Surveillance of Multi-Drug Resistant Organisms

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http://www.unc.edu/depts/spice/

Objectives of Lecture

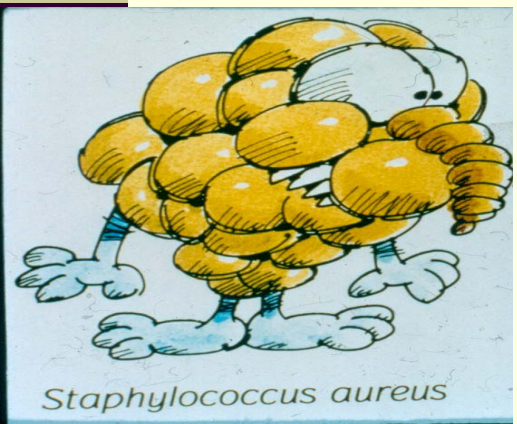
1. State the current status of MDROs (MRSA, VRE, ESBLs, CRKP)
2. Review risk factors for colonization and infection
3. Describe successful control measures for use in LTCF/RCHE

Goals of MDRO Surveillance

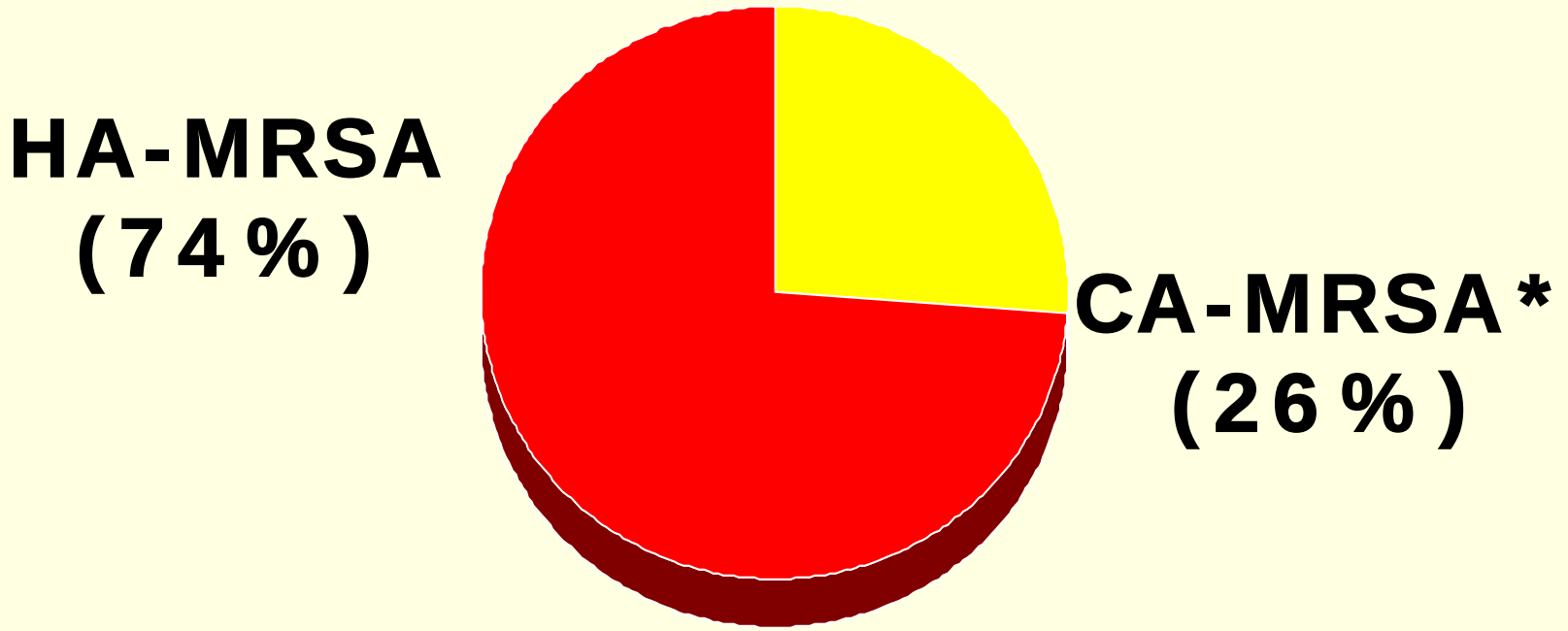
- Quantify burden infection burden and invasive disease from MDROs in LTCF/RCHE
- Monitor trends in MDROs over time to reduce incidence
- Target public health and facility interventions by:
  - Identifying regions / populations with increased incidence of MDROs
  - Monitor changes in antimicrobial susceptibility patterns

Methicillin Resistant *Staph aureus*

- MRSA emerged in the US, UK and Aus, soon after Methicillin became commericially available in the early 1960's.
- Increased prevalence in the 1970's moving to more countries.
- First identified in US LTCF in 1970, but not common until 1985.
- By 2000, MRSA accounted for >50% of all *S aureus* clinical isolates from patients with nosocomial infections in the US ICUs (CDC)

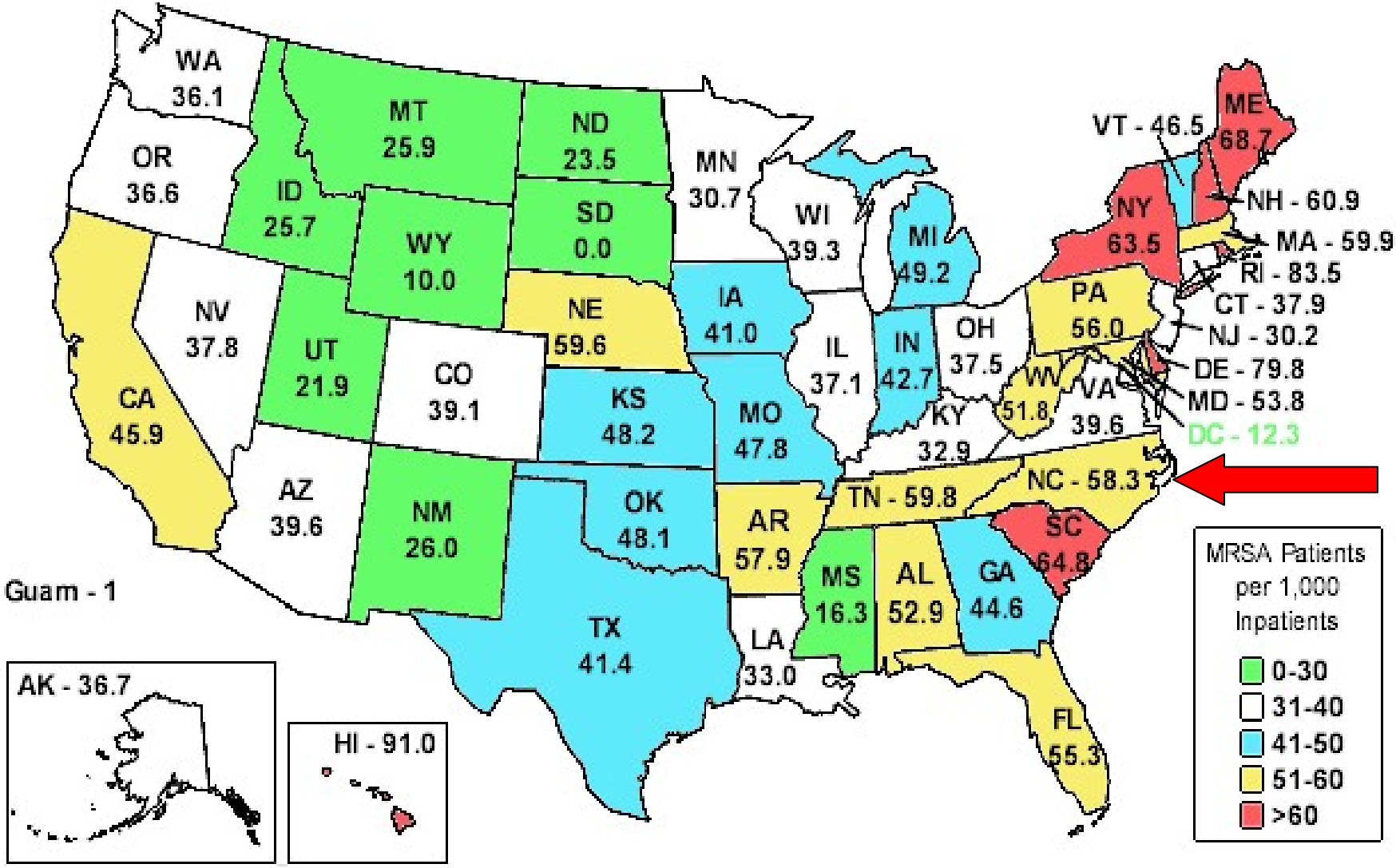


The APIC National MRSA Inpatient Survey Results: HA-MRSA vs. CA-MRSA



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

The APIC National MRSA Inpatient Survey Results: MRSA Rates By State

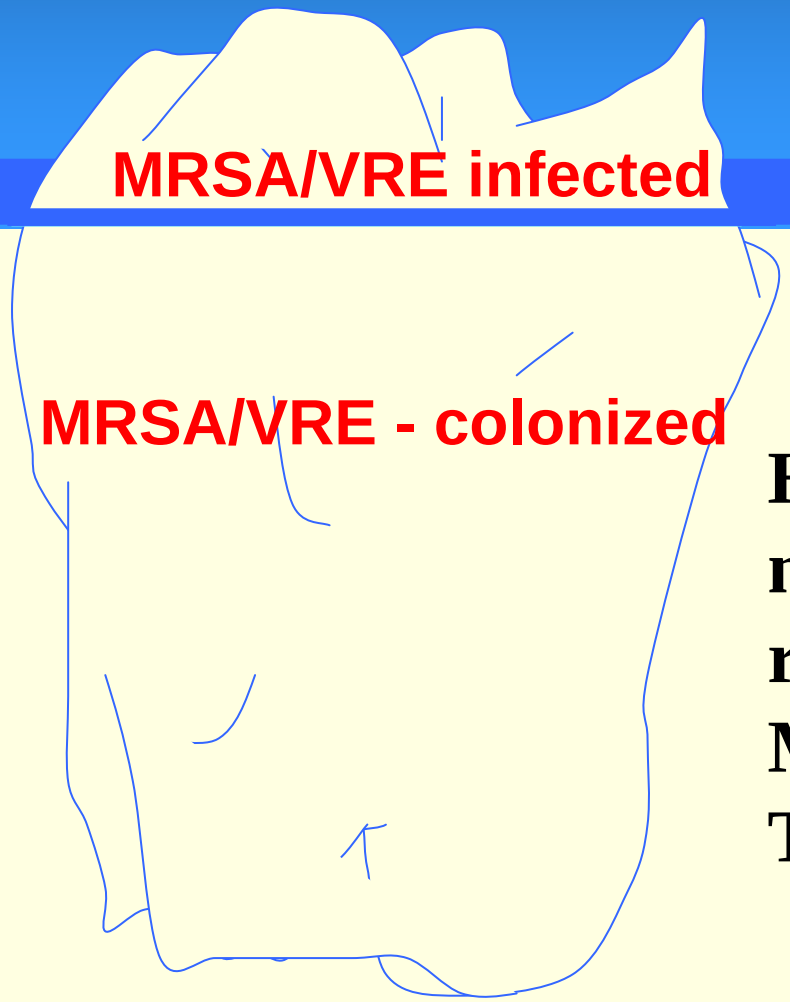


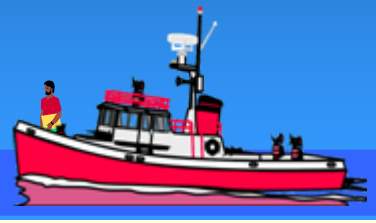
The APIC National MRSA Inpatient Survey Results

- Overall MRSA prevalence rate:

  46.3 per 1,000 inpatients.
  - **34 MRSA infections per 1,000 inpatients.**
  - **12 MRSA colonizations per 1,000 inpatients.**
  - **NC MRSA prevalence rate: 58.3 per 1000 inpatients**

Why Should You Care About Infection Control?





HCWs are the major route of MRSA/VRE Transmission!

Healthcare-Associated Risk Factors Contributing to Infection/colonization in LTCF/RCHE

- Previous MRSA colonization or infection
- Presence of a percutaneous device or indwelling catheter at the time of presentation
- Any of the following within past year:
  - Hospitalization
  - Dialysis
  - Surgery
  - Residence in a long-term care facility

Zack Moore, NCDHHS personal communication

Specific Risk Factors Contributing to MRSA Colonization in LTCF/RCHE

- Poor functional status
- Conditions that cause skin breakdowns (pressure ulcers)
- Antimicrobial therapy
- Nasogastric intubation
- Urinary or fecal incontinence
- Hospitalization within previous 6 months

MRSA

- Can colonize multiple body sites to include anterior nares, skin, GI tract
- Recognized pathogen for hospital and community associated infections
- Intermittent carriage has been demonstrated
- Multiple studies have shown that persons can stay colonized with MRSA for long periods of time, generally months to years

MRSA: Duration of Carriage

- Study conducted in the Netherlands involved 135 patients positive for MRSA upon discharge from the hospital
- Patients were assessed every 6 months for carriage and MRSA risk factors
- At 6 months: 121 patients assessed, 60% (72) remained positive
- At 1 year: 99 patients assessed, 22% (22 patients) remained positive
- At 2 years: 47 patients assessed, 13% (6) remained positive

Vriens, MR. *Infect Control Hosp Epidemiol* 2005; 26: 629-633

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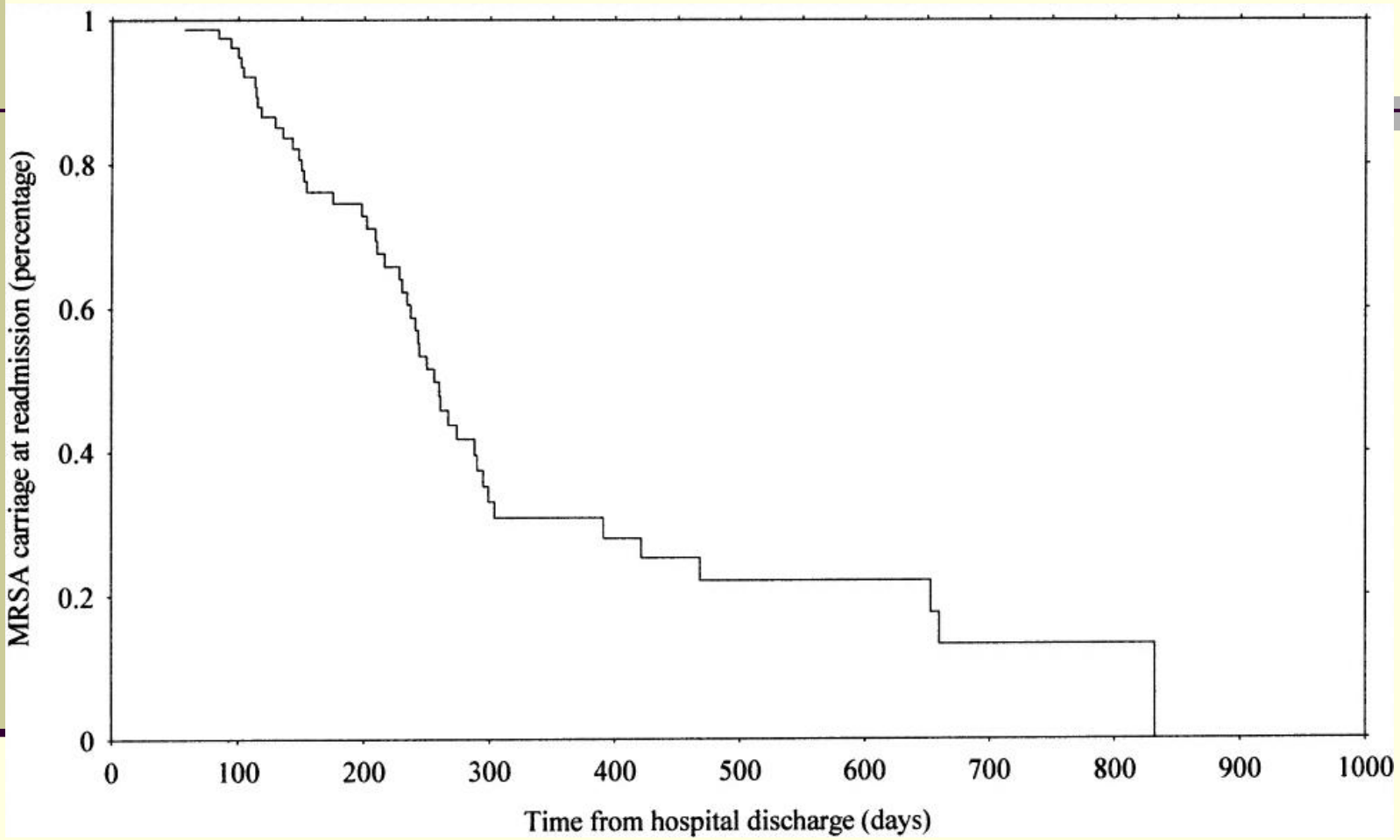
MRSA: Duration of Carriage

- Prospective 10 month study involving 78 patients admitted to a 1200 bed French hospital who were known to have MRSA from a previous admission
- All were readmitted >3 mo after the end of the previous stay
- 40% remained positive at time of readmission
- The median time to a negative MRSA screen was 8.5 mo

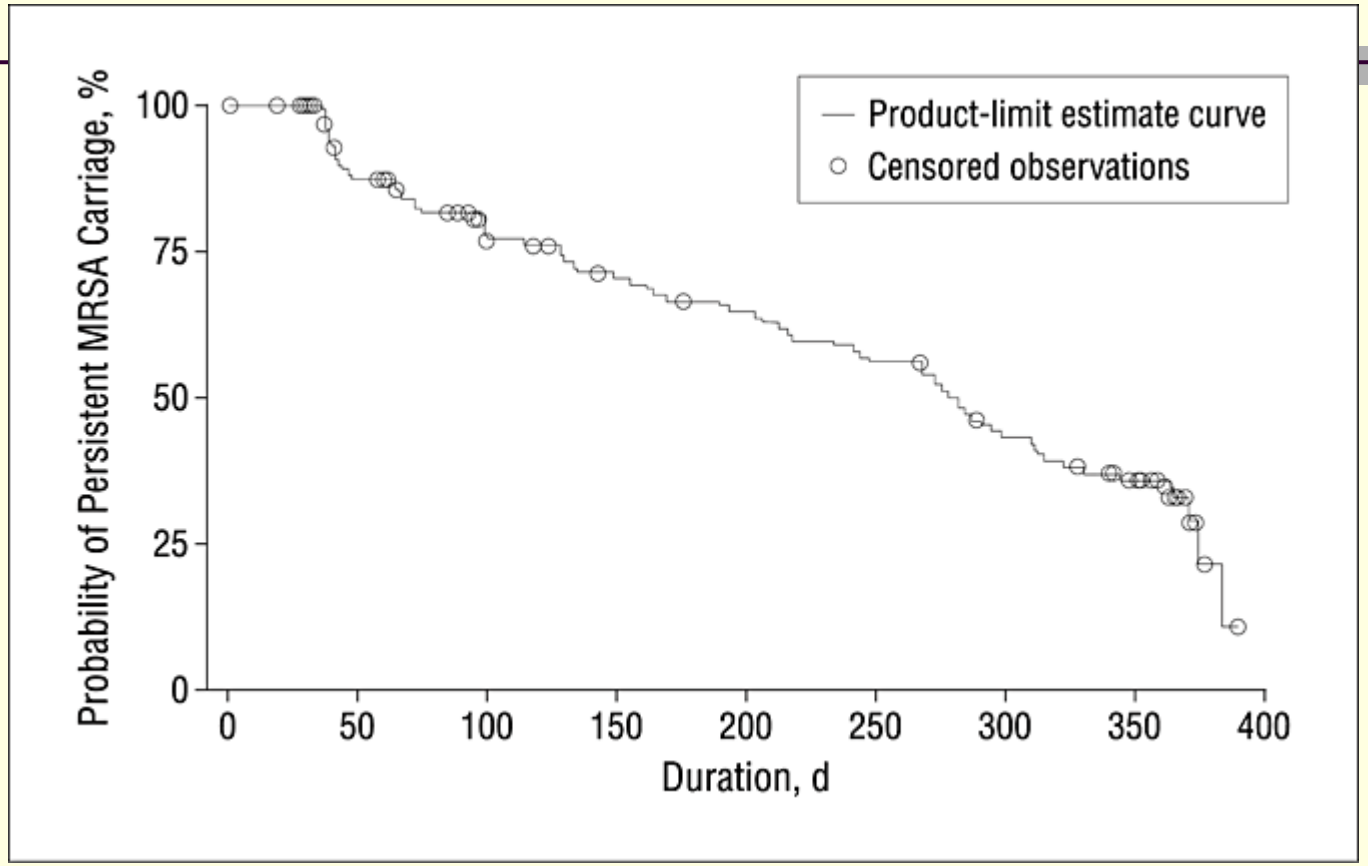
Scanvic A. *CID* 2001; 32: 1393-98



Kaplan-Meier estimates of time until results of screenings for MRSA became negative for readmitted patients (%)

Scanvic A. *CID* 2001; 32: 1393-98

Carriage of MRSA in Home Care Setting



Time to MRSA clearance in 148 MRSA carriers admitted to home health then monitored for 1 year.

Estimated mean time to MRSA clearance was 246 days (95% CI, 222-270 days)
Median time was 282 days (95% CI, 233-313 days)

Lucet, J.-C. et al. *Arch Intern Med* 2009;169:1372-1378

MRSA Colonization Leads to Infection

- Nares cultures on all patients admitted to five units.
- 30/758 (3.96%) patients MRSA-colonized on admission.
- 20% 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=9.5) or un-colonized (RR=12).
- Identifying MRSA-colonized patients at admission may benefit from interventions to decrease infection.

Davis et al CID 2004;39:776-782.

Environmental Surveillance

The Environment and its Role in Infection Transmission in Healthcare Facilities –

What Do We Know and

What to Do?

What's in the Environment?

Detection Rate of Multi-resistant Gram-positive (MRSA, VRE) and Gram-negative Bacteria on Different Environmental Items

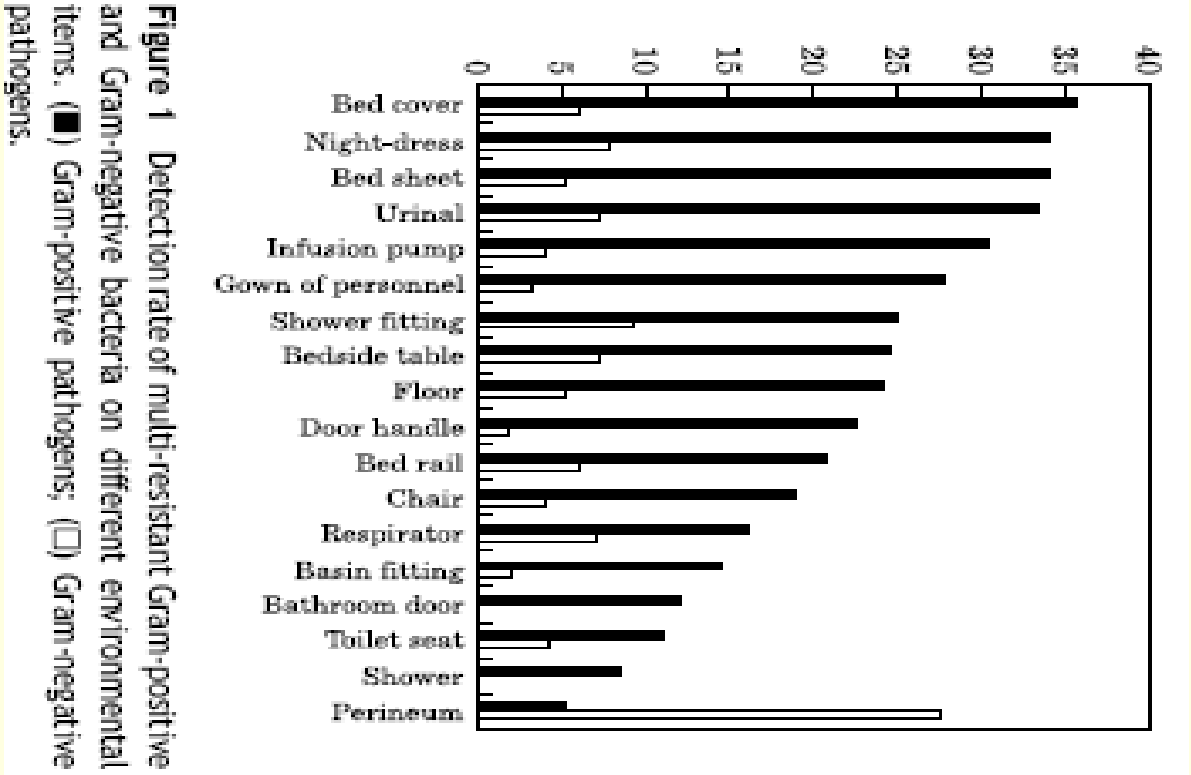


Figure 1 Detection rate of multi-resistant Gram-positive and Gram-negative bacteria on different environmental items. (■) Gram-positive pathogens; (□) Gram-negative pathogens.

Lemmen, et al. *J Hosp Infect* 2004; 56:191-7.

Assessing How Often: Population" Studies

Environmental Sampling in MRSA Isolation Rooms (N=25)

Factor	No. (%) MRSA positive
Surface sample	269/502 (53.6)
Bed sample	25/42 (59.5)
Mattress sample	22/42 (52.4)
Settle plates	102/251 (40.6)
Air sample	70/250 (28)
Identical (or closely related) patient & environmental isolates	14/20 (70)

Sexton et al, *J Hosp Infect* 2006; 62:187-94

Molecular Characterization of the Transmission between the Colonization of Methicillin-resistant Staphylococcus aureus to Human and Environmental Contamination in Geriatric Long-term Care Wards

% Correlation of Environment to Simultaneous Clinical Isolates, Sept-Oct 1998

	MRSA (n=42)	MSSA (n=17)
Identical	62	0
Close	36	0
Possible	2	0
None	0	100

Asoh, et al, *Intern Med* 2005; 44:41-5

Norichika, et al.

VRE

- Colonizes intestinal tract
- High prevalence among hospitalized patients; 33% of enterococci reported to National Healthcare Safety Network (NHSN) were VRE*
- Persons remain colonized for long periods of time, months to years

***Hildron AI, NHSN. *Infect Control Hosp Epidemiol* ; 2008: 996-1011**

VRE and Length of Colonization

- 116 patients hospitalized at the University of Virginia Hospital who were identified with VRE
- F/u cultures obtained on outpatient visits or during hospital stay
- First f/u culture was collected a mean of 125 days after the initial positive isolate
  - After 1st f/u culture: 64% negative
  - After 1st negative f/u culture: 92% negative
  - After 2 negative f/u cultures: 95% remained culture negative
- 22 patients remained persistently colonized for >100 days, including one patient who remained colonized 709 days after the initial isolation

Byers KR. *Infect Control Hosp Epidemiol* 2002; 23: 207-211

Recurrence of VRE

- 16 patients who had cleared VRE colonization
- 3/16 received no antibiotics during study period and remained VRE negative (f/u cultures obtained an average of 5 mo since initial 3 negatives)
- 13/16 patients received antibiotics during the study period
- 8/13 (62%) developed recurrent VRE
- PFGE suggested that both relapse and acquisition of a new strain occurred

Donskey, MD *Infect Control Hosp Epidemiol* 2002; 23: 436-440

North Carolina Guidelines for Control of Antibiotic Resistant Organisms Specifically Methicillin-Resistant *Staphylococcus aureus* (MRSA) and Vancomycin-Resistant Enterococci (VRE)

North Carolina Statewide Infection Control Program
North Carolina General Communicable Disease Control Section
Guideline Advisory Group

January 1997

North Carolina Guidelines for Control of Antibiotic Resistant Organisms

(Designed for long-term care facilities and other non-acute care settings)

- Admission to licensed facilities should not be denied or restricted because of colonization or infection with MRSA/VRE.
- Standard Precautions are adequate for nasal or superficial colonization (e.g., identified from sputum culture, but without purulence) with MRSA, or the continent hygienic patient with VRE.

North Carolina Guidelines for Control of Antibiotic Resistant Organisms (cont)

- Contact Precautions are indicated for:
  - Foley catheter associated MRSA/VRE
  - Wounds heavily colonized or infected with MRSA/VRE
  - Tracheostomy patients colonized with MRSA/VRE or if infected unable to handle secretions.

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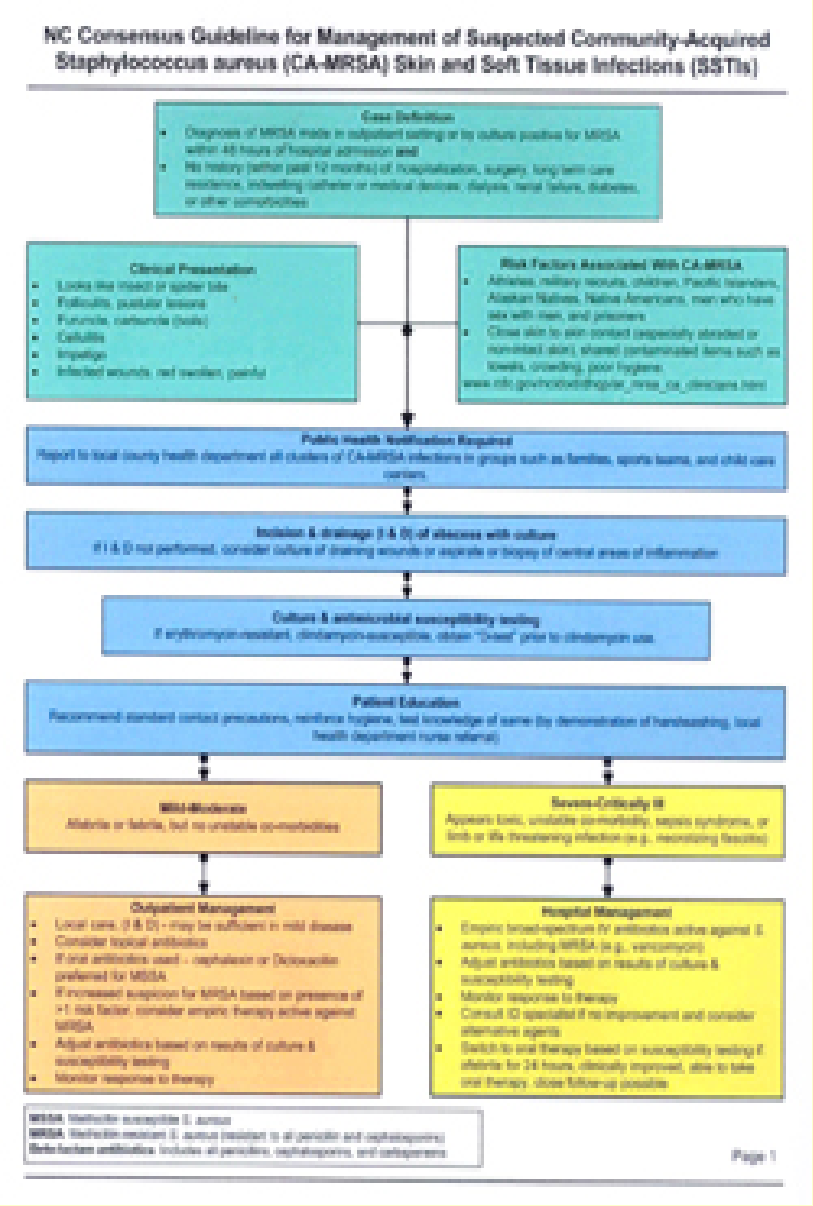
CDC Intensified MDRO Control Measures Options

- In acute care settings
  - Implement CP upon room entry
  - Patient placement – single rooms when available
- In LTCFs (RCHE)
  - Use hand hygiene, gloves routinely
  - Implement contact precautions on a case-by-case basis

The 5 C's for MRSA/VRE (to determine need for CP)

- In LTCFs in US to determine need for Contact Precautions: must have all 5 C's for Standard Precautions (CDC case-by-case factors)
- 1. Compliant
- 2. Competent
- 2. Continence (urine and stool)
- 3. No catheter (invasive devices)
- 4. Colonized
- 5. Covered and contained wounds

http://www.unc.edu/depts/spice/CA-MRSA.html



NC Consensus Guideline for Management of Suspected Community-Acquired Staphylococcus aureus (CA-MRSA) Skin and Soft Tissue Infections (SSTIs)

Case Definition

- Diagnosis of MRSA made in outpatient setting or by culture positive for MRSA within 48 hours of hospital admission **and**
- No history (within past 12 months) of hospitalization, surgery, long-term care residence, indwelling catheter or medical devices, dialysis, renal failure, diabetes, or other comorbidities

Clinical Presentation

- Looks like insect or spider bite
- Folliculitis, pustular lesions
- Furuncle, carbuncle (boils)
- Cellulitis
- Impetigo
- Infected wounds; red, swollen, painful

Risk Factors Associated With CA-MRSA

- Athletes, military recruits, children, Pacific Islanders, Alaskan Natives, Native Americans, men who have sex with men, and prisoners
- Close skin to skin contact (especially abraded or non-intact skin), shared contaminated items such as towels, crowding, poor hygiene.

www.cdc.gov/ncidod/dhqp/ar_mrsa_ca_clinicians.html

Public Health Notification Required

Report to local county health department all clusters of CA-MRSA infections in groups such as families, sports teams, and child care centers.

Incision & drainage (I & D) of abscess with culture

If I & D not performed, consider culture of draining wounds or aspirate or biopsy of central areas of inflammation

Culture & antimicrobial susceptibility testing

If erythromycin-resistant, clindamycin-susceptible, obtain "D-test" prior to clindamycin use.

Patient Education

Recommend standard contact precautions, reinforce hygiene, test knowledge of same (by demonstration of handwashing, local health department nurse referral)

Mild-Moderate

Afebrile or febrile, but no unstable co-morbidities

Severe-Critically Ill

Appears toxic, unstable co-morbidity, sepsis syndrome, or limb or life threatening infection (e.g., necrotizing fasciitis)

Outpatient Management

- Local care, (I & D) - may be sufficient in mild disease
- Consider topical antibiotics
- If oral antibiotics used - cephalexin or Dicloxacillin preferred for MSSA
- If increased suspicion for MRSA based on presence of >1 risk factor, consider empiric therapy active against MRSA
- Adjust antibiotics based on results of culture & susceptibility testing
- Monitor response to therapy

Hospital Management

- Empiric broad-spectrum IV antibiotics active against *S. aureus*, including MRSA (e.g., vancomycin)
- Adjust antibiotics based on results of culture & susceptibility testing
- Monitor response to therapy
- Consult ID specialist if no improvement and consider alternative agents
- Switch to oral therapy based on susceptibility testing if afebrile for 24 hours, clinically improved, able to take oral therapy, close follow-up possible

MRSA: Methicillin resistant *S. aureus*
MSSA: Methicillin susceptible *S. aureus* (resistant to all penicillin and cephalosporins)
Beta-lactam antibiotics: Includes all penicillins, cephalosporins, and carbapenems

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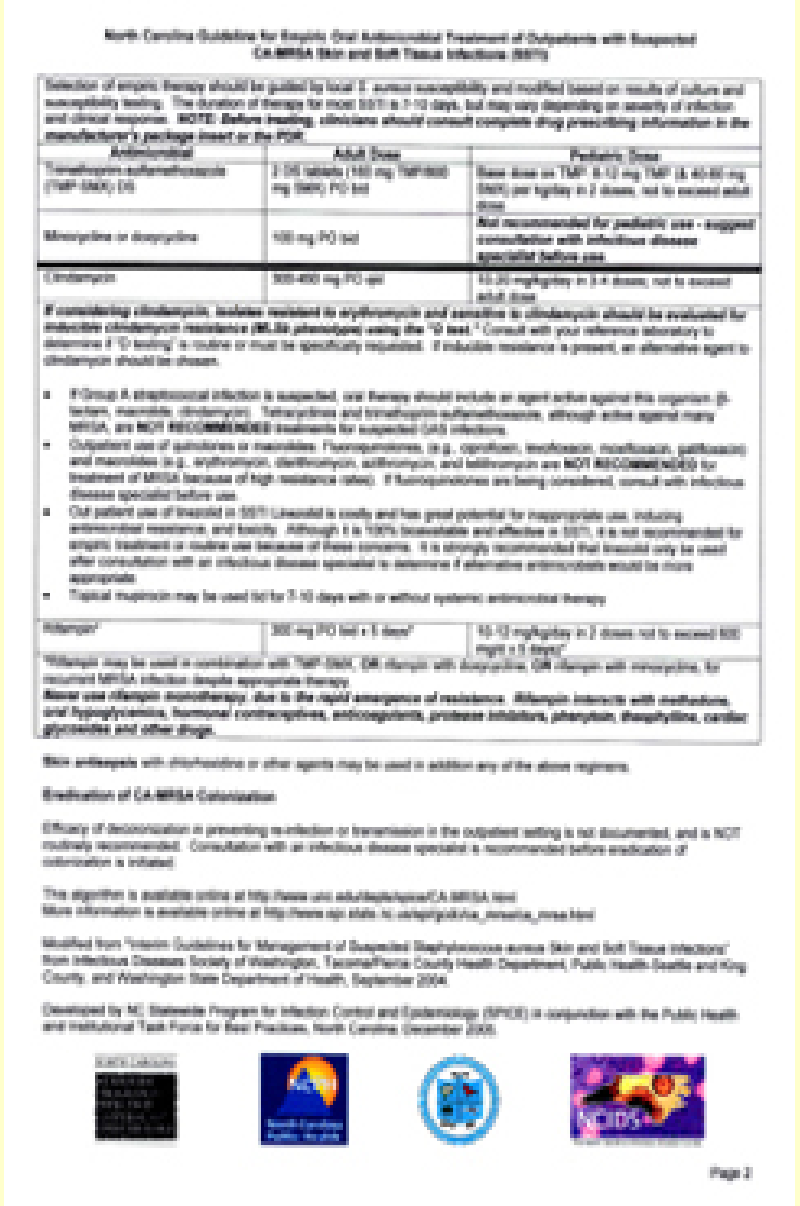


North Carolina Guideline for Empiric Oral Antimicrobial Treatment of Outpatients with Suspected CA-MRSA Skin and Soft Tissue Infections (SSTI)

Selection of empiric therapy should be guided by local *S. aureus* susceptibility and modified based on results of culture and susceptibility testing. The duration of therapy for most SSTI is 7-10 days, but may vary depending on severity of infection and clinical response. **NOTE: Before treating, clinicians should consult complete drug prescribing information in the manufacturer's package insert or the PDR.**

Antimicrobial	Adult Dose	Pediatric Dose
Trimethoprim-sulfamethoxazole (TMP-SMX) [1]	2 DS tablets (160 mg TMP/800 mg SMX) PO bid	Base dose on TMP: 8-12 mg TMP (& 40-60 mg SMX) per kg/day in 2 doses; not to exceed adult dose
Minocycline or doxycycline	100 mg PO bid	**Not recommended for pediatric use - suggest consultation with infectious disease specialist before use.**
Clindamycin	300-450 mg PO qid	10-20 mg/kg/day in 3-4 doses; not to exceed adult dose

If considering clindamycin, isolates resistant to erythromycin and sensitive to clindamycin should be evaluated for inducible clindamycin resistance (MLiSb phenotype) using the "D test." Consult with your reference laboratory to determine if "D testing" is routine or must be specifically requested. If inducible resistance is present, an alternative agent to clindamycin should be chosen.

- If Group A streptococcal infection is suspected, oral therapy should include an agent active against this organism (β-lactam, macrolide, clindamycin). Tetracyclines and trimethoprim-sulfamethoxazole, although active against many MRSA, are **NOT RECOMMENDED** treatments for suspected GAS infections.
- Outpatient use of quinolones or macrolides. Fluoroquinolones, (e.g., ciprofloxin, levofloxacin, moxifloxacin, gatifloxacin) and macrolides (e.g., erythromycin, clarithromycin, azithromycin, and telithromycin are **NOT RECOMMENDED** for treatment of MRSA because of high resistance rates). If fluoroquinolones are being considered, consult with infectious disease specialist before use.
- Oral patient use of linezolid in SSTI Linezolid is costly and has great potential for inappropriate use, inducing antimicrobial resistance, and toxicity. Although it is 100% bioavailable and effective in SSTI, it is not recommended for empiric treatment or routine use because of these concerns. It is strongly recommended that linezolid only be used after consultation with an infectious disease specialist to determine if alternative antimicrobials would be more appropriate.
- Topical mupirocin may be used bid for 5-10 days with or without systemic antimicrobial therapy.

Rifampin[2]	300 mg PO bid x 5 days[2]	10-12 mg/kg/day in 2 doses not to exceed 600 mg/d x 5 days[2]

[2]Rifampin may be used in combination with TMP-SMX, OR rifampin with doxycycline, OR rifampin with minocycline, for recurrent MRSA infection despite appropriate therapy.
Never use rifampin monotherapy due to the rapid emergence of resistance. Rifampin interacts with methadone, oral hypoglycemics, hormonal contraceptives, anticoagulants, protease inhibitors, phenytoin, theophylline, cardiac glycosides and other drugs.

Skin antiseptic with chlorhexidine or other agents may be used in addition any of the above regimens.

Eradication of CA-MRSA Colonization

Efficacy of decolonization in preventing re-infection or transmission in the outpatient setting is not documented, and is NOT routinely recommended. Consultation with an infectious disease specialist is recommended before eradication of colonization is initiated.

This algorithm is available online at http://www.unc.edu/depts/spice/CA-MRSA.html
More information is available online at http://www.epi.state.nc.us/epi/gdiv/ca_mrsa/ca_mrsa.html

Modified from "Interim Guidelines for Management of Suspected Staphylococcus aureus Skin and Soft Tissue Infections" from Infectious Diseases Society of Washington, Tacoma/Pierce County Health Department, Public Health-Seattle and King County, and Washington State Department of Health, September 2004.

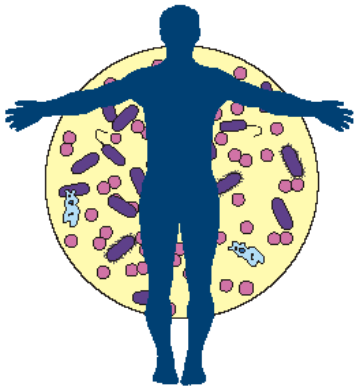
Developed by NC Statewide Program for Infection Control and Epidemiology (SPICE) in conjunction with the Public Health and Institutional Task Force for Best Practices, North Carolina (December 2005)

Page 2

Patient Education

Living with MRSA

(Methicillin-Resistant *Staphylococcus aureus*)



What is MRSA

Protecting Yourself and Others from Infection

Preventing the Spread of MRSA in the Home

Preventing the Spread of MRSA in the Community

MRSA and your Health Care

What is MRSA?

Staphylococci or "staph" are bacteria that live on the skin and in the nose, usually without causing harm. Methicillin-resistant *Staphylococcus aureus* (MRSA) is a kind of staph bacteria that has become resistant to antibiotics. Bacteria develop resistance to antibiotics when a

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Staph infections a
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What do MRS
MRSA bacteria are
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sites. It is most lik
in the skin or othe
body.

Common skin co
boils, infected hair
sores that look lik
can sometimes de
infection to surrou
heart infections.

Page 1

Protecting yourself and others from infection

How is MRSA spread?

MRSA bacteria can spread from an infected person to another person during prolonged skin to skin contact. MRSA can also be transferred by an infected person to commonly shared objects such as towels, which can then transfer to any person who touches that object. MR
contact, not thr
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Page 3

Preventing the Spread of MRSA in the Home

Clean your house often and well

- Regularly clean surfaces and other commonly touched areas (doorknobs, light switches, etc.) with a disinfectant. Bleach solution is an easy-to-make, inexpensive disinfectant. Mix one tablespoon bleach to one quart of water. The solution should be made fresh every day when it sits. Never m
any cleaners containi
ammonia. Disinfectan
widely available in sto
well. Be sure the labe
identifies it as a
disinfectant and follo
instructions for use.
- If body fluids such a
wound drainage get
onto surfaces, clean
and disinfect these
surfaces well.
- Cleaning involves
removing the visible
material (with a paper
disinfecting involves
bacteria. Disinfectant
using a saturated clot
they must be in contac
period of time. Allow
dry after 10 minutes.
- Do not share towels,
items with anyone els
- Change your sheets r
wound.

Preventing spread of MRSA in your community

How to protect others when you are outside the home: *Wherever you go, your MRSA goes.*

Depending on the nature of your infection, there are certain things you can do to help prevent spreading MRSA to others when you are away from home. Be especially careful to keep any infectious material from a wound from coming in contact with other people or common surface areas.

People with active MRSA infections in a wound with uncontrollable drainage (either because there is so much drainage that it leaks out of the bandages or in a child or other person who cannot follow hygiene instructions) should stay home until they are able to completely contain the drainage with bandages.

IF you must leave your home, or if you have an active infection that can be completely contained:

- Cover all sores (wounds, boils, etc.) with clean, dry bandages. If possible, keep bandages covered with clothing.
- For children in school, develop a plan with the school nurse to protect the other children and the school environment.
- If you have sores that cannot be covered, such as impetigo on the face, do not touch the area! If you do touch it, wash your hands immediately.
- Carry alcohol-based hand cleaner with you so you can cleanse your hands if water is not available
- Do not work out at a public gym. School children and athletes should not participate in contact sports. Sweating can cause bandages to loosen and lead to skin-to-skin or skin-to-equipment contact allowing MRSA bacteria to spread.

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Download pamphlet at http://www.unc.edu/depts/spice/CA-MRSA.html

MRSA/VRE SUMMARY

- MRSA is a continued threat in the Healthcare system (especially hospitalized)
- CA-MRSA is a growing problem in the community
- Environment appears to play a role in transmission
- Increased attention to interventions in healthcare facilities may reduce incidence and prevalence of MRSA
  - Hand hygiene, contact isolation, active surveillance, environmental cleaning
  - Each of these interventions will only be effective if carried out with monitoring and timely feedback

MDR-*Acinetobacter sp.*

- Widely distributed in the environment and can colonize the skin of healthy individuals
- Studies of healthy military recruits found 17% (17/102) had skin colonization; however, when their isolates were compared to clinical isolates from injured soldiers, none showed genetic similarities*
- Swab specimens from the nares of 293 healthy soldiers undergoing military training in Texas found no *Acinetobacter* colonization.**

***Griffith, M. *Infect Control Hosp Epidemiol* 2006; 27:659-661**
****Griffith, M. *Infect Control Hosp Epidemiol* 2006; 27:787-788**

Duration of Carriage

- 140 samples obtained from 30 patients with a remote (≥ 6 months) history of *Acinetobacter baumannii*
- 5 (17%) has at least one positive surveillance culture
- Length of time from the last clinical isolate ranged from 8-42 months

Marchaim D. *J Clin Micro* 2007; 45: 1551-1555

Surveillance Cultures

- Twenty two patients with recent (≤10 days) acinetobacter isolates were considered carriers
- Six body sites sampled with 12 patients having at least 1 positive surveillance culture
- Overall sensitivity of 55%

Marchaim D. J Clin Micro 2007; 45: 1551-1555

Sensitivities of Surveillance Cultures

Culture site	No. Patients Sampled	No. with MDR *A. baumannii*	Sensitivity
Surveillance sites			
Nostrils	22	4	18
Pharynx	22	5	23
Skin	22	3	13.5
Rectum	21	3	14
Clinical Sites			
Wounds (only wounds with discharge)	9	2	22
Endotracheal Aspirates	7	2	29

Marchaim D. J Clin Micro 2007; 45: 1551-1555

C. difficile

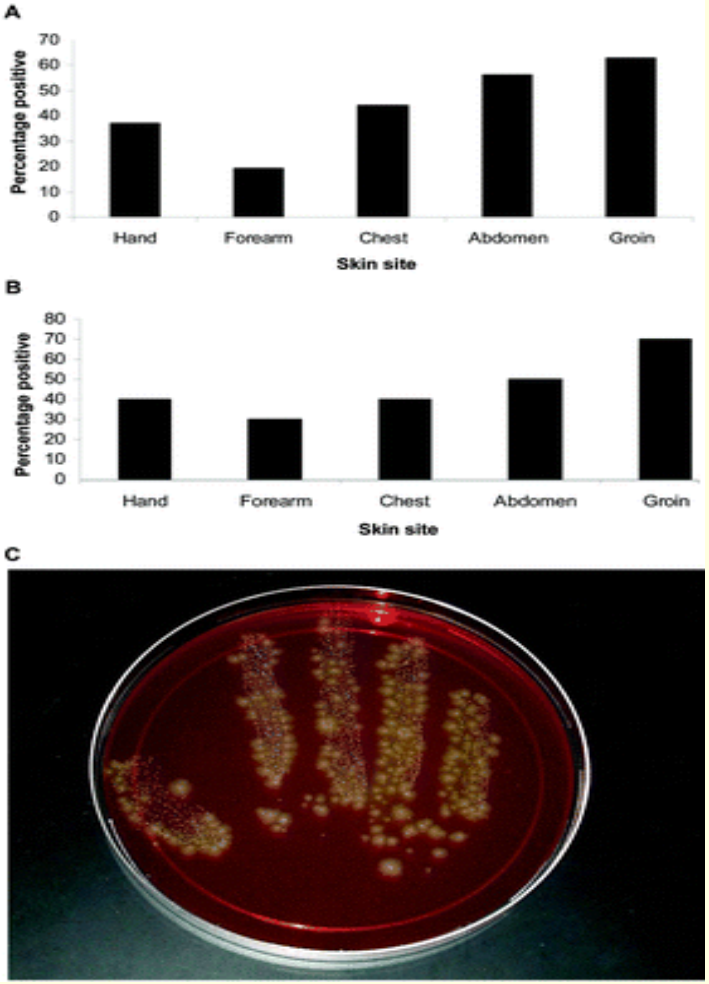
- Occasionally normal flora, found in ≤ 3% of healthy adults
- Once diarrhea stopped, *C. difficile* may still be present in stool but the amount excreted in stool and the amount of environmental contamination is reduced

Clostridium difficile Skin Contamination

A. Frequency of *C. difficile* contamination of skin sites of 27 patients.

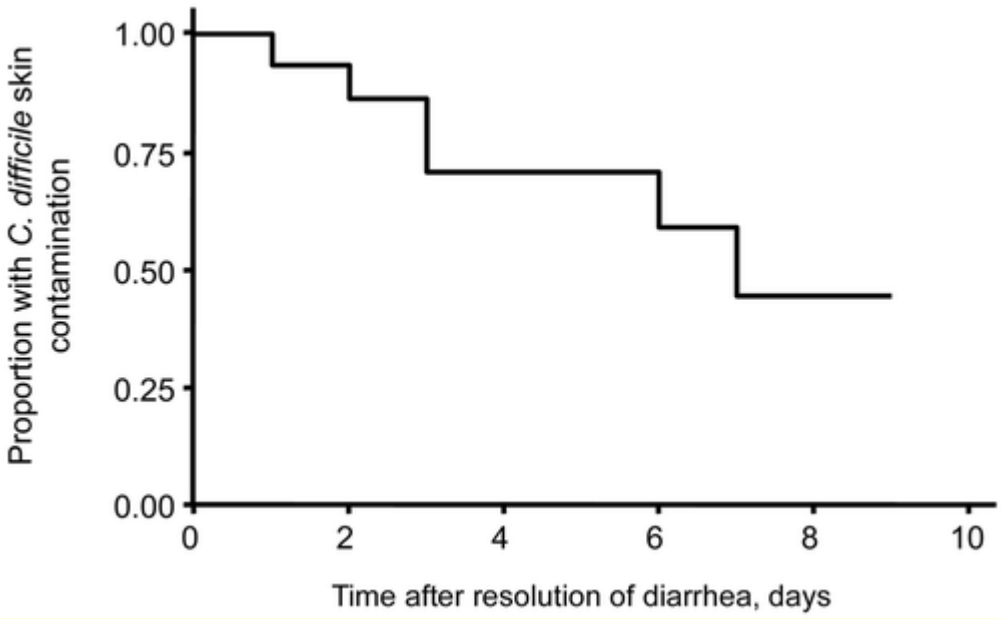
B. Frequency of acquisition on sterile gloves after contact with skin sites of a subset of 10 patients.

C. Typical illustration of acquisition of *C. difficile* on sterile gloves after contact with groin.



Bobulsky GS. *CID*, 2008; 46:447-50

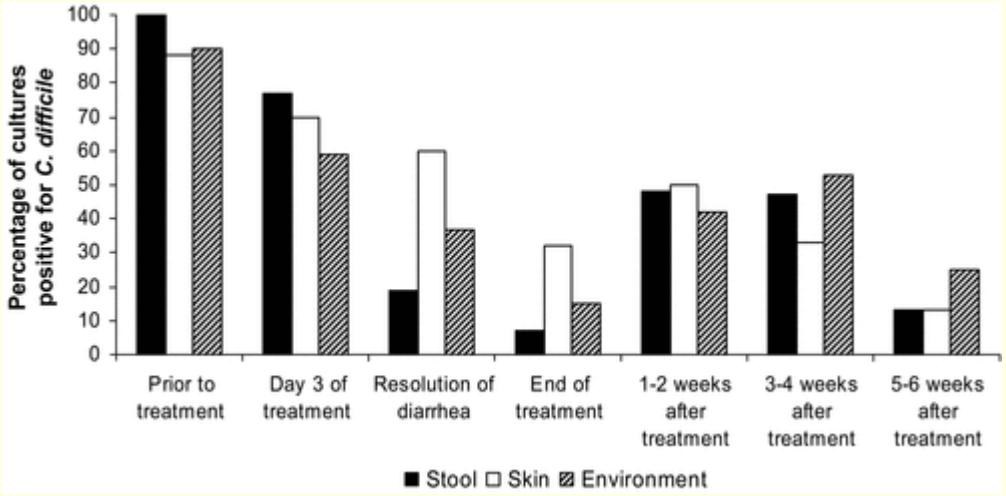
Persistence of Skin Contamination



Kaplan-Meier estimation of time from resolution of diarrhea (day 0) to negative results of culture specimens of abdomen and/or chest skin of patients with *C. difficile* associated disease.

Bobulsky GS. *CID*, 2008; 46:447-50

Persistent Shedding of *C. difficile*



Percentage of stool, skin (chest and abdomen), and environmental (bed rail, bedside table, call button, toilet seat) cultures positive for *Clostridium difficile* among 52 patients with *C. difficile* infection.

The number of patients who had samples cultured at each time point were 52 before treatment, 48 on day 3 of treatment, 43 after resolution of diarrhea, 28 at the end of treatment, 22 at 1–2 weeks after treatment, 15 at 3–4 weeks after treatment, and 8 at 5–6 weeks after treatment.

Sethi AK. *Infect Control Hosp Epidemiol* , Jan 2010; 22-27

Recommendation for Discontinuing Isolation at UNC Health Care

- Patient has completed treatment and is no longer symptomatic
  - Room must be terminally cleaned with bleach
- Continue isolation until discharge in settings where routine control measures are not effective and cross-transmission is ongoing. For long term admissions, consider discontinuing isolation 2-4 weeks after treatment ended and symptoms resolved.

Conclusions: Surveillance for MDROs

- MDRO surveillance strategies are used for identifying residents to be placed on additional precautions or when to discontinue isolation. This is a judgment call based upon published guidelines and research, and assessment of patient population.
- Scientific data are insufficient to clearly define when it is appropriate to do surveillance culturing of residents, HCWs or the environement. Additional research is needed to identify and support isolation control measures.
- Our first priority is always to protect other patients and employees.

Thank you