

Community-acquired pneumonia: the annual cost to the National Health Service in the UK

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ABSTRACT: The aim of this study was to estimate the direct annual healthcare costs to the UK National Health Service (NHS) of managing community-acquired pneumonia.

Using a prevalence-based burden of illness approach, health service resource use and corresponding costs attributable to the management of community-acquired pneumonia during 1992/1993 in the UK were obtained from published sources and commercial databases, and supplemented by a telephone survey of general practitioners, finance directors, community nurses, receptionists and nurses in out-patient respiratory clinics, ambulance services, and consultant respiratory physicians. The study was appraised by a Peer Review Panel, representing a cross-section of experts from different locations. This study was a predefined subgroup analysis of a previous, larger study that estimated the annual cost to the NHS of treating all community-acquired lower respiratory tract infections.

The analysis shows that there are 261,000 episodes of community-acquired pneumonia annually in the UK, costing £440.7 million at 1992/1993 prices (32% of the annual cost for all community-acquired lower respiratory tract infections). Approximately 83,153 annual cases of community-acquired pneumonia are treated in hospital (32% of all episodes) and account for 96% of the annual cost. The average cost for managing pneumonia in the community is £100 per episode, compared to £1,700–£5,100 when the patient is hospitalized, depending on the length of hospitalization. Hospitalization accounts for 87% of the total annual cost.

In conclusion, community-acquired pneumonia in the UK incurs a direct healthcare cost of £440.7 million annually at 1992/1993 prices. Developing and implementing strategies to prevent and minimize hospitalization will significantly reduce this annual cost and should be assessed in future studies.

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Community-acquired pneumonia is associated with significant morbidity, mortality and utilization of health service resources [1] across Europe. For example, the estimated incidence in the UK is 1–3 per 1,000 of the population [2]. Pneumonia is the fifth leading cause of death in the UK [3], accounting for 54,597 deaths in 1993 in England and Wales, equivalent to 9% of total mortality [4]. The young, elderly and those with concomitant disease are more likely to experience morbidity and mortality [2].

Recent European studies suggested that the proportion of community-acquired lower respiratory tract infections (LRTIs) diagnosed as community-acquired pneumonia was around 18% [5]. However, despite being a life-threatening disease, 23% of patients in Germany and 16% in the UK do not receive a prescription for community-acquired pneumonia. Even when patients receive a diagnosis of community-acquired pneumonia, the treatment choice does not reflect differences in antibiotic sensitivity [5].

Effective treatment of pneumonia is essential if the condition is not to prove fatal. Chest radiographs are the only precise way of diagnosing pneumonia, but doc-

tors across Europe tend to prescribe empirically during the first episode [6]. As a result, prescribing of excessive and inappropriate antibiotics increases the economic burden imposed by LRTIs in general, and community-acquired pneumonia in particular.

Against this background, we estimated the direct annual healthcare costs to the National Health Service (NHS) of treating patients suffering from community-acquired pneumonia in the UK. This was a predefined subgroup analysis of a larger study that estimated the annual cost to the NHS of treating all community-acquired LRTIs in the UK [7]. To our knowledge, this is the first economic evaluation to estimate the direct costs imposed by community-acquired pneumonia.

Methods

Study design

The study was designed as a prevalence-based burden of illness analysis to measure health service resource use attributable to the management of community-acquired pneumonia during 1992/1993 in the UK.

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Data collection

Health service resource use and corresponding costs were obtained from published sources, three databases: Medical Data Index (MDI); Medicare; and Hospital Episode Statistics, and supplemented by a telephone survey of general practitioners (GPs), hospital finance directors, community nurses, receptionists and nurses in out-patient respiratory clinics, NHS ambulance services and consultant respiratory physicians from across the UK, as reported previously [7]. The MDI database is produced by Intercontinental Medical Statistics (IMS), and is based on consultations, diagnosis and prescription information provided for a 7 day period in each quarter by 250 panel GPs and 250 sample GPs. The Medicare database is produced by Medicare Audits, and is based on computer print-outs supplied by pharmacists on a monthly basis from 299 hospitals across the UK. The Hospital Episode Statistics is published by the Department of Health and contains the number of completed hospital consultant episodes for each diagnostic category, provided by each health authority.

The resources used in the analysis refer to the UK. When data referred to England alone, the prevalence of community-acquired pneumonia was assumed to be the same throughout the UK.

The study was critically appraised by a Peer Review Panel, representing a cross-section of experts from different locations.

Results

Treatment path

The treatment path constructed for patients suffering from all community-acquired LRTIs [7] was used to determine health service resource use and corresponding costs at 1992/1993 prices. Resource costs are presented at 1992/1993 prices, since NHS resource use was collected for the same period. When resource costs were not available at 1992/1993 prices, they were uprated using the Health Service Price Index [8].

GP consultations

The IMS MDI database [9] suggested that 261,000 annual episodes of community-acquired pneumonia generated 350,000 GP consultations. This represents 1% of GP consultations for all community-acquired LRTIs [7]. Of these, 148,000 were patient visits to the surgery, 197,000 were domiciliary visits, and 5,000 were telephone conversations. The unit cost of a GP surgery consultation is £7.30 [10], and a domiciliary visit costs £21.20 [10]. The analysis assumes that a telephone conversation costs half a surgery consultation (*i.e.* £3.65). Therefore, the annual cost of GP consultations attributable to treating community-acquired pneumonia was £5.3 million.

Forty seven percent of patients consulting a GP for community-acquired pneumonia were over 64 yrs of age. Those aged 45–64 yrs accounted for 24% and those aged 20–44 yrs for 20% of consultations. Those aged <12 yrs accounted for a further 8% of consultations for community-acquired pneumonia, and those aged 12–19 yrs for only 3% [9].

In-patient stay

Community-acquired pneumonia resulted in 83,153 hospital admissions annually, representing 35% of admissions for all community-acquired LRTIs, and occupied 2.5 million bed days each year [11]. Of these, 43,500 bed days were on an intensive care unit (ICU) [12], with the remainder on acute medical wards. A bed day on an acute medical ward costs, on average, £134.43 (range £110.93–£157.92) [13]. The unit cost of an ICU bed day [14] was uprated to £1,214.64 at 1992/1993 prices. Therefore, the estimated total annual cost of in-patient stay attributable to community-acquired pneumonia was £52.8 million for ICU stay, and £330.9 million for acute ward stay, a total of £383.7 million.

The mean hospital admission for community-acquired pneumonia lasted 30 days (median 7 days), with 74% being discharged within 14 days (range 0–91 days) [11]. The 26% of admissions who remained in hospital for at least 15 days incurred 73% of in-patient costs. Therefore, in-patient stay for community-acquired pneumonia for those patients discharged within 14 days cost £103.6 million, excluding diagnostic tests and drugs.

Of patients hospitalized with community-acquired pneumonia [11], those aged >64 yrs accounted for 65% of admissions and those aged 0–4 yrs for a further 10%. Those aged 15–64 yrs accounted for 20%, and those aged 5–14 yrs for 5% of admissions for community-acquired pneumonia [11].

Prescribed drugs

Table 1 summarizes the annual number of prescriptions and corresponding costs [15, 16] of drugs prescribed by GPs for community-acquired pneumonia. Drugs prescribed by GPs were derived from the IMS MDI database [9], and cost an estimated £1.5 million at 1992/1993 prices.

Table 1 also summarizes the annual number of prescriptions and corresponding costs of drugs prescribed by hospital-based clinicians to treat community-acquired pneumonia. Using data derived from the Medicare database [12], the annual hospital drug bill was calculated to be £12.9 million.

The dispensing costs were estimated as 10% of the total drug cost [7]: £0.1 million and £1.3 million for drugs prescribed by GPs and in hospitals, respectively.

Patients receiving intravenous aminoglycosides and glycopeptides undergo serum concentration monitoring ([17], and T. Elliott, Queen Elizabeth Hospital, Birmingham, personal communication, 1995), which cost £17.30 per assay at 1992/1993 prices [17]. The annual cost of therapeutic drug monitoring for these agents was calculated to be £352,800.

In total, drugs prescribed by GPs and in hospitals, dispensing and therapeutic drug monitoring were calculated to cost the NHS £16.1 million annually for the drug treatment of community-acquired pneumonia.

Out-patient visits

We have previously reported that 3% of episodes result in three out-patient visits per patient per year and that

Table 1. – Drugs prescribed for community-acquired pneumonia: annual number and corresponding cost

Drug class	GP-prescribed		Hospital-prescribed	
	Annual number of scrips [9] ×10 ³	Annual cost of scrips £ ×10 ³	Annual number of scrips [12] ×10 ³	Annual cost of scrips £ ×10 ³
Broad spectrum antibiotics	61.0	286.1	166.7	3125.5
Macrolides and similar	42.0	350.7	82.4	3689.6
Cephalosporins and combinations	30.0	455.7	85.9	3754.2
Tetracyclines and combinations	2.0	13.5	0	0
Trimethoprim combinations	12.0	23.0	1.8	103.3
Fluoroquinolones	25.0	341.3	4.8	725.6
Aminoglycosides	0	0	9.2	192.9
Carbenicillins and similar	0	0	0.5	328.4
Polyenes	0	0	0.01	3.6
Chloramphenicol	0	0	0.05	10.8
Nitroimidazoles	0	0	10.9	283.4
Glycopeptides	0	0	1.0	636.6
Rifamycin	0	0	3.2	9.6
Non-antibiotics	7.0	0.1	0	0
Total	179.0	1470.4	366.5	12863.5

Non-antibiotics include cough sedatives, expectorants, systemic nasal preparations, pharyngeal preparations. GP: general practitioner.

each hospital admission results in one postdischarge out-patient clinic visit [7]. Hence, community-acquired pneumonia generates approximately 96,700 out-patient clinic visits annually. An out-patient clinic visit costs £63.66 at 1992/1993 prices [13]. Therefore, the total cost of out-patient visits for community-acquired pneumonia was calculated to be £6.2 million annually.

Diagnostic tests

The mean annual number of diagnostic tests (fig. 1) was based on the GP survey and discussions with respiratory physicians. The average cost of each diagnostic test was determined from discussions with finance directors. The annual cost of GP-initiated and in-patient-based diagnostic tests attributable to community-acquired pneumonia was calculated to be £8.4 million and £12.7 million, respectively. However, the total cost of diagnostic tests attributable to community-acquired pneumonia depends on local unit costs and is underscored by the range of costs in the legend to figure 1. Nevertheless, this analysis indicates the order of magnitude of the cost of diagnostic tests among patients suffering from community-acquired pneumonia.

Community nursing visits

The provider survey suggested that the 42% of patients with community-

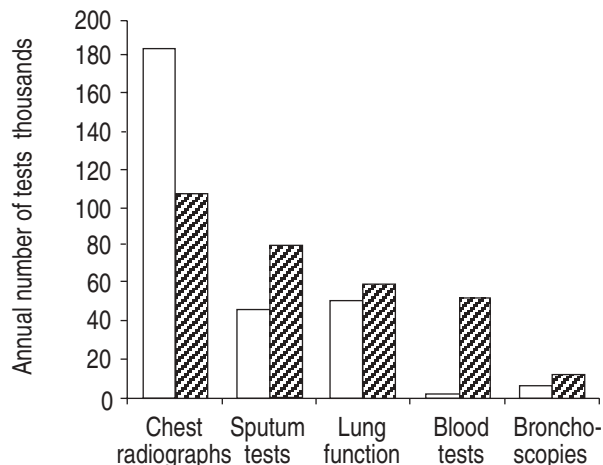


Fig. 1. – Annual number of diagnostic tests. The unit cost of: a chest radiograph was £24.6 (range £10.0–£50.0); a blood test was £22.3 (range £14.4–£50.0); a sputum test was £6.90 (range £6.0–£22.0); lung function testing was £70.5 (range £60–£150); and bronchoscopy was £367 (range £250–£500). □ : out-patients (total cost £8.4 million); ▨ : in-patients (total cost £12.7 million).

acquired pneumonia who are over 65 yrs of age [9] receive three community nursing visits once discharged from hospital. Hence, there are 83,000 community nursing visits attributable to community-acquired pneumonia annually. Using a unit cost of £15.39 per nursing visit [10], community nursing visits to patients cost £1.3 million annually.

NHS transport

We have previously reported the method by which NHS transportation for community-acquired LRTIs was calculated [7]. On this basis, the annual cost of transporting patients suffering from community-acquired pneumonia to and from hospital was calculated to be £7.1 million.

Sensitivity analysis

Precise data for some variables (fig. 2) were unavailable. Consequently, a sensitivity analysis (table 2) examined the impact of varying the assumptions by plausible amounts.

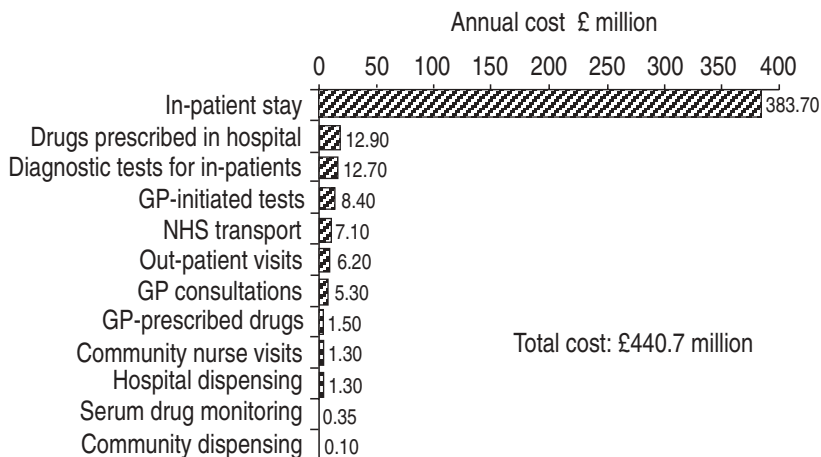


Fig. 2. – The direct annual cost (at 1992–1993 prices) of each component of treatment for community-acquired pneumonia. GP: general practitioner; NHS: National Health Service.

Table 2. – Sensitivity analysis

Scenario	Range of annual burden £ million
Proportion of episodes of community-acquired pneumonia diagnosed by GPs was misdiagnosed by 25% above/below baseline	436.5–444.9
Proportion of in-patients undergoing diagnostic test changes by 25% above/below baseline	438.2–443.0
The unit cost of each diagnostic test changes to the highest and lowest in the range (see fig. 1)	432.7–459.8
Proportion of episodes resulting in out-patient referral changes by 67% above/below baseline	440.1–441.8
The baseline value of out-patient visits increases by two additional visits and decreases by one visit	440.2–441.7
The baseline value of community nursing visits changes by 100% and mortality among in-patients over 65 yrs of age alters by 30% above/below baseline	439.4–442.1
Proportion of patients transported by NHS ambulances and the the average return journey changes by 20% above/below baseline	438.5–443.8
The cost of a bed day increases to £157.92 on acute wards and by 20% on ICUs, and the cost of a bed day decreases to £110.93 on acute wards and by 20% on ICUs	374.1–509.1

GP: general practitioner; NHS: National Health Service; ICU: intensive care unit.

Discussion

Of the £1,364.3 million the NHS spends each year treating 16.3 million episodes of community-acquired LRTIs [7], 32% (£440.7 million) is spent treating pneumonia (fig. 2). Of the 261,000 annual episodes of community-acquired pneumonia, 32% result in hospital admissions and account for 96% of the annual expenditure (table 3). This is not surprising, since in-patient stay accounts for 87% of the total annual cost. Consequently, the 68% of episodes managed in the community incur only 4% of the total annual cost (table 3). In other words, the average cost for managing pneumonia in the community is £100 per episode. In contrast, the cost of managing a patient that is hospitalized with community-acquired pneumonia ranges £1,700–£5,100 per episode, depending on the length of hospitalization.

Table 3. – Annual direct costs to the NHS of managing community-acquired pneumonia

Resource	Community cost £ million	In-patient cost £ million
GP consultations	5.3	-
GP-prescribed drugs	1.5	-
Community dispensing fees	0.1	-
GP-initiated diagnostic tests	8.4	-
Out-patient visits	1.5	4.7
In-patients stay	-	383.7
Diagnostic tests for in-patients	-	12.7
Drugs prescribed in hospital	-	12.9
Laboratory assays	-	0.3
Hospital dispensing fees	-	1.3
Community nurse visits	1.3	-
NHS transport	0.1	7.0
Annual cost to the NHS	18.2	422.6
Distribution of the cost %	4	96

Community cost relates to resources utilized when treating patients in the community. In-patient cost relates to resource use attributable to hospitalization. GP: general practitioner; NHS: National Health Service.

Therefore, reducing the number of in-patients, the length of hospital stay or both will dramatically reduce the direct costs of managing community-acquired pneumonia.

Some 13% of admissions attributable to community-acquired pneumonia last a maximum of 1 day [11]. Therefore, could more effective community management prevent some of these admissions? Would increasing community-based resources allow patients to be discharged from hospital earlier? Assuming a mortality rate of 5.7% [18], the analysis estimated that the annual cost of managing these patients in the community would potentially rise by £1 million. However, this would be offset by the reduction in hospital stay and potentially save £18–£52 million. Hence, this study highlights the need to improve patient and doctor education relating to community-acquired pneumonia and more cost-effective management strategies within the community and the hospital.

Annual influenza vaccinations for all people over 65 yrs of age may reduce the annual cost of community-acquired pneumonia. Such vaccinations not only reduce influenza infections but also reduce cases of pneumonia, hospitalization (resulting from influenza-related illness) and mortality by more than 50% [19]. This strategy has been shown to be cost-effective in the USA [20, 21]. Although the annual cost of influenza to the NHS (estimated to be £15 million at 1992/1993 prices [7]) is lower than in the USA and the cost of vaccination is twice as high, extending vaccination to all the over 65 year olds is still considered to be a cost-effective intervention in the UK [22]. Unlike many other European countries that have an age-related policy, the Department of Health promotes vaccinations only for those considered to be at high medical risk [23].

Precise data were not available for several variables. However, the analysis highlights the magnitude of the direct costs for the treatment of community-acquired pneumonia: £400 million annually. Additionally, the sensitivity analysis demonstrates that varying uncertain assumptions does not significantly affect the outcome of the study: the margin of error is $\leq 4\%$. However, the annual cost of community-acquired pneumonia is sensitive to variations in hospitalization cost. Altering the cost of hospital stay to the limits of the range of unit costs changed the annual burden by up to 16%.

The diagnosis of pneumonia by GPs is difficult [6], and therefore the GPs participating in the MDI database panel may have misdiagnosed some cases. However, sensitivity analysis (table 2) shows that, even if the incidence of misdiagnosis by GPs was as high as 25%, the margin of error within our cost analysis would be less than 1%.

This study, together with our previous analysis [7], provides a framework to assess the relative cost implications of the large variations in the pattern of prescribing and the number of diagnostic tests performed for LRTIs and community-acquired pneumonia in Europe [5, 24].

Our analysis shows that, of drugs prescribed in hospital, 45% of all prescriptions are broad-spectrum antibiotics, 23% are cephalosporins, 22% are macrolides, 3% are aminoglycosides and 3% are nitroimidazoles. In comparison, of drugs prescribed in the community by GPs, 34% of all prescriptions are broad-spectrum antibiotics, 23% are macrolides, 17% are cephalosporins and 14% are fluoroquinolones. A recently reported European survey of prescribing for community-acquired pneumonia [5] showed that oral penicillins were the first-line antibiotic in France and the UK. In contrast, physicians in Germany and Spain preferred to prescribe tetracyclines and macrolides, respectively, and Italian doctors favoured parental third generation cephalosporins. The authors could not identify any specific reasons for these differences, although they considered they may be due to differences in healthcare systems [5]. The European analysis relied on GPs' recall of their prescribing to the last three to four patients with LRTIs, whereas the present study utilized the IMS MDI database [9], which recorded what GPs actually prescribed. Nevertheless, the findings of both studies are broadly similar.

Patients seeking medical attention for community-acquired pneumonia appear to be managed to a greater extent by GPs in other European countries than in the UK, where there is more frequent hospitalization [5]. This difference in management may be due to national differences in healthcare systems and drug availability.

The present study excludes direct costs to patients, their families and non-healthcare providers, and indirect costs, such as lost working days, and intangible costs. Consequently, the cost to the NHS grossly underestimates the cost of community-acquired pneumonia to society as a whole in the UK. Furthermore, it was not possible to assess the impact of potentially influential variables, such as age and co-morbidities, although those aged >64 yrs account for at least 62% of the annual cost. The analysis also excludes the cost of treating nosocomial pneumonia, which accounts for approximately 15% of all nosocomial infections [24]. The highest incidence of nosocomial pneumonia occurs in patients ventilated in an ICU, although the highest incidence of postoperative pneumonia occurs following thoracic or abdominal surgery [25].

In conclusion, the analysis demonstrates that the direct cost to the National Health Service of managing community-acquired pneumonia is £440.7 million annually at 1992/1993 prices (uprated to £480.4 million at 1995/1996 prices). Over 95% of the burden was incurred in hospitals, although only 32% of episodes resulted in hospital admission. Sensitivity analysis demonstrates that the model is sensitive to hospital stay, which itself accounted for 87% of the total annual cost. Developing and implementing strategies to prevent and minimize hospitalization will significantly reduce the annual cost, and should be assessed in future studies.

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References

1. British Thoracic Society. Guidelines for the management of community-acquired pneumonia in adults admitted to hospital. *Br J Hosp Med* 1993; 49: 346–350.
2. Meyer RD, Finch R. Community-acquired pneumonia. *J Hosp Infect* 1992; 22 (Suppl. A): 51–59.
3. Macfarlane J. Community-acquired pneumonia. *Br J Dis Chest* 1987; 81: 116–127.
4. Office of Population Census and Surveys. Mortality statistics. HMSO, London, 1993.
5. Huchon GJ, Gialdroni-Grassi G, Leophonte P, *et al.* Initial antibiotic therapy for lower respiratory tract infection in the community: a European survey. *Eur Respir J* 1996; 9: 1590–1595.
6. Dorca J, Torres A. Lower respiratory tract infections in the community: towards a more rational approach. *Eur Respir J* 1996; 9: 1588–1589.
7. Guest JF, Morris A. Community-acquired lower respiratory tract infections: The annual cost to the NHS. *Br J Med Econ* 1996; 10: 263–273.
8. Department of Health. Health Service Price Index. Appendix 1.
9. Intercontinental Medical Statistics Ltd. Medical Data Index, 1993.
10. Netten A, Smart S. Unit costs of community care 1992/1993. PSSRU, University of Kent, Canterbury.
11. Department of Health. Hospital Episode Statistics, England, 1993.
12. Medicare Audits Ltd, 1993.
13. Chartered Institute of Public Finance and Accountancy (CIPFA): Health Database, 1993.
14. Singer M, Myers S, Hall S, *et al.* The cost of intensive care: a comparison on one unit between 1988 and 1991. *Intensive Care Med* 1994; 20: 542–549.
15. Monthly Index of Medical Specialities (MIMS). Haymarket 1992 and 1993 editions.
16. Department of Health. Drug Tariff 1992 and 1993 editions. London, HMSO.
17. Malek M, Lynch W, Wells N, *et al.* A comparison of the costs of ceftazidime therapy and gentamicin combination in three UK hospitals. *J Antimicrob Chemother* 1992; 29: 207–217.
18. Research Committee of the British Thoracic Society and the Public Health Laboratory Service. Community-acquired pneumonia in adults in British hospitals in 1982–1983: a survey of aetiology, mortality, prognostic factors and outcomes. *Q J Med* 1987; 239: 195–220.
19. Gross PA, Hermogenes AW, Sacks HS, *et al.* The efficacy of influenza vaccine in elderly persons. A meta-analysis and review of the literature. *Ann Intern Med* 1995; 123: 519–527.
20. Mullooly JP, Bennett MD, Hornbrook MC, *et al.* Influenza vaccination programs for elderly persons: cost-effectiveness in a health maintenance organization. *Ann Intern Med* 1994; 121: 947–952.
21. Nichol KI, Margolis KL, Wuorenma J, von Sternberg T. The efficacy and cost effectiveness of vaccination against influenza among elderly persons living in the community. *N Engl J Med* 1994; 22: 778–784.
22. Warren SS, Nguyen-Van-Tam JS, Pearson CG, Madeley RJ. Practices and policies for influenza immunization in old people's homes in Nottingham (UK) during the 1992–1993 season: potential for improvement. *J Public Health Med* 1995; 17: 392–396.
23. Department of Health. Influenza Immunisation. The Chief Medical Officer, Department of Health Press Release. 1996; Annex A/PL CMO (96)7: 1–2.
24. Woodhead M, Gialdroni-Grassi G, Huchon GJ, *et al.* Use of investigations for lower respiratory tract infection in the community: a European survey. *Eur Respir J* 1996; 9: 1596–1600.
25. Winter JH. The scope of lower respiratory tract infection. *Infection* 1991; 19 (Suppl. 7): S359–S364.