J Microbiol Immunol Infect
2007;40:279-283

Guidelines on antimicrobial therapy of pneumonia in adults in Taiwan, revised 2006

Infectious Diseases Society of Taiwan; Taiwan Society of Pulmonary and Critical Medicine; Medical Foundation in Memory of Dr. Deh-Lin Cheng; Foundation of Professor Wei-Chuan Hsieh for Infectious Diseases Research and Education; and CY Lee's Research Foundation for Pediatric Infectious Diseases and Vaccines

The Infectious Diseases Society of Taiwan (IDST) established and issued the first version of "Guidelines on Antimicrobial Therapy of Pneumonia in Taiwan" in December 1999. A revised version was issued in conjunction with the Taiwan Society of Pulmonary and Critical Medicine in 2001. With the advances in many areas of medicine and revisions in the American "Update of Practice Guidelines for the Management of Community-acquired Pneumonia in Immunocompetent Adults" and "Guidelines for the Management of Adults with Hospital-acquired, Ventilator-associated, and Healthcare-associated Pneumonia", featuring the addition of new antimicrobial agents and classification of pneumonia according to risk class, Taiwan investigators have published extensively regarding causative pathogens and antimicrobial resistance in pneumonia. This prompted the IDST-led consensus conference "Revisions of Guidelines on Antimicrobial Therapy of Pneumonia in Taiwan" held in late 2005.* After a year of discussion and evaluation, the revised "Guidelines on Antimicrobial Therapy of Pneumonia in Adults in Taiwan" were completed and approved by the board of the IDST in 2006. The 2006 version includes new antimicrobial agents and dosages of parenteral agents in its recommendations. Community-acquired pneumonia is classified as outpatient and inpatient, with the latter further subdivided into mild/moderate and severe/intensive care unit. Nosocomial pneumonia is categorized as early-onset and late-onset, and considers the presence or absence of risk factors for acquisition of multidrug-resistant pathogens.

The guidelines are published in the *Journal of Microbiology, Immunology and Infection* and are also available in the website of IDST (http://www.idsroc.org.tw). These guidelines will be updated and revised periodically to serve as an accessible reference for physicians in Taiwan.

Guidelines on antimicrobial therapy of pneumonia in adults

A. Target Therapy

Etiology	Antibiotic of choice	Alternative
Streptococcus pneumoniae		
Penicillin MIC		
≤1 mg/mL	Penicillin	First-generation cephalosporins
	Penicillin or amoxicillin	
2 mg/mL	Penicillin (12-18 MU/d)	Third- or fourth-generation cephalosporins[a]
	Ampicillin or amoxicillin	Telithromycin
≥4 mg/mL	Third- or fourth-generation cephalosporins[a]	Vancomycin or teicoplanin + rifampicin
	Vancomycin or teicoplanin	Newer fluoroquinolones[b]
		Telithromycin
Haemophilus influenzae		
Beta-lactamase-negative	Ampicillin or amoxicillin	New macrolides[c]
		TMP-SMX
Beta-lactamase-positive	Ampicillin-sulbactam	Third-generation cephalosporins
	Amoxicillin-clavulanate	New macrolides[c]
	Second-generation cephalosporins	Fluoroquinolones
		Telithromycin

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Moraxella catarrhalis	Second-generation cephalosporins Ampicillin-sulbactam Amoxicillin-clavulanate	Erythromycin or new macrolides[c] Third-generation cephalosporins Fluoroquinolones Telithromycin
Legionella spp.	Erythromycin or new macrolides[c]	Erythromycin or new macrolides[c] + Rifampicin Tetracyclines Fluoroquinolones
Mycoplasma pneumoniae	Erythromycin or new macrolides[c]	Tetracyclines Fluoroquinolones
Chlamydia pneumoniae	Tetracyclines Erythromycin or new macrolides[c]	Fluoroquinolones
B. Empirical Therapy		
1. Community-acquired pneumonia		
Age/core pathogen(s)	Antibiotic of choice	Alternative
Outpatients *Streptococcus pneumoniae* *Mycoplasma pneumoniae* *Chlamydia pneumoniae* *Haemophilus influenzae*, other GNB *Staphylococcus aureus*	Penicillin or Erythromycin, new macrolides[c] or in combination	Ampicillin-sulbactam, Amoxicillin-clavulanate, Second-generation cephalosporins or Erythromycin, new macrolides[c] or in combination Tetracyclines Newer fluoroquinolones[b] Telithromycin
Inpatients, mild-to-moderate *Streptococcus pneumoniae* *Haemophilus influenzae* Other GNB *Legionella* spp. *Chlamydia pneumoniae*	Penicillin, Second-generation cephalosporins or Erythromycin, new macrolides[c] or in combination	Ampicillin-sulbactam, amoxicillin-clavulanate, ertapenem or Erythromycin, new macrolides[c] or in combination Tetracyclines Newer fluoroquinolones[b] Telithromycin
Inpatients, severe, ICU stay[d] *Klebsiella pneumoniae,* *Streptococcus pneuomniae* *Legionella* spp. Other GNB *Pseudomonas aeruginosa* *Acinetobacter* spp.	Third-generation cephalosporins[e] or Ureidopenicillins ± Aminoglycosides[f] ± Erythromycin or new macrolides[c]	Ticarcillin-clavulanate or Piperacillin-tazobactam or Fourth-generation cephalosporins ± Aminoglycosides[f] ± Erythromycin or new macrolides[c] Fluoroquinolones

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Aspiration pneumonia (including lung abscess)		
Anaerobes *Streptococcus pneumoniae* Other streptococci *Enterobacteriaceae*	Penicillin or Clindamycin	Penicillin + metronidazole or Ampicillin-sulbactam or Amoxicillin-clavulanate or Second-generation cephalosporins (cephamycins)[g] or Ertapenem
2. Hospital-acquired pneumonia		
Severity/primary pathogen	Antibiotic of choice	Alternative
No risk factors[h] for MDRP, early-onset,[i] any disease severity		
Klebsiella pneumoniae *Enterobacter* spp. *Haemophilus influenzae* Other GNB *Streptococcus pneumoniae* MSSA	Ampicillin-sulbactam or Amoxicillin-clavulanate or Second- or third-cephalosporins[a] or Ureidopenicillins ± Aminoglycosides[f]	Ticarcillin-clavulanate or Piperacillin-tazobactam or Aztreonam or Ertapenem or Fluoroquinolones ± aminoglycosides[f]
Risk factors[h] for MDRP, late-onset,[j] any disease severity		
Pseudomonas aeruginosa *Acinetobacter* spp. MRSA *Stenotrophomonas maltophilia* *Legionella* spp.	Third-generation cephalosporins[e] or Ureidopenicillins Fluoroquinolones[k] + Aminoglycosides[f] ± Erythromycin or new macrolides[c] ± Vancomycin or Teicoplanin or Linezolid	Ticarcillin-clavulanate or Piperacillin-tazobactam or Aztreonam or Imipenem or Meropenem or Fourth-generation cephalosporins + Aminoglycosides[f] ± Erythromycin or newer macrolides[c] ± Vancomycin or teicoplanin Linezolid ± Sulbactam (for MDRAB) ± Colistin (for MDRPA or MDRAB)
Ventilator-associated pneumonia		
Pseudomonas aeruginosa *Acinetobacter* spp. MRSA	Third-generation cephalosporins[e] or Ureidopenicillins or Fluoroquinolones[k] + Aminoglycosides[f] ± Vancomycin or Teicoplanin or Linezolid	Ticarcillin-clavulanate or Piperacillin-tazobactam or Aztreonam or Imipenem or Meropenem or Fourth-generation cephalosporins + Aminoglycosides[f] ± Vancomycin or Teicoplanin or Linezolid

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C. Recommended dosage of parenteral antimicrobial agents for the treatment of hospital-acquired pneumonia in adults

Antibiotic	Recommended dosage
Anti-pseudomonal cephalosporins	
Cefepime	2 g q8h
Cefpirome	2 g q8-12h
Ceftazidime	2 g q8h
Carbapenems	
Imipenem	500 mg q6h or 1 g q8h
Meropenem	1 g q8h
Beta-lactam/beta-lactamase inhibitor	
Piperacillin-tazobactam	4.5 g q6h
Aminoglycosides	
Gentamicin	7 mg/kg/d
Tobramycin	7 mg/kg/d
Amikacin	20 mg/kg/d
Isepamicin	400 mg/d
Antipseudomonal quinolones	
Ciprofloxacin	400 mg q8h
Levofloxacin	750 mg/d
Glycopeptides	
Vancomycin	15 mg/kg q12h
Teicoplanin	400 mg/d
Miscellaneous	
Linezolid	600 mg q12h
Colistin	2 MU q8h
Sulbactam	1-2 g q6h

Abbreviations: MIC = minimal inhibitory concentration; TMP-SMX = trimethoprim-sulfamethoxazole; GNB = Gram-negative bacilli; ICU = intensive care unit; MDRP = multidrug-resistant pathogens, including *P. aeruginosa*, *Acinetobacter baumannii*, and extended-spectrum beta-lactamase-producing *Enterobacteriaceae*; MSSA = methicillin-susceptible *S. aureus*; MRSA = methicillin-resistant *S. aureus*; MDRAB = multidrug-resistant *A. baumannii*; MDRPA = multidrug-resistant *P. aeruginosa*

[a]Cefotaxime, ceftriaxone, cefepime and cefpirome.

[b]Moxifloxacin, levofloxacin: when used, pulmonary tuberculosis should be considered and aggressive microbiological evaluation for *Mycobacterium tuberculosis* should be performed.

[c]Clarithromycin and azithromycin.

[d]The definition of severe pneumonia is: 1) admission to the ICU; 2) respiratory failure (mechanical ventilation or fraction of inspired oxygen (FiO_2) >0.35 to maintain saturation >90%); 3) rapid radiographic progression, multilobar pneumonia, or cavitation of a lung infiltrate; and 4) evidence of sepsis with hypotension and/or end-organ dysfunction: shock, vasopressor requirement >4-h urine output <20mL/h or <80mL in total, acute renal failure (requiring dialysis).

[e]Consider pneumonia due to *P. aeruginosa.*

[f]Include isepamicin.

[g]Cefoxitin, cefotetan and cefmetazole.

[h]Risk factors for MDRP are: 1) antimicrobial therapy in the preceding 90 days; 2) current hospitalization of 5 days or more; 3) high frequency of antibiotic resistance in the community or in the specific hospital unit; 4) presence of risk factors for hospital-acquired pneumonia (hospitalization for 2 days or more in the preceding 90 days, residence in a nursing home or extended care facility, home infusion therapy [including antibiotics], chronic dialysis within 30 days, home wound care, family member with MDRP); and 5) immunosuppressive disease and/or therapy.

[i]Pneumonia occurs within the first 4 days of hospitalization.

[j]Pneumonia occurs 5 days or more of hospitalization.

[k]Includes ciprofloxacin, levofloxacin.

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