The Changing Face of MRSA: Evolving Epidemiology
Dr. Andrew Simor, University of Toronto
A Webber Training Teleclass

Disclosures
I have received grants, and served as a consultant on Advisory Boards for:
- Astellas Pharma
- BD GeneOhm
- Janssen-Ortho
- Pfizer Canada
- Sepracor Pharmaceuticals
- Wyeth Pharmaceuticals

Objectives
- to appreciate the changing epidemiology of healthcare-associated and community-associated MRSA
- to consider evidence-based infection prevention and control strategies

Staphylococcus aureus
- S. aureus is most common cause of healthcare-associated infections
- MRSA is the major antibiotic-resistant organism in hospitals; CA-MRSA increasing

Global Prevalence of MRSA, 2006

Prevalence of MRSA in US Healthcare Facilities
- point-prevalence survey, 1,237 hospitals and nursing homes, Oct. 2006 (21% of all US facilities)
- 46/1,000 inpatients infected/colonized with MRSA;
- 34/1,000 inpatients infected
- underestimate; little active screening

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Antibiotic Resistant Pathogens in ICU Patients (NNIS)

MRSA in Canada 1995-2007

MRSA Infections (32%)

MRSA Impact
- attributable mortality and morbidity
- prolonged hospital length of stay
  (Engemann, Clin Infect Dis 2003; Cosgrove, Infect Control Hosp Epidemiol 2005)
- excess/attributable costs, $14,360
  (Kim, Infect Control Hosp Epidemiol 2001)

MRSA in Canada
Last year, there were:
- approx 21,000 new MRSA patients
- 6,700 new MRSA infections
- 1,300 MRSA-related deaths
- $200-250 million excess costs attributable to MRSA

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Mortality Associated with S. aureus Bacteremia – A Meta-Analysis
Cosgrove, Clin Infect Dis 2003

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Uninfected (N=193)</th>
<th>MSSA (N=165)</th>
<th>MRSA (N=121)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Death (%)</td>
<td>2.1</td>
<td>6.7</td>
<td>20.7</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Hospital (days)</td>
<td>5</td>
<td>14</td>
<td>23</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Median cost ($)</td>
<td>29,455</td>
<td>52,791</td>
<td>92,363</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>
Engemann, Clin Infect Dis 2003

Why does antibiotic resistance affect outcome?
- Host factors
- Organism virulence
- Delay in instituting effective therapy (or vancomycin less effective)

Community-associated MRSA
Engemann, Clin Infect Dis 2003

MRSA in Emergency Dept. Skin/Soft Tissue Infections
- surveillance in 11 urban hospitals, August 2004
- 15-74% infections MRSA (mean 59%); single most common pathogen
- 97% of these were CA-MRSA (USA 300; SCCmec IV; PVL+)
Morse, NEJM 2005

MRSA in Emergency Departments Toronto, March – June 2007
- SSTI surveillance; 298 with S. aureus
- 18% of S. aureus were MRSA
- 52% of MRSA were CMRSA-10 (USA300)
Adam, AMRICACMO 2008; Abstr. SP-31

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MRSA in Canada Acquisition

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<tbody>
<tr>
<td>Healthcare-associated</td>
<td>92.8</td>
<td>79.5</td>
</tr>
<tr>
<td>Community-associated</td>
<td>7.2</td>
<td>20.5</td>
</tr>
</tbody>
</table>

Canadian Nosocomial Infection Surveillance Program

Community-Associated MRSA

Clonal predominance
- CMRSA10 (USA300)
- CMRSA7 (USA400)

Dissemination of CA-MRSA

Victoria and Vancouver (USA300)
Calgary (USA 300)
USA 400
Toronto (USA 300)

Patient Profile
- often younger
- IVDU, MSM
- incarcerated, homeless
- sports teams
- native aboriginals

Groom, JAMA 2001; Per, CID 2002; Naimi, JAMA 2003; Begier, CID 2004; Kazakov, NEJM 2005

CA-MRSA Clinical Presentations

- skin/soft tissue, furuncles, abscess, cellulitis, necrotizing fasciitis
- necrotizing pneumonia ± empyema
- bone/joint infection
- toxic-shock syndrome

Kazakov, NEJM 2005

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Furuncle finger

MRSA isolated in the abscess

Admission CXR

- patchy infiltrates LLL and lingula
- streaky opacification RLL

CXR Progression: 24 - 48 hrs

- CXR 24 hrs with pleural effusion and opacification RLL
- CXR 48 hrs with complete opacification left hemithorax and infiltrates RLL/RUL

Case Presentation – CT Scan

CT 100 hrs with pyothorax, abscess, BPF, consolidation, Destruction left lung, extensive consolidation R lung

Emergence of CA-MRSA as a Cause of Healthcare-Associated Infections

- USA400 post-partum infections, NY mastitis, cellulitis, abscesses (Saiman, CID 2003)
- USA300 prosthetic joint infections, Atlanta, GA (Kourbatova, Am J Infect Control 2005)
- USA300 accounted for 28% healthcare-associated bacteremias, 20% nosocomial MRSA BSIs, Atlanta, GA (Seybold, CID 2006)
- USA300 common cause of SSI, University of Alabama (Patel, J Clin Microbiol 2007)

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CA-MRSA

Virulence

- USA 300/400 more virulent than other strains of S. aureus/MRSA in a mouse model of bacteremia
- more resistant to killing by human PMNs

Voyich, J. Immunol 2005

Is it possible to control the spread of MRSA?

MRSA Infection Control Strategies

- contact precautions
- screening
- decolonization

Contact Precautions

- Private room or cohort
- Hand hygiene
- Gloves on entering the pt room; remove gloves on exiting
- Gowns for contact with the pt, or the environment
- Limit pt movement out of room
- Dedicate pt care equipment

Contact Precautions Work to Decrease MRSA Transmission

<table>
<thead>
<tr>
<th>Source</th>
<th>Isolated</th>
<th>Unisolated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transmissions</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td>Patient-days</td>
<td>558</td>
<td>72</td>
</tr>
<tr>
<td>Rates</td>
<td>0.009</td>
<td>0.140</td>
</tr>
</tbody>
</table>

RR=15.6, 95% CI=5.3-45.6, p<0.0001


Toronto Globe & Mail, Oct. 2007

Hospital sued over crippling superbug

Seeking $350,000, man says poor controls left him vulnerable

Toronto Globe & Mail, Oct. 2007

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Reservoir for the Spread of MRSA

Active Surveillance to Control Spread of MRSA
- Active surveillance – finding asymptomatic carriers
- Contact precautions for patients identified as colonized/infected

MRSA Screening Strategies
- high risk patients on admission
- high risk inpatient units (e.g. ICU)
- previously known colonized patients or contacts
- periodic point-prevalence surveys
- universal screening

Chromogenic MRSA Media (MRSA-Select)

Evidence for Effectiveness of Active Surveillance + Contact Precautions
- ecological studies (Verhoef, EJCMID 1999; Tiemersma, Emerg Infect Dis 2004)
- mathematical models (Bootsma, PNAS 2006)

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Healthcare-Associated MRSA Bacteremia Rates

Universal MRSA Screening

Harbarth, JAMA 2008
- cohort, crossover study, surgical patients, Geneva
- universal screening (PCR) + contact isolation + topical decolonization
- no ↓ nosocomial MRSA transmission
- no ↓ nosocomial MRSA infections

Universal MRSA Screening

Robicsek, Ann Intern Med 2008
- observational cohort study, historic controls, Chicago
- universal screening (PCR) + contact isolation + topical decolonization
- ↓ nosocomial MRSA infections

PCR vs. Chromogenic Media

- prospective, cross-over study, 2 hospital wards, UK
- median time to report MRSA:
  - 47 hrs vs. 21 hrs (culture vs. PCR; p<0.001)
- no reduction in MRSA transmission

MRSA: The Dutch Experience

- national “search and destroy policy”
  - screening patients, staff
  - strict isolation
  - decolonization
  - environmental cleaning
  - outbreak control

Verhoef, EJCMBD 1999; van Trijp, Infect Control Hosp Epidemiol 2007

Controlling MRSA with Broad-Based Infection Control Interventions

Aldeyab, J Hosp Infect 2009

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CA-MRSA
Information for Patients and Family Members (1)
- wounds/lesions covered with clean, dry bandages
- frequent hand hygiene, especially after touching infected area/drainage (gloves for dressing changes)
- do not share personal items (towels, washcloths, razors, clothing)

CA-MRSA
Information for Patients and Family Members (2)
- wash soiled linens and clothes in hot water and laundry detergent
- avoid contact sports or other skin-to-skin contact until infection has healed
- inform healthcare providers of MRSA

CA-MRSA
Information for Patients and Family Members (3)
- wash hands frequently
- avoid contact sports or other skin-to-skin contact until infection has healed
- inform healthcare providers of MRSA

CA-MRSA
Information for Patients and Family Members (4)
- wash hands frequently
- avoid contact sports or other skin-to-skin contact until infection has healed
- inform healthcare providers of MRSA

The Hands Go ‘Round

EVEN CHEETAHS WASH THEIR HANDS...

MRSA - 2009
Summary
- Healthcare-associated MRSA rates and infectious morbidity continue to increase
- Community-associated MRSA has become predominant in many parts of the country
- Controlling spread of MRSA requires active surveillance, attention to hand hygiene, and contact precautions

THE NEXT FEW TELECLASSES
29 Sep. 09 (Free Teleclass) Voices of CHICA – Part 2
Speaker: CHICA-Canada Board Members & Guests
01 Oct. 09 The Changing Face of MRSA – Evolving Epidemiology
Speaker: Dr. Andrew Simor, Sunnybrook Hospital, Toronto
15 Oct. 09 The Socioeconomic Cost of Enteric Disease
Speaker: Dr. Doug Scott, SDDC
21 Oct. 09 (South Pacific Teleclass) National Work on the Prevention of Healthcare Acquired Infections in Australia
Speaker: Marilyn Chukahark, Australian Commission on Safety & Quality in Healthcare
22 Oct. 09 (Free Teleclass) Improving Infection Control in Developing Countries
Speaker: Benedetta Allegranzi, World Health Organisation
29 Oct. 09 Prevention of Catheter-Associated Urinary Tract Infection

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