Study of community acquired pneumonia aetiology (SCAPA) in adults admitted to hospital: implications for management guidelines

W S Lim, J T Macfarlane, T C J Boswell, T G Harrison, D Rose, M Leinonen, P Saikku

Abstract
Background—Since the last British study of the microbial aetiology of community acquired pneumonia (CAP) about 20 years ago, new organisms have been identified (for example, *Chlamydia pneumoniae*), new antibiotics introduced, and fresh advances made in microbiological techniques. Pathogens implicated in CAP in adults admitted to hospital in the UK using modern and traditional microbiological investigations are described. Methods—Adults aged 16 years and over admitted to a teaching hospital with CAP over a 12 month period from 4 October 1998 were prospectively studied. Samples of blood, sputum, and urine were collected for microbiological testing by standard culture techniques and new serological and urine antigen detection methods. Results—Of 309 patients admitted with CAP, 267 fulfilled the study criteria; 135 (50.6%) were men and the mean (SD) age was 65.4 (19.6) years. Aetiological agents were identified from 199 (75%) patients (one pathogen in 124 (46%), two in 53 (20%), and three or more in 22 (8%)): *Streptococcus pneumoniae* 129 (48%), influenza A virus 50 (19%), *Chlamydia pneumoniae* 35 (13%), *Haemophilus influenzae* 20 (7%), *Mycoplasma pneumoniae* 9 (3%), *Legionella pneumophila* 9 (3%), other *Chlamydia* spp 7 (2%), *Moraxella catarrhalis* 5 (2%), *Coxiella burnetii* 2 (0.7%), others 8 (3%). Atypical pathogens were less common in patients aged 75 years and over than in younger patients (16% v 27%; OR 0.5, 95% CI 0.3 to 0.9). The 30 day mortality was 14.9%. Mortality risk could be stratified by the presence of four “core” adverse features. Three of 60 patients (5%) infected with an atypical pathogen died. Conclusion—*S pneumoniae* remains the most important pathogen to cover by initial antibiotic therapy in adults of all ages admitted to hospital with CAP. Atypical pathogens are more common in younger patients. They should also be covered in all patients with severe pneumonia and younger patients with non-severe infection. (Thorax 2001;56:296–301)

Keywords: adult community acquired pneumonia; pathogens; aetiology; severity assessment

Community acquired pneumonia (CAP) is common in the UK, affecting 250 000 adults per year of whom 83 000 (33%) are admitted to hospital (67% for patients aged 65 years and over).\(^1\) Mortality ranges from 6% to 15%.\(^2\)

Initial antibiotic management of CAP is empirical and dependent on a clear understanding of the likely pathogens. In the UK this knowledge is based on studies performed in the 1970s and early 1980s.\(^3\) The largest study, conducted by the British Thoracic Society (BTS) in 1982, excluded adults over 74 years of age, thus missing the group of patients who carry the burden and mortality of CAP.\(^7\)

In the last two decades a number of factors have potentially affected the pattern of adult CAP in the UK. The increasing age of the population, often with co-morbid illnesses or resident in residential and nursing homes, has raised concerns of Gram negative enteric bacterial infection in CAP.\(^9\) Concerns of antibiotic resistance and the emergence of “new” pathogens such as *Chlamydia pneumoniae*, implicated in 3–18% of cases of CAP elsewhere,\(^7\) has led to the promotion of fluoroquinolones and newer macrolides for the treatment of CAP.\(^10\)

The impact of these changes on the microbial aetiology of CAP in the UK and how they should influence new management guidelines is unknown. We have performed a large prospective study of the aetiology of CAP and the outcome in adults admitted to hospital using a wide range of microbiological investigations.

Methods

All adults aged 16 years and over admitted to a large teaching hospital (Nottingham City Hospital) over a 12 month period from 4 October 1998 with CAP were eligible for inclusion in the study. The hospital shares all unslected adult medical admissions on a daily basis equally with the University Hospital in Nottingham, both covering a population of about 700 000.

All patients admitted with a provisional diagnosis of CAP were identified in the admissions unit where standardised clinical data and investigations were obtained. CAP was defined as the presence of an acute illness of 21 days or less duration with:

1. features of a lower respiratory tract infection including:
   a. two or more of: new or increasing cough, sputum production, shortness of breath, wheeze, chest pain, new focal or diffuse signs on chest examination;
Study of community acquired pneumonia aetiology (SCAPA) in adults admitted to hospital

Table 1  Criteria for microbiological diagnosis

<table>
<thead>
<tr>
<th>Organism</th>
<th>Diagnostic criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>All bacteria</td>
<td>Isolation from blood processed in Bactec 9240 system or from pleural fluid, bronchoscopic aspirates, or post mortem lung aspirates</td>
</tr>
<tr>
<td>(S) pneumoniae, (H) influenzae or (M) catarrhalis infection</td>
<td>(a) Isolation from washed and diluted sputum in significant numbers by semiquantitative culture or (b) for (S) pneumoniae: • Pneumococcal antigen (PCA) detected in urine (BINAX-NOW kit, results read at 60 minutes) or in sputum by countercurrent immunoelectrophoresis (CIE) or (c) Serological criteria for (S) pneumoniae: • ≥3-fold rise in antibody titre against C-polysaccharide (CPS) or ≥2-fold rise against pneumolysin (PLY), pneumococcal surface antigen A (PsaA) or PLY, PsaA- or CPS-specific immune complexes detected or (d) Serological criteria for (H) influenzae or (M) catarrhalis: • ≥3-fold rise in antibody titre for (M) catarrhalis or Staph aureus</td>
</tr>
<tr>
<td>Atypical and viral pathogens</td>
<td>(a) at least 3-fold rise in IgG or IgA antibodies or (b) presence of IgM antibody, using EIA kit (Labystems, Helsinki, Finland)</td>
</tr>
<tr>
<td>(L) pneumophila</td>
<td>4-fold or greater antibody rise or a single titre of ≥128, by complement fixation test</td>
</tr>
<tr>
<td>(M) pneumoniae, (C) burnetti, influenza A and B, respiratory syncytial virus (RSV) and adenoviruses</td>
<td>Serum samples were tested at the National Public Health Institute, Department in Oulu, Finland for antibody responses to (C) pneumoniae, (H) influenzae, (M) catarrhalis, and (S) pneumoniae. Urine antigen testing was performed in conjunction with the Central Public Health Laboratory, Colindale, London, UK. The criteria used to define infection in the 1982 BTS study were followed, updated for new investigations and pathogens.</td>
</tr>
</tbody>
</table>

(b) one or more constitutional symptoms including fever, confusion, sweating, headaches, aches and pains, sore throat or corzy; (2) radiographic shadowing on an admission chest radiograph consistent with infection and which was neither pre-existing nor of other known cause; and (3) treatment for antibiotics for pneumonia by the attending physician. Patients were excluded if the pneumonia was (a) not the primary cause for hospital admission, (b) an expected terminal event or (c) distal to bronchial obstruction (for example, from lung cancer). Patients with tuberculosis and HIV infection were excluded as were those who had been in hospital within the previous 10 days, were immunocompromised (received chemotherapeutic agents during 6 month period before admission or more than the equivalent of prednisolone 10 mg daily for at least 3 months before admission), or had previously been entered in the study. Comorbid illness was defined as the presence of any of the following conditions for which the patient was under active medical supervision or was receiving treatment at the time of hospital admission: chronic lung disease, cardiac disease (ischaemic heart disease, cardiac failure, hypertension, atrial fibrillation), cerebrovascular disease (including previous transient ischaemic attacks), cognitive impairment, diabetes mellitus, chronic liver disease, chronic renal disease, and inflammatory rheumatological disorders (excluding osteoarthritis). Mental confusion was defined as an abbreviated mental test score of 8 or less and severe pneumonia was defined using the modified BTS (mBTS) severity rule. For the benefit of the discussion, patients aged 75 years and over are termed “elderly”. The study was approved by the Nottingham City Hospital ethics committee. Patients were seen within 24 hours of admission by a study investigator to confirm study entry criteria and informed consent. All chest radiographs were reviewed by an experienced radiologist (DR) blinded to patient details to confirm the radiographic study entry criteria. All patients were seen regularly in hospital and after discharge until their clinical and radiological features had stabilised. Patients who failed to attend were visited at home. A repeat chest radiographic and blood sample for serological testing were obtained at follow up. The main outcome measure was 30 day mortality.

LABORATORY INVESTIGATIONS: CRITERIA FOR MICROBIOLOGICAL DIAGNOSIS

Samples were held at 4°C and transported rapidly to the Nottingham Public Health Laboratory Service (PHLS) laboratory for standard and specialised investigations as previously described and summarised in table 1. The criteria used to define infection in the 1982 BTS study were followed but updated for new techniques (table 1). The pathogens included in the term “atypical” pathogen are specified in table 3. Results for the BINAX-NOW pneumococcal antigen detection kit were read at 60 minutes instead of 15 minutes (as recommended by the manufacturers), based on the increased sensitivity of the 60 minute reading and no apparent difference in specificity (100%) determined in a series of 50 cases of non-pneumococcal proven pneumonias (authors, unpublished data).

STATISTICAL ANALYSIS

Data were analysed using SPSS version 8.0 for Windows. \(\chi^2\) or Fisher’s exact tests were used to compare categorical variables. Multivariate analysis was performed by stepwise logistic regression. Results are expressed as odds ratios (ORs) with 95% confidence intervals (CI) and \(p\) values, taking \(p<0.05\) as the level of statistical significance.

Results

Of 309 patients diagnosed with CAP on admission, eight were unwilling to participate
and 34 were subsequently found not to fulfil study entry criteria, leaving 267 patients in the study cohort, 112 (41%) of whom were elderly (table 2). Of the 267 patients, 190 (71%) were admitted over the winter (October to March), most in December and January (n=88 cases (33%)). Comorbid illnesses were more common in the elderly than in younger patients (86% vs 59%; OR 4.1, 95% CI 2 to 7.5, p<0.001).

Table 3  No (%) of pathogens detected in 267 adults studied according to age

<table>
<thead>
<tr>
<th>Pathogen</th>
<th>Total (%) (n=267)</th>
<th>Died (%) (n=155)</th>
<th>Age &lt;75 years (%) (n=112)</th>
<th>Age &gt;75 years (%) (n=155)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bacterial pathogens</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Streptococcus pneumonia</em></td>
<td>144 (54)</td>
<td>19 (13)</td>
<td>88 (57)</td>
<td>56 (50)</td>
</tr>
<tr>
<td><em>Haemophilus influenzae</em></td>
<td>129 (48)</td>
<td>18 (14)</td>
<td>80 (52)</td>
<td>49 (43)</td>
</tr>
<tr>
<td>Moraxella catarrhalis</td>
<td>28 (7)</td>
<td>1 (5)</td>
<td>11 (7)</td>
<td>9 (8)</td>
</tr>
<tr>
<td>Staphylococcus aureus</td>
<td>5 (2)</td>
<td>0 (0)</td>
<td>1 (0.6)</td>
<td>4 (4)</td>
</tr>
<tr>
<td>Anaerobes†</td>
<td>4 (1.4)</td>
<td>1 (25)</td>
<td>3 (1.9)</td>
<td>1 (0.9)</td>
</tr>
<tr>
<td>Atypical pathogens</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Chlamydia pneumoniae</em></td>
<td>35 (13)</td>
<td>2 (6)</td>
<td>20 (13)</td>
<td>15 (13)</td>
</tr>
<tr>
<td><em>Moraxella pneumoniae</em></td>
<td>9 (3)</td>
<td>0 (0)</td>
<td>8 (5)</td>
<td>1 (0.9)</td>
</tr>
<tr>
<td><em>Legionella pneumophila</em></td>
<td>9 (3)</td>
<td>1 (11)</td>
<td>8 (5)</td>
<td>1 (0.9)</td>
</tr>
<tr>
<td>*Chlamydia spp†</td>
<td>7 (2)</td>
<td>0 (0)</td>
<td>5 (3)</td>
<td>2 (2)</td>
</tr>
<tr>
<td><em>Coxiella burnetii</em></td>
<td>2 (0.7)</td>
<td>0 (0)</td>
<td>2 (3)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>*Viral pathogens</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Influenza virus A</em></td>
<td>62 (23)</td>
<td>6 (10)</td>
<td>36 (23)</td>
<td>26 (23)</td>
</tr>
<tr>
<td><em>Influenza virus B</em></td>
<td>50 (19)</td>
<td>6 (12)</td>
<td>30 (19)</td>
<td>20 (18)</td>
</tr>
<tr>
<td><em>Respiratory syncytial virus</em></td>
<td>11 (4)</td>
<td>0 (0)</td>
<td>6 (4)</td>
<td>5 (4)</td>
</tr>
<tr>
<td><em>Rhinovirus</em></td>
<td>2 (0.7)</td>
<td>0 (0)</td>
<td>2 (3.3)</td>
<td>0 (0)</td>
</tr>
<tr>
<td><em>Adenovirus</em></td>
<td>1 (0.4)</td>
<td>0 (0)</td>
<td>1 (0.6)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Pathogen not identified</td>
<td>68 (25)</td>
<td>15 (22)</td>
<td>33 (21)</td>
<td>35 (31)</td>
</tr>
</tbody>
</table>

Pathogens were identified from bronchial washings in two patients (*L pneumoniae, influenza A*), post mortem lung tissue in one (*S pneumoniae), and pleural fluid in one (*Bacteroides spp*). *Gram negative Enterobacteriaceae (details in text).* †Bacteroides spp isolated from pleural fluid in one patient, *Fusobacterium necrophorum* from blood of a patient with dental caries, and *Gordonia morbillorum* from blood of another patient. ‡Excluding those found to be diagnostic in *C pneumoniae* assays.

SPECIMEN COLLECTION

Specimens obtained included blood cultures prior to antibiotics (n=163 patients (55%) who had not received any antibiotics before admission compared with 39 of 104 (37%) who had been treated with antibiotics (OR 2, 95% CI 1.3 to 3.4, p=0.004). *Staphylococcus aureus* was isolated from the blood of two patients, both of whom had influenza A infection and required treatment in the intensive care unit within 24 hours of admission. *Haemophilus influenzae* and *Moraxella catarrhalis* were diagnosed by sputum culture in 11 (four ampicillin resistant) and two (one ampicillin resistant) cases, respectively, and by serological testing in 10 and four cases, respectively.

Of the four cases who fulfilled our criteria for aerobic Gram negative enterobacterial infection, both *Klebsiella* spp and *Escherichia coli* were isolated from blood culture in one patient. *Pseudomonas aeruginosa* was identified by Gram stain and culture from sputum in three patients with chronic lung disease and prior antibiotic use, two of whom recovered without receiving antipseudomonal therapy which strongly suggests that, in these cases, *Pseudomonas* was not an aetiological agent. Details of the three patients with anaerobic infection are given in table 3.

Atypical and viral pathogens

*Chlamydia pneumoniae* was identified serologically in 35 (13%) cases, more commonly in the winter (31 of 190 patients) than in the summer (four of 77; p=0.015).

*Legionella pneumophila* infection was diagnosed in nine patients (by urine antigen detection in seven and serological testing in eight). Three cases were associated with travel. There was no seasonal variation. Only two patients fulfilled the admission criteria for having severe pneumonia and both survived.

Atypical pathogens were found less often in elderly than in younger patients (16% vs 27%; OR 0.5, 95% CI 0.3 to 0.9, p=0.03) both in the group as a whole and when divided into those with severe and non-severe infection (table 5). Their identification was not influenced by prior

Table 2  Characteristics and outcome of study cohort

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>No (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td></td>
</tr>
<tr>
<td>Mean (SD)</td>
<td>65.4 (19.6)</td>
</tr>
<tr>
<td>Range</td>
<td>18–97</td>
</tr>
<tr>
<td>Age groups (years)</td>
<td></td>
</tr>
<tr>
<td>18–44</td>
<td>49 (18)</td>
</tr>
<tr>
<td>45–64</td>
<td>59 (22)</td>
</tr>
<tr>
<td>65–74</td>
<td>47 (18)</td>
</tr>
<tr>
<td>75–84</td>
<td>68 (25)</td>
</tr>
<tr>
<td>85+</td>
<td>44 (16)</td>
</tr>
<tr>
<td>Men</td>
<td>135 (51)</td>
</tr>
<tr>
<td>Admitted from nursing home</td>
<td>22 (8)</td>
</tr>
<tr>
<td>Smoking status</td>
<td></td>
</tr>
<tr>
<td>Current</td>
<td>73 (27)</td>
</tr>
<tr>
<td>Ex-smoker (&gt;6 months)</td>
<td>100 (37)</td>
</tr>
<tr>
<td>Never</td>
<td>80 (30)</td>
</tr>
<tr>
<td>Not known</td>
<td>14 (5)</td>
</tr>
<tr>
<td>Alcohol consumed</td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>158 (59)</td>
</tr>
<tr>
<td>&lt;21 units/week</td>
<td>76 (28)</td>
</tr>
<tr>
<td>≥21 units/week</td>
<td>15 (6)</td>
</tr>
<tr>
<td>Not known</td>
<td>18 (7)</td>
</tr>
<tr>
<td>Vaccination status</td>
<td></td>
</tr>
<tr>
<td>Influenza vaccine (in last 12 months)</td>
<td>76 (28)</td>
</tr>
<tr>
<td>Pneumococcal vaccine (in last 10 years)</td>
<td>39 (14.6)</td>
</tr>
</tbody>
</table>

...
Table 4  Value of pneumococcal diagnostic tests for the 129 patients diagnosed as having pneumococcal infection

<table>
<thead>
<tr>
<th>Diagnostic test</th>
<th>Sensitivity* (%)</th>
<th>Sole means of diagnosis (no of patients)</th>
<th>No prior antibiotics (n=104)</th>
<th>No prior antibiotics (n=163)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blood culture</td>
<td>9/114 (8)</td>
<td>3</td>
<td>0</td>
<td>9</td>
<td>0.01</td>
</tr>
<tr>
<td>Urine antigen</td>
<td>69/114 (61)</td>
<td>31</td>
<td>17 (16)</td>
<td>52 (32)</td>
<td>0.005</td>
</tr>
<tr>
<td>Sputum culture</td>
<td>9/73 (12)</td>
<td>3</td>
<td>1</td>
<td>8</td>
<td>0.08</td>
</tr>
<tr>
<td>Sputum CIE</td>
<td>15/66 (23)</td>
<td>3</td>
<td>4</td>
<td>11</td>
<td>0.3</td>
</tr>
</tbody>
</table>

*Both patients had *C pneumoniae as the sole pathogen detected. One man aged 90 died 7 days after hospital admission and another aged 78 died at home on day 29 having been previously discharged well.
†Travel associated *L pneumophilia infection.

Table 5  Relationship between infection and atypical pathogen, age, and severity

<table>
<thead>
<tr>
<th>Number with atypical pathogen detected</th>
<th>Total (n=60)</th>
<th>Age &lt;75 years (n=42)</th>
<th>Age ≥75 years (n=18)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total no of patients</td>
<td>267</td>
<td>155</td>
<td>112</td>
</tr>
<tr>
<td>Total with atypical pathogen</td>
<td>60 (22%)</td>
<td>42 (27%)</td>
<td>18 (16%)</td>
</tr>
<tr>
<td>Proportion with severe infection who</td>
<td>22/103 (21%)</td>
<td>11/41 (27%)</td>
<td>11/62 (18%)</td>
</tr>
<tr>
<td>had an atypical infection</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Proportion with non-severe infection</td>
<td>38/164 (23%)</td>
<td>31/114 (27%)</td>
<td>7/50 (14%)</td>
</tr>
<tr>
<td>who had an atypical infection</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Severe CAP (died)</td>
<td>22 (2)</td>
<td>11 (0)</td>
<td>11 (2)*</td>
</tr>
<tr>
<td>Non-severe CAP (died)</td>
<td>38 (1)</td>
<td>31 (1)†</td>
<td>7 (0)</td>
</tr>
</tbody>
</table>

*Both patients had *C pneumoniae as the sole pathogen detected. One man aged 90 died 7 days after hospital admission and another aged 78 died at home on day 29 having been previously discharged well.
†Travel associated *L pneumophilia infection.

Discussion

This is the first UK study to employ a wide range of diagnostic tools to identify the aetiological agents in adult CAP, including *C pneumoniae*, and to include patients aged 75 years and above. The high pathogen detection rate (75% of cases) reassuredly found no substantial shift in the causes of CAP or antibiotic sensitivity in the UK over the last 20 years, with penicillin sensitive *S pneumoniae* still the predominant causative agent in nearly half of cases.14 This is an important finding when reviewing management guidelines for this common condition, particularly as perceived changes in the pattern of CAP have led to changes in national antibiotic guidelines elsewhere.10

Pneumococcal infection was diagnosed less commonly in patients who had received antibiotics before admission, presumably due to decreased sensitivity of microbiological tests in this circumstance.1 None of the bacteraemic patients had received prior antibiotics. If prior antibiotic use is taken into account, then the true estimate of pneumococcal incidence is 55%, similar to the 1982 BTS study.

This is the first UK report on *C pneumoniae* infection in adult CAP and it was identified as the second most common pathogen. However, *C pneumoniae* was frequently found in mixed infections, in over half of the cases with *S pneumoniae*, as reported in other countries.8,11,12 Pathogens such as *C pneumoniae* may play a role in promoting other bacterial infection through their effect on ciliated epithelial cells.13 The evidence regarding the importance of *C pneumoniae* as a pathogen is conflicting. Some studies report that outcome is not affected when beta-lactam antibiotics alone are used for patients with evidence of *C pneumoniae* infection.8,14 By contrast, studies from Finland have shown that mixed pneumococcal and *C pneumoniae* infections cause more severe CAP than that associated with either pathogen alone.11,14 Our study did not find this (data not shown). The number of patients fulfilling the criteria for severe infection were similar for these three groupings. The overall mortality in patients with pneumococcal infection was much higher than in those infected with *C pneumoniae* (14% v 6%)
and no patients with mixed pneumococcal and 
C pneumoniae infection died. However, two 
elderly patients with C pneumoniae infection alone died. Outbreaks associated with signif-
cant mortality have been reported in homes 
for the elderly in the USA.15

Our study supports the view that, unlike 
other atypical infections, C pneumoniae infec-
tion affects adults of all ages, usually as a 
co-pathogen, and can be associated with severe 
infection and occasionally death. This provides 
support to the recommendations to include an 
antibiotic effective against atypical pathogens 
for patients of all ages with severe CAP.1

The frequency of L pneumophila infection 
was lower than the 15% we reported 17 years 
ago, a trend seen in other countries.2 16 
Although yearly variation may partly explain 
these findings,17 increased use of macrolides in 
the community may also be relevant.16 Most of 
our cases had non-severe CAP, contrary to the 
view that Legionella infection is usually severe.18 
All our cases received an early macrolide as 
part of their hospital treatment, possibly influ-
encing our low mortality. Delayed treatment 
for Legionella infection relates to increased 
mortality.19 Furthermore, the report of a 
positive Legionella urine antigen test within 3 
days of admission positively influenced early 
management in seven of nine patients, empha-
sising the likely value of urine antigen detection 
as a rapid diagnostic tool for patients admitted to 
hospital with CAP.

Infection with M pneumoniae was uncom-
mon which is probably explained by the four 
yearly cycle of mycoplasma epidemics in 
Europe; our study coincided with the tail end of a 
national epidemic.1 Our mycoplasmal 
pneumonia rate of 3% is similar to the 2% 
reported in 1982, contrasting with the 14% 
and 18% rates reported in UK studies during 
epidemic years.20 6 Ready access to current epi-
demiological trends, as is available on the 
PHLS website (www.phls.co.uk), could be use-
ful to clinicians for planning empirical anti-
biotic management.

Most of the cases of influenza were compli-
cated by bacterial co-infections, emphasising 
the importance of influenza prevention. Only 
68 of 175 eligible patients (39%) had received 
the influenza vaccine in the preceding 12 
months, higher than the estimated 23% vaccine 
uptake among high risk patients in England 
and Wales in 1996/7 but still an area that can be 
improved.21 Similarly, pneumococcal vaccina-
 tion in the last 10 years was reported in only 29 
(25%) of 114 eligible patients.

IMPLICATIONS FOR THE MANAGEMENT OF CAP

How does this study contribute to the develop-
ment of an up to date management strategy for 
patients hospitalised with CAP?

Nearly all hospitals in the UK now operate 
an integrated emergency admission policy for 
adults of all ages, many of whom are elderly. 
Our patient cohort is typical of the pattern of 
CAP in the UK with half aged 65 years and 
above and about 40% over 75 years.1 21 We have 
shown that penicillin sensitive S pneumoniae 
remains the most important pathogen in adults 
of all ages admitted with CAP and this should 
be covered effectively by the chosen empirical 
antibiotic. Ampicillin resistant bacteria are 
uncommon and concerns regarding Gram 
negative enterobacterial infections in the eld-
ery seem unfounded.

Our study confirmed that pneumococcal, 
Haemophilus, and staphylococcal infections are 
the usual bacterial pathogens implicated in 
fatal CAP and such pathogens should always 
be covered by initial antibiotic therapy for 
severe pneumonia. We also recommend that 
empirical cover for atypical pathogens should 
be offered to all patients with severe CAP as 
21% of our patients with atypical infection had 
features of severe pneumonia and three died. 
This is also important as several previous stud-
ies have found Legionella infection to be the 
second most common cause of CAP requiring 
intensive care.5 18 The high proportion of 
patients who died or needed admission to the 
intensive care unit within the first few days of 
hospital admission emphasises the need for 
early identification of patients with severe 
pneumonia. The modified BTS rule performs 
better than the BTS rule in this regard, with 
sensitivity and NPV values being high, even in 
the elderly population. We found that patients 
could be stratified into increasing mortality risk 
groups using the four individual “core” fea-
tures of the mBTS rule (CURB: Confusion, 
Urea, Respiratory rate, Blood pressure) — a 
strategy which may be more useful in manage-
ment than just two categories of severe and 
non-severe. The “post-take” ward round is 
recommended as a good time to review 
patients and to decide on step up or step down 
of treatment options.

For non-severe CAP our study supports the 
use of empirical antibiotic cover for atypical 
pathogens for younger patients admitted to 
hospital but not for elderly patients. Atypical 
pathogens were twice as common in younger 
patients and led to no deaths in elderly patients 
presenting with features of non-severe pneu-
monia. Avoidance of early routine combination 
antibiotics, including a macrolide, in the latter 
patient group would probably be of net advan-
tage in view of the complications of multiple 
antibiotic use in the elderly.

Overall, this study supports the current UK 
recommendations for covering the range of 
pathogens found in the management of CAP, 
stratified according to disease severity. Rapid 
urine antigen testing looks promising as 
an early way of detecting some pathogens 
including S pneumoniae and L pneumophila. 
More experience is needed before recom-
mending these tests as a reliable way of direct-
more accurately the initial antibiotic 
choice for CAP.
Study of community acquired pneumonia aetiology (SCAPA) in adults admitted to hospital

Conflicts of interest: TR has received research funding from Eisai Ltd and support for attending conferences from Wyeth; WSL has received research funding from Hoechst Marion Roussel (this study) and Bayer and support for attending conferences from Bayer. JTM has received consultancy fees from Pfizer, Abbott, Hoechst Marion Roussel, Trinity, Glaxo Wellcome, research funding from Hoechst Marion Roussel (this study), Rhone Poulenc Rorer and Bayer, lecture fees from AstraZeneca, Hoechst Marion Roussel and Pfizer and support for attending conferences from Astra, Pfizer, Allen and Hanburry and 3M.