versible airflow obstruction as predictor of overall mortality in asthma and chronic obstructive pulmonary disease. *Am J Respir Crit Care Med* 1999;**159**:1267–71.
9 Boyd G, Morice AH, Pounsford JC, Sibert M *et al*. An evaluation of salmeterol in the treatment of chronic obstructive pulmonary disease (COPD). *Eur Respir J* 1997;**10**: 815–21.
10 Dahl R, Greefhorst LA, Nowark D, Nonikov V *et al*. Inhaled formoterol dry powder versus ipratropium bromide in chronic obstructive pulmonary disease. *Am J Respir Crit Care Med* 2001;**164**:778–84.
11 Vincken W, van Noord JA, Greefhorst AP, Bantje TA *et al*. Improved health outcomes in patients with COPD during 1 yr's treatment with tiotropium. *Eur Respir J* 2002; **19**:209–16.
12 Sutherland ER, Allmers H, Ayas NT, Venn AJ, Martin RJ. Inhaled corticosteroids reduce the progression of airflow limitation in chronic obstructive pulmonary disease: a meta-analysis. *Thorax* 2003;**58**:937–41.
13 Soriano JB, Vestbo J, Pride NB, Kiri V *et al*. Survival in COPD patients after regular use of fluticasone propionate and salmeterol in general practice. *Eur Respir J* 2002;**20**: 819–25.
14 Calverley P, Pauwels R, Vestbo J, Jones P *et al*; the TRial of Inhaled STeroids ANd long-acting beta2 agonists study. Combined salmeterol and fluticasone in the treatment of chronic obstructive pulmonary disease: a randomised controlled trial. *Lancet* 2003; **361**:449–56.
15 Rodriguez-Roisin R. Towards a consensus definition for COPD exacerbations. *Chest* 2000;**117**:3985–4015.
16 Thompson WH, Nielson CP, Carvalho P, Charan NB, Crowley JJ. Controlled trial of oral prednisone in outpatients with acute COPD exacerbation. *Am J Respir Crit Care Med* 1996;**154**:407–12.
17 Anthonisen NR, Manfreda J, Warren CP, Hershfield ES *et al*. Antibiotic therapy in exacerbations of chronic obstructive pulmonary disease. *Ann Intern Med* 1987; **106**:196–204.

Community acquired pneumonia

Wei Shen Lim MRCP MD, Consultant Physician, Respiratory Medicine, *David Evans Research Centre, Nottingham City Hospital, Nottingham*

Clin Med 2004;**4**:224–8

Community acquired pneumonia (CAP) is common in adults. Annual incidence rates increase from six per 1,000 population in the 16–59 age group to 34 per 1,000 population in those aged 75 and over.[1] Hospital admission is needed in 20–40% of patients with CAP, 5–10% of whom require admission to an intensive care unit. Most studies report an overall mortality of 5–10%. In recognition of the importance of CAP, several countries have published national guidelines for its management. The latest British Thoracic Society (BTS) guidelines were published in 2001 and have recently been updated.[2,3,4]

This review will discuss key aspects of the management of CAP, including changes or new issues to be covered in the BTS guidelines 2004 update.

How to recognise community acquired pneumonia

The diagnosis of CAP in hospital is defined by the BTS as the presence of symptoms and signs of an acute lower respiratory tract infection (LRTI) together with new radiographic shadowing for which there is no other explanation. Diagnosing CAP in the community in the absence of a chest X-ray (CXR) is less straightforward. Even in patients with symptoms of an LRTI plus focal chest signs, there is radiographic evidence of pneumonia in only about 40%.[5] Furthermore, the classic symptoms and signs of an LRTI (eg fever and cough) may not always be present in the elderly, while non-specific symptoms such as mental confusion are more common than in younger patients.[6] A healthy index of suspicion is required in such patients. Ultimately, the CXR remains the definitive test for diagnosing CAP.

What are the likely pathogens implicated in community acquired pneumonia in the UK?

Streptococcus pneumoniae continues to be the most frequently isolated organism in CAP (Table 1).

Other pathogens should be considered when there is a coincidence of certain epidemiological features (Table 2). *Chlamydia pneumoniae* has been identified in up to 20% of cases; it is often isolated together with another pathogen, most commonly *S. pneumoniae*.[7] Specific antibiotic therapy against *C. pneumoniae*

Key Points

- **Streptococcus pneumoniae remains the most important pathogen in community acquired pneumonia (CAP), even in patients with underlying chronic obstructive pulmonary disease**
- **Patients with three or more of the following features have severe CAP: (a) Confusion, (b) Urea >7 mmol/l, (c) Respiratory rate 30 per min, (d) Blood pressure (systolic <90 mmHg or diastolic #60 mmHg), (e) Age 65 years (CURB-65)**
- **Patients who do not have severe CAP may not require intravenous antibiotics**
- **Hospitalised patients with severe CAP should be treated with a beta-lactam based antibiotic in combination with a macrolide (eg cefuroxime, clarithromycin)**
- **The new 'Gram-positive' fluoroquinolones (eg levofloxacin, moxifloxacin) should not be used in the community or as first-line treatment of CAP**

KEY WORDS: adult, antibiotics, community acquired pneumonia, fluoroquinolone, guidelines, respiratory tract infection, review, *Streptococcus pneumoniae*

is not always required to effect clinical recovery.

Viral infections are increasingly being recognised as important causes of pneumonia. In a recent UK study, evidence of a viral infection was found in 23% of 267 patients hospitalised with CAP.[8] Influenza and respiratory syncytial virus infections comprised 20% and 4% of the total, respectively. Neuraminidase inhibitors such as oseltamivir and zanamivir are effective in treating influenza A and B infections if given within the first 48 hours of symptoms. The Infectious Diseases Society of America's (IDSA) latest guidelines update (December 2003) recommends consideration of these agents in influenza pneumonia.[9]

Patients with chronic obstructive pulmonary disease (COPD) who present with CAP are generally infected by the same spectrum of organisms as other patients with CAP.[10] Similarly, in the only UK study of CAP in nursing home residents, there was no difference in the range of pathogens identified in them and in other elderly patients without CAP. In particular, Gram-negative organisms were not identified any more frequently. Therefore, there is currently no reason for a different antibiotic choice in patients with COPD or those from nursing homes presenting with CAP.

Table 1. Pathogens (%) implicated in community acquired pneumonia in the UK (adapted from Ref 2).

Pathogens	Community	Hospital	ICU
No. of studies	1	5	4
No. of patients	236	1,137	185
Streptococcus pneumoniae	36	39	22
Haemophilus influenzae	10	5	4
Staphylococcus aureus	0.8	2	9
Moraxella catarrhalis	NK	2	NK
Legionella spp	0.4	4	18
Mycoplasma pneumoniae	1.3	11	3
Chlamydia pneumoniae	NK	13	NK
Chlamydia psittaci	1.3	3	2
Coxiella burnetii	0	1.2	0
Influenza A & B	8	11	5
None identified	45	31	32

ICU = intensive care unit; NK = not known.

Table 2. Circumstances in which certain pathogens are more common.

Pathogen	Epidemiological features
Legionella spp	Late summer and autumn Visit to Mediterranean resorts in last 10 days Use of steroids
Mycoplasma pneumoniae	Younger person Epidemic year (these occur about every 4 years, the last in 1998–1999)
Staphylococcus aureus	Post-influenza
Chlamydia psittaci	Contact with birds (poultry workers) Human-to-human spread possible
Coxiella burnetii	Lambing and calving season (April and June) Contact with sheep

How should severity of illness be assessed?

Many features are associated with a poor prognosis.[11] Based on these features and on risk of mortality, a number of severity prediction tools have been advocated over the years. The most widely studied is the Pneumonia Severity Index (PSI); this is based on large studies conducted in North America and is the preferred severity assessment tool recommended by the IDSA.[12] However, the PSI is complex, requiring up to 20 different features to be computed to produce a score (index), which in turn is related to 30-day mortality.

A simpler six-point score (CURB-65) has recently been developed which allows patients to be stratified into different prognostic groups suitable for different management pathways (Fig 1).[13] This has been adopted by the BTS as the recommended tool for assessing severity. However, it is emphasised that management decisions should not be based on these severity prediction tools alone, and that clinical judgement must be exercised in all cases. One study showed that up to 40% of patients admitted to hospital with CAP based on conventional clinical criteria were assigned by the PSI to low risk groups possibly suitable for ambulatory care.[14]

What diagnostic tests should be performed?

The haematological and biochemical tests considered routine in patients admitted with CAP are set out in Table 3. Measurement of C-reactive protein (CRP) levels is becoming increasingly widespread, its main value being in the differentiation of CAP from other diagnoses on initial presentation. In one study, only 5% of patients with CAP had CRP levels below 50 mg/l. Beyond diagnosis, the initial CRP level does not correlate with prognosis but serial measurement is useful. A CRP level that does not fall by 50% within four days suggests a failure of treatment or the development of complications such as empyema.

The extent of microbiological testing in patients with CAP should be determined by disease severity (Table 4). Recent studies have demonstrated that the diagnostic yield of routine microbiological investigations (blood and sputum cultures) in CAP is low (ca 15%),

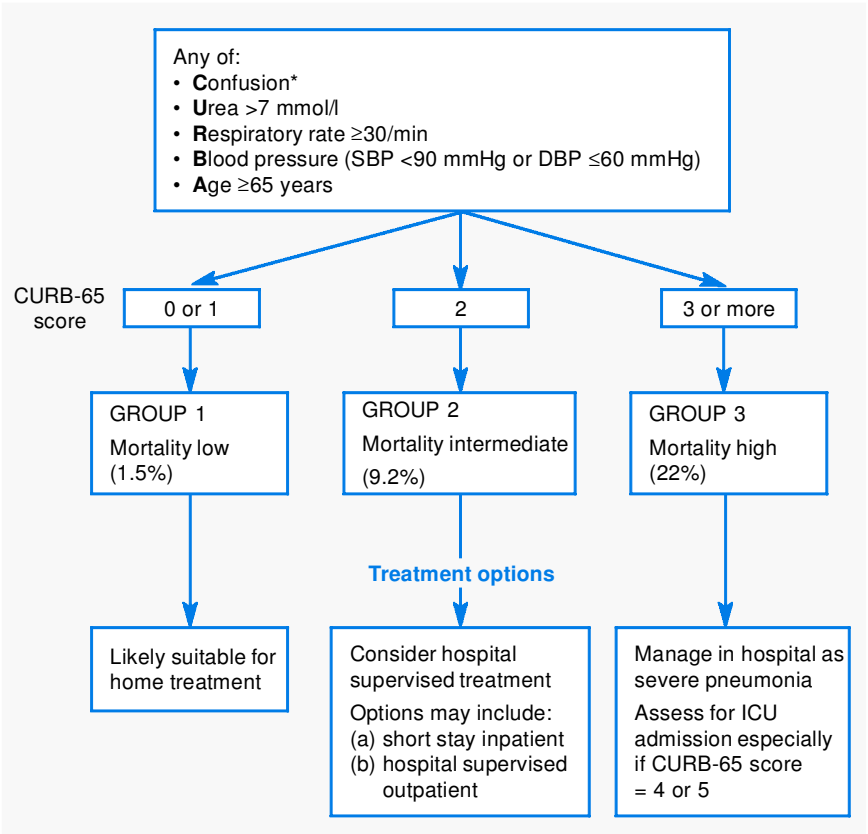

Fig 1. Severity assessment using the CURB-65 score (DBP = diastolic blood pressure; ICU = intensive care unit; SBP = systolic blood pressure) (adapted from Ref 11). * Defined as a Mental Test Score of ⩽8 or new disorientation in person, place or time.

Table 3. Suggested haematological and biochemical tests in community acquired pneumonia.

Test	Special considerations
Full blood count	White cell count >15 × 10^9/l suggests bacterial pathogen White cell count <4 or >20 × 10^9/l associated with poor prognosis
Urea and electrolytes	Urea >7 mmol/l associated with poor prognosis
Liver function tests	Albumin <30 g/dl associated with poor prognosis
C-reactive protein	If <50 mg/l, consider other diagnosis

Table 4. Suggested microbiological tests in community acquired pneumonia (CAP).

A	Patients with non-severe CAP	• Sputum culture in those who have not received prior antibiotics • Blood culture (may be omitted in patients with no comorbid illness)
B	Patients with severe CAP	• Blood culture • Sputum for: – Gram stain and culture – direct immunofluorescence for *Legionella spp*, atypical pathogens and viruses • Acute and convalescent serology for *Legionella spp*, atypical pathogens and viruses • Urine for pneumococcal and legionella antigen

particularly in patients with neither severe disease nor comorbid illnesses. Therefore, while blood cultures are recommended for all patients with severe CAP, they may be omitted in otherwise well patients with non-severe CAP.

Testing for pneumococcal and legionella antigens in the urine is now available in the form of commercial kits (BINAX NOW). These are rapid tests which can give a positive result in 15 minutes, have greater sensitivity rates than blood and sputum cultures and are less affected by previous antibiotic use. Their increased use in patients with severe CAP is encouraged, although currently there is no robust evidence to indicate that this leads ultimately to improved clinical outcomes.

General management and antibiotic choice

Patients with CAP may require oxygen supplementation. The aim should be to keep oxygen saturation levels above 92%. This may sometimes entail the use of continuous positive airways pressure. Dehydration is common, particularly in the elderly, and adequate fluid replacement is essential.

Any empirical antibiotic choice in CAP must provide cover against the pneumococcus. In the UK, the rate of penicillin resistance remains low (<4% in 1998) and beta-lactam antibiotics are still useful. Addition of a macrolide or fluoroquinolone antibiotic provides cover against infection by *Legionella spp* and other atypical pathogens. Most CAP guidelines offer different antibiotic combinations according to disease severity. The BTS recommendations are given in Table 5.

Are the new fluoroquinolones the ideal antibiotics for community acquired pneumonia?

There has been a large increase over the last few years in the use of the new fluoroquinolones which are more active against Gram-positive organisms (including *S. pneumoniae*) than older fluoroquinolones. Combined with their activity against *Legionella spp* and the

Table 5. Antibiotic recommendations (adapted from Ref 2).

		Treatment recommendation	
		Preferred	**Alternative**
A B	Home treated, not severe *or* Hospital treated, not severe and admitted for non-clinical reasons	Amoxicillin 500 mg to 1 g tds po	Erythromycin 500 mg qds po *or* Clarithromycin 500 mg bd po
C	Hospital treated, not severe	Amoxicillin 500 mg to1 g tds po *plus* Erythromycin 500 mg qds po *or* Clarithromycin 500 mg bd po	Levofloxacin 500 mg od po *or* Moxifloxacin 400 mg od po
D	Hospital treated, severe	Co-amoxiclav 1.2 g tds iv *or* Cefuroxime 1.5 g tds iv *or* Cefotaxime 1g tds iv *plus* Erythromycin 500 mg qds iv *or* Clarithromycin 500 mg bd iv (consider also adding rifampicin 600 mg bd iv in legionella infection)	Levofloxacin 500 mg bd iv po *plus* Benzylpenicillin 1.2 g qds iv

iv = intravenous; po = by mouth.

Table 6. Clinical features associated with clinical instability on discharge.

- Temperature >37.8ºC
- Heart rate >100 per min
- Respiratory rate >24 per min
- Systolic blood pressure <90 mmHg
- Oxygen saturation <90%
- Abnormal mental status
- Inability to take oral medication

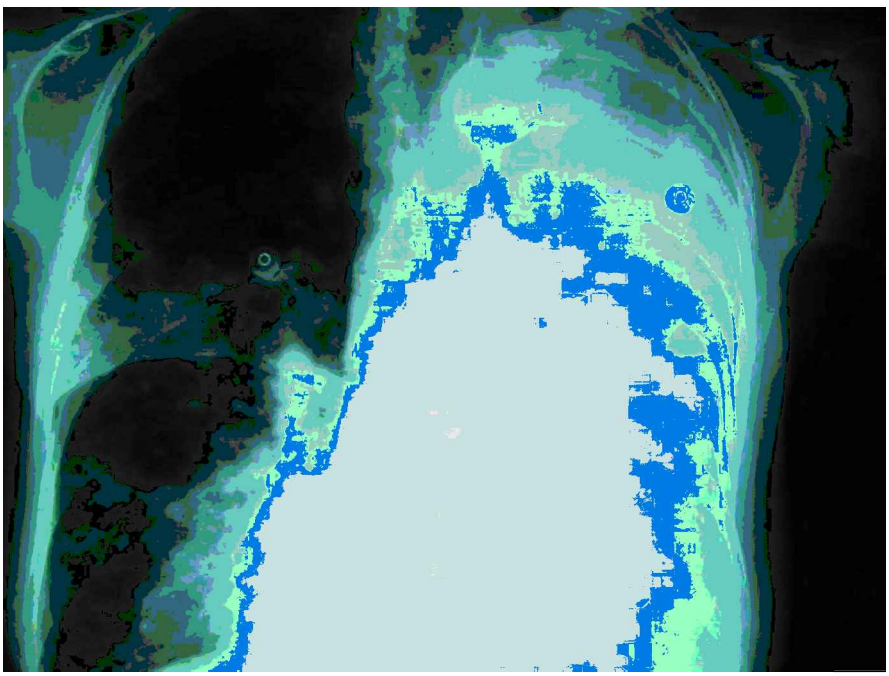

Fig 2. Bronchoalveolar carcinoma causing radiographic appearances of consolidation mimicking pneumonia.

atypical pathogens, they are potentially 'ideal' antibiotics for CAP. Levofloxacin has led the way and is widely used in North America. However, the emergence of *S. pneumoniae* with reduced susceptibility to fluoroquinolones has recently been reported in areas of high fluoroquinolone usage. There are also separate concerns that excessive fluoroquinolone use may encourage infection by methicillin-resistant *Staphylococcus aureus*.[15] The current recommendation is for the new fluoroquinolones not to be used as first-line agents or in the community for CAP. They represent a useful alternative in situations of intolerance to penicillins or macrolides or where there are institutional concerns over *Clostridium difficile*-associated diarrhoea.

Moxifloxacin, the other new Gram-positive fluoroquinolone currently licensed in the UK, has a higher level of activity against the pneumococcus. However, it is not yet licensed for severe CAP and no intravenous formulation is available in the UK at the time of writing.

When is it safe to discharge from hospital?

At the time of hospital discharge, the presence of clinical features associated with clinical instability predicts an adverse clinical course (Table 6). In a cohort study of 680 patients, 40% of those discharged home with two or more of these features died or were readmitted within 30 days compared with 11% of those with none of these features.[16]

Resolution of radiographic changes generally lags behind clinical recovery. Complete resolution occurs in about 50% of cases at two weeks and 70% at six weeks; it is slower in the elderly, those

with multilobar involvement and infection with *Legionella spp*. Repeat CXR at about six weeks is recommended for patients with persistent symptoms and signs or those at higher risk of underlying malignancy (ie smokers and those over 50 years) (Fig 2).

Acknowledgements

I would like to thank Dr John Macfarlane for reviewing this manuscript.

References

1 Jokinen C, Heiskanen L, Juvonen H, Kallinen S *et al*. Incidence of community-acquired pneumonia in the population of four municipalities in eastern Finland. *Am J Epidemiol* 1993;**137**:977–88.
2 BTS Guidelines for the Management of Community Acquired Pneumonia in Adults. *Thorax* 2001;**56**(Suppl 4):iv1–64.
3 www.brit-thoracic.org.uk/docs/MACAPrevisedApr04.pdf
4 Macfarlane JT, Boldy D. 2004 update of BTS pneumonia guidelines: what's new? *Thorax* 2004;**59**:364–6.
5 Woodhead MA, Macfarlane JT, McCracken JS, Rose DH, Finch RG. Prospective study of the aetiology and outcome of pneumonia in the community. *Lancet* 1987;**i**:671–4.
6 Metlay JP, Schulz R, Li YH, Singer DE *et al*. Influence of age on symptoms at presentation in patients with community-acquired pneumonia. *Arch Intern Med* 1997;**157**:1453–9.
7 Lieberman D, Schlaeffer F, Boldur I, Lieberman D *et al*. Multiple pathogens in adult patients admitted with community-acquired pneumonia: a one year prospective study of 346 consecutive patients. *Thorax* 1996;**51**:179–84.
8 Lim WS, Macfarlane JT, Boswell TC, Harrison TG *et al*. Study of community acquired pneumonia aetiology (SCAPA) in adults admitted to hospital: implications for management guidelines. *Thorax* 2001;**56**:296–301.
9 Mandell LA, Bartlett JG, Dowell SF, File TM Jr *et al*. Update of practice guidelines for the management of community-acquired pneumonia in immunocompetent adults. *Clin Infect Dis* 2003;**37**:1405–33.
10 Torres A, Dorca J, Zalacain R, Bello S *et al*. Community-acquired pneumonia in chronic obstructive pulmonary disease: a Spanish multicenter study. *Am J Respir Crit Care Med* 1996;**154**:1456–61.
11 Metlay JP, Fine MJ. Testing strategies in the initial management of patients with community-acquired pneumonia. Review. *Ann Intern Med* 2003;**138**:109–18.
12 Fine MJ, Auble TE, Yealy DM, Hanusa BH *et al*. A prediction rule to identify low-risk patients with community-acquired pneumonia. *N Engl J Med* 1997;**336**:243–50.
13 Lim WS, van der Eerden MM, Laing R, Boersma WG *et al*. Defining community acquired pneumonia severity on presentation to hospital: an international derivation and validation study. *Thorax* 2003;**58**:377–82.
14 Roson B, Carratala J, Dorca J, Casanova A *et al*. Etiology, reasons for hospitalization, risk classes, and outcomes of community-acquired pneumonia in patients hospitalized on the basis of conventional admission criteria. *Clin Infect Dis* 2001;**33**:158–65.
15 Weber SG, Gold HS, Hooper DC, Karchmer AW, Carmeli Y. Fluoroquinolones and the risk for methicillin-resistant *Staphylococcus aureus* in hospitalized patients. *Emerg Infect Dis* 2003;**9**:1415–22.
16 Halm EA, Fine MJ, Kapoor WN, Singer DE *et al*. Instability on hospital discharge and the risk of adverse outcomes in patients with pneumonia. *Arch Intern Med* 2002;**162**:1278–84.