

TREATMENT PATHWAY FOR ADULT PATIENTS WITH PNEUMONIA

The purpose of this document is to guide the appropriate treatment of adult patients presenting with pneumonia. Three pathways with different empiric treatment regimens based on risk of infection with multidrug-resistant (MDR) pathogens (including MRSA, Pseudomonas spp., Acinetobacter spp., organisms not susceptible to beta-lactams (ceftriaxone or ampicillin-sulbactam) and/or fluoroquinolones (ciprofloxacin, levofloxacin)) are shown below.



See UMHS Procalcitonin Usage Guidelines for more information



Indication	Common Pathogens	Empiric Therapy	Duration of Therapy	Comments
		Pat	thway A (Part I, non-ICU)	
Inpatient	Streptococcus	Preferred:	Uncomplicated/Aspiration	 Appropriately tailor therapy based on
community	pneumonia	Ampicillin-sulbactam* 3	Pneumonia:	respiratory culture results.
-acquired	I	g IV a6h	• 5 days for patients who	
pneumonia.	Haemonhilus	+ Azithromycin 500 mg	defervesce within 72 hours and	Anaerobic coverage is not necessary for
no risk	influenzae	IV/PO x1 day then 250	have no more than 1 sign of CAP	patients with pneumonia following an
factors		mg α 24h x4 days	instability at the time of antibiotic	aspiration event. Only those with
	Moraxella			empyema or lung abscess should receive
(Non-ICU	catarrhalis			empiric anaerobic coverage.
patient)		Low/medium risk PCN	Patients with delayed response	
P ,	Mvcoplasma	allergy:	should discontinue therapy 48-72	 For culture negative pneumonia.
	pneumoniae	Ceftriaxone 2 g IV g24h	nours after defervesce and have	transition to oral therapy when patient
	P	+ Azithromycin 500 mg	no more than I sign of CAP	is afebrile with clinical improvement and
	Chlamvdia	IV/PO x1 day. then	instability ⁺ at time antibiotic	hemodynamically stable for 48 hours:
	pnemoniae	250mg q24h x4 days	discontinuation.	1 st line
				• <u>1 IIIIC.</u>
	Legionella	Consider the addition of	Complicated Pneumonia:	Amoxiciiin-ciavuianate <u>*</u> 875 mg
	species	anaerobic coverage with	• Patients with empyema, infected	BID
		metronidazole 500 mg	pleural effusions, and bacteremia	course of azithromycin)
		PO q8h <u>if</u> empyema or	secondary to pneumonia may	 Low/medium risk PCN allergy:
		lung abscess present	require longer durations of	Cefuroxime* 500 mg BID nlus
			therapy. Bacteremic	azithromycin (complete 5-day
			be treated for a minimum of 7.14	course of azithromycin)
		High risk PCN and	be treated for a minimum of 7-14	High risk PCN or cephalosporin
		cephalosporin allergy:	for nationts with bactoromia	allergy:
		Levofloxacin [*] 750 mg	for patients with bacterennia.	Levofloxacin* 750 mg PO q24h
		IV/PO q24h	Pathogen-Specific Considerations:	
			Uncomplicated pneumonia with	 Adjust levofloxacin and ampicillin-
		Consider the addition of	non- fermenting GNRs (e.g.	sulbactam for renal dysfunction. Always
		anaerobic coverage with	Pseudomonas. Achromobacter.	give levofloxacin loading dose of 750 mg
		metronidazole 500 mg	Acinetobacter,	x1 dose
		PO den <i>ij</i> empyema or	Stenotrophomonas) or	
		iung abscess present	Staphylococcus aureus should	Use azithromycin 500 mg q24 h if
			receive 7 days of therapy if	documented or high clinical suspicion for
		Addition of vancomycin	defervescensce within 72 hours	Legionella (can pursue further diagnostic
		Consider if high clinical	and have <i>no more than</i> 1 sign of	testing \rightarrow respiratory legionella PCR)
		suspicion for CA-MRSA	CAP instability at the time of	
		(prior isolation of	antibiotic discontinuation+.	In setting of macrolide allergy can use
		MRSA from	Delayed response will likely	doxycycline for atypical coverage in
		respiratory culture in	require longer durations.	absence of Legionenia concern.
		past 12 months or		 In nationts with documented
		post-influenza		Myconlasma use of dovycycline should
		pneumonia)	- CAP CIINICAI SIGNS OT INSTADIIITY (If	he preferred for treatment due to
			ctatus)	concern for macrolide resistance
			\rightarrow HP > 100 hpm	
			• $RR > 24$ breaths/min	Antibiotic coverage of atypical
			• SBP < 90 mmH σ	organisms can be discontinued if the
			• Arterial Ω_2 sat < 90% or $n\Omega_2$	respiratory panel (RPAN) and urine
			$\leq 60 \text{ mmHg on room air}$	antigens are negative.
			Altered mental status	
				• See front page for tips on <i>utilization of</i>
				procalcitonin (PCT) levels



Indication	Common Pathogens	Empiric Therapy	Duration of Therapy	Comments	
	Pathway A (Part II. ICU)				
Inpatient	Streptococcus	Preferred:	Uncomplicated/Aspiration	Appropriately tailor therapy based on	
community	pneumonia	Ampicillin-sulbactam [*] 3	Pneumonia:	respiratory culture results.	
-acquired	-	g IV q6h	• 5 days for patients who		
pneumonia,	Haemophilus	+ Azithromycin 500 mg	defervesce within 72 hours and	Anaerobic coverage is not necessary for	
no risk	influenzae	IV q24h x5 days	have no more than 1 sign of CAP	patients with pneumonia following an	
factors			instability at the time of antibiotic	aspiration event. Only those with	
	Moraxella		discontinuation +	empyema of lung abscess should receive	
(ICU	catarrhalis	Low/medium risk PCN	• Patients with delayed response	empire anaerobie coverage.	
patient)		<u>allergy:</u>	should discontinue therapy 48-72	• IV therapy for first 24 hours for ICU	
	Mycoplasma	Ceftriaxone 2 g IV q24h	hours after defervesce and have	patients	
	pneumoniae	+ Azithromycin 500 mg	no more than 1 sign of CAP		
	Chlamudia	iv q24n x5 days	instability ⁺ at time antibiotic	For culture negative pneumonia, transition	
	chianiyala	Consider the addition of	discontinuation.	to oral therapy when patient is afebrile	
	phemoniae	anaerobic coverage with		with clinical improvement and	
	Legionella	metronidazole 500 mg IV	Complicated Pneumonia:	st	
	species	a8h if empyema or lung	Patients with empyema, infected	• <u>1st line:</u>	
		abscess present	pleural effusions, and bacteremia	Amoxicillin-clavulanate <u>*</u> 8/5 mg	
		· · · · · · · · ·	secondary to pneumonia may	DID + Azithromycin (complete 5-day	
			require longer durations of	course of azithromycin)	
		High risk PCN and	therapy. Bacteremic	 Low/medium risk PCN allergy: 	
		cephalosporin allergy:	pneumococcal pneumonia snould	Cefuroxime [*] 500 mg BID plus	
		Vancomycin <u>**</u> IV (see	days ID consult is recommended	azithromycin (complete 5-day	
		nomogram)	for natients with hacteremia	course of azithromycin)	
		+ Aztreonam 2 g IV q8h	for patients with bacterenna.	High risk PCN or cephalosporin allergy:	
		+ Azithromycin 500 mg	Pathogen-Specific Considerations:	Levotioxacin <u>*</u> 750 mg PO q24n	
		1V 42411 X5 udys	Uncomplicated pneumonia with	Adjust levofloxacin, ampicillin-sulbactam.	
		Consider the addition of	non- fermenting GNRs (e.g.,	aztreonam, and piperacillin-tazobactam	
		anaerobic coverage with	Pseudomonas, Achromobacter,	for renal dysfunction. Always give	
		metronidazole 500 mg IV	Acinetobacter,	levofloxacin loading dose of 750 mg x1	
		q8h <u>if</u> empyema or lung	Stenotrophomonas) or	dose	
		abscess present	Staphylococcus aureus should	• Use arithromusin 500 mg a24 h if	
			receive / days of therapy if	Ose azitinoinycin 500 mg q24 mg documented or high clinical suspicion for	
			and have no more than 1 sign of	Legionella (can pursue further diagnostic	
		Addition of vancomycin	CAP instability at the time of	testing \rightarrow respiratory legionella PCR)	
		Consider if high clinical			
		suspicion for CA-MRSA	antibiotic discontinuation I	In setting of macrolide allergy can use	
		MRSA from	require lenger durations	doxycycline for atypical coverage in	
		respiratory culture in		ausence of <i>Legionella</i> concern.	
		past 12 months or	±	In patients with documented Mycoplasma	
		post-influenza	[⊤] CAP clinical signs of instability (if	use of doxycycline should be preferred for	
		pneumonia)	different than patient baseline	treatment due to concern for macrolide	
		, ,	status)	resistance.	
			• HK \geq 100 bpm • PR > 24 broaths /min		
			• SBP < 90 mmHg	Antibiotic coverage of atypical organisms can be discontinued if the receivatory	
			• Arterial Ω_2 sat < 90% or $n\Omega_2$	panel (RPAN) and urine antigens are	
			\leq 60 mmHg on room air	negative.	
			Altered mental status	č	
				• See front page for tips on <i><u>utilization of</u></i>	
				procalcitonin (PCT) levels	
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Pathway B (Previous culture data should be used to guide empiric therapy)					
Indication	Empiric Therapy	Duration	Comments		
 Patients presenting with any of the following risk factors for drug-resistant pathogens OR unknown etiology of septic shock: History of infection or colonization with Pseudomonas spp., MRSA, or other MDR gram-negative pathogens (resistant to ampicillin-sulbactam or ceftriaxone) within previous 12 months 	Preferred: Cefepime* 2 g IV q8h (+ Tobramycin* IV if admitted to ICU) + Vancomycin** IV (see nomogram) NOTE: If patient has a history of Pseudomonas or MDR gram- negative pathogen ONLY, empiric vancomycin use is not necessary. If MRSA history ONLY, use of cefepime is not necessary (preferred regimen	 Uncomplicated/Aspiration Pneumonia: 5 days for patients who defervesce within 72 hours and have no more than 1 sign of CAP instability at the time of antibiotic discontinuation + Patients with delayed response should discontinue therapy 48-72 hours after defervesce and have no more than 1 sign of CAP instability + at time 	If atypical pathogens are suspected, start azithromycin 500 mg IV x1 day, followed by 250 mg IV/PO daily x4 days. Use azithromycin 500 mg q24h if high clinical suspicion for <i>Legionella</i> . Treatment duration may be longer for confirmed <i>Legionella</i> . In setting of macrolide allergy can use doxycycline for atypical coverage in non-ICU patients and in the absence of <i>Legionella</i> concern In patients with documented or high clinical suspicion for <i>Mycoplasma</i> , use of levofloxacin * should be preferred for treatment due to concern for macrolide		
 In patients with severe community-acquired pneumonia (septic shock OR requiring mechanical ventilation OR high clinical concern for needing ICU level care^Q), <u>AND Hospitalization for</u> <u>at least 48 hours AND use of</u> <u>any intravenous antibiotic,</u> <u>fluoroquinolone, or linezolid</u> <u>within previous 90 days</u> 	would be ampicillin-sulbactam + vancomycin). <u>Low/medium risk cephalosporin</u> <u>allergy:</u> <u>Meropenem</u> [*] 2 g IV q8h (+ Tobramycin [*] IV if admitted to ICU) + Vancomycin ^{**} IV (see <u>nomogram</u>)	 antibiotic discontinuation. Complicated Pneumonia: Patients with empyema, infected pleural effusions, and bacteremia secondary to pneumonia should receive longer durations of therapy. Bacteremic pneumococcal pneumonia should be treated for a minimum of 7-14 days. ID 	resistance. Discontinue vancomycin if no evidence of MRSA colonization (negative MRSA nasal swab) if clinically appropriate. In patients with evidence of colonization (positive MRSA nasal swab) or if unknown, discontinue vancomycin after 48-72 hours if no positive respiratory cultures for MRSA and clinically appropriate. Vancomycin can be continued for gram-positive coverage in patients with no microbiological diagnosis		
 OR Immunocompromised, defined as: 	Consider the addition of anaerobic coverage with metronidazole 500 mg IV g8h <i>if</i>	consult is recommended for patients with bacteremia.	who are receiving aztreonam due to allergies.		
 AIDS (CD4 <200) Neutropenia (ANC <1000) Kidney or liver or heart transplant recipient within previous 1 year Solid organ transplant recipient treated for rejection within previous 6 months Lung transplant recipient Allogeneic stem cell transplant within previous 1 year or those with chronic GVHD Autoimmune disorders on biologic agents (TNFα inhibitors, rituximab, etc.) 	empyema or lung abscess present <u>High risk PCN and cephalosporin</u> <u>allergy:</u> Aztreonam [*] 2 g IV q8h (+ Tobramycin [*] IV if admitted to ICU) + Vancomycin ^{**} IV (see <u>nomogram</u>) Consider the addition of anaerobic coverage with metronidazole 500 mg IV q8h <i>if</i> empyema or lung abscess present <i>Linezolid</i> may be used in patients with vancomycin allergy (not vancomycin infusion reaction). See restriction criteria for appropriate empiric and definitive use of linezolid.	 Uncomplicated pneumonia with non- fermenting GNRs (e.g., Pseudomonas, Achromobacter, Acinetobacter, Stenotrophomonas) or <i>Staphylococcus aureus</i> should receive 7 days of therapy if defervescensce within 72 hours and have <i>no more than 1</i> sign of CAP instability at the time of antibiotic discontinuation +. Delayed response will likely require longer durations. +CAP clinical signs of instability (if different than patient baseline status) HR ≥ 100 bpm RR ≥ 24 breaths/min SBP ≤ 90 mmHg Arterial O2 sat ≤ 90% or pO2 ≤ 60 mmHg on room 	 recommended for patients with ventilator- associated tracheobronchitis (defined as fever with no other recognizable cause, with new or increased sputum production, positive endotracheal aspirate culture, and no radiographic evidence of pneumonia). Definitive therapy should be tailored to culture results. In patients with negative respiratory cultures who are clinically stable after 48 hours, deescalate antibiotic therapy to CAP treatment. Oral antibiotics should be considered in clinically stable patients. <u>Preferred:</u> Amoxicillin-clavulanate[*]_875 mg BID Low/medium risk PCN allergy: Cefuroxime[*]_500 mg BID <u>High risk PCN allergy:</u> Levofloxacin[*]_750 mg PO q24h In patients with VAP or in those with inadequate cultures, physician discretion is advised. See front page for tips on <u>utilization of</u> procalcitonin (PCT) levels 		

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Pathway C (Previous culture data should be used to guide empiric therapy)						
Indication	Empiric Therapy	Duration	Comments			
Hospital-acquired pneumonia (current hospitalization for ≥72 hours) Ventilator-associated pneumonia	Preferred: Cefepime* 2 g IV q8h (+ Tobramycin* IV if admitted to ICU) + Vancomycin** IV (see nomogram) Low/medium risk cephalosporin allergy: Meropenem* 2 g IV q8h (+ Tobramycin* IV if admitted to ICU) + Vancomycin** IV (see nomogram) Consider the addition of anaerobic coverage with metronidazole 500 mg IV q8h if empyema or lung abscess present High risk PCN and cephalosporin allergy: Aztreonam* 2 g IV q8h (+ Tobramycin* IV (see nomogram)) Consider the addition of anaerobic coverage with metronidazole 500 mg IV q8h if empyema or lung abscess present High risk PCN and cephalosporin allergy: Aztreonam* 2 g IV q8h (+ Tobramycin* IV (see nomogram)) Consider the addition of anaerobic coverage with metronidazole 500 mg IV q8h if empyema or lung abscess present Linezolid may be used in patients with vancomycin allergy (not vancomycin infusion reaction). See restriction criteria for appropriate empiric and definitive use of linezolid.	 7 days for uncomplicated pneumonia with rapid clinical response within 72 hours (including patients with Stenotrophomonas, Acinetobacter, or Burkholderia). Patients with empyema, infected pleural effusions, lung abscesses, and bacteremia secondary to pneumonia should receive longer durations of therapy. For Pseudomonas pneumonia, 14 days is <i>recommended</i> for patients with any of the following to decrease recurrence: Circulatory shock Acute respiratory distress syndrome Extracorporeal membrane oxygenation (ECMO) For Pseudomonas pneumonia, 14 days <i>could be</i> <i>considered</i> in patients with any of the following: Multiple recurrences of Pseudomonas pneumonia Immunocompromised Delayed clinical improvement >3 days Postobstructive pneumonia Bronchiectasis 7 days is recommended in patients that don't meet any of the above criteria for Pseudomonas pneumonia. 	If atypical pathogens are suspected, start azithromycin 500 mg IV x1 day, followed by 250 mg IV/PO daily x4 days. Use azithromycin 500 mg q24h if high clinical suspicion for <i>Legionella</i> . Treatment duration may be longer for confirmed <i>Legionella</i> . In setting of macrolide allergy can use doxycycline for atypical coverage in non-ICU patients and in the absence of <i>Legionella</i> concern In patients with documented or high clinical suspicion for <i>Mycoplasma</i> , use of levofloxacin * should be preferred for treatment due to concern for macrolide resistance. Discontinue vancomycin if no evidence of MRSA colonization (negative MRSA nasal swab) if clinically appropriate. In patients with evidence of colonization (positive MRSA nasal swab) or if unknown, discontinue vancomycin after 48-72 hours if no positive respiratory cultures for MRSA and clinically appropriate. Vancomycin can be continued for gram-positive coverage in patients with no microbiological diagnosis who are receiving aztreonam due to allergies. Antibiotic therapy is not generally recommended for patients with ventilator- associated tracheobronchitis (defined as fever with no other recognizable cause, with new or increased sputum production, positive endotracheal aspirate culture, and no radiographic evidence of pneumonia). <i>Definitive therapy should be tailored to culture</i> <i>results</i> . In patients with VAP or in those with inadequate cultures, physician discretion is advised. See front page for tips on <u>utilization of</u> <u>procalcitonin (PCT) levels</u>			

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Footnotes:

- * Dose may need to be adjusted for renal dysfunction
- ** For ADULTS: Dose per vancomycin nomogram with AUC goal 400-600 mcg*hr/mL
- α High clinical concern for needing ICU level care can be defined as having at least 3 of the following: RR ≥30 breaths/min, SpO₂ <90% OR O₂ supplementation ≥7 L, multilobar infiltrates, confusion, hypothermia (<36°C), severe sepsis

NOTE: See <u>Beta-lactam Allergy Evaluation and Empiric Therapy Guidance</u> document for further allergy information. High-risk allergies are defined as: respiratory symptoms (chest tightness, bronchospasm, wheezing, cough), angioedema (swelling, throat tightness), cardiovascular symptoms (hypotension, dizzy/lightheadedness, syncope/passing out, arrhythmia), anaphylaxis. If a patient has a high-risk allergy to penicillins, cephalosporins, or carbapenems, the only beta-lactam antibiotic that can be safely used without Allergy consult is aztreonam (if the allergy is to ceftazidime or aztreonam, aztreonam should be avoided as well).

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09/21: Updated vacomycin infusion reaction terminology						
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The recommendations in this guide are meant to serve as treatment guidelines for use at Michigan Medicine facilities. If you are an individual experiencing a medical emergency, call 911 immediately. These guidelines should not replace a provider's professional medical advice based on clinical judgment, or be used in lieu of an Infectious Diseases consultation when necessary. As a result of ongoing research, practice guidelines may from time to time change. The authors of these guidelines have made all attempts to ensure the accuracy based on current information, however, due to ongoing research, users of these guidelines are strongly encouraged to confirm the information contained within them through an independent source.

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