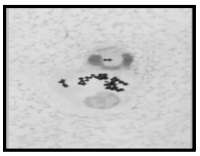
The Changing Face of MRSA: Evolving Epidemiology

Dr. Andrew Simor, University of Toronto

A Webber Training Teleclass

The Changing Face of MRSA: Evolving Epidemiology



Andrew E. Simor, MD, FRCPC, FACP
Sunnybrook Health Sciences Centre
University of Toronto

Hosted by Paul Webber
paul@webbertraining.com

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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**

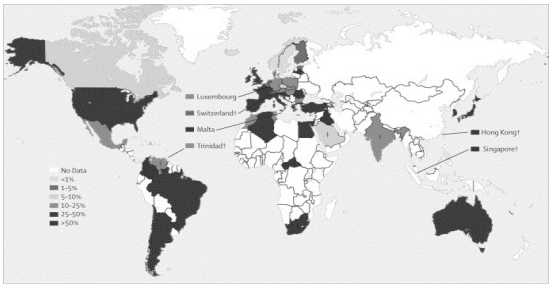
Objectives

- **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



Grundmann, Lancet 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**

Jarvis, Am J Infect Control 2007

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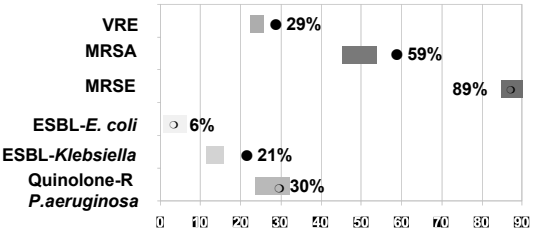
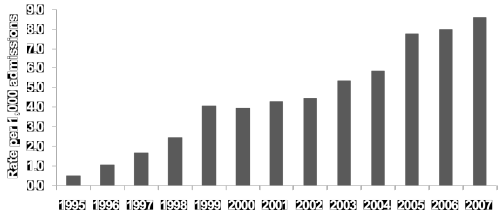
Antibiotic Resistant Pathogens in ICU Patients (NNIS)



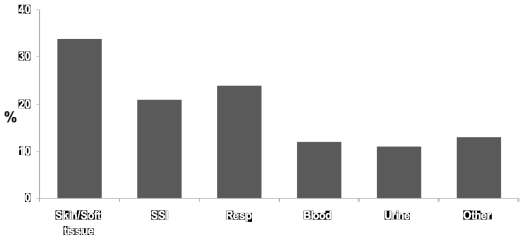
NNIS, Am J infect Control 2004

MRSA in Canada 1995-2007



Canadian Nosocomial Infection Surveillance Program

MRSA Infections (32%)



Canadian Nosocomial Infection Surveillance Program

MRSA Bloodstream Infections

Location	MRSA as a % of *S. aureus* bacteremias
U.K.*	36
Ontario†	19
Quebec§	24

* Jeyaratnam, BMJ 2008; † QMPLS, 2008;
§ Institut National de Santé Publique du Québec, 2008

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

MRSA Impact

- **attributable mortality and morbidity**
  (Whitby, Med J Austr 2001; Cosgrove, Clin Infect Dis 2003)
- **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)

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Mortality Associated with *S. aureus* Bacteremia – A Meta-Analysis

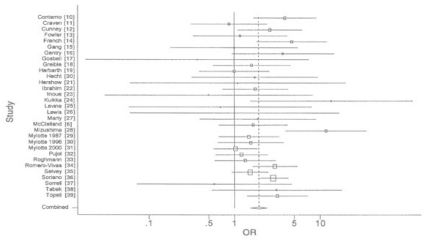


Figure 1. Forest plot summary of the unadjusted results of the 31 studies included in the meta-analysis. The OR and 95% CI are shown for each study. The pooled OR is 1.93 (95% CI, 1.54–2.42). There was significant heterogeneity among the studies' results ($P = .03$).

Cosgrove, Clin Infect Dis 2003

MRSA Surgical Site Infections

Outcome	Uninfected (N=193)	MSSA (N=165)	MRSA (N=121)	p value
Death (%)	2.1	6.7	20.7	<0.001
Hospital (days)	5	14	23	<0.001
Median cost ($)	29,455	52,791	92,363	<0.001

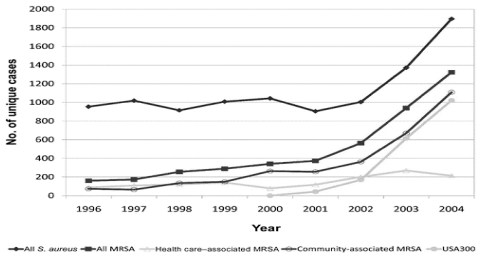
Engemann, Clin Infect Dis 2003

Why does antibiotic resistance affect outcome?

- Host factors
- Organism virulence
- Delay in instituting effective therapy (or vancomycin less effective)

Bradley, Clin Infect Dis 2002; Paterson, Clin Infect Dis 2004; Kim, Antimicrob Agents Chemother 2008

Community-associated MRSA



Community-associated MRSA from laboratory-based surveillance, San Francisco, CA, Miller, Clin Infect Dis 2008.

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; SCC_{mec} IV; PVL+)

Moran, NEJM 2006

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, AMMI/CACMID 2008; Abstr. SP-31

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MRSA in Canada Acquisition

Acquisition	1995-2002	2003-2007
Healthcare-associated	92.8	79.5
Community-associated	7.2	20.5

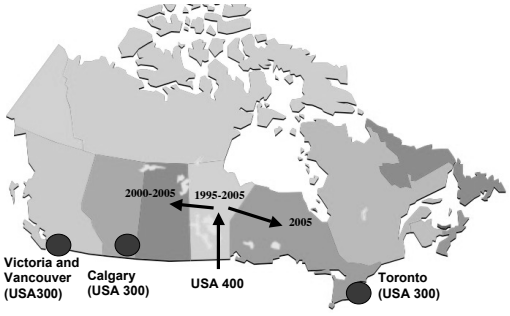
Canadian Nosocomial Infection Surveillance Program

Community-Associated MRSA

Clonal predominance

- CMRSA10 (USA300)
- CMRSA7 (USA400)

Dissemination of CA-MRSA



Wylie, J Clin Microbiol 2005; Mulvey, Emerg Infect Dis 2005; Gilbert CMAJ 2006.

CA-MRSA Patient Profile

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

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

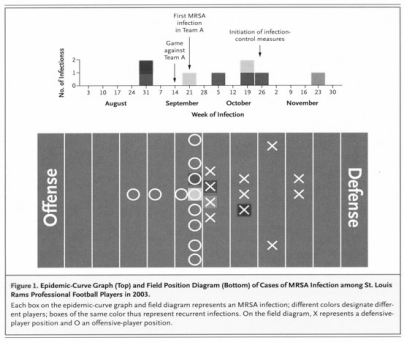


Figure 1. Epidemic-Curve Graph (Top) and Field Position Diagram (Bottom) of Cases of MRSA Infection among St. Louis Rams Professional Football Players in 2003.
Each box on the epidemic-curve graph and field diagram represents an MRSA infection; different colors designate different players; boxes of the same color thus represent recurrent infections. On the field diagram, X represents a defensive-player position and O an offensive-player position.

Kazakova, NEJM 2005

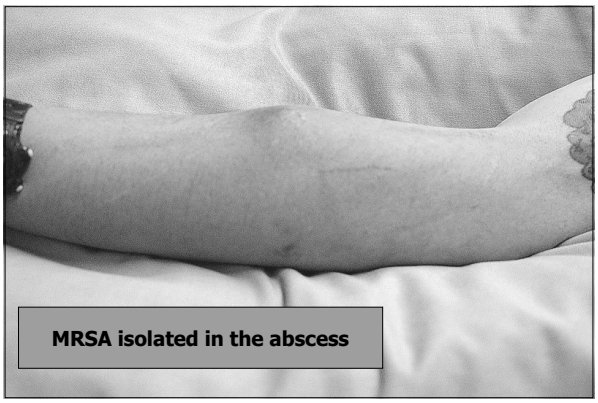
CA-MRSA

Clinical Presentations

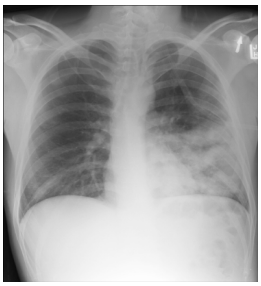
- skin/soft tissue, furuncles, abscess, cellulitis, necrotizing fasciitis
- necrotizing pneumonia ± empyema
- bone/joint infection
- toxic-shock syndrome

Furuncle finger

Furuncle finger



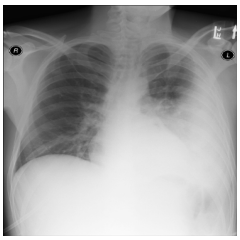
Admission CXR



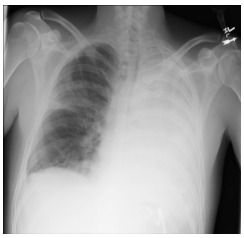
- patchy infiltrates LLL and lingula
- streaky opacification RLL

CXR Progression: 24 - 48 hrs

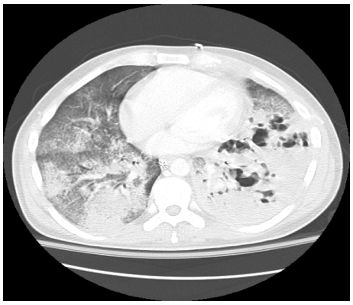
CXR 24 hrs with pleural effusion and ↑ opacification RLL



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% nosocomomial MRSA BSIs, Atlanta, GA (Seybold, CID 2006)
- USA300 common cause of SSI, University of Alabama (Patel, J Clin Microbiol 2007)

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

INFECTIOUS DISEASE » 'WHEN I CAME HOME, I STARTED TO HAVE BAD PAIN'

Hospital sued over crippling superbug

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

BY LISA PRIEST TORONTO

A young man training to become a chef is suing a Toronto hospital, claiming inadequate isolation and infection-control procedures caused him to catch a superbug, permanently disabling him.

Matthew Rash, 30, said he tested negative for methicillin-resistant *Staphylococcus aureus* (MRSA) when he was admitted to Bridgepoint Hospital almost four years ago. He was sent there for rehabilitation after undergoing surgery at another hospital for injuries, including a broken left leg, fractured right foot and ankle, which were the result of a car crash.

"When I came home [from Bridgepoint], I started to have bad pain," Mr. Rash said in a telephone interview. "I went to the doctor; she took off my bandage and green goo floated out of my foot."

He is seeking $350,000 in damages, saying Bridgepoint did not move an alleged MRSA carrier to an isolation unit, staff failed to follow the hospital's infection-control protocol and workers did not thoroughly wash their hands, according to a statement of claim filed in Ontario Superior Court. The claim contains allegations that have not been proven in court.

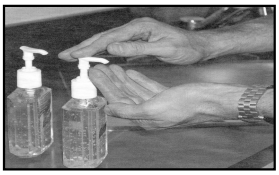
Bridgepoint Hospital denies causing Mr. Rash's superbug infection, saying none of the patients on his ward tested positive for MRSA during his hospital stay, according to the statement of defence.

» SEE 'SUPERBUGS' PAGE A6

Toronto Globe & Mail, Oct. 2007

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

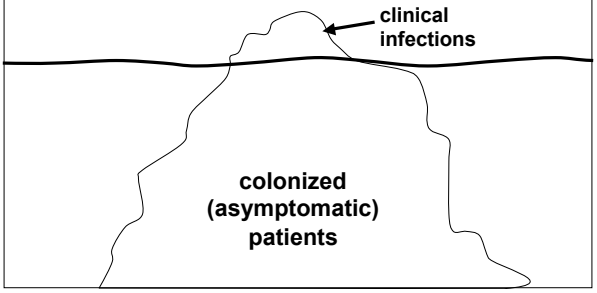
Contact Precautions Work to Decrease MRSA Transmission

	Source	
	Isolated	Unisolated
Transmissions	5	10
Patient-days	558	72
Rates	0.009	0.140

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

Jernigan, Am J Epidemiol 1996

Reservoir for the Spread of MRSA



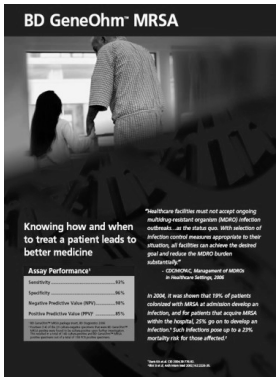
Active Surveillance to Control Spread of MRSA

- 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 (eg. 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)
- **observational/quasi-experimental studies** (Jernigan, Am J Epidemiol 1996; Chaix, JAMA 1999; Huang, Clin Infect Dis 2006; Robicsek, Ann Intern Med 2008)
- **mathematical models** (Bootsma, PNAS 2006)

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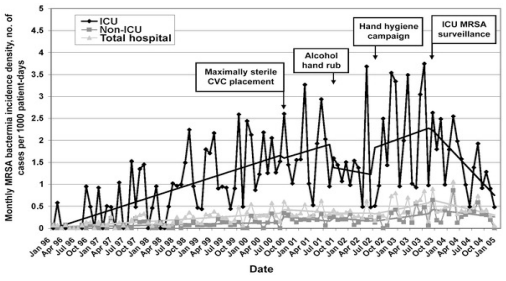
Healthcare-Associated MRSA Bacteremia Rates



Huang, Clin Infect Dis 2006

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

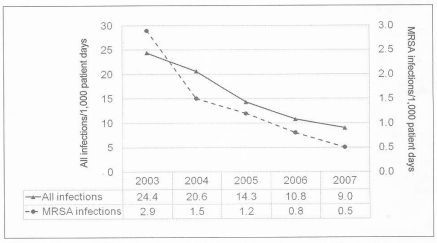
Aldeyab, J Hosp Infect 2009

MRSA: The Dutch Experience

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

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

Controlling MRSA with Broad-Based Infection Control Interventions



	2003	2004	2005	2006	2007
All infections	24.4	20.6	14.3	10.8	9.0
MRSA infections	2.9	1.5	1.2	0.8	0.5

Figure 1. Nosocomial infections due to MRSA and all organisms per 1,000 patient days, 2003 through 2007, at VCU Medical Center.

Edmond, Am J Infect Control 2008

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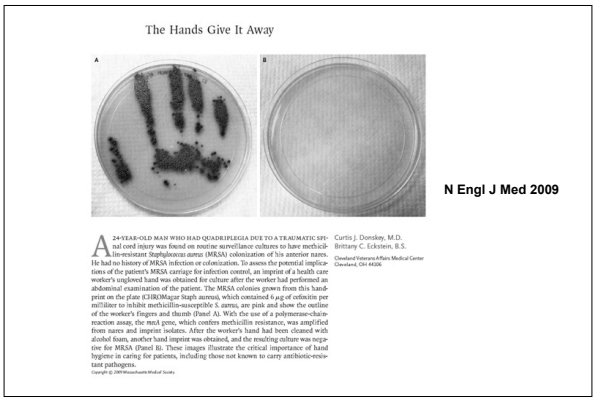
CA-MRSA
Information for Patients and Family Members (1)

- 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

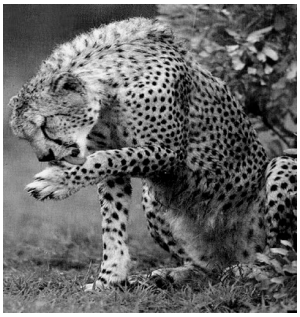

The Hands Give It Away

A 24-YEAR-OLD MAN WHO HAD QUADRIPLEGIA DUE TO A TRAUMATIC SPINAL cord injury was found on routine surveillance cultures to have methicillin-resistant Staphylococcus aureus (MRSA) colonization of his anterior nares. He had no history of MRSA infection or colonization. To assess the potential implications of the patient's MRSA carriage for infection control, an imprint of a health care worker's ungloved hand was obtained for culture after the worker had performed an abdominal examination of the patient. The MRSA colonies grown from this handprint on the plate (CHROMagar Staph aureus), which contained 6 μg of cefoxitin per milliliter to inhibit methicillin-susceptible S. aureus, are pink and show the outline of the worker's fingers and thumb (Panel A). With the use of a polymerase-chain-reaction assay, the mecA gene, which confers methicillin resistance, was amplified from nares and imprint isolates. After the worker's hand had been cleaned with alcohol foam, another hand imprint was obtained, and the resulting culture was negative for MRSA (Panel B). These images illustrate the critical importance of hand hygiene in caring for patients, including those not known to carry antibiotic-resistant pathogens.

Curtis J. Donskey, M.D.
Brittany C. Eckstein, B.S.
Cleveland Veterans Affairs Medical Center
Cleveland, OH 44106

N Engl J Med 2009

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, CDC
21 Oct. 09	(South Pacific Teleclass) National Work on the Prevention of Healthcare Acquired Infections in Australia Speaker: Dr. Marilyn Cruikshank, Australian Commission on Safety & Quality in Healthcare
22 Oct. 09	(Free Teleclass) Improving Infection Control in Developing Countries Speaker: Dr. Benedetta Allegranzi, World Health Organisation
29 Oct. 09	Prevention of Catheter-Associated Urinary Tract Infection: New

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