COMMUNITY ACQUIRED PNEUMONIA
Supporting information

This guideline has been prepared with reference to the following:

NICE. Pneumonia: diagnosis and management. 2025. London. NICE

https://www.nice.org.uk/guidance/ng250

NICE. COVID-19 rapid guideline: managing COVID-19. 2025. London. NICE

https://www.nice.org.uk/guidance/ng191

American College of Emergency Physicians Clinical Policies Subcommittee (Writing Committee) on Community-Acquired Pneumonia. Clinical Policy: Critical Issues in the Management of Adult Patients Presenting to the Emergency Department with Community-Acquired Pneumonia. Ann Emerg Med. 2021;77:e1-e57

https://www.sciencedirect.com/science/article/pii/S019606442031355X

British HIV Association, British Association of Sexual Health & HIV British Infection Society British Infection Association. Adult HIV Testing guidelines 2020

https://www.bhiva.org/HIV-testing-guidelines

Metlay JP, Waterer GW, Long AC 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;200:e45-e67

https://pmc.ncbi.nlm.nih.gov/articles/pmid/31573350/

Baggaley R. HIV for non-HIV specialists: Diagnosing the undiagnosed. 2015. London. Medical Foundation for AIDS & Sexual Health

https://nat.org.uk/publications/medfash-hiv-for-non-hiv-specialists-diagnosing-the-undiagnosed/

British Thoracic Society. Guidelines for the management of community acquired pneumonia in adults: Update 2009. Thorax 2009;64:Suppl 3:iii1

https://thorax.bmj.com/content/64/Suppl_3/iii1

Recognition and assessment

Is urinalysis appropriate for the detection of legionella or pneumococcal antigen in the seriously ill patient?

A 2019 review found that there have been advances in urine antigen detection tests for patients with community acquired pneumonia (Viasus, 2019). The new methodologies show greater sensitivity, detect S. pneumoniae and L. pneumophila in a single test, and also detect pneumococcal serotypes. In addition, urine antigen detection tests have shown a high specificity, which means that a positive result practically indicates the causative pathogen of CAP. Therefore, a positive result can lead to a targeted therapy that is likely to improve patient outcomes and reduce the risk of resistance and adverse events.

Using non-concentrated urine samples, the Bartels enzyme immunoassay test had a sensitivity of 74.1%, compared to 51.7% for the equivalent Binax test for the detection of legionella antigen (Dominguez, 2001).

A number of evaluation studies have concluded that the Binax NOW immunochromatographic test has good sensitivity (57-79%, mean 65.8%) and specificity (83-91.6%, mean 85.5%) for the detection of *Streptococcus pneumoniae* antigen in urine (Blasi, 2004; Stralin, 2004).

These tests are valuable in allowing rapid identification of specific causative organisms and their accurate targeting with appropriate antibiotics.

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Viasus D, Calatayud L & McBrown MV et al. Urinary antigen testing in community-acquired pneumonia in adults: an update. Expert Rev Anti Infect Ther. 2019. 17:107-15

Blasi F. Urinary antigen detection in the diagnosis of Streptococcus pneumoniae infection. GIMT G Ital Mal Torace 2004;58:199-208

Dominguez J, Galf N, Blanco S, et al. Assessment of a new test to detect Legionella urinary antigen for the diagnosis of Legionnaires' disease. Diagn Microbiol Infect Dis 2001;41:199-203

Stralin K, Kaltoft MS, Konradsen HB, et al. Comparison of two urinary antigen tests for establishment of pneumococcal etiology of adult community-acquired pneumonia. J Clin Microbiol 2004;42:3620-5
http://www.ncbi.nlm.nih.gov/pmc/articles/PMC497583/

Evidence Level: IV

Immediate treatment

Supportive treatment with oxygen is beneficial?
A Cochrane systematic review of 3 RCTs in a total of 151 patients (Zhang, 2012) found that non-invasive ventilation can reduce the risk of death in pneumonia patients in the ICU, OR 0.28, 95% CI 0.09 to 0.88; endotracheal intubation, OR 0.26, 95% CI 0.11 to 0.61; complications, OR 0.23, 95% CI 0.08 to 0.70; and shorten ICU length of stay, mean duration (MD) -3.28, 95% CI -5.41 to -1.61.Non-invasive ventilation and standard oxygen supplementation via a Venturi mask were similar when measuring mortality in hospital, OR 0.54, 95% CI 0.11 to 2.68; two-month survival, OR 1.67, 95% CI 0.53 to 5.28; duration of hospital stay, MD -1.00, 95% CI -2.05 to 0.05; and duration of mechanical ventilation, standard MD -0.26, 95% CI -0.66 to 0.14.

Zhang Y, Fang C, Dong BR, et al. Oxygen therapy for pneumonia in adults. Cochrane Database Syst Rev. 2012, CD006607
https://www.cochranelibrary.com/cdsr/doi/10.1002/14651858.CD006607.pub4/full

Evidence Level: I

Indometacin 25-50 mg orally 8 hourly controls pleuritic pain in a high proportion of patients?
The evidence for the efficacy of indometacin in pleurisy rests on one small randomised controlled trial of 51 patients (Sacks, 1973) and a small number of anecdotal reports (Klein, 1984; Ghosh, 1978). The RCT compared treatment with a single 100 mg indometacin suppository with placebo. 84% of patients receiving indometacin reported satisfactory pain relief compared with 35% receiving placebo.

Ghosh JS. Indomethacin in pleurisy. BMJ 1978;1:302
http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1602684/pdf/brmedj00111-0054b.pdf

Klein RC. Effects of indomethacin on pleural pain. South Med J 1984;77:1253-4

Sacks PV, Kanarek D. Treatment of acute pleuritic pain: comparison between indomethacin and a placebo. Am Rev Respir Dis 1973;108:666-9

Evidence Level: III

Physiotherapy does not improve the outcome in CAP?
A 2020 review identified no studies examining the effect of respiratory physiotherapy specifically for invasively ventilated adults with CAP (van der Lee, 2020).
A 2019 systematic review identified four studies (3 RCTs and one retrospective cohort study) found that early mobility did not reduce the risk of mortality compared with usual care (risk ratio 0.9 [95% CI: 0.27, 2.97]; p = 0.86) but did reduce the mean length of stay (-1.1 days [95% CI: 2.21, -0.04]; p = 0.04) [Larsen, 2019]. Early mobility also did not affect the rate of hospital readmissions or emergency department visits.

Larsen T, Lee A, Brooks D et al. Effect of Early Mobility as a Physiotherapy Treatment for Pneumonia: A Systematic Review and Meta-Analysis. Physiother Can. 2019;71:82-9

van der Lee, K, Hill A-M & Patman S. Clinical validation of expert consensus statements for respiratory physiotherapy management of invasively ventilated adults with community-acquired pneumonia: A qualitative study. Intensive Crit Care Nurs. 2020 epub ahead of print

Evidence Level: I

***Streptococcus pneumoniae* is the most frequent causative agent in CAP?**

A meta-analysis of studies spanning 30 years showed that of 7,000 patients in whom a causative agent was found, *Strep. pneumoniae* was identified in 66% (Fine, 1996).
A Japanese study of 89 hospitalised CAP patients found that streptococcus pneumoniae was the most frequently identified pathogen (n = 55, 61.8%) [Kumaga, 2016].
A 2020 review found that respiratory viruses are now the most common pathogens detected in CAP, outpacing Streptococcus pneumonia (Walter, 2020). This was explained as being due to pneumococcal vaccination programs, declining rates of cigarette smoking, an aging population, and increasingly sensitive diagnostic tests.

Fine MJ, Smith MA, Carson CA, et al. Prognosis and outcomes of patients with community-acquired pneumonia. JAMA 1996;275:134-41

Kumagai S, Ishida T, Tachibana H et al. Polybacterial aetiology and outcomes in patients with community-acquired pneumonia. Int J Tuberc Lung Dis. 2016;20:129-35

Walter JM. Other Respiratory Viruses as a Cause of Community-Acquired Pneumonia. Semin Respir Crit Care Med 2020;41:579-91

Evidence Level: II

Amoxicillin successfully treats a high proportion of patients with pneumonia that is not severe?

A systematic review (Pomilla, 1994) comparing rates of clinical cure or improvement of CAP with different antibiotics found broadly similar rates in all of them. BTS guidelines recommend amoxicillin, with erythromycin as an alternative (BTS, 2009).
A study of susceptibility to tetracyclines or co-amoxiclav in non-severe CAP (Blackburn, 2011) found that, of the 70,288 and 45,288 isolates with susceptibility results for tetracyclines or co-amoxiclav, 96% and 92%, respectively, were susceptible. Overall susceptibility to ciprofloxacin, ampicillin / amoxicillin and macrolides was lower than for tetracyclines or co-amoxiclav and varied markedly by organism. There were few clinically relevant variations in susceptibility to doxycycline or co-amoxiclav over time, geographically or between age groups.
A systematic review and meta-analysis of 23 studies in a total of 137,574 patients (Asadi, 2012) found that macrolide use was associated with a statistically significant (22%) mortality reduction compared with non-macrolide use (3.7% [1738 of 47,071] vs 6.5% [5861 of 90,503]; RR, 0.78; 95% CI .64-.95; P=.01; I(2)= 85%).

British Thoracic Society. Guidelines for the management of community acquired pneumonia in adults: Update 2009
https://www.brit-thoracic.org.uk/document-library/clinical-information/pneumonia/adult-pneumonia/bts-guidelines-for-the-management-of-community-acquired-pneumonia-in-adults-2009-update/

Asadi L, Sligl WI, Eurich DT, et al. Macrolide-based regimens and mortality in hospitalized patients with community-acquired pneumonia: a systematic review and meta-analysis. Clin Infect Dis 2012;55:371-80
http://cid.oxfordjournals.org/content/55/3/371.long

Blackburn RM, Henderson KL, Lillie M, et al. Empirical treatment of influenza-associated pneumonia in primary care: a descriptive study of the antimicrobial susceptibility of lower respiratory tract bacteria (England, Wales and Northern Ireland, January 2007-March 2010). Thorax 2011;66:389-95
http://thorax.bmj.com/content/66/5/389.long

Pomilla PV, Brown RB. Outpatient treatment of community-acquired pneumonia in adults. Arch Intern Med 1994;154:1793-1802

Evidence Level: I (in favour of any antibiotic)

Oral antibiotics are as effective as intravenous antibiotics in the treatment of CAP?

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A meta-analysis of 7 RCTs involving 1,366 patients with non-severe CAP (Marras, 2004) found no difference in the relative risk of mortality between oral and IV treatment. Mean length of hospital stay was shorter in patients taking oral antibiotics (6.1 days vs 7.8 days). A 2023 systematic review similarly found that oral was not inferior to IV administration (Teng, 2023).
IDSA guidelines (Mandell, 2003) and BTS guidelines (Anon, 2009) recognise that the intravenous administration of drugs that are well absorbed from the gut offers no obvious advantage over the oral route. They also, however, recommend that treatment of acutely ill patients should be given intravenously at least initially, if any concern about absorption exists. The guidelines, as well as a number of well-designed studies (Osterheert, 2006; Rhew, 2001) also endorse the practice of early switching from intravenous to oral antibiotic therapy within 2-3 days.

British Thoracic Society. Guidelines for the management of community acquired pneumonia in adults: Update 2009.
https://thorax.bmj.com/content/64/Suppl_3/iii1

Mandell LA, Bartlett JG, Dowell SF, et al. Update of practice guidelines for the management of community-acquired pneumonia in immunocompetent adults. Clin Infect Dis 2003;37:1405-33
http://cid.oxfordjournals.org/content/37/11/1405.long

Marras TK, Nopmaneejumrusiers C, Chan CK. Efficacy of exclusively oral antibiotic therapy in patients hospitalized with nonsevere community-acquired pneumonia: a retrospective study and meta-analysis. Am J Med 2004;116:385-93

Oosterheert JJ, Bonten MJ, Schneider MM, et al. Effectiveness of early switch from intravenous to oral antibiotics in severe community acquired pneumonia: multicentre randomised trial. BMJ 2006;333:1193-7
http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1693658/

Rhew DC, Tu GS, Ofman J, et al. Early switch and early discharge strategies in patients with community-acquired pneumonia: a meta-analysis. Arch Intern Med 2001;161:722-7
http://archinte.jamanetwork.com/article.aspx?articleid=647622

Teng GL, Chi JY, Zhang HM et al. Oral vs. parenteral antibiotic therapy in adult patients with community-acquired pneumonia: a systematic review and meta-analysis of randomized controlled trials. J Glob Antimicrob Resist. 2023:32:88-97
https://linkinghub.elsevier.com/retrieve/pii/S2213-7165(23)00003-6

Evidence Level: I

What is the evidence that pneumococcal pneumonia (caused by *Streptococcus pneumoniae*) is successfully treated by:

I. **Amoxicillin**
II. **Benzylpenicillin**
III. **Clarithromycin**

See above for the evidence for amoxicillin. It appears that prompt initiation of antibiotic therapy is more important than the choice of antibiotic, which has little or no influence on mortality rate (Anon, 2007).
Benzylpenicillin (Penicillin G) is the preferred beta-lactam for use against *Strep. pneumoniae* in the IDSA guidelines (Mandell, 2003. Resistant strains (MIC >=2mcg/mL) may require alternatives such as ampicillin, cefotaxime, or ceftriaxone. Strains with intermediate susceptibility (MIC = 0.1-1.0mcg/mL) still respond well to large (4-15 million units per day) doses of benzylpenicillin (Heffelfinger, 2000).
Reviews offering a synthesis of current published guidelines (Brown, 1988; Finch, 1998) also list benzylpenicillin as a preferred agent in uncomplicated pneumonia for patients with intact immune systems.
Clarithromycin is active against *Strep. pneumoniae* (Mandell, 2003).
Doxycycline or moxifloxacin may be used if resistant strains are encountered (Ludlam, 2008).

Anon. Incorrect antibiotic choice doesn't affect CAP outcome. J Fam Pract 2007;56:180

British Thoracic Society. Guidelines for the management of community acquired pneumonia in adults: Update 2009
https://www.brit-thoracic.org.uk/document-library/clinical-information/pneumonia/adult-pneumonia/bts-guidelines-for-the-management-of-community-acquired-pneumonia-in-adults-2009-update/

Brown PD, Lerner SA. Community-acquired pneumonia. Lancet 1998;352:1295-302

Finch R. Community acquired pneumonia. J R Coll Physicians Lond 1998;32:328-32

Heffelfinger JD, Dowell SF, Jorgensen JH, et al. Management of community-acquired pneumonia in the era of pneumococcal resistance: a report from the Drug-Resistant Streptococcus pneumoniae Therapeutic Working Group. Arch Intern Med 2000;160:1399-1408

Ludlam HA, Enoch DA. Doxycycline or moxifloxacin for the management of community-acquired pneumonia in the UK? Int J Antimicrob Agents 2008;32:101-5

Mandell LA, Bartlett JG, Dowell SF, et al. Update of practice guidelines for the management of community-acquired pneumonia in immunocompetent adults. Clin Infect Dis 2003;37:1405-33
http://cid.oxfordjournals.org/content/37/11/1405.long

Evidence Level: III

Efficacy of specific pathogen directed antibiotic treatment

Patients not responding to empirical antibiotic treatment are likely to have pneumonia caused by organisms other than *S. Pneumoniae* (although 10% of infections may be mixed) (Anon, 2004). Other antibiotics more specific to the eradication of identified organisms will thus need to be used. A systematic review of 24 trials involving 5015 patients (Shefet, 2005) found no difference in mortality between patients treated empirically with antibiotics with (compared to without) a spectrum covering atypical organisms (RR 1.13; 95% CI 0.82-1.54). A later Cochrane review by the same team, in 28 trials involving 5939 patients (Eliakim-Raz, 2012), came to the same conclusion.

British Thoracic Society. Guidelines for the management of community acquired pneumonia in adults: Update 2009
https://www.brit-thoracic.org.uk/document-library/clinical-information/pneumonia/adult-pneumonia/bts-guidelines-for-the-management-of-community-acquired-pneumonia-in-adults-2009-update/

Eliakim-Raz N., Robenshtok E., Shefet D. et al. Empiric antibiotic coverage of atypical pathogens for community acquired pneumonia in hospitalized adults. Cochrane Database Syst Rev. 2012
http://onlinelibrary.wiley.com/doi/10.1002/14651858.CD004418.pub4/abstract

Shefet D, Robenshtok E, Paul M, et al. Empirical atypical coverage for inpatients with community-acquired pneumonia: systematic review of randomized controlled trials. Arch Intern Med 2005;165:1992-2000
http://archinte.jamanetwork.com/article.aspx?articleid=486707

***Staphylococcus aureus* is killed by flucloxacillin?**

Most clinical isolates of *Staph. aureus* are resistant to benzylpenicillin, due to the production of a beta-lactamase that binds to the antibiotic and renders it inactive (Baird, 1996). The beta-lactamase-resistant (isoxazolyl) penicillins, of which flucloxacillin is one, are therefore the antibiotics of choice for staphylococcal pneumonia (Anon, 2009).

British Thoracic Society. Guidelines for the management of community acquired pneumonia in adults: Update 2009
https://www.brit-thoracic.org.uk/document-library/clinical-information/pneumonia/adult-pneumonia/bts-guidelines-for-the-management-of-community-acquired-pneumonia-in-adults-2009-update/

Baird D. Staphylococcus: Cluster-forming gram-positive cocci. In: Collee JG, Fraser AG, Marmion BP, et al (eds). Mackie & McCartney Practical medical microbiology, 14th ed. New York: Churchill Livingstone, 1996. p247

Evidence Level: V

Monitoring treatment

C Reactive Protein (CRP) test should be repeated if patient not improving after 72 hr despite adequate therapy?

A study in 96 consecutive admissions for CAP in a Swedish hospital (Hedlund, 2000) found no association between CRP and severity of disease. Again, no association was found in a subgroup of 258 patients amongst a cohort of 1,222 in a Spanish study (Garcia Vazquez, 2003).

A population-based case-control study in 201 patients compared with 84 healthy subjects (Almirall, 2004) found higher CRP levels in those with more severe disease, and suggested cut off points of 106 mg/L for men and 110 mg/L to indicate severe illness.

Almirall J, Bolibar I, Toran P, et al. Contribution of C-reactive protein to the diagnosis and assessment of severity of community-acquired pneumonia. Chest 2004;125:1335-42
http://journal.publications.chestnet.org/pdfaccess.ashx?ResourceID=2111093&PDFSource=13

British Thoracic Society. Guidelines for the management of community acquired pneumonia in adults: Update 2009
https://www.brit-thoracic.org.uk/document-library/clinical-information/pneumonia/adult-pneumonia/bts-guidelines-for-the-management-of-community-acquired-pneumonia-in-adults-2009-update/

Garcia Vazquez E, Martinez JA, Mensa J, et al. C-reactive protein levels in community-acquired pneumonia. Eur Respir J 2003;21:702-5
http://erj.ersjournals.com/content/21/4/702.long

Hedlund J, Hansson L-O. Procalcitonin and C-reactive protein levels in community-acquired pneumonia: correlation with etiology and prognosis. Infection 2000;28:68-73

Evidence Level: IV

Subsequent Management

5 to 7 days of treatment with antibiotics is adequate for uncomplicated pneumonia?
A meta analysis of nine trials (2399 patients) found that the absolute clinical improvement rates of the following durations were: 3-day treatment 75% (95% CI: 68% to 81%), 5-day treatment 72% (95% CI: 66% to 78%) and 7-day treatment 69% (95% CI: 61% to 76%) [Furukawa, 2023]. The authors therefore concluded that shorter treatment duration (3-5 days) probably offers the optimal balance between efficacy and treatment burden for treating CAP in adults if they achieved clinical stability.
A meta-analysis of 15 RCTs in 2,796 patients (Li, 2007) found no significant differences in the risk of clinical failure between short (</= 7 days) and extended (> 7 days) courses of antibiotics (0.89, 95% CI 0.78-1.02).

Furukawa Y, Luo Y, Funada S et al. Optimal duration of antibiotic treatment for community-acquired pneumonia in adults: a systematic review and duration-effect meta-analysis. BMJ Open. 2023;13:e061023
https://bmjopen.bmj.com/content/13/3/e061023.long

Li JZ, Winston LG, Moore DH, et al. Efficacy of short-course antibiotic regimens for community-acquired-pneumonia: a meta-analysis. Am J Med 2007;120:783-90

Evidence Level: I

Antibiotics need to be continued for 2 weeks in i) severe pneumonia ii) staphylococcal pneumonia iii) legionella pneumonia?
IDSA guidelines (Mandell, 2003) recommend that treatment lasts for 2 weeks or longer in these circumstances. BTS guidelines (Anon, 2009) recommend 10 days for severe pneumonia, though this may need to be extended to 14-21 days according to clinical judgement; for example, where Staphylococcus aureus or Gram negative enteric bacilli pneumonia is suspected or confirmed.

British Thoracic Society. Guidelines for the management of community acquired pneumonia in adults: Update 2009
https://www.brit-thoracic.org.uk/document-library/clinical-information/pneumonia/adult-pneumonia/bts-guidelines-for-the-management-of-community-acquired-pneumonia-in-adults-2009-update/

Mandell LA, Bartlett JG, Dowell SF, et al. Update of practice guidelines for the management of community-acquired pneumonia in immunocompetent adults. Clin Infect Dis 2003;37:1405-33
http://cid.oxfordjournals.org/content/37/11/1405.long

Evidence Level: V

Failure to respond to treatment may be indicative of undiagnosed HIV infection?
Please see:

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British HIV Association, British Association of Sexual Health and HIV British Infection Society. UK National Guidelines for HIV Testing 2008
http://www.bhiva.org/documents/Guidelines/Testing/GlinesHIVTest08.pdf

Baggaley R. HIV for non-HIV specialists: Diagnosing the undiagnosed. London, Medical Foundation for AIDS & Sexual Health, 2008
http://www.medfash.org.uk/uploads/images/file/HIV_for_non_HIV_specialists.pdf

Discharge Policy

Only 50% of x-rays have cleared completely 6 weeks after CAP?
IDSA guidelines (Mandell, 2003) state that "Radiographs of most patients with bacteremic pneumococcal pneumonia who are aged <50 years clear by 4 weeks; however, in older patients, patients with underlying illness (particularly alcoholism or chronic obstructive pulmonary disease), or patients with extensive pneumonia on presentation, the rate of resolution slows considerably, and only 20%-30% may show clearing by 4 weeks. *Legionella pneumophila* infection may take substantially longer to clear; only 55% of such infections show complete resolution by 12 weeks." This statement is based on two series of patients, one of 72 patients with *Strep. Pneumoniae* pneumonia (Jay, 1975) and the other comparing 91 patients with pneumococcal pneumonia with 49 legionnaires' disease sufferers (Macfarlane, 1984). A later prospective assessment of 81 patients (Mittl, 1994) confirms these findings.

Jay SJ, Johanson WG, Pierce AK. The radiographic resolution of streptococcus pneumoniae pneumonia. N Engl J Med 1975;293:798-801

Macfarlane JT, Miller AC, Smith WH, et al. Comparative radiographic features of community acquired legionnaires' disease, pneumococcal pneumonia, mycoplasma pneumonia, and psittacosis. Thorax 1984;39:28-33
http://www.ncbi.nlm.nih.gov/pmc/articles/PMC459717/pdf/thorax00217-0036.pdf

Mandell LA, Bartlett JG, Dowell SF, et al. Update of practice guidelines for the management of community-acquired pneumonia in immunocompetent adults. Clin Infect Dis 2003;37:1405-33
http://cid.oxfordjournals.org/content/37/11/1405.long

Mittl RL, Schwab RJ, Duchin JS, et al. Radiographic resolution of community-acquired pneumonia. Am J Resp Crit Care Med 1994;149:630-5

Evidence Level: IV

Should metronidazole be used in patients who are already being treated with co-amoxiclav, piperacillin-tazobactam or meropenem?
A review by Brook et al. (2013) demonstrates that an anaerobe is as susceptible to co-amoxicalv, piperacillin-tazobactam or meropenem as it is to metronidazole. Hence, there is no need for metronidazole in patients already using co-amoxiclav, piperacillin-tazobactam or meropenem.

Brook I, Wexler HM, Goldstein EJ. Antianaerobic antimicrobials: spectrum and susceptibility testing. Clin Microbiol Rev. 2013;26:526-46
http://cmr.asm.org/content/26/3/526.full

Evidence Level: III

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