MICHIGAN MEDICINE
UNIVERSITY OF MICHIGAN

TREATMENT OF OCULAR INFECTIONS IN HOSPITALIZED ADULTS

Clinical Setting	Empiric Therapy	Duration	Comments

Periorbital Cellulitis
 	
Severe infection warranting hospital admission, or failing outpatient oral antibiotics
 	
Staphylococcus aureus
 	
Streptococcus pneumonia
 	
Streptococcus milleri group
 	
Streptococcus pyogenes
 	
Haemophilus influenzae
 	
Oral anaerobes
	1st line:
	Vancomycin (see nomogram, AUC goal 400-600)*
	+ **Ampicillin-sulbactam** 3 g IV q6h*
	
	Low-to-High Risk PCN Allergy (including anaphylaxis)#:
	Vancomycin IV (see nomogram, AUC goal 400-600)*
	+ **Ceftriaxone** 2 g IV q24h
	
	Severe non-IgE PCN Allergy (e.g. Stevens-Johnson Syndrome, DRESS) #:
	Vancomycin IV (see nomogram, AUC goal 400-600)*
	+ **Aztreonam** 2 g IV q8h*
	
	Recommend the addition of anaerobic coverage with **metronidazole** 500 mg PO q8h if dental infection presumed to be initial source in the setting of PCN allergy and regimen without ampicillin-sulbactam.
	
	Alternative for vancomycin allergy or intolerance (not vancomycin infusion reaction):
	Linezolid 600 mg PO/IV q12h
	+ other antibiotic as listed above
		Transition to oral antibiotics can be considered if significant improvement within 24-48 hours.
		
		Antibiotic duration for severe periorbital cellulitis is typically about 10 days but should be guided by clinical resolution.
			• # See Appendix for further details, including options for patients with purported cephalosporin allergies. Consult the Beta-Lactam Allergy Evaluation Service (BLAES) to assess patients with purported β-lactam allergies. > 90% of patients can be de-labelled.
			
			• Appropriately tailor therapy based on culture results, if obtained.
			
			• For culture negative or not obtained, transition to oral therapy when patient is afebrile with clinical improvement and hemodynamically stable for 48 hours:
			  • 1st line:
			  Amoxicillin-clavulanate 875 mg BID*
			  + **Linezolid** 600 mg PO BID
			  • PCN Allergy:
			  Levofloxacin 750 mg PO daily*
			  + Linezolid 600 mg PO BID
			
			Linezolid is contraindicated in patients on MAO-I. It can be used, with caution, in pts on other serotonergic agents. See SSRI & Linezolid Education

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Orbital cellulitis *Staphylococcus aureus* *Streptococcus pneumonia* *Streptococcus milleri group* *Streptococcus pyogenes* *Haemophilus influenzae* *Oral anaerobes*	1st line: **Vancomycin** IV (see nomogram, AUC goal 400-600)* + **Ampicillin-sulbactam** 3 g IV q6h* Low-to-High Risk PCN Allergy (including anaphylaxis)#: **Vancomycin** IV (see nomogram, AUC goal 400-600)* + **Ceftriaxone** 2 g IV q24h Severe non-IgE PCN Allergy (e.g. Stevens-Johnson Syndrome, DRESS) #: **Vancomycin** IV (see nomogram, AUC goal 400-600)* + **Aztreonam** 2 g IV q8h* Recommend the addition of anaerobic coverage with **metronidazole** 500 mg PO q8h if dental infection presumed to be initial source in the setting of PCN allergy and regimen without ampicillin-sulbactam. Alternative for vancomycin allergy or intolerance (not vancomycin infusion reaction): **Linezolid** 600 mg PO/IV q12h **+ other antibiotic as listed above**	Uncomplicated Orbital cellulitis (without abscess or bony destruction): If rapid and dramatic improvement (Afebrile, normal WBC, normal vitals, exam improved with significant decrease in swelling, redness, and pain), transition to oral antibiotics can be considered after 24-48 hours. Antibiotic duration is typically at least 2 weeks and should be guided by clinical resolution. Complicated Orbital cellulitis (with abscess or significant bony destruction): If abscess is drained, antibiotic duration is typically 2-3 weeks, and should be guided by clinical resolution. If significant ethmoid bony destruction, would recommend at least 4 weeks of therapy, guided by clinical resolution.	**Ophthalmology and ID consult is strongly recommended.** • # See Appendix for further details, including options for patients with purported cephalosporin allergies. Consult the Beta-Lactam Allergy Evaluation Service (BLAES) to assess patients with purported β-lactam allergies. > 90% of patients can be de-labelled. • Appropriately tailor therapy based on abscess culture results, if obtained. • For culture negative or not obtained, transition to oral therapy when patient is afebrile with clinical improvement and hemodynamically stable for 48 hours: • 1st line: **Amoxicillin-clavulanate** 875 mg BID* + **Linezolid** 600 mg PO BID • PCN Allergy: **Levofloxacin** 750 mg PO daily* **+ Linezolid** 600 mg PO BID Linezolid is contraindicated in patients on MAO-I. It can be used, with caution, in pts on other serotonergic agents. See SSRI & Linezolid Education

Clinical Setting	Empiric Therapy	Duration	Comments
Orbital cellulitis with INTRACRANIAL EXTENSION *Staphylococcus aureus* *Streptococcus pneumonia* *Streptococcus milleri group* *Streptococcus pyogenes* *Haemophilus influenzae* *Oral anaerobes*	1st line: No PCN Allergy or Low-to-High Risk PCN Allergy (including anaphylaxis)[#]: **Vancomycin** IV (see nomogram, AUC goal 400-600)* + **Ceftriaxone** 2 g IV q12h + **Metronidazole** 500 mg IV q8h Severe non-IgE PCN Allergy (e.g. Stevens-Johnson Syndrome, DRESS)[#]: **Vancomycin** IV (see nomogram, AUC goal 400-600)* + **Aztreonam** 2 g IV q6h* + **Metronidazole** 500 mg IV q8h Alternative for vancomycin allergy or intolerance (not vancomycin infusion reaction): **Linezolid 600 mg PO/IV q12h + other antibiotic as listed above**	Duration depends on source control and clinical improvement, typically 6-8 weeks.	**Ophthalmology Consult is required, and ID consult is strongly recommended.** • # See Appendix for further details, including options for patients with purported cephalosporin allergies. Consult the Beta-Lactam Allergy Evaluation Service (BLAES) to assess patients with purported β-lactam allergies. > 90% of patients can be de-labelled. • Appropriately tailor therapy based on abscess culture results, if obtained. Linezolid is contraindicated in patients on MAO-I. It can be used, with caution, in pts on other serotonergic agents. See SSRI & Linezolid Education
Endophthalmitis prophylaxis in patients with penetrating trauma to the globe of the eye (open globe) *Staphylococcus* spp *Streptococcus* spp *Bacillus cereus*	1st line: **Moxifloxacin** 400 mg IV/PO q24h	To 48 hours post repair.	• Endophthalmitis prophylaxis is warranted in patients with penetrating trauma to the globe of the eye. • Prophylaxis regimen should be the same whether prophylaxis is initiated pre- or post- repair. • The major difference in spectrum between levofloxacin and moxifloxacin is a lack of activity against *Pseudomonas* with moxifloxacin. While moxifloxacin is more potent in vitro against *Staphylococcus* and *Streptococcus*, the clinical relevance is unclear.

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Bacterial Endophthalmitis Post-surgical • *S. epidermidis* (60-70%) • *S. aureus,* streptococci, and enterococci (5%–10%) • Gram-negative species (~5%) • *P. acnes* (delayed disease) Post-traumatic • Staphylococci, streptococci, *B cereus* Endogenous • Endocarditis is the source in 40% of cases • Staphylococci, gram-negative bacilli, streptococci	***Ophthalmology and Infectious Diseases consultation is strongly recommended*** Treatment for *endogenous* endophthalmitis usually consists of a combination of intravitreal and systemic antibiotics. Systemic antibiotics should be targeted towards the infecting pathogen, by the direction of the Infectious Diseases consult service. Systemic antibiotics with adequate intravitreal penetration are recommended (see comments). *Post-surgical* and *post-traumatic* endophthalmitis is usually treated with intravitreal antibiotics alone. If systemic antibiotics are deemed necessary, the below empiric regimens are recommended (in combination with intravitreal antibiotics). Definitive treatment should be based on results of culture, as available. Intravitreal antibiotics: 1. **vancomycin** 1 mg/0.1 mL (0.1 mL) intravitreal 2. **ceftazidime** 2.25 mg/0.1 mL (0.1 mL) intravitreal 3. **amikacin** 0.4 mg/0.1 ml (0.1 mL); instead of ceftazidime if PCN allergy 1st line: No PCN Allergy *or* Low-to-High Risk PCN Allergy (including anaphylaxis)[#]: **Vancomycin** IV (see nomogram, AUC goal 400-600)* + **Cefepime** 2 g IV q8h* Severe non-IgE PCN Allergy (e.g. Stevens-Johnson Syndrome, DRESS)[#]: **Vancomycin** IV (see nomogram, AUC goal 400-600)* + **Levofloxacin** 750 mg IV/PO q24h* Alternative for vancomycin allergy or intolerance (not vancomycin infusion reaction): **Linezolid** 600 mg PO/IV q12h **+ other antibiotic as listed above**	Post-surgical and post-traumatic infection: Minimum 7-10 days; dependent on resolution of findings Endogenous infection: Should be based on duration required to treat endogenous source	• # See Appendix for further details, including options for patients with purported cephalosporin allergies. Consult the Beta-Lactam Allergy Evaluation Service (BLAES) to assess patients with purported β-lactam allergies. >90% of patients are able to be de-labelled. • A general rule is that agents that readily penetrate the central nervous system also penetrate the vitreous. Intravenous administration of beta-lactams is necessary to achieve therapeutic levels. 3rd and 4th generation cephalosporins are preferred over 1st generation agents. Levofloxacin, moxifloxacin and linezolid also rapidly achieve therapeutic levels. The difficulty in reliably (rapidly) achieving therapeutic concentrations with systemic antibiotics necessitates early intravitreal therapy in ALL patients. • If intravitreal therapy is not able to be administered, this should be communicated to Infectious Diseases so that the need for a brief course of antibiotics which do rapidly penetrate the vitreous (linezolid, quinolones) may be considered prior to transitioning to the listed empiric/definitive regimens. • Linezolid is contraindicated in patients on MAO-I. It can be used, with caution, in pts on other serotonergic agents. See SSRI & Linezolid Education

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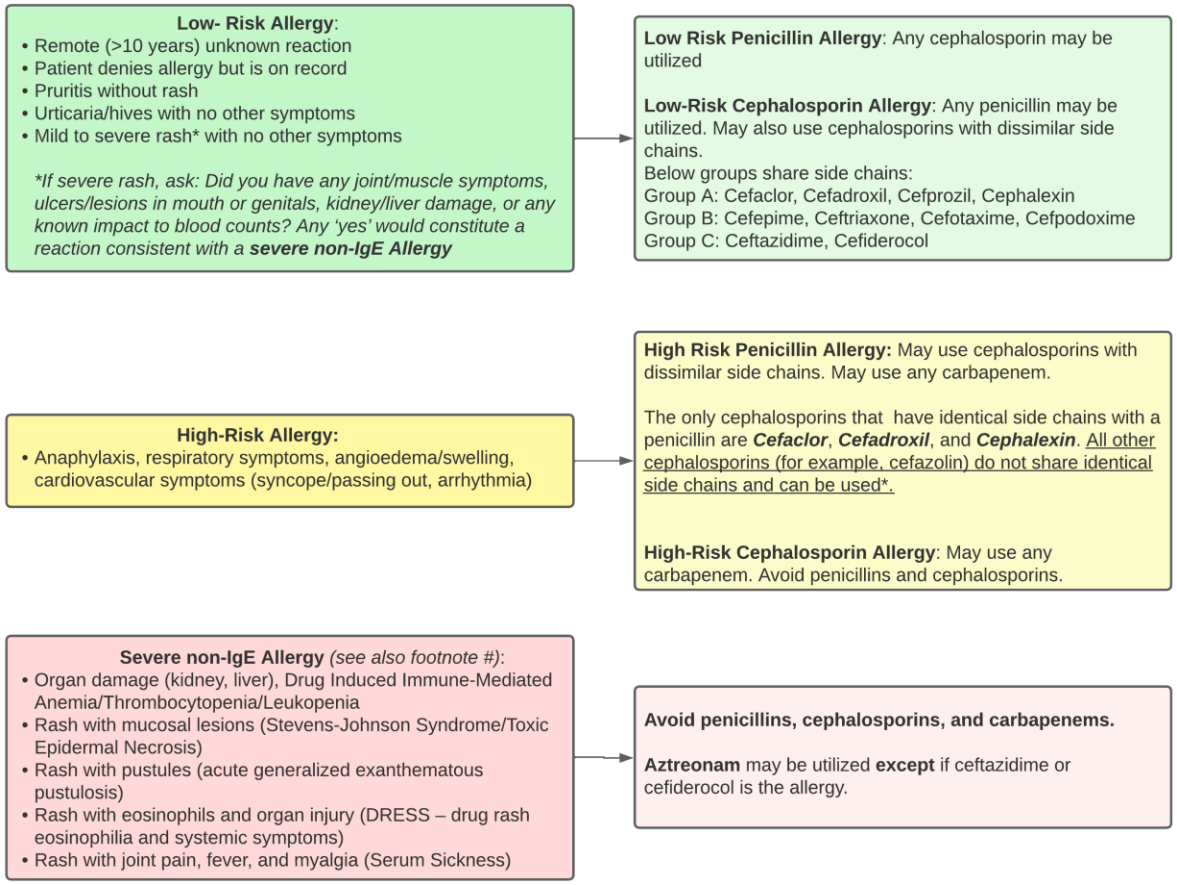
Candida **Endophthalmitis**	***Ophthalmology and Infectious Diseases consultation is strongly recommended*** Intravitreal antifungal therapy: **Voriconazole** 100 micrograms/0.1 mL (0.1 mL) **OR** **Amphotericin B** 5 micrograms/0.1 mL (0.1 mL) Empiric systemic antifungal therapy, *Candida* suspected/confirmed: Note: Therapy may include **Micafungin** in addition to the below. See comment. **Fluconazole** 1,600 mg X 1, then 800 mg IV/PO daily* Empiric systemic therapy, *Candida* species confirmed, susceptibilities pending: *Candida albicans, Candida dubliniensis, Candida parapsilosis, Candida tropicalis, Candida lusitaniae, C. glabrata* **Fluconazole** 1,600 mg X 1, then 800 mg IV/PO daily* *C. krusei*: **Voriconazole** 6 mg/kg PO/IV q12h x2 doses, then 4 mg/kg PO/IV q12h Definitive systemic therapy: *Candida albicans, Candida dubliniensis, Candida parapsilosis, Candida tropicalis, Candida lusitaniae* Fluconazole 800 mg IV/PO daily* if susceptible *C. krusei*: **Voriconazole** 6 mg/kg PO/IV q12h x2 doses, then 4 mg/kg PO/IV q12h if susceptible *C. glabrata*: **Fluconazole** 1,600 mg X 1, then 800 mg IV/PO daily* if fluconazole MIC ≤ 4 *Fluconazole resistant isolates and C. glabrata isolates with elevated MICs as defined above:* **Liposomal amphotericin B** (3 - 5 mg/kg IV daily) + **Flucytosine** (25 mg/kg PO QID)* IF SUSCEPTIBLE	*Candida*: Typically, 4-6 weeks. Duration is dependent on resolution of eye lesions based on serial examination	• **Treatment consists of a combination of intravitreal and systemic antifungal therapy** • **Micafungin is not recommended for the treatment of endophthalmitis due to poor vitreous penetration, thus fluconazole/voriconazole should be added, as appropriate per the treatment algorithm, if micafungin is being used for the treatment of candidiasis/candidemia. See candidemia guidelines.** • Antimicrobial Dosing guidelines • Weight-based dosing recommendations for adult obese patients • Therapeutic drug monitoring is recommended for voriconazole. Please see Recommendations for Therapeutic Drug Monitoring of Antifungal Agents • Numerous significant drug interactions occur with azole antifungals. A comprehensive review of the patient profile should be undertaken when these agents are initiated and discontinued. • **For scenarios outside those listed (i.e., *C. albicans* resistant to fluconazole or concern for *Aspergillus* or other non-*Candida* fungi), please consult Infectious Diseases**

*Dose may need to be adjusted for renal dysfunction. See renal dosing guidelines.

APPENDIX: Strategies for safe use of beta-lactams in patients with purported beta-lactam allergies.
Full Guideline available at: https://www.med.umich.edu/asp/pdf/adult_guidelines/Beta-lactam-Evaluation-and-Empiric.pdf



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