ABSTRACT: Methicillin-resistant Staphylococcus aureus (MRSA) infections are becoming increasingly prevalent in North America among community populations. A case series of prospectively identified MRSA infections in one practice in the Fraser Valley suggests that aggressive infections among patients without risk factors, including pediatric patients, are becoming more common. The prevalence of MRSA infections in the community has made the empiric treatment of skin and soft tissue infections more complicated, and also suggests that culture should be used more often as a backup to treatment.

Methicillin-resistant Staphylococcus aureus (MRSA) has long been recognized and was cited soon after the development of beta-lactam-resistant anti-staphylococcal antibiotics. In Canada, most MRSA infection and colonization has occurred among patients in hospital. However, patients in the community with chronic antibiotic exposure have also been a source of MRSA.

Recent reports from international sources indicate that community-acquired MRSA infections are becoming more prevalent, in keeping with the high frequency of MRSA in health care institutions. Recent reports also suggest the occurrence of more virulent MRSA pathogens in the community, again a reflection of changes in nosocomial MRSA. Severe infections among children and other historically low-risk populations are being documented increasingly.

Case data

The 15 cases of MRSA infection described here occurred in a general practice setting in the Fraser Valley between September 2002 and November 2005. The demographic and clinical details are provided in the Table.

The majority of the infections (9) were identified in 2005. All but three of the infections occurred in adults. Infections were generally initiated in the skin and progressed aggressively to ulceration, cellulitis, boils, and deep abscesses. The only exception was one infection that began after a traumatic ear perforation. Seven patients had infections associated with drug abuse; two of these patients had direct knowledge of MRSA infections by name, and one had been instructed on the percutaneous drainage of abscesses by a drug user who apparently encountered many such infections among peers. Another patient developed MRSA infection shortly after being physically traumatized by drug users. Two patients had recent exposure to family or friends who had been either residing in a chronic care facility.

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# Community-acquired MRSA infection: An emerging trend

## Table. Demographic and clinical data for prospectively identified MRSA infections in a general practice setting, Sept. 2002 to Nov. 2005.

<table>
<thead>
<tr>
<th>Patient</th>
<th>Date</th>
<th>Age (years)</th>
<th>Gender</th>
<th>Infection site</th>
<th>Risk factor</th>
<th>Treatment</th>
<th>Susceptibility</th>
<th>Resistance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Sept. 02</td>
<td>51</td>
<td>M</td>
<td>Folliculitis, cellulitis, axillary abscess</td>
<td>Previous MRSA infection after visiting relative in a nursing home</td>
<td>cipro</td>
<td>cipro, SXT, clinda, fus, mup, lin</td>
<td>erythro</td>
</tr>
<tr>
<td></td>
<td>Apr. 03</td>
<td>Hand cellulitis</td>
<td></td>
<td></td>
<td></td>
<td>SXT</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>May 03</td>
<td>Nasal</td>
<td></td>
<td></td>
<td>chlorhexidine wash and nasal mup (no further MRSA detected)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Oct. 03</td>
<td>26</td>
<td>M</td>
<td>Forearm cellulitis and abscess</td>
<td>ceph changed to SXT</td>
<td>SXT, fus, mup, lin</td>
<td>erythro, clinda, cipro</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Mar. 04</td>
<td>8</td>
<td>F</td>
<td>Buttock abscess and boils</td>
<td>erythro changed to ceph</td>
<td>SXT, clinda, fus, mup, lin</td>
<td>erythro, cipro</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>July 04</td>
<td>39</td>
<td>M</td>
<td>Forearm abscess</td>
<td>cefaz in hospital changed to ceph; mup and fus ointments</td>
<td>SXT, clinda, fus, mup, lin</td>
<td>erythro, cipro</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>July 04</td>
<td>45</td>
<td>M</td>
<td>Forearm cellulitis</td>
<td>ceph</td>
<td>SXT, clinda, fus, mup, lin</td>
<td>erythro, cipro</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Nov. 04</td>
<td>49</td>
<td>F</td>
<td>Multiple torso abscesses</td>
<td>ceph changed to SXT</td>
<td>SXT, clinda, fus, mup, lin</td>
<td>erythro, cipro</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Dec. 04</td>
<td>22</td>
<td>M</td>
<td>Hand lesions and forearm cellulitis</td>
<td>telithro changed to cefaz IV then clinda (sulfa allergy)</td>
<td>SXT, clinda, fus, mup, lin</td>
<td>erythro, cipro</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Feb. 05</td>
<td>46</td>
<td>M</td>
<td>Otitis externa</td>
<td>Traumatic exposure to drug addicts 3 weeks prior</td>
<td>chlor</td>
<td>SXT, fus, mup, lin</td>
<td>erythro, clinda, cipro</td>
</tr>
<tr>
<td></td>
<td>Feb. 05</td>
<td>Perianal abscess</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Apr. 05</td>
<td>6</td>
<td>M</td>
<td>Boils on thigh and buttocks</td>
<td>ceph</td>
<td>SXT, clinda, fus, mup, lin</td>
<td>erythro, cipro</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Apr. 05</td>
<td>31</td>
<td>M</td>
<td>Perianal abscess</td>
<td>ceph</td>
<td>SXT, clinda, fus, mup, lin</td>
<td>erythro, cipro</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>July 05</td>
<td>62</td>
<td>F</td>
<td>Abdominal skin</td>
<td>Visited two friends who had recent surgery in hospital</td>
<td>erythro changed to SXT, topical Polysporin</td>
<td>SXT, clinda, fus, mup, lin</td>
<td>erythro, cipro</td>
</tr>
<tr>
<td>12</td>
<td>July 05</td>
<td>6</td>
<td>F</td>
<td>Forearm boil</td>
<td>Drug use in a parent and family history of boils</td>
<td>SXT</td>
<td>SXT, clinda, fus, mup, lin</td>
<td>erythro, cipro</td>
</tr>
<tr>
<td>13</td>
<td>Aug. 05</td>
<td>26</td>
<td>F</td>
<td>Breast ulcers</td>
<td>Had previous MRSA</td>
<td>SXT</td>
<td>SXT, clinda, fus, mup, lin</td>
<td>erythro, cipro</td>
</tr>
<tr>
<td>14</td>
<td>Nov. 05</td>
<td>36</td>
<td>M</td>
<td>Buttock abscess</td>
<td>Past drug use</td>
<td>SXT</td>
<td>SXT, clinda, fus, mup, lin</td>
<td>erythro, cipro</td>
</tr>
<tr>
<td>15</td>
<td>Nov. 05</td>
<td>31</td>
<td>M</td>
<td>Forearm cellulitis</td>
<td>Past drug use</td>
<td>SXT</td>
<td>SXT, clinda, fus, mup, lin</td>
<td>erythro, cipro</td>
</tr>
</tbody>
</table>

Antibiotics listed under Treatment, Susceptibility, and Resistance: cefaz=cefazolin, ceph=cephalexin, chloro=chloramphenicol, cipro=ciprofloxacin, clinda=clindamycin, erythro=erythromycin, fus=fusidic acid, lin=linezolid, mup=mupirocin, sulfa=sulfonamides, SXT=cotrimoxazole, telithro=telithromycin
ty or who had undergone an inpa-
tient surgery in a large hospital. Five
patients, however, did not have any ap-
parent risk factors, including two of
the three infected children. Apart from
the localized infection site manifesta-
tions, several of these patients were
clinically septic and considerably un-
well; no episodes of toxic shock were
evident.

MRSA are considered to be resis-
tant to all beta-lactam antibiotics. Other
resistance profiles are variable. For
example, the isolate from Patient 1
(see Table) manifested erythromycin
resistance but was susceptible to cotri-
noxazole, clindamycin, and cipro-
loxacin. Most other isolates in the 15
cases described here showed resistance
to erythromycin and ciprofloxacin but
susceptibility to cotrimoxazole and clindamycin, with two exceptions in
which clindamycin resistance was
found. For one patient, two isolates
were obtained from different infection
sites over 1 week, and these were dis-
crepant for clindamycin susceptibility.
All bacterial isolates were susceptible
to fusidic acid, mupirocin, and line-
zolid.

Not all patients were available for
follow-up. For most patients, initial
empiric treatment included either
cephalexin or a macrolide antibiotic.
For three patients, foreknowledge of
MRSA in the given context led to the
use of an antibiotic to which the bac-
terium was susceptible.

Discussion
S. aureus continues to be a major in-
fected agent,2 and there has been lit-
tle real progress in vaccination. MRSA are now complicating the treat-
ment of both inpatient and communi-
ty-acquired infections. Initially, the evo-
lution of these bacteria meant only
limitations to the use of beta-lactam
antibiotics. Unfortunately, these bac-
teria have now developed resistance to
a variable number of other antibiotics.
Indeed, some strains have acquired
resistance to most antibiotics.

Most of the isolates from the pa-
tients described here demonstrated ery-
thropenic and ciprofloxacin resis-
tance. Both of these antibiotics are
commonly used for outpatient ther-
apy. Erythromycin is commonly used
as a practical alternative to beta-lactam
agents for community-acquired skin
and soft tissue infections, especially
when S. aureus and beta-hemolytic
streptococci are likely to be involved.

Quinolones have also become popular
agents for outpatient skin and soft tis-
sue infections. Thus, the resistance
profile of the majority of isolates has
come to complicate the empiric ther-
apy. Our patient data indicated that the
antibiotic chosen for first-line treat-
ment often did not match the antibiot-
ic for which the bacterium was sus-
ceptible. While sulfa and clindamycin
remain options for most infections,
the increasing resistance of S. aureus
should prompt physicians to use cul-
ture as a backup to empiric treatment
more often.

The prevalence of community-acquired MRSA infections in the Lower
Mainland is perhaps best reflected
by antibiogram reports from predomi-
nantly community-based laboratories.
In this light, a profile published by
BC Biomedical Laboratories itemized
S. aureus as having an 8% frequency
of methicillin resistance among iso-
lates from 2002. Of these general iso-
lates (n=4259), 23% were deemed to
be resistant to erythromycin, 8% to
clindamycin, and 9% to cotrimoxa-
zole. For MRSA in particular (n=328),
94% were resistant to erythromycin,
83% to clindamycin, 79% to cotri-
noxazole, and 94% to ciprofloxacin.

When MRSA first emerged, most
infections were occurring among high-
risk patients (e.g., chronic antibiotic
users, individuals exposed to nosoco-
mial infection, intravenous drug users)
and modification of first-line treatment
for these patient groups could be antic-
ipated. The emerging trend, however, is
toward infections in patients without
traditional risk factors, including pedi-
atric patients.1 Recent reports in the
United States cite epidemic proportions
of infection among the pediatric popu-
lation.14 Other reports cite MRSA as an
emerging problem in athletics.15
Although sulfa drugs remain low cost,
the same cannot be said of other oral
antibiotics, including clindamycin.
The mere presence of antibiotic resistance does not equate with increased virulence. That is, MRSA are not necessarily more likely to cause disease because of modifications in antibiotic susceptibility genes. It is possible, however, that the continued presence of MRSA in an environment where more virulent strains are circulating could lead to the emergence of \textit{S. aureus} that is both antibiotic resistant and more virulent. This already appears to have occurred elsewhere.

In both the United States and United Kingdom, MRSA are emerging as common community pathogens. Simultaneously, the nasal carrier rate of MRSA is rapidly increasing. Mulvey and colleagues recently found evidence of more virulent and resistant \textit{S. aureus} among community infections in Saskatchewan. The latter report also presents evidence that a large proportion of the bacterial isolates are similar to those with greater virulence that are currently affecting community patients in the United States. The Panton-Valentine leukocidin gene appears to be a major virulence marker, and an increasing number of epidemic and community-acquired strains carry the trait.

As community-acquired MRSA infections become more prevalent, infection will inevitably occur among individuals who apparently lack risk factors. Such widespread infection is documented in the recent medical literature, and the cases described here are part of this emerging trend.

The empiric treatment of skin and soft tissue infections has accordingly become more complicated than is generally appreciated. Treatment approaches for community-acquired MRSA infections have been detailed elsewhere, and there are several new developments in the area. Such developments are necessary, given the alarming increase in community-acquired MRSA infections as the frequency of MRSA continues to increase. Most such infections seen in general practice would fit into Eron’s class 1 or 2. Such categorization would lead to treating empirically with beta-lactam-resistant semisynthetic penicillins or first-generation cephalosporins. It is relevant, therefore, for general practitioners to make greater use of wound microbiology from bacterial culture specimens to ensure a precise “drug-bug” match.

Hospitals have historically been major foci for MRSA epidemics. Such hotbeds of infection have thereafter served as reservoirs for community-acquired infection.

Patients with risk factors for MRSA infection have then acted as vectors to reintroduce infection back into health care centres. Strategies to reduce MRSA in both hospitals and the community are critical. This is especially so when strains combining increased virulence and multiple antibiotic resistance become endemic. The economic impact of nosocomial MRSA in British Columbia during the 1990s. Unfortunately, there is no longer a mandate to report these infections. Some major health centres in this province have now become sites with endemic MRSA. Some have experienced crises to the point of closing beds and nearly closing units. This trend will only continue unless more attention is directed to this very important infectious disease. The morbidity associated with MRSA in British Columbia is considerable, albeit largely unmeasured, and it is time to direct more resources to public health intervention.

\textbf{Acknowledgments}

I thank BC Biomedical Laboratories for their contribution to the initial compilation of data. Identification and susceptibility results were performed at BC Biomedical Laboratories for this cohort of patients. The antibiogram for bacterial isolates obtained at BC Biomedical Laboratories can be reviewed at www.bcbio.com in the section for health care professionals, under "Treat-
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Competing interests
None declared.

References