

DSM Micro Notes



CLINICAL MICROBIOLOGY DISCIPLINE PUBLICATION
DIAGNOSTIC SERVICES OF MANITOBA

November 13, 2009

Methicillin Resistant Staphylococcus aureus (MRSA)

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MRSA – Definition:

Methicillin resistant Staphylococcus aureus (MRSA) is defined as *S. aureus* (Figure 1) that is resistant to penicillinase stable penicillins (e.g. methicillin, oxacillin, and cloxacillin). Resistance results from an alteration in the beta-lactam target site, NOT from beta-lactamase production.

MRSA isolates are resistant to all conventional beta-lactam antibiotics, including penicillins (e.g. penicillin, cloxacillin, ampicillin), cephalosporins (e.g. cefazolin, cefuroxime, ceftriaxone), carbapenems (e.g. imipenem, ertapenem, meropenem), and monobactams (e.g. aztreonam). MRSA isolates are also resistant to beta-lactam/beta-lactamase inhibitor combinations (e.g. piperacillin-tazobactam).

Clinical Disease:

MRSA may cause significant disease, including skin and soft tissue infections, joint infections (septic arthritis), bone infections (osteomyelitis), bacteremia, heart valve infections (endocarditis), and pneumonia.

Frequency of Occurrence:

In Winnipeg, 15 to 20% of *S. aureus* isolates evaluated at the Health Sciences Centre and St. Boniface General Hospital Microbiology Labs in 2008 were MRSA. Clinicians should be aware that within Manitoba, there may be significant geographic variability in MRSA rates. As illustration of this point, in 2008 42% of all *S. aureus* isolates evaluated at the Thompson Hospital Microbiology Laboratory were MRSA.

Community versus Hospital-Associated MRSA:

MRSA may be subdivided into community-associated (CA) and hospital-associated (HA) strains. HA-MRSA may be defined as MRSA isolates obtained from patients who meet at least one of the following criteria:

- Isolation of MRSA more than 48 hours after hospital admission
- History of hospitalization, dialysis, surgery, or residence in a long term care facility within 1 year of the culture date
- Presence of an indwelling catheter or percutaneous device at the time of culture
- Previous isolation of MRSA

HA-MRSA strains tend to circulate and be transmitted within health care facilities. Conversely, CA-MRSA strains are strains isolated from patients with none of the above risk factors. These strains are obtained from individuals in the community who have not had

exposure to the health care system. Distinct populations/risk factors have been associated with the acquisition of CA-MRSA (Table 1).

CA-MRSA strains differ genetically from HA-MRSA strains, allowing for separation of strain type based on pulsed field gel electrophoresis (PFGE). PFGE involves the comparison of large genomic DNA fragments after digestion with a restriction enzyme. The distribution of MRSA (CA-MRSA versus HA-MRSA) in representative hospitals in Winnipeg is presented in Table 2.

Transmission:

Spread of MRSA results from physical contact. Transmission in the hospital environment may be prevented through the use of contact precautions when caring for infected patients (patient isolation, gloves, gowns, dedicated patient care equipment), as well as through meticulous hand hygiene.

Antimicrobial Susceptibility:

Susceptibility of MRSA to various antimicrobials is presented in Table 3. In general, HA-MRSA isolates are more likely to be resistant to multiple antimicrobial agents than CA-MRSA isolates.

Table 1. Risk Factors for CA-MRSA Infection

High risk populations

- Younger people
- Minority populations – Native/Aboriginal, African American
- Athletes – those involved in contact sports (football teams, wrestling teams, other competitive sports)
- Intravenous drug use
- Men who have sex with men
- Military personnel
- Inmates of correctional institutions

Previous MRSA cultures

- MRSA carriage
- Past MRSA infection

Medical History

- Chronic skin disorder/chronic dermatitis
- Recurrent or recent antimicrobial use

Environmental factors

- Low socioeconomic status
- Overcrowding
- Contact with colonized pet
- Veterinary work

Table 2. Distribution of CA-MRSA versus HA-MRSA, 2008^a

	Percentage of Isolates	
	CA-MRSA	HA-MRSA
Health Sciences Centre	65%	35%
St. Boniface General Hospital	47%	53%

^aData based on new isolates identified at the Health Sciences Centre and St. Boniface General Hospital Microbiology Labs in 2008. Distinction between CA-MRSA and HA-MRSA based only on pulsed field gel electrophoresis strain type.

Table 3. Antimicrobial Susceptibility of MRSA Isolates Obtained from Patients in Canadian Hospitals, 2008^a

Organism (number tested)	Antimicrobial (% Susceptible)						
	Oxacillin	Tetracycline ^b	Clindamycin	TMP/SMX	Ciprofloxacin	Vancomycin	Linezolid
MSSA (735)	100	n.d.	92.5	98.8	87.3	100	100
MRSA (272)	0	n.d.	45	90	13	100	100
CA-MRSA (75)	0	n.d.	80	100	30.7	100	100
HA-MRSA (187)	0	n.d.	27.3	85	3.2	100	100

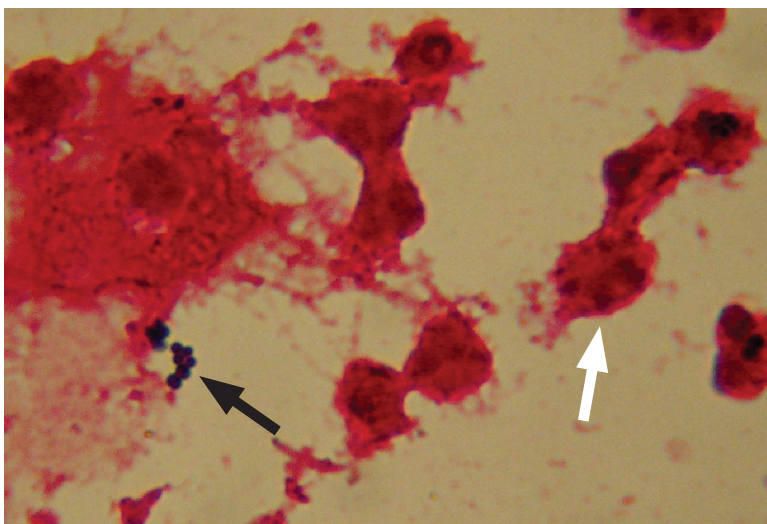
n.d. = no data, TMP/SMX = trimethoprim/sulfamethoxazole

Distinction between HA-MRSA and CA-MRSA was made entirely on the basis of pulsed field gel electrophoresis strain type.

^aData obtained from the CANWARD study (Zhan et al., <http://can-r.ca/>). Isolates were from respiratory, wound, bloodstream, and urine sources. Surveillance isolates were excluded from CANWARD.

^bTetracycline susceptibility was not evaluated in CANWARD. MSSA and CA-MRSA are typically susceptible to tetracycline. Susceptibility of HA-MRSA to tetracycline is variable.

Figure 1. Staphylococcus aureus Gram Stain



S. aureus (black arrowhead) seen in Gram stain from a wound swab. The typical appearance of gram-positive cocci in clumps is apparent here. Numerous pus cells (white arrowhead) are also present.

References:

1. Barton, M et al. Guidelines for the prevention and management of community-associated methicillin-resistant Staphylococcus aureus: A perspective for Canadian health care practitioners. Can J Infect Dis Med Microbiol 2006;17(suppl C):4C-24C.