

# ENHANCING ANTIMICROBIAL STEWARDSHIP FOR PATIENTS WITH SKIN AND SOFT TISSUE INFECTIONS

February 14, 2024  
NC CLASP Hospital Stewardship

# INTRODUCTIONS

Please put your name, hospital, and location in the chat!

# CONFLICT OF INTEREST DISCLOSURES

- ▶ The views and opinions expressed in this series are those of the speakers and do not reflect the official policy or position of any agency of the US or NC government or UNC.
- ▶ Our speakers have the following financial relationships with the manufacturer(s) and/or provider(s) of commercial services discussed in this activity:
  - ▶ Dr. Willis has performed contracted research with: Pfizer (pediatric nirmatrelvir-ritonavir and maternal RSV vaccine), Novavax (pediatric COVID-19 vaccine), and Merck (monoclonal antibody for RSV prevention)
- ▶ The speakers do not intend to discuss an unapproved/investigative use of a commercial product/device in this series, and all COI have been mitigated.
- ▶ These slides contain materials from a variety of colleagues, as well as the CDC, WHO, AHRQ, etc.

# CME AND CE CREDIT



## ▶ CME & CE for participants

- ▶ Attendance and active participation per learning session
- ▶ Click the link in the chat during the session to document your attendance
- ▶ Complete surveys as requested

# NC CLASP: YEAR TWO

6 hour-long learning sessions  
September 2023-May/June 2024

CE included: CME, RN,  
Pharmacist (ACPE)

Two in-person conferences

- ▶ In-depth discussion topics include:
  - ▶ Stewardship program in smaller hospitals
  - ▶ Diagnostic stewardship/ collaborating with the Clinical Microbiology lab
  - ▶ Stewardship principles for skin/skin structure infections
  - ▶ Handling antibiotic allergies
  - ▶ Stewardship in transitions of care
- ? Is there another topic you'd like to learn about or discuss in these sessions?

# TARGETS FOR TODAY'S DISCUSSION

- ▶ **NOT** a primer on diagnosis and treatment of skin and soft tissue infections
- ▶ **Equip** with a few concepts and tools to help stewardship practitioners engage and improve care
- ▶ **Review** some published stewardship principles in the SSTI arena
- ▶ **Share** stewardship strategies, successes, barriers in this space

# BREAKOUT#1

## 66 YEAR OLD MAN ADMITTED VIA THE EMERGENCY DEPARTMENT

- ▶ Came to ED from home for painful, erythematous, warm, extensive lesion that has ascended from ankle to knee over 3-4 days. No bullae or pustules are evident.
- ▶ **Admission:** temp 101.1°F, BP 135/80, HR 95bpm, RR=29, O<sub>2</sub> sat on room air: 98%. CMP normal. WBC 19.5, 79% PMNs, 6% bands.
- ▶ **Medical history:** hypertension, MI 3 months ago, found to have extensive CAD, underwent emergent CABG x 5, including L saphenous vein graft. BMI:29. No recent antimicrobials. 35 pack years smoking. NKA. Moderate LLE edema managed with walking and compression garments.
- ▶ **Therapy started:** Ceftriaxone 2 grams q24h, Linezolid 600mg IV q12h
- ▶ **Day 2** blood cultures negative, temperature: 99.2, pain improved
- ▶ **Day 3** Team concerned that erythema has regressed only slightly from pen-line on leg

**How (and when in his course) would your AS system have helped this patient?**



# SKIN ANATOMY / PATHOPHYSIOLOGY

<b>Epidermis</b>	Impetigo
<b>Dermis</b>	Folliculitis Furuncles/ Carbuncles Erysipelas Cellulitis
<b>“Sub-cutaneous” fatty tissue Fascia (layer between skin and tissues underneath)</b>	Necrotizing fasciitis
<b>Muscle/tissue below fascia</b>	Myositis Myonecrosis/gas gangrene

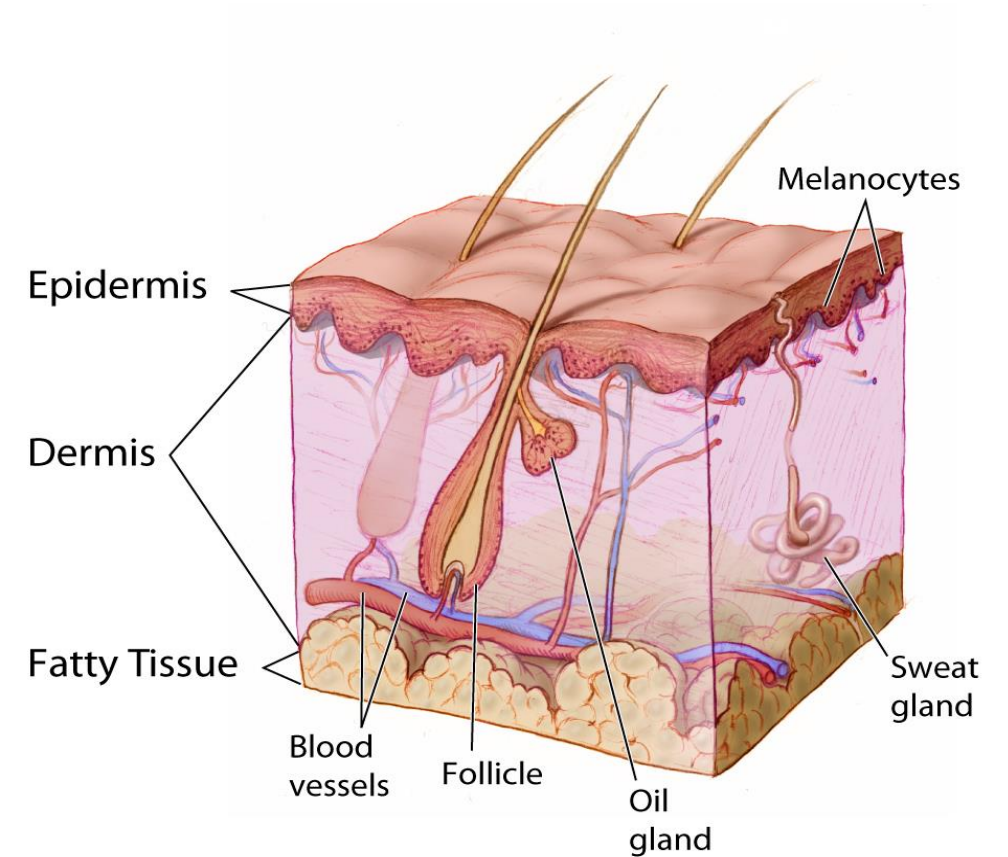


Image: National Cancer Institute, Illustrator Don Bliss. <https://visualsonline.cancer.gov/details.cfm?imageid=4604> (Public domain)  
Duane, et al. Surgical Infections 22: 2021



# CLASSIFICATION SYSTEMS FOR SSTI / TERMINOLOGY

Uncomplicated <sup>1,2</sup>	Complicated
Cellulitis Simple abscesses Impetigo Furuncles	Cellulitis Carbuncles Diabetic foot infections Pressure sores Bite wounds Burn wounds Necrotizing fasciitis

Non-purulent <sup>3</sup>	Purulent
Erysipelas Cellulitis Necrotizing infection	Furuncle Carbuncle Abscess

## Acute Bacterial Skin and Skin Structure Infections (ABSSSIs)<sup>4</sup>

Cellulitis/erysipelas  
Wound infection  
Major cutaneous abscess

## Surgical Literature<sup>1,5</sup>

Surgical Site infections  
Incisional, Superficial / Deep  
Non-necrotizing SSTIs  
Superficial infections (Impetigo, erysipelas, cellulitis)  
Simple abscess, boils and carbuncles  
Complex abscesses  
Necrotizing SSTIs (NSTIs)  
Necrotizing cellulitis, Necrotizing fasciitis,  
Fournier's gangrene, Necrotizing myositis

Eron<sup>6</sup> classifies by patient status/severity of infection

1. World J Emerg Surg. 2014;9:57; 2. Infect Dis Clin N Am.2009;23:571-591; 3. Clin Infect Dis. 2014;59:e10-52; 4. FDA guidance document ABSSSI: Developing Drugs for Treatment, 2013 ([www.fda.gov/media/71052/download](http://www.fda.gov/media/71052/download)); 5. Surgical Infections. 2021;22;1-16; 6. J Antimicrob Chemother 2003;52 (suppl 1):i3-17. Slide concept: Ronda Akins, SIDP

# CLASSIFICATION OF SSTIS, CONTINUED

Usually Monomicrobial	Often Polymicrobial
Cellulitis Carbuncle, furuncle Mild-moderate diabetic foot infection Surgical incision infection	Severe diabetic foot infection Infected pressure ulcers Fournier's gangrene Some bite wounds

**Not** "when to use double coverage"



Antibiotics alone may suffice	Surgery +/- antibiotics	Surgery + antibiotics
Cellulitis Mild-moderate diabetic foot infection	Any purulent infection Furuncle, Carbuncle Surgical incision infection	Any necrotizing infection

# CELLULITIS



# PURULENT SKIN ABSCESS



Photo Credit: Gregory Moran, M.D.



# BACTERIOLOGY OF SSTI

***Most skin infections are caused by Streptococci or S aureus***

Risk factor	Characteristic pathogens
Diabetes	<i>S. aureus</i> , group B streptococci, anaerobes, Gram-negative bacilli
Cirrhosis	<i>Campylobacter fetus</i> , <i>Klebsiella pneumoniae</i> , <i>Escherichia coli</i> , <i>Capnocytophaga canimorsus</i> , other Gram-negative bacilli, <i>V. vulnificus</i>
Neutropenia	<i>P. aeruginosa</i>
Bite wounds	
human	oral flora ( <i>Eikenella corrodens</i> )
cat	<i>P. multocida</i>
dog	<i>C. canimorsus</i> , <i>P. multocida</i>
rat	<i>Streptobacillus moniliformis</i>
Animal contact	<i>Campylobacter</i> spp.
Reptile contact	<i>Salmonella</i> spp.
Hot tub exposure/loofah sponges	<i>P. aeruginosa</i>
Fresh water exposure	<i>Aeromonas hydrophila</i>
Sea (or fish tank) water exposure	<i>V. vulnificus</i> , <i>Mycobacterium marinum</i>
Drug abuse	
intravenous	MRSA, <i>P. aeruginosa</i>
subcutaneous	anaerobes, especially <i>Eikenella corrodens</i>



Eron, et al. J Antimicrob Chemother 2003:52



Figure 1. Clinical Presentation of Conditions That Mimic Cellulitis and True Cellulitis

**A** Deep venous thrombosis



**B** Calciphylaxis



**C** Stasis dermatitis



**D** Hematoma



**E** Erythema migrans



**F** Cellulitis



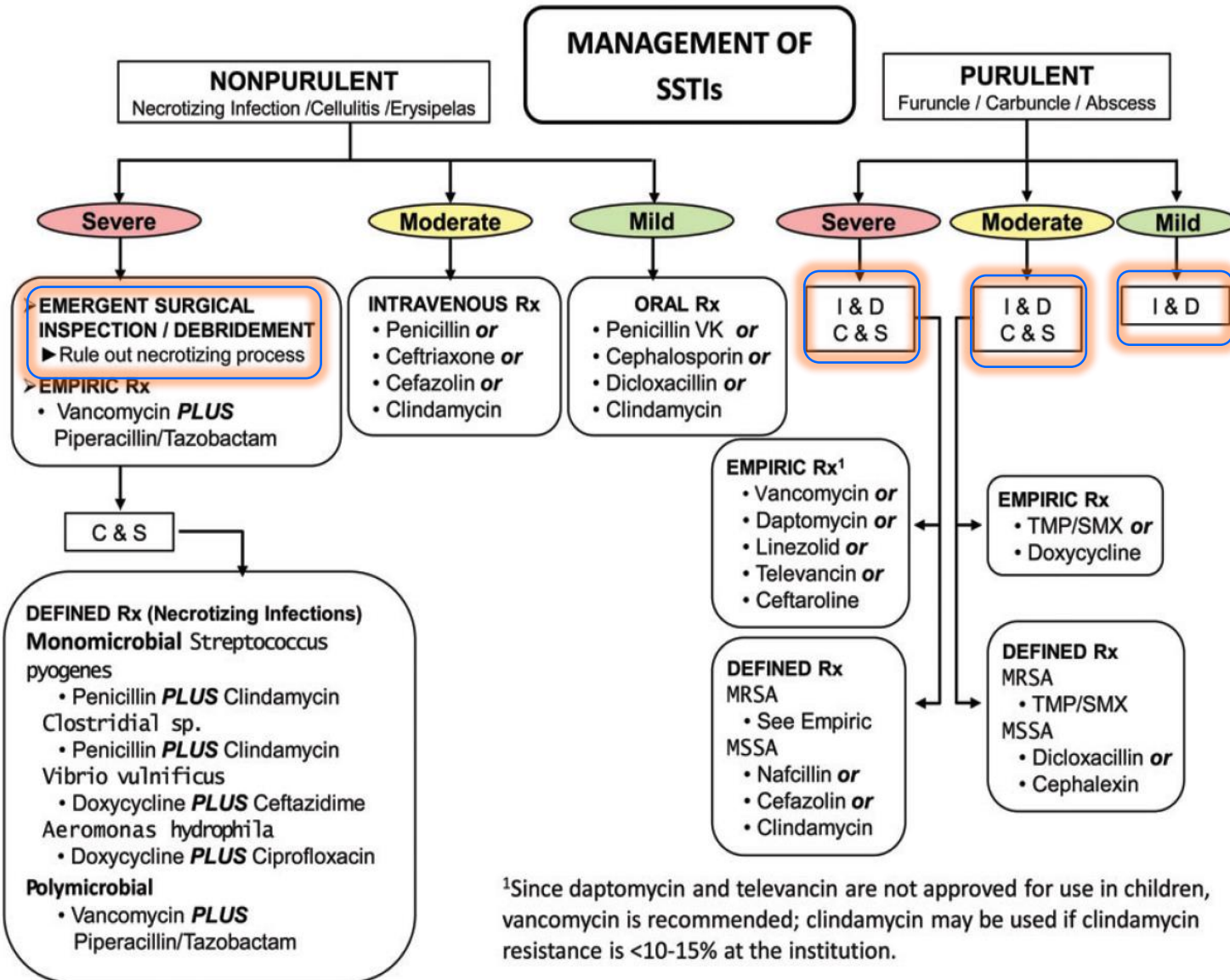
What else could this be?

Conditions that can *mimic* cellulitis

Poor or no response to antibiotics for cellulitis

Raff, Kroshinsky. JAMA 2016;316:325

# IT'S NOT JUST ABOUT ANTIBIOTICS...



Surgical attention:  
“source control”

- Surgical site infection: suture removal/ I&D
- Infected burn wounds
- Traumatic wounds (e.g. road rash)

<sup>1</sup>Since daptomycin and televancin are not approved for use in children, vancomycin is recommended; clindamycin may be used if clindamycin resistance is <10-15% at the institution.

Stevens, et al. CID 2014;59:10ff

## LOOKING BEYOND THE SURFACE:

# SITUATIONS THAT REQUIRE ASSESSMENT OF DEEPER INVOLVEMENT

### ▶ *S aureus, S lugdunensis*

- ▶ Blood cultures indicated if severe infection or SIRS
- ▶ Bacteremia: complicated vs uncomplicated, assess for metastatic foci

### ▶ Osteomyelitis

- ▶ Contiguous focus: diabetic foot infections, infected pressure ulcers
  - ▶ Imaging, probe to bone
- ▶ Disseminated, hematogenous: e.g. *S aureus*
- ▶ Osteo can *present* as a skin lesion: “sinus tract”

### ▶ *S pyogenes*

- ▶ Super antigen mediated toxic shock *S pyogenes, S aureus*

### ▶ Necrotizing fasciitis

- ▶ Next slide

# NECROTIZING SOFT TISSUE INFECTIONS

## Skin findings

Erythema

Tense edema

Gray or discolored wound drainage

Vesicles or bullae

Skin necrosis

Ulcers

Crepitus

## Systemic features

Severe pain out of proportion to physical findings

Pain that extends past margin of apparent skin infection

Fever

Tachycardia, tachypnea

Diaphoresis

Delirium

- Laboratory Risk Index for Necrotizing Fasciitis Score LRINEC Score
- Definitive: Surgical exploration

Type I Polymicrobial: enterics

Type II Monomicrobial: (*S pyogenes* +/- *S aureus*)

Type III Other (water borne: *Aeromonas*, *Vibrio* sp)

Myonecrosis: *Clostridium* spp



# DECISION POINTS IN MANAGEMENT OF SSTIS

<b>1</b>	<b>Assessment, classification, and admission decision</b>	Including lab and clinical micro studies before antibiotics if possible. Each infection type has recs about whether and how to culture: skin swabs not generally helpful
<b>2</b>	<b>Initial antimicrobial selection: Empiric Rx</b>	Empiric Rx, surgical intervention if needed Need for adjunctive therapy
<b>3</b>	<b>Antimicrobial switch</b>	Modification/de-escalation based on response, cultures, etc
<b>4</b>	<b>Discharge: transition to next level of care</b>	Keep Rx duration in mind at transition of care. switch to oral, alternate IV therapy
<b>5</b>	<b>Discontinuing antimicrobial therapy</b>	Less can be more even in SSTI

# SITUATIONS REQUIRING BROADENED ANTIMICROBIAL REGIMENS

(MAY OR MAY NOT COMPRISE MULTIPLE DRUGS)

- ▶ Severe Group A streptococcal infection,
  - ▶ Toxin suppression: additional clindamycin or primary linezolid
- ▶ Complicated, moderate to severe, recurrent diabetic foot infection, infected pressure ulcer, human bite wounds
  - ▶ Include Enterobacterales, colonic anaerobes (Bacteroides, Prevotella)
- ▶ Polymicrobial, synergistic necrotizing fasciitis: Fournier's gangrene
  - ▶ Include Enterobacterales, colonic anaerobes (Bacteroides, Prevotella)

# MONITORING PARAMETERS FOR SKIN INFECTIONS: HOW TO KNOW IF YOUR THERAPEUTICS ARE WORKING

- ▶ Fever resolution
- ▶ WBC / differential
- ▶ Skin symptoms: induration, erythema, warmth, pain/tenderness
- ▶ Lesion size:
  - ▶ Erythema can progress before it regresses,
  - ▶ A pen line drawn around a cellulitis lesion: Evaluate entire patient status, not just extent of erythema
- ▶ Before modifying antimicrobials: assess source control
  - ▶ *S aureus*, necrotizing fasciitis
  - ▶ *“Lack of source control is NOT failure of antibiotics”*

# TREATMENT DURATIONS FOR SSTI

- ▶ Duration of therapy is individual and failure to respond may be:
  - a. Inadequate source control
  - b. Resistant organisms
  - c. Host factors: immune deficiencies
  
- ▶ Cellulitis                      5 days
- ▶ Cutaneous abscess        5 days after source control
- ▶ Necrotizing infections   >7 days (source control and response dependent)

# ADDRESS UNDERLYING CAUSES OF SSTI

- ▶ Address /prevent edema: venous or lymphatic insufficiency
- ▶ *S aureus* (and *Streptococci*) loves wounds: prevent them
- ▶ Immunosuppression
- ▶ LE cellulitis: look for and address skin integrity: dry, cracked skin, tinea pedis, etc.
- ▶ Risks for necrotizing infections
- ▶ Diabetic foot: optimize diabetic control
- ▶ Peripheral vascular disease
- ▶ Controversial but applicable to selected patients: In recurrent *S aureus*, consider decolonization measures: nasal mupirocin/retapamulin, chlorhexidine

# CDC HOSPITAL CORE ELEMENTS

- ▶ Interventions have focused on ensuring patients with uncomplicated infections do not receive antibiotics with overly broad spectra (e.g. unnecessary coverage for methicillin-resistant *Staphylococcus aureus* (MRSA) and gram-negative pathogens) and prescribing the correct route, dosage and duration of treatment.
- ▶ DX: Develop diagnostic criteria to distinguish purulent and non-purulent infections and severity of illness (i.e., mild, moderate and severe) so that skin and soft tissue infections can be managed appropriately according to guidelines.
- ▶ Avoid empiric use of antipseudomonal beta-lactams and/or anti-anaerobic agents unless clinically indicated.
- ▶ Use of therapy specific for MRSA may not be necessary in uncomplicated non-purulent cellulitis.
- ▶ Definitive Rx: Guidelines suggest that most cases of uncomplicated bacterial cellulitis can be treated for 5 days if the patient has a timely clinical response.

# PUBLISHED REPORTS OF AS PROGRAMS FOR SSTI

- ▶ Simple design
  - ▶ Pre-post, or 2 comparable locations
- ▶ Target common syndromes
  - ▶ e.g cellulitis +/- cutaneous abscess
- ▶ Multifaceted programs are optimal
  - Local guideline/algorithm\*
  - Education
  - Audit with feedback
- Consider the ED encounter
- Simple outcome measures
  - Abx DOTs/ treatment duration
  - LOS
  - DOTs: Anti-Gm neg, anti-pseudomonal, anti-anaerobe

Walsh, et al. *Mayo Clin Proc Inn Qual Out* 2017;1(1):91-99

Gibbons, et al. *Am J Infection Control* 2017;45:1203-7

Jenkins, et al. *Arch Intern Med* 2011;171:1072-9

Haran, et al. *Ann Emerg Med* 2020;76:55-66

May, et al. *Am J Emerg Med* 2021;46: 374–381

## BREAKOUT #2

- ▶ What strategies has your stewardship program employed to help improve care of patients with SSTIs?
- ▶ What successes in this space can you report?
- ▶ What barriers to improving care for SSTI patients have you encountered? Discuss how these might be overcome.



▶ Questions?

▶ Comments?

# FOUR “EQUIPPING” GUIDELINE DOCUMENTS

- ▶ Eron L, et al. Managing skin and soft tissue infections: Expert panel recommendations on key decision points. *J Antimicrob Chemother* 2003;52( Suppl 1):i3-17.
- ▶ Stevens DL, et al. Practice Guidelines for the Diagnosis and Management of Skin and Soft Tissue Infections: 2014 Update by the Infectious Diseases Society of America. *Clin Infect Dis* 2014;59:e10–
- ▶ Sartelli M, et al. World Society of Emergency Surgery (WSES) guidelines for management of skin and soft tissue infections. *World Journal of Emergency Surgery* 2014;9:57-75.
- ▶ Duane TM, et al. Surgical Infection Society 2020 Updated Guidelines on the Management of Complicated Skin and Soft Tissue Infections. *Surgical Infections* 2021;22:1-17

*Table 1. Definitions of Skin and Soft Tissue Infections*

Cellulitis	Acute infection of skin involving deep dermis and subcutaneous fat
Erysipelas	More superficial infection of the skin, involving the lymphatics; characterized by a tender, erythematous plaque with well-demarcated borders
Folliculitis	Superficial infection of the hair follicle with purulence in the epidermis
Furuncle	Infection of the hair follicle with associated small subcutaneous abscess
Carbuncle	A cluster of furuncles
Cutaneous abscess	Localized collection of pus within the dermis and deeper skin tissues
Pyomyositis	Purulent infection of skeletal muscle, often with abscess formation
Impetigo	Superficial infection of the skin characterized by pustules or vesicles that progress to crusting or bullae
Ecthyma	A deeper variant of impetigo; begins as vesicles/pustules and evolves into "punched-out"-appearing ulcers
Gas gangrene	Necrotizing infection involving muscle; also known as clostridial myonecrosis
Necrotizing fasciitis	Aggressive infection of the subcutaneous tissue that spreads along fascial planes

# SOME SPECIAL THERAPY CONSIDERATIONS

## ▶ Toxin suppression

- ▶ GAS, Clostridium: Clindamycin, linezolid
  - ▶ Duration: 4 days?
- ▶ Streptococcal Toxic Shock: IVIg

## ▶ Don't forget vaccines

- ▶ Tetanus
- ▶ Animal bites: consider Rabies risk

## ▶ Long acting injectable lipoglycopeptides

- ▶ Dalbavancin
- ▶ Oritavancin