MRSA: Methicillin Resistant *Staphylococcus aureus*

### Epidemiology

- **Colonization:**
  - Nasal passage common,
  - Axillae, groin, moist skin
  - Rectum
  - Sputum, trach site in intubated
  - May last for months or yrs

- **Source:**
  - ++Human carriers,
  - -Pet animals,
  - -Fomites, environment

- **Transmission**
  - ++ Direct contact: hands
  - ++Indirect Contact: less common: Fomites, Environmental surfaces
  - -Droplets from Colonized with URTI, low role

- **Incubation:** 2d
  - Difficult to determine because of carriers

- **Infection:**
  - -Suppurative wound in skin / soft tissue
  - -Bacteremia / Septicemia
  - -Focal internal abscess
  - -Pneumonia, meningitis,

- **Communicability:** Colonized /infected throughout carriage or infection

### Risk factors for colonization:
- Severity of illness
- Previous expo to antimicrobial
- Underlying disease conditions:
  - - Chronic renal disease
  - - Insulin-dependent diabetes
  - - Peripheral vascular disease
  - - Dermatitis or skin lesions
  - - Invasive procedures:
    - - Dialysis
    - - Invasive devices
    - - Urinary catheterization
    - - Ventilators
    - - Repeated contact with the healthcare system
  - - Previous colonization by an MDRO
  - - Advanced age

**Colonized person at higher risk of infection**

### Basic bacteriology
- **Penicillin resistance:** In 1940s *Staphylococcus aureus* rapidly produced a β-lactamase able to inactivate the penicillin ring. Genie mecA responsible for β-lactam resistance

  - **Methicillin / oxacillin:** penicillin derivatives with radicals shielding the penicillin ring

  - **Methicillin resistance:** In 1960s *S.aureus* modified its penicillin binding site → MRSA

  -Resistance results from 4 mec genes: I to IV chromosomal elements encoding penicillin-binding proteins. Genes in staphylococcal cassette chromosome (SCC)

- **HA-MRSA:** First appeared in the 1960s and progressed as a hospital strain
  - Types I, II and III
  - - Many strains cause sporadic in-patient cases, few strains (EMRSA) cause epidemics
  - - Most are simple colonizers; NOT more virulent than other SA; NO difference in animal lethality, in production of enzymes, in production of toxins associated with invasiveness
  - - Multi-resistant: Penicillins and derivatives, macrolides, cipro and other fluoroquinolones, cyclines, trimethoprim-sulfa. Sensitive to vancomycin, linezolid

- **CA-MRSA:** Appeared in the 1990s as community-associated then proliferate to become the most frequent strain (in HCF and community)
  - Type IV smaller cassette replicating faster than other types. Predominant clone in the U.S. is strain US300
  - - More virulent, severe pneumonia, higher lung bacterial density, greater expression of regulatory genes associated with virulence factors (PVL leukocidin and α hemolysin)
  - - Link to Arginine Catabolic Mobile Element (ACME) promoting pathogenicity
  - - Other pathogenicity “islands”: TSS, exotoxin, enterotoxin islands
  - - Fewer antibiotic resistance genes
  - - Doubling time shorter than HA-MRSA

### Diagnosis

1. **Culture of S. aureus** and confirmation of MRSA with antibiogram
   - Differentiate between colonization from real infection: important in case of pressure ulcer.
   - Generally less costly, common practice most labs are used to
   - May take 72 hours to identify MRSA colonized patients. If pre-emptive isolation not employed, may allow for transmission prior to recognizing patient as positive
   - **2-Polymerase chain reaction**
     - Rapid results
     - Expensive, technically more challenging

### Treatment

- Localized mild to moderate skin and soft tissue infection (SSTI): Incision and drainage
- Patient with severe /extensive disease or rapidly progressing systemic symptoms and risk factors for severity, **assume MRSA** (Predictive value for MRSA rather than MSSA is very poor.

#### Oral antibiotics
- Trimethoprim/Sulfamethoxazole
- Doxycycline or Minocycline
- Clindamycin
- Linezolid

#### Parenteral antibiotics
- Vancomycin
- Televancin
- Ceftriaxone
- Daptomycin
- Linezolid
- Tigecycline
- Quinupristin/Dalfopristin

**http://www.infectiousdisease.dhh.louisiana.gov**
(800)256-2748
**Control**

**1. Surveillance**
- Only invasive cases are reportable: Positive culture from blood, CSF, other internal fluid, organ infection. Do not report skin and soft tissue infections (SSTI)
- Tag the medical records of MRSA colonized or infected patients. Upon readmission use contact precautions and repeat cultures
- Warn receiving HCF when a patient is transferred
- Active surveillance: screening to detect colonization even if no evidence of infection

Widely used and even recommended as a core prevention strategy by some, but precise role remains controversial. At admission / discharge
- NO routine active case finding in LTCF.

**2. Interrupt transmission from person to person: Standard and Contact Precautions in hospitals (h) or Modified Contact Precautions in LTCF (m):**
- Hand-washing or alcohol-based hand sanitizers (hm)
- Contact precautions including
  - Gloving whenever touching:
    - patient
    - surfaces contaminated including areas in contact with the patient
    - high touch surfaces as bedrails, light switches, faucets
    - uncontrolled secretions, pressure ulcers, draining wounds, stool incontinence, ostomy bags
  - Gowning whenever getting in the room (h) or only when close contact with secretions & excretions, damaged skin (m)
  - Masks if close to patient with URTI, suctioning respiratory secretions, irrigation of large wounds
  - Patient placement:
    - Private room with a bathroom solely used by the patient
    - If private room not available, cohorting with another MRSA
    - If sharing room at least a 3 foot separation between beds to avoid inadvertent sharing of items between patients
    - Avoid sharing room with patient with feeding tube, IV line, tracheostomy tube, urinary catheter (any device entering orifice or breaching skin)
    - Curtain or a red tape on the floor identifying areas of restricted access (h)
  - Equipment: Dedicated to patient (h) or properly disinfected (m)
  - Proper handling of contaminated waste and fomites
  - Patient transport: Transportation or movement outside the room should be limited in hospital. In LTCF allow movement but educate patient about proper hand hygiene.
  - Contact precautions status need to be communicated to all HCP susceptible to come in contact with the patient.
  - Linen: handled as other linen: collected, bagged at bedside and sent to laundry
  - Cleaning: Focus on frequently touched areas: bedrails, bedside commodes, bathroom and fixtures, doorknobs, light switches, remote controls, monitor cables, call buttons
  - Ambulatory patient (m): may attend activities
    - If nares or sputum colonized (no need to wear mask if able to cover cough or sneeze) and other colonized sites are covered.
    - Good hygiene and hand washing

**Discontinuation of contact precautions after 2 negative cultures of colonized or infected site.**
- First 72 hrs after antibiotic Rx
- Second 1 week after

**LTCF may NOT arbitrarily refuse to accept a resident with MRSA colonization or infection if the facility can address satisfactorily the medical needs of the patient.**

**3. Preventing infection in colonized individuals:**

### 3a. Not MRSA-specific
- Strategies aimed at preventing device and procedure-associated infections (e.g., ventilator associated pneumonias, central line associated bloodstream infections, etc), not necessarily

**3b. MRSA Specific = Decolonization:**
- In theory decolonization would reduce the load of MRSA BUT it requires use of local and systemic antibiotics and that leads to widespread resistance
- Use decolonization sparingly
- Use in case of outbreak or special circumstances in consultation with an Infectious Disease Specialist
- Monitor by culture the sensitivity of the strains to detect any shift towards resistance
- Strong indication for surgery

**Other Sites:**
- Antiseptic detergent (chlorhexidine, povidone-iodine, Triclosan) for skin and hair
- Mupirocin (Bactroban) to treat lesions (eczema, pressure sores)
- Hexachlorophene powder (0.33% Sterzac powder) on axillae and groins if colonized. Do not use on broken areas of skin. Use cautiously in infants.
- In cases of throat or sputum colonization, topical nasal applications ineffective.
- Urine: remove the catheter, if possible. If not, change half way through Rx.

**3c. Employee Health**
- Employee hand carriage is usually transient
- Surveillance cultures of HCP for MRSA not recommended unless in outbreak situation
- If employees epidemiologically implicated as source --HCP infected should be treated with antibiotics.
- HCP with respiratory infections /cough not to be assigned to direct care until healing of lesions
- HCP with skin lesions or dermatitis to be removed from direct care

**3d. Education of healthcare providers, patient and visitors**
- HCP need to understand the difference between infection and colonization

**Cleaning ENV PERSIST**

Thorough cleaning is necessary to maximize the disinfectant action of the germicide.
Use a commercially available solution which contains a detergent or use a detergent for thorough cleaning before applying the bleach solution.
Contact time of 1 minute should be sufficient. Wetting the surface with the bleach solution and allowing it to dry should provide sufficient contact time.

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