# Skin & Soft Tissue Infections

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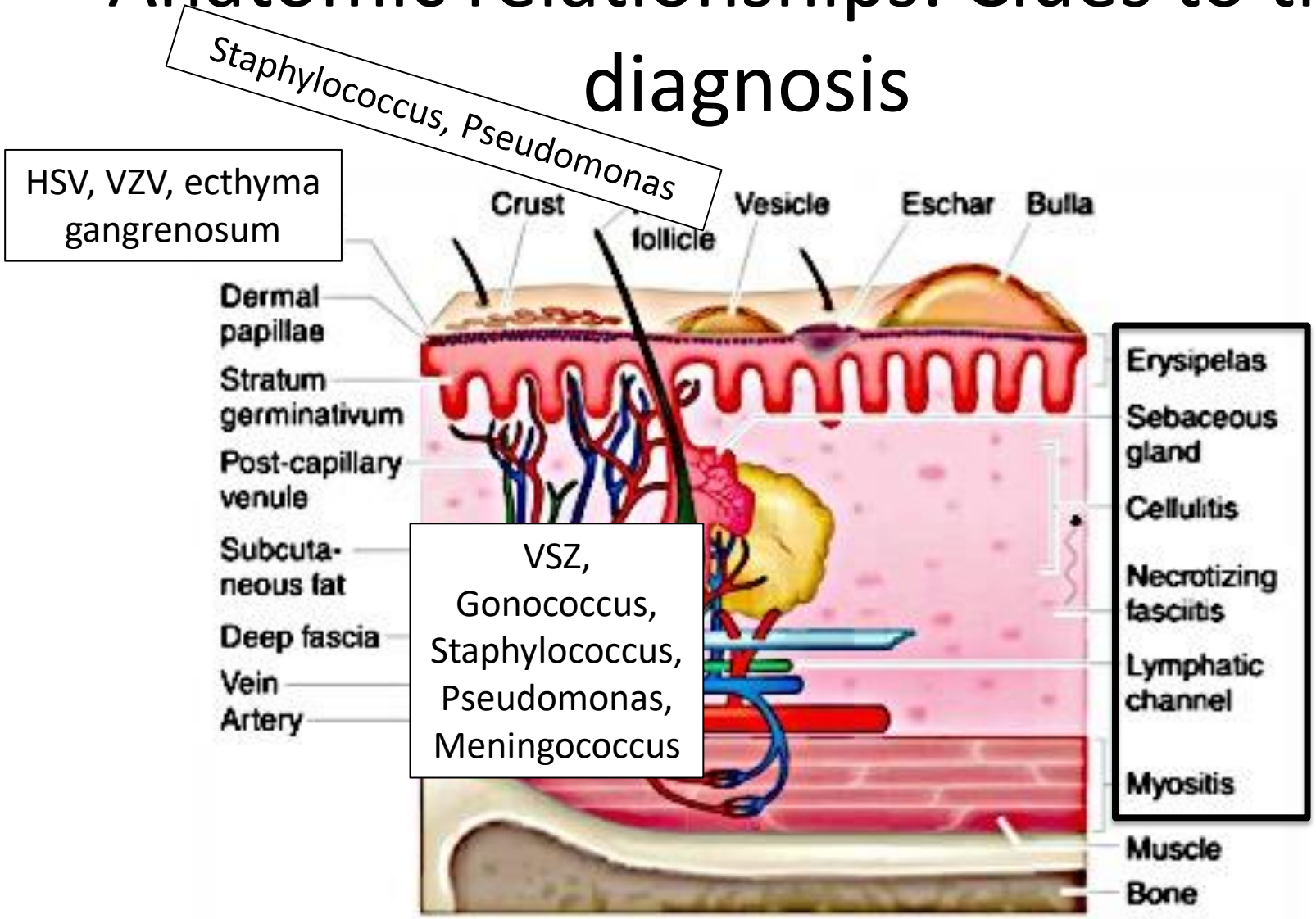
# Infections of the Skin, Muscles and Soft Tissues

- Occurs in all
- Now microbes rapidly disseminated throughout the world (air travel)
- Natural disasters predispose to infection
- Combat & terrorist activites can affect deeper structures

Harrison's Principles of Internal Medicine, 19th edition.

# Anatomic relationships: Clues to the diagnosis

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# Infections associated with VESICLES

- Smallpox (Variola virus)
- Chickenpox (VZV)
- Shingles/herpes zoster (VZV)
- Cold sores, herpetic whilow, herpes gladiatorum (HSV)
- Hand-foot-and-mouth disease (Coxsackivirus A6)
- Molluscum contagiosum (Molluscum contagiosum)

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# Infections associated with BULLAE

- SSSS (S. aureus)
- Necrotizing fasciitis (S. pyogenes, Clostridium spp., mixed aerobes and anaerobes)
- Gas gangrene (Clostridium spp.)
- Halophilic vibrio (V. vulnificus)

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# Infections assoc. w/ CRUSTED LESIONS

- Bullous impetigo/ecthyma (S. aureus)
- Impetigo contagiosa (S. pyogenes)
- Ringworm (Superficial dermatophyte fungi)
- Sporotrichosis (Sporothrix schenkii)
- Histoplasmosis (H. capsulatum)
- Coccidiomycosis (C. immitis)
- Blastomycosis (B. dermatidis)
- Cutaneous leishmaniasis (Leishmania spp.)
- Cutaneous tuberculosis (MTB)
- Nocardiosis (N. asteroides)

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# Folliculitis

- Furunculosis (S. aureus)
- Hot-tub folliculitis (P. aeruginosa)
- Swimmer's itch (Schistosoma spp.)
- Acne vulgaris (P. acnes)

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# Papular & nodular lesions

- Fish-tank or swimming-pool granuloma (M. marinum)
- Creeping eruption/cutaneous larva migrans (A. braziliense)
- Dracunculiasis (D. medinensis)
- Cercarial dermatitis (Schistosoma spp.)
- Verruca vulgaris (HPV-1,2,4)
- Condyloma acuminata/anogenital warts (HPV-6,11, 16, 18)
- Onchocerciasis nodule (O. volvulus)

Harrison's Principles of Internal Medicine, 19th edition.

# Papular & nodular lesions

- Cutaenous myasis (Dermatobia hominis)
- Verruca peruana (B. bacilliformis)
- Cat-scratch disease (B. henselae)
- Secondary syphilis – papulosquamous & nodul lesions, condyloma lata (T pallidum)
- Tertiary syphilis - nodular gummatous lesions (T. pallidum)
- Lepromatous leprosy (Mycobacterium leprae)


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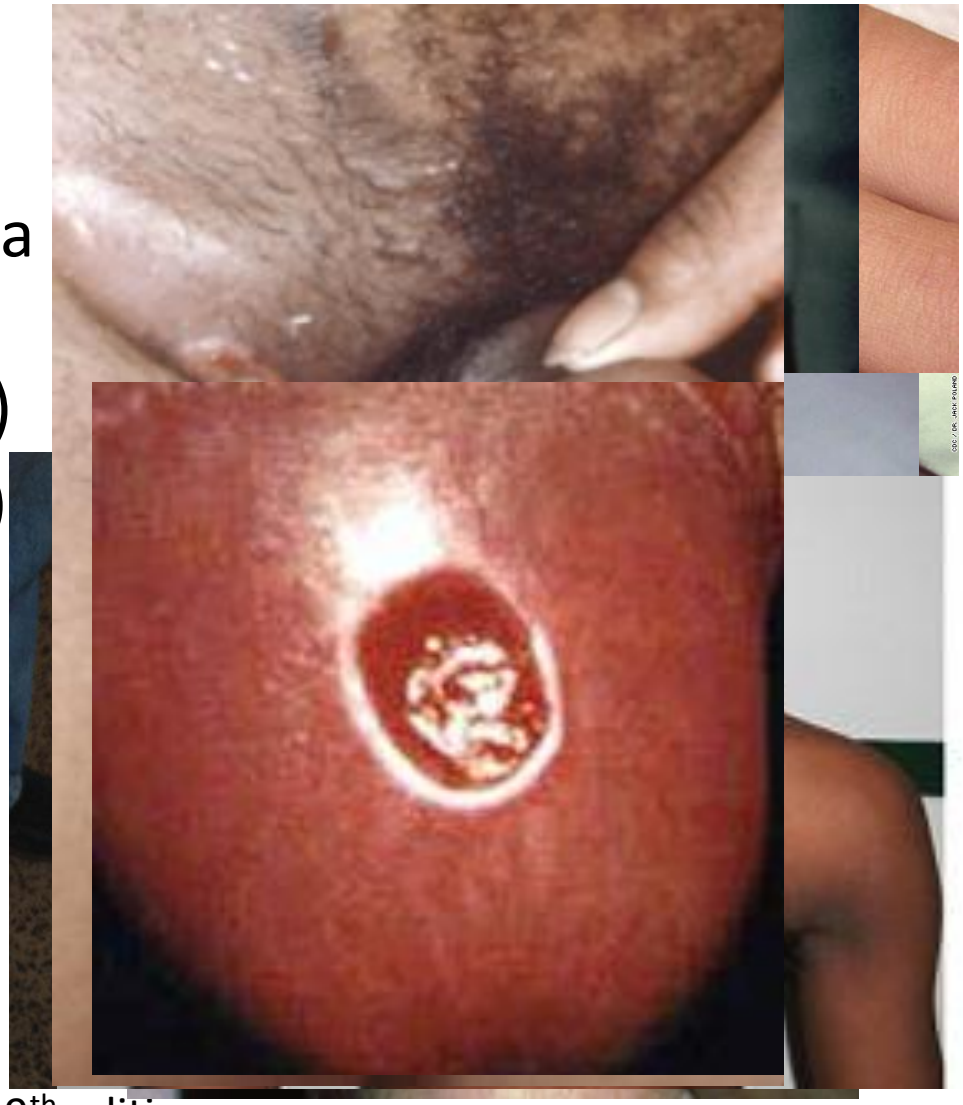
# ULCERS with or without eschars

- Anthrax (B. anthracis)
- Ulceroglandular tularemia (F. tularemia)
- Bubonic plague (Y. pestis)
- Buruli ulcer (M. ulcerans)
- Leprosy (M. leprae)
- Cutaneous TB (MTB)
- Chancroid (H. ducreyi)
- Primary syphilis (T. pallidum)



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# Cellulitis & Superficial Infections

- Impetigo
- Staphylococcal Scalded Skin Syndrome (SSSS)
- Staphylococcal Scarlet Fever
- Folliculitis
- Furuncles & Carbuncles
- Ecthyma
- Chancriform lesions
- Erysipelas
- Cellulitis

# Infectious Gangrene (Gangrenous Cellulitis)

- Clostridial Anaerobic Cellulitis/Clostridial Gas Gangrene
- Non-Clostridial Anaerobic Cellulitis
- Necrotizing Fasciitis

# Miscellaneous Skin & Soft Tissue Infections

# Imp

- Vesicular → Crusted

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# Impetigo

- Bullous by S. aureus
- Highly communicable
  - Families, crowding, poor hygiene
- Exposed areas
  - Vesicles/Halos → Pustulate → Rupture
  - Characteristic thick, golden-yellow, “stuck-on” crusts
  - Pruritus
  - Mild LAD

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# Impetigo

- Lab
  - Gram stain of pus or exudates: Gram positive cocci
  - Culture: GAS, S. aureus
- Differentials
  - Varicella, Tinea circinata, HSV, Acute palmoplantar pustulosis, Localized acute pustular psoriasis, Primary cutaneous listeriosis, Atopic or contact dermatitis, Discoid lupus erythematosus, Scabies

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# Impetigo

- Treatment
  - Oral or topical
    - Oral recommended for numerous lesions or outbreaks
    - Topical Mupirocin BID x 5 days
    - Oral 7-day regimen active vs. S. aureus unless only Strep alone in culture
      - MSSA: Cloxacillin or Cephalexin
      - MRSA: Doxycycline, Clindamycin, TMP-SMX
      - Systemic abx during outbreaks of Poststreptococcal GN

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# Staphylococcal Scalded Skin Syndrome (SSSS)

- One of the most severe & manifestation of S. aureus infection
- Exfoliative exotoxin
- Pemphigus neonatorum = SSSS of newborn

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# Staphylococcal Scalded Skin Syndrome (SSSS)

- Fever, skin tenderness, scarlatiniform rash
  - Mortality higher in adults

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# Staphylococcal Scalded Skin Syndrome (SSSS)

- Treatment
  - Presumptive
    - IV Nafcillin or Oxacillin
      - 100 mg/kg/d for newborns
      - 100-200 mg/kg/d for older children
    - IV Vancomycin in newborn nurseries or in communities with high MRSA rates
    - Topical cool saline compresses
    - NOT systemic steroids

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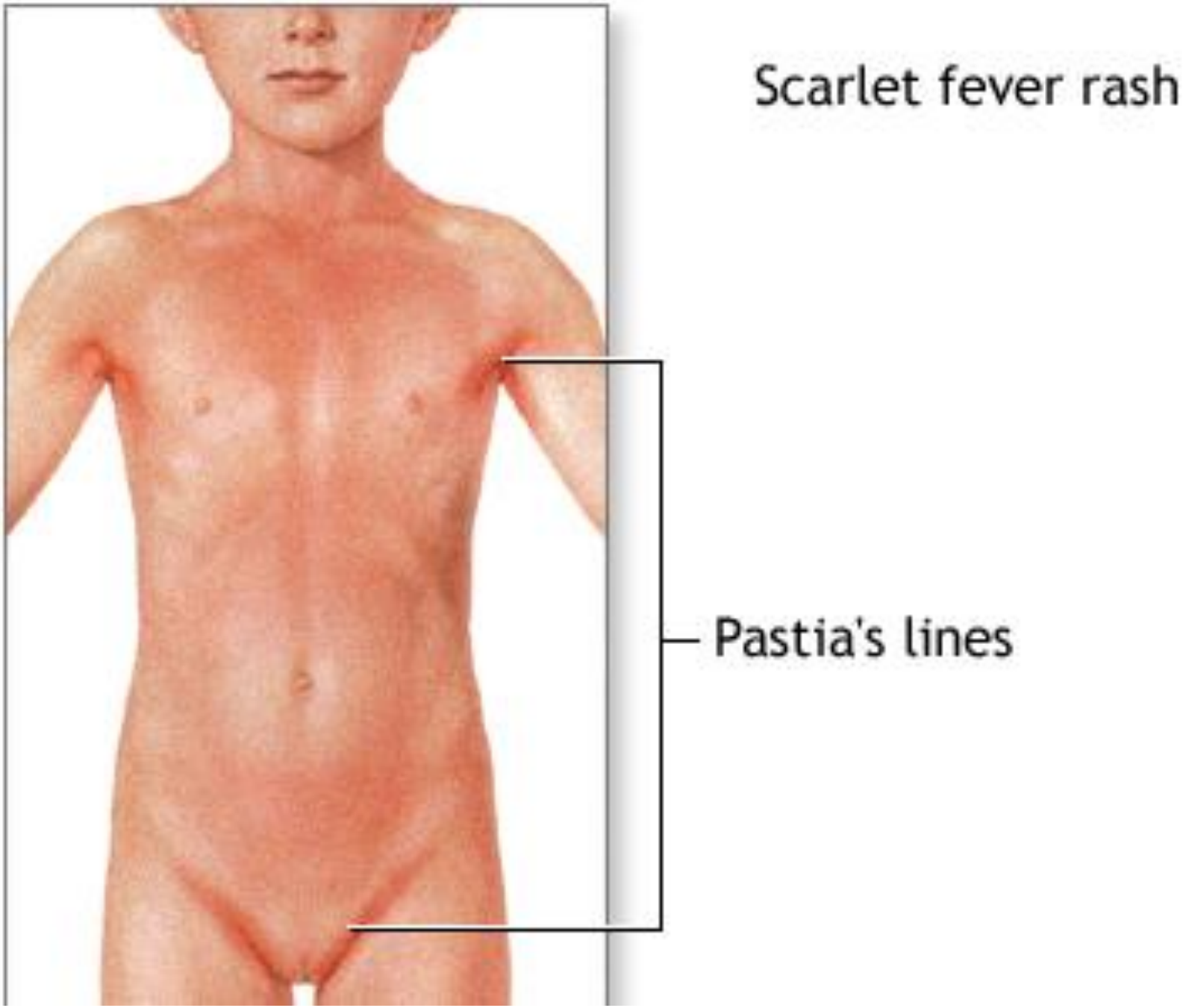
Scarlet fever rash
Pastia's lines

# Folliculitis

- Treatment
  - Local
    - Saline compresses
    - Topical antibacterials (e.g., mupirocin) or antifungals (e.g., clotrimazole)
  - Severe or widespread
    - Oral FQ (if Pseudomonas)

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# Furuncles & Carbuncles

- Furuncle (boil)
  - Deep inflammatory nodule extending into SC tissue
  - Develops from preceding folliculitis
- Carbuncle
  - More extensive coalescent process
  - Involves multiple follicles
  - Extends into SC fat in areas covered by thick, inelastic skin
  - Multiple abscesses separated by connective tissue septa
- Cause: S. aureus
- Gram stain & culture of pus

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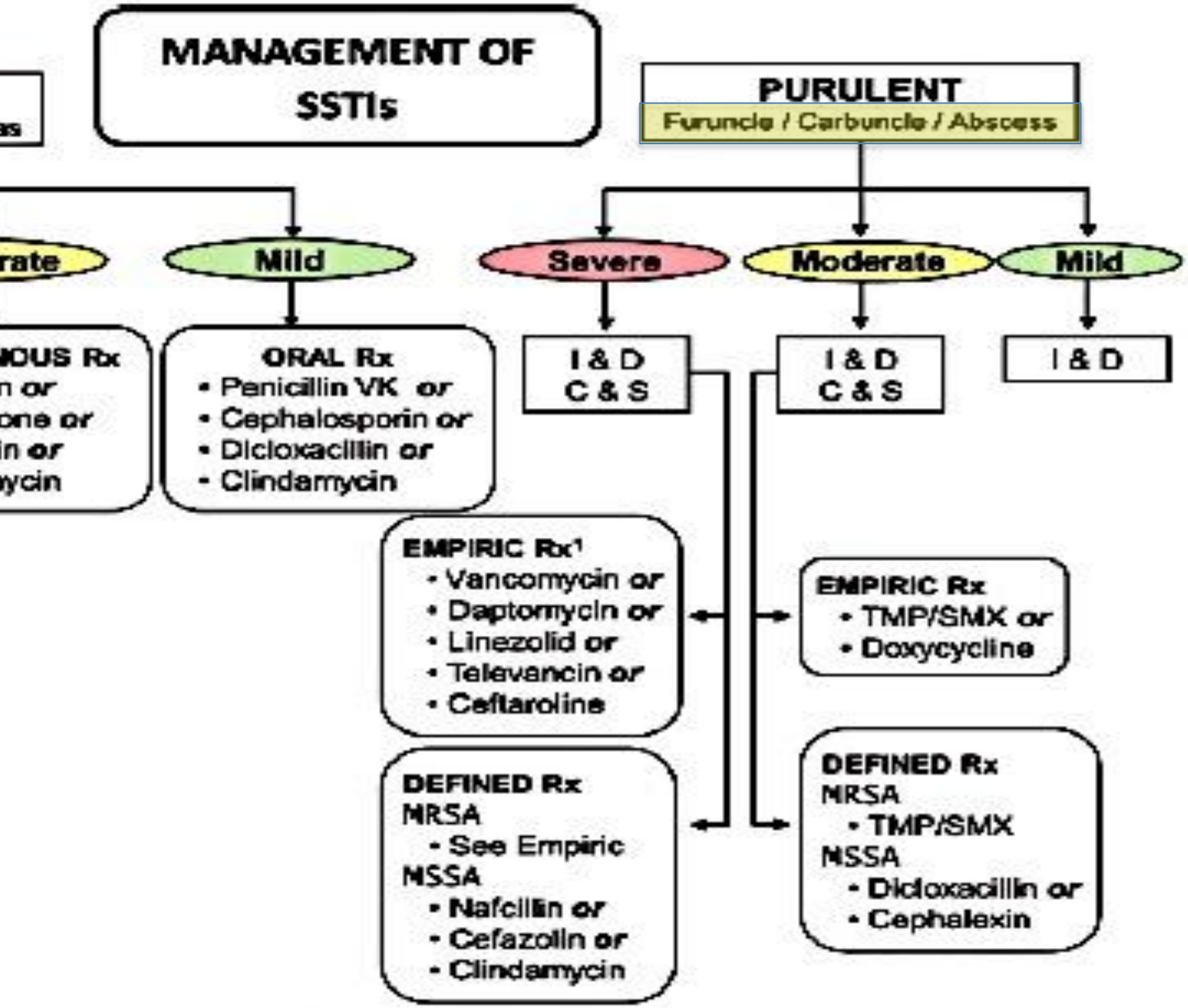


[1]Since daptomycin and televancin are not approved for use in children, vancomycin is recommended; clindamycin may be used if clindamycin

# Furuncles & Carbuncles

- Management of recurrent furunculosis
  - Prophylaxis with:
    - Antibiotic (systemic) for most recent episode
      - 10-14 days same as 2 month treatment
    - General skin care
      - Antibacterial soap & water
      - Handwashing
      - Separate towel & washcloth
      - Chlorhexidine 4%
    - Care of clothing (high temperatures & changed daily)
    - Care of dressings
      - Lesions covered at all times with sterile dressings

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# Furuncles & Carbuncles

- Management of recurrent furunculosis
  - Further measures:
    - Elimination of nasal carriage & frequent shedding of S. aureus
      - Intranasal application of 2% mupirocin BID x 5 days (monthly can suppress S. aureus carriage by 50%)
      - Oral rifampin NOT recommended because of resistance
      - Intensive combined topical & systemic decolonization
        - » Above + doxycycline to prevent rifampin resistance


TREATMENT IS SAME AS FOR IMPETIGO

# Chancriform Lesions

- Anthrax

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# Chancriform Lesions

- Anthrax
  - Malaise, low grade fever
  - Regional lymphadenopathy
  - If untreated, bacteremic dissemination, high fever, hypotension (even, meningitis)
  - Diagnosis
    - Culture, immunohistochemical staining, PCR
  - Treatment
    - AVOID incision & debridement (will increase risk of bacteremia)
    - Penicillin (DOC for ages) V 500 mg QID x 7 – 10 days
    - Oral Ciprofloxacin 500 mg BID or Levofloxacin 500 mg IV/PO OD x 60 days for bioterrorism cases (or Doxycycline) now recommended

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# Erysipelas

- Superficial cellulitis of skin with prominent lymphatic involvement
- GAS (or uncommonly, Group C or G streptococci; rarely, GBS or very rarely, S. aureus)
- More in infants, young children, older adults
- Formerly, face with preceding strep RTI
- Now, more in lower extremities

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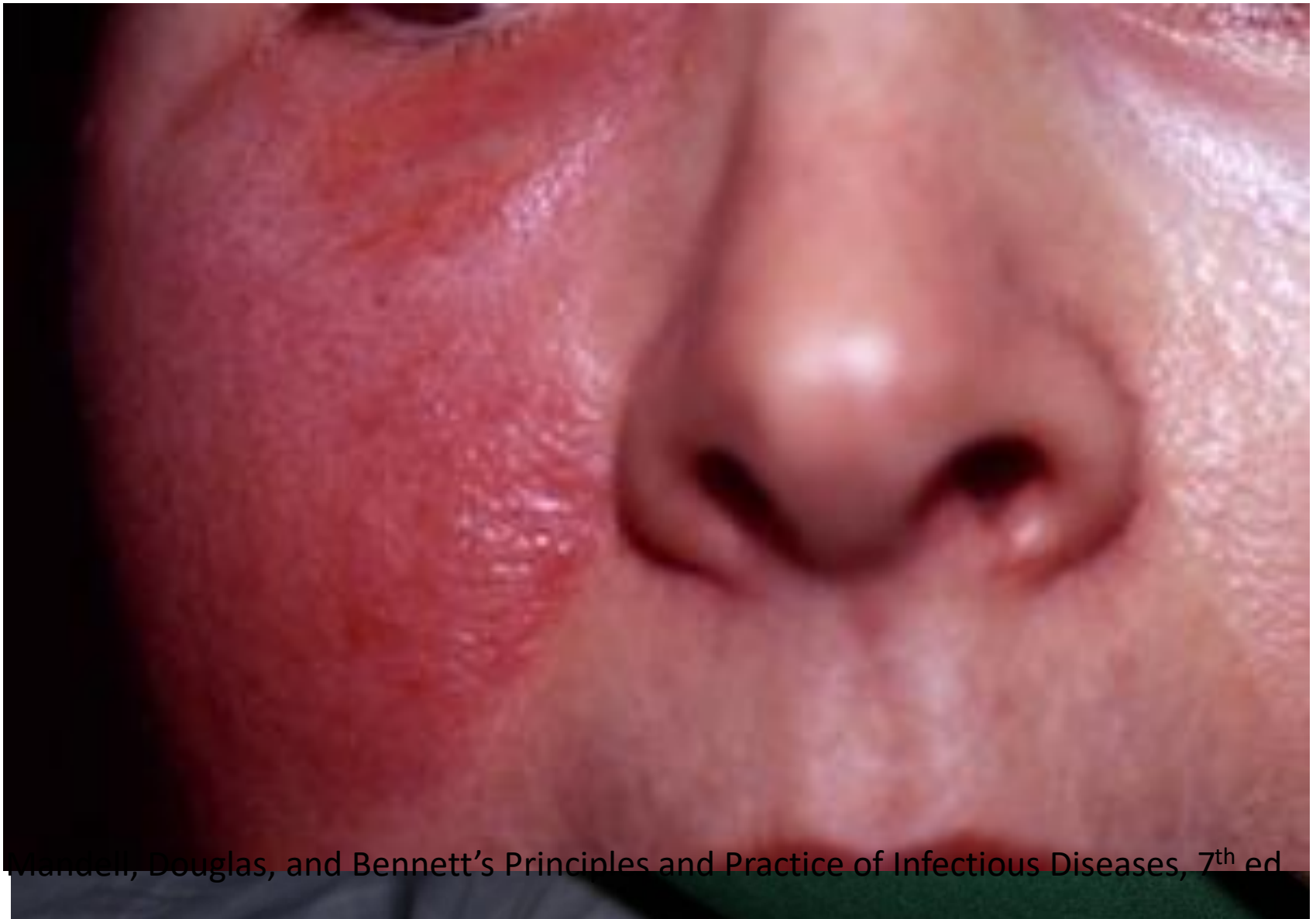
# Erysipelas



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# Erysipelas

- Cultures of blood or cutaneous aspirates, biopsies or swabs NOT routinely recommended except in:
  - Patients with CA on chemotherapy
  - Neutropenia
  - Severe immunodeficiency
  - Immersion injuries
  - Animal bites

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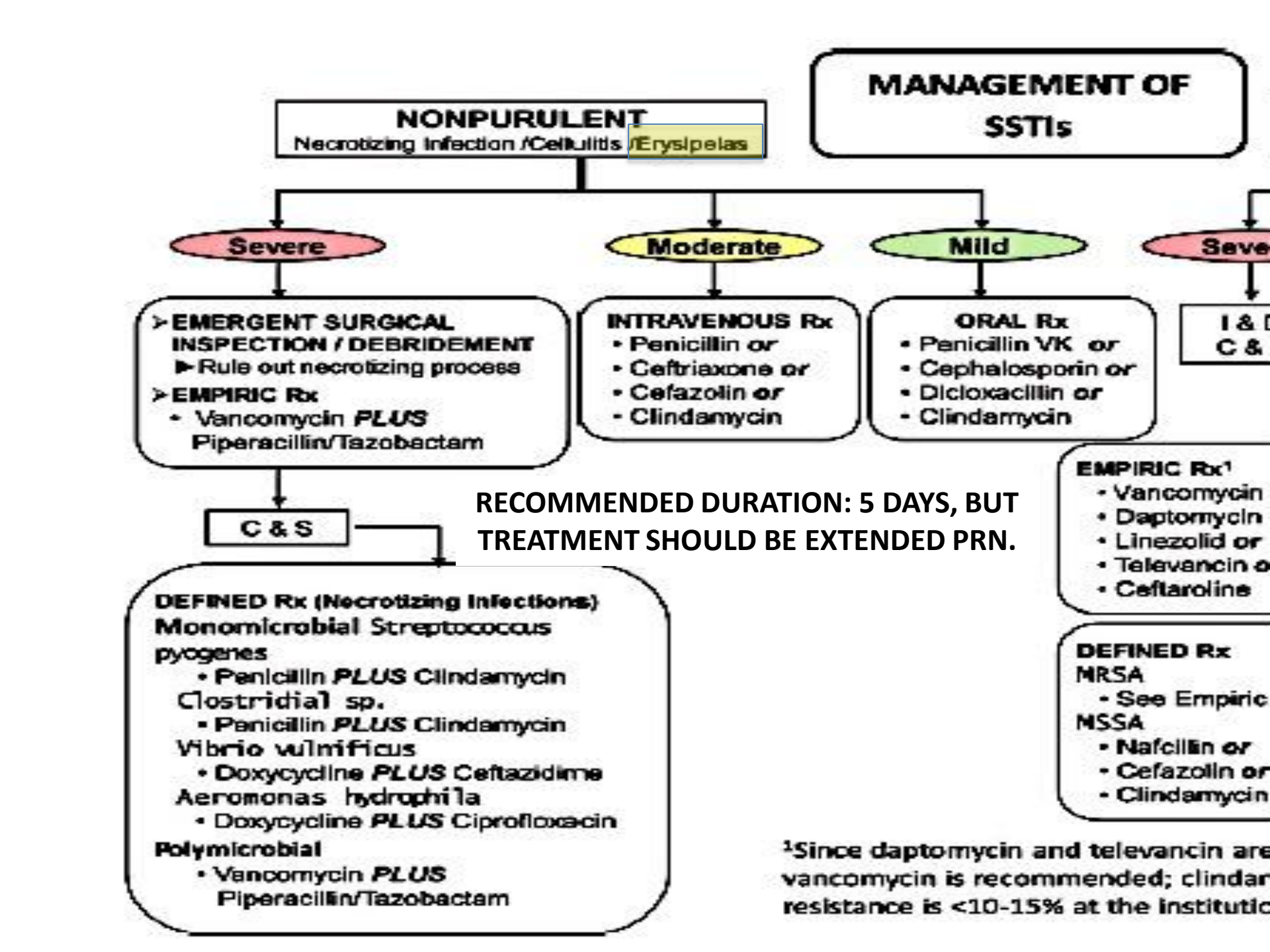
MANAGEMENT OF SSTIs
NONPURULENT
Necrotizing Infection /Cellulitis /Erysipelas
Severe
Moderate
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➢EMERGENT SURGICAL INSPECTION / DEBRIDEMENT
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INTRAVENOUS Rx
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• Ceftriaxone or
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• Dicloxacillin or
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RECOMMENDED DURATION: 5 DAYS, BUT TREATMENT SHOULD BE EXTENDED PRN.
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• Daptomycin
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# Erysipelas

- Elevate affected area
- Treat predisposing factors (e.g., edema, underlying cutaneous disorders)
- In lower extremities, carefully examine interdigital toe spaces
  - Treating fissuring, scaling or maceration may eradicate colonization of pathogen & reduce recurrence)
- OPD treatment recommended for those who do not have SIRS, altered mental status, hemodynamic instability
- Hospitalization if w/ concern for a deeper necrotizing infection, for px w/ poor adherence to tx, for severely ICHs, or if OPD tx failing

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# Cellulitis

- Acute spreading infection of the skin
- Extends deeper than erysipelas, involving SC tissues
- GAS & S. aureus: most common
- Predisposing factors:
  - Previous trauma, underlying skin lesion
  - Occasionally, blood-borne, direct spread from subjacent infections

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# Cellulitis

# Cellulitis

- Polymorphonuclear leukocytosis
- Cultures of ulcers & abrasions contiguous w/ areas of cellulitis have shown similar pathogens
- Consider diagnostic aspiration only if unusual pathogens are suspected (e.g., ICH), fluctuant areas present, or initial antimicrobial therapy is unsuccessful
- Blood cultures positive only in 2 – 4% in community-acquired cellulitis

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# Cellulitis

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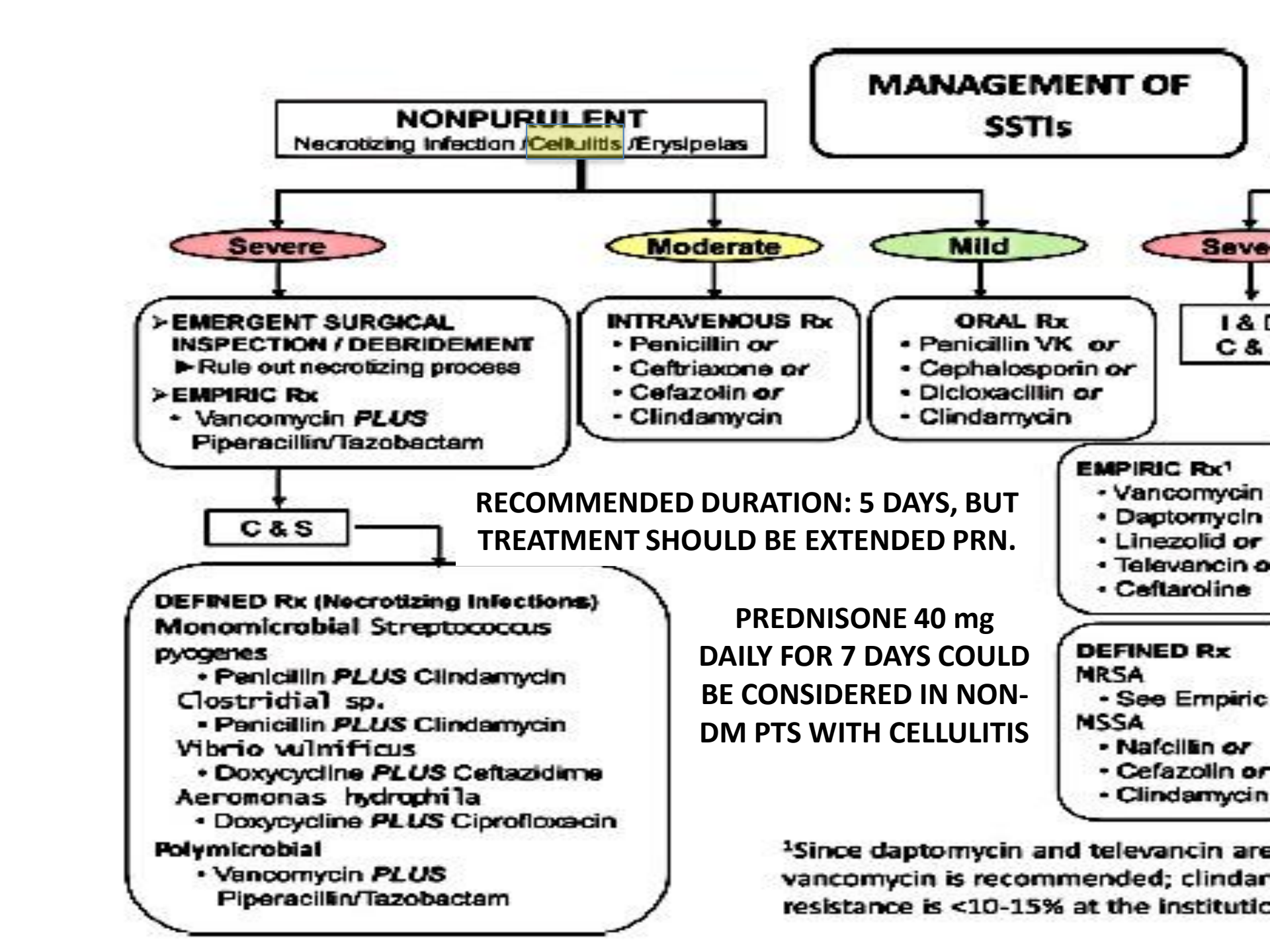
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Vibrio vulnificus
• Doxycycline PLUS Ceftazidime
Aeromonas hydrophila
• Doxycycline PLUS Ciprofloxacin
Polymicrobial
• Vancomycin PLUS Piperacillin/Tazobactam
PREDNISONE 40 mg DAILY FOR 7 DAYS COULD BE CONSIDERED IN NON-DM PTS WITH CELLULITIS
DEFINED Rx
MRSA
- See Empiric
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# Recurrent Cellulitis

- Identify & treat predisposing conditions, such as:
  - Edema, obesity, eczema, venous insufficiency, toe web abnormalities
- Prophylactic antibiotics (e.g., oral penicillin or erythromycin BID for 4 – 52 weeks, or IM benzathine penicillin Q 2 – 4 weeks) should be considered in patients who have 3 – 4 episodes of cellulitis per year despite attempts to control predisposing factors

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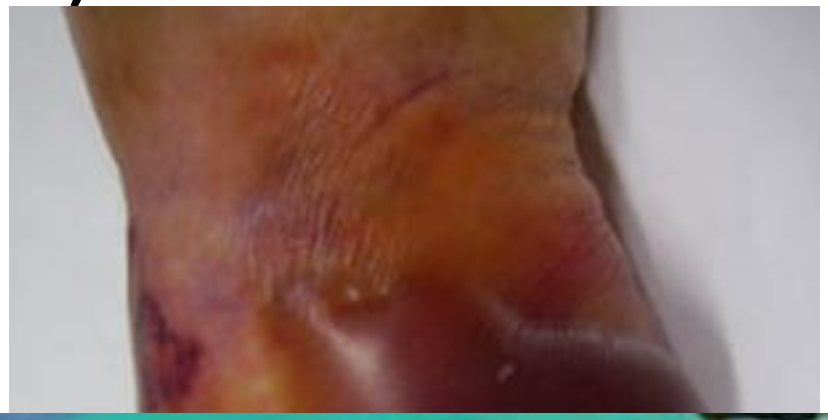
# Infectious Gangrene (Gangrenous Cellulitis)

# Infectious Gangrene (Gangrenous Cellulitis)

- Clostridial gas gangrene
- Vibrio vulnificus
- Aeromonas hydrophila



# Clostridial Anaerobic Cellulitis

- Necrotizing infection of devitalized tissue
- Deep fascia not involved
- No myositis
- Usually, C. perfringens; sometimes, C. septicum (bacteremia in the setting of leukemia & granulocytopenia)
- Gram stain: numerous blunt-ended, thick, gram-positive bacilli & PMNs
- X-ray: abundant gas
- Unnecessary delay because of CT or MRI should be avoided
- Hyperbaric Oxygen treatment controversial (poor quality evidence)

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# Non-Clostridial Anaerobic Cellulitis

- By various non-spore-forming anaerobic bacteria (e.g., Bacteroides spp., peptostreptococci, peptococci, or mixed with others
- Other gas-forming infections by E. coli, Klebsiella, Aeromonas

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# Infectious Gangrene (Gangrenous Cellulitis)

- Diagnosis
  - May not be apparent on 1st seeing patient
  - Features suggesting involvement of deeper tissues
    - Severe pain disproportional to clinical findings
    - Failure to respond to initial antibiotic therapy
    - Hard, wooden feel of SC tissue
    - Systemic toxicity, often w/ altered mental status
    - Edema or tenderness extending beyond skin erythema
    - Crepitus, indicating gas in tissues
    - Bullous lesions
    - Skin necrosis or ecchymoses

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# Infectious Gangrene (Gangrenous Cellulitis)

- Diagnosis
  - CT or MRI
    - Edema extending along fascial plane
    - May delay definitive diagnosis & treatment
  - Clinical judgement is most important
  - At operation, most important diagnostic feature is appearance of SC tissues or fascial planes
    - Swollen, dull gray w/ stringy areas of necrosis
    - Brownish exudate may br present
    - Typically no true pus

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# Infectious Gangrene (Gangrenous Cellulitis)

- Definitive bacteriologic diagnosis
  - Culture & Gram Stain of deep tissue at OR or by positive Blood Cultures
  - Direct needle aspiration of area of skin inflammation GS/CS

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# Necrotizing fasciitis

- Type I
  - At least 1 anerobic species (Bacteroides or Peptostreptococcus) + facultative anaerobic spp. (Streptococcus) and/or Enterobacteriaceae
- Type 2
  - GAS with or without S. aureus
- Hemolytic streptococcal gangrene
  - After minor trauma, wounds or surgery
  - In DM, Peripheral vascular diseases
  - Also in cirrhosis, steroid therapy

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# Necrotizing fasciitis

- Acute (rarely subacute & progressive)
- Most commonly: extremities (legs)
- Portal of entry: site of trauma, usually

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# Necrotizing fasciitis

- Findings
  - Erythema, swelling, without sharp magins, hot, shiny, exquisitely tender, painful
  - Rapid progression
  - Skin color changes (red-purple → blue-gray
  - Within 3-5 days, skin breakdown w/ bullae or gangrene (with ANESTHESIA)

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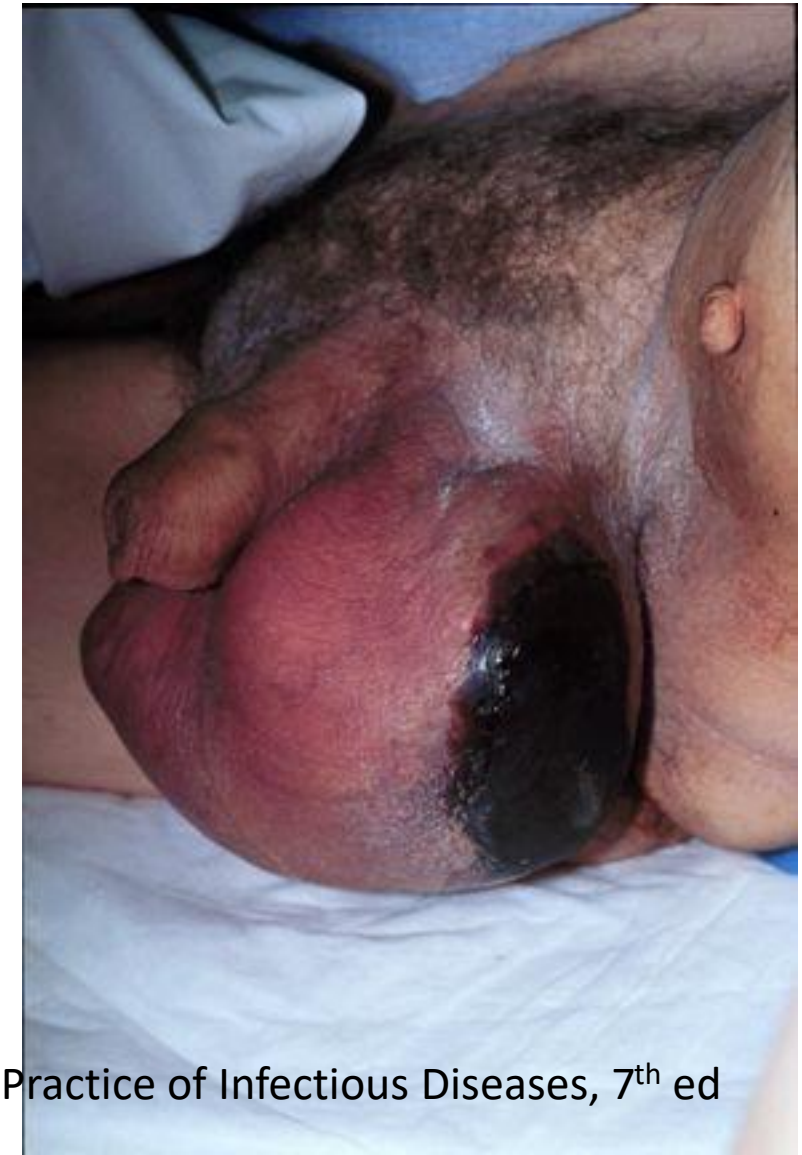
# Necrotizing faciitis

- Fournier's gangrene
  - Around the male genitals



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# MANAGEMENT OF SSTIs

## NONPURULENT

Necrotizing Infection /Cellulitis /Erysipelas

### Severe

- **EMERGENT SURGICAL INSPECTION / DEBRIDEMENT**
  - Rule out necrotizing process
- **EMPIRIC Rx**
  - Vancomycin ***PLUS*** Piperacillin/Tazobactam

C & S

**DEFINED Rx (Necrotizing Infections)**

**Monomicrobial** Streptococcus pyogenes
- Penicillin ***PLUS*** Clindamycin

Clostridial sp.
- Penicillin ***PLUS*** Clindamycin

Vibrio vulnificus
- Doxycycline ***PLUS*** Ceftazidime

Aeromonas hydrophila
- Doxycycline ***PLUS*** Ciprofloxacin

**Polymicrobial**
- Vancomycin ***PLUS*** Piperacillin/Tazobactam

### Moderate

**INTRAVENOUS Rx**
- Penicillin *or*
- Ceftriaxone *or*
- Cefazolin *or*
- Clindamycin

### Mild

**ORAL Rx**
- Penicillin VK *or*
- Cephalosporin *or*
- Dicloxacillin *or*
- Clindamycin

### Seve

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C &

**MOST NEED TO RETURN TO OR 24-36 HOURS AFTER 1ST DEBRIDEMENT & DAILY THEREAFTER UNTIL NO FURTHER NEED**

**ABX GIVEN UNTIL DEBRIDEMENT NO LONGER NEEDED, CLINICALLY IMPROVED, & NO MORE FEVER X 48 – 72 HOURS**

**EMPIRIC Rx[1]**
- Vancomycin
- Daptomycin
- Linezolid *or*
- Televancin *o*
- Ceftaroline

**DEFINED Rx**

MRSA
- See Empiric

MSSA
- Nafcillin *or*
- Cefazolin *or*
- Clindamycin

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# Miscellaneous

# Animal & Human Bite Prevention & Treatment

- Preemptive early abx for 3 – 5 days for:
  - Immunocompromised
  - Asplenic
  - Advanced liver disease
  - Pre-existing or resultant edemea of affected area
  - Moderate to severe injuries, especially to hand or face
  - Injuries that may have penetrated the periosteum or joint capsule
- Post-exposure prophylaxis for rabies may be indicated

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# Treatment for Infected Animal Bite-Related Wounds

- Abx active vs. aerobic & anaerobic bacteria (purulent wounds likely polymicrobial; nonpurulent wounds from staph & strep; Pasteurella spp from both; plus, Eikenella corrodens in human bites)
  - Co-amoxiclav or Ampicillin-Sulbactam
  - Alternatives:
    - 2nd generation cephalosporins (Cefuroxime) + anaerobic coverage (Clindamycin or Metronidazole)
    - Carbapenem, Moxifloxacin, Doxycycline
    - (TMP-SMX or Levofloxacin) + (Clindamycin or Metronidazole)

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# Treatment for Infected Animal Bite-Related Wounds

- Tetanus toxoid should be administered to patients without toxoid vaccination within 10 years.
  - Tdap preferred over Td if former has not been previously given
- Primary wound closure not recommended for wounds except those to the face (managed w/ copious irrigation, cautious debridement, preemptive abx)

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# Tetanus-prone wounds

- Wounds present for >6 hours
- Deep (>1 cm) wounds
- Grossly contaminated wounds
- Wounds that are exposed to saliva, feces, stellate, or ischemic or infected (including abscesses)
- Avulsions, punctures, or crush wounds

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# Bacillary Angiomatosis (BA) & Cat Scratch Disease (CSD)

- Azithromycin is recommended for CSD
  - >45 kg: 500 mg on day 1, followed by 250 mg x 4 more days
  - <45 kg: 10 mg/kg on day 1, & 5 mg/kg x 4 more days
- Erythromycin 500 mg QID or doxycycline 100 mg BID x 2 weeks – 2 months for BA

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# Erysipeloid

- Cutaneous infection caused by Erysipelothrix rhusiopathiae (thin, pleomorphic, non-spore forming Gram-positive rod)
- Zoonosis acquired by handling fish, marine animals, swine, poultry
- Culture of aspirate &/or biopsy
- Preferred treatment
  - Penicillin 500 mg QID or Amoxicillin 500 mg TID x 7 – 10 days.

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# Tularemia

- Francisella tularensis
- Acquired by handling infected animals, by tick bites & sometimes animal bites, especially cats
- Serologic tests are preferred in diagnosis
- Streptomycin 15 mg/kg Q12h IM or gentamicin 1.g mg/kg IV Q8h for treatment of severe cases
- Tetracycline 500 mg QID or doxycycline 100 mg BID PO for mild cases
- Notify microbiology lab if tularemia is suspected

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# Myositis & Myonecrosis

- Viral infections
  - Influenza, dengue, coxsackie virus B
- Parasitic
  - Trichinellosis, cysticercosis, toxoplasmosis
- Hallmark: Severe muscle pain
- Complication: Rhabdomyolysis
  - Predictably with Clostridium & Streptococcus

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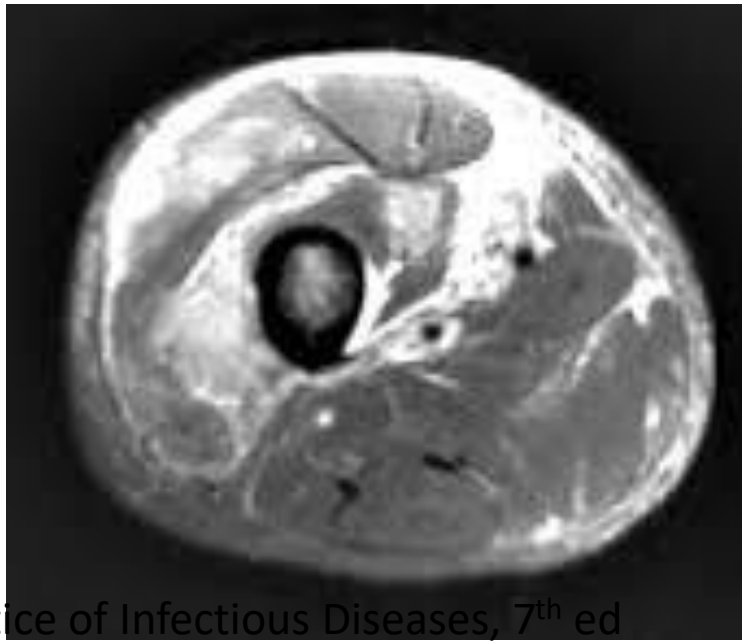
# Myositis & Myonecrosis

- Pyomyositis
  - Usually from S. aureus
  - Common in tropical areas
  - Generally, no known portal o entry
  - Localized unless shock arises from toxin from bacteria (e.g., TSST-1, enterotoxins)
  - Streptococcal necrotizing myositis (S. pyogenes)
    - 50% with necrotizing fasciitis



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# Not discussed

- Infection of skeletal muscle (infectious myositis)
  - GAS Necrotizing Myositis
  - Gas Gangrene (Clostridial Myonecrosis)
  - NonClostridial (Crepitant) Myositis
  - Psoas Abscess
- Approach to SSTIs in Immunocompromised Patients
  - Cancer patients with Neutropenia
  - Patients with Cellular Immunodeficiency

# References


- Mandell, Douglas, and Bennett's Principles and Practice of Infectious Diseases, 7th ed. Edited by Gerald L. Mandell, John E. Bennet, and Raphael Dolin. Philadelphia, PA: Churchill Livingstone Elsevier, 2009.
- 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. Clinical Infectious Diseases 2014;59(2):e10-52.
- Harrison's Principles of Internal Medicine, 19th edition.

Thank you and good luck!