provided the information to characterize those infected with CMRSA 10 and to determine the geographic distribution of CMRSA 10 in Alberta. In addition, prevalence information for other MRSA infections was collected.

The information collected will be important in developing appropriate public health action and to guide future research in the area of CA MRSA. This information is useful at both the provincial and regional levels.

Limitations

This was an outbreak investigation and was not designed as a research study. Much of the information obtained from the investigation has been useful in characterizing CMRSA 10 and MRSA in the province.

There are limitations that make some analysis and interpretation difficult:

- The small number of individuals infected with CMRSA 10 makes subgroup analysis futile. Investigations of a specific population would not be possible and this results in some questions remaining unanswered.
- The use of comments to interpret some findings was required due to the structure of the questionnaire. Unfortunately, comments were not consistently collected and therefore may not accurately represent the population of infected cases. However, the comments that were collected did provide useful anecdotal information for the investigation.
- Colonization information was not collected and as a result the prevalence of CMRSA 10 in the population is unknown. This information can assist in better understanding the transmission dynamics of CMRSA 10 and the carriage rate in the population. The determination of infection was based on site of collection and not on physician diagnosis.
- The receipt of MRSA isolates may not have been consistent by RHA and there is no audit process in place to verify whether or not all first clinical isolates have been submitted to the PPHL.
- Finally, no information is available for analysis regarding the population who did not have an MRSA infection but whose isolates were tested for it. This information would assist in determining possible cultural and demographic differences within particular geographic areas.

Conclusions

The public health (PH) investigation (June 1, 2005 - February 28, 2006) describes the emergence of CMRSA 10 in this province. CMRSA 10 is geographically widespread with individuals infected from across the province. The number of individuals identified as being infected with clinical MRSA during this outbreak is an underestimate. Case follow - up was labour intensive and approximately 40 per cent were lost to follow - up which reflects the limitations of contacting hard to reach populations.

Given the findings detailed below, there is a strong argument for a public health approach to ongoing surveillance and intervention:

- Significant morbidity of CMRSA 10 with nearly one in five cases requiring hospitalization and with five CMRSA 10 related deaths. This indicates a virulent MRSA strain with the potential to enter the acute care setting.
- Many cases report no known risk factors for CMRSA 10 infection indicating that there are unknown risk factors for CMRSA 10 or that this pathogen is broadly distributed in the population.
- The only risk group clearly identified in (EI) #286 are those individuals associated with correctional facilities in the province. Correctional facilities and other group settings provide ideal conditions for the transmission for MRSA.
- There were 50 children infected with MRSA and 16 of these were infected with CMRSA 10. All of the children infected with CMRSA 10 appear to have acquired infection in the community. CMRSA 10 may pose significant risk for children in Alberta, especially due to its potentially high morbidity and mortality.
- Travel outside of the RHA of residence was reported in approximately one - third of CMRSA 10 cases. Travel does not appear to be a factor for acquisition of CMRSA 10 but presents a challenge for containment.

References

1 Gilbert M, MacDonald J, Gregson D, Siushansian J, Zhang K, Elsayed S, Laupland K, Louie T, Hope K, Mulvey M, Gillespie J, Nielsen D, Wheeler V, Louie M, Honish A, Keays G, Conly J. Outbreak in Alberta of Community-acquired (USA300) Methicillin-resistant *Staphlococcus aureus* in People with a History of Drug Use, Homelessness or Incarceration. *Canadian Medical Association Journal.* 175(2) | 149. Early release, published at www.cmaj.ca on June 27, 2006.

2 British Columbia CDC. (2005). A Report on the Emergence of Community-Acquired Methicillin-Resistant *Staphylococcus aureus* (CA MRSA). www.bccdc.org.

3 Raboud J, Saskin R, Simor A, Loeb M, Green K, Low D, & Mc Geer A. (2005). Modeling Transmission of Methicillin-Resistant *Staphylococcus aureus* Among Patients Admitted to Hospital. Infection. *Infection Control Hospital Epidemiology*. 26:607-615.

4 Davis AK, Stewart JJ, Crouch HK, Florez CE, & Hospenthal DR. (2004). Methicillin-resistant *Staphylococcus aureus* (MRSA) Nares Colonization at Hospital Admission and Its Effect on Subsequent MRSA Infection. *Clinical Infectious Diseases*. Vol. 39 (6) p. 776-88).

5 Upton D. Allen (2006). Public Health Implications of MRSA in Canada. *Canadian Medical Association Journal.* 175(2) | 161. Early release, published at www.cmaj.ca on June 27, 2006.

6 Gilbert M. (2005). MRSA Colonization Study: *Study Guide.* March 5, 2005.

7 Hawkes M, Barton M, Carson J, Moore D, Moore A, Waters V, Gold R, Katz K, Embree J, Brophy J, Upton A, Richardson S, and Ford-Jones L. (2005). Management and Prevention of Community-Associated Methicillin-Resistant *Staphylococcus aureus* Infections in Children. DRAFT. Submitted to Ontario Ministry of Health. October 21, 2005 (unpublished).

8 Louie M, Chui L, & Preiksaitis J. (2006). Province- Wide MRSA Laboratory Surveillance Summary to Date: June 1-December 31, 2005. January 26, 2006. (unpublished).

9 Zetola N, Francis J, Nuermberger E, Bishai W. (2005). Community-acquired methicillin-resistant *Staphylococcus aureus*: an emerging threat. *Lancet Infectious Disease*. 5: 275-86.

10 Trent JT, Federman D, & Kirsner R. (2001). Common Bacterial Skin Infections. *Ostomy/Wound Management.* Vol. 47(8): 30-34.

12 Nicolle LE (2006). Community-acquired Methicillin-resistant *Staphylococcus aureus:* Getting over it. *Canadian Journal of Infectious Diseases and Medical Microbiology*. Editorial. Vol. 16 (6) page 323.

13 Gorwitz R. (2005). Emergence and Epidemiology of Community Acquired Methicillin Resistant *Staphylococcus aureus* in the United States. Communicable Disease Control. *Webber Training Teleclass*-August 25, 2005. www.webbertraining.com.

14 Rybak M, LaPlante. (2005). Community Associated Methicillin-Resistant *Staphylococcus aureus:* A Review. *Medscape*. http://www.medscape.com/viewarticle/497754.

15 Mulvey M, MacDougall L, Cholin B, Horsman G, Fidyk M, Woods S, and the Saskatchewan Study Group. (2005). Community-associated Methicillin-resistant *Staphylococcus aureus*. Canada*. Emerging Infectious Diseases*. Vol. 11, No.6.

16 Public Health Agency of Canada. (2005). Surveillance for Methicillin-Resistant *Staphylococcus aureus* in Canadian Hospitals- A Report Update from the Canadian Nosocomial Infection Surveillance Program. *Canada Communicable Disease Report*. Volume 31-03.

17 Canadian Pediatric Society. (2005). Methicillin-Resistant *Staphylococcus aureus* in First Nations Communities in Canada. *Pediatric Child Health*. Vol.19. No.9.

18 Canadian Committee on Antibiotic Resistance. (2005). Antimicrobial Resistance: An Update from the Canadian Committee on Antibiotic Resistance*. Canadian Journal of Infectious Disease Medical Microbiology*. Vol.16.(5). Pages 309-311.

19 British Columbia CDC. (2005). A Report on the Emergence of Community-Acquired Methicillin-Resistant *Staphylococcus areus* (CA MRSA). www.bccdc.org.

20 Larke B. (February 20, 2005). Personal Correspondence. Medical Health Officer, Yukon.

21 Levett P. (2006) Personal Correspondence. Assistant Clinical Director. Provincial Laboratory Saskatchewan Public Health.

22 McDonald RR, Antonishyn NA, Hansen T, Snook LA, Nagle E, Mulvey MR, Levett PN, & Horsman GB. (2005). Development of a Triplex Real-Time PCR Assay for Detection of Panton-Valentine Leukocidin Toxin Genes in Clinical Isolates of Methicillin-Resistant *Staphylococcus aureus. Journal of Clinical Microbiology*. December, 2005, p. 6147-6149.

23 Wylie JL, Nowicki DL. (2005). Molecular Epidemiology of Community – and Health Care – Associated Methicillin – Resistant *Staphylococcus aureus* in Manitoba, Canada. *Journal of Clinical Microbiology*, June 2005. p. 2830-2836.

24 Kaplan SL, Hulten KG, Gonzalez BE, Hammerman WA, Lamberth L, Versalovic J, and Mason EO. (2005). Three Year Surveillance of Community-Acquired *Staphylococcus aureus* Infections in Children*. Clinical Infectious Diseases*. 40. 1785-91.

25 Chambers HF. (2001). The Changing Epidemiology of *Staphylococcus aureus*. *Emerging Infectious Diseases*. http://www.cdc.gov/ncidod/eid/vol7no2/chambers.htm.

26 Alberta Health and Wellness (2005), Community Acquired MRSA in Alberta Exposure Investigation (EI) # 286 Provincial Outbreak Investigation Protocol, Disease Control and Prevention (unpublished).

27 Alberta Health and Wellness Geographic Methodology Series, Geographic Methodology Series No. 5. Calculating Small Area Analysis: Definition of Sub-regional Geographic Units in Alberta. ISBN: 0-7785-3453-7.

28 Turabelidze G, Lin M, Wolkoff B, Dodson D, Gladbach S, Zhu B-P. Personal Hygiene and Methicillin-Resistant *Staphylococcus aureus* Infection. *Emerging Infectious Diseases*. Vol. 12, No. 3, March 2006.

29 Bagger JP, Zindrou D, Taylor KM. Postoperative Infection With Methicillin-Resistant *Staphylococcus aureus* and Socioeconomic Background. *Lancet*. 2004 Feb 28; 363 (9410):706-8.

30 Tirabassi MV, Wadie G, Moriarty KP, Garb J, Konefal SH, Courtney RA, Sachs BF, Wait R Geographic Information System Localization of Community-Acquired MRSA Soft Tissue Abscesses. *Journal of Pediatric Surgery*. 2005 Jun; 40(6):962-5.

31 Seybold U, Kourbatova EV, Johnson JG, Halvosa SJ, Wang YF, King MD, Ray SM, Blumberg HM. Emergence of Community-Associated Methicillin-Resistant *Staphylococcus aureus* USA300 Genotype as a Major Cause of Health Care-Associated Blood Stream Infections*. Clinical Infectious Diseases.* 2006 Mar 1;42(5):647-56.

32 Adcock PM, Pastor P, Medley F, Patterson JE, Murphy TV. Methicillin-Resistant *Staphylococcus aureus* in Two Child Care Centers. *Journal of Infectious Diseases*. 1998 Aug; 178 (2):577-80.

33 Patricia Leithead**,** Provincial Coordinator Nursing, Alberta Solicitor General and Public Security**.** Personal Communication, April 3, 2006.

34 Centers for Disease Control and Prevention (CDC). Methicillin-Resistant S*taphylococcus aureus* Infections Among Competitive Sports Participants--Colorado, Indiana, Pennsylvania, and Los Angeles County, 2000-2003. *MMWR.* 2003 Aug 22;52(33):793-5.

Appendix A: Variables and Community Data Form

Variable Name	Variable Description	
Meets Case Definition	Yes*	No exclusion categories were checked on the case report form. *The lost to follow - up category and the meets case definition Y/N category are mutually exclusive.
	No*	The patient does not meet the case definition as is indicated on the case report form. The exclusion categories are: hospitalization within prior 12 months, hospital transfer, MRSA positive within the past year or resident in a long term care facility. *The lost to follow - up category and the meets case definition Y/N category are mutually exclusive.
last name/surname	Patient surname	
first name	Patient First name, if multiples please list all	
personal health number	Alberta PHN (9 digits)	
address*	Address of the patient *If address is a drop in center or shelter, please indicate No Fixed Address and the shelter/centre name.	
city	City where the patient resides	
postal code	Postal Code corresponding to the address (if available)	
homeless	Associated with street life or in the recent past had no permanent address	
out of province	Does this patient reside outside of Alberta?	
out of country*	Does this patient reside outside of Canada? * Both out of province and out of country can be checked off if the individual resides outside of Canada. Please specify where they reside in the city section.	
home region	The region in which the patient resides	
home phone	The home phone number of the patient	
DOB	Date of Birth of the patient	
sex	Gender of the patient, if unknown please indicate	
occupation	Current occupation or volunteer work that the patient is involved in	

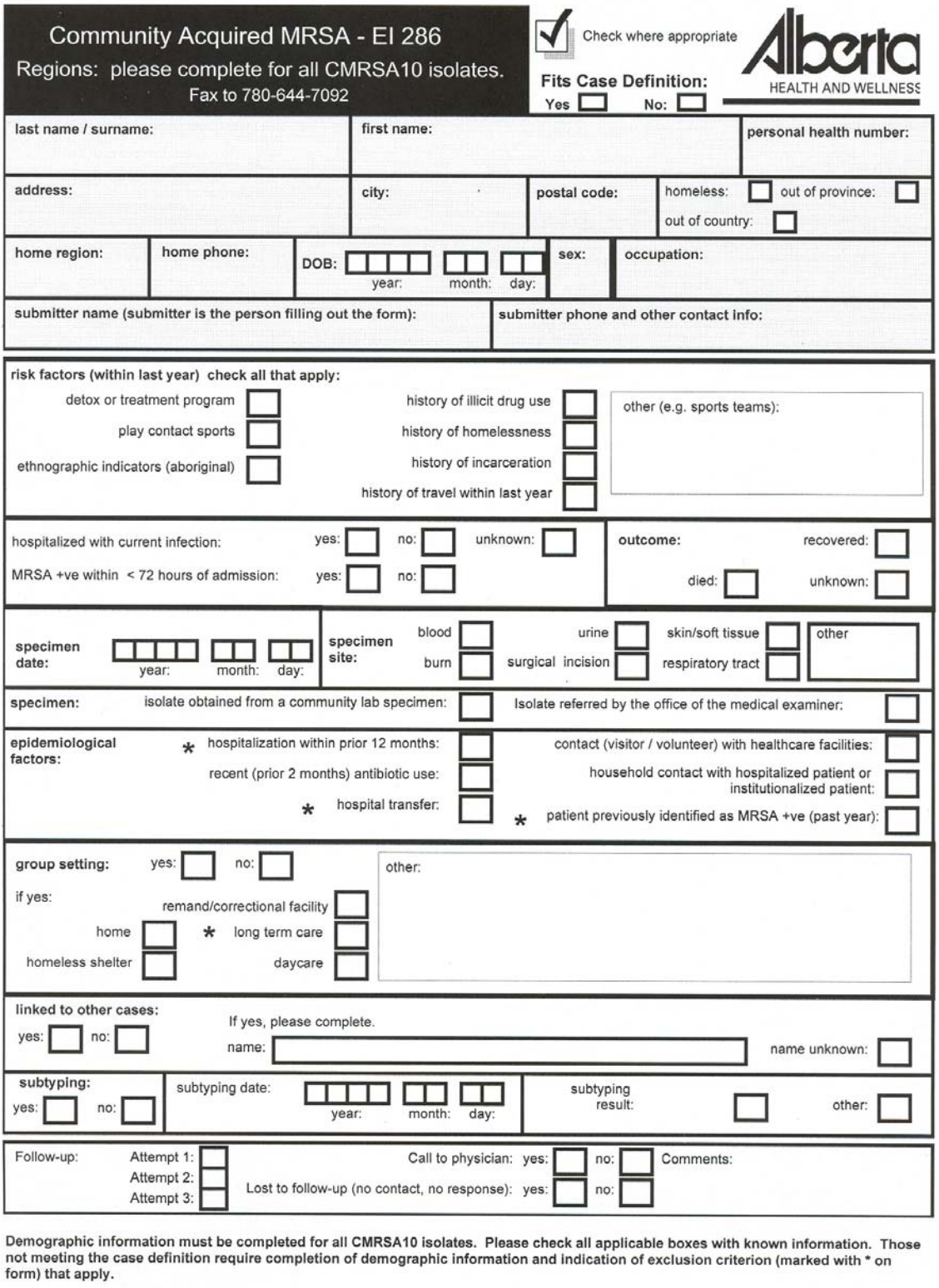
Variable Name	Variable Description	
submitter name	Name of the individual completing the form	
submitter phone and other contact info	Phone number and other contact information, including email address of the individual completing the form.	
risk factors (within last year) check all that apply	detox or treatment	The patient has been entered into a drug/alcohol detoxification or treatment program
	play contact sports*	The patient plays sports that have physical contact with other players. *Indicate in the comments section the type of sports played.
	ethnographic indicators (aboriginal)	The patient is of Aboriginal decent (includes First Nations, Métis, Inuit).
	history of illicit drug use*	The patient has in the past year used an illegal drug(s) (e.g., crack , cocaine or heroin). *Does not need to be injection drug use.
	history of homelessness	In the past year (or presently) the patient was associated with street life or had no permanent address.
	history of incarceration	In the past year (or presently) the patient was incarcerated, regardless of the length of stay.
	history of travel within the last year*	In the past year (or presently) the patient has travelled outside the RHA. *Indicate in the other section the location of travel.
	other	Any other activities/lifestyle choices that might potentially be a source of the infection.
hospitalized with current infection	As a result of, or corresponding to, the diagnosis of MRSA infection the patient was admitted to hospital.	
MRSA +ve within <72 hours of admission	Positive specimen for MRSA collected less than 72 hours after admission to the hospital.	
outcome	died	The patient died after diagnosis. If died please indicate if the death was the result of the MRSA infection.

Variable Name	Variable Description	
	recovered	The patient recovered after the MRSA infection. If there are serious residual effects please indicate in the comments.
	unknown	The patient's outcome post - infection is not known.
specimen date	Date the specimen was collected. Can be obtained from the PPHL line list.	
specimen site	Anatomical site of the patient where the specimen was collected.	
specimen	isolated from a community lab specimen	If the specimen was isolated from a community lab.
	isolate by the office of the medical examiner	If the specimen was isolated from the medical examiner's office.
epidemiological factors	hospitalization within prior 12 months*	The patient was admitted to the hospital within the 12 months previous to diagnosis. *Does not refer to the current hospitalization. ** Day surgery is considered a hospitalization, while outpatient clinics of any kind are not.
	recent antibiotic use	The patient has taken antibiotics for any period in time within the last 8 weeks (2 months).
	hospital transfer	The patient was transferred to a hospital from another hospital, long - term care or assisted living facility.
	contact (visitor/volunteer) with healthcare facility*	The patient is a regular visitor/ volunteer (more than 1 visits per month) to a healthcare facility such as a hospital or long - term care facility. *Does not refer to clinic visits.
	household contact with hospitalized patient or institutionalized patient*	The patient lives with, either permanently or occasionally, an individual who is regularly

Variable Name	Variable Description	
		hospitalized or in an institution such as a long - term care facility. *Does not refer to contact with a prisoner.
	patient previously identified as MRSA +ve past year	The patient has been infected or colonized by any strain of MRSA in the previous 12 months.
group settings	The patient lives in a group setting of some type.	
if yes	home	In the past year (or presently) the patient resided in a group home of some type (not a family home) such as for youth or individuals with disabilities.
	remand/correction facility	In the past year (or presently) the patient resided in a correctional facility or remand centre.
	long - term care	In the past year (or presently) the patient resided in a long - term care or assisted living facility.
	homeless shelter	In the past year (or presently) the patient resided in a homeless shelter or transitional housing.
	daycare	In the past year (or presently) the patient attends or has recently attended a daycare or day home.
	other	Any other group residence that might potentially be a source of the infection.
linked to other cases	The patient my have been infected by or have infected another known CMRSA 10 case.	
	name	The name of the case that maybe linked to the patient.

Variable Name	Variable Description	
	name unknown	If the name of the patient is not known.
subtyping*	Was subtyping completed on the patient? *This should always be yes.	
subtyping date	date of the subtyping, if known.	
subtyping result	type of CMRSA, should only be CMRSA 10.	
follow - up	attempt 1	Please check if an attempt to contact the patient was made.
	attempt 2	Please check if two attempts to contact the patient were made.
	attempt 3	Please check if three attempts to contact the patient were made.
lost to follow - up*	The patient was not able to be contacted despite three attempts. *An out of province case that cannot be contacted is considered loss to follow - up. **The lost to follow - up category and the meets case definition Y/N category are mutually exclusive.	
Call to physician	The physician was contacted as part of the attempt to contact the patient.	
comments	Any pertinent comments that might help with determining the source of the MRSA infection or is of note about this patient.	

Community Data Form



Community Acquired MRSA - EI 286

Regions: please complete for all CMRSA10 isolates.

Fax to 780-644-7092

Check where appropriate

Fits Case Definition: Yes ☐ No: ☐

Alberta HEALTH AND WELLNESS

last name / surname: | first name: | personal health number:

address: | city: | postal code: | homeless: ☐ out of province: ☐ out of country: ☐

home region: | home phone: | DOB: year: month: day: | sex: | occupation:

submitter name (submitter is the person filling out the form): | submitter phone and other contact info:

risk factors (within last year) check all that apply:

- detox or treatment program ☐
- play contact sports ☐
- ethnographic indicators (aboriginal) ☐
- history of illicit drug use ☐
- history of homelessness ☐
- history of incarceration ☐
- history of travel within last year ☐

other (e.g. sports teams):

hospitalized with current infection: yes: ☐ no: ☐ unknown: ☐

MRSA +ve within < 72 hours of admission: yes: ☐ no: ☐

outcome: recovered: ☐ died: ☐ unknown: ☐

specimen date: year: month: day:

specimen site: blood ☐ urine ☐ skin/soft tissue ☐ other ☐ burn ☐ surgical incision ☐ respiratory tract ☐

specimen: isolate obtained from a community lab specimen: ☐ Isolate referred by the office of the medical examiner: ☐

epidemiological factors:

- * hospitalization within prior 12 months: ☐
- recent (prior 2 months) antibiotic use: ☐
- * hospital transfer: ☐
- contact (visitor / volunteer) with healthcare facilities: ☐
- household contact with hospitalized patient or institutionalized patient: ☐
- * patient previously identified as MRSA +ve (past year): ☐

group setting: yes: ☐ no: ☐

if yes:

- home ☐
- homeless shelter ☐
- * remand/correctional facility ☐
- * long term care ☐
- daycare ☐

other:

linked to other cases: yes: ☐ no: ☐ If yes, please complete. name: name unknown: ☐

subtyping: yes: ☐ no: ☐ subtyping date: year: month: day: subtyping result: ☐ other: ☐

Follow-up: Attempt 1: ☐ Attempt 2: ☐ Attempt 3: ☐ Call to physician: yes: ☐ no: ☐ Comments: Lost to follow-up (no contact, no response): yes: ☐ no: ☐

Demographic information must be completed for all CMRSA10 isolates. Please check all applicable boxes with known information. Those not meeting the case definition require completion of demographic information and indication of exclusion criterion (marked with * on form) that apply.

Appendix B: MRSA Isolate Submission Form

Provincial Laboratory for Public Health

ProvLab Edmonton	ProvLab Calgary
University of Alberta Hospital	3030 Hospital Drive N.W.
8440-112 St. Edmonton, Alberta T6G 2J2	Calgary, Alberta T2N 4W4
Telephone (780) 407-7121 Fax (780) 407-3864	Telephone (403) 944-1200 Fax (403) 270-2216

MRSA ISOLATE SUBMISSION FORM

ProvLab use only: Accession #: _____
Date Received: _____

#1. Submitting Laboratory and Specimen Source Information

Submitting Laboratory (Name/Address):

_____ Submitting Lab Specimen No: _____

_____ Date Submitted: Day ____ Mon ____ Yr ____

_____ Specimen Collection Date: Day ____ Mon ____ Yr ____

Attending Physcian: _____

#2. Patient Information

Patient Name: _____ Personal Health Care Number (PHN): _____

Patient Street Address: _____ Date of Birth: Day ____ Mon ____ Yr ____

Patient City/Town of residence: _____ Gender: ☐ M ☐ F

Patient Postal Code: _____ Clinical DIAGNOSIS: _____

Patient Phone Number: _____ _____

#3. Specimen Clinical Information

Specimen Collection Location:

☐ In-patient specimen ☐ Out-patient / Community specimen ☐ LTCF specimen

☐ Other _____ ☐ Unknown

MRSA Isolate: ☐ Screening ☐ Clinical ☐ Referred by Medical Examiner's Office ☐ Unknown

Anatomical Specimen Site: ☐ Nares ☐ Groin(s) ☐ Axilla

☐ Perianal / Rectal ☐ Urine

☐ Other _____ ☐ Unknown

Previous MRSA +'ve (past 12 months): ☐ Yes ☐ No ☐ Unknown

Send MRSA Isolates To:

Provincial Laboratory for Public Health – Edmonton
Attention: Reference Bench
8440-112 Street
Edmonton, T6G 2J2

Appendix C: MRSA Typing Nomenclature

MRSA Typing Nomenclature

The PPHL and Calgary Laboratory Services in Alberta have adopted the pulsed - field gel electrophoresis (PFGE) nomenclature of MRSA strains used by the Canadian Nosocomial Infection Surveillance Program (CNISP) at the National Microbiology Laboratory (NML). Molecular fingerprinting of over 9,000 MRSA strains collected through CNISP since 1995 has identified the emergence of 10 different "epidemic clones" labeled CMRSA1 to CMRSA10. Each of these epidemic strains has been observed at five or more hospital sites and/or three or more geographically distinct areas in Canada [1, 2]. These epidemic strains account for about 80 per cent of all MRSA observed at CNISP hospital sites. CMRSA1 to CMRSA6 strains are typical nosocomial strains with multi - drug resistant phenotypes [2]. CMRSA7 to CMRSA10 strains have been recently identified as "epidemic" strains and have emerged only within the last several years in Canada (personal communication, M. Mulvey, NML). CMRSA8 and CMRSA9 are also typical of nosocomial MRSA strains and comprise approximately one per cent of the total epidemic strains observed to date at the CNISP study sites. CMRSA7 and CMRSA10 strains, also known as USA 400 and USA 300 respectively, are typically labeled as community - associated. Similar to reports from other countries, CMRSA7 and CMRSA10 have been associated with community related outbreaks in Canada [3, 4, 5]. These CAMRSA strains are generally more susceptible to many classes of antimicrobials and often carry a toxin (Panton - Valentine leukocidin, PVL) not typically found in nosocomial MRSA strains. More recently, CMRSA7 and CMRSA10 strains are beginning to be observed in some acute care facilities (personal communication, E Sameer).

CNISP surveillance uses "retrospective" assignment of PFGE profiles to strains with the potential for epidemic spread as defined above. In general, the criteria for assigning patterns to a particular epidemic clone are based on guidelines as described by Tenover et al.[6]. Although Tenover's guidelines for PFGE interpretation are intended for use in analyzing discrete sets of isolates during potential outbreaks spanning relatively short time periods, it is also suggested that these criteria may be modified in light of parallel epidemiological information to allow flexibility when determining relatedness between strains collected over more extended time periods.

Not all MRSA strains typed in Alberta will have an assigned PFGE profile using the NML/CNISP nomenclature. The "not assigned" profiles will refer to strains with new PFGE patterns, i.e., unique profiles that are not the same as any of the CNISP prototype strains. When PPHL identifies a new MRSA strain that is a cause of arising clone, a representative strain will be forwarded to the NML for further characterization and comparison to the national MRSA PFGE database. NML will assign a CMRSA - prototype number accordingly.

The *mecA* gene is located on a mobile element named *Staphylococcal Cassette Chromosome* (SCC) on the chromosome of MRSA. Several SCC types have been identified. SCC Type I to SCC Type III have been associated with hospital - acquired strains that tend to be more multi - resistant to antibiotics. SCC Type IV and V have been associated with community - acquired strains that tend to more susceptible to antibiotics than hospital - acquired strains [7, 8]. However, as community - acquired strains become established and endemic within hospital settings, the utility of designating an MRSA strain using SCC typing as either community or nosocomially - acquired may be lost. The Panton - Valentine Leukocidin (PVL) is a toxin more often associated with community - acquired MRSA strains. Most of the Alberta CMRSA7 and CMRSA10 strains are SCC Type IV and PVL positive.
The following table compares the Canadian prototype nomenclature of epidemic clones

with those used in the United States (USA) and Europe (E) and with typing by multilocus sequence typing (MLST).

	Other PFGE Names	MLST
CMRSA 1	USA600	ST45
CMRSA 2	USA100/800 / NEW YORK	ST5
CMRSA 3	USA 700	ST241
CMRSA 4	USA200 / EMRSA16	ST36
CMRSA 5	USA500	ST8
CMRSA 6	USA700	ST239
CMRSA 7	US400/MW2	ST1
CMRSA 8	EMRSA15	ST22
CMRSA 9		ST8
CMRSA 10	USA300	ST8

References

1. Simor A, Boyd D, Louie L, McGeer A, Mulvey M, Willey B for CHEC and CNISP. Characterization and proposed nomenclature of epidemic strains of methicillin - resistant *Staphylococcus aureus* in Canada. Canada Communicable Disease Report. 1999. 25:105 - 108.

2. Simor AE, Ofner-Agostini M, Bryce E, McGeer A, Paton S, Mulvey MR, and CHEC and CNISP. Laboratory characterization of methicillin-resistant *Staphylococcus aureus* in Canadian hospitals: results of 5 years of national surveillance, 1995-99. Journal of Infectious Diseases. 2002. 186:652-660.

3. Mulvey, M. R., L. MacDougall, B. Cholin, G. Horsman, M. Fidyk, and S. Woods, and the Saskatchewan CA-MRSA Study Group. Emergence of the USA400 Clone of Community-Associated Methicillin Resistant Staphylococcus aureus in Canada. Emerging and Infectious Diseases. 2005. **11:**844-850.

4. Wylie JL and DL Nowicki. Molecular epidemiology of community- and health care-associated methicillin-resistant *Staphylococcus aureus* in Manitoba, Canada. J Clin Microbiol. 2005. **43:**2830-6.
5. Gilbert M, Siushansian J, MacDonald J, Gregson D, Elsayed S, Zhang K, Laupland K, Louie M, Louie T, Nielsen D, Keays G, Honish A, Gravel D, Mulvey M, Gillespie J, Conly J. An outbreak of the USA300 strain of community-acquired methicillin-resistant *Staphylococcus aureus* CMRSA infections in individuals with histories of drug use, homelessness or incarceration. AMMI-Canada-CACMID 2005. Annual Conference, Ottawa, Ontario April 14-17, 2005.

6. Tenover FC. Arbeit RD, Goering RV, Mickelsen PA, Murray BE, Persing DH, and Swaminathan B. Interpreting chromosomal DNA restriction patterns produced by pulsed-field gel electrophoresis: criteria for bacterial strain typing. J Clin Microbiol. 1995. 33:2333-2339.

7. Zhang K, McClure JA, Elsayed S, Louie T, Conly JM. Novel multiplex PCR assay for characterization and concomitant subtyping of staphylococcal cassette chromosome mec Types I to V in methicillin-resistant *Staphylococcus aureus*. J Clin Microbiol. 2005. 43:5026-33.

8. Tenover FC, McDougal LK, Goering RV, Killgore G, Projan SJ, Patel JB, Dunman PM. Characterization of a strain of community-associated methicillin resistant *Staphylococcus aureus* widely disseminated in the United States. J Clin Microbiol. 2006. 44(1):108-18.

Submitted by M. Louie, ProvLab
with
L. Chui, ProvLab
E. Sameer, Calgary Laboratory Services
M. Mulvey, National Microbiology Laboratory