Clinical Utility of the Methicillin-Resistant S. aureus (MRSA) Nasal Swab Test
FM - Male, 38yo

- HPI: Previously healthy male presents to ED febrile (102F) and in moderate distress ~2 weeks after getting a tattoo on his left forearm. There is diffuse left forearm swelling and erythema and patient reports pain as 8/10. Picture of affected area taken yesterday shows a large carbuncle near patient’s left elbow that has apparently ruptured and is now draining serosanguineous fluid. Given 1g vancomycin in ED and admitted for SSTI w/ SIRS.

- MRSA nasal swab (+)

- “Due to positive MRSA nasal swab test, patient will be continued on Vancomycin 1500mg IV q12 for MRSA treatment...”

...Is this appropriate?
Objectives

Clinical Utility of the MRSA Nasal Swab Test

1) What is the purpose of the MRSA nasal swab?
2) Is it an accurate method for detection of MRSA in nares?
3) Is there a correlation between MRSA nasal colonization and MRSA infection?
4) Can the MRSA nasal swab be used to guide treatment for active infections?
   - Does its utility vary based on infection site?
5) Reexamine patient case
Objective 1

What is the purpose of the MRSA nasal swab?
MRSA – Why do we care?

- NHSN Report (2009-2010): 54.6% of S. aureus CLABSIs, 58.7% of S. aureus catheter-associated UTIs, 48.4% of S. aureus VAP, and 43.7% of S. aureus SSIs caused by MRSA

- MRSA HAIs associated with significant morbidity and mortality.
  - Compared with patients with an MSSA SSI, one study found that those with an MRSA SSI have a 3.4x higher risk of death and almost 2x greater median hospital costs.

- The reservoir for transmission composed of 2 groups of patients; those with clinical MRSA infection and asymptomatic MRSA carriers.

- Guidance document - SHEA, IDSA, AHA, APIC, Joint Commission

- PURPOSE: To assist acute care hospitals in implementing and prioritizing their (MRSA) prevention efforts.

“Part 2. **Implement an MRSA monitoring program.**

a. The MRSA monitoring program should have **2 goals**:  
   i. Identify any patient with a current or prior history of MRSA to **ensure application of infection prevention strategies** for these patients...  
   ii. Provide a mechanism for tracking hospital-onset cases of MRSA for purposes of **assessing transmission and infection and the need for response...**”
Objective 1: Summary

The purpose of the MRSA nasal swab test is to prevent MRSA transmission and infection.

1) By instituting contact precautions
2) By continually assessing MRSA transmission, infection, the need for response.
Objective 2

Is the MRSA nasal swab test an accurate method for detection of MRSA in nares?
Multicenter evaluation of the Cepheid Xpert (MRSA) test as a rapid screening method for detection of MRSA in nares.

- **OBJECTIVE:** To assess the performance of the Cepheid Xpert MRSA assay.

- **METHODS:** 1,077 nares specimens collected from 7 geographically distinct health care sites across the US
  - Nares specimens tested by:
    - The Xpert MRSA PCR assay
    - Direct culture on CHROMagar MRSA medium (direct CM culture)
    - Broth-enriched culture followed by plating onto CHROMagar MRSA medium (broth-enriched CM culture)
Multicenter evaluation of the Cepheid Xpert (MRSA) test as a rapid screening method for detection of MRSA in nares.

**RESULTS:**

- **Direct CM culture (reference)**
  - Sensitivity 94.3%, specificity 93.2%, PPV 73%, NPV 98.8%

- **Broth-enriched CM culture (reference)**
  - Sensitivity 86.3%, specificity 94.9%, PPV 80.5%, NPV 96.6%

- BD GeneOhm MRSA (BDGO) assay also performed as comparative method. No statistical differences observed.

**CONCLUSION:** The Xpert MRSA assay is a simple, rapid, and accurate method for performing active surveillance for MRSA in a variety of health care populations.⁴
Objective 2: Summary

The Xpert MRSA PCR assay is an accurate method of detecting MRSA nasal colonization.

Sensitivity 86.3%, specificity 94.9%, PPV 80.5%, NPV 96.6%

- Gained **FDA Approval** in 2007 for detection of MRSA from nares specimens.
- Most rapid of all commercial MRSA PCR methods (turnaround <1hr)
Objective 3

What is the correlation between MRSA nasal colonization and MRSA infection?
OBJECTIVE: To evaluate the impact of asymptomatic nares MRSA colonization on the development of subsequent MRSA infection.

METHODS: Prospective evaluation of 758 patients with nares samples obtained at admission and during hospitalization. Culture results monitored to identify MRSA infections that occurred during study and 1 year thereafter.

RESULTS: Of the patients who had cultures of nares samples performed at admission; 3.4% colonized with MRSA, 21% colonized with MSSA.

- MRSA colonization at admission increased the risk of subsequent MRSA infection, compared with MSSA colonization (RR=13; 95% CI: 2.7-64) or no staphylococcal colonization (RR=9.5; 95% CI: 3.6-25)

CONCLUSIONS: MRSA colonization of nares, either present at admission or acquired during hospitalization, increases the risk for MRSA infection.
Objective 4

Can the MRSA nasal swab test be used to guide antimicrobial treatment decisions?
OBJECTIVE: To examine whether MRSA nasal colonization predicts MRSA involvement in a patient with positive clinical cultures from sites of suspected infection elsewhere in the body.

METHODS: Retrospective review of 5,779 nasal MRSA tests performed within a 24-h period before or after a clinical culture showed growth of any organism.

RESULTS and CONCLUSIONS:
- Positive nasal MRSA test strongly predicted MRSA involvement at a clinical site, RR=12.9 (95% CI: 10.4-16.1)
- Negative nasal MRSA test less useful
  - Only 67.2% patients (95% CI: 61.8-72.3) with MRSA clinical cultures had concomitant nasal MRSA colonization.
**Prediction of Methicillin-Resistant Staphylococcus aureus Involvement in Disease Sites by Concomitant Nasal Sampling**

**TABLE 1. Nasal-MRSA-colonization status of patients with MRSA recovered from clinical cultures**

<table>
<thead>
<tr>
<th>MRSA culture site</th>
<th>No. of patients with indicated nasal-colonization test result</th>
<th>% of clinically positive patients who were nasally positive (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Negative</td>
<td>Positive</td>
</tr>
<tr>
<td>Bloodstream</td>
<td>11</td>
<td>31</td>
</tr>
<tr>
<td>Extremity</td>
<td>39</td>
<td>62</td>
</tr>
<tr>
<td>Other*</td>
<td>30</td>
<td>45</td>
</tr>
<tr>
<td>Respiratory</td>
<td>6</td>
<td>18</td>
</tr>
<tr>
<td>Ulcer</td>
<td>6</td>
<td>14</td>
</tr>
<tr>
<td>Urine</td>
<td>14</td>
<td>47</td>
</tr>
<tr>
<td>Total</td>
<td>106</td>
<td>217</td>
</tr>
</tbody>
</table>

* Most frequently, “other” cultures were obtained from the abdominal wall, buttock, or breast.

**TABLE 2. Prevalence of MRSA in clinical cultures included in the study**

<table>
<thead>
<tr>
<th>MRSA culture site</th>
<th>No. of cultures that were:</th>
<th>% of cultures positive for MRSA (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Negative</td>
<td>Positive</td>
</tr>
<tr>
<td>Bloodstream</td>
<td>970</td>
<td>42</td>
</tr>
<tr>
<td>Extremity</td>
<td>356</td>
<td>101</td>
</tr>
<tr>
<td>Other*</td>
<td>789</td>
<td>75</td>
</tr>
<tr>
<td>Respiratory</td>
<td>402</td>
<td>24</td>
</tr>
<tr>
<td>Ulcer</td>
<td>52</td>
<td>20</td>
</tr>
<tr>
<td>Urine</td>
<td>2,887</td>
<td>61</td>
</tr>
<tr>
<td>Total</td>
<td>5,456</td>
<td>323</td>
</tr>
</tbody>
</table>

* Most frequently, “other” cultures were obtained from the abdominal wall, buttock, or breast.
Predictive value of methicillin-resistant Staphylococcus aureus (MRSA) nasal swab PCR assay for MRSA pneumonia.

**OBJECTIVE:** To evaluate the performance of the nasal swab MRSA PCR assay in predicting MRSA pneumonia.

**METHODS:**
- Total of 435 patients with clinically confirmed pneumonia included.
- Majority of cases HCAP (54.7%) or CAP (34%)
RESULTS:
- MRSA nasal PCR positive in 62 (14.3%) cases
- MRSA pneumonia confirmed by culture in 25 (5.7%) cases
- 88.0% sensitivity, 90.1% specificity, PPV=35.4%, NPV=99.2%

CONCLUSIONS:
- “In cases of culture-negative pneumonia where initial empirical antibiotics include a MRSA-active agent, a negative MRSA PCR swab can be reasonably used to guide antibiotic de-escalation.”
OBJECTIVE: To determine potential risk factors for MRSA SSTIs.

METHODS: Case-control study of patients treated at 2 hospital-affiliated outpatient clinics in Taiwan. Risk factors identified by multivariate analysis.

RESULTS: S. aureus isolated from 39/100 eligible patients, 74% MRSA.

- Significant risk factors identified for MRSA SSTIs
  - Male gender (P = 0.09)
  - Nasal carriage of MRSA (P = 0.02)
  - Exposure to individual who had surgery within a year before infection (P = 0.02)
  - Antibiotic treatment for SSTI in the year before infection (P = 0.04)
Patient Case Review

- FM (56”, 105kg) is a 38yo previously healthy, moderately distressed male w significant swelling, erythema and pain of left forearm originating from a tattoo he received near left wrist ~2 weeks ago. Large carbuncle near left elbow ruptured and is draining clear, serosanguinous fluid. Admitted for purulent SSTI w systemic signs of infection.

- T 102, HR 84, BP 167/75, RR 24, WBC 8,000

- MRSA nasal swab (+)

- Blood culture: no growth after 24 hours

“Due to positive MRSA nasal swab test, patient will be continued on Vancomycin 1500mg IV q12 for MRSA treatment...”
Management of Purulent SSTI

- Majority of purulent skin infections caused by *S. aureus*

- Based on a (+) MRSA nasal swab test ....can we conclude this SSTI is caused by MRSA?
  - No, but MRSA nasal colonization is a risk factor for MRSA infection, regardless of site.

- IDSA Guidelines for the Diagnosis and Management of SSTIs (2014) recommend that empiric treatment include a MRSA-active agent.\(^\text{10}\)

- Appropriate management of patient FM at this time:
  - Culture of wound exudate - to definitely determine causative agent
  - Begin administering antibiotic with activity against MRSA while awaiting speciation and susceptibilities
Management of Purulent SSTI

2014 IDSA SSTI Guidelines

Figure 1. Purulent skin and soft tissue infections (SSTIs). Mild infection: for purulent SSTI, incision and drainage is indicated. Moderate infection: patients with purulent infection with systemic signs of infection. Severe infection: patients who have failed incision and drainage plus oral antibiotics or those with systemic signs of infection such as temperature >38°C, tachycardia (heart rate >80 beats per minute), tachypnea (respiratory rate >24 breaths per minute) or abnormal white blood cell count (<12,000 or <400 cells/μL), or immunocompromised patients. Nonpurulent SSTIs. Mild infection: typical cellulitis/erysipelas with no focus of purulence. Moderate infection: typical cellulitis/erysipelas with systemic signs of infection. Severe infection: patients who have failed oral antibiotic treatment or those with systemic signs of infection (as defined above under purulent infection), or those who are immunocompromised, or those with clinical signs of deeper infection such as bullae, skin sloughing, hypotension, or evidence of organ dysfunction. Two newer agents, tedizolid and dalbavancin, are also effective agents in SSTIs, including those caused by methicillin-resistant *Staphylococcus aureus*, and may be approved for this indication by June 2014. Abbreviations: C & S, culture and sensitivity; I & D, incision and drainage; MRSA, methicillin-resistant *Staphylococcus aureus*; MSSA, methicillin-susceptible *Staphylococcus aureus*; Rx, treatment; TMP/SMX, trimethoprim-sulfamethoxazole.
The CDC encourages clinicians to consider MRSA in the differential diagnosis of skin and soft tissue infections (SSTIs) compatible with S. aureus infections, especially those that are purulent.
Clinical Utility of MRSA Nasal Swab is Limited

- Patients that are MRSA nasal carriers are at an increased risk for subsequent MRSA infections, at any site.

- Evidence for MRSA nasal swab clinical utility most compelling for **MRSA pneumonia** – upper + lower resp. tract
  - Negative MRSA swab result can be reasonably used to de-escalate ABX treatment

- In general, the risk of not effectively treating a MRSA infection is greater than the risk of providing MRSA coverage that proves to be unnecessary (side effects/toxicity, resistance, etc.)
  - IDSA: when in doubt of organism responsible for purulent SSTI – treat with antibiotic with MRSA activity
References


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