Methicillin-resistant *Staphylococcus aureus* (MRSA):
Session Objectives

• Describe the epidemiology of methicillin-resistant *Staphylococcus aureus* (MRSA) in the U.S. and Michigan

• Understand how progress with prevention of MRSA across the U.S. relates to healthcare facilities in Michigan

• List at least one strategy to prevent cross transmission within and between healthcare facilities
Identification

• **S. aureus**: gram-positive cocci, coag. positive

• **Susceptibility testing:**
  - Methicillin (oxacillin) resistance = strains produce penicillin binding protein 2a encoded by *mecA* gene; MIC against oxacillin ≥ 4μ/ml
  - *mecA*: mobile chromosomal element: staphylococcal cassette chromosome (SCCmec)
  - Dissolve beta lactam antibiotics, e.g. penicillins and cephalosporins

• **Diagnostic methods:**
  - Std. Culture or use chromogenic agar (24-72 hrs)
  - Molecular: PCR (2-5 hrs; but most labs need to run in batches); weakness - mixed culture, e.g. S. aureus & coagulase negative Staphylococci?
Evolution of Drug Resistance in *S. aureus*

- **Penicillin:**
  - *S. aureus* [1950s]
- **Methicillin:**
  - Penicillin-resistant *S. aureus* [1970s]
  - Methicillin-resistant *S. aureus* (MRSA) [1970s]
- **Vancomycin:**
  - Vancomycin-resistant enterococci (VRE) [1990s]
  - Vancomycin intermediate-resistant *S. aureus* (VISA) [1997]
  - Vancomycin-resistant *S. aureus* [2002]

2008: 7/9 isolates in US are from patients in SE MI.

Community-associated MRSA (CA-MRSA): No prior exposure to health care.
Next New Strain?

S. aureus
Prevalence of S. aureus colonization in the US: 2001-2002

- Nasal swabs
- ~10,000 non-institutionalized persons over age 12 months
- 32.4% colonized with S. aureus; extrapolated total for U.S = 89.4 million people
- 0.84% colonized with MRSA or for U.S. = 2.3 million people
  - Associated with age >60; female
  - Over 40 unique strains

How Big of a Problem are Health care-associated Infections (HAIs) in U.S. hospitals?
Total HAIs / year = 1.7 million; 98,987 deaths

- 274,098 TOTAL
  - 967 HRN
  - 21 WBN
  - 28,725 Non-newborn ICU

- 244,385 = SSI
- 263,810 = Other 22%
- 133,368 = BSI 11%
- 424,060 = UTI 36%
- 129,519 = PNEU 11%

HRN = high risk newborns
WBN = well-baby nurseries
ICU = intensive care unit
SSI = surgical site infections
BSI = bloodstream infections
UTI = urinary infections
PNEU = pneumonia

Pathogens Causing CLABSI

Rank Order, NHSN, CDC, 2006-07

1. Coagulase negative *Staphylococci*
2. *Enterococcus spp*
3. *Candida spp.*
4. *S. aureus:* 57% = MRSA
5. *K. pneumoniae*

Hidron AI, 2008

• 58% reduction in No. of cases in ICU [pooled mean, NHSN 3.64 (2001) vs 1.65 (2009)]

• 27,000 lives saved

• CLABSI cost avoidance = $1.8 Billion
More Good News on MRSA

- 9.4% decrease in invasive MRSA infections between 2005-08
- Most prominent for: BSIs (hospital-onset) and health care-assoc. community-onset infections

Successful Implementation of HICPAC/CDC Guidelines Prevents Bloodstream Infections

Pennsylvania

FIGURE. Central line–associated bloodstream infection rate* in 66 intensive care units (ICUs), by ICU type and semiannual period — southwestern Pennsylvania, April 2001–March 2005

- All other unit types
- Medical/surgical units

Semiannual period

- 2001
- 2002
- 2003
- 2004
- 2005

* Pooled mean rate per 1,000 central line days.
† Includes cardiorthoracic, coronary, surgical, neurosurgical, trauma, medical, burn, and pediatric ICUs.
§ p<0.001.

MMWR 2005;54:1013-16

Michigan

103 ICUs at 67 Michigan hospitals, 18 months

BSIs/1,000 catheter days


REMARKABLE MEDICINE. REMARKABLE CARE.
MRSA in Michigan

Quarterly HAI Report, SHARP Unit, 10/1 – 12/31/2011

**MRSA LabID Rates**

- 2011 Q1: 5
- 2011 Q2: 4
- 2011 Q3: 3
- 2011 Q4: 2

**Infection Surveillance Rates**

- MRSA Surveillance: Decreasing from 4.5 in 2011 Q1 to 1 in 2011 Q4
- C. diff Surveillance: Increasing from 3 in 2011 Q1 to 5 in 2011 Q4
Basic Principles... Are Important

Most MDROs are transmitted via hands of HCWs

Contaminated Surface → Hands of the HCW → Non Compliance Hand Hygiene → Susceptible Patient

Kramer A
BMC Infect Dis 2006;6: 130
Prevention Strategies: Hand Hygiene

WHO 5 Moments for Hand Hygiene

1. BEFORE TOUCHING A PATIENT
2. BEFORE CLEAN / ASEPTIC PROCEDURE
3. AFTER BODY FLUID EXPOSURE RISK
4. AFTER TOUCHING A PATIENT
5. AFTER TOUCHING PATIENT SURROUNDINGS
The Environment of Care:

“Honest Russ, I just touched the bed rail…”

100-1,000 bacteria transferred by
- Pulling patients up in bed
- Taking a blood pressure or pulse
- Touching a patient’s hand
- Rolling patients over in bed
- Touching patient’s gown or bed sheets
- Touching equipment like bedside rails, over-bed tables, IV pumps
Rounding Up Reservoirs of Microbes: Source control aka Patient Hygiene

**Foundation of Fundamentals**
- Hand Hygiene
- Catheter Bundle
- VAP Bundle
- OR Best Practices
- Judicious Antibiotics

The Patient

Swab
Mupirocin
CHG Bath

OR

ER

Floor

Hospital Transfer

72 hours

Potentially Preventable

ICU Discharge

Floor

LTAC
Patient Safety

Using Hygiene

Effectiveness of Chlorhexidine Bathing to Reduce Catheter-Associated Bloodstream Infections in Medical Intensive Care Unit Patients

Susan C. Bleasdale, MD; William F. Trick, MD; Ines M. Gonzalez, MD; Rosie D. Lyles, MD; Mary K. Hayden, MD; Robert A. Weinstein, MD

• 1 yr. cross over study in two MICUs, Stroger hospital, Chicago IL
  – Intervention: daily cleansing of patients with disposable cloth containing chlorhexidine gluconate (CHG)
  – Control group: daily cleansing with soap and water

• Results:
  – Intervention group:
    • 4.1 primary BSIs / 1,000 pt. days
    • 6.4 / 1,000 central line days
  – Control group:
    • 10.4/ 1,000 pt. Days
    • 16.8 / 1,000 central line days

• Conclusion: Incidence of BSI in CHG-cloth group was 61% lower than control (soap and water) group. Reduction of concentration of bacteria on skin lessens risk of BSI.

Isolation
Precautions + Prevention

Resources:
MDCH HAI Pages
MI-MARR LTC Toolkit
www.mi-marr.org
APIC MRSA Elimination Guide: LTC, 2009
SHEA Compendium, 2008
CDC Isolation Gdln, 2007
APIC MRSA Elimination Guide: Acute Care, 2007
CDC MDRO Gdln, 2006

<table>
<thead>
<tr>
<th>CONTACT PRECAUTIONS</th>
<th>PATIENT PLACEMENT</th>
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</thead>
<tbody>
<tr>
<td>PRIVATE</td>
<td>• Private room</td>
</tr>
<tr>
<td>WEAR GLOVES</td>
<td>• Wear gloves when entering room.</td>
</tr>
<tr>
<td>HAND HYGIENE</td>
<td>• Apply handrub or wash hands after glove removal and when leaving room.</td>
</tr>
<tr>
<td>WEAR GOWN</td>
<td>• Wear a gown whenever anticipating direct contact with the patient or surfaces/equipment near the patient. For these situations, put on gown before entering room.</td>
</tr>
<tr>
<td>PATIENT TRANSPORT</td>
<td>• Limit transport and movement of the patient outside the room to medically-necessary purposes. Personnel - use hand hygiene prior to transporting patient from room.</td>
</tr>
<tr>
<td>PATIENT CARE EQUIPMENT</td>
<td>• Dedicate the use of noncritical patient care equipment to a single patient or disinfect after use.</td>
</tr>
<tr>
<td>REMOVE PPE</td>
<td>• Remove gown, gloves, and then perform hand hygiene prior to leaving room.</td>
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The Inanimate Environment Can Facilitate Transmission

Contaminated surfaces increase cross-transmission ~

X represents VRE culture positive sites
Renewed Respect for EOC: Who’s Been in the Room Before or With You?

• Documented increased risk of acquisition of certain MDROs when admitted to a room if prior occupant had MDRO or in multibed room
  – Huang SS (2006)¹
  – Drees M (2008)²
  – Zhou Q (2008)³
  – Moore C (2008)⁴
  – Hamel M (2010)⁵
Additional Prevention Strategies: Active Detection of MRSA Colonization: A Tale of Two Approaches

• Broader Aspects of ASC + Contact Precautions:
  – Do you have enough private rooms & personnel?
  – Do you actively monitor adherence with contact precautions (CP)?
  – Consequences of placing patients in contact precautions = less care and increased risk of other adverse effects; e.g., falls/med errors
  – Decolonization therapy?
  – Once positive for a MDRO does this mean isolation for all future possible readmissions forever?
No difference in mean incidence of MRSA or VRE in intervention (AS+CP) vs control ICUs.

NEJM 2011; 364:1407–18
Veterans Affairs Initiative to Prevent Methicillin-Resistant \textit{Staphylococcus aureus} Infections

\textbf{2007 MRSA bundle:}
AS+CP, HH, culture of safety on infection prev./control – all VAMC/all patients.

Significant drop (62\%) in HA-MRSA infs. after the MRSA Bundle in ICUs + signif. Reduction in non-ICU

Antimicrobial Stewardship
Other Prevention Strategies

- Standard Precautions
- Intra-Facility Communication of detection of MDRO in the patient/resident – We’re all in this together!
- Education & awareness
- **Supplemental measures:**
  - Active surveillance + pre-emptive contact precautions
  - Decolonization
  - Enhanced disinfection: whole area disinfection
  - Self-Disinfecting Surfaces

[Russ’s Take on the latter two: little scientific evidence, ready for prime time???? Probably not but say tuned….]