

## **VANDERBILT** WNIVERSITY

## MEDICAL CENTER

**Guideline:** Burn Antimicrobial Stewardship Guidelines

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## **Content Experts**

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## I. Purpose:

To guide appropriate antimicrobial, antibiotic and antifungal, use and decrease microbial resistance on the Burn Surgery service

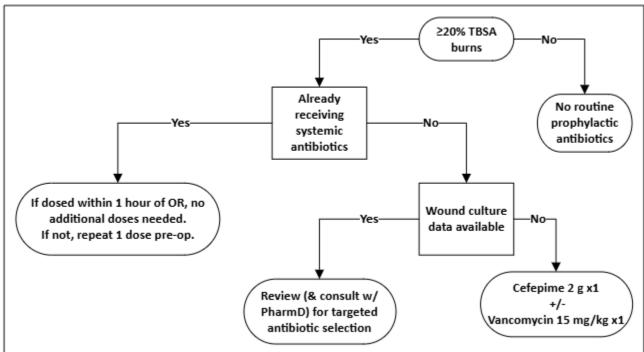
## II. Background:

Appropriate empiric therapy is critical for decreasing mortality associated with severe infections. Empiric regimens should be chosen based on local antibiograms, common fungus and bacteria associated with the suspected infection, and patient specific factors. Rotation of antimicrobials is not currently recommended by the Infectious Diseases Society of America (IDSA) as a strategy to reduce antibiotic resistance, as data do not support its use. Guidelines for empiric antimicrobial utilization and dosing and appropriate de-escalation strategies such as MRSA nasal PCR screening allow for hospitals to optimize treatments of infections <sup>1,2,3,4,5</sup>.

## III. Components:

## Surgical Prophylactic Antibiotics

- Evidence is limited and conflicting regarding the necessity, risks and benefits of perioperative antibiotic prophylaxis. Studies reviewed were all performed in the adult population. For burns < 20% TBSA prophylactic antibiotics do not appear necessary to improve outcomes or avoid complications. For burns ≥ 20% TBSA data is limited and suggests that an antibiogram focused approach is best practice with current trials ongoing. (35-38,45-48)
- Adult Perioperative Antibiotics
  - <20% TBSA No routine prophylactic antibiotics</p>
  - ≥20% TBSA A review of individualized patient wound culture data will direct prophylactic antibiotic selection. In the absence of wound culture data, Cefepime 2 g x1 dose +/- Vancomycin 15 mg/kg x 1 dose (max 2000 mg), based on MRSA nasal screen or empiric decolonization should be given.
  - For patients already receiving systemic antibiotic therapy, perioperative antibiotics should be redosed if the patient has not had a dose of their current regimen within 1 hour of the procedure start.



- Empiric Nasal MRSA Decolonization<sup>6,7,8,9</sup> per protocol (see policy tech protocol Vanderbilt University Medical Center Adult- Nasal Decolonization)
  - Briefly: Everyone age >18 admitted to an ICU or with a central line not meeting exclusion criteria receives 5 days of BID nasal mupirocin



## • Empiric Burn Wound Cultures

- This information is to be used only in the event of a later development of clinical signs of a wound infection and should not be treated solely based on growth of organisms in the absence of clinical signs of infection.
- Surveillance cultures will be collected upon admission and weekly during treatment. When ordering surveillance cultures, the ordering provider will place a comment in the order stating surveillance cultures to separate these from clinically indicated cultures when concerned for infection.
  - Timing of surveillance cultures:
    - Admission Should be done with the initial debridement for all burn patients, following debridement and cleaning and prior to antibiotic ointment application.
    - Weekly Should be done on patients every Monday during wound care/hydrotherapy
    - Burn Pack Takedown Should be done following removal of the dressings and cleaning, prior to
      application of hypochlorous acid or other specialized ointments and prior to application of fresh
      antimicrobial dressings. For wounds with stapled on dressings protecting the grafts, a
      representative swab from under the dressing when available or over the dressing if it is well
      adhered.
  - Technique for surveillance cultures:
    - Wounds should be washed, debrided, and rinsed prior to swabbing the representative burn wound area
    - Cultures should be sent from any areas of specific concern from their appearance (heavy biofilm, graft loss, discoloration, malodor, etc.)
    - Cultures should be sent from the donor sites in addition to the wounds when a donor site is present
    - Swabs should be rolled and swabbed in a "S" or serpentine pattern over the target area.
    - Tissue for culture may be sent when present.
    - Cultures should be tested for Aerobes, Anaerobes, and Fungus.

#### Infection Prevention

- Universal Contact Precautions for all burn patients
- o All burn patients (ICU, step down, off-unit, PICU and general peds floors) are under contact precautions, regardless of TBSA % burn.
- All burn patient families/visitors must wear PPE (blue or yellow gown and gloves) while in the room, follow hand hygiene rules, etc.
- o Patients with MDRO are limited to staying within the unit for infection prevention purposes.
- When burn patients are out of their rooms, their wounds must be dressed (faces open to the air with ointment applied are acceptable), the patient must wear a hospital gown to cover front and back (adequately tied up or two gowns as needed for full coverage) and gloves as able.
- o If transporting off the unit on a stretcher, gown and sheet coverage is acceptable.

## • Evidence-based diagnosis of infections and Initiation of Empiric Antibiotics 10, 11, 12, 13, 14, 15, 16

- o Burn Wound Infection must meet VUMC PMG guideline definitions, see respective PMG for details.
  - Presence of ONE of the following:
    - Obvious purulence from the wounds
    - Burn Wound Cellulitis redness extending >2cm from the edge of the wound
  - Or presence of at least TWO of the following:
    - One or more of the following:
      - Fever without other source
      - Elevated WBC above normal or trending significantly up from previous values
      - Increased pain and swelling at the site
      - Abnormal Drainage, or odor increasing
      - Loss of previously established graft (ghosting, pockmarking, graft melt, etc...)



- And an Organism(s) identified from blood by a culture or non-culture based microbiologic testing method which is performed for purposes of clinical diagnosis or treatment, for example, not Active Surveillance Culture/Testing (ASC/AST)
- Sepsis signs in Adult Burn Patients (>/= 16 yo) include the presence of at least 2 of the following<sup>10</sup>:
  - Core Body Temperature >39°C or <36.5°C</li>
  - Progressive Tachycardia >120 bpm
  - Progressive Tachypnea >25 bpm (not ventilated) and >12L/min minute ventilation on ventilator
  - New Thrombocytopenia greater then 3days post resuscitation <100,000/mcL</li>
  - Mean Arterial Pressure <65 mmHg</li>
  - Lactate elevated above the normal range (>2.2mmol/L)
  - Procalcitonin level >0.69 ng/mL<sup>16, 17, 18, 19, 20</sup>
  - New insulin requirement, worsening glucose control, glucose >150mg/dL<sup>14</sup>
- Septic Workup in Burn Patients:
  - Obtain Blood Cultures x2
  - Obtain Wound Cultures
    - Culture should be obtained in an area of the burn wound at most risk for infection (eg. back, posterior thighs, etc) at the same time as blood, urine, sputum, etc.
  - Obtain BAL if intubated
  - Obtain Urine analysis with reflex culture
  - Obtain CXR
  - Discuss with Attending Burn Surgeon need for dressing removal and wound evaluation.
    - Evaluation for suspected Fungal infection<sup>21</sup>:
      - Fungal infection is often visibly present in the wounds and can be associated with severe inflammatory response resulting in profound laboratory and physiologic derangements.
      - White, fluffy, cheesy appearing patches of growth in the wounds are consistent with mold and fungal overgrowths and should be excised and sent for tissue culture.
      - Surgical excision and debridement is necessary for source control
      - Wound bed tissue following excision should be sent for analysis to confirm source control
  - Initiate Targeted empiric antimicrobial +/- antifungal therapy (when source is known or suspected)
- Positive surveillance wound cultures do not indicate wound infection in burn patients, clinical correlation is required

#### • Source-Specific Empiric Antimicrobial Selection

- Directed by unit-specific antibiograms.
  - Review the individual patient's recent microbial susceptibilities and adjust broad spectrum choices as needed to cover resistant organisms accordingly.
- Early De-escalation <sup>22</sup> Discussed separately below.
- Documentation

## IV. Source-Specific Preferred Empiric Antibiotics:

	Burn Wound Infection	CAP*	VAP <sup>^</sup> or HAP <sup>#</sup>	Skin/Soft Tissue Infection	Bacteremia
Empiric	Vancomycin	Ceftriaxone	Vancomycin	Cefazolin or	Vancomycin
Antibiotic	+ Cefepime	+ Azithromycin	+ Cefepime	Cefalexin	+ Cefepime

<sup>\*</sup>Community- acquired pneumonia (CAP): pneumonia acquired outside of the hospital setting

<sup>^</sup>Ventilator-acquired pneumonia (VAP): pneumonia occurring greater than 48 hours after endotracheal intubation

## BICU Antimicrobial Stewardship Guidelines



#Hospital-acquired pneumonia (HAP): pneumonia not incubating at the time of hospital admission and occurring ≥ 48h after admission and includes ventilator-associated pneumonia

**For patients with PCN allergy**- review allergy type. Most patients can safely receive cephalosporins. See guidance from VUMC VASP below

- <u>Beta-lactam Allergy Risk Stratification</u>
- Beta-lactam Allergy Cross-Reactivity Table

<u>IDSA Practice Guidelines</u>- additional info regarding preferred and alternative empiric regimens

Empiric Antibiotic Dosing Recommendations								
Drug	Dose	Route	Frequency	Notes				
Azithromycin	500 mg x1 then 250 mg x4 doses	IV/PO	Q24 hours					
Cefazolin	2 gm	IV	Q8 hours	Renal dose adjustment per pharmacy				
Cefepime	2 gm	IV	Q8 hours (infused over 30 minutes OR over 4 hrs)	Renal dose adjustment per pharmacy				
Cephalexin	500 mg	РО	Q6 hours	Renal dose adjustment per pharmacy				
Ceftriaxone	2 gm	IV	Q24 hours					
Doxycycline	100 mg	IV/PO	Q12 hours					
Levofloxacin	750 mg	IV/PO	Q24 hours	Renal dose adjustment per pharmacy				
Piperacillin- tazobactam	4.5 g x 1, then 3.375	IV	Q8 hours (infused over 4 hours)	Renal dose adjustment per pharmacy				
Vancomycin	15-20 mg/kg (If critically ill, 20-25 mg/kg loading dose)	IV	x1	Consult Pharmacy for dosing/monitoring				



## V. Source specific recommendations:

## • Burn Wound Infection<sup>21</sup>

- i. When obvious purulence or cellulitis is present:
  - 1. IV antibiotics if a recent culture is present, recommended treatment with an antibiotic effective against previous cultures until a final diagnostic culture returns with sensitivity unless there are obvious signs of sepsis in addition to the wound infection.
  - 2. Possible change in the topical wound care to address the possible bacteria present more appropriately.
- ii. When 2 or more of the other signs/symptoms are present (fever, elevated WBC, etc.)
  - 1. Recommend starting with a focused change in wound care and topical wound care treatment to address the known bacteria in the wound.
  - 2. With no improvement over 24 hours, recommend adding an appropriate IV antibiotic.
- iii. When only 1 of the signs/symptoms are present:
  - 1. Focused change in wound care and topical wound care treatment.
- iv. When considering focused changes in wound care topical treatments:
  - 1. Discuss Topical wound dressing selection with Attending Burn Surgeon
  - 2. Consider a change in frequency of dressing changes
  - 3. Consider addition of Hypochlorous Acid topical adjunct during wound care
  - 4. Consider adding Bilirubin lights during dressing changes
  - 5. Consider Topical Mupirocin if Graft Ghosting or Impetigo is suspected.
  - 6. Consider the need for Fungal coverage with topical or systemic antifungals
  - 7. Consider viral cultures for herpes and antiviral coverage as clinically indicated
- v. A burn wound culture without any of the above should not be treated with antibiotics.
- vi. Changes in the topical antimicrobial selection and the wound care have a separate guideline, please see the Wound Care Algorithm for additional detail and guidance.
- vii. Discuss need for surgical/operative management to obtain source control with Burn Surgeon
- viii. Empiric antibiotic treatment per Burn Wound infection guidelines (above)
- ix. Herpesviruses (initial therapy)
  - 1. HSV Types 1,2-oral or genital lesions
    - a. Initial episode: Valacyclovir 1000 mg PO BID
    - b. Recurrent episodes: Valacyclovir 500 mg PO BID or 1 g PO daily x 5 days
  - 2. Herpes zoster (shingles)
    - a. Valacyclovir 1000 mg PO TID x 7 days

#### x. Duration of therapy

- 1. Burn Wound Infection de-colonization: 7 days or through burn pack takedown followed by daily clinical evaluation of ongoing antibiotic needs.
- Pneumonia protocol considerations<sup>23, 24, 25, 26</sup>
  - Noninvasive sampling with semiquantitative cultures is recommended to diagnose VAP (deep tracheal aspirate)
  - ii. If BAL is performed, cultures with <10<sup>4</sup> CFU/mL should prompt discontinuation of antibiotics
    - 1. A quantitative BAL with  $\geq 10^4$  CFU/mL is diagnostic of VAP



# iii. Consider alternative spectrum coverage with Levofloxacin (for atypical and additional anti-Pseudomonal coverage) if:

- 1. Prior intravenous antibiotic use within the past 90 days
- 2. Prior multi-drug-resistant infections
- 3. Septic shock
- 4. ARDS
- 5. Development of VAP ≥5 days after admission
- 6. Acute renal replacement therapy prior to VAP onset
- 7. Failure to improve on current regimen

## iv. Antimicrobial Duration

- 1. CAP 5-7 days if improving clinically
- 2. HAP: 7 days
- 3. Empyema<sup>26</sup>
  - a. 2-6 weeks
  - b. Recommend ID consult due to prolonged antibiotics requiring outpatient follow-up

## • Bacteremia<sup>27, 28, 30</sup>

- i. Initiate empiric IV treatment
- ii. Set stop dates on antibiotics
- iii. Evaluate for potential sources of bacteremia
- iv. Consult ID for gram+ bacteremia
- v. Change indwelling catheters as appropriate
- vi. Duration of therapy
  - 1. Gram negative
    - a. Uncomplicated: 7 days
    - b. Complicated (hemodynamic instability, persistently febrile, uncontrolled focus of infection, endocarditis, recurrent bacteremia, polymicrobial growth, or immunosuppression): 14 days

#### 2. Gram positive

- a. ID consult required for S. aureus or Enterococcus bacteremia
- b. Duration: 2-6 weeks depending on presence/absence of endocarditis, clearance of repeat cultures (generally obtained 48 hours after initial set), defervescence within 72h of antimicrobial therapy, and evidence of metastatic sites of infection

## • Fungal Infections<sup>31, 32, 33</sup>

- i. Send fungal specific cultures
- ii. Initiate treatment
  - 1. Fluconazole
    - a. Active against most Candida spp, Cryptococcus, Coccidioides
      - i. NOT active versus *Candida kruesi* (intrinsically resistant)
      - ii. Dose dependent susceptibility versus *Candida glabrata* (requires higher dosing, 800 mg daily)
    - b. Candidiasis Dosing (non-blood): 200-400 mg IV/PO daily
    - c. Candidemia: 800 mg (12 mg/kg) IV x 1, then 400 mg IV (6 mg/kg) daily
      - i. Requires renal dose adjustments- consult pharmacy

- 2. Consult ID for access to restricted non-azole antifungals (e.g., micafungin, amphotericin B) for species resistant to fluconazole
- iii. Duration:
  - 1. Non-Fungemia: 7 days
  - **2.** Fungemia: 7-14 days with early de-escalation based on clearance in subsequent cultures
- iv. De-escalation:
  - 1. Beta-D-glucan levels may be falsely elevated in large TBSA burns and does not presently have sufficient evidence to support its use in detection or de-escalation of invasive fungal infections in burn patients<sup>34</sup>. This is an area of ongoing investigation.
- Urinary Tract Infection
  - i. Follow UTI specific PMG
- Intrabdominal, Trauma, Ortho, Neuro
  - i. Refer to current Trauma and Surgical Critical Care VUMC PMG

## VI. De-escalation Strategies:

- Early discontinuation of antibiotics when appropriate, e.g.:
  - Negative cultures
  - o Clinically stable with no identifiable source
  - o For patients initiated on Vancomycin empiric therapy:
    - Obtain MRSA PCR nasal Swab (if collected prior to decolonization) and de-escalate as appropriate
    - Repeat MRSA PCR nasal swab if 7 days have elapsed since prior swab and starting antibiotics for a new infection (HAP and IAI only).
    - Can consider re-initiating vancomycin in patients with a negative MRSA PCR nasal swab if patient is decompensating
- Patients receiving systemic antibiotics who undergo surgical excision and grafting will continue on an-appropriate sensitivity-based coverage until the initial dressing change and wound inspection.
- Procalcitonin as a guide for de-escalation is under ongoing investigation, current trends include de-escalation if the PCT levels drop by >80% of their peak or drop below 0.5 ng/mL

#### VII. Documentation:

- Antibiotic use must be documented in the daily progress note in the medical record including:
  - i. Indication (Suspected source, clinical findings and changes, Relevant data, cultures, WBC, temperature)
  - ii. Interventions (i.e., New cultures sent blood/urine/sputum/wound/tissue/fluid, lines removed or exchanged)
  - iii. Anticipated duration of antibiotic use and end date of therapy
  - iv. Consultants involved if applicable



#### VIII. References

- 1. Barlam TF, Cosgrove SE, Abbo LM, et al. Implementing an Antibiotic Stewardship Program: Guidelines by the Infectious Diseases Society of America and the Society for Healthcare Epidemiology of America. *Clin Infect Dis* 2016; 62(10):e51-77.
- 2. van Duijn P, Verbrugghe W, Jorens PG, et al. The effects of antibiotic cycling and mixing on antibiotic resistance in intensive care units: a cluster-randomised crossover trial. *Lancet Infect Dis*. 2018 Apr;18(4):401-409.
- 3. Dortch MJ, Fleming SB, Kauffmann RM et al. Infection reduction strategies including antibiotic stewardship protocols in surgical and trauma intensive care units are associated with reduced resistant gram-negative healthcare-associated infections. Surg Infect (Larchmt) 2011; 12:15-25.
- 4. Bennett KM, Scarborough JE, Sharpe M et al. Implementation of antibiotic protocol improves antibiotic susceptibility profile in a surgical intensive care unit. J Trauma 2006; 63: 307-11.
- 5. CDC. Core Elements of Hospital Antibiotic Stewardship Programs. Atlanta, GA: US Department of Health and Human Services, CDC; 2019. https://www.cdc.gov/antibiotic-use/core-elements/hospital.html.
- 6. Raush N, Betthauser KD, Shen K, et al. Prospective Nasal Screening for Methicillin-Resistant Staphylococcus aureus (MRSA) in Critically III Patients with Suspected Pneumonia. *Open Forum Infect Dis.* 2021;9(1).
- 7. Parente DM, Cunha CB, Mylonakis E, et al. The Clinical Utility of Methicillin-Resistant Staphylococcus aureus (MRSA) Nasal Screening to Rule Out MRSA Pneumonia: A Diagnostic Meta-analysis With Antimicrobial Stewardship Implications. *Clin Infect Dis.* 2018;67(1):1-7.
- 8. Turner SC, Seligson ND, Parag B, et al. Evaluation of the timing of MRSA PCR nasal screening: How long can a negative assay be used to rule out MRSA-positive respiratory cultures? *Am J Health Syst Pharm*. 2021;78(Supplement\_2):S57-S61.
- 9. Mergenhagen KA, Starr KE, Eattengel BA, et al. Determining the utility of methicillin-resistant staphylococcus aureus nare screening in antimicrobial stewardship. *Clin Infect Dis.* 2020;71(5):1142-1148.
- 10. Greenhalgh DG, Saffle JR, Holmes JHt, Gamelli RL, Palmieri TL, Horton JW, et al. American Burn Association consensus conference to define sepsis and infection in burns. J Burn Care Res. 2007;28(6):776-90.
- 11. Walker SAN, Cooper A, Peragine C, Elligsen M, Jeschke MG. Development and validation of a screening tool for early identification of bloodstream infection in acute burn injury patients. Surgery. 2021;170(2):525-31.
- 12. Greenhalgh DG. Sepsis in the burn patient: a different problem than sepsis in the general population. Burns & Trauma. 2017;5(1).
- 13. Torres MJM, Peterson JM, Wolf SE. Detection of Infection and Sepsis in Burns. *Surg Infect (Larchmt)*. 2021;22(1):20-27
- 14. Singh SR, Dhanasekara CS, Tello N, Southerland P, Alhaj Saleh A, Kesey J, et al. Variations in insulin requirements can be an early indicator of sepsis in burn patients. Burns. 2022;48(1):111-7.
- 15. Nauriyal V, Rai SM, Joshi RD, Thapa BB, Kaljee L, Prentiss T, et al. Evaluation of an Antimicrobial Stewardship Program for Wound and Burn Care in Three Hospitals in Nepal. Antibiotics. 2020;9(12):914.
- 16. Jastram CW, Jr, Carter JE, Bilbe S, Vu C, Phelan HA, III. 509 Use of a burn sepsis screening protocol results in lower antibiotic usage rates. Journal of Burn Care & Research. 2021;42(Supplement 1):S101-S2.
- 17. Tan J, Li N, Gong Y, Yuan L, Zhou J, Luo G. Procalcitonin kinetics early after severe burn injury and its value in diagnosis of sepsis. Burns. 2021;47(8):1802-9.
- 18. Lin JC, Chen ZH, Chen XD. Elevated serum procalcitonin predicts Gram-negative bloodstream infections in patients with burns. Burns. 2020;46(1):182-9.
- 19. Cabral L, Afreixo V, Santos F, Almeida L, Paiva JA. Procalcitonin for the early diagnosis of sepsis in burn patients: A retrospective study. Burns. 2017;43(7):1427-34.
- 20. Cabral L, Afreixo V, Meireles R, Vaz M, Chaves C, Caetano M, et al. Checking procalcitonin suitability for prognosis and antimicrobial therapy monitoring in burn patients. Burns Trauma. 2018;6:10.
- 21. Herndon, D. N. (2017). *Total Burn Care, Fifth Edition. Chapter 11: Treatment of Infection in Burn Patients*. Elsevier. 2018



- 22. Campion M, Scully G. Antibiotic Use in the Intensive Care Unit: Optimization and De-Escalation. *J Intensive Care Med*. 2018;33(12):647-655.
- 23. Metlay JP, Waterer GW, et al. Diagnosis and Treatment of Adults with Community-acquired Pneumonia. An official Clinical Practice Guideline of the American Thoracic Society and Infectious Diseases Society of America. *Am J Respir Crit Care Med.* 2019 Oct 1;200(7):e45-e67.
- 24. Kalili A, Metersky M, Klompas M, et al. Management of adults with hospital-acquired and ventilator-associated pneumonia: 2016 clinical practice guidelines by the Infectious Diseases Society of America and the American Thoracic Society. *Clin Infect Dis.* 2016;63(5):e61-e111.
- 25. Chastre J, Wolff M, Fagon J et al. Comparison of 8 vs 15 days of antibiotic therapy for ventilator-associated pneumonia in adults. *JAMA* 2003; 290 (19): 2588-98.
- 26. Shen KR, Bribriesco A, Crabtree T, et al. The American Association for Thoracic Surgery consensus guidelines for the management of empyema. *JTCVS*. 153(6):e129-e146.
- 27. Liu C, Bayer A, Cosgrove SE, et al. Infectious Diseases Society of America. Clinical practice guidelines by the infectious diseases society of America for the treatment of methicillin-resistant Staphylococcus aureus infections in adults and children. *Clin Infect Dis.* 2011;52(3):e18-55.
- 28. Yahav D, Franceschini E, Koppel F, et al. Bacteremia Duration Study Group. Seven Versus 14 Days of Antibiotic Therapy for Uncomplicated Gram-negative Bacteremia: A Noninferiority Randomized Controlled Trial. *Clin Infect Dis.* 2019;69(7):1091-1098.
- 29. CDC/NHSN Surveillance Definition of Healthcare-Associated Infection and Criteria for Specific Types of Infections in the Acute Care Setting. January 2023. www.cdc.gov/nhsn/PDFs/pscManual/17pscNosInfDef\_current.pdf
- 30. Chaudhry A, Allen B, Paylor M, Hayes S. Evaluation of the reliability of MRSA screens in patients undergoing universal decolonization. *Am J Health Syst Pharm*. 2020;77(23):1965-1972.
- 31. Tu Y, Lineaweaver WC, Breland A, Zhang F. Fungal Infection in Burn Patents: A Review of 36 Case Reports. Ann Plast Surg. 2021;86(4S Suppl 4):S463-S7
- 32. Ballard J, Edelman L, Saffle J, Sheridan R, Kagan R, Bracco D, et al. Positive fungal cultures in burn patients: a multicenter review. J Burn Care Res. 2008;29(1):213-21.
- 33. Palackic A, Popp D, Tapking C, Houschyar KS, Branski LK. Fungal Infections in Burn Patients. Surgical Infections. 2021;22(1):83-7.
- 34. Shupp JW, Petraitiene R, Jaskille AD, et al. Early serum  $(1\rightarrow 3)$ - $\beta$ -D-glucan levels in patients with burn injury. *Mycoses*. 2012;55(3):224-227.
- 35. Bratzler DW, Dellinger P, Olsen KM, et al. Clinical practice guidelines for antimicrobial prophylaxis in surgery. Am J Health-Syst Pharm 2013;70:195-283.
- 36. Hill DM, Guido A, Sultan-Ali I, Arif F, Velamuri SR. A non-inferiority study comparing efficacy of preoperative prophlyactic antibiotics for preventing infectious complications in patients with less severe burns. Burns 2021;47:67-71.
- 37. Puthumana JS, Khan IF, Tiongco RFP. Is antibiotic prophylaxis necessary in small (≤20% TBSA) burn excisions? A retrospective study. Plast Reconstr Surg Glob Open 2022;10:e4388.
- 38. Robben PM, Ayalew MD, Chung KK, Ressner RA. Multi-drug resistant organisms in burn infections. Surg Infect 2021;22:103-112.
- 39. Ladhani HA, Yowler CJ, Claridge JA. Burn Wound Colonization, Infection, and Sepsis. Surgical Infections. 2021;22(1):44-8.
- 40. Tuncal S, Altiner S, Erguder E, Buyukkasap C, Kusabbi R, Unal Y. Comparison of open and closed burn wound dressing applications with tissue culture sampling. Ulus Travma Acil Cerrahi Derg. 2023;29(7):758-63.
- 41. Hemmati J, Azizi M, Asghari B, Arabestani MR. Multidrug-Resistant Pathogens in Burn Wound, Prevention, Diagnosis, and Therapeutic Approaches (Conventional Antimicrobials and Nanoparticles). Canadian Journal of Infectious Diseases and Medical Microbiology. 2023;2023:1-17.
- 42. Maitz J, Merlino J, Rizzo S, McKew G, Maitz P. Burn wound infections microbiome and novel approaches using therapeutic microorganisms in burn wound infection control. Adv Drug Deliv Rev. 2023;196:114769.
- 43. Dai T, Huang Y-Y, K. Sharma S, T. Hashmi J, B. Kurup D, R. Hamblin M. Topical Antimicrobials for Burn Wound Infections. Recent Patents on Anti-Infective Drug Discovery. 2010;5(2):124-51.

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- 44. Church D, Elsayed S, Reid O, Winston B, Lindsay R. Burn Wound Infections. Clinical Microbiology Reviews. 2006;19(2):403-34.
- 45. Ramos G, Resta M, Machare Delgado E, Durlach R, Fernandez Canigia L, Benaim F. Systemic perioperative antibiotic prophylaxis may improve skin autograft survival in patients with acute burns. J Burn Care Res. 2008;29(6):917-23.
- 46. Puthumana JS, Khan IF, Tiongco RFP, Akhavan AA, Khoo KH, Qiu CS, et al. Is Antibiotic Prophylaxis Necessary in Small (</=20% TBSA) Burn Excisions? A Retrospective Study. Plast Reconstr Surg Glob Open. 2022;10(6):e4388.
- 47. Dépret F, Farny B, Jeanne M, Klouche K, Leclerc T, Nouette-Gaulain K, et al. The A2B trial, antibiotic prophylaxis for excision-graft surgery in burn patients: a multicenter randomized double-blind study. Trials. 2020;21(1).
- 48. Avni T, Levcovich A, Ad-El DD, Leibovici L, Paul M. Prophylactic antibiotics for burns patients: systematic review and meta-analysis. BMJ. 2010;340(feb15 1):c241-c.

## Revised

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