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
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
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, O₂ 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?**
<table>
<thead>
<tr>
<th>Skin Anatomical Region</th>
<th>Pathophysiology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Epidermis</td>
<td>Impetigo</td>
</tr>
</tbody>
</table>
| Dermis                                 | Folliculitis
Furuncles/ Carbuncles
Erysipelas
Cellulitis |
| “Sub-cutaneous” fatty tissue Fascia (layer between skin and tissues underneath) | Necrotizing fasciitis                                                        |
| Muscle/tissue below fascia             | Myositis
Myonecrosis/gas gangrene                                                     |

### Classification Systems for SSTI / Terminology

<table>
<thead>
<tr>
<th>Uncomplicated&lt;sup&gt;1,2&lt;/sup&gt;</th>
<th>Complicated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cellulitis</td>
<td>Cellulitis</td>
</tr>
<tr>
<td>Simple abscesses</td>
<td>Carbuncles</td>
</tr>
<tr>
<td>Impetigo</td>
<td>Diabetic foot infections</td>
</tr>
<tr>
<td>Furuncles</td>
<td>Pressure sores</td>
</tr>
<tr>
<td></td>
<td>Bite wounds</td>
</tr>
<tr>
<td></td>
<td>Burn wounds</td>
</tr>
<tr>
<td></td>
<td>Necrotizing fasciitis</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Non-purulent&lt;sup&gt;3&lt;/sup&gt;</th>
<th>Purulent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Erysipelas</td>
<td>Furuncle</td>
</tr>
<tr>
<td>Cellulitis</td>
<td>Carbuncle</td>
</tr>
<tr>
<td>Necrotizing infection</td>
<td>Abscess</td>
</tr>
</tbody>
</table>

### 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 SSTIs (NSTIs)**
  - Necrotizing cellulitis, Necrotizing fasciitis,
  - Fournier’s gangrene, Necrotizing myositis

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

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### CLASSIFICATION OF SSTIS, CONTINUED

**Usually Monomicrobial**

<table>
<thead>
<tr>
<th></th>
<th>Often Polymicrobial</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cellulitis</td>
<td>Severe diabetic foot infection</td>
</tr>
<tr>
<td>Carbuncle, furuncle</td>
<td>Infected pressure ulcers</td>
</tr>
<tr>
<td>Mild-moderate diabetic foot infection</td>
<td>Fournier’s gangrene</td>
</tr>
<tr>
<td>Surgical incision infection</td>
<td>Some bite wounds</td>
</tr>
</tbody>
</table>

**Antibiotics alone may suffice**

<table>
<thead>
<tr>
<th></th>
<th>Surgery +/- antibiotics</th>
<th>Surgery + antibiotics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cellulitis</td>
<td>Any purulent infection</td>
<td>Any necrotizing infection</td>
</tr>
<tr>
<td>Mild-moderate diabetic foot infection</td>
<td>Furuncle, Carbuncle</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Surgical incision infection</td>
<td></td>
</tr>
</tbody>
</table>
CELLULITIS

PURULENT SKIN ABSCESS
**BACTERIOLOGY OF SSTI**

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

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

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)

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

<table>
<thead>
<tr>
<th>Decision Point</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Assessment, classification, and admission decision</td>
<td>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</td>
</tr>
<tr>
<td>2. Initial antimicrobial selection: Empiric Rx</td>
<td>Empiric Rx, surgical intervention if needed Need for adjunctive therapy</td>
</tr>
<tr>
<td>3. Antimicrobial switch</td>
<td>Modification/de-escalation based on response, cultures, etc</td>
</tr>
<tr>
<td>4. Discharge: transition to next level of care</td>
<td>Keep Rx duration in mind at transition of care. switch to oral, alternate IV therapy</td>
</tr>
<tr>
<td>5. Discontinuing antimicrobial therapy</td>
<td>Less can be more even in SSTI</td>
</tr>
</tbody>
</table>
SITUATIONS REQUIRING BROADENED ANTIMICROBIAL REGIMENS
(MAY OR MAY NOT COMPRISIE 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
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

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


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