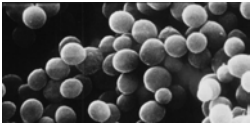


Community-Associated Methicillin Resistant *Staphylococcus Aureus*

Dr. Rachel Gorwitz, CDC

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Emergence and Epidemiology of Community-Associated Methicillin-Resistant *Staphylococcus aureus* in the United States



Rachel J. Gorwitz, MD MPH
Centers for Disease Control and Prevention
Atlanta, GA

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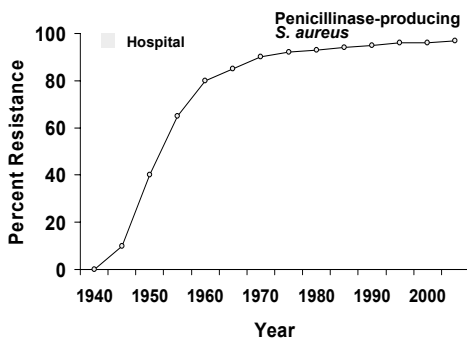


Overview

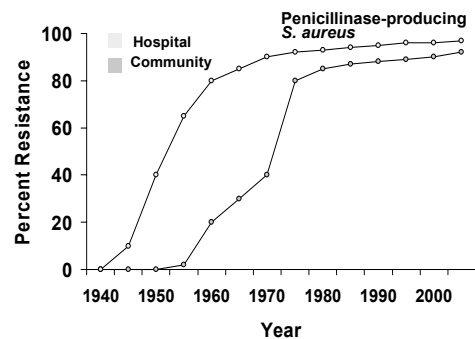
- Background / Terminology
- Outbreak Investigations
- Community emergence
- Reasonable approaches to prevention and control (Expert Panel Summary)



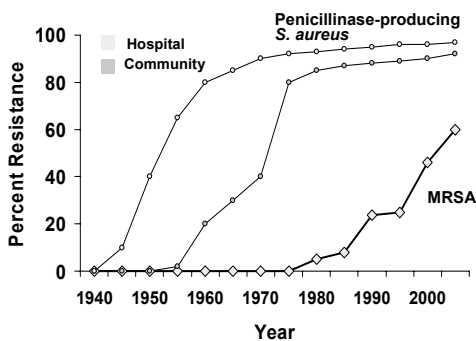
Trends in *S. aureus* Antimicrobial Resistance (Chambers EID 2001, NNIS, Fridkin NEJM 2005)



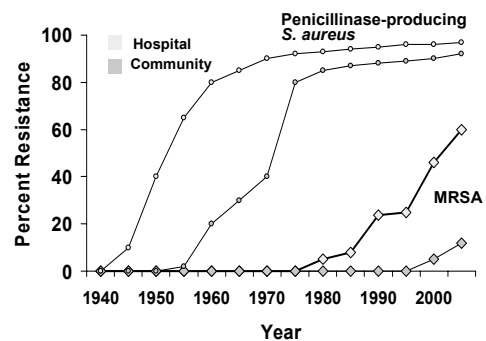
Trends in *S. aureus* Antimicrobial Resistance (Chambers EID 2001, NNIS, Fridkin NEJM 2005)



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Trends in *S. aureus* Antimicrobial Resistance (Chambers EID 2001, NNIS, Fridkin NEJM 2005)



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MMWR Four Pediatric Deaths from Community-acquired Methicillin-Resistant *S. aureus* -- Minnesota and North Dakota, 1997-1999

MRSA is an emerging community pathogen among patients without established risk factors for MRSA infection (e.g., recent hospitalization, recent surgery, residence in a long-term-care facility, or injecting-drug use).

MMWR 48:707; 1999



Terminology

- Terminology has been inconsistent
- **Community-Onset (CO) MRSA:** infection diagnosed or index culture collected in community
- **Established risk factors (RFs):** recent hospitalization, surgery, dialysis, long-term care; indwelling catheter or percutaneous medical device; history of MRSA
- **Community-Acquired MRSA:** Used for CO infections or CO infections in patients without established RFs, but difficult to establish with certainty where acquisition occurred
- **Community-Associated MRSA:** CO infections in persons without established RFs



Bacteriologic Differences in CA-MRSA and HA-MRSA Isolates

	CA-MRSA	HA-MRSA
Antimicrobial resistance	Few agents	Multiple agents
SCC <i>mec</i> (genetic element carrying <i>mecA</i> resistance gene)	Type IV	Type II
PFGE Types	USA 300, 400	USA 100, 200
PVL toxin gene	Common	Rare



Panton-Valentine Leukocidin (PVL) Toxin

- Necrotizing cytotoxin
- Associated with abscesses and severe pneumonia
- Also found in some methicillin-susceptible *S. aureus* (MSSA) isolates

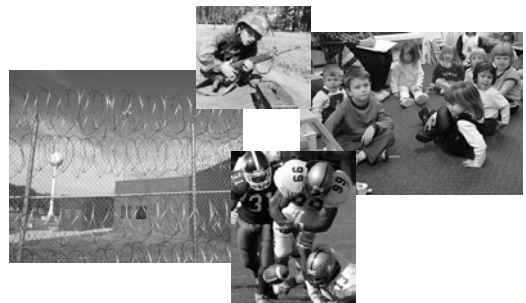


Terminology

- “CA-MRSA” now sometimes used to refer to MRSA strains with certain bacteriologic properties
- However:
 - No definitive bacteriologic criteria for community strains
 - Attributes may change over time, particularly if community strains become established in healthcare settings or vice versa (differences in selective pressures, interchange of genetic material)
 - Eventually may be impossible to distinguish CA-MRSA and HA-MRSA



CA-MRSA Outbreaks



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Page 2


Community-Associated Methicillin Resistant Staphylococcus Aureus

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CA-MRSA Outbreaks

- Often first detected as clusters of abscesses or “spider bites”
- Various settings
 - Sports participants: football, wrestlers, fencers
 - Correctional facilities: prisons, jails
 - Military recruits
 - Daycare and other institutional centers
 - Newborn nurseries and other healthcare settings
 - Men who have sex with men




Competitive Sports



MMWR: Methicillin-Resistant *Staphylococcus aureus* Infections Among Competitive Sports Participants --- Colorado, Indiana, Pennsylvania, and Los Angeles County, 2000--2003



August 22, 2003 / 52(33);793-795



CA-MRSA Abscesses among Professional Football Players

(Kazakova et al NEJM 2005;352:468-75)



- MRSA abscesses in 5/58 players at sites of turf burns
- Association with:
 - BMI>30
 - Lineman/Linebacker
 - Recent antibiotic use
- Abx use
 - 2.6 scripts/yr for Rams
 - 0.2 scripts/yr for gen pop'n
- No MRSA on colonization survey or environmental sampling



CA-MRSA Abscesses among Professional Football Players

(Kazakova et al NEJM 2005;352:468-75)

- Observational:
 - Trainers providing wound care had no access to hand hygiene
 - Towels frequently shared
 - Players often did not shower before using whirlpool
 - Weight-training equipment not regularly cleaned
- Transmission controlled with improved wound care, targeted therapy, enhanced hygiene



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Turf Burns



Prevention and Control

- Cover all wounds
- Train athletes in first aid for wounds and signs of infection
- Encourage good hygiene
- Discourage sharing of items
- Establish routine cleaning schedules for shared equipment
- Encourage players to report skin lesions



Correctional Facilities



Methicillin-Resistant *Staphylococcus aureus* Skin or Soft Tissue Infections in a State Prison – Mississippi, 2000 (MMWR 2001 50:919-22)

- 59 skin infections in 3000 inmate prison
- Case-patients frequently reported: helping or being helped by other inmates with wound care, lancing own or other inmates' boils with fingernails or tweezers, sharing potentially contaminated personal items (linen, pillows, clothing, tweezers)
- High nasal carriage rate of MRSA (4.9%)



MRSA Outbreaks in Correctional Facilities



Methicillin-Resistant *Staphylococcus aureus* Infections in Correctional Facilities, 2001–2003 October 17, 2003/ 52(41):992-996

- Georgia
- California
- Texas



Intervention to Reduce the Incidence of MRSA Skin Infections in a Correctional Facility in Georgia (Wooten et al ICHE 2004;25:402-7)

- 16 cases of MRSA skin lesions in 200-bed detention center
- Prior to intervention:
 - Co-pay required for clinic visit
 - Lesions treated with warm compresses and topical antibiotics (no capacity for I&D)
 - Soap kept in locked drawers
- Rates declined significantly after implementing measures to improve skin disease screening, personal hygiene, wound care, and antimicrobial therapy



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Contributing Factors to MRSA Spread in Correctional Facilities

- Barriers to routine hygiene
 - Access to soap limited
 - Mental health problems contributed to poor adherence
 - Improper handling of laundry
- Barriers to inmates accessing the medical system
 - Cost
 - Language and literacy
 - Fear
- Barriers within the medical system
 - Frequent medical staff turnover and understaffing
 - Limited services available (e.g., no I & D)
 - Lack of coordination between facilities
- Unrecognized cause of skin infections
 - Cultures rarely performed; lesions attributed to spider bites
- Crowding



Prevention and Control

- Collaborated with Bureau of Prisons*
 - Implement skin infection screening and monitoring
 - Culture suspect lesions and provide targeted therapy
 - Improve inmate hygiene (education, availability of soap, etc)
 - Improve access to wound care and trained healthcare staff
 - Additional Interventions (antiseptic washes, nasal decolonization) to be considered in consultation with public health

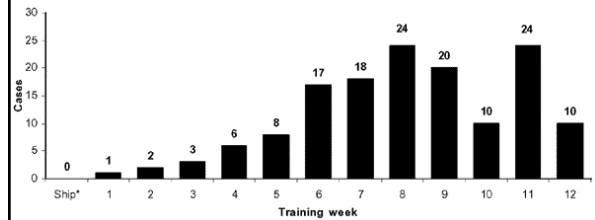
*<http://www.bop.gov/news/PDFs/mrsa.pdf>



Military Trainees



Military Training Facility, 2001-2003 Cases of CA-MRSA Soft Tissue Infections

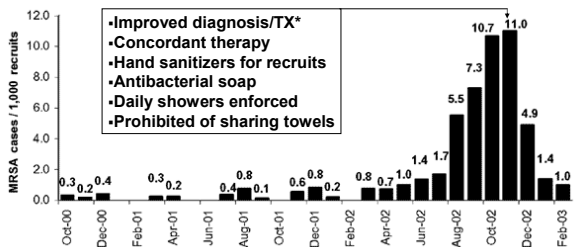


- 235 skin infections
- Transmission peaked in later weeks

Zinderman, Emerg Infect Dis Vol 10, May 2004 941-944



Military Training Facility, 2001-2003 Cases of CA-MRSA Soft Tissue Infections



- Improved diagnosis/TX*
- Concordant therapy
- Hand sanitizers for recruits
- Antibacterial soap
- Daily showers enforced
- Prohibited of sharing towels

Zinderman, Emerg Infect Dis Vol 10, May 2004 941-944

* Micycline or TMP/Sulfa with rifampin and mupirocin (10 days)



Other Outbreaks



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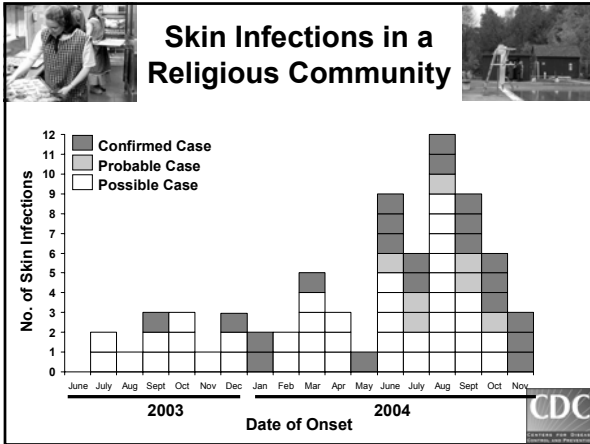
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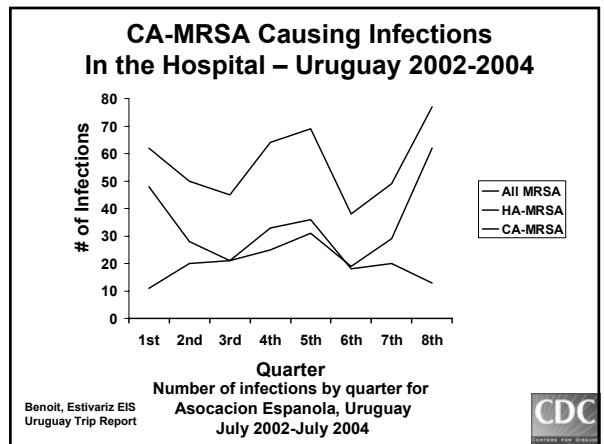


- ### Skin Infections in a Religious Community
- 24 confirmed or probable cases
 - Antibiotic use in past year and use of community sauna were independently associated with disease
 - MRSA (different from outbreak strain) isolated from sauna
 - Transmission interrupted with multi-faceted intervention and closing sauna

- ### Tattoo Recipients
- Outbreaks reported in several states associated with licensed and unlicensed tattooing
 - Investigations underway
 - Tattoo parties, improvised equipment
-

- ### Hospital Transmission of CA-MRSA
- Hospital transmission of CA-MRSA among post-partum women, NY (Saiman L, CID, 2003;37:1313-9)
 - CA-MRSA in a NICU, TX (Healy CM, CID, 2004;39:1460-6)

- ### CA-MRSA outbreaks among otherwise healthy full-term newborns
- Clusters of MRSA skin infections among newborns delivered at a common facility
 - Onset of symptoms in 1st few weeks of life – usually about a week after discharge from term nursery
 - No risk factors for acquisition following discharge identified
 - Resolved after reinforcement of nursery infection control practices and, in some cases, decolonization of colonized health care workers



CA-MRSA Outbreaks: Summary



CA-MRSA Differs from HA-MRSA

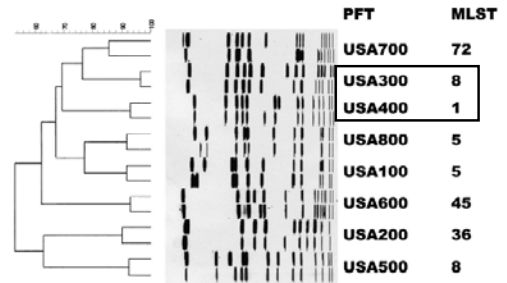
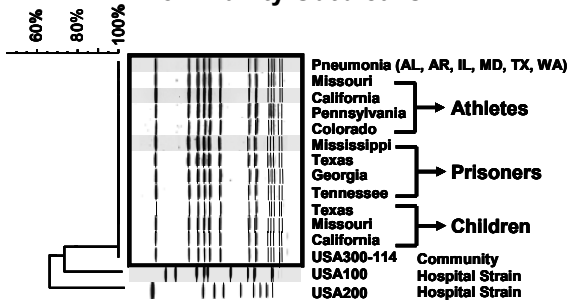


FIG. 1. Dendrogram of PFGEs with type strain (most frequent pattern) and a variant strain. Also shown is the corresponding MLST for each PFGE (18, 19, 20).

PFGE Typing of ORSA from the US: Establishing a National Database. McDougal et al. J Clin Microbiol 2003;41:5113-20.



A Few CA-MRSA Strains Cause Most Community Outbreaks

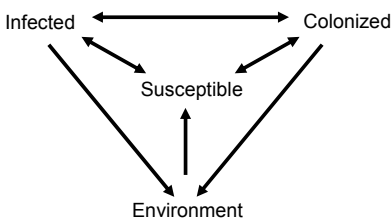


CA-MRSA: Factors for Transmission

Factors: Crowding, Frequent Contact, Compromised Skin, Contaminated Surfaces and Shared Items, Cleanliness



Transmission Dynamics CA-MRSA Outbreaks



CA-MRSA Outbreak Control Measures

- Multi-component strategies used (difficult to assess individual contribution of each)
- Strategies focusing on increased awareness, early detection and appropriate management, enhanced hygiene, and maintenance of a clean environment appear to have been successful at interrupting transmission



Community-Associated Methicillin Resistant Staphylococcus Aureus

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CA-MRSA: Emergence in the Community



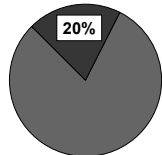
Methicillin-Resistant *Staphylococcus aureus* in Three Communities

- Fridkin SK. NEJM 2005;352:1436-44.
- Emerging Infections Program – Active Bacterial Core Surveillance (ABCs)
- 2001-2002
- Atlanta, Baltimore, Minnesota
- Laboratory-based surveillance, all culture-confirmed (invasive and non-invasive) infections in surveillance area
- Determined absence of established risk factors by record review, patient interview

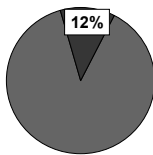


CA-MRSA Prevalence Varies by Region

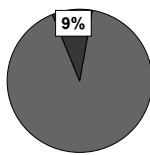
■ Healthcare-Associated MRSA ■ Community-Associated MRSA



Atlanta
n=7819



Minnesota
n=3714



Baltimore
n=1720

CA-MRSA Prevalence in Three Sites – ABCS/EIP

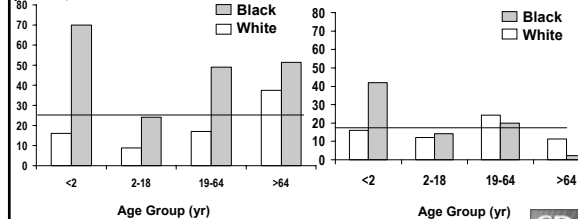


Incidence of CA-MRSA Disease in Atlanta and Baltimore, According to Race and Age Group

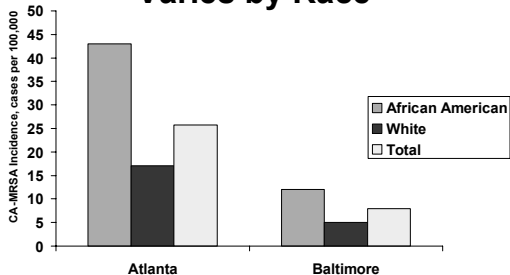
Atlanta, 2001-2002
26 per 100,000

Baltimore, 2002
18 per 100,000

Incidence, Cases
per 100,000



CA-MRSA Incidence Varies by Race



Incidence of CA-MRSA by Race, ABCS/EIP



CA-MRSA Predominantly Causes Skin Disease

Disease Syndrome	(%)
Skin/soft tissue	1,266 (77%)
Wound (Traumatic)	157 (10%)
Urinary Tract Infection	64 (4%)
Sinusitis	61 (4%)
Bacteremia	43 (3%)
Pneumonia	31 (2%)



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Community-Associated Methicillin Resistant Staphylococcus Aureus

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Infesting Strain of CA-MRSA Often Resistant to Prescribed Antimicrobial

- 73% of CA-MRSA infections treated initially with an antimicrobial to which the infecting strain was resistant
- Among patients with SSTIs, therapy to which the infecting strain was resistant did not appear to be associated with adverse outcomes



CA-MRSA in Hawaii, 2001-2003

- Retrospective chart review of patients with MRSA infection, 2001-2003
- Four health-care facilities (40% of acute care beds):
 - Children and woman's center
 - Private urban clinic
 - County urban hospital
 - Rural community hospital

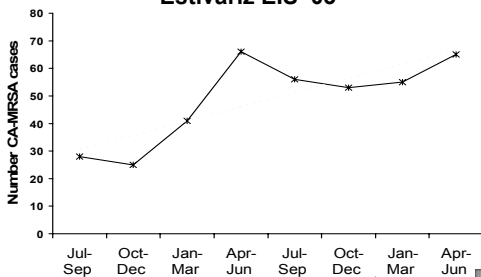


Estivariz: MMWR 53(33);767-770, 2004



Increase in CA-MRSA Infections, Hawaii 2001-03

Estivariz EIS '03

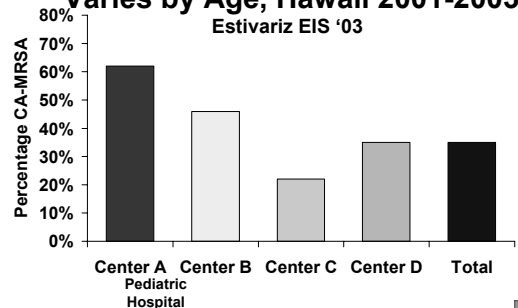


CA-MRSA is increasing in Four Facilities in Hawaii, 2001-2003



CA-MRSA Prevalence Varies by Age, Hawaii 2001-2003

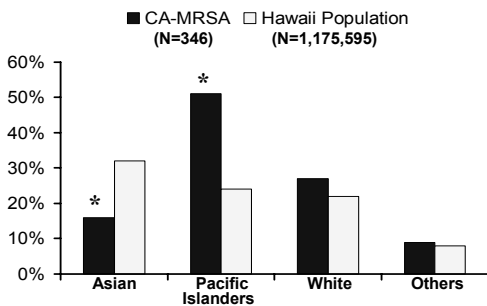
Estivariz EIS '03



CA-MRSA Prevalence at Four Facilities in Hawaii, 2001-3



Race Distribution of Case-patients Hawaii, 2001-2003



• P<.05 for CA-MRSA vs expected
• Data from 2001 Hawaii Health Survey, HI State DOH



S. aureus Community-Acquired Pneumonia Following Influenza-Like Illness, 2003-4

Characteristic	No. (%) n=17
Age, median [range]	21 (8 mos.-62 yrs)
Sex, female	9 (52)
MRSA	15 (88)
Race	
White	10 (59)
Black	7 (41)
Underlying disease*	5 (29)
MRSA risk factors	4 (24)
Documented influenza vaccination	1 (6)

*One each: Diabetes, multiple sclerosis, abdominal wall malformation, cystic fibrosis, eczema



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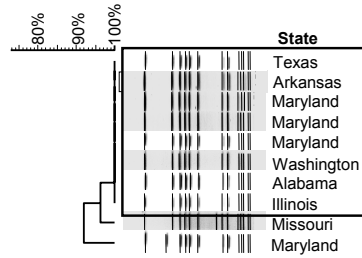
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S. aureus Community-Acquired Pneumonia Following Influenza-Like Illness, 2003-4

Characteristic	No. (%) n=17
Evidence of preceding influenza illness	
Clinical symptoms only	5 (29)
Laboratory Confirmed	12 (71)
Rapid antigen test	10 (59)
Paired serology	1 (6)
Fluorescent antibody staining	1 (6)
Hypotension (systolic<90mmHg)	7 (41)
Leukopenia (WBC < 3,500/mm ³)	4 (24)
Thrombocytopenia (<150,000/mm ³)	4 (24)
Hospitalization	16 (94)
ICU (8 intubated)	13 (81)
Death (Median Age = 28)	5 (29)

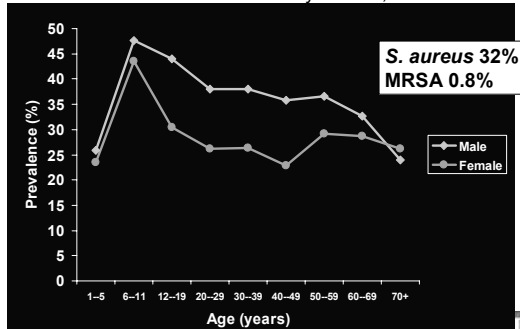


Eight Indistinguishable MRSA Patterns from CAP Patients

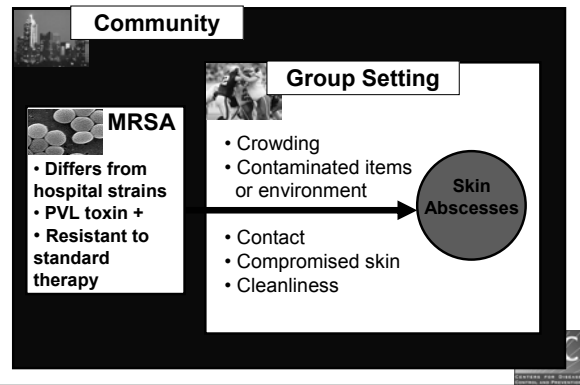


S. aureus Colonization

NHANES Nasal Swab Survey 2001-2. Kuehnert et al.



CA-MRSA Transmission



Prevention and Control of Community-Associated Methicillin-Resistant Staphylococcus aureus

CA-MRSA Expert Panel Summary

Rachel J. Gorwitz, MD MPH
Division of Healthcare Quality Promotion
National Center for Infectious Diseases

DRAFT



CA-MRSA Prevention and Control

- Meeting July 2004
 - American Academy of Pediatrics
 - Peds Infectious Disease Society
 - Amer College of Emergency Physicians
 - State and Local Health Departments
 - FDA
- Goals
 - Identify reasonable approaches to prevention and control of MRSA in the community
 - Identify needed areas for research

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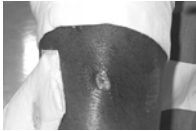


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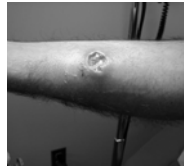
Clinical Considerations



Clinical Considerations - Evaluation

Increase Awareness

- MRSA belongs in the differential diagnosis of skin and soft tissue infections (SSTI's) compatible with *S. aureus* infection:



- Abscesses, pustular lesions, "boils"
- "Spider bites"
- Cellulitis?

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Clinical Considerations - Evaluation

Increase Awareness

- MRSA should also be considered in differential diagnosis of severe disease compatible with *S. aureus* infection:
 - Sepsis syndrome
 - Osteomyelitis
 - Necrotizing pneumonia
 - Septic arthritis
 - Necrotizing fasciitis



DRAFT



Clinical Considerations - Evaluation

Collect Diagnostic Specimens

- Obtain material for culture
 - Guides clinical management
 - Contributes to knowledge of local prevalence, epidemiology, susceptibility patterns

DRAFT



Clinical Considerations - Management

Incision and Drainage Should Be Routine

- Primary therapy for abscesses
- May be adequate sole therapy in some circumstances
- Provider education / refreshers on appropriate technique may be necessary

DRAFT



Clinical Considerations - Management

Adequate Follow-Up Must be Maintained

- Develop follow-up plan for all non-hospitalized patients
- Instructions to return if:
 - Develop systemic symptoms
 - Worsening local symptoms
 - No improvement in 48-72 hours

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Community-Associated Methicillin Resistant Staphylococcus Aureus

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Clinical Considerations - Management

Empiric Antimicrobial Therapy May Be Needed for SSTIs

- Significant associated cellulitis
- Systemic signs of illness
- Associated co-morbidities

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Clinical Considerations - Management

Antimicrobial Selection

- Beta-lactams still appropriate first-line therapy for SSTIs in some circumstances?
- Take into account:
 - Local prevalence of MRSA
 - Severity of illness
 - Patient co-morbidities

DRAFT



Clinical Considerations - Management

Antimicrobial Selection (SSTIs)

- Alternate agents:
 - Clindamycin
 - TMP/SMX
 - Tetracyclines
 - Rifampin (in combination with other agent)
 - Linezolid
- More data needed to establish effectiveness!

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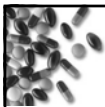


Clinical Considerations - Management

Inducible Clindamycin Resistance

- Mediated by *erm* gene
- Isolates appear macrolide (erythromycin)-resistant and clindamycin-susceptible on routine susceptibility testing
- In vitro resistance to clindamycin can occur during a course of therapy
- Detected by a D-test, or double disk diffusion test
- Clinical implications of positive D-test unclear, but should check for inducible resistance and avoid clindamycin if detected

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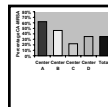


Clinical Considerations - Management

Antimicrobial Selection

- Not optimal for MRSA:
 - Macrolides
 - Fluoroquinolones
- High prevalence of resistance or potential for rapid development of resistance

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Clinical Considerations - Management

Use Local Data for Treatment

- MRSA prevalence and susceptibility to alternate agents vary geographically
- Local epidemiologic risk factors may be useful in assessing likelihood of MRSA in a given patient

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Clinical Considerations *Patient Education*

- Critical component of case management
 - Wound care
 - Hygiene
 - Hand washing
 - Regular bathing
 - Avoid sharing of potentially contaminated objects

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Clinical Considerations

Management of Household Clusters and Recurrent Disease

- Education is critical
- Instruct patients and household members to seek care early so that prompt appropriate treatment of new infections can be provided
- Decolonization???

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Clinical Considerations *Decolonization Regimens*

- Topical Nasal Agents
 - Mupirocin, Others
- Antiseptic Body Washes
 - Chlorhexidine, Others
- Oral antimicrobials
 - TMP/SMX + Rifampin, Others
 - Infected individuals only
- Single, short courses

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Clinical Considerations

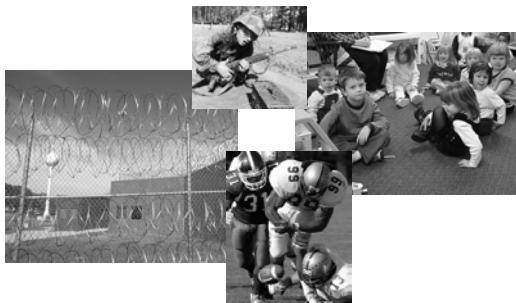
Management of Household Clusters and Recurrent Disease: Decolonization

- Data from healthcare settings (pre-op, dialysis, long-term care):
 - Regimens can be effective in eliminating colonization, at least in the short term
 - Effectiveness in preventing disease less clear
- Almost no data on effectiveness in community setting
- Resistance can emerge
- Basic strategies should be optimized first

DRAFT



Public Health Intervention



Public Health Intervention

When to Investigate

- Consider investigation when culture-proven MRSA cases have been detected in a cluster among epidemiologically-linked individuals in the community

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Community-Associated Methicillin Resistant Staphylococcus Aureus

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Public Health Intervention

When to Investigate

- Decision to investigate should take into account various factors
 - Number of cases and temporal proximity of the cluster
 - Setting in which transmission is occurring
 - Severity of illness among cases
 - Presence of ongoing transmission or recurrent illness among cohort members
 - Host factors of those likely to be infected
 - Likelihood that an intervention could be successfully implemented

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Public Health Intervention

Components of Interventions

- Enhance surveillance
- Target empiric therapy to the pattern of the outbreak strain
- Educate on wound care and wound containment
- Promote enhanced personal hygiene and limit sharing of personal items
- Consider excluding patients from certain activities
- Achieve and maintain a clean environment

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Public Health Intervention

Risk Factor Study?

- Can be labor and resource intensive
- Not always necessary for outbreak management
- Consider when:
 - Cluster occurs in a new setting
 - Results are likely to:
 - Directly impact control efforts
 - Contribute to general understanding of the disease and future prevention efforts

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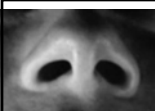


Public Health Intervention

Colonization Swab Surveys?

- Have been used in many published investigations
- Yield has often been low
- Not generally necessary to direct control and prevention efforts
- May be useful:
 - To determine extent of or identify risk factors for transmission (“carrier-control” study)
 - To contribute to the understanding of CA-MRSA epidemiology (non-nasal colonization sites)

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Components of a Public Health Intervention

Decolonization?

- No data to support efficacy in preventing disease transmission in the community; trials are needed.
- Control of previous outbreaks has been achieved without use of decolonization
- Emphasis should be placed on basic control strategies first

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Conclusions

- Various studies are underway and more are needed to determine best methods for control and prevention of MRSA in the community
- Strategies focusing on increased awareness, early detection and appropriate management, enhanced hygiene, and maintenance of a clean environment appear to have been successful

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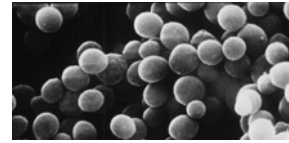
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