Preventing Healthcare-Associated Methicillin-Resistant Staphylococcus aureus Infections
Dr. William Jarvis, Jason and Jarvis Associates
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SHEA MRSA Recommendations

Outcomes Associated With MRSA-HAIs
- MRSA HAIs are associated with significant morbidity and mortality;
- Compared to patients with methicillin-susceptible S. aureus (MSSA) bacteremia, those with MRSA bacteremia have nearly twice the mortality rate, significantly longer hospital stays, and significantly increased median hospital costs;
- Compared to patients with an MSSA surgical site infection (SSI), those with an MRSA-SSI, have 3.4-times higher risk of death and almost two times greater median hospital costs;

Risk of MRSA-HAI Among Colonized Patients
- A substantial proportion of colonized patients will subsequently develop an MRSA infection;
- One study of persons in whom MRSA colonization had been identified during a previous hospital stay reported that the risk of developing an MRSA infection, such as bacteremia, pneumonia, or soft tissue infection, within 18 months of detection of MRSA colonization was 29%.

Rationale and Statements of Concern
- Increasing rates of hospital-acquired infections (HAI) caused by methicillin-resistant Staphylococcus aureus (MRSA) in acute-care facilities;
- In the U.S., the rate of methicillin resistance among hospital-associated S. aureus infections in intensive care unit (ICU) patients has steadily increased and approaches 60%; and
- MRSA has also been documented in other areas of the hospital and other types of healthcare facilities including those that provide long-term care.


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**Surveillance Definitions**

- **Hospital-onset MRSA:** A patient’s first MRSA isolate is classified as a new case of “hospital-onset MRSA” if it is identified from a specimen obtained after the third calendar day of hospitalization, with the day of admission being counted as calendar day number one.
- **Community-onset MRSA:** A patient’s first MRSA isolate is classified as “community-onset” if it is identified from a specimen obtained on or before the third calendar day of a patient’s hospitalization, with the day of admission being counted as calendar day number one.


**Methods for MRSA Surveillance—Active Surveillance Testing**

- Active surveillance testing for MRSA can be defined as performing diagnostic testing for the purpose of detecting asymptomatic MRSA colonization.
- Involves collection of superficial swab specimens from ≥1 common sites of MRSA colonization.
- Tests specimens for the presence of MRSA using bacterial culture techniques or other methodologies.
- Detects a large proportion of the MRSA-colonized persons within a hospital who otherwise would go undetected.
- Identifies patients who are already colonized at the time of admission so that subsequent MRSA isolates are not falsely attributed to intra-facility acquisition.
- May more accurately monitor MRSA transmission and effectiveness of prevention programs than monitoring of clinical specimens alone.
- May reduce the potential for unrecognized patient-to-patient transmission of MRSA when colonized patients are placed into contact precautions.
- Multiple published reports have shown an association between active surveillance testing and control of MRSA when such testing was included as part of a comprehensive MRSA prevention program.


**Methods for MRSA Surveillance—Routine Surveillance of Clinical Specimen**

- The reservoir for transmission of MRSA is largely composed of the group of patients who are merely colonized. Various surveillance methods can be used to identify one or both of these groups.
- **Routine surveillance of clinical specimens:** Clinically infected patients and some asymptomatically colonized patients are recognized when MRSA is isolated from a clinical specimen sent to the microbiology laboratory.
- A program to identify patients from whom MRSA has been isolated from a clinical specimen should be in place in all hospitals.
- A common surveillance strategy used by IC programs includes a daily review of laboratory culture results to identify patients from whom MRSA has been isolated.
- However, studies have shown that this method is not reliable for identifying asymptomatically colonized patients, potentially missing 85% of this group. Active surveillance testing can be useful in detecting this group of patients.


**Recommendations for Implementing Prevention and Monitoring Strategies**

- **Institute basic practices**
- Conduct an MRSA risk assessment
- Educate HCWs regarding MRSA
- Ensure compliance with hand hygiene recommendations
- Ensure proper disinfection with equipment and environment
- Ensure compliance with contact precautions for colonized and infected patients
- Implement an MRSA monitoring program
  o Implement an MRSA line-list
  o Implement a laboratory-based alert system so that new cases of MRSA are immediately identified by IC program
  o Implement an alert system that identifies readmitted or transferred MRSA-positive patients


- **Continue to monitor MRSA rates**
- Develop a regular reporting system to relevant stakeholders, physicians, nurses, staff, and other hospital leaders.
- Hold relevant individuals and groups accountable for implementing and complying with basic prevention measures.


**Recommendations for Implementing Prevention and Monitoring Strategies**

- **If MRSA NOT effectively controlled**
- Ensure compliance with basic practices
- Institute advanced practices
  – Conduct active surveillance for MRSA colonization among patients
  – Ensure compliance with active surveillance program
- Continue to monitor MRSA rates
- Continue MRSA reporting and accountability system


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Recommendations for Implementing Prevention and Monitoring Strategies
- If MRSA STILL NOT effectively controlled
- Ensure compliance with advanced practices
- Assess need to intensify active surveillance testing program
- Consider additional control measures
  - Decolonization/eradication therapy
  - Active surveillance testing among HCW
- Continue to monitor MRSA rates
- Continue MRSA reporting and accountability system

U.S. MRSA Hospitalizations
- From 2000-2005, MRSA hospitalizations increased from ~45/100,000 population to ~115/100,000 population (Zilberberg M et al. EID 2008;14:1756-8). 2.6 fold increase
- From 1999-2005, MRSA-related U.S. hospitalizations increased from 127,036 to 278,203 (Klein E et al. EID 2007;13:1840-6). 2-fold increase

Invasive MRSA Infections in the United States, 2005
- 8,987 cases of invasive MRSA (July 2004- December 2005).
- HA-MRSA: 7,639 (85%), CA-MRSA 1,234 (13.7%), 114 (1.3%) not classified.
  - HA-MRSA-community onset rate: 17.6 per 100,000.
  - HA-MRSA-hospital-onset rate: 8.9 per 100,000
  - Community-acquired-MRSA rate: 4.6 per 100,000 (interval estimate: 3.6-4.4).
- When standardized for the U.S. population, it was estimated that in 2005:
  - 94,360 patients had invasive MRSA infections
  - 18,650 in-hospital deaths from invasive MRSA.

Location-Specific Methicillin-Resistant Staphylococcus aureus (MRSA) Healthcare-Associated Infections (HAIs), Centers for Disease Control and Prevention’s National Healthcare Safety Network (NHSN), 2009
- Background: The recent SHEA/HICPAC position paper recommends monitoring MRSA-HAIs by patient-care area, yet national data on all types of MRSA-HAIs by patient location have never been reported.
- Objective: Describe MRSA-HAIs reported from various patient-care locations in NHSN hospitals.
- Methods: Data on all MRSA-HAIs reported to the CDC’s NHSN Multidrug-Resistant Organism (MDRO) and Clostridium difficile-Associated Disease (CDAD) Module from January-September 2009 were analyzed. An MRSA-HAI incidence rate (MRSA-HAIs /1,000 patient-days) was calculated for each facility-defined patient unit (unit-specific), and data were also summed across all units of the same type for a pooled mean MRSA-HAI incidence rate (location-specific).

Results:
- 403 facilities performed MRSA-HAI surveillance in ≥ 1 unit for ≥ 1 month.
- 197 (48.8%) reported no MRSA-HAIs.
- 206 facilities reported 915 MRSA-HAIs from 317 facility-defined patient units which mapped to 38 different location types.
- Most reporting facilities were general hospitals and 54% had ≤ 200 beds.
- Of all MRSA-HAIs reported,
  - 55% were among males.
  - Mean patient age was 58 (range: 0-102) years.

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Location-Specific Methicillin-Resistant Staphylococcus aureus (MRSA) Healthcare-Associated Infections (HAIs), Centers for Disease Control and Preventions, National Healthcare Safety Network (NHSN), 2009

Conclusions:
Bloodstream infections (BSIs) represent a minority of the MRSA HAI identified from the select locations evaluated. Hospital wards had MRSA infection incidence rates comparable to the ICUs. Focusing MRSA surveillance only on BSIs in ICUs overlooks a large proportion of the patient population at high risk for MRSA-HAI.

Sewell CM et al., Abstract S20, FPR Decennial Conference, Atlanta, GA March 18-22, 2010

The APIC National MRSA Inpatient Survey Results: HA-MRSA vs. CA-MRSA

HA-MRSA (74%)

CA-MRSA* (26%)

*CA-MRSA = diagnosed <48 hours, skin/soft tissue infection, susceptible to clindamycin and Levofloxacin.

APIC U.S. Inpatient MRSA Prevalence Survey, October 2006

- 8,654 MRSA patients with colonization/infection.
- 187,058 inpatients
- Overall MRSA prevalence rate: 46.3 per 1,000 inpatients.


Seattle Times Investigative Report on MRSA
- Mike Berens and Ken Armstrong (November 2008)
- Methods: Reviewed available data (comprehensive state hospital records, death certificates, and other records) for the decade 1996-2006.
- Results: 2000 to 2006: MRSA infections increased from 815 to 4843 and deaths increased from 58 to 190 per year.
- During the decade, MRSA infection rates increased 33-fold;
- At least 23,707 documented MRSA infections and 1217 deaths.
- If each infection cost $20,000. Washington state has spent >$474 million on MRSA infections.

Seattle Times Investigative Report on MRSA

- http://seattletimes.nwsource.com/html/localnews/2008403751_mrsaday3m0.html

Invasive MRSA (mostly HA-MRSA and mostly BSI) kills nearly 19,000 patients annually in the United States.

<table>
<thead>
<tr>
<th>Cause</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>MRSA (invasive)</td>
<td>~19,000</td>
</tr>
<tr>
<td>HIV/AIDS</td>
<td>~15,000</td>
</tr>
<tr>
<td>Parkinson’s</td>
<td>19,544</td>
</tr>
<tr>
<td>Homicides</td>
<td>18,124</td>
</tr>
<tr>
<td>Injuries at work</td>
<td>5,113</td>
</tr>
<tr>
<td>Infant mortality</td>
<td>9,070</td>
</tr>
</tbody>
</table>

Killer Staph
Experts say U.S. deaths from ‘superbug’ may surpass AIDS

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MRSA Colonization Leads to Infection
- Nares cultures on all patients admitted to five units.
- 30/756 (3.96%) patients MRSA-colonized on admission.
- 19% of those MRSA-colonized on admission and 25% of those acquiring MRSA in the hospital developed MRSA infections compared to 1.5% of those MSSA-colonized or 2% of those not colonized.
- MRSA-colonization increased infection risk compared to MSSA-colonization (RR=9.6) or un-colonized (RR=12).
- Identifying MRSA-colonized patients at admission may benefit from interventions to decrease infection.


Risk of MRSA Infection and Death in Long-term MRSA Carriers
- Study design: Follow-up of 281 prevalent (>1 yr) MRSA carriers.
- Results:
  - 65/281 developed 96 discrete and unrelated MRSA infections within 1 year.
    - Pneumonia 38%
    - Soft tissue 14%
    - CVC-infections 14%
    - BSI 24%
  - 38 MRSA infections occurred during new hospital admissions. 32 (84%) were the reason for the admission.
  - 14 deaths occurred: 22% of MRSA infections and 5% of colonized patients.

Datta R et al., CID 2008;47:176-81.

Can’t You Just Rely On Clinical Cultures To Detect MRSA-Patients?
- Muder et al. showed that in a VA Hospital Surgical Unit from November 2001-August 2002, when they performed AST (cultures) on all admitted patients, only 33/91 (36%) with MRSA-positive cultures would have been detected by clinical cultures. (Muder et al, SHEA Annual Meeting 2004).
- Salgado et al. found that of 437 patients MRSA-colonized on hospital admission, only 66 (15%) had positive clinical cultures for MRSA during their hospital stay. (Infect Control Hosp Epidemiol. 2006;27:116-21).
- Muto et al found that only 26% (118/459) of the 459 patients identified as MRSA-colonized via AST had a MRSA + clinical culture; 33/91 (36%) with MRSA-positive cultures would have been missed if AST were not in place. (Muto et al, SHEA Annual Meeting 2005).

MRSA Prevention-Guideline Comparison

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Active Surveillance Testing</td>
<td>Routinely; on admission; periodic/weekly sweeps of high-risk areas</td>
<td>AMPR, when MRDRO rates are Not going down.</td>
<td>Routinely; on admission; periodic/weekly sweeps of high-risk areas and high-risk pts. Monitor for trends</td>
<td>Routinely; on admission; periodic/weekly sweeps of high-risk areas and high-risk pts.</td>
</tr>
<tr>
<td>When to conduct</td>
<td>When MDRO rates are Not going down.</td>
<td>Routinely; on admission; periodic/weekly sweeps of high-risk areas and high-risk pts.</td>
<td>Routinely; on admission; periodic/weekly sweeps of high-risk areas and high-risk pts.</td>
<td>Routinely; on admission; periodic/weekly sweeps of high-risk areas and high-risk pts.</td>
</tr>
</tbody>
</table>

Adapted from document provided by Amber Hogan, MD. www.BD.com/HAIs

SHEA Guideline Recommendations-Five Steps to Controlling Antibiotic Resistant Pathogens: Active Detection and Isolation (ADI)
1. Risk assessment to identify high risk patients.
2. Active surveillance testing of identified high-risk populations to identify the reservoir for spread.
3. Hand hygiene.
4. Barrier precautions for patients known or suspected to be colonized or infected with epidemiologically important antimicrobial-resistant pathogens, such as MRSA or VRE.
5. Antibiotic Stewardship.
6. Decolonization or suppression of colonized patients.


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MRSA Prevention-Guideline Comparison

<table>
<thead>
<tr>
<th>IHI</th>
<th>CDC</th>
<th>SHEA</th>
<th>APIC</th>
</tr>
</thead>
<tbody>
<tr>
<td>AST of which patients?</td>
<td>High-risk patients include: hospital-acquired (≥ 48h); surgical; and vancomycin-resistant enterococci (VRE).</td>
<td>High-risk patients include: hospital-acquired (≥ 48h) and those with VRE.</td>
<td>High-risk patients include: hospital-acquired (≥ 48h) and those with VRE.</td>
</tr>
<tr>
<td>Which sites to test/culture?</td>
<td>Anterior nares will identify majority of colonized adults; adding wound cultures increases sensitivity.</td>
<td>Anterior nares usually sufficient. Obtain cultures from areas of skin breakdown and draining wounds.</td>
<td>Anterior nares areas of skin breakdown and wounds.</td>
</tr>
</tbody>
</table>

Adapted from document provided by Amber Hogan, BD; www.BD.com/HAIs

Recommendations For Preventing MRSA Transmission-Active Detection and Isolation (ADI)

- Conduct a risk assessment.
- Active surveillance testing to identify MRSA-colonized patients.
- Isolation (cohorting) of colonized and infected patients.
- Hand hygiene—before/after patient/environment contact.
- Gown and glove, if patient or contaminated environment contact anticipated.
- Routine environmental cleaning.

Selective Media

- First step towards improved turn-around time for microbiologic information in the laboratory.
- Agars that have additives:
  - Antimicrobials
  - Reaction dyes that lead to color change
  - Initially read at 18 - 24 hours
- Based on phenotypic and biologic characteristics of the organism.
- ~ equal sensitivity to non-selective growth methods.
- Examples: Mannitol salt agar, chromogenic agars, CCFA (cycloserine-cefoxitin-fructose agar), Clostridium difficile Selective Agar (CDSA), etc.

Culture Screening Methods

- Mannitol salt agar (with or without oxacillin)
- MRSA medium (Oxoid)
- MRSA Select (BioRad)
- CHROMagar MRSA
  - BD Diagnostics
  - M-Tech Diagnostics
- MRSA-ID (BioMerieux)

Rapid Molecular Diagnostics

- Molecular detection technology
  - Based on genetic characteristics
  - Using technology that amplifies the DNA and then uses probes to label the results of the amplification

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### Surveillance Methods for Detection of MRSA Colonization

<table>
<thead>
<tr>
<th>Method</th>
<th>Traditional Culture</th>
<th>Combined Culture plus rapid testing</th>
<th>Rapid molecular testing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Optimal turnaround times (hrs)</td>
<td>48 – 72</td>
<td>24</td>
<td>~ 2 - 6</td>
</tr>
<tr>
<td>Isolate available</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Details</td>
<td>Chromogenic agars, polymerase chain reaction (PCR) from oxacillin-enhanced broth, PCR from culture, latex agglutination</td>
<td>Immuno-capture plus real-time PCR, real-time PCR</td>
<td></td>
</tr>
</tbody>
</table>

### Reducing MRSA-BSI Rates

Impact of ICU Surveillance on Nosocomial MRSA Bacteria January 1996 – December 2004

75% reduction in MRSA bacteremia

### Comparison of Routine Culture vs. PCR for MRSA Control

<table>
<thead>
<tr>
<th>Method</th>
<th># Patients</th>
<th>Time to Result</th>
<th>MRSA Incidence Rate*</th>
<th>Odds Ratio</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Routine Culture</td>
<td>612</td>
<td>3 days</td>
<td>13.9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PCR</td>
<td>693</td>
<td>1 day</td>
<td>4.9</td>
<td>0.65</td>
<td>0.28-1.07</td>
</tr>
</tbody>
</table>

*Cmean rate per 1000 patient-days. Cunningham et al. JHI 2007:65:24-28

### Does True Universal MRSA Screening Reduce Transmission and MRSA Infections?

**Study Design:** Observational, prospective interventional study with universal screening using MRSA-PCR on all admissions to three hospitals (total: 850 beds and 40,000 admissions per year) in Evanston, Ill.

- **Compared:** Passive surveillance (clinical detection-12m);
- Targeted surveillance cultures (clinical culture + high risk = ICU-12m); or Universal patient screening—21m.

- **Intervention:** Nasal screening. MRSA+ contact isolation, topical decolonization (mupricin).

- Poisson and segmented regression models used to compare prevalence density. Robicsek et al. Annals Intern Med 2008;148:409-418

### Controlling Endemic MRSA

- **Study Design:** Retrospective study of 4 major infection control interventions—promoting compliance with:
  1. maximum barrier precautions;
  2. institution of alcohol-based hand rubs for hand disinfection;
  3. hand hygiene campaign; and
  4. institution of routine nares cultures for MRSA in all ICU patients on admission and weekly thereafter (+ cult contact isolation). Four years. Eight ICUs.

- **Analysis:** Interrupted time series. Huang SS. et al. CID 2006:43:971-978

- **Results:** In 16 months of active surveillance cultures for MRSA, the incidence density of MRSA-BSI decreased by 75% in the ICUs (P=.007) and by 40% in non-ICUs (P=.008), leading to a 67% hospital-wide reduction in the incidence of MRSA-BSI (P=.002). MSSA rates remained stable. The other interventions were not associated with a statistically significant change in MRSA-BSI.

- **Conclusion:** Routine surveillance for MRSA in ICUs allowed earlier initiation of contact isolation precautions and was associated with a large and statistically significant reduction in MRSA-BSI in the ICUs and hospital-wide. No similar decrease was attributable to the other infection control interventions— including hand hygiene and contact isolation. Huang SS. et al. CID 2006:43:971-978

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Impact of a 4-Year Universal Surveillance and Decolonization Program to Control Methicillin-Resistant Staphylococcus aureus (MRSA)

Objective: To expand the data available on the effect of universal surveillance, with contact isolation and decolonization of positive patients.

Study design: Observational study in a 3-hospital, 850-bed system with 40,000 annual admissions comparing MRSA clinical disease rates during and 30 days after hospital admission. Intervention using a real-time PCR-based nasal MRSA surveillance followed by topical decolonization and contact isolation of MRSA-positive patients. The evaluation involved 3 consecutive periods: baseline (1 year), MRSA surveillance for all ICU admissions (ICU; 1 year), and universal MRSA surveillance for all hospital admissions (4 years). After showing no autocorrelation, aggregate hospital-associated MRSA rates were compared using a segmented Poisson regression model. Chi square test was used for other statistical comparisons.

Conclusions: The introduction of universal admission surveillance for MRSA was associated with a large and progressive reduction in MRSA disease during admission and 30 days after discharge that was sustained for 4 years. It also reduced total S. aureus infections due to reduction in MRSA disease, global healthcare cost, and mortality.

The Veteran’s Hospital Administration (VHA) MRSA Control Program

- The national initiative focuses on implementing the VHA MRSA Bundle which consists of four essential elements (ADJ):
  - Active Surveillance Testing (AST)/Admission/Transfer/Discharge Swabbing
  - Hand Hygiene
  - Contact Precautions
  - Cultural Transformation (Leadership and Staff Engagement)
- Consistent use of the VHA MRSA Bundle had been shown to markedly reduce MRSA-related infections in the pilot facilities.
- Phase I: The VHA system began doing universal patient testing in 2006 at its approximately 150 hospitals in ICU patients.
- Phase II of the initiative began in March 2007 and was a national roll-out including all VHA medical facilities with all patients (ICU and non-ICU).
- MRSA prevalence on admission ranged from 5% to 22% (clinical culture 1-1.5%; AST 9%-12%).

Impact of a 4-Year Universal Surveillance and Decolonization Program to Control Methicillin-Resistant Staphylococcus aureus (MRSA)

The rate of total clinical S. aureus (20.2 to 13.4/1,000 admissions) and MRSA (10.4 to 4.1/1,000 admissions) (P<0.001), but MSSA did not change.

The prevalence density of aggregate hospital-associated MRSA disease (all body sites) at baseline, during ICU surveillance, and during universal surveillance was 8.9, 7.4 (P=0.15 compared with baseline), and 3.5 (P<0.001 compared with baseline and ICU surveillance), respectively.

The prevalence density of MRSA infection at each body site decreased. The percentage of exogenous MRSA fell from 48.1% to 33.3%.

This intervention was estimated to reduce healthcare infection cost by almost $9 million and prevented 72 deaths.


VHA MRSA Control Program Results

<table>
<thead>
<tr>
<th>Year</th>
<th>FY06</th>
<th>FY07</th>
<th>FY08</th>
<th>FY09</th>
</tr>
</thead>
<tbody>
<tr>
<td>ICU-MRSA-HAI Rate*</td>
<td>1.37</td>
<td>1.36</td>
<td>1.20^</td>
<td>0.79^</td>
</tr>
<tr>
<td>Non-ICU MRSA Rate</td>
<td>0.54</td>
<td>0.378#</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

MRSA-CVC-BSI rate: 0.4 to 0.18 per 1000 CVC-days: P=0.02
MRSA VAP rate: 10.0 to 7.9 per 1000 Ventilator-days: P=0.009

In March 2009, the VA expanded the MRSA control program to their long-term care facilities nationwide.

*Rate per 1,000 bed-days 07 vs. 08: P=0.04; 08 vs. 09: P=0.001; #P=0.02
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Results of a Veterans Affairs Initiative to Prevent Healthcare-Associated Methicillin-Resistant Staphylococcus aureus Infections

- **Objective:** To reduce MRSA HAIs in acute care VA hospitals.
- **Methods:** An “MRSA bundle” was implemented in all 153 acute care VA medical centers nationwide. The bundle consisted of: 1) nasal surveillance testing for MRSA on all admissions, in-hospital transfers, and discharges, 2) contact precautions for MRSA-positive patients, 3) hand-hygiene, and 4) a culture change where infection control became everyone’s responsibility.
- **Results:** Personnel at each center entered aggregate data on surveillance compliance, MRSA prevalence, healthcare-associated MRSA transmissions, and HAIs each month into a central database. Data from October 2007 to June 2009 included here.

Hand Hygiene Noncompliance and the Cost of Hospital-Acquired MRSA Infection

- **Background:** Hand hygiene noncompliance is a major cause of nosocomial infection, but the effect of hand hygiene noncompliance is unknown.
- **Objective:** To estimate MRSA-related cost of an incident of hand hygiene noncompliance by a healthcare worker (HCW) during patient care.
- **Design:** Two models were created to simulate sequential patient contacts by a hand hygiene-noncompliant HCW. Model 1 involved encounters with patients of unknown MRSA status. Model 2 involved an encounter with an MRSA-colonized patient followed by an encounter with a patient of unknown MRSA status. A simulation of 10 noncompliant events was performed. Total costs of resulting infections were aggregated and amortized over all events. Setting, Duke University Medical Center, a 750-bed tertiary medical center in Durham, North Carolina.

Assessing the role of undetected colonization and isolation precautions in reducing Methicillin-Resistant *Staphylococcus aureus* transmission in intensive care units.

- **Background:** Screening and isolation are central components of hospital MRSA control policies. Prevention of patient-to-patient spread depends on minimizing undetected/unisolated MRSA-positive patient-days.
- **Methods:** Colonization data from admission and weekly nares cultures were collected from eight single-bed adult ICUs over 17 months. Detected MRSA-positive patients were isolated using single rooms and barrier precautions. Data were analyzed using stochastic transmission models and model fitting was performed within a Bayesian framework using a Markov chain Monte Carlo algorithm.
- **Results:** Models estimated the mean percent of MRSA-colonized patient-days attributed to undetected carriers as 14.1% (95% CI: 11.7, 16.5). The percent of colonized-patient-days attributed to patients awaiting care was 1.34 (0.45, 3.97), but varied widely across ICUs.
- **Conclusions:** Screening consistently detected >80% of colonized-patient-days. Estimates of the effectiveness of barrier precautions showed considerable uncertainty, but in all units except burns/general surgery and one cardiac surgery ICU, the best estimates were consistent with reductions in transmission associated with barrier precautions.

Results of The Veterans Affairs Initiative to Prevent Healthcare-Associated Methicillin-Resistant Staphylococcus aureus (MRSA) Infections

- **Results:**
  - 1,213,646 admissions and transfers (230,470 to intensive care units (ICUs), and 983,176 to non-ICUs) and 5,296,757 bed-days of care (646,570 ICU and 4,450,187 non-ICU).
  - Admission screening increased from 82% to 92%; transfer/discharge screening increased from 71% to 92%.
  - The mean (95%) admission MRSA prevalence was 13.2 ± 4.9% (facility mean range 5.2% to 28.1%).
  - In-hospital MRSA transmission rates fell 23% in the non-ICU (P = 0.01, linear regression) and 32% in the ICU (P = 0.004 setting).
  - HAIs rates declined 24% in the non-ICU setting (P = 0.04), including declines in bloodstream infections (BSIs; 58%), pneumonias (43%), urinary tract infections (UTIs; 30%), and skin and soft-tissue infections (SSTIs; 26%). HAIs rates in ICU did not change in the two years before full implementation of the MRSA bundle (P = 0.69 for trend), but declined 77% (P = 0.001) with the MRSA bundle. During the intervention period, the following decreased: MRSA-VAPs (53%), CLA-BSIs (44%), non-device related MRSA-BSIs (58%), pneumonias (67%), UTIs (70%), and SSTIs (32%).
- **Conclusions:** A program of universal surveillance, contact precautions, hand hygiene, and culture change was associated with a decrease in MRSA in-hospital transmissions and HAIs.

Hand Hygiene Noncompliance and the Cost of Hospital-Acquired MRSA Infection

- **Results:**
  - A 200-bed hospital incurs $1,779,283 in annual MRSA infection-related expenses attributable to hand hygiene noncompliance.
  - A 1.0% increase in hand hygiene compliance resulted in annual savings of $39,650 to a 200-bed hospital.
- **Conclusions:** Hand hygiene noncompliance is associated with significant attributable hospital costs. Minimal improvements in compliance lead to substantial savings.

Is Pre-Operative MRSA Screening of Surgical Patients Cost Effective?

- **Study design:** Budget impact model using 2003 U.S. Nationwide Inpatient Sampling data.
- **Results:** 7,161,484 patients admitted to hospitals for elective surgery.
  - Pre-admission testing and subsequent decolonization therapy for patients colonized with *S. aureus* would result in:
    a) A mean annual cost savings to U.S. hospitals of $231,538,400 (95%CI -$300 million to $1.3 billion);
    b) A mean of 364,919 days of hospitalization avoided (95% CI: 67,893-926,983 days); and
    c) A mean of 935 in-hospital deaths avoided per year.
- **Conclusions:** Sensitivity analysis indicate a 64.5% probability that there would be significant cost savings, even after the accounting for variations in the model inputs.

A Webber Training Teleclass
Hosted by Paul Webber paul@webbertraining.com
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Preventing Healthcare-Associated Methicillin-Resistant Staphylococcus aureus Infections
Dr. William Jarvis, Jason and Jarvis Associates
Sponsored by Virox Technologies Inc. www.virox.com

A Webber Training Teleclass
Hosted by Paul Webber paul@webbertraining.com
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Preventing MRSA Infections in Surgical Patients: “Universal Screening”

- **Results:** Period 1: 696 patients. Period 2: 1462 patients.
  - SSI rate decreased from 3.3% to 2.2%
  - MRSA infection rate decreased: Relative risk 0.77, 95% CI: 0.56-0.95.
- **Discussion:** MRSA screening and decolonization of MRSA + patients reduced cardiac surgery overall surgical and MRSA infection rates.


Preventing Surgical-Site Infections in Nasal Carriers of *Staphylococcus aureus*

- **Background:** Nasal carriers of *Staphylococcus aureus* are at increased risk for healthcare–associated infections with this organism. Decolonization of nasal and extranasal sites on hospital admission may reduce this risk.
- **Methods:** A randomized, double-blind, placebo-controlled, multi-center trial at 3 university and 2 general hospitals in Holland from October 2005 through June 2007 assessing whether rapid identification of *S. aureus* nasal carriers by real-time polymerase-chain-reaction (PCR) assay, followed by treatment with mupirocin nasal ointment and chlorhexidine soap, reduces the risk of hospital-associated *S. aureus* infection.


Preventing Surgical-Site Infections in Nasal Carriers of *Staphylococcus aureus*

- **Results:** Of 6771 patients screened on admission, 1270 nasal swabs from 1251 (18.5%) patients were *S. aureus*-positive.
  - 917 patients enrolled in the intention-to-treat analysis, of whom 808 (88.1%) underwent a surgical procedure.
  - All the *S. aureus* strains identified on PCR assay were susceptible to methicillin and mupirocin.
  - The rate of *S. aureus* infection was 3.4% (17/504 patients) in the mupirocin–chlorhexidine group vs. 7.7% (32/413 patients) in the placebo group (RR, 0.42; 95% CI, 0.23 to 0.75).
  - The effect of mupirocin–chlorhexidine treatment was most pronounced for deep surgical-site infections (RR, 0.21; 95% CI, 0.07 to 0.62).
  - The time to the onset of nosocomial infection was shorter in the placebo group than in the mupirocin–chlorhexidine group (P = 0.005).

Kluymans et al. ICAAC 2008, Abstract #: K-1711

Preventing MRSA Infections in Surgical Patients: “Universal Screening”

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Should Universal Surveillance for Methicillin-Resistant Staphylococcus aureus (MRSA) Be Performed in Neonatal Units?

**Background:** Newborns may be particularly susceptible to MRSA colonization, infection, and severe complications because of their underdeveloped immune systems. Performing universal MRSA surveillance of infant newborns and placing colonized neonates on contact precautions is one potential method of preventing transmission. The economic value of this strategy is not established.

**Objective:** To determine the potential economic impact of performing universal surveillance of infant newborns.

**Methods:** Use of a stochastic computer simulation model to determine the potential economic impact of performing universal MRSA surveillance for all inpatient newborns at different MRSA prevalence and reproductive rate (R0) thresholds. Newborns who tested positive for MRSA were placed on contact precautions. MRSA carriers not placed on contact precautions could transmit MRSA to R0 other newborns. Each new case then entered into a newborn MRSA clinical outcomes model accruing costs and utilities.

**Results:** Each simulation run involved sending 1,000 simulated newborns through the model 1,000 times (i.e., 1,000,000 trials). Performing surveillance was cost-effective (incremental cost-effectiveness ratio (ICER) < $50,000 per quality-adjusted life year (QALY)) at R0 ≥ 0.05. In fact, surveillance was the effective [incremental cost-effectiveness ratio (ICER) < $50,000 per quality-adjusted life year (QALY)] at R0 ≥ 0.05.  In fact, surveillance was the effective...
Joint Commission 2009 National Patient Safety Goal

Implement evidence-based practices to prevent health care-associated infections due to multiple drug-resistant organisms in acute care hospitals.

Note 1: This requirement applies to, but is not limited to, epidemiologically important organisms, such as methicillin-resistant Staphylococcus aureus (MRSA), vancomycin-resistant Enterococcus (VRE), and multiple-drug-resistant gram-negative bacteria.

Note 2: This requirement has a one-year phase-in period that includes defined exceptions for planning, development, and testing (implementation of policies, etc.). See note on cover for 2009 with the expiration of full implementation by January 1, 2010.

Reasons Given For Not Performing MRSA Screening

- MRSA bundle—don’t know the impact of the various intervention components.
- Screening (high-risk or universal) that dramatically reduced MRSA infection rates were just “regression to the mean”.
- Negative impact of contact isolation.
- AST alone not useful.
- Concluding that “screening for MRSA reduces MRSA infections—is not necessarily correct”.
- Costs too much, too much work, laboratory burden, ignores all other HAIs, etc., etc., etc.

How Active Resisters and Organizational Constipators Affect Healthcare-associated Infection (HAI) Prevention Efforts?

- **Study question:** Why is translation of HAI prevention interventions so difficult?
- **Study design:** In-depth phone and in-person interviews with 86 participants (31 MDs) including CEOs, Chiefs of Staff, hospital epidemiologists, IPs, ICU directors, nurse managers, and frontline physicians and nurses.
- **Results:** Active resistance to evidence-based change was pervasive. Effective methods to overcome active resistors include benchmarking, identifying champions, and participating in collaborative efforts. Organizational constipators, mid to high level executives who act as insidious barriers to change—and increased difficulty of implementing change, need to be identified, included in early change discussions, obtaining buy-in, working around the individual and terminating resistor and organization constipator employment.


Conclusion

- The epidemiology of **S. aureus** continues to change.
- U.S. population **S. aureus** colonization rates are similar to those described in the 1950s.
- MRSA colonization rates of the U.S. population remain low (<2%), but vary widely by location.
- MRSA now account for >60% of the **S. aureus** isolates causing healthcare-associated infections.
- Active interventions to control the transmission of HA-MRSA using ADI have been successful.
- Rapid MRSA detection systems result in quicker isolation of patients and reduces the risk of MRSA transmission.
- To prevent and control MRSA
  - For CO-MRSA-hygience.
  - For HA-MRSA-ADI.
- If we in infection control do not lead the effort to prevent and control MRSA, private activists and politicians will legislate it.

THE NEXT FEW TELECLASSES

18 Mar 10 (Novice Teleclass) How to Prepare for OIC Certification Without Becoming Certification Speaker: Susan Cooper, Southeastern Ontario Infection Control Network

23 Mar 10 (Free Teleclass) Voices of CHICA Speaker: Directors & Guests of the Community & Hospital Infection Control Association of Canada


1 Apr 10 (Free Teleclass) Infections in the Elderly Speaker: Dr. Charles John Palenik, Indiana University School of Dentistry

8 Apr 10 Simple Precautions - Simplifying Infection Control Speaker: Dr. Jim Hutchinson, Health Care Corporation of St. John’s

13 Apr 10 (Free Teleclass) Improvement in Healthcare Settings Around the World and the “SAVE LIVES: Clean Your Hands” Initiative Speaker: Claire Kipinath, World Health Organization

Thank you!

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