MRSA in Healthcare Facilities, The Growing Burden
Dr. Susan Huang, University of California School of Medicine
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The Need for MRSA Assessment

- The scope of the problem in healthcare
- The impact of MRSA carriage
- The changing reservoir
- Options for response

Staphylococcus aureus

- 30% of people carry S. aureus
- Methicillin resistant form (MRSA)
  - First noted in US in 1968
  - Rapid increase since 1980s
  - Traditionally acquired in hospital settings
  - Resistant to common antibiotics
  - Source of outbreaks, infections
- Community-associated strains

Healthcare Associated MRSA

The Hospital

Methicillin (oxacillin)-resistant Staphylococcus aureus (MRSA) Among ICU Patients, 1995-2004

Source: National Nosocomial Infections Surveillance (NNIS) System
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**Canadian MRSA Rates**

**UK - *S. aureus* Deaths**

**US Burden Estimates**

- **2000**
  - 133,500 hospitalizations
  - 33,250 septic events
  - 29,000 pneumonias
  - 71,000 other infections

- **2005**
  - 278,200 hospitalizations
  - 56,250 septic events
  - 36,500 pneumonias
  - 185,500 other infections


**What happens to you if you acquire MRSA?**

**Post-Acquisition Studies**

- Among new carriers, how many develop infection?
  - All inpatients: 11-20% 1 2
  - ICU patients: 38% develop bacteremia 3


**MRSA Sequelae**

- Among tertiary care patients, there is a substantial risk of later infection
  - 29% develop infection in next 18 months
  - 28% of infections involve bacteremia
  - 49% of all infections occur post-discharge


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The Nursing Home

Nursing home slides are attributed to C. Crnich, MD at U Wisconsin

Risk of MRSA Infections in NH

- Michigan VA Nursing Home, 1989-90
- 341 patients, screened on admit and monthly
- Carriage
  - 20% of patients imported MRSA on admission
  - 14% of MRSA-negative patients acquired MRSA
  - Overall MRSA prevalence = 23%
- Infection
  - 9 infections, 4 requiring re-hospitalization
  - 11% risk of infection among carriers


MRSA Colonization and Subsequent Infection Risk in NH


Re-Hospitalization Rates Among MRSA+ and MRSA- NH Residents

- 3 year prospective cohort study 2000-2003
- 23 Belgian nursing homes
- 2,814 patients

<table>
<thead>
<tr>
<th>Reason</th>
<th>N</th>
<th>MRSA(+)</th>
<th>MRSA(-)</th>
<th>IRR (95% CI)</th>
<th>P-value</th>
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</thead>
<tbody>
<tr>
<td>Cardiopulmonary</td>
<td>287</td>
<td>8.0</td>
<td>4.9</td>
<td>1.2 (0.7 - 2.2)</td>
<td>0.49</td>
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<tr>
<td>Infection</td>
<td>273</td>
<td>7.5</td>
<td>4.9</td>
<td>1.6 (0.9 - 2.6)</td>
<td>0.09</td>
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<tr>
<td>RTI</td>
<td>121</td>
<td>4.5</td>
<td>2.1</td>
<td>2.1 (1.1 - 4.1)</td>
<td>0.83</td>
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<tr>
<td>UTI</td>
<td>45</td>
<td>1.0</td>
<td>0.8</td>
<td>1.2 (0.3 - 5.0)</td>
<td>0.79</td>
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<tr>
<td>Other</td>
<td>87</td>
<td>2.0</td>
<td>1.6</td>
<td>1.3 (0.5 - 3.4)</td>
<td>0.65</td>
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<tr>
<td>Other causes</td>
<td>556</td>
<td>11.0</td>
<td>9.3</td>
<td>1.2 (0.7 - 1.8)</td>
<td>0.36</td>
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<tr>
<td>Any admission</td>
<td>1,904</td>
<td>36.0</td>
<td>35.1</td>
<td>1.0 (0.8 - 1.3)</td>
<td>0.89</td>
</tr>
</tbody>
</table>


Mortality Among LTC Residents by MRSA Status

- Adjusted HR = 1.38 (1.09 - 1.76)


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How common is MRSA? Should we screen?

The Iceberg Phenomenon


The Hidden Reservoir

- Active Surveillance
  - Increases detection 30-50%
  - Recommended for high risk areas in 2003 SHEA Guidelines

Lucet et al. Arch Intern Med 2003;163:181-8

CDC Prevention Epicenters

- 12 ICUs
- Admission and weekly nares cultures
- 1-year study period
- Measures with and without surveillance cultures


Enhanced Detection of MRSA Reservoirs in ICUs

<table>
<thead>
<tr>
<th></th>
<th>Estimate</th>
<th>% Increase w Screen</th>
</tr>
</thead>
<tbody>
<tr>
<td>Importation</td>
<td>12%</td>
<td>50% (30-135%)</td>
</tr>
<tr>
<td>Acquisition</td>
<td>3.4%</td>
<td>31% (7-157%)</td>
</tr>
<tr>
<td>Prevalence</td>
<td>18%</td>
<td>31% (19-63%)</td>
</tr>
</tbody>
</table>
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Enhanced Detection

House-wide prevalence
- 2.7% MRSA+ - Emory University Hospital¹ '08
- 7.3% MRSA+ - Grady Memorial Hospital² '03
- 6.3% MRSA+ - Evanston Northwestern Healthcare³ '05

Value of Active Surveillance

- Knowledge of iceberg
  - Increases detection
  - Increases awareness
  - Corrects misclassification
- Rapid isolation
  - Contact precautions
  - Prevents transmission

National Trends

- Institute of Healthcare Improvement
  - 5,000 Lives Campaign
- VA Medical Centers
  - Mandatory MRSA surveillance
- CDC
  - NHSN begin screening for MRSA in one unit

National Measures

- Institute of Healthcare Improvement
- VA Medical Centers
- CDC
- Institute of Healthcare Improvement

MRSA Legislation

- Minnesota (May 07)
  - Mandatory MRSA program
- Tennessee (May 07)
  - Mandatory MRSA reporting to DPH
- Texas (June 07)
  - Mandatory MRSA reporting to DPH and public
- Pennsylvania (July 07), Illinois (Aug 07)
  - Active surveillance in acute/subacute hospitals if high risk
  - Public reporting of MRSA HAI rates
- New Jersey (Aug 07)
  - Mandatory active surveillance in all ICUs, flagging, isolation, compliance, reporting to state
- California (Sept 08)
  - Active surveillance among ICU and high risk patients

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MRSA Carriage Among Nursing Home Admissions

MRSA Prevalence in Nursing Homes

The Changing MRSA Reservoir

Prevalence of MRSA Nasal Colonization
2001-02 and 2003-04
NHANES Nasal Swab Survey

Overall MRSA Prevalence:
2001-02: 0.8%
2003-04: 1.5%

Kuehnert et al. JID 2006;193:172
R Gorenz et al. JID 2008;197:1226-34

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MRSA was the most commonly identified cause of purulent SSTIs among adult ED patients (EMERGENCY ID Net), August 2004

Moran et al NEJM 2006

Community vs Hospital MRSA

CA-MRSA
- No risk factors
- USA 300, 400
- Antibiotic sensitive
- PVL Toxin
- Skin & Soft Tissue
- Necrotizing

HA-MRSA
- Risk factors
- USA 100, 200
- Antibiotic resistant
- No PVL Toxin
- Pna > Soft Tissue
- Non-Necrotizing

Antibiotic Profiles Merging

<table>
<thead>
<tr>
<th>Antibiotic</th>
<th>CA-MRSA % Susceptible</th>
<th>HA-MRSA % Susceptible</th>
</tr>
</thead>
<tbody>
<tr>
<td>β-lactams</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>clindamycin</td>
<td>85%</td>
<td>30%</td>
</tr>
<tr>
<td>levofloxacin</td>
<td>20-80%</td>
<td>10%</td>
</tr>
<tr>
<td>Bactrim</td>
<td>85-99%</td>
<td>85%</td>
</tr>
<tr>
<td>doxycycline</td>
<td>65-90%</td>
<td>90%</td>
</tr>
<tr>
<td>rifampin</td>
<td>70-100%</td>
<td>95%</td>
</tr>
</tbody>
</table>


Invasive MRSA Cases
CDC ABCs 2004-2005

- Community-Associated
- Healthcare-Associated (community-onset)
- Healthcare-Associated (hospital-onset)

Klevens M et al. JAMA 2007;298(15):1763-71

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USA 300 In Nursing Homes

- Raab et al., Infect Control Hosp Epidemiol 2006; 27: 208-211
  - 15/197 (7.6%) colonized with PVL(+) MRSA
  - PVL(+) > PVL(-) MRSA isolates

- Mody et al. 44th Annual IDSA Meeting
  - 7/213 (3.3%) colonized with MRSA containing the SCCmec IV

Screen and Isolate

Impact of Screening on MRSA Bacteremias

Phased In Screening & Isolation Impact on MRSA Acquisition

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Housewide Screening & Isolation Impact on MRSA Infections

Evanston Northwestern Health Care

High Risk Screening & Isolation Impact on MRSA Infection

Klinikum im Friedrichshain, Berlin Germany

Persistence of MRSA

- MRSA is carried for a long time
- Median carriage among inpatients is 6-40mo\(^1\)\(^-\)\(^3\)
- Strain typing studies have shown 40-50% patients serially carry multiple strains\(^1\)\(^4\)\(^5\)
- Repeat MRSA infection is often due to the same strain\(^6\)

- Sanford et al. CID 1994;19(6):1123-8
- Scanvic et al. CID 2001;32(10):1393-8
- Huang et al. JID 2007;196(3):330-6
- Herwaldt et al. ICHE 2002
- Huang et al. CID 2008;46:1241-7

Decolonize

What Regimen?

- Mupirocin
- Chlorhexidine bathing
- Mupirocin + Chlorhexidine
- Systemic agents
  - Bactrim, doxycycline, rifampin

Mupirocin

- VA Nursing Home in Michigan
- 38% S. aureus carriage (N=39)
  - 54% MRSA
  - 46% MSSA
- Mupirocin for 7d eradicated 91%
- At two months, 56% remained persistently clear
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Mupirocin + Chlorhexidine

- 52% Decrease in MRSA incidence Density

Ridenour et al. ICHE 2007;28(10):1155-61

Topical + Oral + Bathing

- 74% remained negative at 3 months

Simor et al. CID 2007;44(2):178-85

Common Regimen

- Intrasal mupirocin bid x 5-7d
- Chlorhexidine baths x 5-7d
- Serial screening
  - nares
  - prior colonized sites

Vaccinate

Vaccine Trial

- S. aureus conjugate vaccine
- Tested on patients on hemodialysis
- Provided partial immunity
  - Initially thought to be 40 weeks
  - Difficult to verify with serial inoculations
- No imminent candidates


Disinfect

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Environmental Contamination

- Widespread contamination in room
  - Door knobs
  - Bed rails
  - Counters/tables
  - Phone
  - Monitors
  - Window ledges
- 58% of ICU acquisition had the same strain type as another patient actively or very recently in the ICU

Boyce et al. ICHE 1997;18(9):622-7

Environmental Contamination

- Similar whether colonized or infected
  - Shelley et al. (SHEA 2008)
    - Contamination of room sites (bed rail, table, call button, phone) was similar among colonized patients (47%) vs infected patients (45%)
    - Similar contamination of providers’ hands after examination
    - 90% of environmental strains were same as nares

Common Cleaning Issues

- National Standards
  - 10 minutes wet contact time
  - Visual inspection
- Application of disinfectant
- Time pressures
- Uncertain ownership of items

Black Light Marker

- Fluorescent marker
  - An invisible gel that glows under blacklight
  - Applied to surfaces in over 40 US hospitals
  - An inert, safe, and unreactive substance

Improving Room Cleaning

- Carling PC. Clin Infect Dis 2006;42(3):385

Back to Basics

<table>
<thead>
<tr>
<th>TABLE 1</th>
<th>TABLE 2</th>
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</thead>
<tbody>
<tr>
<td>Effectiveness of Disinfection</td>
<td>No. of Colonized Sites (%)</td>
</tr>
<tr>
<td></td>
<td>Conventional Disinfection</td>
</tr>
<tr>
<td>First disinfection</td>
<td>8/11</td>
</tr>
<tr>
<td>Second disinfection</td>
<td>8/10</td>
</tr>
<tr>
<td>Third disinfection</td>
<td>3/29</td>
</tr>
<tr>
<td>Fourth disinfection</td>
<td>0/29</td>
</tr>
</tbody>
</table>

Byers et al. ICHE 1998; 19:261-4
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Educate

MRSA Conclusions

- Endemic in hospitals, nursing homes, communities
- Morbidity and mortality is high among inpatients
- Community and healthcare reservoirs are merging and expanding
- Legislation and public reporting have arrived
- There are several options for response

Patient Education Materials

http://www.cdc.gov/mrsa

Teleclass Education 2009
. . . A World of Knowledge

www.webbertraining.com/schedule1.php

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