Disseminated Staphylococcus Infection in children

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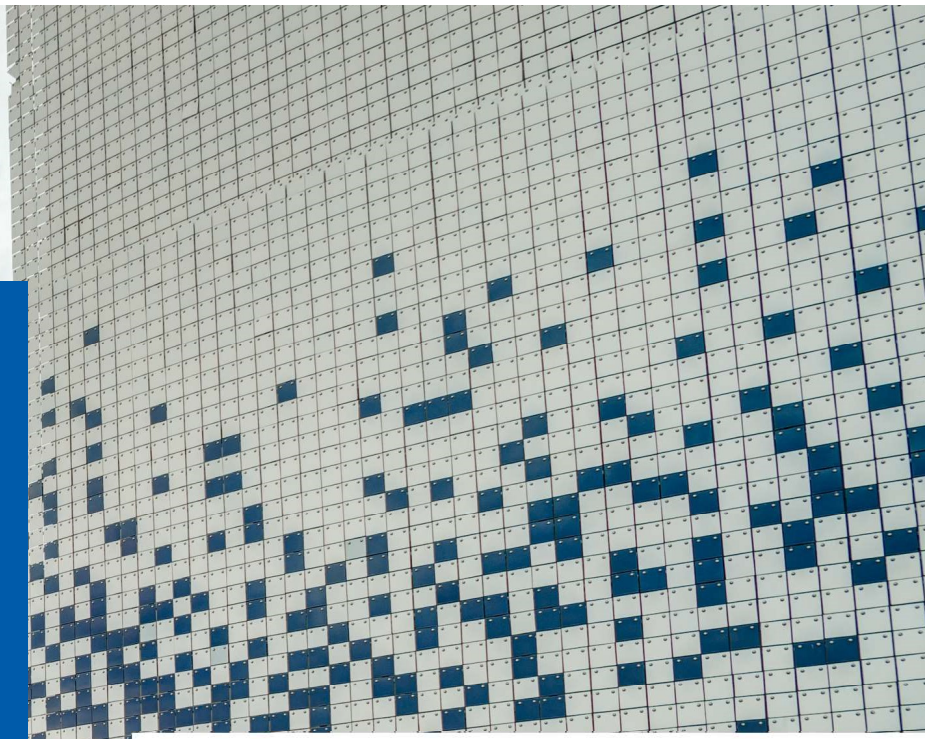

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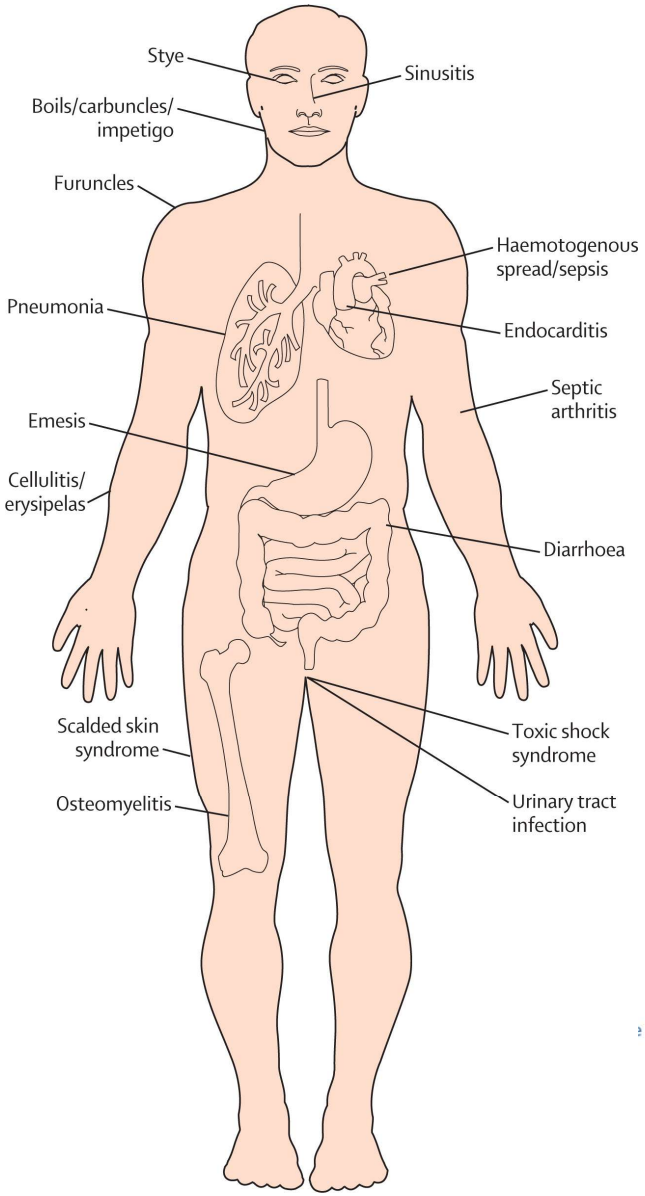
Focus

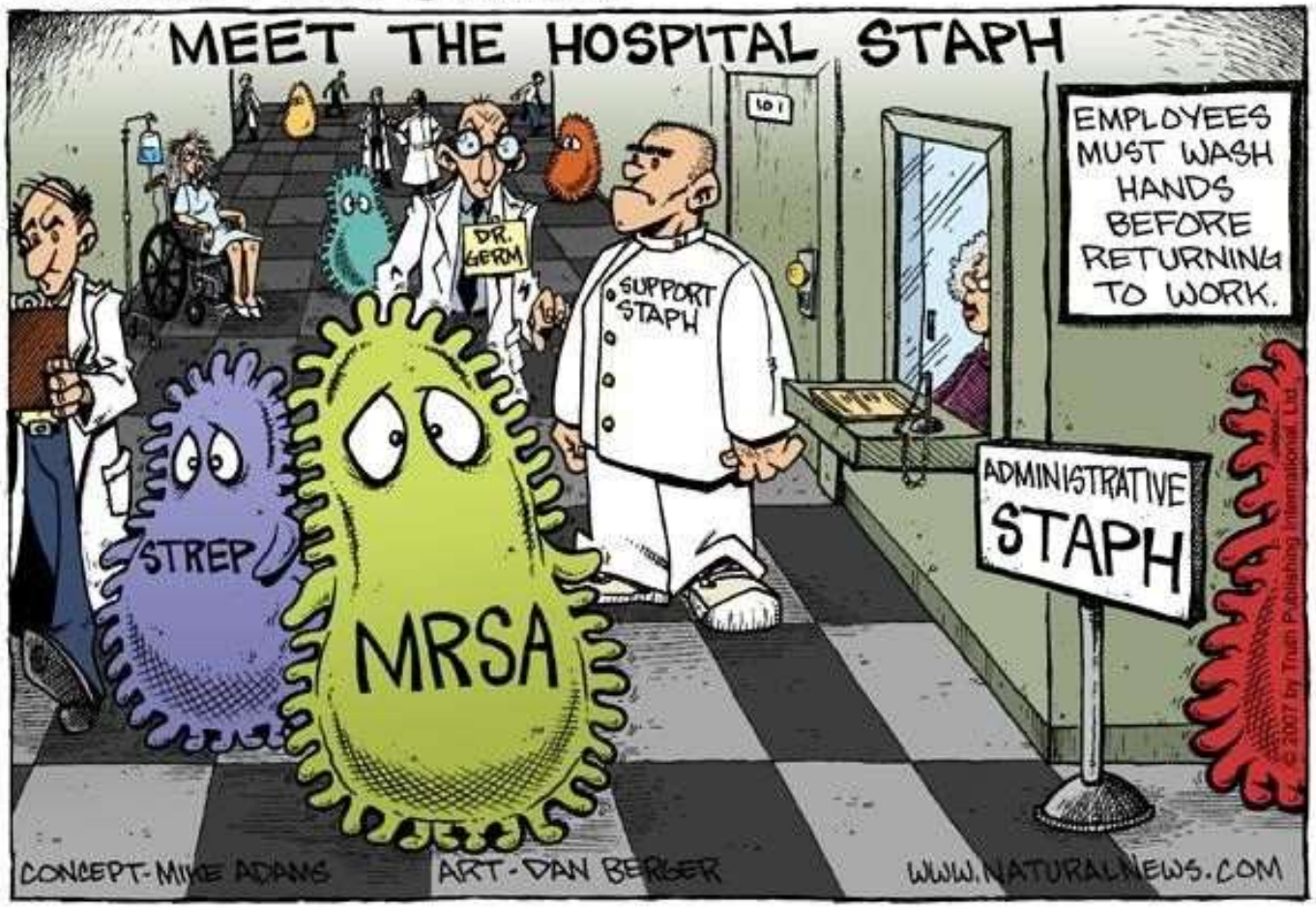
Who is at risk

Source control

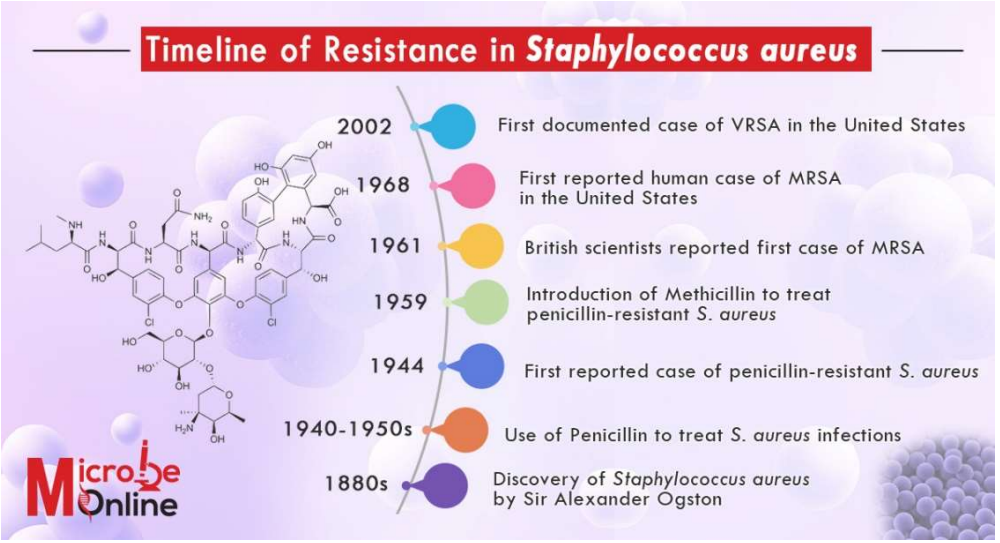
Antibiotic therapy



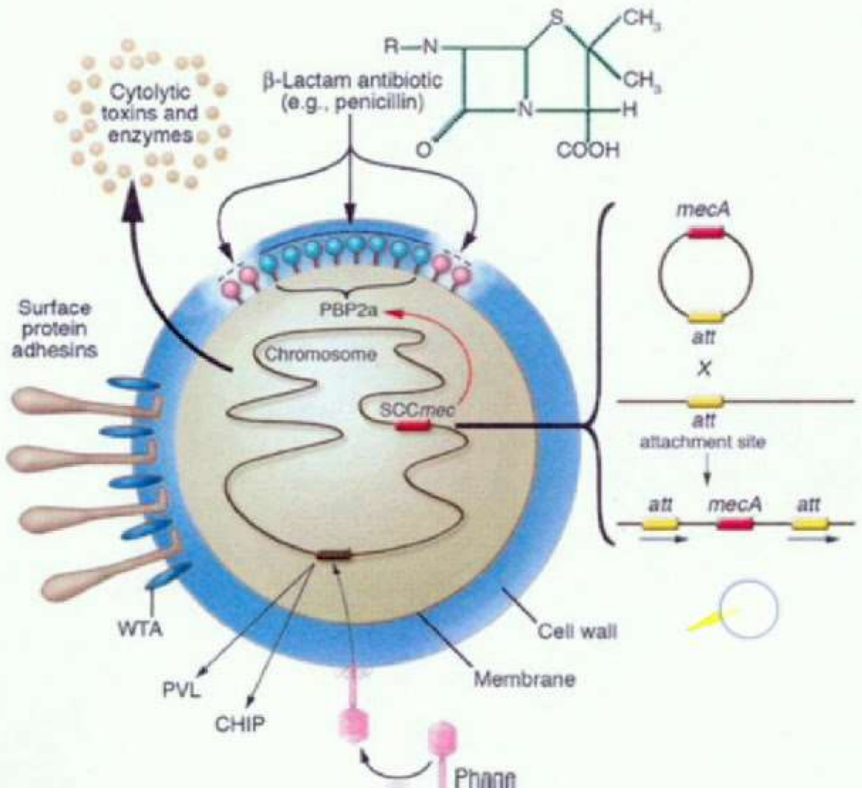
COUNTERTHINK



- Methicillin-susceptible *S. aureus* – *S. aureus* isolate with an oxacillin MIC ≤2 mcg/mL
- Methicillin-resistant *S. aureus* – *S. aureus* isolate with an oxacillin MIC ≥4 mcg/mL
- Vancomycin-susceptible *S. aureus* – *S. aureus* isolate with a vancomycin MIC ≤2 mcg/mL
- Vancomycin-intermediate *S. aureus* – *S. aureus* isolate with a vancomycin MIC 4 through 8 mcg/mL
- Vancomycin-resistant *S. aureus* – *S. aureus* isolate with a vancomycin MIC ≥16 mcg/mL



MRSA – mechanism – I



- **Horizontally transferred DNA element - SCC*mec*.**
- **Site specific recombination.**
- ***mec*A gene encodes PBP2a.**
- **PBP2a = 78 KDa PBP - capable of cell wall synthesis.**
- **PBP2a has low affinity for all β-lactams.**

HA-MRSA vs CA-MRSA

- MRSA has traditionally been classified into health care-associated (HA-MRSA) and community-associated (CA-MRSA), BUT no longer 2 distinct entities.
- HA-MRSA can spread to community contact, and CA-MRSA is an important cause of health care-associated infection.
- Several criteria are used to classify MRSA infections into one of these groups (not standardized):
  - The time of isolation (eg, an infection is considered to have onset in the hospital)
  - Host risk factor profile
  - Antimicrobial susceptibility pattern
  - Molecular characteristics of the isolate
    - SCCmec type
    - pulsed-field gel electrophoresis (PFGE) type
    - presence of the genes for Panton-Valentine leukocidin

	CA-MRSA	HA-MRSA
At-risk groups/conditions	Children, athletes, prisoners, soldiers, selected ethnic populations, IVDA, SAHM	LTC facility residents, diabetics, dialysis patients, prolonged hospitalization, ICU patients, IV lines
SCC*mec* type	IV	I, II, and III
Antimicrobial resistance	β-lactam alone, common Usually susceptible to TMP/SMX, clindamycin	Multidrug, common Usually susceptible to TMP/SMX
PVL toxin	Common	Rare
Associated clinical syndromes	SSTI, postinfluenza necrotizing pneumonia	Nosocomial pneumonia, catheter-related UTIs, bloodstream infections, SSTIs

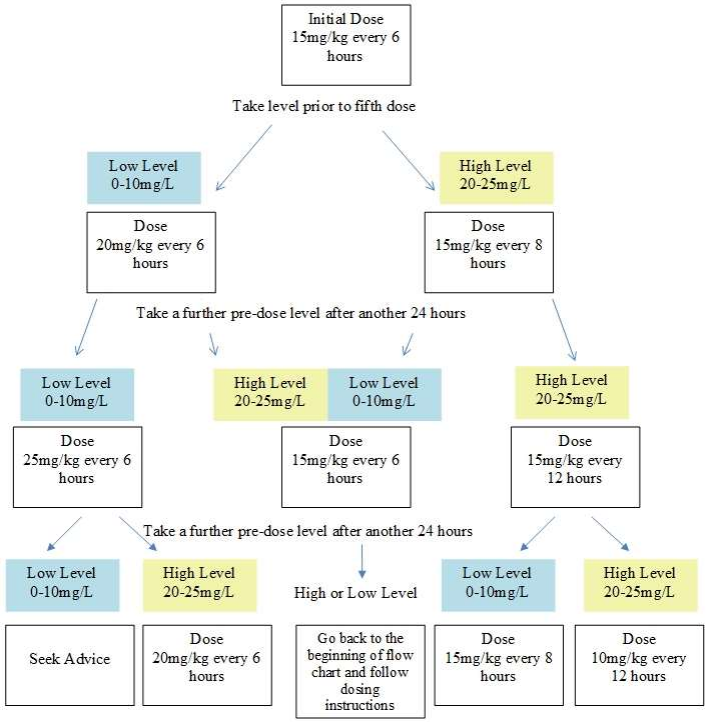
Antibiotic Choices for Pediatric CA-MRSA Infection

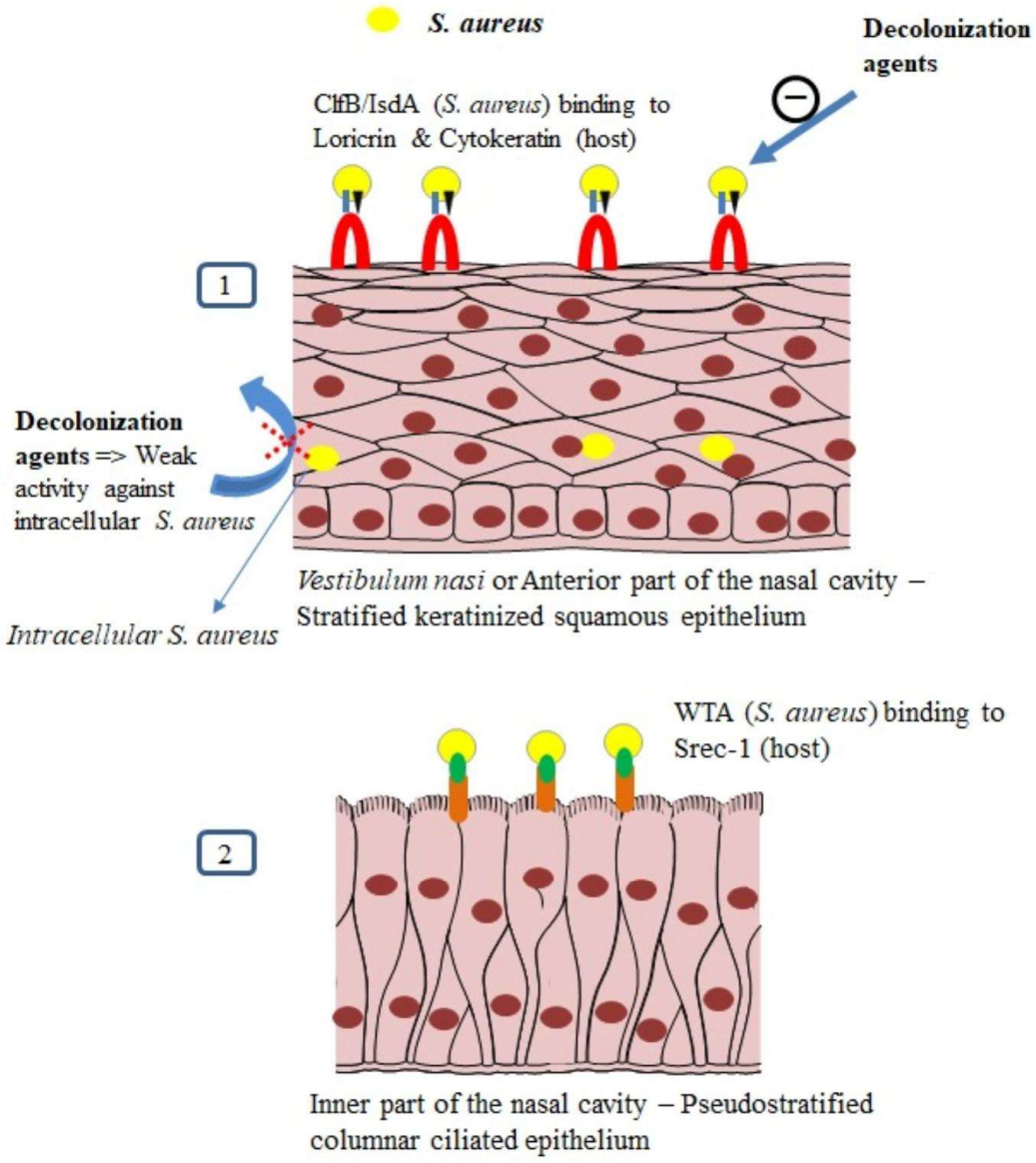
Antibiotic	Comment
Trimethoprim-sulfamethoxazole	• appropriate initial therapy • contains sulfa moiety • do not use in hyperbilirubinemic infants • not active against group A streptococci • available in liquid formulation
Clindamycin	• important to test for inducible resistance with D-test • available in liquid formulation • may be beneficial for severe illness caused by PVL and exotoxins
Linezolid (Zyvox)	• expensive • may cause reduced platelet count, anemia • may be beneficial for severe illness caused by PVL and exotoxins • oral and intravenous formulations
Vancomycin	• generally considered drug of choice for serious CA-MRSA infection
Doxycycline, minocycline	• do not use < 9 years of age • potential for more adverse effects with minocycline
Rifampin	• do not use as monotherapy • may be beneficial as adjunctive therapy for severe illness • potential for drug-drug interactions

Linezolid

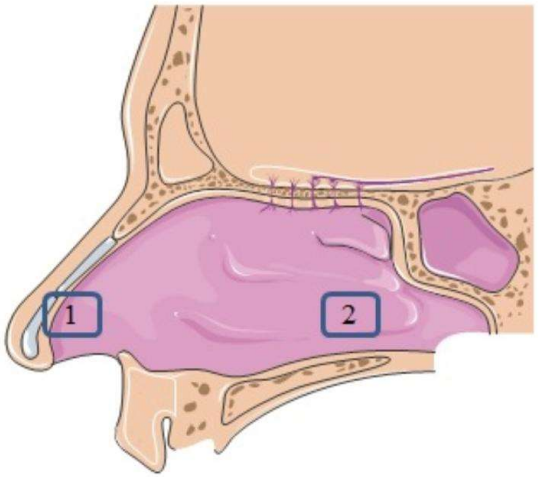
Infection*	Dosage, Route, and Frequency of Administration		Recommended Duration of Treatment (consecutive days)
	Pediatric Patients less than 12 Years of Age	Adults and Adolescents (12 Years and Older)	
Nosocomial pneumonia Community-acquired pneumonia, including concurrent bacteremia Complicated skin and skin structure infections	10 mg/kg intravenously every 8 hours	600 mg intravenously every 12 hours	10 to 14
Vancomycin-resistant *Enterococcus faecium* infections, including concurrent bacteremia	10 mg/kg intravenously every 8 hours	600 mg intravenously every 12 hours	14 to 28

Vancomycin

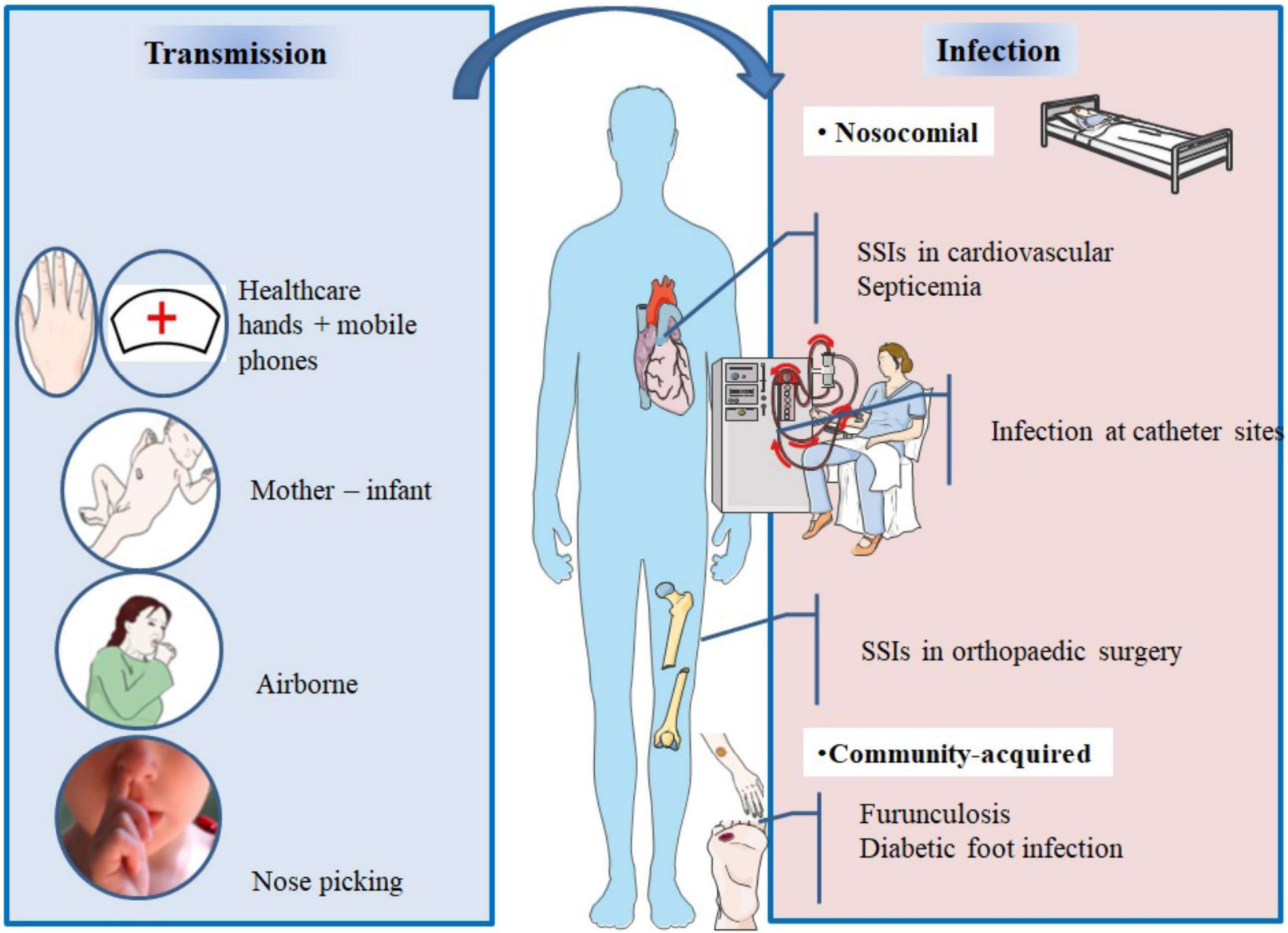


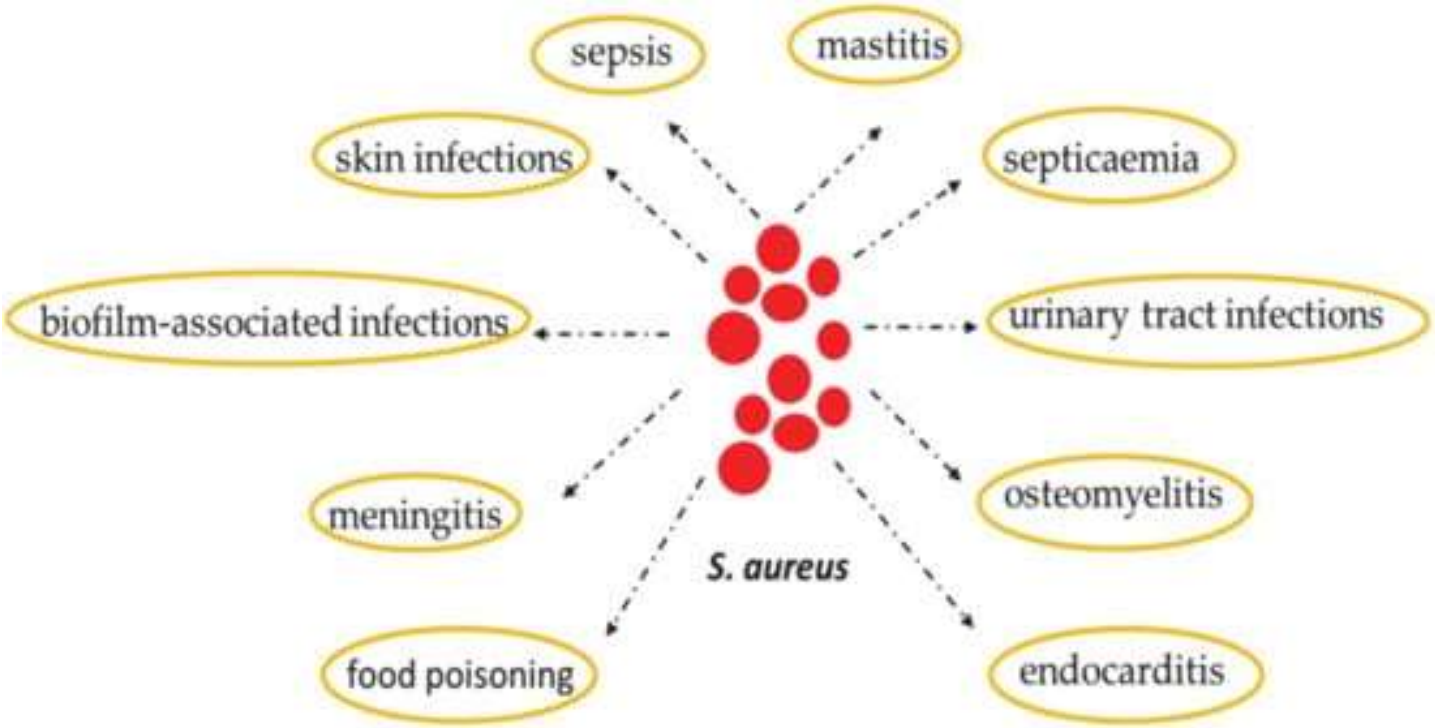


Most important risk for invasive infections



30% (50% preschool ages) MRSA colonization can be prolonged (40mo)


Transmission
Healthcare hands + mobile phones
Mother – infant
Airborne
Nose picking
Infection
• Nosocomial
SSIs in cardiovascular Septicemia
Infection at catheter sites
SSIs in orthopaedic surgery
•Community-acquired
Furunculosis
Diabetic foot infection



In 1884 Anton J. Rosenbach (1842-1923), a German surgeon, isolated two strains of staphylococci, which he named for the pigmented appearance of their colonies: Staphylococcus aureus, **from the Latin aurum for gold**, and Staphylococcus albus (now called epidermidis), from the Latin albus for white


Staph Infection: Skin-Related Symptoms
Boils
Cellulitis
Infection in hair follicles
Impetigo
Paronychia
verywell

Who is at risk?

< 28 days vs >28 days

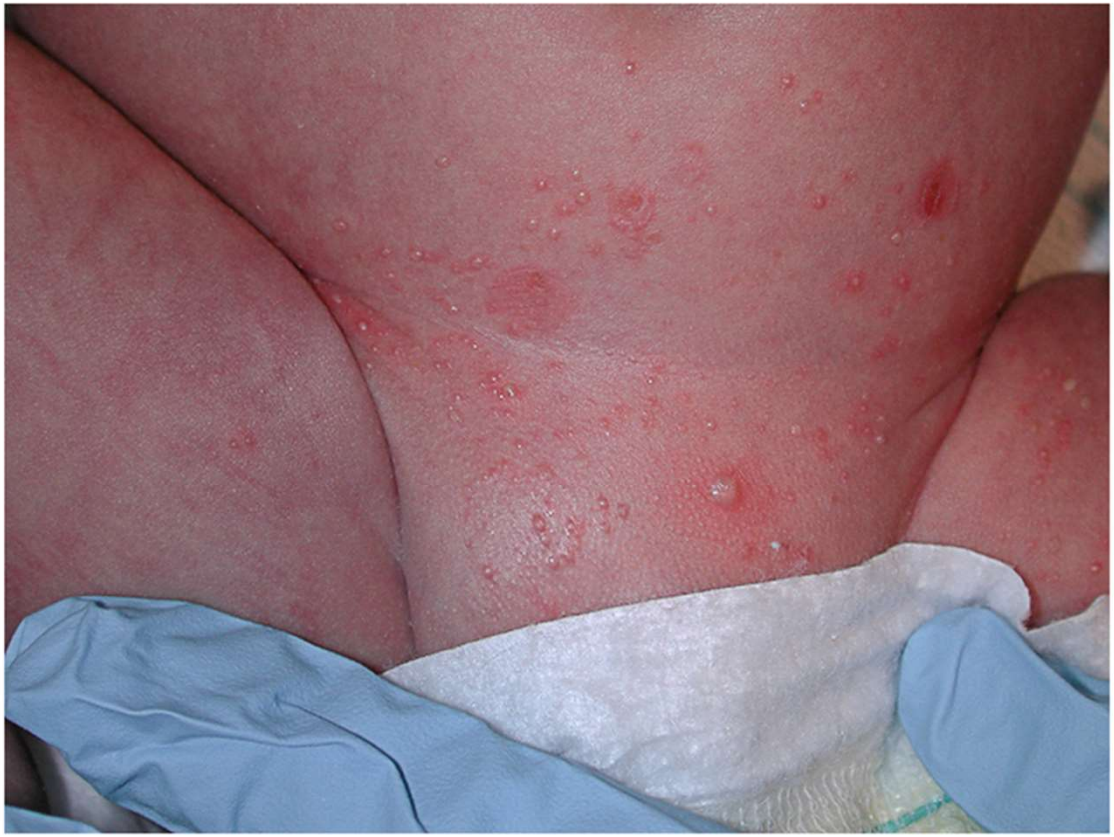
Most bacterial skin and soft tissue infections (SSTIs) in neonates are caused by *S. aureus*.

Group B *Streptococcus* occasionally causes cellulitis.

Group A streptococcal SSTIs in neonates are uncommon but may occur.

Neonates with SSTI other than localized pustulosis are at increased risk for sepsis and invasive infection.

Staphylococcal pustulosis



Community-associated *Staphylococcus aureus* pustulosis in the diaper area of a previously healthy neonate.

Courtesy of Sheldon L Kaplan, MD

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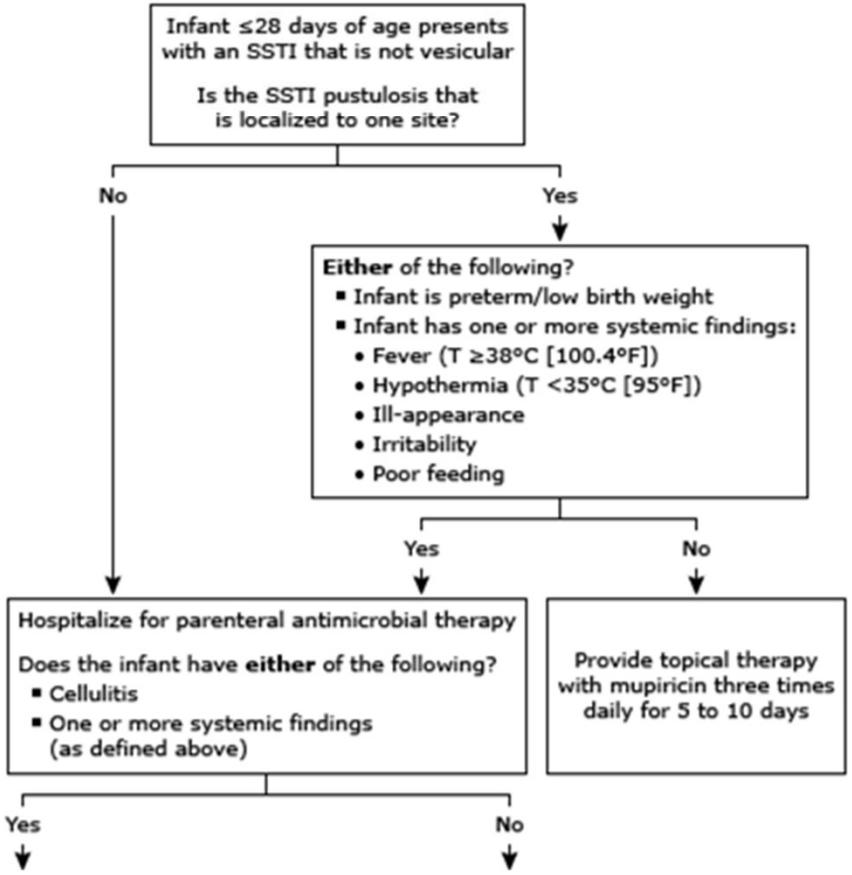
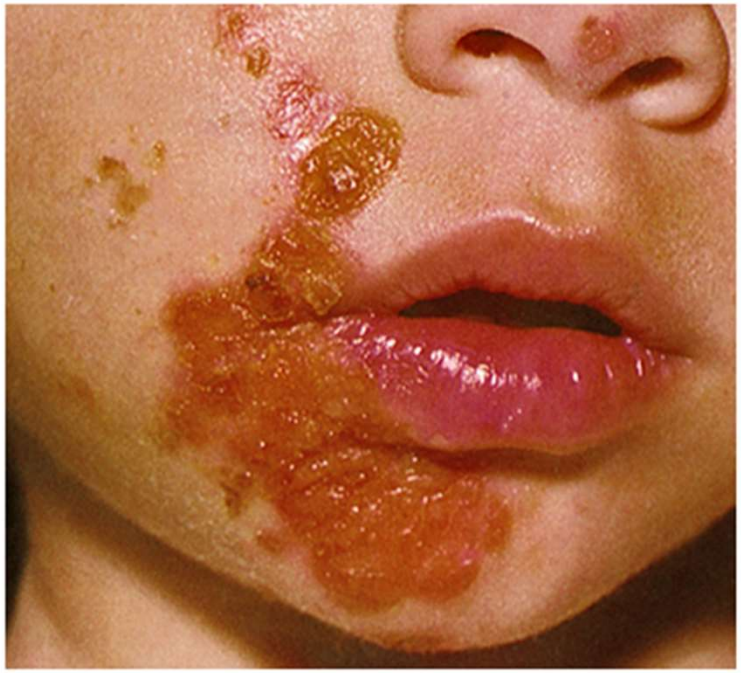
Suggested approach to initial antimicrobial therapy for suspected *Staphylococcus aureus* or streptococcal skin and soft tissue infections in infants ≤28 days of age

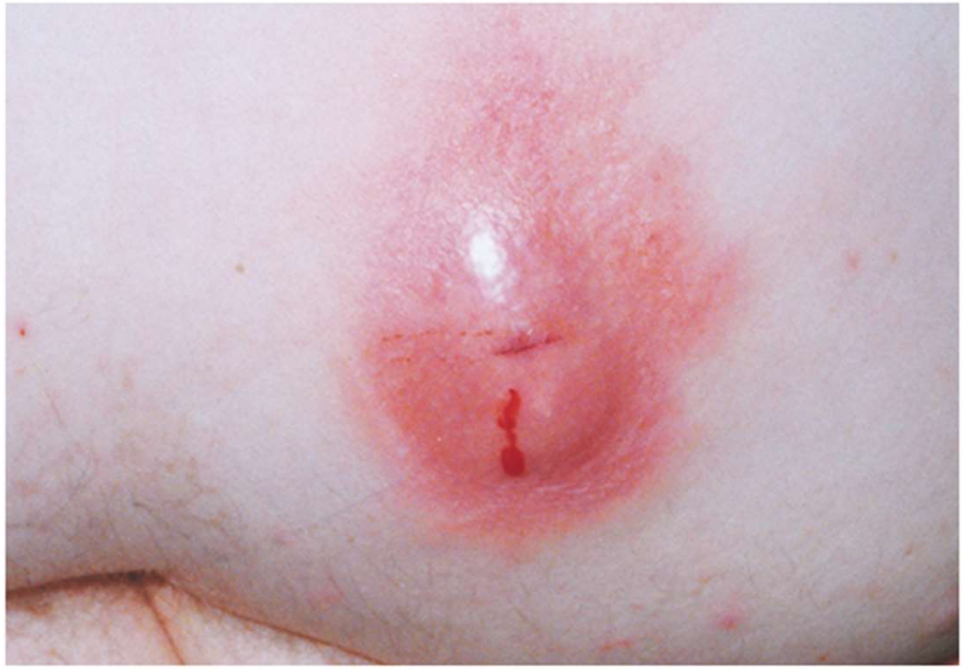


Impetigo



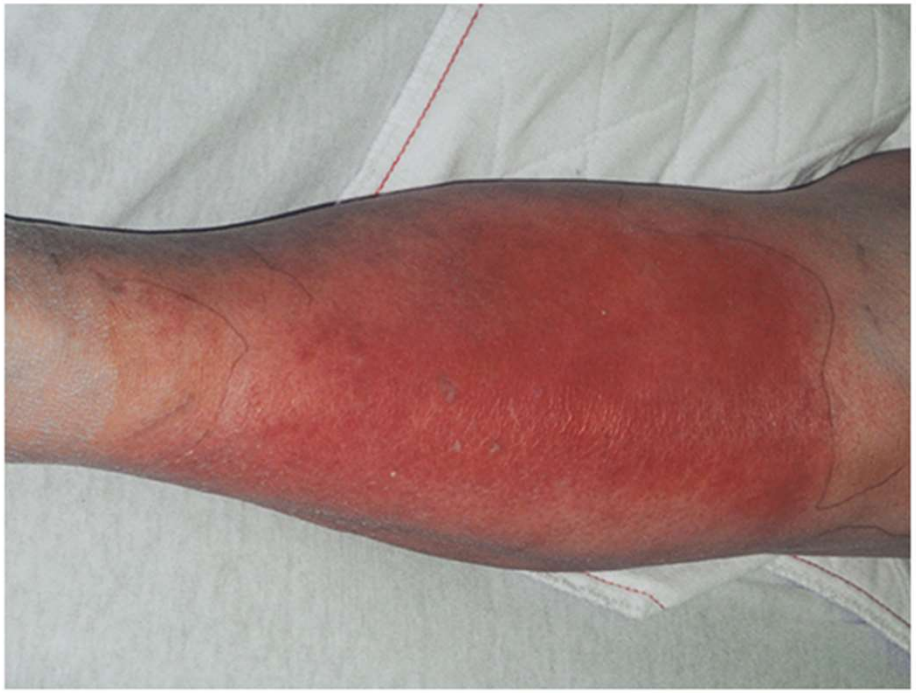
"Honey-crusted" plaques on the face of a child with impetigo.

Carbuncle



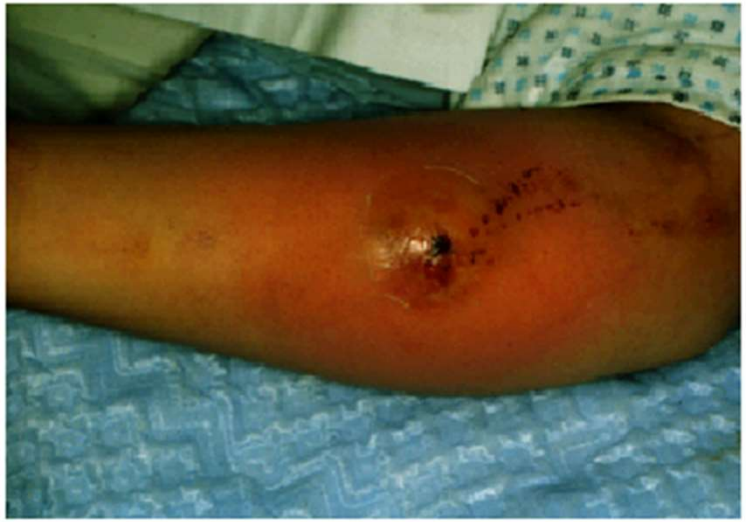
Carbuncle, which is a series of abscesses in the subcutaneous tissue that drain via hair follicles.

Erysipelas of the leg



Erysipelas of the lower leg. The rash is intensely red, sharply demarcated, swollen, and indurated.

Skin abscess



Courtesy of Larry M Baddour, MD.

Adjunctive antibiotics are particularly important for children with:

Systemic signs

Underlying medical problems that increase the risk of poor response or complications (eg, primary immune deficiency, diabetes mellitus)

Multiple sites of infection

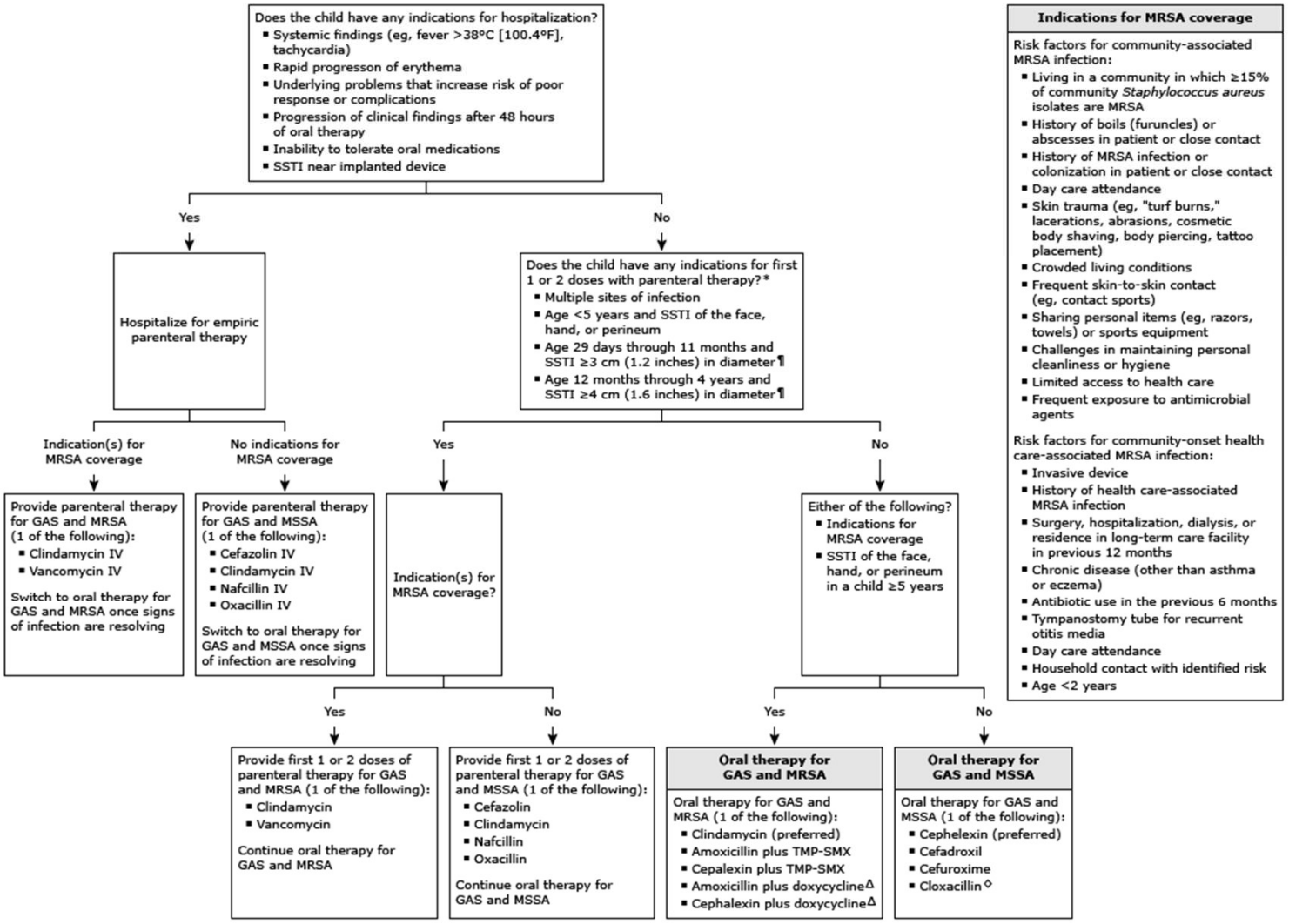
Age <12 months

Lesions ≥5 cm (including surrounding erythema/cellulitis) in children age ≥9 years and ≥4 cm in children age 12 months through 8 years

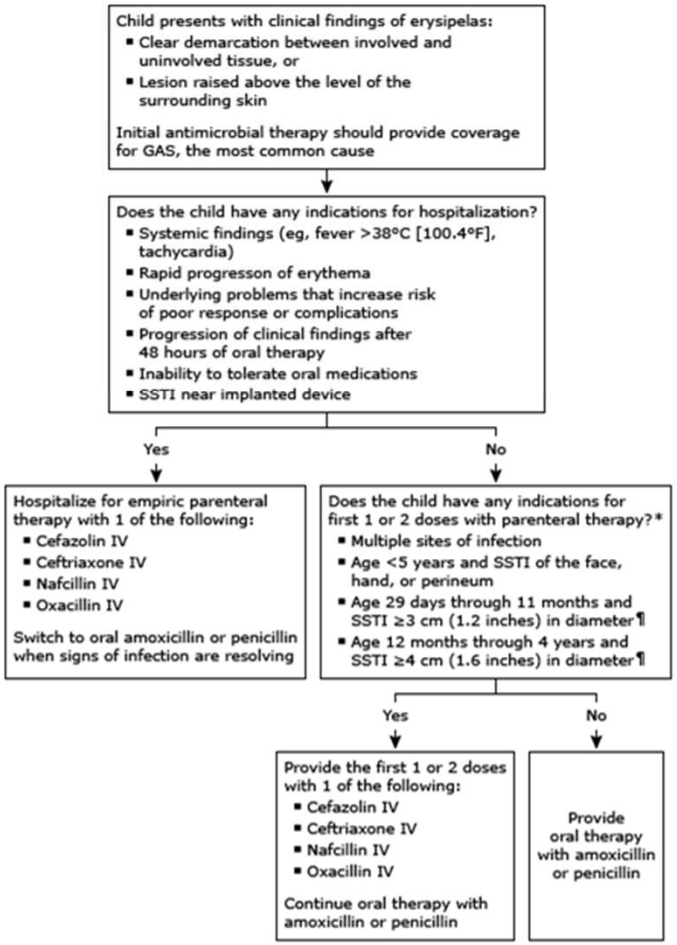
Lesions of the face, hand, or perineum (which are difficult to drain)

Lesions near an implanted device

Antimicrobial therapy for nonpurulent cellulitis in hemodynamically stable children older than 28 days



Antimicrobial therapy for erysipelas in hemodynamically stable children older than 28 days



Risk factors for community-associated and community-onset health care-associated methicillin-resistant *Staphylococcus aureus* infection in children and adolescents

Community-associated MRSA infection
▪ Living in a community in which ≥15% of community *S. aureus* isolates are MRSA ▪ History of boils (furuncles) or abscesses in patient or close contact ▪ History of MRSA infection or colonization in patient or close contact ▪ Day care attendance ▪ Skin trauma (eg, "turf burns," lacerations, abrasions, cosmetic body shaving, body piercing, tattoo placement) ▪ Crowded living conditions ▪ Frequent skin-to-skin contact ▪ Sharing potentially contaminated personal items (eg, razors, towels) or sports equipment ▪ Challenges in maintaining personal cleanliness or hygiene ▪ Limited access to health care ▪ Frequent exposure to antimicrobial agents
Community-onset health care-associated MRSA infection
▪ Invasive device ▪ History of health care-associated MRSA infection ▪ Surgery hospitalization, dialysis, or residence in long-term care facility in previous 12 months ▪ Chronic disease (other than asthma or eczema) ▪ Antibiotic use in the previous six months ▪ Tympanostomy tube for recurrent otitis media ▪ Day care attendance ▪ Household contact with identified risk factor ▪ Age <2 years

MRSA: methicillin-resistant *S. aureus*.

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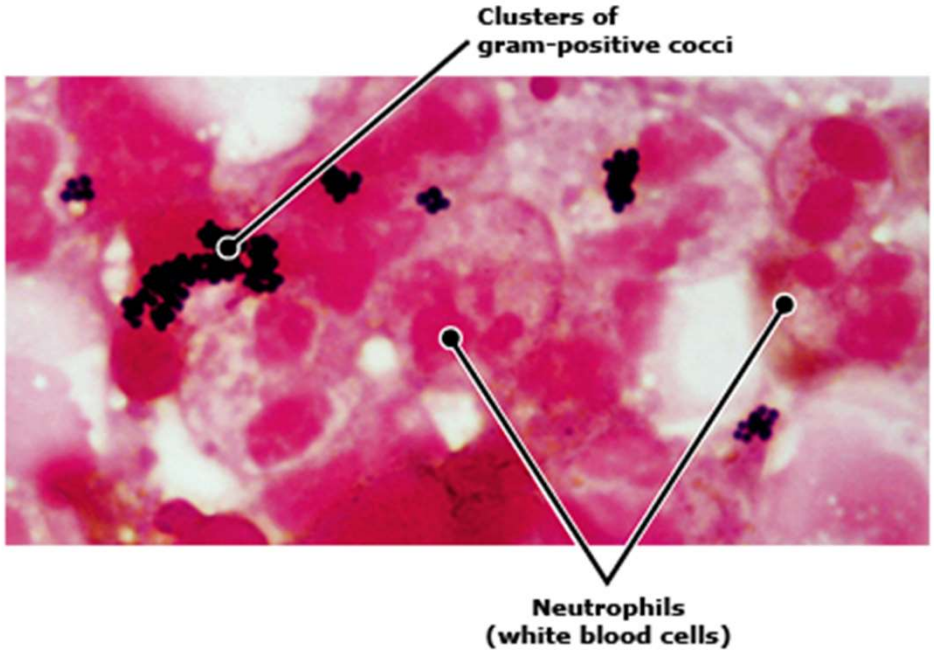
Gram-positive cocci clusters



Gram-positive cocci (*Staphylococcus aureus*) in pus (large, dark-red globules are white cell nuclei).

Risk factors for invasive *S. aureus* infection

Although most children with invasive *S. aureus* infections are normal hosts, risk factors for invasive *S. aureus* infection include:

Foreign body (eg, intravascular catheter or graft, peritoneal catheter, cerebrospinal fluid shunt)

Preceding influenza or measles infection

Malignancy

Prematurity

Immunodeficiency or immunocompromised host (eg, those with phagocyte deficiency or dysfunction, HIV infection)

Diabetes mellitus

Important points to remember

All staphylococci isolated from normally sterile sites should undergo quantitative antimicrobial susceptibility testing.

Invasive infection = Infection of a normally sterile body site:

- Osteomyelitis, septic arthritis
- Pneumonia
- Visceral abscess
- Endocarditis ***– always consider cardiac ECHO in invasive disease***
- Bacteremia (whether or not associated with a foreign body)
- Central nervous system infections (eg, cerebrospinal fluid shunt infection, empyema, brain abscess)
- Toxic shock syndrome

Management principles

Management of invasive *S. aureus* infection:

- Removal of potential foci of infection
- IV anti-staphylococcus antibiotics

The duration of therapy depends upon the site

- usually is at least four weeks for severe infections

Parenteral therapy is recommended for the entire course in patients with endocarditis and central nervous system infections.

Oral therapy may be used for a portion of the course in patients with other types of infection.

Eradication considerations OPD

Question I see otherwise healthy children in my practice with recurrent staphylococcal skin infections. While I am comfortable with managing each acute infection, what can be done to eradicate *Staphylococcus aureus* and reduce the chance of recurrent infections?

Answer *Staphylococcus aureus* skin and soft tissue infections (SSTIs) are common in children and are increasing in frequency. Risk factors for the development of staphylococcal SSTIs are colonization with *S aureus* and recent diagnosis of SSTI in a household member. Current evidence suggests that a combined strategy using hygiene education, nasal mupirocin, and bath washes with chlorhexidine or diluted bleach has the most success in decolonization. However, decolonization appears to only provide temporary reduction in carriage rate. According to the limited research in the ambulatory population, decolonization of a patient does not confer a reduced risk of recurrent infections. Further research and large studies are required to understand the factors in *S aureus* pathogenesis and whether decolonization of a child and his or her household is of benefit in reducing subsequent *S aureus* infections.

Eradication considerations In-Patients

S. aureus carriage eradication is instrumental for infection prevention.

Extra-nasal *S. aureus* colonization is more common than previously believed.

The usual decolonization strategies with only mupirocin nasal ointment are probably insufficient because extra-nasal body regions remain colonized with *S. aureus*.

Our approach to decolonization of children with recurrent methicillin-resistant *Staphylococcus aureus* infections

Indication for decolonization	Nasal decolonization	Topical decolonization
Child with 1 or 2 recurrences	▪ Mupirocin ointment to the anterior nares 2 to 3 times per day for 1 week	▪ Chlorhexidine baths or showers* daily for 5 to 14 days
Child with ≥3 recurrences	▪ Mupirocin ointment to the anterior nares 2 to 3 times per day for 1 week of each month for 3 months	▪ Dilute bleach baths¶ twice per week for 3 months ▪ Chlorhexidine baths or showers* once daily on the days of the week that bleach baths are not given for 3 months
Household contacts of child with ≥3 recurrences if ≥1 other household contact has MRSA infection[Δ]	▪ Mupirocin ointment to the anterior nares 2 to 3 times per day for 1 week	▪ Dilute bleach baths¶ twice per week for 1 week ▪ Chlorhexidine baths or showers* once daily on the days of the week that bleach baths are not given for 1 week

THANK YOU FOR YOUR TIME AND ATTENTION