4 Lower Respiratory Disease

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1 Executive summary

Statement of the problem

Respiratory disease has a substantial impact on the health of populations at all ages and every level of morbidity. Acute upper respiratory infections are the commonest illnesses experienced by individuals throughout life, accounting for over 27% of all GP consultations. Asthma and chronic obstructive pulmonary disease are the cause of almost 5% of all admissions and bed-days, and lower respiratory infections are responsible for almost 11% of deaths. While still uncommon, TB rates appear to be rising and it remains an important problem in some communities. Cystic fibrosis is the commonest inherited disorder in the UK and is an important cause of death in young adults. Improvements in survival mean increasing use of expensive medications and medical technologies.

Sub-categories

The principal sub-categories of lower respiratory disease considered in this review were chosen on the basis of their public health or health service impact, and are:

1 lower respiratory infections in children
2 lower respiratory infections in adults, including pneumonia
3 asthma
4 chronic obstructive pulmonary disease (COPD)
5 tuberculosis
6 cystic fibrosis.

Upper respiratory conditions (including allergic rhinitis), influenza, lung cancer, neonatal respiratory problems, occupational diseases, sleep-disordered breathing, diffuse parenchymal lung disease (a wide range of conditions that include fibrosing alveolitis and sarcoidosis) and other respiratory disorders are not specifically reviewed in detail in this revision. Together, these conditions account for 7% of deaths and 2.5% of hospital admissions, and form a substantial part of the workload of respiratory physicians.

Prevalence and incidence

In 1999, lower respiratory disorders (excluding lung cancer) accounted for 17.6% of all deaths, 7.1% of finished consultant episodes (FCEs) and 10.2% of inpatient bed-days, and during 1991–92, these conditions were the reason for 12.1% of general practitioner consultations.

Acute respiratory infections in children

Acute lower respiratory infections comprise a wide range of poorly defined clinical syndromes causing considerable distress and possible long-term lung damage. Population surveys suggest that about 20% of children are affected by bronchitis or bronchiolitis, and 1–5% suffer pneumonia at some time. Risk factors for bronchitis include male sex, the North or West regions of the UK, poor socio-economic status, large families, white ethnic group, tobacco smoke exposure and bottle feeding. Of children aged 0–4 years, 157.8 per 1000 consult GPs annually with bronchitis or bronchiolitis, and admissions account for 24.3 per 10 000 FCEs in this age group. Including pneumonia, lower respiratory infections account for 3% of childhood deaths. Infection rates are seasonal, varying 2–3 fold during the year, and overall rates of hospital admissions appear to be falling. Whooping cough is now rare, with almost all eligible children immunised (up from a low point of just over 30% in 1979).

Lower respiratory infections in adults

Respiratory tract infections in adults are major causes of morbidity and mortality in the community. They are the stated reason for 16% of all adult GP consultations and resulted in over 50 million antibiotic prescriptions during 1995. Community-acquired pneumonia affects approximately 500 adults per 100 000 annually (230–360 per 100 000 all ages), 32% of whom are hospitalised. There is a marked seasonal distribution in infections, with a peak between January and March. Pneumonia has a case fatality rate of approximately 3% and is identified as the cause of 11% of adult deaths (3.3% in adults under 65 years). Pathogens are identified in only 45–70% of pneumonia, and classification by infective aetiology may not be helpful. However, *Streptococcus pneumoniae*, *Haemophilus influenzae* and influenza A are the commonest pathogens (> 50%), along with *Mycoplasma* in epidemic years. Nosocomial pneumonia is a significant burden on the health service and has a case fatality rate of 36%. There are currently no readily available UK figures on its occurrence, but in the USA its incidence is estimated at 5–10 per 1000 of all admissions (120–220 per 1000 admissions to ITU).

Asthma

Asthma is a clinical diagnosis characterised by episodic wheezy dyspnoea resulting from chronic inflammation of the airways and increased responsiveness to a variety of stimuli. Wheezing within the last 12 months is reported by up to 38% of children and a third of adults, and is more frequently reported for children living in Southern England or Wales, from poor socio-economic backgrounds and those exposed to tobacco smoke. Doctor-diagnosed asthma is reported for 21% of children and by 12% of adults, and about 4–6% of children and 4–13% adults are thought to require regular medical supervision. The incidence of asthma is highest in the first 7 years of life (2–3% per annum) and then levels off at 0.7% per annum, so that the cumulative incidence by age 23 is 30%, and age 33 is 43%. About 50% of regular childhood wheezing persists to early adulthood. Data is lacking on patterns of asthma attacks and utilisation of services over an individual's lifetime. Trends in asthma are difficult to interpret, suggesting little change in lifetime prevalence. However, there may be a shift towards more severe asthma among

individuals, and self-reported asthma, GP consultations, prescriptions of anti-asthma drugs and hospital admissions increased during the 1990s, especially in children, though asthma incidence may now be falling. Even so, there may still be under-diagnosis in the community and up to 3.4% of undiagnosed 12–14 year olds may display severe symptoms. Mortality rates appear to have been stable since 1979 (small increase in 15–25 year age group) and age-standardised mortality rates have fallen since the 1980s. Fatal asthma is rare, occurring in 6.7 per million aged 0–14 years and 6.7 per million aged 15–44 (diagnostic confusion and transfer may influence rates in older adults). In 1999, there were 1521 deaths due to asthma, compared with 1969 in 1992.

Chronic obstructive pulmonary disease

The term 'COPD' is used to describe a syndrome of chronic progressive airflow obstruction which is not completely reversible. It is due to a number of pathological and clinical entities that frequently overlap (e.g. emphysema, a pathological diagnosis, or chronic bronchitis, defined clinically by the presence of a productive cough for at least 3 months of two successive years). The condition is rare in people who have never smoked, and the prevalence of COPD reflects the patterns of smoking in the population, with a strong social class gradient. Chronic bronchitis (i.e. chronic productive cough) affects 17% of men and 6% of women of middle age, whereas COPD affects 5% and 3% of middle-aged men and women respectively. Prevalence of COPD is rising among women, reflecting secular trends in smoking. Mortality rates for COPD have declined in the last 30 years and the condition now accounts for 5.7% male and 4.0% female adult deaths, a significant number of which were premature (168 per million before age 65).

Tuberculosis

The majority of cases of TB affect the lungs, and can vary in severity from a fulminant infection to sub-clinical disease, which may be reactivated at times of stress or immuno-compromise. TB is a notifiable disease, and while this underestimates the total prevalence, notifications provide useful data on patterns and trends. Rates have risen since 1988 at approximately 1% per year, with the highest rates in London (34 per 100 000) and lowest in the Eastern Region (5 per 100 000). Deaths remain relatively rare (300 per year) and case fatality rates continue to fall in all age groups. Ethnicity is a major risk factor in the UK (169–178 per 100 000 in South Asian communities and 7 per 100 000 in whites), although prevalence decreases with time of residence in the UK, and while rates are falling in Indian and Caribbean groups, they are rising in Black African, Pakistani, Bangladeshi and other groups. In the UK, there is currently little overlap between the population with HIV and those previously exposed to TB. About 2% (4.3% in London) of notifications are in those who are also HIV positive. UK data also indicates a rise in the problem of drug resistance for TB; isoniazid resistance is present in 6.3% of isolates from those with no previous history of TB, and 17.0% of others. Equivalent figures for multi-drug resistant TB are 1% and 11%.

Cystic fibrosis

Cystic fibrosis is the product of a variety of genetic defects inherited in an autosomal recessive fashion and results in secretions (especially those from the lung, pancreas, sweat glands and reproductive tract) becoming more viscous. Thick lung mucus readily becomes infected, and respiratory disease is the cause of most deaths. 1 in 25 carries a defective gene and approximately 1 in 2500 live births are affected by cystic fibrosis annually. Case registry data indicate that there are 7500 individuals in the UK with cystic fibrosis, of whom 43% (and rising) are adults. Prevalence depends upon age (440 per million aged 0–14 years, 300 aged 15 to 24, and 35 aged 25+) and while current median survival is 28 years, the current birth cohort may

expect to live beyond 40 years. While the condition is a rare cause of death overall (< 0.1%), it accounts for 23% of all deaths due to respiratory disease in those aged 5–25 years (1.4% overall).

Services available and their effectiveness

Respiratory diseases are managed at all levels of the health service. Patients with chronic conditions use family health services and outpatients to manage their ongoing care, a major feature of which is self-care and patient decision-making. There is insufficient evidence of effectiveness to claim that a substantial unmet need for inpatient services exists in the community.

Acute respiratory infections in children

Over 80% of lower respiratory infections in childhood are treated by GPs, accounting for 16% of consultations in those aged 0–4 and 9% in those aged 5–15. Most inpatient referrals are managed by general paediatric services, resulting in 2.1% of all FCEs and 1.8% of bed-days for those aged 0–14.

Primary preventive activities include reducing passive exposure to tobacco smoke, promoting breast-feeding and vaccinating against whooping cough and measles. The use of antibiotics to treat viral upper respiratory tract infections is ineffective at preventing bacterial lower respiratory infections and may result in increased antibiotic resistance. No norms for treatment services exist, and management may include antibiotic therapy where bacterial infection is suspected, and supportive care in an environment appropriate to the severity of the illness. The diagnosis is primarily clinical and the choice of antimicrobial drug is usually made without microbiological findings.

Lower respiratory infection in adults

Most (67–95%) adults with community-acquired pneumonia are treated outside hospital and pneumonia accounts for 0.3% all adult consultations. Up to a third of pneumonia cases are admitted and they comprise 0.43% of FCEs in those aged 15–64, and 2.2% of FCEs in over-65s. Nosocomial pneumonia results in 7–9 extra days in hospital for each patient affected.

The use of antibiotics to treat viral upper respiratory tract infections is ineffective at preventing lower respiratory infections and may result in increased antibiotic resistance. Pneumococcal vaccination is recommended in those for whom infection would be more common or serious, and may prevent re-admission with pneumonia in those over 60 years admitted for any reason. Diagnosis in the community is primarily clinical – X-ray and other investigations being reserved for slow responders to treatment and to exclude cancer. No norms exist for treatment services, although UK guidelines for management exist and have recently been updated. Treatment includes antibiotics and supportive care in an environment appropriate to the severity of the illness. The diagnosis is primarily clinical and the choice of antimicrobial drug is usually made without microbiological findings. Neuraminidase inhibitors may reduce the duration of influenza and are recommended for those at risk of secondary complications, but their place in influenza prevention is not yet established, and neither are the nature of the at-risk groups who might benefit from treatment.

Asthma

GP consultations for asthma represent 7% of the total for children, and 1–2% for adults. In addition, self-referral to A&E departments is common, resulting in 40–50% of all asthma admissions (at least as many again are also seen in A&E and discharged). Asthma admissions have risen since the 1970s and now account for 6% of FCEs in childhood and 2% in adults.

There is currently limited scope for primary prevention outside of the occupational setting, other than efforts to limit *in utero* and postnatal exposure of babies and young children to environmental tobacco smoke. However, secondary prevention does have an important role and includes the avoidance of precipitating factors (passive tobacco smoke, moulds, infections and allergen exposure (especially house dust mite and pet allergens), although the evidence that allergen avoidance is effective is relatively weak) and the control of the outdoor environment (especially ozone). There is currently no place for screening.

There are no norms for asthma treatment services and in general the facilities for diagnosis, investigation and ongoing management are available to GPs and hospital doctors alike. Management of chronic asthma occurs at all levels of the health service, while the management of acute severe asthma may require investigations and therapies unavailable in the community; the British Thoracic Society recommends that such inpatients are managed by respiratory specialists. However, the criteria for admission vary widely. The treatment of chronic and acute severe asthma is subject to UK evidence-based and consensus guidelines. The mainstay of chronic treatment is by (usually inhaled) drugs and guidelines emphasise the inflammatory basis of asthma and the need to use regular anti-inflammatory drugs in preference to anti-spasmodic medications 'as needed'. Spacer devices for inhalers are probably as effective as nebulisers for drug delivery, and the place of nebulisers for chronic therapy is unclear. The principles of care are becoming more proactive, and engage the patient in monitoring their condition and self-management according to predefined protocols. Education alone does not improve outcomes, although intensive behavioural interventions may do so. The role of allergen desensitisation and physiotherapy is unclear, while acupuncture and hypnotherapy are ineffective. The provision of specialist asthma nurses has increased recently, but there is evidence that specialist nurse-led interventions in hospital have no effect on patient-related outcomes. There is a move towards increasing specialisation of asthma treatment in primary care through general practitioners with a special interest, and specialist asthma nurses.

Chronic obstructive pulmonary disease

Overall, 1.4% of the population consults their GP for COPD each year, and this condition accounts for 2% of FCEs and over 3% of bed-days in adults. As for asthma, the pyramid of disease severity has a broad base in the community, with only 10% being referred to secondary care.

COPD is a chronic, progressive, irreversible disease, and stopping smoking both prevents its development and slows its progress. Other (secondary) preventive activities include vaccination against influenza and pneumococcal disease. The clinical diagnosis requires confirmation by pulmonary function tests (spirometry), which also helps to stratify severity, and other radiological and invasive tests may be helpful to exclude other diseases. Spirometry is not universally available in primary care. There are no norms for the provision of treatment services. Management is subject to UK-based guidelines and concentrates upon smoking advice, the treatment of acute (often infective) exacerbations with antibiotics, corticosteroids and oxygen, symptomatic treatment with bronchodilators and inhaled anti-inflammatory drugs to maximise any reversible airflow limitation, and domiciliary oxygen in selected severe cases. The balance between primary and secondary care for ongoing care is unclear. Physiotherapy alone is probably of no benefit, although formal multidisciplinary rehabilitation programmes are beneficial. Screening of patients with chronic cough, wheeze or breathlessness and/or smokers for COPD has been recommended to allow early smoking cessation interventions, but there is a lack of objective evidence of effects on mortality or of the most appropriate methods of delivering screening.

Tuberculosis

The historical decline in TB owes much to improvements in the population's social and nutritional status and later introduction of effective drug therapy. Mass screening is no longer practised in the UK, although

the school immunisation programme is still recommended. Vaccination is also recommended for immigrants from countries where TB is common, and children born to high-risk families. The prevention and control of TB in the UK is the subject of published guidelines and there remains the provision of designated TB services with facilities for contact tracing and administering chemo-prophylaxis or vaccination. Drug treatment requires 6–9 months of therapy, and while reminder cards, monetary incentives, lay worker involvement and clinic supervision have all been shown to improve compliance, evidence from the UK suggests that directly observed therapy does not.

Cystic fibrosis

Evidence of improved outcomes exists for care undertaken in specialist centres for cystic fibrosis, and this is the subject of recommendations by special interest groups. However, care may be shared with local respiratory services and GPs using a variety of models. The majority of care occurs on an outpatient basis and requires a multidisciplinary approach including paediatricians and physicians specialising in cystic fibrosis, specialist nurses, dieticians, physiotherapists and social workers. On average, patients attend outpatients 4.6 times annually and admission rates vary between 0.3 and 2.0 times per person per year. Handover of adolescent patients from paediatric to adult services is recommended and most patients continue to attend school and work full-time.

Screening may be carried out on an antenatal or postnatal basis and may detect up to 70% of cases. A population-based screening programme is not yet available in the UK, but a national neonatal screening programme has been recommended. The availability and content of treatment services are the subject of guidelines by special interest groups. The mainstay of drug therapy is early aggressive treatment with high doses and prolonged courses (often parenteral or nebulised) of antibiotics to prevent colonisation of the lung by some organisms and to treat recurrent infective exacerbations. Patients should be segregated according to colonisation by the organism *Burkholderia cepacia*. There is increasing evidence that segregation should be extended to include patients with transmissible strains of other organisms including *Pseudomonas aeruginosa*. Many patients self-administer intravenous treatments. Those with pancreatic insufficiency should use enzyme supplements and additional fat soluble vitamins and oral or parenteral feeding may also be required. A proportion of patients gain benefit from Domase alpha to reduce sputum viscosity and all require physiotherapy (usually self-conducted) to clear secretions (some gain benefit from nebulised bronchodilators prior to physiotherapy). Those with end-stage lung disease may gain benefit from single lung or lung–heart transplantation and approximately 5% develop liver failure and may require liver transplantation.

Quantified models of care

The prevention, treatment and rehabilitation of lower respiratory disease is complex, but of the various models available, the two considered most relevant for purchasers for these conditions are the natural history model and the service model. Decision points within these models focus upon the balance between preventive and therapeutic services, between primary and secondary care, and between specialist and generalist care within each of these settings.

It is argued that the direction of marginal shifts in provision of health services for most lower respiratory conditions should probably be:

- treatment → prevention
- secondary/tertiary care → primary care and patient enablement

However, *within* each of these settings there is a general view that treatment should be provided by specialists in respiratory conditions, rather than generalists. These specialists are usually in the hospital

setting specialist respiratory physicians, and in the primary care setting, general practitioners with a specialist interest, or nurses with specialist training.

Thus within each care setting, the general marginal shift should be:

- generalist care → specialist care

For some conditions, such as cystic fibrosis, increasing specialisation of care can produce significantly better clinical outcomes, and there is a clear need for increased specialisation and more tertiary care provision.

This conclusion does not deny the value of hospital care in the diagnosis and management of difficult or unusual cases. Neither does it deny the value of intensive respiratory care for clinically severe patients, or the therapeutic effectiveness of antibiotics and anti-asthmatic therapy currently available in both a hospital and a community setting.

Outcome measures and audit methods

In general, it is easier to specify the desired direction of changes than to set quantified targets. Improvements in the scope and linkage of health information, and greater use of clinical audit are suggested as means of facilitating needs assessment and monitoring outcomes.

Information and research requirements

There is a need for further research into the incidence of acute respiratory illness in the community, variations in referral, diagnosis and management, and the overlap of disease severity at service interfaces. Consensus guidelines for clinical management are incompletely evaluated in terms of efficacy and the extent to which population mortality and morbidity can be reduced by treatment is uncertain. Future prospects for prevention depend upon further aetiological research and the continued development of vaccines.

2 Statement of the problem

General approach to the task

The original brief required a concise review of the whole of lower respiratory disease, following the framework for research reviews. However, the range of disease entities is broad and therefore this chapter focuses on a specific group of disorders and *does not attempt to cover the full range of conditions that fall within the remit of the respiratory specialist.* The areas for detailed review (acute infections in childhood, acute infections in adults, COPD, asthma, tuberculosis and cystic fibrosis) were chosen on the basis of their public health impact, the demands they place upon specialist (respiratory and other) services, and the costs incurred in their management.

Tables and figures displaying data relevant to the full range of lower respiratory disease are collected in **Appendix B** and referenced in **bold** type. Tables and figures displaying data of relevance to the detailed reviews of specific groups of conditions are included in the text and indicated using Roman numerals.

We are aware that the main purpose of the review is to help purchasers of health care. However, in considering interventions and their effectiveness, we have included some aspects of prevention, which are not the direct responsibilities of the purchasers. It is our belief that purchasers need such information to set their own efforts in context and to influence other agencies to help in reducing health problems.

The first version of this chapter was prepared collaboratively by five authors (HRA, AE, JH, PL and DS). The conditions subject to detailed review were included as appendices and were the work of single authors. Two authors prepared this revision (SW and DW), one of whom (SW) also provided the detailed review of cystic fibrosis, not included in the first series.

Changes from the first edition

While following the protocol common to all in the Needs Assessment series, the structure of this chapter has been considerably altered since the first edition. In its original form, specific conditions subject to detailed review were included in referenced appendices. The information in these appendices has now been integrated into the main text. In addition, cystic fibrosis has been added to the list of conditions reviewed in detail.

Routine data summarised in the tables and figures collected in **Appendix B** and accompanying text has all been updated to 1998–99 for mortality and Hospital Episode Statistics (finished consultant episodes and occupied bed-days), and 1991–92 for GP consultations. Detailed discussions on the sub-categories under review have been amended to reflect changes in the understanding and coding of certain conditions, especially asthma and chronic obstructive pulmonary disease. Similarly, new data on incidence and prevalence have been included for asthma and TB, where recent trends are more fully explored, and cystic fibrosis. New developments in the organisation and delivery of services related to specialisation (and sub-specialisation for cystic fibrosis), treatment pathways (for asthma and chronic obstructive pulmonary disease in particular) and the role of multidisciplinary team members (asthma, chronic obstructive pulmonary disease and cystic fibrosis) are more fully considered. Finally, recent developments in prevention and treatment are also considered, and highlight the growth of evidence-based and consensus guidelines (pneumonia, asthma, chronic obstructive pulmonary disease, TB and cystic fibrosis). In particular, new evidence is considered on the use of existing and novel therapies for influenza, chronic obstructive pulmonary disease, asthma (for which an extensive review is provided) and cystic fibrosis.

The nature of the public health problem

Scale

Respiratory disease has a substantial impact on the health of populations at all ages and every level of morbidity. Acute upper respiratory infections are the commonest illnesses experienced at all ages, leading to school absence, loss of productivity, widespread consumption of non-prescribed medicines and a substantial burden of consultations in general practice. Lower respiratory infections impinge upon inpatient and mortality statistics. Asthma is one of the commonest chronic diseases of childhood and COPD in adults is a major contributor to sickness absence, premature retirement, disability and mortality in old age. Tuberculosis, although now rare in the United Kingdom, remains a problem among certain immigrant groups, and is likely to re-emerge elsewhere as the AIDS epidemic progresses. Cystic fibrosis is an increasingly important cause of death among young adults, and improvements in survival mean increasing use of expensive medication and medical technology.

Table B.1 shows the percentage of all deaths, hospital discharges, inpatient bed-days and general practitioner consultations attributable to various respiratory diseases nationwide. **Table B.2** translates these proportions into the number of deaths and respiratory workload for a given population size. The relative importance of all respiratory conditions and of particular diagnostic categories varies considerably according to age (**Figures 1 to 8**).

Major issues

The major issues in the field of lower respiratory disease relate to the balance of care between primary, secondary and tertiary care, and the cost, availability and cost-effectiveness of expensive new drugs and technologies.

Balance of care

There is widespread debate about the balance of care between primary, secondary and tertiary care for both common and rare respiratory conditions and, within each level of care, about the appropriate balance of care between generalists and those with specialist interests and training. In general there is scanty evidence on which to base decisions about balance of care.

New drugs and technologies

Because respiratory disease is so common, new drugs in this field represent important potential costs to the NHS. New drugs on the horizon in this field include new anti-inflammatory therapies for asthma and COPD and new drugs in the treatment of cystic fibrosis. Inhaled therapies will need to be converted to CFC-free inhalers, with potential cost implications.

Diseases included (ICD-9 and ICD-10 codes)

International Classification of Diseases (ICD) codes relevant to respiratory disease are shown and discussed in **Appendix A**. These are based on diagnoses but for certain purposes other classifications (by site, chronicity, cause or age) may be more appropriate. These issues are discussed further in **Appendix A.**

We have selected for this review groups of conditions which make an important contribution to at least one of the indicators shown in **Table B.2** and which are broadly 'lower respiratory' in nature. Cystic fibrosis is included because it makes a significant contribution to morbidity and mortality in young adults, and because of the expensive nature of some of the interventions used in its treatment. Although it is no longer the cause of substantial mortality and morbidity, tuberculosis is included because it makes special demands upon chest medicine services and is a particular problem in certain districts with substantial immigrant populations. Conditions included in the review are:

- lower respiratory infections in children
- lower respiratory infections in adults
- asthma (ICD-9 493, ICD-10 J45–46)
- chronic obstructive pulmonary disease (COPD) (ICD-9 490–492 and 494–496, ICD-10 J41–44)
- respiratory tuberculosis (ICD-9 011–012, ICD-10 A15–16)
- cystic fibrosis (ICD-9 277, ICD-10 E84).

Each section of this chapter presents detailed information relating to acute lower respiratory infections in children (acute bronchitis, bronchiolitis, pneumonia and whooping cough), acute lower respiratory

infections in adults (pneumonia and influenza), asthma, chronic obstructive airway disease, respiratory tuberculosis and cystic fibrosis.

Diseases excluded (ICD-9 and ICD-10 codes)

- Upper respiratory infections (ICD-9 460–465, ICD-10 J01–06) and other upper respiratory conditions (ICD-9 470–478, ICD-10 J01–06) have been excluded because, although they are extremely common and cause a lot of minor morbidity, their impact upon mortality is small and the related hospital workload is often in ear, nose and throat surgery, which is the subject of a separate review.
- Lung cancer (ICD-9 162, ICD-10 C33–34) is a major cause of death, particularly among middle-aged and elderly men, and places a substantial burden upon inpatient services in general and chest medicine. It is considered as a separate review in the Health Care Needs Assessment first series.
- Neonatal respiratory problems (ICD-9 769–770, ICD-10 P28).
- Occupational diseases such as farmers' lung (ICD-9 495, ICD-10 J67), coalworkers' pneumoconiosis (ICD-9 500, ICD-10 J60) and other dust diseases (ICD-9 501–505, ICD-10 J60–67) are not discussed in detail, although such conditions may present special local problems in some areas.
- Other respiratory conditions (ICD 510–519, ICD-10) are also not discussed in detail since the category includes a heterogeneous assortment of conditions. The category is nevertheless important in terms of the burden on inpatient services and demands on respiratory specialists.

During 1999, these conditions together accounted for 7% of all deaths, 2.5% of finished consultant episodes (FCEs) and 3.3% of bed-days.

3 Sub-categories

Lower respiratory infections in children

Acute lower respiratory tract infections (LRTI) in children include a wide variety of diagnoses that frequently represent poorly defined clinical syndromes used as convenient diagnostic labels, without any implication of specific site of involvement in the respiratory tract.

- **Acute bronchitis (ICD-10 J20):** Unspecified bronchitis (ICD8 and ICD-9 490, ICD-10 J40) is more usually acute than chronic in children, and should be included in estimates of disease incidence. It may present with cough and/or wheeze. The presence of stridor (noise on inspiration) is characteristic of laryngotracheobronchitis ('croup'). This relatively benign illness does not appear as a separate entity in published statistics.
- **Acute bronchiolitis (ICD-10 J21):** This is combined with acute bronchitis in ICD8. The distinction is controversial, as there is rarely pathological evidence to implicate the smaller, rather than the larger airways. Bronchiolitis is usually applied to the more severe illnesses without evidence of pulmonary consolidation in the first year of life, and is closely related to respiratory syncytial virus (RSV) infection. It is rarely diagnosed in children over 12 months of age, although RSV infection may occur at any age.
- **Pneumonia (ICD-10 J12–J17):** Strictly, this diagnosis is only applicable when there is radiological or pathological evidence of pulmonary consolidation, but is much more widely applied as a label for severe illness, particularly by parents. Subdivisions by cause (viral, ICD-9 480; pneumococcal, ICD-9

481; other bacterial, ICD-9 482) or by presumed site (bronchopneumonia, ICD-9 485; 'other' pneumonia: organism unspecified, ICD-9 486) are of little use for epidemiological work in children.
- **Whooping cough (ICD-10 A37):** This is primarily a clinical diagnosis, as culture of *Bordetella pertussis* is inconsistent, particularly after the early days of the illness. It is included here because its severe effects are mainly confined to the respiratory system.

These are illnesses of concern for three reasons:

- They are an important contribution to childhood mortality, particularly in the post-natal period (although case-fatality of the average episode is low).
- They cause considerable distress in the child and arouse anxiety among parents.
- Although episodes are usually self-limiting, there is concern about the long-term consequences for respiratory health in adulthood.[1] There is controversy about whether observed associations between childhood LRTI and later cough, phlegm and poor lung function are a result of 'lung damage' or simply a reflection of a chronic tendency of some children to develop all kinds of chest troubles (asthma being one possible explanation for such continued susceptibility).

Currently, the objective of services is to prevent death and distress, and to minimise long-term health consequences of these conditions.

Cause

There is a poor correspondence between the infecting agent and clinical manifestations. However, the distinction between bacterial and viral illnesses potentially affects management. A more detailed aetiological classification may be required if specific antiviral therapies are developed.

The majority of LRTI in infants and young children in the developed world have a viral aetiology,[2] predominantly parainfluenza types 1–3 (35%), respiratory syncytial virus (22%), influenza types A or B (12%), and adenovirus (7%).[2] *Streptococcus pneumoniae* and *Mycoplasma pneumoniae* account for most of the pneumonias in children above four years of age.[3] *Mycoplasma pneumoniae* accounts for about 15% of other LRTI in children.[2]

Comorbidity

Infants with pre-existing cardiorespiratory disease (congenital heart disease, bronchopulmonary dysplasia, cystic fibrosis) or immunosuppression are at increased risk of death during acute episodes of LRTI.[4] More vigorous therapeutic regimes may be justified in these vulnerable children, but their impact on the total requirement for services is likely to be small.

Children with asthma are much more common and are at increased risk of episodes labelled as bronchitis or pneumonia.

Lower respiratory infections in adults

Respiratory tract infections are a major cause of morbidity and mortality in the community and the most important burden on the health service after mental illness.[5] They represent the commonest condition seen by general practitioners, accounting for 16% of all adult consultations. They are the fifth most important reason for sickness benefit claims.[5]

In the 1970s in England and Wales, 25 million prescriptions were written for antibiotics for respiratory infections per year,[6] rising to a peak of over 50 million prescriptions a year in 1995 (Prescription Pricing

Authority web site). In 1994, the annual cost of prescribed antibiotics exceeded £160 million. More recent information on prescribing patterns is not routinely available but there is no evidence to suggest that the burden of illness due to respiratory tract infections has decreased over the last decade.

Within ICD-9 and ICD-10, pneumonia and influenza are coded as follows:

	ICD-9	ICD-10
Influenza	487	J10–11
Pneumonia	480–486	J12–J18

Pneumonia

Pneumonia is one of the most serious lower respiratory tract infections and accounts for about ten times as many deaths in the United Kingdom as all other deaths from infectious diseases combined. In those under 65 years of age, pneumonia deaths equal those from all other infections.[7] There are nearly four times as many deaths from pneumonia in England and Wales in the 5–49 year age group every year as there are from asthma.[8] The case fatality in community-acquired pneumonia ranges from 3% to 15%.[9–11] Although definitions of pneumonia vary, it is estimated that in England and Wales, one person per 1000 in the general adult population is admitted to hospital with pneumonia annually.[12]

ICD-9 and 10 include codes for pneumonia attributable to specific causes (viral causes, ICD-9 480, ICD-10 J12; pneumococci, ICD-9 481, ICD-10 J13; and other bacteria, ICD-9 482, ICD-10 J14–15), but such classification is often unsatisfactory since no pathogen can be demonstrated in 30–55% of cases. Non-specific codes, which include bronchopneumonia (ICD-9 485, ICD-10 J180) and pneumonia, organism unspecified (ICD-9 486, ICD-10 J181–189), are commonly used in routine statistics, particularly as a non-specific certified cause of death in patients with other chronic conditions. Recent changes in the coding of death certificates have been introduced in an attempt to minimise this ambiguity and the usefulness of the ICD codes in the classification of pneumonia is discussed more fully in **Appendix A**.

Cause-specific pneumonias (i.e. with a named organism) are a potentially preventable cause of premature mortality, accounting for four times as many deaths under 50 years of age as there are from asthma. They may usefully be subdivided into infections acquired in the community and in hospital (nosocomial pneumonia), the latter presenting special problems of prevention and therapy.

Asthma

Asthma is characterised by recurrent episodes of airflow limitation that are usually reversible either spontaneously or with appropriate treatment. It is accompanied by symptoms of breathlessness, wheezing, chest tightness and cough.[14] It is caused by variations in airways resistance which occur because the airways have an increased level of responsiveness to a variety of stimuli. Its pathological basis is thought to be a type of chronic non-infective inflammation.[14–16]

Asthma is of concern for three reasons:

- It is one of the commonest chronic diseases of childhood and a major cause of acute and chronic morbidity at all ages, including school absence in children and loss of time from work in adults. There is evidence that asthma is under-diagnosed and under-treated and thus the 'community effectiveness' of anti-asthma medications is limited, despite their proven efficacy, at least in the short term.

- It incurs major costs in terms of prescribed medications, general practitioner and consultant (paediatric, respiratory medicine, geriatrics and general medicine) time, and hospital admissions. Indicators of service use and prescribing have been increasing in recent years.
- It has been listed as a potentially avoidable cause of premature mortality (0–44 years). Although uncommon in absolute terms, asthma mortality is appreciable relative to other causes, and while admissions are less common in adults relative to childhood, mortality is more frequent.

ICD codes

In ICD-9, it is 493, and in ICD-10 it is J45 and J46.

1 There is diagnostic confusion and overlap with other conditions. In children the main overlapping condition is acute bronchitis (ICD-9 466, ICD-10 J20, J21). In adults the main areas of overlap are diseases characterised by chronic airflow obstruction (ICD-9 490, 491, 497 ICD-10 J40–43); some analyses group all of these together with asthma, but this is unhelpful because asthma has different health care requirements.
2 Coding rules have changed at each revision of the ICD in line with changing concepts of asthma vis-à-vis COPD. Broadly, the rules have shifted with successive revisions away from giving priority to bronchitis towards giving more priority to asthma.
3 The ICD code does not indicate the severity of asthma, which may vary from subclinical to life-threatening. Conceptually, severity reflects two factors, the first being the actual physical disturbance and the second the risk of sudden life-threatening deteriorations. Medical decisions are made with both factors in mind. Various clinical classifications of asthma have been proposed[17] but these have no ICD counterpart, and tend to be part of a spectrum of clinical and pathophysiological characteristics. In practice it is probably useful to distinguish chronic asthma and acute asthma but there are all shades of severity and combinations of these.
4 Chronic asthma may lead to airway re-modelling and eventually to an element of fixed airflow obstruction similar to COPD.[18]
5 Asthma tends to be under-diagnosed and doctors in both the primary and secondary sector vary in their diagnostic practice.[19–22]
6 The diagnosis of asthma indicates not only the current clinical 'state' but also the tendency to asthma i.e. the asthmatic 'trait'. Thus a patient may have 'asthma' but be currently free of symptoms.
7 In older adults, it may be difficult to distinguish chronic asthma from COPD. Although aetiology differs, symptoms and in some instances medication used may be similar.[23]
8 In both children and adults, the medical care of asthma is influenced by the increased likelihood of co-morbidity due to other conditions belonging to the 'atopic' group, namely eczema and hay fever. These add to the total burden of illness and also tend to be associated with increased severity and worse prognosis.[24]

Sub-categories of asthma

For health service purchasing and provision, the most important sub-categories are acute asthma and chronic asthma. Ideally, sub-categorisation by severity would also be useful. Unfortunately, neither of these sub-categories are accessible through the routine information systems. ICD-10 now separates acute severe asthma (J46) from other forms of asthma (J45).

Chronic obstructive pulmonary (airways) disease

The term COPD is used to describe a syndrome of chronic progressive airflow obstruction, which is not fully reversible. The airflow limitation is usually both progressive and associated with an abnormal inflammatory response to inhaled particles or gases.[25]

The term COPD formerly embraced the pathological diagnosis of emphysema and the clinical diagnosis of chronic bronchitis, defined by a productive cough for at least three months of the year for two successive years. However, a productive cough may be present without airflow limitation, and airflow limitation may develop without a chronic cough, and chronic bronchitis may not necessarily lead to progressive impairment of respiratory function and life expectancy. For this reason, these terms are not now used interchangeably with the preferred diagnosis of COPD.

Diagnosis requires lung function to be measured. Life expectancy is related to the reduction in lung function. COPD was responsible for 4.8% of all deaths in 1999, although diagnostic confusion with chronic asthma may occur, particularly in the elderly, and statistics based upon diagnosis alone should be interpreted cautiously.

COPD poses a major public health problem in terms of:

- Mortality, particularly in middle and old age. The three diagnoses remain among the principal certified causes of death, although their relative contribution is declining, particularly among men. There is also evidence that impaired ventilatory function (related mainly to COPD) is a risk factor for premature death from cardiovascular disease, independent of smoking.
- Chronic respiratory disability and recurrent chest infections, leading to premature retirement, loss of productivity, general practitioner contacts and use of hospital resources.

These diseases rarely occur among persons who have never smoked, and their progression can be slowed if smoking patients give up smoking. Childhood respiratory infections may also be an important risk factor.[1] Thus, much of the public health burden is potentially preventable.

ICD codes

COPD is a relatively new overarching diagnostic term introduced because of considerable diagnostic confusion between chronic or unspecified bronchitis (ICD-9 490–491, ICD-10 J40–42) and emphysema (ICD-9 492, ICD-10 J43) in adults. A diagnosis of COAD or COPD (coded to chronic airways obstruction, ICD-9 496, ICD-10 J44) is increasingly used for adult patients with cough, phlegm, and/or breathlessness with evidence of irreversible reductions in ventilatory function. In an individual patient, all of these components may be present, or one or other may be dominant at any particular time. Asthma is distinguished from these categories on the basis of reversibility of airflow obstruction, although there is substantial overlap in terms of clinical presentation and therapeutic management, particularly in the elderly. The ICD-9 and ICD-10 codes relating to COPD and asthma are shown below.

ICD-9 description	ICD-9 code	ICD-10 code	ICD-10 description
Bronchitis, not specified as acute or chronic	490	J40	
Chronic bronchitis	491	J41	Chronic bronchitis, type specified
		J42	Chronic bronchitis, unspecified
Emphysema	492	J43	
Asthma	493	J45	Asthma, specified or unspecified
		J46	Status asthmaticus
Chronic airways obstruction, not elsewhere classified	496	J44	Chronic obstructive pulmonary disease

Tuberculosis

This infectious disease still affects millions of people worldwide but until recently has been a diminishing problem in Britain.[26] While the disease can affect any organ, the lungs are involved in 75% of cases.[27] Primary infection with the tubercle bacillus can result in clinical disease, or in a contained form of disease without clinical symptoms that may subsequently be reactivated at times of stress or immune compromise. Thus, there is a spectrum of pulmonary tuberculosis, from a fulminant disease to an asymptomatic carrier state. The latter is particularly important as it may spread the disease.

Historically, tuberculosis (TB) prevention and treatment has been the responsibility of a respiratory physician working from a chest clinic. Appropriate antibiotic therapy is curative and prevents cross-infection. Concern is growing about the increasing prevalence of drug-resistant TB infections in the UK and elsewhere.

It is of concern for two reasons:

- it is a preventable cause of death
- it is communicable.

The public health problem in Britain is greatest among immigrant groups, although certain groups of people are particularly at risk e.g. immunosuppressed patients and those with HIV infection. In America, the risk of patients with HIV infection acquiring TB is estimated to be 500 times greater than the general population.[28] Although the current impact of HIV on TB in the UK appears small, trends in HIV infection and clinical AIDS could have a major influence on future patterns of tuberculosis and its impact on services.

Tuberculosis is commonly subdivided according to the site of involvement: pulmonary (ICD-9 011, ICD-10 A15-A16), other respiratory (ICD-9 012, ICD-10 A15–A16) and non-respiratory (ICD-9 013–019).

Cystic fibrosis

Cystic fibrosis (ICD-9 277.0, ICD-10 E84) is the commonest inherited disorder in Caucasian populations. Inherited by the autosomal recessive route, one person in 25 carries one of a variety of genetic defects affecting a single gene responsible for production of a protein called CFTR (cystic fibrosis transmembrane conductance regulator). CFTR acts as a chloride channel and genetic defects in this gene affect transport of salt and water across cell membranes. This primarily affects exocrine secretions in the lungs, pancreas and sweat glands. In the lung, this causes thickening of mucus, which can readily become infected with opportunistic bacteria. If untreated, chronic infection leads to bronchiectasis, respiratory failure and death. Although it is a multi-system disorder, respiratory disease is the main cause of death in 95% of cases. Defective production of exocrine enzymes in the pancreas results in steatorrhoea and malabsorption. A high concentration of sodium and chloride in the sweat is used as a diagnostic test. Other organs affected include the male reproductive tract (absence of the vas deferens in a high proportion of patients, causing infertility), and the liver.

It is of concern because:

- The prevalence is rising rapidly, particularly among adults, thanks to very marked increases in survival and improvements in treatment.
- The cost of treating this disease is very high. The average NHS cost has recently been placed at around £8000 per patient per year, but this varies according to age and severity.
- It is now an important cause of death and hospital admission among young adults.

There is potential for prevention by use of prenatal genetic screening, and to prevent long-term morbidity by early diagnosis and aggressive treatment in specialist centres. Treatment is centred on aggressive management of respiratory infections, including use of nebulised and intravenous antibiotics, to minimise lung damage, maximise lung function and allow individuals to pursue a normal active lifestyle. Individuals need regular respiratory physiotherapy, an active exercise programme, a high calorie diet, vitamin supplements and pancreatic enzyme supplements. Where possible, treatment is undertaken at home, work or school to minimise impact on lifestyle. In severely affected individuals, life can be prolonged by heart-lung or double-lung transplantation. Survival and clinical status are significantly increased if a centre specialising in treatment of cystic fibrosis undertakes treatment.

The link between genotype and phenotype is not completely clear. The commonest mutation affecting the cystic fibrosis gene is the delta-F-508 mutation, responsible for just over two-thirds of all mutations in the UK population. Pancreatic insufficiency occurs in about 10% of patients with cystic fibrosis, and appears to be associated with both a favourable prognosis, and also with absence of the delta-F-508 mutation, but this association is not absolute. Therefore, at present it is not possible to predict phenotype from the genotype.

Use of sub-categories in this chapter

The six sub-categories described above have sufficient clinical, epidemiological and public health differences to be dealt with separately throughout most of this chapter. However, in the sections concerned with models of care, outcomes, targets and research, some categories have been collapsed into lower respiratory infections (adult and children) and obstructive lung diseases (asthma and COPD).

4 Prevalence and incidence

Morbidity

Table B.3 summarises the principal findings from ad hoc surveys of prevalence and incidence of lower respiratory disease. Many respiratory problems are characterised by acute episodes occurring periodically in persons with chronic symptoms or increased susceptibility. Measures of prevalence, i.e. numbers of persons affected, are the most commonly reported index. Incidence may be estimated from recall of episodes over a defined prior period (often from birth), i.e. cumulative incidence. Few surveys offer information on the incidence of spells of illness (comparable to hospital admission rates), which may be the most relevant measure for planning acute services.

Acute lower respiratory infections in children

Population surveys

A number of large population surveys of respiratory disease in childhood carried out in the 1960s and 1970s included questions relating to bronchitis and pneumonia (**Table 1**). More recent evidence is not available, reflecting the declining interest in these conditions. There are major problems posed by the definition and incomplete recall of disease episodes by parents.[29]

Table 1: Estimates of incidence of acute lower respiratory illness in early childhood obtained by parental recall from population surveys of British children.

Place	Date	Number studied	Illness	Cumulative incidence	By age	Notes
Kent[36]	1964	4,700	Bronchitis	23.0%	5	
			Pneumonia	3.0%	5	
National (1958 cohort)[31,37]	1965	10,500	Pneumonia	3.0%	5	
				1.0%	1	
		14,000	Bronchitis with wheezing	17.0%	7	(i)
Selected urban and rural areas in England and Wales[31,32]	1966	11,500	Bronchitis	23.0%	6–10	(ii)
				9.0%	1	
			Pneumonia	5.0%	6–10	(ii)
				1.8%	1	
			Whooping cough	16.0%	6–10	
				1.6%	1	
National (1970 cohort)[30]	1975	13,500	Bronchitis	17.0%	5	
			Pneumonia	1.6%	5	

(i) should probably be considered as a manifestation of asthma
(i) & (ii) unpublished analyses of data[31]

These surveys suggest that about 20% of children are affected by bronchitis (probably including bronchiolitis) at some time in early childhood, but estimates of the cumulative incidence of pneumonia are less consistent (ranging from 1% to 5%). Many of the illnesses recalled as bronchitis may have been episodes of wheeze related to asthma.

Epidemiological surveys have found associations of bronchitis, bronchiolitis and pneumonia in children with:

- **Sex:** The male:female ratio is about 1.3:1.[30]
- **Region:** Marked regional variation exists in reported bronchitis, but not pneumonia.[30,31] High bronchitis incidence is reported in north and west England, and Wales, and low incidence in Scotland and East Anglia.
- **Poor socio-economic status:** There are strong trends for both parental recall of bronchitis and pneumonia.[30,32] Effects are partly related to family size/composition, parental smoking and, possibly, infant feeding.
- **Sibship size:** Lower respiratory illnesses in the first two years of life are more common in large families.[30,31] There is some evidence for an association with day care attendance.[2]
- **Ethnicity:** A lower incidence of bronchitis among inner-city ethnic minorities than among inner-city whites has been reported, though based on small numbers.[33]
- **Parental smoking:** A strong, consistent and dose-related association has been reported, particularly in children under three years of age.[34,35]
- **Breast feeding:** Findings are less consistent, though they tend towards an increased risk of LRTI in bottle-fed children. This may be due to confounding by parental smoking.
- **Prematurity and low birth weight:** These are related to bronchiolitis and pneumonia, particularly in early life, but not to bronchitis.[30]

General practice consultations

There are three principal sources. These data principally rely on clinical diagnoses with only limited reference to laboratory and radiological tests and therefore caution is required when comparing rates of disease with those from other sources (e.g. special studies or hospital data).

- **National Morbidity Studies 1981–2 and 1991–2:** Acute bronchitis is a much more common presentation in general practice than pneumonia. In the Fourth National Morbidity Survey 1991–2, 157.8 per 1000 persons aged 0–4 consulted during the year with one or more episodes of acute bronchitis (including bronchiolitis), whereas the figure for pneumonia was only 3.7 per 1000 (**Table B.7**). The male:female ratio was 1.12:1 for acute bronchitis and 1.48:1 for pneumonia, consistent with the cumulative incidence data from surveys. In 1991–2, 1.2 per 1000 children consulted for whooping cough, almost a ten-fold fall from 1981–2, but this figure will vary from year to year.
- **Medical Research Council Collaborative Study 1964–66:** A special study of respiratory illnesses in selected practices,[38] this provides more detail on the clinical syndromes encountered in general practice and in hospital than is available in the other two sources, but is based on a relatively small number of cases.
- **RCGP Weekly Returns Service 1967–90:** This continuous monitoring using 'spotter' practices highlights the marked seasonality in acute LRTI, with a two to three-fold variation in incidence of acute bronchitis and three to four-fold variation in incidence of pneumonia during childhood.[39] This places high demands upon primary and secondary care during the winter months, upon which may be superimposed epidemics of pertussis, measles and influenza.

Hospital admissions

- **Rates of admission:** In England in 1998–99, there were 24.3 FCEs per 10 000 children aged 0–14 for acute bronchitis (including bronchiolitis) and 13.4 per 10 000 for pneumonia (including influenza). The 0–4-year age group accounted for over 99% of FCEs for acute bronchitis and over 75% of FCEs for pneumonia. The male:female ratio for acute bronchitis and bronchiolitis was higher than for incidence or general practice data (1.5:1), but was lower for pneumonia (1.3:1).
- **Regional variations:** Variations by hospital region cannot be adequately described from published statistics because admissions for acute bronchitis are not presented by region. The available data, relating to chronic/unspecified bronchitis and pneumonia, may be influenced by diagnostic transfer from acute bronchitis.
- **Time trends:** National rates of admission for bronchitis, bronchiolitis and pneumonia in childhood have been falling. The rates for 1985 were about 10% lower than the equivalent figures for 1982. More recent data indicate that the rate of FCEs for 1998–99 is higher than the admission rate for 1985 (37.7 vs. 21.8 per 10 000), but the change to recording FCEs confuses the interpretation of these data, and it is not possible to comment on the trend in admissions during this time period. Further reductions may well have occurred since 1985.

Infectious disease notifications

Information on notifications of infectious disease are available from the Public Health Laboratory Service web site on http://www.phls.co.uk/topics_az/index.htm.

Figure 1 shows notifications of whooping cough by age group 1980–1998. There has been a quite dramatic decline in notifications, particularly in children under 10 years of age. Figure 2 shows immunisation uptake for whooping cough from 1966 to 1998, showing a large rise in proportion of eligible children immunised by 1998.

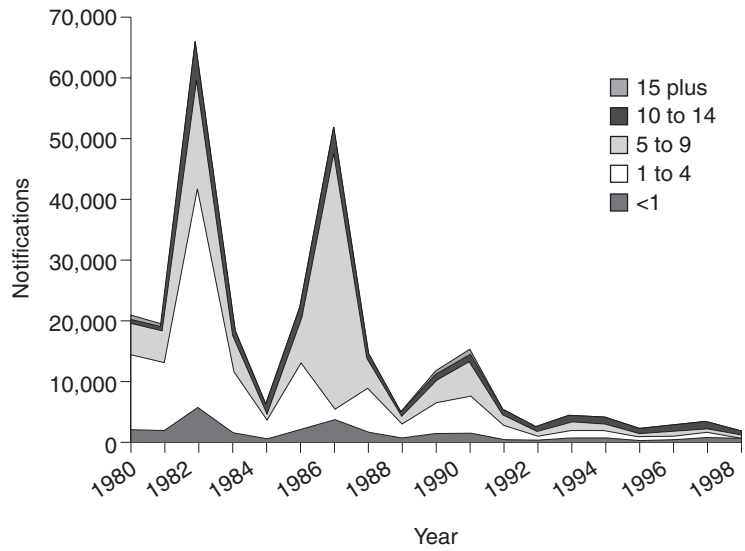

Figure 1: Notifications of whooping cough, England and Wales, by age group, 1980 to 1998. From Public Health Laboratory Service web site.

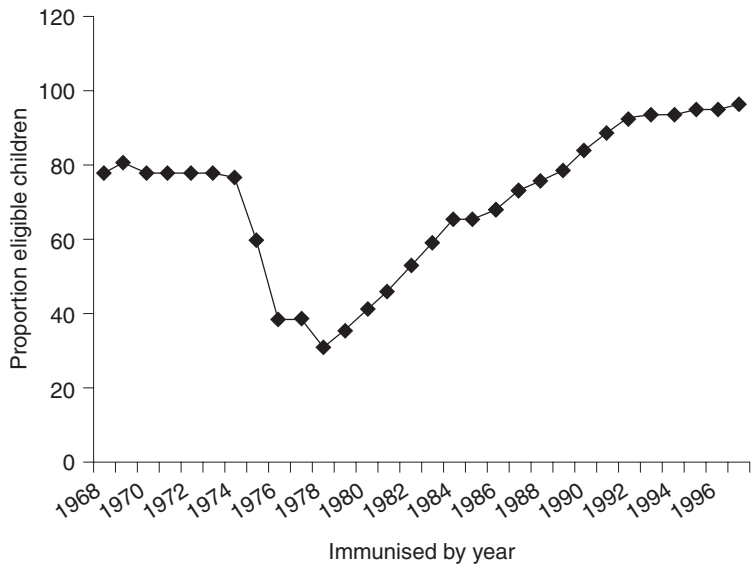

Figure 2: Proportion of eligible children immunised by target date, 1968–1997. Data from Public Health Laboratory Service web site.

Lower respiratory infections in adults

Community-acquired pneumonia

The incidence of community-acquired pneumonia varies from 230 to 360 per 100 000 population at all ages, and 470 per 100 000 in the adult population.[9–11,40] Recent UK figures put the incidence slightly higher

at 500 per 100 000, with 32% of episodes treated in hospital. The incidence is high in infants, falls in young children, and then rises again to over 1000 per 100 000 beyond age 45. The median age at onset is 59 years (mean 48–51 years). There is a marked seasonal distribution with a peak occurring between January and March. Approximately 3% of all patients with community-acquired infections will die and 5–22% will be admitted to hospital. This wide variation in hospital admission reflects methodological differences between surveys as well as health service factors such as availability of beds and admission policy.

It is possible to estimate the relative contribution of various micro-organisms from community surveys of pneumonia where the case has been admitted to hospital. However, because pathogens can only be demonstrated in 45–70% of pneumonias,[10,11,41] classification by causative organism is not entirely satisfactory. Clinical definitions of pneumonia may also vary. For example, some surveys have used evidence of chest infection with radiological confirmation as a case definition whereas others have used clinical findings only. These factors help account for the variation in prevalence and incidence rates in different studies.

Streptococcus pneumoniae	34–36%
Haemophilus influenzae	10%
Influenza A	6–7%
Staphylococcus aureus	1%
Escherichia coli	1%
Legionella pneumophila	0.5–15%
Proteus mirabilis	0.5%
Actinomyces israelii	0.5%
Mycoplasma pneumoniae	1–18%
Chlamydia psittaci	1%
Influenza B	2%
Respiratory syncytial virus (RSV)	2%
Adenovirus	2%
Parainfluenza virus	2%
Cytomegalovirus	0.5%

Streptococcus pneumoniae, *Haemophilus influenzae* and influenza A virus are the commonest pathogens causing community-acquired pneumonia. *Mycoplasma pneumoniae* epidemics occur about every four years.[42] Some organisms show seasonal patterns of infection. Microbiology may differ in patients with chronic respiratory disorders, immunocompromised patients or in alcoholic patients. In epidemic years, *Mycoplasma* is the most common cause of pneumonias requiring hospital admission.[43] Influenza pneumonia also occurs in epidemics; the most recent in the UK was in the winter of 1989/90 when 25 000 excess deaths were estimated to have occurred, 82% of which occurring in people over 75 years of age.[44] *Legionella* accounts for 2–5% (up to 15% in one survey)[9] of cases of pneumonia,[11] of which about a third will have been acquired abroad.

Risk factors for death from community-acquired pneumonia include age, tachypnoea, hypotension, hypothermia, diabetes mellitus, neoplasm, neurological disease, leukopenia, bacteraemia and more than one lobe affected.[45]

Nosocomial pneumonia

Despite the significant economic burden that it represents, the aetiology and pathogenesis of nosocomial pneumonia is poorly understood and there are no readily available UK figures on its incidence. However, data from the United States suggests that the incidence of nosocomial pneumonia ranges from 5–10 cases

per 1000 patient admissions[46] and up to 120–220 per 1000 admissions in intensive care units.[47] Hospital-acquired pneumonia accounts for 10–19% of all nosocomial infections.

Risk factors for nosocomial pneumonia include: age greater than 70 years, admission to an intensive care unit, chronic lung disease and thoracic and upper abdominal surgery.[47] Several of these risk factors are amenable to modification and it has been estimated that approximately a third of the mortality may be preventable.[48] American studies[47] suggest a 36% fatality rate with increased risk related to the type of organism, bilateral radiographic changes, the presence of respiratory failure, age and inappropriate antibiotic therapy.

Asthma

Prevalence and incidence as indicators of health needs

Most studies were not done with health needs in mind and lack relevant data on severity and other clinically relevant aspects of the illness. Thus, knowledge of prevalence and incidence is not readily translated into a measure of health need. Also, because asthma is a treatable and suppressible condition, prevalence could, theoretically, reflect treatment in the community. This will have implications for outcome indicators.

Table 2 shows various indicators of asthma morbidity and mortality by broad age group taken from the data in **Appendix B** and from ad hoc studies. The following discussion deals with some of these in more detail and includes a list of references to British studies of prevalence and incidence.

Table 2: Summary of available information on morbidity and mortality statistics for asthma and symptoms of wheeze (percentages). Figures updated to include Health Survey for England 1996 which includes different age groups.

	Age group (%)			
	0–14	**15–44**	**45–64**	**65+**
Morbidity and mortality				
Incidence per year	1–2			
Life-time incidence	30	32	34	34
Current wheezing or 12 month period prevalence	12–18	10 (19% 16–44)	15–22	24
Persistent wheezing	4	4	6	
Severe acute attacks	1			
Disabling disease	1–2		3	
Diagnosis of asthma	4–6 (21% 2–15)	4 (15% 16–44)	10	10
Requiring regular treatment or care	4–6	4–9	4–9	4–13
Mortality	0.00020	0.00067	0.00247	0.0108

Prevalence of current asthma

Because of the variable level of diagnosis of asthma in children it is customary to use wheezing as the indicator of asthma in prevalence surveys. This approach is less helpful in middle-aged and elderly groups because wheezing may be a symptom of COPD. Prevalence may be recorded as 'current' but it is preferable to record the reported prevalence over the previous year (12 month period prevalence) to permit comparability between surveys. These rates will include a considerable proportion of subjects with mild disease and, in the elderly, it may be difficult to infer the proportion who have asthma rather than wheezing

associated with COPD. Very few studies have measured the severity of asthma in such a way as to aid the evaluation and planning of clinical care and services.

Overall, the prevalence of asthma sufficiently severe to require regular medical supervision is very similar across all ages – about 4%, and this figure appears to be rising. In children, 7–10% of all 12–14 year olds in the UK report more than four attacks per year, and 5% of adults report themselves to be on regular anti-asthma medication.

Information on the prevalence of symptoms has recently been incorporated in the Health Survey for England,[49] and a review of respiratory symptoms and lung function in young people was also carried out using this survey.[50] The important findings from these surveys are summarised in **Table 3** and **Figures 3** to **5**. Overall, one third of adults and 28% of children had a history of wheezing. The prevalence of

Table 3: Risk factors for wheeze in last 12 months for adults and children, by sex 1995–1996 for adults and 1995–1997 combined for children.

	OR	95% confidence interval
Factors associated with prevalence of wheeze in last 12 months in adults		
Males		
Exposure to other people's smoke > 20 hrs a week	1.19	1.05, 1.35
Ex regular smoker	1.46	1.28, 1.60
Less than 20 a day	2.07	18.4, 2.34
20 or more a day	3.44	3.00, 3.93
Social class IIIN	1.15	1.04, 1.56
Social class IIIM	1.43	1.18, 1.72
Social class IV	1.24	1.00, 1.52
Social class V	1.48	1.15, 1.90
Suburban dwelling	1.13	1.01, 1.25
Urban dwelling	1.15	1.01, 1.31
Females		
Exposure to other people's smoke 6 to 19 hrs a week	1.32	1.17, 1.49
Exposure to other people's smoke > 20 hrs a week	1.4	1.24, 1.58
Ex smoker	1.67	1.51, 1.85
Less than 20 a day	2.03	1.83, 2.25
20 or more a day	2.76	2.40, 3.19
Suburban dwelling	1.17	1.06, 1.29
Urban dwelling	1.3	1.15, 1.46
Factors associated with prevalence of wheeze in last 12 months in children		
Boys aged 2 to 15		
5 or more in household	0.8	0.66, 0.97
Father has diagnosed asthma	2.11	1.63, 2.74
Mother has diagnosed asthma	2.15	1.69, 2.73
Girls aged 2 to 15		
Suburban dwelling	1.46	1.10, 1.94
Rural dwelling	1.63	1.18, 2.24
5 or more in household	0.8	0.65, 0.98
Father has diagnosed asthma	1.39	1.04, 1.87
Mother has diagnosed asthma	1.74	1.34, 2.26

Source: Health Survey for England.

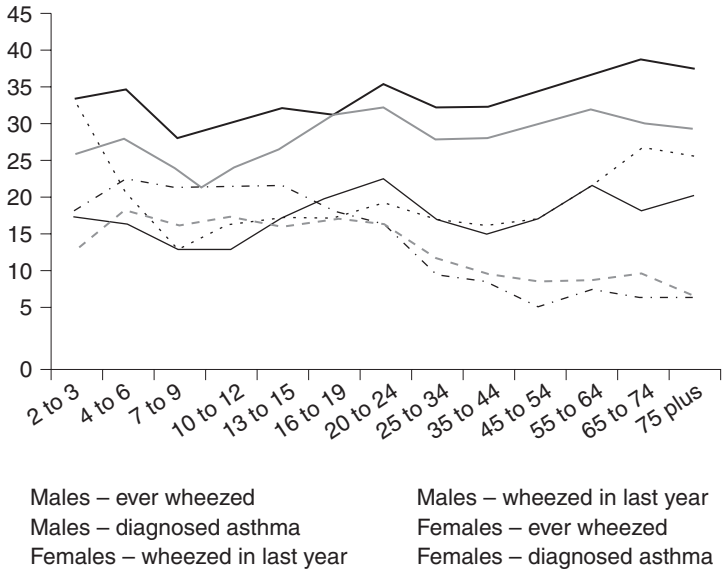

Figure 3: Proportion of children and adults with various respiratory symptoms by age and sex, 1995–1996 for adults and 1995–1997 combined for children.
Source: Health Survey for England.

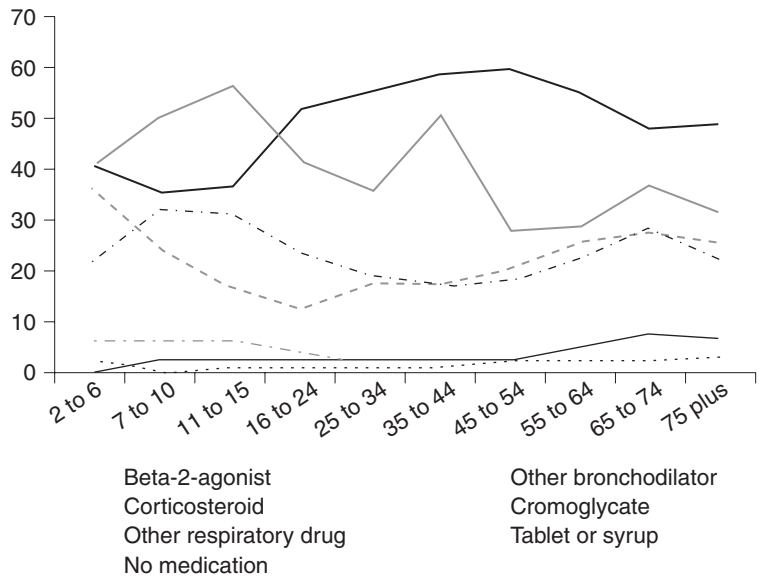

Figure 4: Proportion who have ever wheezed and who had most recent attack within five years who are currently receiving certain types of drug treatment 1995–1996 for adults and 1995–1997 combined for children.
Source: Health Survey for England.

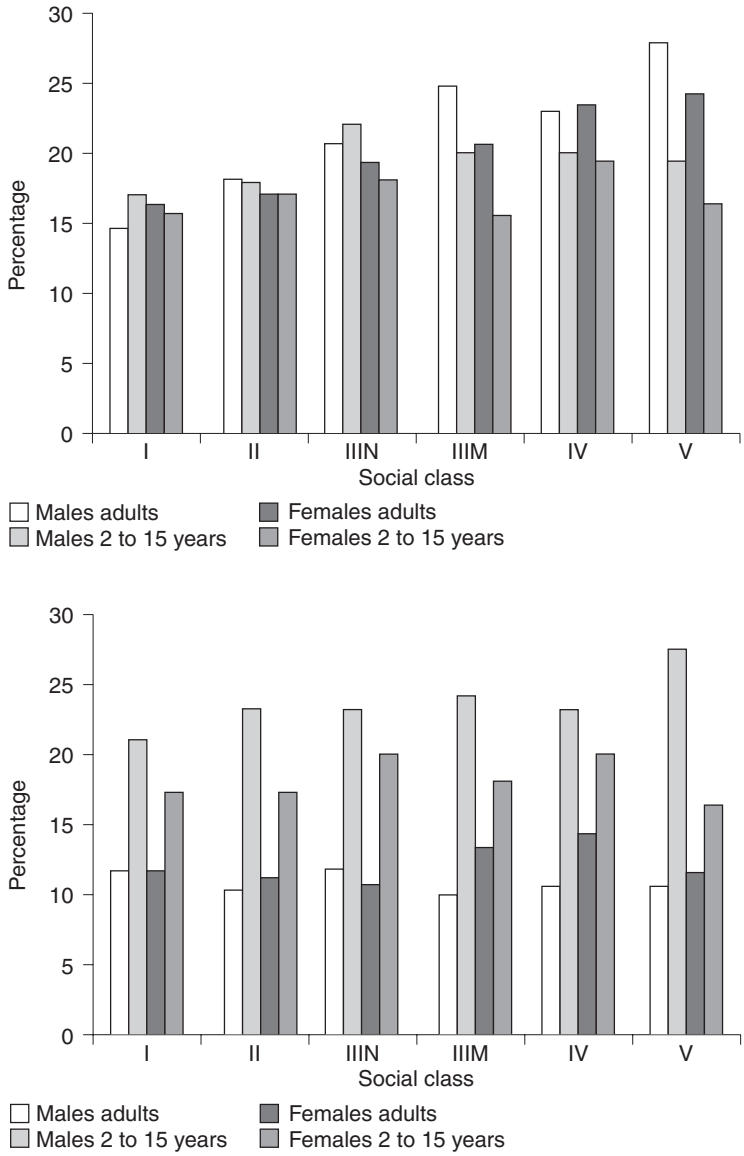

Figure 5: Prevalence of wheeze and doctor-diagnosed asthma by social class 1995–1996 for adults and 1995–1997 combined for children.
Source: Health Survey for England.

doctor-diagnosed asthma was 12% in adults and 21% in children. Of those reporting wheezing or asthma, 47% adults and 62% of children had been prescribed medication for their symptoms in the last 12 months.

Incidence

Incidence (persons) is a measure of the rate at which persons develop asthma for the first time. In the National Child Development Study 1958 Cohort, incidence was highest in the first seven years of

life (approximately 2–3% per annum) then levelled out at 0.7% per annum from ages 11 to 23.[51] The cumulative incidence to age 23 was about 30%, and to 33 was 43%, which agrees with studies of general practice records.[52–54] These are higher than previous figures because asthma has a good prognosis in childhood – only about 20% of early wheezers (50% in more severe cases) persist to age 23. The health service implication is that a much higher proportion of the population will require care for asthma at some time during their life than is apparent from the prevalence figures.

Incidence during childhood is strongly associated with pneumonia, hay fever and eczema, and more weakly with male sex, antepartum haemorrhage, whooping cough, migraine and recurrent abdominal pain. From 17–33 years, incidence is strongly related to cigarette smoking and hay fever, and more weakly with female sex, albuminuria in pregnancy, eczema and migraine. Smoking in pregnancy is weakly associated with childhood asthma, but more strongly with incidence after age 16. Relapse at 33 is associated with atopy and current smoking. These suggest several preventive measures may reduce both incidence and improve prognosis of asthma.[54]

For understanding health needs it is also important to have information about the patterns of acute asthma attacks experienced by individuals, i.e. incidence (spells). High utilisation may be due to a higher number of patients presenting for care or to a similar number of patients presenting more frequently. Because there is a lack of data about the epidemiology of acute episodes of asthma it is difficult to estimate the risk of fatality in an attack or understand the dynamics of care of acute asthma.

Prognosis

About 50% of young children with regular wheezing will still have symptoms in early adult life. The longer-term prognosis is uncertain. Mortality follow-up of patients with asthma reveals a considerable cumulative risk of mortality.[55] There is also evidence that chronic asthma is associated with the development of fixed airflow obstruction or remodelling similar to that seen in COPD.[18]

Sex difference

Incidence and prevalence are higher among boys than girls but by the late teens the incidence has become higher in girls. Prevalence is fairly similar between the sexes during adult life.

Trends

Temporal changes to reported asthma prevalence may be difficult to interpret due to an increasing acceptance of the label 'asthma'. However, there have been a small number of studies in children that have reported the prevalence of recurrent symptoms, principally wheezing in the absence of respiratory infection, using the same questionnaire instrument. Overall, these suggest an overall rise in symptom prevalence.[56–60] In the UK, one survey suggested that the prevalence of wheezing among 5–11 year olds rose by more than 30% during the period 1982–1992, while a separate study from Aberdeen found that wheezing prevalence rose from 10 to 20% between 1964 and 1989 along with a general rise in the symptoms of other atopic diseases (hayfever and eczema).[60] Similar changes have been observed for children in the USA.[60] However, data for adults is lacking and there is little evidence regarding changes to the severity of asthma symptoms. These are areas that need further research. In children, more marked changes have occurred in the prevalence of a diagnosis of asthma,[56,58,61] GP consultations[62] and hospital admissions,[63] all three of which are susceptible to non-epidemiological influences.

Trends in self-reported asthma, GP consultations, inpatient treatment, mortality and prescribing for asthma have been reported in a recent epidemiological overview of asthma.[64] Self-reported asthma has risen in all age groups, most markedly in children between 1984 and 1991. Prescriptions for asthma drugs

rose from 12.71 million items in 1980 to 31.25 million items in 1993. However, the extent to which this reflects an increased awareness of asthma and appropriate treatment compared to an increase in either incidence or severity is not clear. There is evidence from a recent survey in children aged 12–14 that substantial asthma morbidity is still going undiagnosed and untreated,[65] with up to 3.4% displaying severe symptoms that were untreated.

When viewed over the long term, there is evidence of an increase in asthma mortality.[66] An epidemic of asthma deaths was experienced in the mid-1960s but this subsided to prior levels, probably due to the correction of its cause (iatrogenic effect of a new anti-asthmatic preparation).[67] Following this there was further evidence of an increase from 1973 to 1985 in mortality among the 5–35 age group.[66] A recent analysis of mortality from 1979–1989 (within ICD 9th revision) up to age 45 indicated that the only significant increase was within the 15–25 age group (averaging +2% per year), with the other groups showing no change.[68] In adults over 65 the trend is upward but difficult to interpret because of the scope for transfer from the more numerous COPD deaths. Age-standardised mortality rates for asthma have been falling in Britain since the early 1990.[64]

Geographical, social and ethnic effects on incidence and prevalence

In children, asthma may be more prevalent in the south of the UK than in the north.[69] The prevalence also appears to be relatively high in Wales.[32] Little is known about geographical factors and adult asthma although there is clearly some variation.[70] In the 1996 Health Survey for England, adult asthma prevalence appeared to be slightly higher in the south.[49]

Most studies of infants and young children report a positive influence of social factors on the incidence of wheezing illness, possibly reflecting greater exposure to infections and tobacco smoke in the manual classes.[71–73] After about the age of five the effect of social factors tends to fade.[51] In the past there was probably a class effect on labelling[74–76] but this has not been observed in recent studies. Among adults, a diagnosis of asthma is still reported more by non-manual classes.[77] Analysis of the OPCS disability survey indicates that disability associated with asthma is two to three times more frequent in manual than in non-manual classes. It is relevant here to note evidence that adult asthmatics of manual social class have been found to have potentially greater degrees of reversibility of air flow obstruction.[78] Asthma in childhood has a measurable though small effect on employment prospects and on social status.[79] There is some evidence that mortality is higher in adults from lower social classes.[80]

In the recent Health Survey for England, self-reported wheezing in the last 12 months showed a noticeable positive social class gradient for adult men and women, but the gradient was less clear for children and doctor-diagnosed asthma (**Figure 5**).

Two epidemiological studies have examined the question of ethnicity and asthma in children. One found no relationship with ethnicity.[81] The other, while finding no relationship with asthma, did find a higher prevalence of wheezing in whites and those from Caribbean communities.[33] It is unlikely that the ethnic composition of a district will have a significant effect on health needs for asthma. There is no epidemiological evidence relating to ethnicity in adults although there are reports which indicate that hospital use may be greater among Asian asthmatics.[82] Studies in the US indicate that more frequent and severe asthma in adult blacks can be explained by social and environmental factors.[73]

Chronic obstructive pulmonary (airways) disease

The prevalence of chronic bronchitis and COPD is closely related to the smoking habits of the population.[83] There has been a decline in morbidity attributed to chronic bronchitis over the last 40 years. However, Britain continues to have high prevalence rates compared to other developed countries even after controlling for smoking habits.[84] **Table 4** summarises population-based surveys of the

Table 4: Prevalence (%) of chronic respiratory symptoms in general populations in Britain (1950s to 1990s)[49,85,87–96]

	Men				Women			
	Cough	Phlegm	Persistent cough and phlegm	Wheeze	Cough	Phlegm	Persistent cough and phlegm	Wheeze
Leigh (urban England) (1956) (55–64 years)	30	33	18	38				
Great Britain selected general practices (1958) (45–64 years)	47	41		38	21	18		32
Glamorgan (rural Wales) (1957) (55–64 years)	31	28	26	48	13	13	8	48
Annandale (rural Scotland) (1958) (55–64 years)	29	23	20	44	15	14	11	38
Rhondda Fach (industrial Wales) (non-miners) (1961) (55–64 years)	42	35	29		16	16	10	
Peterborough (industrial) 1961 (55–64 years)	31							
Holt-cromer (residential seaside town) 1961 (55–64 years)	22							
Halesworth (rural) 1961 (55–64 years)	20							
Scotland general population (1965–75) (45–64 years)	26				14			
England, Scotland and Wales (55–64 years) (1970)			25				9	
England, Scotland and Wales (general population) (1972) (37–67 years)	30			32	20			24
England, Scotland and Wales (national cohort of men) (40–59 years) (1978)			16					
London (urban general practice) (1985) (55–64 years)	27	27	21	34	15	12	9	21
Southern England (general rural population) (1990) (55–64 years)	19	19	15		13	12	8	
England (general population – Health Survey for England) (1995–6) (55 and over)				38				31

prevalence of chronic cough and phlegm over the last 40 years. Chronic bronchitis as defined by the Medical Research Council (persistent cough with phlegm production) now affects about 17% of men and 6% of women in middle age. The prevalence of COPD is lower; about 5% in men and 3% in women of middle age.[85] Prevalence increases with age, and is found to be higher in men.[86]

Comparing these figures with surveys carried out during the 1950s and 1960s suggests that prevalence is declining, in line with trends in the smoking habits of this age group.

Both productive cough and impaired lung function are much more common in poorer socio-economic groups, in northerly regions and Wales, and among urban rather than rural populations.[86] These variations are only partly explained by smoking habits.

Tuberculosis

Tuberculosis is a notifiable disease, and although an underestimate of the true level of disease, notifications provide a useful indicator of trends in the level of disease.

Notifications declined steadily since recording began in 1913, but have levelled off since the mid-1980s (**Figure 6**). Since 1988, notifications have risen slightly year on year at a rate of approximately 1% per annum for respiratory TB and 4% per annum for non-respiratory TB (**Figure 7**). This reversal in decline has also been seen in America where it has been attributed to HIV infection, but this does not appear to be the case in the UK at present.

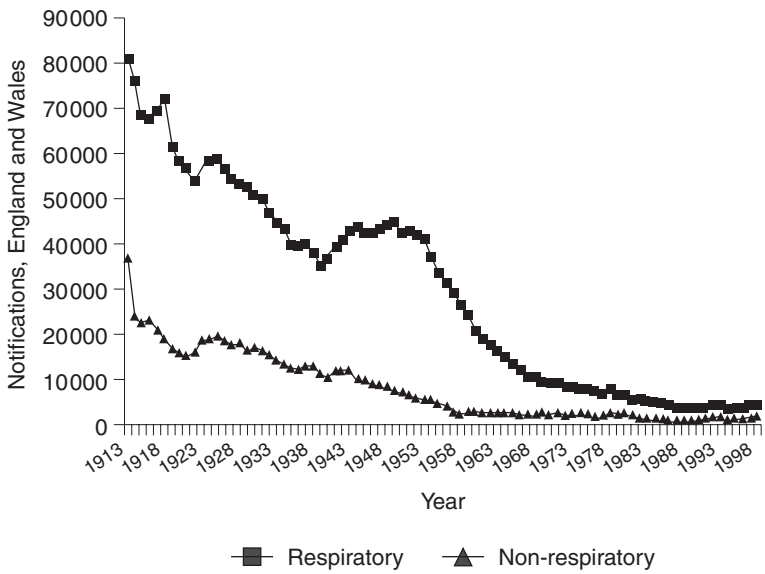

Figure 6: Notifications of tuberculosis in England and Wales, 1913–1998.
Source: Public Health Laboratory Service web site (www.phls.co.uk).

Notification rates show wide regional variations, with the highest rates and greatest rise since 1993 being in London (34.0 per 100 000, rising from 28.3 per 100 000 in 1993), and the lowest rate being in Eastern region (5.0 per 100 000).[97]

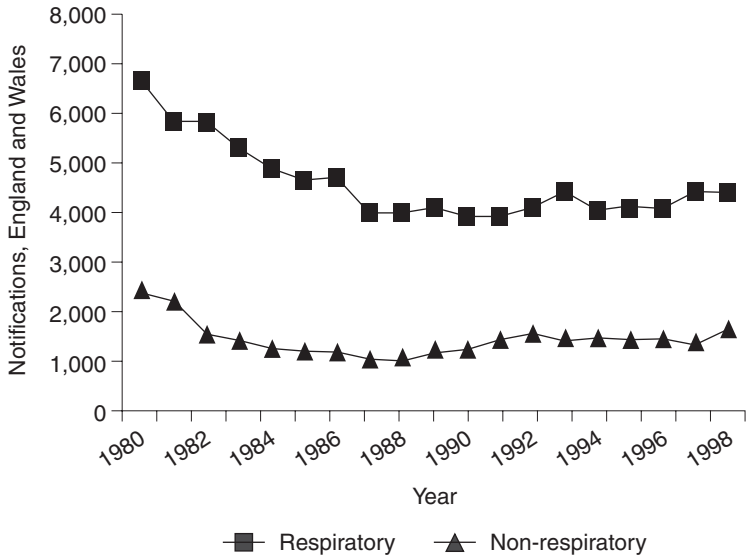

Figure 7: Notifications of tuberculosis in England and Wales, 1980–1998.
Source: Public Health Laboratory Service web site (www.phls.co.uk).

TB and HIV infection

TB in those with HIV infection is most commonly the result of reactivation of a dormant infection and therefore occurs in those previously exposed to TB.[98] In the UK, there currently appears to be little overlap between the sub-population with HIV infection and those with previous tuberculous infection.[99] The proportion of AIDS cases in whom TB occurs is relatively small (5% of AIDS cases by July 1990, between 4 and 6% in 1998),[100] and less than 0.5% of patients notified with TB in 1988 were identified as having AIDS.[101] By the 1993 survey of notifications, this proportion had risen to 2.0% of all eligible adult cases, and this was higher in London (4.3%) than elsewhere (0.8%).[102] However, the likely future impact of HIV on TB is uncertain.

TB and ethnicity

The MRC study in 1983[27] showed considerable differences between ethnic groups in the estimated yearly rates of notifications of respiratory TB in England and Wales, subsequently confirmed by further surveys of notifications in 1988 and 1993[102] (**Figure 8**). Notification rates have generally decreased in the white, Indian and Black Caribbean groups, but have increased in the Black African, Pakistani, Bangladeshi and other ethnic groups since 1988.

Amongst immigrants from the Indian sub-continent, prevalence rates decrease as period of residence in the UK increases, particularly beyond five years.[103] The majority of the increase in cases in the Black African and other ethnic groups in 1993 were also due to recent immigration.[102]

Non-respiratory TB is more common in patients of Indian subcontinent origin (46% non-respiratory cases, compared with 16% in the white population).

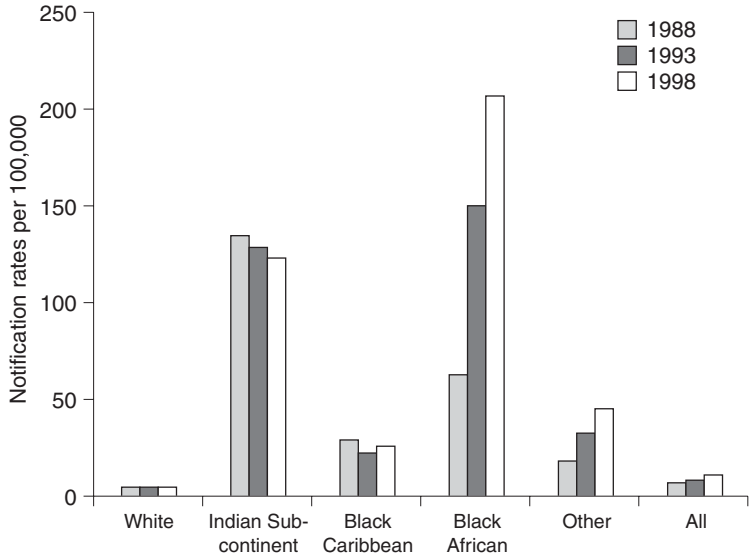

Figure 8: Notification rates per 100 000 population by ethnic group for tuberculosis in England, 1983–1993.
Source: Kumar *et al.* (1997)[98] and PHLS web site (www.phls.co.uk).

TB and other risk factors

Age is a major risk factor for tuberculosis, and notification rates increase with age in all ethnic groups. Among white patients, the majority of cases are in older age groups,[104] while the greatest proportion of cases in patients from the Indian sub-continent occur in those aged under 35 (**Figure 9**).[103]

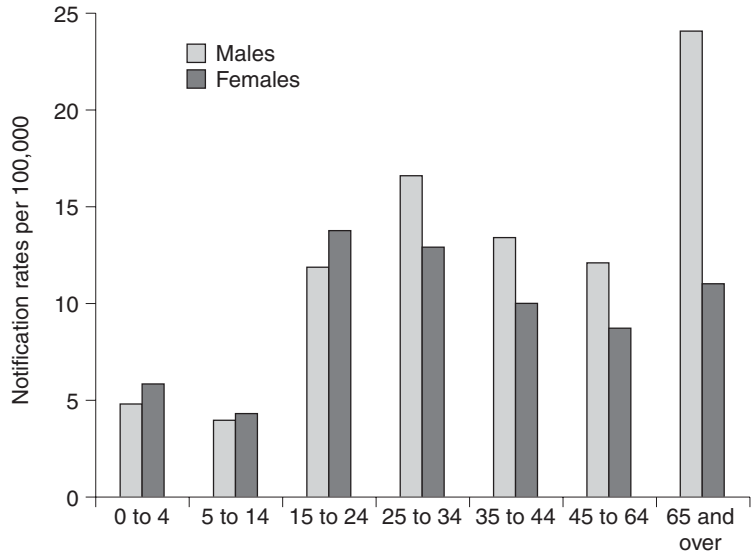

Figure 9: Notification rates of TB by age and sex, England and Wales, 1998.
Source: Public Health Laboratory Service web site (www.phls.co.uk).

The homeless constitute a major risk group, with a confirmed prevalence of 1.5% (1500 per 100 000) in one study.

Drug resistance

Resistance to one or more anti-tuberculous drug is a global problem. A study in 1998 for the World Health Organisation identified the total prevalence of resistance to a single drug to be 12.6% globally, and 1.9% in England and Wales.[105] Recent data from the UK Mycobacterial Resistance Network suggests that isoniazid resistance occurs in 6.3% of isolates in individuals with no previous history of TB, and 17.0% in those with previous history of TB. Multi-drug resistance occurs in 1.0% of those with no previous history, and 11.0% of those with a previous history.

Cystic fibrosis

People who carry the defective gene comprise about one in 25 of the population, and the great majority of these individuals have no clinical abnormality. Approximately 1 in 2500 live births are affected by cystic fibrosis in the UK, i.e. approximately 250 births in England and Wales per year. The United Kingdom Cystic Fibrosis Survey,[106] which is a case register, estimates that there are 7500 individuals in the UK with cystic fibrosis of whom 57% are under 15 years of age and 43% are adults (**Figures 10** and **11**). The proportion of adults is expected to rise to over 50% by the year 2000. This gives a prevalence of approximately 140 affected individuals per million resident population. Prevalence is higher in the 0 to 14 age group (440 per million) and 15 to 24 age group (300 per million), but is lower in the over 25 age group (35 per million). The prevalence in the UK is rising by approximately 160 individuals per year, of whom the majority are adults.[107] Current median survival is around 28 years of age, but survival of the current birth cohort is predicted to exceed 40–50 years.

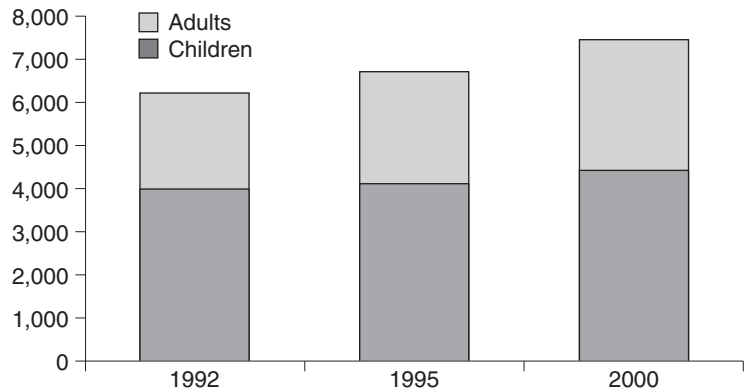

Figure 10: United Kingdom cystic fibrosis population: based on estimates or projections from 1992 UK CF Survey Data.[165]

Prevalence varies little across the country. The disease is much more common in Caucasian populations than those from other ethnic backgrounds, but still occurs in these groups, although much more rarely. Cystic fibrosis can in particular be underdiagnosed in people with an ethnic origin in the Indian subcontinent.

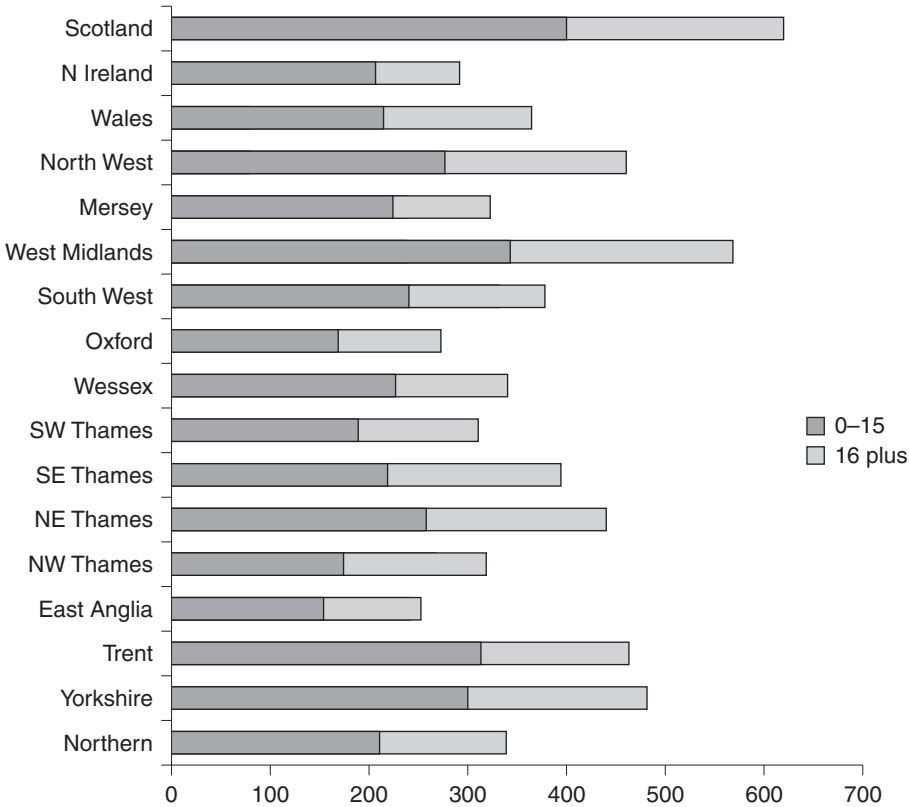

Figure 11: Regional population of cystic fibrosis patients (adults and children): 1992 regional boundaries.[165]

The majority of affected individuals are able to undertake normal education and full-time employment, but one quarter of affected adults are unable to work due to ill health.

Mortality

Lower respiratory conditions (including lung cancer) account for 23% of all deaths. They account for almost 15% of all deaths up to age 65, increasing thereafter due to a rising contribution from COPD and pneumonia to almost 25% (**Figures B.1** and **B.2**).

Lower respiratory infection in childhood

Lower respiratory infection in childhood is rarely fatal (15 per million 0–14 year olds in 1999), yet bronchitis, bronchiolitis and pneumonia account for 3% of all deaths in this age group (**Table B.4**). Deaths due to acute LRTI in childhood are mainly a problem of the first year of life. Deaths up to 28 days should be excluded from consideration, as they will be heavily influenced by cases of respiratory distress syndrome in premature babies. In England and Wales during 1989, bronchitis, bronchiolitis and pneumonia together accounted for 5% of all post-neonatal deaths.[108] In 1999, deaths due to bronchitis, bronchiolitis,

pneumonia and whooping cough comprised 2.9% all deaths in the 0–4 age group. The male:female ratio at this age is about 1.4:1, closely reflecting the sex difference in admissions and somewhat greater than that for incidence. For children aged 5–14, the male:female ratio rises to 1.9:1. Children of parents in social class IV or V are three times more likely to die of respiratory conditions at ages one to four than children in social classes I or II.[109] This is somewhat greater than the social class differential in incidence suggested by survey data. Post-neonatal mortality and deaths at ages 5–14 are less strongly related to parental social class. Regional variations in mortality are difficult to interpret in the absence of good data on geographical patterns of incidence.

Pneumonia in adults

Pneumonia is frequently recorded as the cause of death, especially in the very old, where other chronic diseases may have predisposed to death. Changes in the coding of underlying cause of death in England and Wales from 1984 onwards now give precedence to certain other conditions mentioned on the death certificate when pneumonia is recorded as the primary cause, but this does not entirely solve this problem.

Pneumonia (all forms) was certified as the underlying cause in 10.7% of all deaths in 1999 (after implementing the new coding rules as discussed above). In the 15–64 age group, this proportion was 3.3%, representing rates of 22 per million at age 15–44 years and 198 per million at age 45–64 years (**Table B.4**).

Asthma

Mortality is best thought of as an indicator of case-fatality rather than of morbidity and it is notable that the ratio of mortality to prevalence increases rapidly with age.[19,22,23,56,57,63,70,85,110–115] Asthma mortality has a high profile, but accounts for less than 0.25% of all deaths (**Table B.1**); an average general practice could expect to experience the death of a child asthmatic only once in 1000 practice-years. There is concern that asthma mortality has risen over the past 20 years, but this is mainly a problem in older adults, where transfer of deaths from COPD poses a major problem of interpretation. Among children and young adults, where diagnostic transfer is less problematic, the actual rates of fatal asthma are low: 2.3 per million (0.4% of all deaths) at age 0–14 and 6.3 per million (0.8% of all deaths) at age 15–44 (**Table B.4**). Asthma mortality in children has not increased during the 1990s.

Chronic obstructive pulmonary disease

While mortality attributed to chronic bronchitis has decreased considerably over the last 30 years,[116,117] mortality due to Chronic Airways Obstruction (a new ICD code introduced in 1979), and later COPD (ICD-9 496, ICD-10 J40–47), has been increasing. This is probably due to an increasing shift in diagnostic labelling from chronic bronchitis and emphysema (ICD-9 490–492, ICD-10 J40–43) rather than a change in the epidemiology of COPD.[118] However, overall death rates from these three conditions combined have been declining over the past 30 years. In 1999, these three diseases were certified as the underlying cause of 5.7% of all male deaths and 4.0% of all female deaths. The majority of these deaths occurred in elderly people, but in middle age (45–64 years) 194 per million persons died of chronic bronchitis, emphysema or COPD, 3.4% of all such premature deaths.

Tuberculosis

Pulmonary tuberculosis now accounts for less than 0.1% of all deaths, about 300, in the UK per year. Age-specific mortality rates for tuberculosis have been declining in England and Wales since the mid-1900s. Case-fatality rates continue to decrease in all age groups, although the overall annual mortality rate

declined by only 0.13% between 1974 and 1987. This is because the incidence of disease in those over 75 years has declined more slowly than in the rest of the population and the size of this age group has increased.[119]

Cystic fibrosis

Overall, cystic fibrosis is a rare cause of death, accounting for less than 0.1% of all deaths. However, in children and young adults aged 5–25 it is the second most important respiratory cause of death (after pneumonia), accounting for 23% of all respiratory deaths, and 1.4% of all deaths, in these age groups. Median survival continues to increase, and is currently around 27 years. Survival is improving for each successive birth cohort, and for the current birth cohort it is expected to exceed 40 years.[120]

5 Services available

Health care sectors concerned

Respiratory conditions are managed at all levels of the health service. Acute conditions or acute exacerbations of chronic conditions involve family health services and in some cases result in hospital admission including the use of intensive care units and the whole range of emergency services. Patients with chronic respiratory conditions use family health services and outpatients. Self-care and patient decision-making is a major feature of the management of chronic conditions and of their acute exacerbations.

Patients with respiratory diseases are managed by the specialties of paediatrics, adult general medicine, respiratory medicine, cardiothoracic surgery and geriatrics. Varying degrees of sub-specialisation are observed within respiratory medicine. The care is essentially medical, i.e. using clinical assessment and treatment with drugs and other non-surgical supportive treatment. Respiratory diseases are also the concern of public health medicine and non-health agencies concerned with air quality, living conditions and smoking control.

Provision of respiratory specialist care

The British Thoracic Society (BTS) now recommends one consultant with a specialist interest in thoracic medicine per 60 000 population (the previous figure proposed in the late 1970s was one per 150 000, and in the 1990s, one per 100 000). This would bring Britain into line with the European average for respiratory consultant provision. Figures from the Royal College of Physicians of London Consultant Census showed that in 1996 there were 426 consultants citing a specialist interest in thoracic medicine in England and Wales, representing 0.8 per 100 000, with considerable regional variation. By 2003 this figure had risen to 502 consultants, or 1 per 100 000. This figure includes consultants working in academic and research posts. Expansion in consultant numbers occurred in thoracic medicine at a similar rate to medical specialties in general (7% per annum) during the 1990s but have fallen to 5.7% per annum since 2000 (figures from British Thoracic Society). Diagnostic facilities are used by a minority of patients and include lung function laboratories, radiology, blood gas analysis, endoscopy, allergy testing and microbiology.

Supporting services are used by only a minority of patients and include physiotherapy, specialist home care nurses, rehabilitation and domiciliary oxygen.

Service availability and utilisation

Table B.1 shows the proportion of all hospital discharges, hospital bed-days and general practice consultations attributable to various respiratory diseases, for both sexes and all ages combined. These estimates are based on reliable recent data (i.e. hospital admissions data for England 1998–99, cause specific and overall mortality for England and Wales from the Office for National Statistics, 1999, and the Fourth National Morbidity Survey in General Practice 1991–92), with rates calculated using the appropriate mid-year population estimates. These figures represent the workload directly attributable to respiratory illness. Such data are only indirectly related to the measures of incidence and prevalence discussed above. Co-existing respiratory disease is often an important but unquantified factor contributing to case fatality in other diseases (e.g. myocardial infarction), and may substantially prolong length of stay (e.g. after surgical operation).

Table B.2 translates these figures into the experience of a hypothetical 'average' district with a population of 500 000 persons of similar age and sex distribution to that of England and Wales in 1999. In any specific district, these figures will be subject to a degree of modification to take account of geographical variations related to environmental, occupational, social and other factors. It must also be remembered that some respiratory conditions are undergoing marked trends in both their epidemiology and medical care.

Tables B.5–B.8 are provided as a resource for readers wishing to derive estimates of caseload based on local population estimates and national age-specific rates of utilisation.

Figures 3, 5 & 7 show the hospital admissions, inpatient bed-days and general practice consultations due to lower respiratory conditions at different ages. **Figures 4, 6 & 7** show equivalent figures for all respiratory causes. Interpretation of these figures should take account of the different all-cause rates at different ages. The corresponding rates of service use (related to age-specific population denominators) are shown in **Tables B.5–8**.

Excluding lung cancer, lower respiratory conditions account for 7.8% of all FCEs (approximately 6% of hospital admissions) and about 85% of the admissions due to all respiratory diseases. The remaining respiratory admissions are mainly due to upper respiratory conditions (principally to ENT units) in children, and to lung cancer and non-specific symptoms in older adults. Most of the paediatric admissions for lower respiratory conditions are for acute respiratory illnesses and asthma, whereas in middle and old age, COPD and pneumonia assume greater importance.

The age-related pattern of bed occupancy is broadly similar, although the contribution of lower respiratory conditions to inpatient bed-days in the elderly is greater than their share of admissions. This reflects the tendency for old persons to be admitted with pneumonia, but then retained in hospital because of multiple disease problems or inadequate social support. This problem is seasonal and contributes to the widespread shortage of acute medical beds in winter months. Planning of inpatient services needs to allow for this seasonal phenomenon.

Lower respiratory conditions account for about 16% of all consultations in general practice, proportionately more in children and the elderly than in middle age. Much of this workload is attributable to asthma and acute lower respiratory infections. These graphs also emphasise the substantial contribution of upper respiratory conditions (which are excluded from this review) to workload in primary care (overall they account for 22% of consultations, and 50% of consultations in children under 5).

Lower respiratory infections in children

Available routine statistics and ad hoc surveys show that over 80% of lower respiratory tract infections in children are treated by general practitioners. Bronchitis, bronchiolitis and pneumonia (including

influenza) account for 19% of all GP consultations in the age group 0–4 years and 9% of all GP consultations in the age group 5–15 years (**Table B.7**). Whooping cough accounted for a further 0.8% in 1981–82, and 0.1% in 1991–92, although this has almost certainly declined in more recent years.

General paediatric hospital services receive most of the inpatient referrals, either from the general practitioner or through casualty. These conditions have few implications for outpatient services. Of all hospital admissions at ages 0–14 years, acute bronchitis, bronchiolitis and pneumonia (including influenza) accounted for 2.3% of admissions in 1985, 3.35% in 1996, and 2.1% of FCEs in 1998–99. However, they also account for a lower proportion of occupied bed-days (1.79% in 1998–99, **Tables B.5 and B.6**). The burden posed by whooping cough varies from year to year since the disease follows a four-year epidemic cycle. In 1985 whooping cough accounted for 0.3% of all paediatric hospital admissions and a similar proportion of occupied bed-days. By 1996, this had fallen to 0.06% of admissions and 0.03% of bed-days and in 1998–99, 0.06% of FCEs, but 0.07% of bed-days.

There are no norms for the provision of services for treating lower respiratory infections. Wide variations in service use may arise because of the epidemic or seasonal nature of lower respiratory infections.

Primary preventive health care includes reduction of passive exposure to tobacco smoke, promotion of breast feeding, and vaccination against whooping cough and measles, for which GPs and community services are responsible.

Lower respiratory infection in adults

The health care sectors concerned with the management of influenza and community-acquired or nosocomial pneumonia in adults are based on the natural history of the disease. Ad hoc surveys show that 67–95% of adults with community-acquired pneumonia are treated at home by general practitioners.[10,121] Pneumonia and influenza account for 0.3% of all GP consultations in the 15+ age group (**Table B.7**), but diagnosis in the community is difficult.

In general practice, the diagnosis is mainly on the basis of clinical history and examination. A convalescent chest radiograph may be taken to confirm resolution of the infection, and in smokers to exclude underlying cancer of the lung. Slow responders to treatment may have further investigations, especially during epidemics of *Mycoplasma*, *Legionella* and influenza.

Between 5% and 33% of all patients with community-acquired pneumonia will be admitted to hospital. In 1998–99 pneumonia and influenza accounted for 0.43% of all FCEs in the 15–64 age group, and 2.2% of FCEs in the over-65 age group (**Table B.5**). Because of the age-related pattern of bed occupancy discussed above, pneumonia and influenza account for 4.6% of occupied beds in the over-65s.

The main activities for preventing community-acquired pneumonia concern smoking reduction and the vaccination against influenza and *Streptococcus pneumoniae* of special risk groups.

Two-thirds of nosocomial pneumonias occur in patients who have undergone thoracic or upper abdominal surgical procedures or who have had intensive respiratory care such as assisted ventilation. It has been estimated that excess stay in hospital as a direct consequence of nosocomial pneumonia ranges from 7 to 9 days per affected patient. Twenty-five percent of all extra days spent in hospital are due to nosocomial pneumonia and 40% of the extra costs attributable to nosocomial infections are due to nosocomial pneumonia.[122] The direct cost of nosocomial pneumonia in the USA has been estimated as approximately $1.1 billion annually.

No norms exist for the provision of services for treating lower respiratory infections in adults. However, there are guidelines for the management of community-acquired pneumonia.[123] The clinical management of certain other conditions such as stroke and of post-operative patients is partly directed at preventing nosocomial pneumonia.

Asthma

The main data about the use of services for asthma are summarised in **Table 5**. Most are taken from routine sources tabulated in **Appendix B**, but **Table 2** also includes data from some ad hoc surveys. Interpretation of routine utilisation data needs to take into account the way in which the data were collected, especially the process of diagnosis, which is subject to much variation and confusion in the case of asthma.

Table 5: Summary of data on service use for asthma. All expressed as per hundred population per year.

	% by age group			
	0–14	**15–44**	**45–64**	**65+**
Patients consulting GP	2.8	1.5	1.7	1.8
Consultations with GP	7.1	1.1	1.8	1.7
GP home visit	2			
Referral to outpatients	1		1–2	
Prescribed anti-asthmatic drugs	6	4	4	
A&E attendance (without admission)	1			
Hospital admissions (spells)	0.69	0.35	0.39	0.65
Hospital bed-days	1.17	1.16	1.84	4.87

Most data on the activity of GPs are from the Royal College of General Practitioner's (RCGP) volunteer practices, which are scattered about the country,[124] but limited data are also available from ad hoc surveys of practice populations.[22,125,126] About 2% of the population consult their general practitioner annually for asthma, accounting for 1.4% of all consultations (**Table B.7**). The four National Morbidity Surveys in General Practice (1955–6, 1970–71, 1981–2 and 1991–2) show that there has been an increase in patients consulting between 1970/71 and 1980/81 and again in 1990/91, accompanied by a fall in consultations per patient consulting.[62] This is consistent with the postulated increase in the prevalence or severity of asthma although an artefactual explanation associated with changing diagnostic fashions and health behaviour of patients cannot be excluded. Since 1993 there is some evidence that the number of new consultations for asthma episodes in primary care, making a change in diagnostic preference less likely as an explanation for the previous observed rises.[127]

No routine data about outpatient use by diagnosis are available. Data from the RCGP morbidity survey are unreliable because of the small numbers of referrals in the sample. Ad hoc surveys in children and adults indicate that about 10–15% of those consulting are referred.[115,125] Very little is known about rates of attendance at Accident and Emergency (A&E) departments for acute asthma because here again, no data are collected routinely. Ad hoc surveys of children indicate that for every child admitted, one is seen in A&E and sent home.[58,125] Data from over 10 years ago suggested a trend away from GP domiciliary visits and towards A&E attendance,[58] while other evidence indicates that there is a marked increase in self-referral to hospital for acute asthma in children, the current level being about 40–50% of admissions.[63] The impact of NHS Direct on use of other services for asthma is as yet unclear.

Asthma admissions in children have increased dramatically since the early 1970s,[63–64] particularly for the pre-school age group, and asthma represents an important contributor to the workload in paediatrics, accounting for 3.5% of all FCEs at ages 0–14 years. The increase is not explained by diagnostic transfer or an increase in re-admission rates. In adults, asthma accounts for about 2.3% of FCEs and 1.8% of bed-days (**Tables B.5 and B.6**), and there has been only a modest rise in admissions in young adults and no trend in older adults.[64,128] Because of the large pool of asthma in the community, at least some of the increase could

be explained by a shift towards hospital as the preferred place to treat acute asthma in children;[58] or alternatively, the increase could be explained by epidemiological factors.[57] Asthma admission rates vary across different regions by a factor of about two. Limited information from Scotland and from the Oxford Record Linkage Study indicates that social class does not have an important effect on admissions. There is no evidence concerning ethnic factors.

There are no norms for the provision of services for asthma. Evidence-based guidelines for hospitalisation in acute asthma are now available[25,140] but it is not possible to construct a norm from this information. For the management of chronic asthma the evidence is even less clear. The tools of diagnosis, investigation and treatment are to a large extent available to general practitioners and hospital doctors alike. However, it is not clear where the general balance between primary and secondary care, and within each setting the balance between generalist and specialist care, should lie, nor is it clear which is the most suitable method of managing recall for ongoing care in each setting. Therefore it is not possible to construct norms for asthma service provision. Patients with severe acute asthma admitted to hospital should be under the care of a specialist in respiratory medicine or respiratory paediatrics.

Primary prevention

Asthma probably results from an interaction between genetically susceptible individuals and environmental factors and it is thought that the wide geographical variations which exist are explained by environmental factors. Little is known about the cause of asthma itself.[127] However, interventions to prevent whooping cough, and smoking in pregnancy may reduce incidence of childhood and later onset asthma.[54] Risk factors for earlier onset in childhood include a family history of atopy, increased levels of allergic antibodies, artificial feeding, exposure to tobacco smoke and higher exposure to house dust mites.

A large number of precipitating factors have been identified, including respiratory infections, emotional upset, exercise, allergens and irritant atmospheres. The relative public health importance of these is poorly understood. Factors in the indoor environment have received most attention, particularly allergens of animal origin (house dust mites, pets),[130,131] moulds[113] and passive smoking.[132,133] Standards for indoor levels of house dust mite have been proposed[134] although there is little evidence that methods currently available have any significant impact on either house dust mite levels, or asthma symptoms.[167,168] No standard for tobacco smoke exists, and the approach has been to discourage it altogether. Young adults who have ever had asthma should not smoke, since this increases risk of relapse in later adulthood[54] and increases the risk of COPD. Breast feeding may delay onset of wheezing in at-risk infants[72] and is promoted for this and many other reasons. Specific problems arise in the workplace where there may be exposure to allergens and other asthmogenic substances not encountered elsewhere.

Control of precipitating factors in the outdoor environment is even less developed. Rarely a man-made source of aeroallergen exposure can be identified and controlled. There is recent interest in the role of air pollution in aetiology of and exacerbation of existing asthma, especially levels of ozone, although evidence that this is important in the UK is lacking.[135]

Where it is possible to control exposure to allergens or irritants, one approach may be to concentrate on individuals known to be at risk because they are atopic or of atopic parentage.

Overall, there is very little preventive care for asthma and the main activity is probably the control of active and passive smoking and limitation of exposure to known occupational precipitants. Other agencies are responsible for housing and domestic environment, air pollution and occupational hazards.

Secondary prevention

Undiagnosed asthma may be detected by screening for symptoms suggestive of asthma with a simple questionnaire. It has been suggested that this could be done through schools or by surveys of practice

populations. Although asthma may be identified at a pre-symptomatic stage by tests of bronchial hyperreactivity, no screening test of sufficient sensitivity or specificity exists and if it did there would be other factors to consider before considering a screening programme. The American Thoracic Society does not recommend screening.[136]

Diagnosis and treatment

The diagnosis and treatment of asthma have been the subject of recent consensus statements and other reviews. Diagnosis is usually based on clinical history and examination, but may be supplemented by lung function tests, chest X-ray and therapeutic trial where other conditions (primarily COPD) are considered. Overlap with COPD in older subjects has led many clinicians to ensure that any reversible component of airways obstruction is identified and treated using bronchodilating and anti-inflammatory drugs. Most diagnosis and treatment comes within the realm of the general practitioner, although spirometry, which is not universally available in primary care, is required for diagnosis and assessment of COPD and its differentiation from asthma.

Individuals with asthma carry a long-term susceptibility to the disease and the chronic inflammation now believed to be the basis of this susceptibility may be present even when the patient is symptom-free. The development of the inflammatory concept has led to an increasing emphasis on the use of anti-inflammatory rather than anti-spasmodic drugs, and on regular rather than ad hoc regimes of care.

The aims of treatment are mixed:

- to reduce exposure to precipitating factors (*see* above)
- to reduce or abolish disability
- to reduce or abolish symptoms
- to reduce the incidence of acute severe attacks
- to reduce the risk of death in an attack
- to achieve a target level of lung function
- to improve long-term prognosis.

The clinical care of asthma is a regular topic in medical journals directed at a general medical readership. There have recently appeared consensus statements which provide guidelines on the clinical management of asthma in adults[16,137] and children.[138] The original consensus groups were initially composed mainly of respiratory specialists. These were recently updated for both adults and children, have become more evidence-based in approach and incorporated guidance for treatment in primary care.[25,139,140]

There is a potential conflict between the aims of the doctors and those of their patients. This applies for example to the question of how intensively acute attacks should be treated and the lengths to which regular treatment should go in order to prevent attacks. Confidential enquiries have demonstrated that some deaths occur quickly, in patients who do not appear to be particularly ill.[141–143] It may be that these patients had unrecognised severe asthma (a well-demonstrated entity) or that the attack was indeed very quick and severe. Some patients exhibit what is termed 'brittleness' and may deteriorate suddenly. Although doctors may wish to treat each attack as if it were potentially fatal, this is probably not an attitude that can be sustained by patients on a day-to-day basis. Similarly, patients with chronic symptoms may prefer to live with a certain level of symptoms rather than have the extra burden of treatment. They may prefer to 'normalise' their illness rather than consider themselves to be chronically ill. This may explain why some severely affected patients delay treatment or seeking medical attention.[144] Thus the expectations and objectives of carers may conflict with those of the patient. In contrast, parents may be so concerned about their or their child's asthma as to want treatment or hospitalisation that is not needed on medical grounds.[145]

Assessment will determine the type, level and place of treatment. Clear guidelines are available with recommendations for treatment of childhood asthma, acute asthma attacks and chronic treatment and monitoring of asthma.[16,140,13] These include clear guidelines for specialist referral (to a respiratory physician or respiratory paediatrician) for clarification of diagnosis or for assessment of treatment.[140]

Chronic asthma

Despite its high prevalence, chronic asthma is still under-diagnosed. Diagnosis and investigation of chronic asthma should include a high level of clinical suspicion among any adult or child presenting with wheeze, a full clinical and occupational history, measurements of lung function that should include spirometry and serial measurements of peak expiratory flow rate, where required, challenge with methocholine, histamine or exercise, and might also include non-invasive markers of airway inflammation, and measurement of allergic status. Facilities to undertake these investigations are not universally available in primary care, and their correct application requires appropriate training of the health professional responsible. There are guidelines available for the appropriate provision of spirometry services.[146]

Evidence-based guidelines recommend a stepped approach to treatment that is tailored to the severity of asthma symptoms and patient response at each stage.[25,140] Guidelines differ slightly for adults and children, and treatments are set out in **Table 10** (*see* p. 313). The aim is to step up therapy until optimum asthma control is obtained, and attempt to step down once asthma is controlled to keep the patient on the minimum level of effective therapy.

A wide variety of devices exist for delivery of inhaled drugs. Current guidelines[140] recommend a pressurised metered dose inhaler with a spacer, but choice of device also needs to be based upon patient preference and ability to use the device correctly.

A minority of patients with severe asthma under specialist care will require more intensive therapy, including the use of oral steroid-sparing agents. A wide variety of devices are available for the delivery of inhaled therapies including metered dose aerosol inhalers, dry powder inhalers, spacer devices and nebulisers.

Non-drug treatment that has been tried in asthma includes acupuncture, homeopathy, ayurvedic medicine, herbal medicine, ionizers, osteopathy and chiropractic, and Buteyko. There is no good evidence for the effectiveness of these alternatives. Treatment of allergic rhinitis, which co-exists in many individuals with asthma, may also improve asthma symptoms.

Effective monitoring of peak expiratory flow combined with self-management plans are a vital element of management of asthma. The principles of care are becoming more proactive, with increased use of treatment plans in which procedures for the patient to make decisions about prescribed treatment and when to obtain medical assistance are agreed. There is increased emphasis on self-management and, to assist this, various schemes for self-monitoring have been devised. These may take the form of a card carried by the patient (e.g. National Asthma Campaign adult asthma card). Evidence-based and consensus guidelines for self-management are available[16,25,140] and devices for the self-monitoring of lung function are available on prescription.

Acute episodes of asthma

Acute episodes of asthma do not all require hospitalisation, and many can be managed in the community by following self-management plans tailored to the patient. The severity of an asthma attack can be assessed by symptoms (breathlessness, ability to talk, level of consciousness, respiratory rate, use of accessory muscles, wheeze, pulse and pulsus paradoxus), peak expiratory flow rate, blood gases and oxygen saturation. Clear guidelines are available on when patients should contact a clinician or self-refer to

hospital, and on investigation, treatment and admission to hospital and intensive care during an acute attack.[25,140] However, it is important to note that because the course of acute asthma is unpredictable, assessment of severity incorporates the doctor's perception of the risk of deterioration and this leads inevitably to a degree of variation in the way that the same patient would be managed by different doctors.[147,148] Individual patients do not always fit into guideline categories, and clinical assessment remains an important variable in treatment.

The mainstay of treatment of acute episodes includes frequent or continuously administered inhaled or nebulised $®_2$ agonists, oral glucocorticoids and oxygen. To this may be added inhaled anticholinergics, intravenous methylxanthines, intravenous magnesium, parenteral $®_2$ agonists and assisted ventilation. Peak flow measurement forms the basis of monitoring and clinical treatment decisions.

Education

Self-care is an indispensable aspect of the domiciliary care of asthma. Education aims to improve self-care by educating the patient about his/her illness and its medical treatment, by training the patient to perform necessary techniques (e.g. using inhaler) properly, and by helping them monitor the illness and make appropriate decisions about adjusting treatment and seeking assistance.

Dynamics and organisation of care

The majority of care for chronic asthma and for non life-threatening attacks of acute asthma takes place in the community setting and primary care.

Acute asthma

Most treatments for non life-threatening attacks of acute asthma are available in the domiciliary setting but more severe acute cases tend to be referred or self-refer to hospital. As mentioned above, the assessment of severity is influenced by the perception of risk of deterioration. **Figure 12** (*see* overleaf)shows the possible pathways for a child with an acute asthma attack. One feature of acute asthma is that a sizeable proportion self-refer, including calling an ambulance. Guidelines suggest thresholds at which self-referral should occur, based upon written self-management plans and/or advice on what to do if symptoms of an attack occur.[25,140] In some areas there is a formal self-admission policy.[149] Guidelines also suggest pathways and decision points for referral to clinicians, direct self-referral to hospital, and routes of management once in hospital, including admission to intensive care units.[25,140]

Chronic asthma

For chronic asthma, the majority of care takes place in the community. In recent years there have been marginal shifts in management of asthma from secondary to primary care, but within each setting there has been a marginal shift towards the management of asthma by respiratory physicians (secondary care), and general practitioners with a special clinical interest (primary care), together with the use of specialist asthma nurses (in both primary and secondary care). Increasing numbers of general practices offer asthma clinics, and the majority of hospitals offer special respiratory clinics for adults, and some offer special paediatric respiratory clinics. Adolescents with asthma may come under the care of their general practitioners, a paediatrician or respiratory physician depending on local policy.

Although the above pattern of marginal shifts from secondary to primary care and, within each setting, from general to specialist care is established, the general balance between primary and secondary care, and general and specialist care within each setting is still variable, and the correct balance is not yet known. In

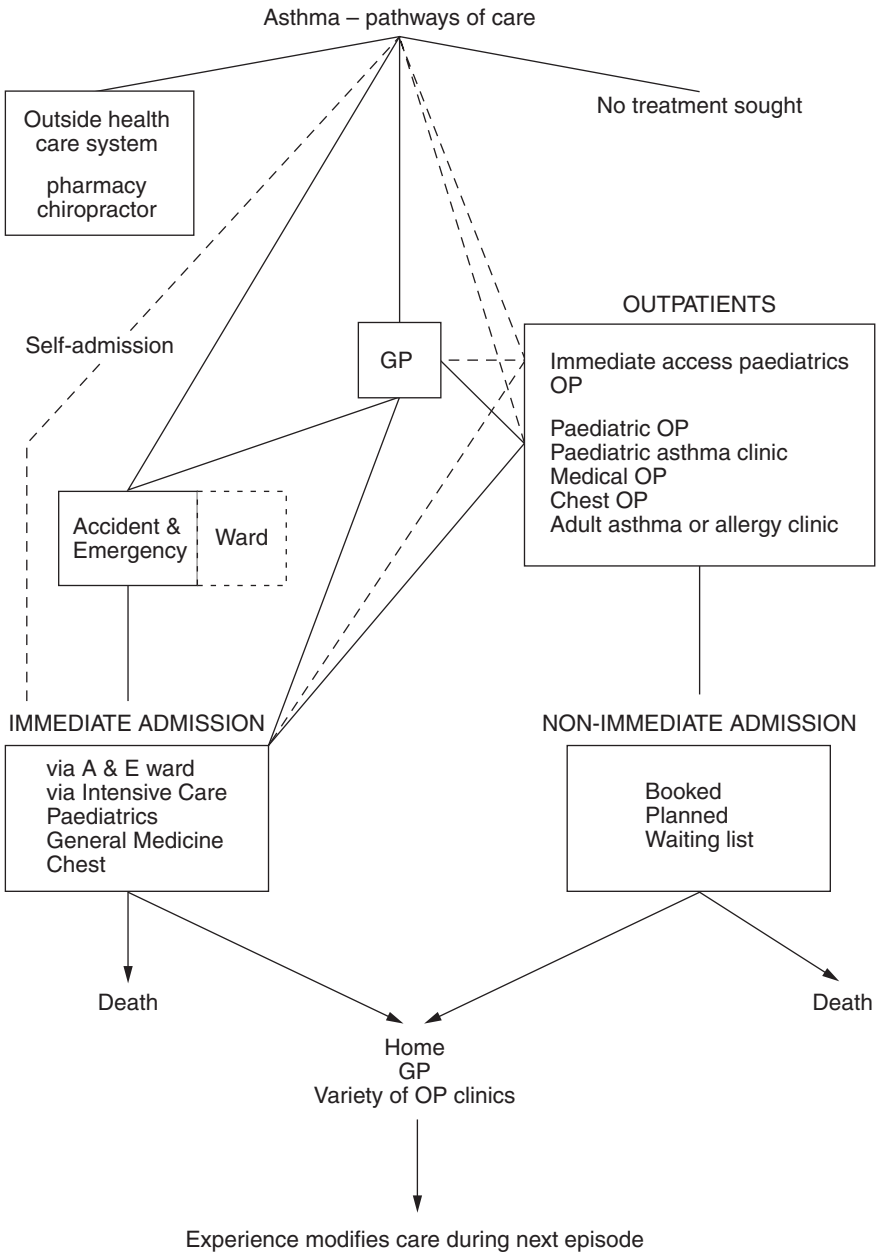

Figure 12: Possible pathways of care for asthma in Britain. Solid lines represent the departures from the basis NHS referral system.

particular we do not know which patients benefit most from regular specialist review. Shared care between primary and secondary care, led either in the primary or secondary care setting is also established in some areas, although there are several different models for this.[286] The best method of arranging ongoing review for those with chronic asthma in either primary or secondary is also unclear and a high proportion of patients do not want practice-initiated review.[150,16]

Emergency care

Because this may be required urgently, other arrangements are required. One is the self-admission or open access policy based upon written advice upon what to do when symptoms occur that has been referred to above. The other is the need for a rapid response by ambulances: recently crews have been trained in the emergency treatment of asthma.

Chronic obstructive pulmonary (airways) disease

Among persons of all ages, about 1.4% consult their general practitioner each year for chronic bronchitis, emphysema and obstructive airways disease (**Table B.7**). The proportion is greatest among the elderly (4.5%) and a further 15% of the over-65 age group consult with acute or unspecified bronchitis which probably includes many cases of chronic disease. Recurrent consultations are common, with an average of three per year among elderly patients consulting for bronchitis, emphysema or COPD. Consultation rates (spells) and patient consultation rates (persons) are much higher among males than females.

This condition accounts for about 2% of all FCEs and a somewhat greater proportion (3.2%) of all inpatient bed-days (**Table B.5** and **Table B.6**). Most admissions are in those aged 65 or more, where it accounts for 5% of FCEs and bed-days. The increase in hospitalisation for 'chronic airways obstruction' has been balanced by a decline in hospitalisation for 'chronic bronchitis'.

As for asthma, the pyramid of care has a broad base in the community and sharp apex in the hospital. This means that small shifts in referral practice will have relatively greater effects on hospital use.

There are no norms for the provision of services for COPD. British Thoracic Society Guidelines provide indications as to when referral for hospital care might be appropriate in the management of ongoing care and acute exacerbations.[330] As for asthma, the tools of diagnosis, investigation and treatment are to a large extent available to general practitioners and hospital doctors alike and referral habits vary greatly.

The main aetiological factor in COPD is smoking and its control is the most important preventive activity. An effective smoking prevention programme would therefore dramatically reduce the associated morbidity and mortality. In addition, smoking cessation remains the only proven means of preventing the deterioration of lung function in individuals with the disease.[151] Other agencies are responsible for housing and domestic environment, air pollution and occupational exposures.

Vaccination against influenza and/or pneumococcal disease, and early treatment with antibiotics are employed in a variable fashion to prevent or reduce the impact of these diseases on patients with COPD.

Diagnosis is made on clinical history and is confirmed by pulmonary function tests (peak expiratory flow rate, forced expiratory flow rate in one second – FEV_1). Access to testing equipment in primary care and training in its use is not universal. A diagnosis of COPD implies that airflow obstruction is present, the significance of symptoms (typically cough and phlegm) with no deterioration in lung function is unclear. Differential diagnosis from asthma can present a problem.[23] A chest X-ray may be helpful in excluding other diseases, but will only be abnormal in severe forms of the disease (associated emphysema). Many clinicians attempt to ensure that any potentially reversible airways obstruction is identified and treated using bronchodilating and anti-inflammatory treatments.

COPD is an incurable disease, although smoking cessation can alter the prognosis for an individual. The natural history involves a gradual deterioration of lung function leading to shortness of breath, increasing exercise intolerance and finally heart failure and death. The speed of deterioration is variable; in some patients it can be rapid. The wide spectrum of disease severity means that general practitioners manage most patients with a minority (about 10%) being referred to hospital.[124,126] Assessment of the severity of both chronic and acute disease using tests of lung function is an important aspect of management.

Management in most cases involves:

- Smoking advice. Smoking cessation can stop the rate of deterioration but lung function will not improve.[152]
- The treatment of acute exacerbations, usually acute respiratory tract infections, with antibiotics.
- Symptomatic treatment with bronchodilator drugs and/or steroids is often attempted to maximise any airways reversibility. These can be administered in tablet form or inhaled either using simple devices or more sophisticated nebulisers.
- In the most severe forms of the disease, oxygen can be used. This can be provided in various ways and can be given intermittently or on a long-term basis. However, the use of domiciliary oxygen therapy for end-stage chronic respiratory failure is variable.

Historically, treatment has been on a demand basis but recently there has been a move towards regular surveillance and early intervention in acute exacerbations. There are various ways that this can be achieved, e.g. respiratory nurses, general practitioner clinics and outpatient departments. There has been an increase in the use of respiratory health workers for chronic lung disease (mainly COPD but also chronic asthma). Their purpose is to provide continuity, support and education. In general practice, there has been a growth of clinics for asthma, usually run by a practice nurse with additional training. Active physical training and rehabilitation of patients has been recommended by some as it may improve exercise tolerance.[153]

Tuberculosis

The main causes of the reduction in morbidity and mortality due to tuberculosis were improvements in the social and nutritional status of the general population and the introduction of effective drug therapy.

In the past, prevention and treatment have been carried out through the school BCG immunisation programme; the mass chest X-ray service (to identify infected individuals); and a national network of chest clinics with the responsibility for treating cases and undertaking contact tracing. As the number of cases has diminished the cost-benefit of these programmes has changed and the pattern of management has been modified. Screening of new immigrants is still undertaken by port authorities in conjunction with departments of public health medicine and chest clinics, and is still recommended.[154] Contact tracing continues and individuals are either treated if found to be infected, given prophylactic drugs if at high risk, or monitored.

There is no longer a mass-screening programme and the school immunisation programme has been phased out in some areas.[155,156] However, because of the uncertainty surrounding the impact of HIV infection on TB in this country, and the cessation of fall in incidence of TB, continuation of the schools BCG immunisation programme was recommended until 1995/96,[157] and is still currently recommended in guidelines from the Department of Health.[154] BCG vaccination is also currently recommended for high-risk groups, including immigrants from countries where TB is common, and infants born into high-risk families.[158]

Guidelines for the control and prevention of tuberculosis in the United Kingdom have been published.[154,159] The provision of designated TB services has ensured that the decline in the morbidity and mortality initiated by public health measures has continued. However, there remain sporadic outbreaks in schools and new cases in ethnic minority groups and susceptible people (including homeless individuals).

Treatment is mainly with drugs for varying periods of time (6–12 months). There have been various recommendations published by the British Thoracic Society,[158–161] the World Health Organization[162] and other agencies.[163] Despite these guidelines there is evidence that prescribing habits still vary.[164]

Unlike other respiratory infections, tuberculosis has predominantly been managed at special outpatient clinics equipped with facilities for contact tracing. However, in many areas the chest clinic as originally set

up has disappeared and its function is shared between respiratory physicians and departments of public health. Patterns of services vary depending on the prevalence of disease in the community (ethnic minority groups) and local availability of respiratory physicians and public health doctors.

Cystic fibrosis

Cystic fibrosis is a chronic condition that is managed across health care sectors. There is evidence that outcome is improved if care is undertaken by a hospital specialist who has a major specialist interest in the condition. However, care can be shared with a local hospital physician and general practitioner, using a variety of different models. The majority of care takes place on an outpatient basis, including intravenous antibiotic treatment, nebulised antibiotics and mucolytics, self-administered physiotherapy, nutritional management and pancreatic enzyme supplementation. Outpatient care is usually undertaken by specialist multidisciplinary teams, including physicians or paediatricians, specialist nurses, physiotherapists, dietitians and social workers. Handover of adolescent patients to adult specialists is recommended. All patients with cystic fibrosis require life-long specialist medical supervision and treatment. Severely affected patients may require oxygen, and non-invasive ventilatory support. Heart-lung or double-lung transplantation is performed on a few selected patients with end-stage lung disease.

Diagnosis may be made on the basis of symptoms or as part of a local neonatal screening programme, using a combination of sweat electrolyte concentrations and genetic typing.

Overall, cystic fibrosis contributes a very small proportion of GP consultations, hospital admissions and hospital bed-days (under 1%). The majority of care takes place in hospital outpatients.

Screening

Two forms of screening are possible for cystic fibrosis. The first detects carriers of the defective gene before birth of an affected child. The second is the screening of newborn babies to detect cystic fibrosis early. This would permit early treatment, which should improve clinical prognosis for the affected child, and may also prevent the birth of a second affected child into a family before the first is diagnosed.

Genetic screening is possible using a simple test taking cells from a mouthwash, and screening these for the six most commonly occurring alleles in the UK population, about 85% of all abnormal alleles. It can be offered in several different ways. In the antenatal clinic it can be offered either sequentially (screen mother first and father if mother is positive) or as a couple (couple are either positive or negative, but individual results are not given). It can also be offered to schoolchildren or through general practice. Finally, it can be offered to relatives of affected patients, known as 'cascade' screening.

The uptake varies according to the model used. In the antenatal model, the test has the potential to detect 70% of cases of cystic fibrosis, and the uptake is around 70%, thus reducing its potential to prevent cystic fibrosis to around 50% of cases, assuming all affected pregnancies are terminated.

Population carrier screening programs are not universally available in the UK, and methods vary according to region.

Neonatal screening is possible using the Guthrie blood spot that is used to detect other inborn errors of metabolism such as phenylketonuria and congenital hypothyroidism. This test is cheap, and there appear to be short-term benefits to babies and young children with cystic fibrosis, but there is still controversy as to whether long-term prognosis is improved.

Treatment

The majority of care for patients with cystic fibrosis takes place as outpatients, with inpatient care reserved for those with complicated disease, severe disease, or lacking social support to undertake treatment at

home. The majority of patients with cystic fibrosis are able to attend school and work full-time. Adults have 80% the rate of employment of normal adults, with 50% able to work, and a further 25% being in full-time education.

In a study for the Clinical Standards Advisory Group,[165] patients attended outpatients an average of 4.6 times a year, with a range of 0.5 to 8.1 times per year (**Table 6**). Admission rates ranged from 0.3 to 2.0 per patient per year. However, in a survey of adults with cystic fibrosis, 40% had no hospital admissions and 45% no courses of home intravenous antibiotics in the previous year.[166] Among adults, the mean number of admissions was 1.7, mean number of home intravenous antibiotic courses also 1.7, and mean number of ward visits 2.7 per patient per year. There was a marked relationship to severity of disease, with patients in the more severe group requiring a mean of five admissions per year.

Where dedicated beds were available, the provision ranged from 1.7 to 7.7 per 100 patients, with a mean of 3.8, but the majority of clinics admit patients to general medical or paediatric beds. The level recommended by the BPA is 6 to 8 beds per 100 patients.

Table 6: Activity rates per 100 patients per year for cystic fibrosis in specialist clinics.[165]

	Rate per 100 patients per year		
Activity	**Mean**	**Range**	**n**
New referrals	10	2 to 19	13
Follow-up appointments	465	50 to 813	10
Admissions	96	36 to 204	9

Organisation of care

It has been recommended by the British Paediatric Association and British Thoracic Society, and by the Clinical Standards Advisory Group (CSAG) that patients with cystic fibrosis (both paediatric and adult) should have access to specialist centres for their treatment. The Clinical Standards Advisory Group defined various levels of care (**Table 7**). Level I was the national specialist centre, level II a regional specialist centre, level III a local specialist centre, and level IV a local cystic fibrosis clinic or general hospital. Definitions of

Table 7: Staffing levels of CF centres in relation to BPA recommendations. Expressed as number of sessions (half days) per 50 patients attending the clinic. The latter denominator includes those attending for shared care.

Staff type	Mean	Max	Min	Recommended	Units with adequate staff
Consultant sessions	1.55	5.5	0	3–4	3
Junior medical sessions	1.16	5.9	0	5	1
Other medical sessions	0.42	3.2	0	2	2
Physiotherapist sessions	3.13	11.6	0	20	0
Dietician sessions	1.20	4.4	0	2–3	1
Social worker sessions	0.81	4.4	0	3	3
Nurse specialist sessions	6.16	20.8	0	10	4
Secretarial sessions	0.87	9.4	0	2	4
Other sessions	0.36	3.2	0	–	–

Source: Walters S, Jordan D (1996).[165]

specialisation depended largely on the number of patients cared for, with a level III centre requiring a minimum of 40 to 50 patients.[167]

The Cystic Fibrosis Trust, British Paediatric Association and British Thoracic Society produced joint clinical guidelines for the care of patients with cystic fibrosis.[168] These have recently been updated by the Cystic Fibrosis Trust into a document on standards of clinical care for patients with cystic fibrosis.[169] These embrace the concept of a specialist centre, staffed by a multidisciplinary team skilled in dealing with cystic fibrosis patients and their families. They lay down consensus standards for staffing and facilities at such centres, although few existing centres currently meet the required standards.

The Clinical Standards Advisory Group reviewed access and availability of specialist services for patients with cystic fibrosis in 1992[167] and again in 1995.[165] In the latter report, access was measured both by interviews with clinicians and purchasers and also by surveys of patients and parents of children with cystic fibrosis. It was noted that although access to specialist care had improved, it was still not universal and also varied between regions (**Figure 13**).

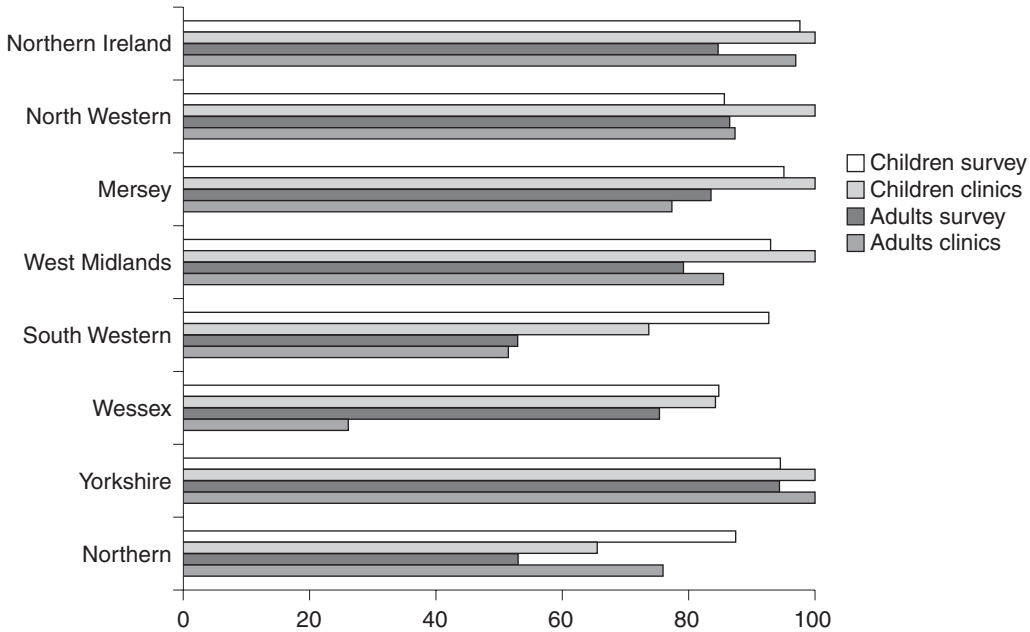

Figure 13: Proportion of patients attending specialist clinics by region comparing estimates made by clinic directors and estimates made by patients themselves through surveys.
Source: Walters S, Jordan D (1996).[165] (Note: not all regions were studied in this survey.)

The concept of shared care was also introduced in the CSAG reports – in this instance, shared care means care shared between a specialist centre and a local hospital, rather than a hospital and general practitioner. This has been widely practised as a method of improving convenience for patients, whilst at the same time permitting specialist input into care, but as yet it has not been very well evaluated. It may take the form of alternating visits between local and specialist clinics, annual appraisals by a specialist clinic, peripatetic or visiting clinics from specialists to local hospitals, or other less formal types of arrangement.

The Cystic Fibrosis Trust is in the process of developing methods to accredit specialist clinical services for patients with cystic fibrosis based upon their standards document.

Drug therapy

The mainstay of treatment for cystic fibrosis is aggressive early therapy with antibiotics to reduce the impact of recurrent infective exacerbations on the respiratory tract. Antibiotics may be given orally for treatment of some organisms. However, respiratory infection frequently progresses from organisms sensitive to oral antibiotics (*Haemophilus influenzae*, *Staphylococcus aureus*, some strains of *Pseudomonas aeruginosa*) to organisms that require intravenous antibiotics (most strains of *Pseudomonas aeruginosa*, *Burkholderia cepacia*). A high proportion of adult patients are colonised by organisms resistant to several antibiotics. This has important implications for infection control in hospital, since outbreaks of infection due to both *Burkholderia cepacia* and *Pseudomonas aerginosa* have been attributed to contact between patients in hospital and social settings. The Cystic Fibrosis Trust has produced guidelines on cross-infection with *Pseudomonas aeruginosa*,[170] and has produced guidelines for *Burkholderia cepacia*,[171] suggesting that patients should be segregated in wards and outpatient clinics.

Antibiotics need to be given in high doses for relatively long periods of time to penetrate the sputum and have effect, and treatment does not often eradicate the organism.

A large proportion of patients or parents may be trained to give their own intravenous antibiotic treatment at home, either for the whole of the course, or to complete a course initiated in hospital. The Cystic Fibrosis Trust has produced guidelines on antibiotic treatment for cystic fibrosis.[172]

A proportion of patients derives benefit from nebulised bronchodilator therapy, given prior to physiotherapy to prevent bronchospasm. A proportion also derives benefit from recombinant human deoxyribonuclease (Dornase alpha), which reduces sputum viscosity.

All patients with cystic fibrosis who are pancreatic insufficient require treatment with pancreatic enzyme supplements given prior to and during meals, sometimes in high doses, with the goal of normalising fat absorption, and producing normal growth and weight gain. Fat-soluble vitamin supplements are required, notably vitamins A, D and E. Some patients require additional oral or enteral feeding to maintain weight.

Non-drug therapy

Physiotherapy is essential to clear infected sticky secretions from the chest and maintain lung function. This is usually performed by the patient themselves, with the help of parents for younger children. A variety of devices are available to assist with physiotherapy. Exercise is also used as an adjunct to physiotherapy to maintain fitness, increase clearance of secretions, and improve well-being and functional capacity. Nutritional supplementation, which may be administered orally, by nasogastric tube or gastrostomy, may be required for some patients. Patients with end-stage lung disease may require oxygen, and non-invasive ventilation at home or in hospital may be used by patients awaiting lung transplantation. The Cystic Fibrosis Trust has produced guidelines for physiotherapy and nutritional management in cystic fibrosis.[173,174]

Patients who develop severe end-stage lung disease may benefit from lung transplantation (single lung, double lung or heart-lung). Approximately 5% of patients develop liver failure, and this may require liver transplantation. The number of patients who can benefit from transplantation is limited by the supply of donor organs. In 1990–1992, 40 cystic fibrosis patients per year had lung or heart-lung transplants.

Health care Resource Groups

The health care resource groups (HRGs) of relevance to lower respiratory disease are described in **Appendix A**.

The total number of FCEs and bed-days according to HRG, together with the percentage of all grouped episodes in 1995–6 are shown in **Table B.9**. It should be noted that the HRG data were provided from a

central resource for this project. When compared to data on FCEs for respiratory diagnoses collected during the same period, only a fraction of respiratory episodes have been coded to HRGs. Data are also missing on some key respiratory HRGs including cystic fibrosis (D17), some tuberculosis (D19), pulmonary embolus (D9 to 11), respiratory neoplasms (D25) and sleep-disordered breathing (D31). The reason for the incomplete nature of the data provided is not known. Data were not provided according to age group, so further analysis is not possible. No data were available on costs for HRGs.

6 Effectiveness of services

In this section, the nature and quality of evidence relating to the effectiveness of particular interventions is indicated in parenthesis and bold type using the agreed criteria (*see* Introductory chapter on force of the recommendation [A–D] and quality of evidence [I–IV]).

Prevention

Smoking (AII-2)

There is ample observational, but sparse experimental evidence indicating that a reduction in active and passive smoking would reduce the incidence, prevalence and severity of a wide range of respiratory diseases, including infections and obstructive airways diseases, across the whole age range. Because about a third of the population smoke, there is scope for major improvement. Benefits would be both short- and long-term and include reductions in lung cancer and non-respiratory diseases. Smoking control strategies can operate at national and local levels by reducing uptake as well as encouraging cessation (BI). The most effective strategies seem to be the raising of price, increasing no-smoking areas, and provision of advice and nicotine chewing gum by general practitioners.[175] In quality adjusted life year ('QALY') terms, advice by the general practitioner to a patient to stop smoking is probably one of the most cost-effective interventions available to the NHS.[176]

Passive exposure to tobacco smoke is associated with bronchitis and bronchiolitis in children under 5 (especially where the mother smokes), and evidence from China, where few mothers smoke, suggests a post-natal effect of paternal smoking. Damage from smoking may begin before birth[177] and antenatal and post-natal services have an opportunity to influence smoking behaviour, although experimental evidence is not available to confirm whether this reduces subsequent LRTI in the offspring.

Passive exposure to tobacco smoke is also associated with asthma symptoms in children aged 2 to 15 and there is good observational evidence to suggest that reduction in environmental tobacco smoke (ETS) would be beneficial, and to pursue this without formal trial[178] (AII-2). Reducing exposure of children to environmental tobacco smoke is likely to produce health gain by reducing both acute and chronic respiratory disease (BII-2).

In patients with existing COPD, stopping smoking is the most effective treatment (AI). A number of evaluative studies have assessed the respective effectiveness of chest physicians, smoking clinics, and nurse counsellors in smoking control but no single method offers a substantial advantage over the others.

Other inhaled hazards (B-III)

In the outdoor environment, it is not known whether a reduction in existing levels of air pollution from fossil fuel combustion would reduce the incidence and burden of respiratory disease, including asthma, to

any extent, and there is considerable uncertainty about the cost-effectiveness of this approach. Aero allergens implicated in asthma reflect patterns of agriculture, local authority planting policies, and fashions in gardening, but it is not known to what extent changes would be beneficial.

The beneficial effect of reduction of hazards in the workplace has been demonstrated (AII).

In the indoor environment, evidence of improvement in asthma after removal from damp, mouldy premises is anecdotal. The targeting of individuals with asthma or those known to be at risk of developing asthma because of the existence of other atopic diseases, or a family history of atopy, with strategies to lower the levels of exposure to known important precipitants over which there is some control, has been suggested to reduce the burden of asthma. In the home, the main agents to be reduced are allergens (house dust mites, pets, moulds), and irritants (tobacco smoke).

Trials have shown that house dust mites can be controlled by various procedures, but unless radical changes can be made to the household arrangements and unrelenting control measures instituted, there is recolonisation.[179] Systematic reviews have shown that there is no evidence that currently available methods of house dust mite control have any effect on asthma (DI).[180,181] The effect of removing objects or animals to which an individual is sensitive is likely to be beneficial (BIII), but may be difficult in practice. There is no evidence that maternal antigen avoidance during pregnancy reduces atopic disease in offspring, and may have important detrimental effects on maternal or foetal nutrition (DI).[182]

Breast feeding (BII-2)

Observational evidence indicates that this may reduce the incidence of lower respiratory infections, and in atopic families, delay the onset of wheezing illness. Community and other perinatal services may play a role in promoting and supporting breast feeding.

Immunisation

Whooping cough

The efficacy of whooping cough (pertussis) vaccination has been demonstrated by randomised controlled trials (AI). The MRC field trials found the vaccine to be effective in reducing primary infection and dissemination of infection to secondary cases. A decline in uptake in the mid-1970s was accompanied by a return of epidemic pertussis in the UK (whereas in the USA, where vaccine uptake was maintained, notification rates remained low). Uptake has been rising throughout the 1980s and is now at record levels (over 75% among 2-year-olds nationwide).[183] The proportion immunised rose further during the 1990s (**Figure 2**).

Concern has been focused on neurological side effects, particularly acute encephalopathy, the risk of which is increased three-fold after pertussis vaccination.[184] However, the overall numbers of deaths, hospital admissions and severe neurological illnesses in the population would be reduced by increasing pertussis vaccine uptake.[185] Thus, at a public health level, the risk of adverse reactions to whooping cough vaccine is low compared with the benefits – although individual families may not come to the same conclusion.

Measles

The efficacy of measles vaccination has been demonstrated by randomised controlled trials (AI). Lower respiratory illnesses may be due to secondary infection following measles, particularly in the first year of life. The existing schedule for measles vaccination (at 15 months) may have some indirect impact through a reduction in incidence, particularly if high levels of uptake can be achieved. Newer vaccines which

promote effective immunity when used at six months of life may further reduce this problem, although they have so far only been evaluated in developing countries.[186]

Pneumococci

The efficacy of pneumococcal vaccines has been established in younger age groups in other, mainly Third World, countries. Such evidence is not available specifically for the elderly, the main group of concern in the UK. The effectiveness of pneumococcal vaccination has been evaluated by systematic review and found to be effective in healthy low-risk individuals, but of lower efficacy in high-risk individuals (BI).[187] An evaluation of current recommendations by case control study showed the vaccine to be effective in splenectomised patients and those with chronic disease (BII-2),[188] but a randomised controlled trial has shown it to be ineffective in patients over 50 with previous community-acquired pneumonia (DI).[189] Thus the prevention of pneumonia by the use of pneumococcal vaccine remains controversial. American guidelines from the Communicable Diseases Centre[190] recommend its use for:

- immunocompromised adults at increased risk of pneumococcal disease
- adults with asymptomatic or symptomatic HIV infection
- immunocompetent adults who are at increased risk of pneumococcal disease because of chronic illness (AIII).

In Britain, the vaccine is recommended for use in all people over two years of age in whom pneumococcal infection will be either more common or serious (BI).[191] The main controversy concerns the use of pneumococcal vaccine in immunocompetent adults who are at increased risk of pneumococcal disease.

Randomised clinical trials carried out in 1976/77 established the efficacy of pneumococcal vaccination in South African gold miners.[192,193] Studies in Papua New Guinea[194] and on hyposplenic patients in the USA[195] also showed significant reductions in the occurrence of pneumonia in immunised groups. Based on the results of these earlier trials, a licence was granted in the United States for pneumococcal vaccine for use in patients at risk for serious pneumococcal infections: the elderly, patients with chronic illness and the immunocompromised.

Reports of vaccine failure in some targeted populations in the United States led to uncertainty about the vaccine's efficacy.[196–198] However, these studies have been criticised because they have included too few patients and because of other methodological problems.[199] Two carefully conducted case–control studies have shown polyvalent pneumococcal vaccine to have an aggregate efficacy of between 60 and 70% in preventing pneumococcal bacteraemia in the elderly[198,200] and a very large case–control study[201] established the efficacy of pneumococcal vaccination in preventing pneumonia in patients admitted to hospital.

It is probably because of doubts concerning the efficacy of pneumococcal vaccine and the conflicting evidence from the different trials that only about 10% of the target population in the United States has been immunised.[202] It is also likely that clinicians underestimate the impact of pneumococcal disease because establishing a definitive diagnosis in non-bacteraemic patients is often not possible. In the UK where there are no recommendations concerning the use of vaccine, use of this vaccine is negligible.

Because of the low uptake of pneumococcal vaccination in the UK, several authors have argued for a different approach. Evidence from the Oxford record linkage study has shown that many patients hospitalised for, or dying from, pneumonia have been discharged from a hospital within the previous five years.[203,204] This suggests that there may be an epidemiological rationale for immunising all patients over a certain age who are admitted to hospital for any reason.

The methodology of the Oxford study was used in a similar study[205] in the USA and produced similar results. The Shenandoah study showed that approximately 62% of patients discharged with a diagnosis of pneumonia had been discharged from hospital in the previous four years.[205] The authors were able to

demonstrate that discharged patients with any diagnosis had a 6–9% probability of re-admissions with pneumonia within five years and that immunising a few high-risk patients could prevent many of these re-admissions. Cost-benefit analysis showed that costs of vaccination would be approximately one-third the costs of hospital care for unvaccinated discharged patients readmitted with pneumonia.

Cost-effectiveness analysis indicates that the 23 valent pneumococcal vaccine can improve the health of elderly persons for a reasonable expenditure and compares well with influenza vaccination in terms of healthy years gained for a given expenditure.[206] There is therefore sufficient evidence to suggest that purchasers should make it a requirement that all patients over the age of 60 who are admitted to hospital for any reason should have pneumococcal vaccination (AII-2).

Influenza

In contrast to pneumococcal vaccination, there are established guidelines for immunisation against influenza[207] and recommendations are circulated to doctors by the Chief Medical Officer on a yearly basis. Vaccination is not recommended for the attempted control of the general spread of influenza but is recommended for persons at special risk (evidence for recommendation graded AI). Groups recommended for vaccination include the elderly suffering from certain chronic diseases and those living in residential homes and long-stay hospitals. There is evidence from a systematic review that influenza vaccination may reduce exacerbations in patients with chronic obstructive pulmonary disease (AI).[208] However, a similar review has found no beneficial effect of influenza vaccine in patients with asthma (CI).[209]

There is strong evidence from systematic reviews that influenza vaccination is effective in reducing mortality, hospital admissions and incidence of pneumonia in the elderly (AI).[210] Immunisation programmes are highly cost-effective, resulting in estimated net cost savings between 1 and 235 US dollars per person (AII-2).[211,212]

Tuberculosis

Immunisation with BCG (Bacille Calmette-Guerin) is used in the prevention of TB. The calculated protective efficacy of BCG varies according to type of tuberculosis and age group. It is around 50% for pulmonary TB, but higher for military TB, meningitis and for mortality reductions (AI).[213–215]

Because of the decline in the prevalence and incidence of tuberculosis, the cost-effectiveness of many prevention programmes at district level is being questioned. However, continuation of immunisation of high-risk individuals, health care workers and schoolchildren is currently still recommended (CIII).

Immunisation against other pathogens

Trials of respiratory syncytial virus vaccine have found it to be ineffective and possibly harmful (EI).[4] Vaccines to prevent colonisation with against *Pseudomonas aeruginosa* in cystic fibrosis have not been shown to be effective and may be harmful (DI).[216]

Screening

Asthma

Increased bronchial reactivity in subjects without symptoms may be predictive of later asthma but cannot be advised as a screening procedure because few of the criteria for screening can be satisfied. Screening of schoolchildren for symptoms suggestive of undiagnosed asthma is not strictly screening because the

disease is not subclinical. Uncontrolled trials of such 'screening' followed by medical intervention where indicated show a temporary improvement in morbidity.[217] Recent evidence from a controlled trial indicates that the effectiveness of this approach is very limited.[218] This result vindicates the position adopted in a previous review of child health screening in which it was recommended that such programmes should not be introduced without further evaluation (DI).[219]

It is possible to identify, through family history and indicators of atopy, individuals at increased risk of developing asthma in response to environmental allergens. Screening along these lines may be useful in certain occupations (BII-2). It might also be useful in advising families about pets, furnishings, etc. (CIII), but this approach has not been evaluated (DIII).

Chronic obstructive pulmonary disease

At present, there is no case for screening unselected asymptomatic individuals with spirometry to identify individuals at increased risk of developing COPD (DIII).[136] COPD is frequently under-diagnosed and associated with significant health impact.[220,221] The place of spirometric testing (case-finding) in symptomatic individuals or smokers who are at risk of developing COPD is not clear (CIII), although it is certainly feasible and does not increase costs of health care.[222,223] A systematic review suggested that in symptomatic patients, addition of spirometric testing does not increase smoking quit rates[224] but studies since this review suggest increased quit rates.[225]

Tuberculosis

The value of selective screening (immigrants, health workers, etc.) for tuberculosis has recently been reassessed, and guidance recommends their continuation. There is evidence that incidence in high-risk groups can be reduced by this strategy (BIII).

Cystic fibrosis

A systematic review of screening for cystic fibrosis was carried out by Murray *et al.*[226] This review considered both antenatal screening to detect carriers, and neonatal screening. It concluded that antenatal screening should be introduced as a routine, and that health authorities should consider introduction of neonatal screening (BI). They estimated costs of screening to be approximately £46–53 000 per pregnancy detected, and £4400 to £6400 per case diagnosed early for neonatal screening.

Other systematic reviews of neonatal screening suggest that neonatal screening may be beneficial (BI),[227] or that further information is needed before recommending that existing programmes for cystic fibrosis be extended (CI).[228,229] Nevertheless, national neonatal screening is to be implemented for cystic fibrosis in the UK[230] on the basis of more recent studies from the USA.[231]

An economic evaluation from the United States differed in conclusion regarding antenatal carrier screening from that of Murray *et al.* They concluded that only 41% of births were preventable, and that screening resulted in a net cost per birth averted of over $1 million, with a cost per QALY of over $8000 (CII-2).[232]

Other preventive measures

Antibiotics in acute respiratory infections

The non-selective use of antibiotics to treat upper respiratory tract infections or acute bronchitis in healthy adults or children in general practice has occasionally been considered justified in order to prevent

bacterial lower respiratory complications of viral infections. However, this strategy is likely to be ineffective in upper respiratory illness,[233] and may result in unnecessary adverse effects (DI).[234] In addition, a systematic review and randomised controlled trials from Australia[235] and Thailand[236] have shown that overall (in adults and children) the use of antibiotics in acute bronchitis confers little overall benefit (CI).[237] However, acute bronchitis can be difficult to distinguish from community-acquired pneumonia in the primary care setting. The use of antibiotics in this way is also thought to promote the emergence and spread of antibiotic-resistant organisms and this is a significant argument against their unselective use. A reduction in the use of antibiotics in this context forms part of a national strategy to encourage the 'prudent use' of these drugs in order to tackle the growth of such resistance.[234]

Neuraminidase inhibitors in influenza

There is evidence to show that neuraminidase inhibitors shorten the duration of influenza symptoms but not yet serious complications (AI).[238] Their use is recommended by the National Institute for Clinical Excellence for treating 'influenza like illness' in adults at risk from serious complications of influenza infection at times when influenza is circulating in the community.[239]

Neuraminidase inhibitors may also be effective in preventing influenza (AI). Randomised controlled trials have shown efficacy in preventing experimental infection,[238] cross-infection among household contacts[240,241] and during community administration.[242,243] However, there is no evidence as to their efficacy in preventing serious complications of influenza and these trials do not specifically consider those in the population at risk of such complications, i.e. those who are currently the target group for immunisation. These groups include the elderly, health care workers, and people with COPD, asthma and cystic fibrosis. The cost-effectiveness of using these drugs for prophylaxis is not known.

Prevention of nosocomial pneumonia

Established surveillance programmes exist in many hospitals to prevent nosocomial infections. These are usually the responsibility of trained infection control nurses. The role of infection control nurses includes conducting surveillance of infections, applying policies for preventive patient care practices (e.g. urinary catheter care) and reducing wasteful environmental culturing. In some cases, rates of surgical wound infections are reported to surgeons to encourage more careful operating techniques.[122]

The efficacy of infection control nurses was highlighted in a large study in the United States[122] which found that an infection control nurse working together with a clinician with a special interest in infection control and practising epidemiological surveillance and control techniques could prevent about one-third of all nosocomial infections. The same may not be true for nosocomial pneumonia but specific action could probably achieve some reduction.

It has been suggested that much of the surveillance work that is at present carried out in hospital relies too much on process measures,[244] for example establishing baseline measures of the prevalence of pathogens. A lot of effort is also expended in evaluating established control measures and reinforcing patient care practices. However, trying to reduce nosocomial infections by using outcome measures would require setting as an objective the reduction of the nosocomial pneumonia rate from the present level of 10–19% with possible additional outcome measures being reductions in the overall extra hospital stay and reductions in the extra costs attributable to this condition.

A potentially effective surveillance system to prevent pneumonias would include post-operative surveillance with results reported back to surgeons,[122] possibly as a part of existing audit activity. Surveillance of pneumonia occurring in medical patients would need to encompass high-risk groups in areas such as stroke units, intensive care units and neonatal intensive care units. At present there is little activity of this type in the UK.

There are no cost-effectiveness studies or randomised trials evaluating the role of infection control nurses. However, based on experience in the United States and the theoretical possibilities for prevention, there is some case for this type of service. The strength of the recommendation and the quality of evidence for infection control nurses can be graded as CIII.

Contact tracing and chemoprophylaxis for tuberculosis

In addition to immunisation with BCG (Bacille Calmette-Guerin), key strategies for TB prevention include contact tracing and chemoprophylaxis. The cost-effectiveness of identifying cases through contact tracing remains uncertain (CIII).[245,248] However, the effectiveness and cost-effectiveness of chemoprophylaxis with isoniazid, for which contact-tracing is a pre-requisite, have been studied. Isoniazid is effective in preventing active TB and death from TB (AI).[249] An economic evaluation showed chemoprophylaxis to result in an absolute cost saving in men aged 20 recently infected. For older men aged 55 with no risk other than lifelong presence of TB bacillus, the cost per QALY was calculated at between £629 (no discount) to £11 000 (discount) (AII-2).[250,251]

Clinical services

Lower respiratory infections in adults and children

Management is by antibiotic therapy against bacterial infections (AI) and supportive treatment, depending on severity (AIII). The choice of antimicrobial drug is usually made without definite information about the infecting organism (which in children is often a virus). Even if a satisfactory sample can be obtained, microbiological results come too late to guide initial therapy and the role of the chest radiograph in this decision has not been clarified. Cost-effectiveness is rarely addressed but, as inpatient costs predominate, this will be influenced more by the level of the health system where the patient is treated than by details of diagnosis and therapy. Evidence is emerging that oral antibiotics can be used in most hospitalised patients, shortening length of stay (BI).

Lower respiratory infections in children

Evidence-based guidelines on the management of community-acquired pneumonia in childhood are available.[377] Given the predominantly viral nature of acute LRTI in young children, treatment is most often supportive (*see* below) rather than specific (antibiotics). Clinical signs and symptoms do not reliably distinguish between bronchitis and pneumonia, or between viral and bacterial illness. It has been suggested that all children over one year with pneumonia should receive antibiotics,[3] and a chest X-ray may assist such a decision. Microbiological tests rarely influence immediate clinical management, but can be justified in the severely ill child as a guide to subsequent changes of treatment.

The most important management decisions are determined by the clinical severity of the illness, rather than by a specific pathological or microbiological diagnosis. Regardless of cause, children in respiratory failure require transcutaneous monitoring of hypoxia, oxygen therapy and may occasionally need mechanical ventilation. On the other hand, the vast majority of children with LRTI recover spontaneously without even antibiotic therapy.

A recent systematic review demonstrated that bronchodilators may have significant benefit for children with bronchiolitis[252] (BI). However, randomised controlled trials in infants with bronchiolitis have shown no substantial benefit from bronchodilators, humidified air, or physiotherapy,[3] although a recent meta-analysis indicates that steroids may have a role in improving symptoms and reducing length of stay.[251] A specific aerosolised treatment for respiratory syncytial virus (Ribavirin) is under

evaluation, but is expensive. It may have a role for vulnerable infants with pre-existing cardiorespiratory disease, but is not currently recommended for use in previously healthy infants.[3] Early data also shows benefit from leukotriene receptor antagonists ('antileukotirnes'),[252] and these medications warrant further evaluation.

Unselective use of antibiotics for upper respiratory illness and acute bronchitis in general practice has been suggested as an approach to preventing bacterial lower respiratory complications of viral respiratory infections. However, this strategy is likely to be ineffective, result in unnecessary adverse effects and promote widespread antibiotic resistance (DI – *see* above).

Community-acquired pneumonia in adults

General practitioners can treat 80% of community-acquired pneumonia effectively provided that appropriate antibiotics are employed.[10] Consensus guidelines for management of community-acquired pneumonia in adults have recently been updated by the British Thoracic Society, and made evidence-based (AI).[123] The new guidelines offer guidance as to the investigation and management of community-acquired pneumonia. A prediction rule is available to determine which patients are at low risk and may be managed at home, but this is derived from the United States and has not been tested in a prospective trial (CIII).[253]

Treatment in the community should reflect the prominence of *Streptococcus pneumoniae* and *Haemophilus influenzae* and these organisms should be covered by the initial antibiotic in any patient with community-acquired pneumonia (AIII).[123,254] In addition, therapy should cover *Mycoplasma pneumoniae* during regular epidemics. Routine treatment for *Staphylococcus aureus* and *Legionella pneumophila* should not be instituted except in the case of influenza epidemics or if there is a local outbreak of *Legionella*. Monitoring of local and national patterns of disease will help guide therapy in these areas.

There is evidence that for hospitalised patients who can take oral antibiotics, there is no difference in clinical outcome when compared to intravenous antibiotics, but length of stay is reduced (BI).[255] In hospitalised patients treated with intravenous antibiotics, there is evidence that these can be safely converted to oral therapy after 2 days, with substantial cost saving (54%) (AI),[256,257] and once converted to oral therapy, complications are rare and patients may be discharged home (AII-2).[258]

About 6% of admitted patients will die. Risk factors for mortality include age, treatment with digoxin and raised blood urea.[11] Treatment with an appropriate antibiotic prior to admission improves outcome. 1982/83 figures suggest that the average length of stay in hospitalised patients who survive is 10.8 days; 80% return to work within six weeks.

The impact of adherence to management guidelines has been studied. There was no overall impact on mortality, but unplanned transfer to intensive care was reduced, and bacteriological investigation increased (CIII).[259]

Clinical care of chronic asthma

Patients with chronic symptoms usually present with acute attacks. However, for the purposes of this paper it will be simplest to deal with acute and chronic asthma separately. This follows the approach of the latest guidelines.

Diagnosis

In both adults and children, there is a problem of under-diagnosis which, in turn, is associated with worse treatment.[19,21,65,126,260] Since this phenomenon began to be publicised, there has been a doubling in the

proportion of wheezy children diagnosed as having asthma.[56,58,61] The situation remains less than satisfactory. Some doctors treat all patients with COPD with bronchodilators initially so that any reversible element can be identified and treated (not evaluated). This carries a risk of over-treating COPD patients with bronchodilator drugs. Guidelines state clearly when patients should be referred to specialists (respiratory paediatricians or physicians) for diagnosis and assessment.[140]

Drug treatment

Drugs used have all been tested for efficacy using randomised clinical trials with outcomes such as improvement of lung function, reduction of symptoms, improved activity and reduced need for other therapy (AI). However, recent evidence indicates that one preparation (fenoterol, which is not much used in the UK) may be associated with increased mortality. There is also concern about the effects of long-term regular administration of short-acting beta agonists generally[261,262] and current guidance[25,140] suggests that regular use of short-acting beta agonists should be avoided. In addition there is evidence that the mainstay of anti-inflammatory treatment (inhaled steroids) is not as free from systemic side effects as was first hoped. There s a need for more placebo-controlled long-term trials designed to look for adverse effects. A summary of available recent evidence on effectiveness of drug therapy for both chronic and acute asthma is provided in **Table 8** (*see* overleaf). This evidence has been translated into guidelines and a summary of the current guidance on stepped drug therapy for chronic asthma is provided in **Table 10**.

The place of nebulisers in the treatment of both acute and chronic asthma is unclear. There is evidence that the use of spacer devices with inhalers is as effective as nebuliser therapy and may confer advantages in children (CI).[263–265]

The impact of current services and therapy on chronic symptoms of asthma at a population level is unsatisfactory with surveys consistently reporting high proportions of patients with disabling symptoms despite treatment or without treatment at all,[125,266] and underuse of preventive therapy.[22,267] Poor treatment also occurs in accident and emergency[243] and on admission.[22,269,270] Possible reasons include:

- variability between doctors in prescribing
- failure to identify and treat all patients
- inadequate efficacy of the drugs
- lack of patient co-operation with care (poor 'compliance' or 'adherence').

One community study has shown a better level of control of asthma amongst more compliant patients indicating that such control is beneficial.[242] Recent controlled trial evidence indicates that standard setting in general practice improves both the process and outcome of care for children with wheezing (BI).[271] Another controlled trial failed to show an effect on outcome of GP group education.[272] There is a strong anecdotal impression that since the introduction of inhaled steroids, crippling asthma in children has become extremely rare. The recent flurry of audit activity and consensus statements on treatment guidelines should lead to more consistent approaches to the management of chronic asthma. There is some evidence that guidelines when applied in practice improve prescribing practice (BI), but have no impact on other outcomes including patient-related outcomes (CI) and hospitalisation rates[273] (BI). In Canada, prescribing habits improved, but there was little evidence that guidelines improved patient outcomes (CIII).[274,275]

Self-care with drugs is a feature of asthma therapy and, for this reason, a variety of systems have been devised to enable the patient to monitor their condition using symptoms (and peak flow measurements) and to act appropriately by changing their medication or seeking help. This is still not adequately evaluated. Uncontrolled trials show evidence of benefit (CII-1)[276,277] but this does not seem to be due to the peak flow monitoring.[277]

Table 8: Summary of recent available evidence on effectiveness of drug therapy for asthma.

Authors	Title	Reference	Study type			Summary
1. Inhaled corticosteroids						
Calpin C, Macarthur C, Stephens D, Feldman W, Parkin PC	Effectiveness of prophylactic inhaled steroids in childhood asthma: a systematic review of the literature	*J Allergy Clin Immunol* 1997; **100**: 452–7	Systematic review	A	1	Clear evidence of beneficial effect on cough, wheeze, beta agonist and oral steroid use. Minor adverse effects noted.
Hatoum H, Schumock G, Kendzierski D	Meta-analysis of controlled trials of drug therapy in mild chronic asthma: the role of inhaled corticosteroids	*Ann Pharmacotherapy* 1994; **28**: 1285–9	Systematic review	A	1	Regular corticosteroids should be used if repeated doses of B-2 agonist are needed.
Salmeron S, Guerin JC, Godard P *et al.*	High doses of inhaled corticosteroids in unstable chronic asthma: a multicenter, double-blind, placebo-controlled trials	*Am Rev Resp Dis* 1989; **140**: 167–71	RCT	A	1	High dose inhaled corticosteroids control symptoms and improve lung function in chronic unstable asthma.
Adams N, Bestall J, Jones PW	Budesonide for chronic asthma in children and adults	Cochrane Library: Update Software, 2001	Systematic review	A	1	Budesonide is significantly better than placebo in controlling symptoms of mild persistent asthma.
Adams N, Bestall J, Jones PW	Inhaled beclomethasone versus placebo for chronic asthma	Cochrane Library: Update Software, 2001	Systematic review	A	1	Beclomethasone is significantly better than placebo in controlling symptoms of mild persistent asthma.
Adams N, Bestall J, Jones PW	Inhaled fluticasone proprionate for chronic asthma	Cochrane Library: Update Software, 2001	Systematic review	A	1	Fluticasone is significantly better than placebo in controlling symptoms of mild persistent asthma.
Booth P, Wells N, Morrison A	A comparison of the cost effectiveness of alternative prophylactic therapies in childhood asthma	*Pharmacoeconomics* 1996; **10**: 262–8	Economic evaluation	B	1	Open label study. Fluticasone more effective than cromoglycate in symptom control, lung function improvement, fewer adverse effect reports. Total drug cost was higher for cromoglycate. Fluticasone more effective and cost-effective.

Lipworth B	Systemic adverse effects of inhaled corticosteroid therapy: A systematic review and meta analysis	*Arch Int Med* 1999; **159**: 941–55	Systematic review	A	1	Adrenal suppression worse above 1.5 mg a day. Fluticasone causes greater adrenal suppression than other inhaled steroids. Bone mineral density, cataract, bruising also affected by similar doses. 400 mcg day beclomethasone inhibits growth.
Price D, Appleby J	Fluticasone propionate: an audit of outcomes and cost effectiveness in primary care	*Resp Med* 1998; **92**: 351–3	Economic evaluation	D	1	Fluticasone resulted in improved lung function, reduced use of other medication, reduced asthma nurse and GP attendances. However, it was still more expensive than alternative treatment. Study was not randomised. No conclusion can be drawn.
2. Oral corticosteroids						
Rowe B, Spooner C, Ducharme F, Bretzlaff J, Bota G	Corticosteroids for preventing relapse following acute exacerbations of asthma	Cochrane Library: Update Software, 1999	Systematic review	A	1	A short course of corticosteroids following assessment for acute severe asthma reduces relapses and decreases beta agonist use without increase in side effects.
O'Driscoll B, Kaira S, Wilson M *et al.*	Double-blind trial of steroid tapering in acute asthma	*Lancet* 1993; **341**: 324–327	RCT	A	1	A short course of corticosteroids given for acute asthma can safely be stopped abruptly.
Levy ML, Stevenson C, Maslen T	Comparison of a short course of oral prednisone and fluticasone propionate in the treatment of adults with acute exacerbations of asthma in primary care	*Thorax* 1996; **51**: 1087–92	RCT	B	1	No difference in treatment failure or relapse rate.
Edmonds M, Camargo C Jr, Pollack C *et al.*	Early use of inhaled corticosteroids in the emergency department treatment of acute asthma	Cochrane Library: Update Software, 2001	Systematic review	C	1	Inhaled corticosteroid reduces hospital admission in those not taking oral corticosteroid only when compared with placebo.

Table 8: Continued.

Authors	Title	Reference	Study type			Summary
Edmonds M, Camargo C Jr, Saunders L *et al.*	Inhaled steroids in acute asthma following emergency department discharge	Cochrane Library: Update Software, 2001	Systematic review	C	1	No significant relapse rates when comparing oral and high dose inhaled corticosteroids, or the combination of both versus oral corticosteroids alone.
Manser R, Reid D, Abramson M	Corticosteroids for acute severe asthma in hospitalised patients	Cochrane Library: Update Software, 1999	Systematic review	D	1	High doses (over 80mg per day prednisolone or equivalent) show no significant advantage over lower doses in initial management of acute severe asthma in terms of lung function, or respiratory failure.
3. Short-acting beta-2 agonist						
Walters EH, Walters J	Inhaled short acting beta-agonist use in asthma: regular versus as needed treatment	Cochrane Library: Update Software, 2001	Systematic review	A	1	Regular beta-2 agonists produce no clinically important benefits over as required use of this medication.
Chapman K, Kesten S, Szalai J	Regular versus as needed inhaled salbutamol in asthma control	*Lancet* 1994; **343**: 1379–82	RCT	B	1	Regular salbutamol resulted in fewer exacerbations, less medication use and better asthma control. No difference in lung function.
Van Schayck C, Dompeling E, van Herwaarden C *et al.*	Bronchodilator treatment in moderate asthma or chronic bronchitis: continuous or on demand? A randomised controlled study	*BMJ* 1991; **303**: 1426–31	RCT	C	1	The rate of lung function decline was slower in patients taking drugs on-demand, with no difference in symptoms.
Spitzer W, Suissa S, Ernst P *et al.*	The use of beta agonists and the risk of death and near death from asthma	*NEJM* 1992; **326**: 501–6	Case–control study	D	2.2	Use of regular high dose beta agonists by metered dose inhaler was associated with increased risk of death from asthma. Less for nebuliser use, no risk for oral steroids or cromoglycate. The higher the dose, the greater the risk of death.

Shrestha M, Bidadi K, Gourlay S *et al.*	Continuous versus intermittent albuterol at high and low doses in the treatment of severe acute asthma in adults	*Chest* 1996; **110**: 42–7	RCT	B	1	Continuous administration improves lung function.
Rudnitsky G, Eberlien R, Schoffstall J *et al.*	Comparison of intermittent and continuously nebulised albuterol for treatment of asthma in an urban emergency department	*Ann Emerg Med* 1993; **22**: 1847–53	RCT	C	1	No difference in lung function or admission rates, except in post hoc group with very severe airflow obstruction.
Travers A, Jones A, Kelly K *et al.*	Intravenous beta-2 agonists for acute asthma in the emergency department.	Update Software. *Cochrane Library*, 2001	Systematic review	D	1	No difference between intravenous and nebulised delivery of beta-2 agonists in any clinical outcomes.
4. Long-acting beta-2 agonists						
Shrewsbury S, Pyke S, Britton M	Meta-analysis of increased dose of inhaled steroid or addition of salmeterol in symptomatic asthma (MIASMA)	*BMJ* 2000; **320**: 1368–73	RCT	A	1	Where asthma is not controlled on low dose inhaled corticosteroids, addition of long-acting beta-2 agonists produced significant clinical benefits when compared with increasing the dose of inhaled corticosteroids.
Fish JE, Israel E, Murray JJ *et al.*	Salmeterol powder provides significant better benefit than monteleukast in asthma patients receiving concomitant inhaled corticosteroid therapy	*Chest* 2001; **120**: 423–30	RCT	A	1	Adding salmeterol to inhaled corticosteroids produces greater benefit than adding monteleukast to inhaled corticosteroids.
Lundback B, Rawlinson D, Palmer J	Twelve month comparison of salmeterol and salbutamol as dry powder formulations in asthmatic patients	*Thorax* 1993; **48**: 148–53	RCT	A	1	Salmeterol more effective than salbutamol in control of symptoms, drug use, especially if overnight relief required.
Pearlman D, Chervinsky P, LaForce C *et al.*	A comparison of salmeterol with albuterol in the treatment of mild to moderate asthma	*NEJM* 1992; **327**: 1420–5	RCT	A	1	Salmeterol more effective than albuterol in symptom control, drug use and lung function.
Britton M, Earnshaw J, Palmer JBD	A twelve month comparison of salmeterol with salbutamol in asthmatic patients	*Eur Resp J* 1992; **5**: 1062–7	RCT	A	1	Salmeterol more effective than salbutamol in control of symptoms, lung function, drug use.

Table 8: Continued.

Authors	Title	Reference	Study type			Summary
de Benedictis F, Tuteri G, Pazzelli P, Niccoli A, Mezzetti D, Vaccaro R	Salmeterol in exercise-induced bronchoconstriction in asthmatic children: comparison of two doses	*Eur Resp J* 1996; **9**: 2099–103	RCT	A	1	Salmeterol more effective than salbutamol in exercise induced asthma.
Greening A, Ind P, Northfield M, Shaw G	Added salmeterol versus higher-dose corticosteroid in asthma patients with symptoms on existing inhaled corticosteroid	*Lancet* 1994; **344**: 219–24	RCT	A	1	Salmeterol more effective than increasing dose of inhaled steroids.
Woolcock A, Lundback B, Ringdal N, Jackes L	Comparison of addition of salmeterol to inhaled steroids with doubling the dose of inhaled steroids	*Am J Resp Crit Care Med* 1996; **153**: 1481–8	RCT	A	1	Salmeterol more effective than increasing dose of steroids.
Wilding P, Clark M, Coon J *et al.*	Effect of long-term treatment with salmeterol on asthma control: a double blind randomised crossover study	*BMJ* 1997; **314**: 1441–6	RCT	A	1	Salmeterol may permit reduction in dose of inhaled steroids.
Rutten van Molken M, van Doorslaer E, Till M	Cost effectiveness analysis of formoterol versus salmeterol in patients with asthma	*Pharmacoeconomics* 1998; **14**: 671–84	Economic evaluation	C	1	There was no difference in effectiveness or cost between the two long acting beta agonists. Choice of drug should therefore be based on cost in each country.
6. Anticholinergic agents						
Plotnick L, Ducharme F	Should inhaled anticholinergics be added to beta-2 agonists for treating acute childhood and adolescent asthma	*BMJ* 1998; **317**: 971–7	Systematic review	A	1	A single dose does not reduce hospital admission but does improve lung function. Multiple doses improve lung function and reduce hospital admission, but only in school age children with severe exacerbations.

Plotnick L, Ducharme F	Combined inhaled anticholinergics and beta-2 agonists for initial treatment of acute asthma in children	Cochrane Library: Update Software, 1999	Systematic review	B	1	Single doses have no effect, but multiple doses reduce hospital admission and improve lung function in children with acute severe asthma when added to beta-2-agonists.
Osmond M, Klassen T	Efficacy of ipratropium bromide in acute childhood asthma: a meta-analysis	*Academic Emergency Medicine* 1995; **2**: 651–6	Systematic review	B	1	Ipratropium, when combined with beta-agonist, produced a significant increase in lung function, but no difference in clinical parameters. In very severe asthma there may be reduction in lung function.
Everard M, Kurian M	Anticholinergic drugs for wheeze in children under the age of two years	Cochrane Library: Update Software, 1999	Systematic review	C	1	Parents preferred ipratropium, and symptom scores were better, but there was no difference in hospitalisation rates, oxygen saturation, treatment response, length of stay.
Aaron S	The use of ipratropium bromide for the management of acute asthma exacerbations in adults and children	*J Asthma* 2001; **38**: 521–30	Systematic review	A	1	Significantly improves lung function and reduces hospital admission when combined with salbutamol, compared with salbutamol alone.
7. Leukotriene antagonists						
Fish JE, Kemp JP, Lockey RF *et al.*	Zafirlukast for symptomatic mild to moderate asthma: A 13 week multicenter study	*Clin Ther* 1997; **19**: 675–90	RCT	B	1	Zafirlukast improves symptoms when compared with placebo in patients otherwise not taking regular anti-asthma medication.
Suissa S, Dennis R, Ernst P *et al.*	Effectiveness of the leukotriene receptor antagonist zafirlukast for mold to moderate asthma. A randomised double-blind, placebo-controlled trial	*Ann Intern Med* 1997; **126**: 177–83	RCT	B	1	Zafirlukast improves symptoms when compared with placebo in patients otherwise not taking regular anti-asthma medication.
Nathan RA, Bernsteain JA, Bieloray L *et al.*	Zafirlukast improves asthma symptoms and quality of life in patients with moderate reversible airflow obstruction	*J Allergy Clin Immunol* 1998; **102**: 935–42	RCT	B	1	Zafirlukast improves symptoms when compared with placebo in patients otherwise not taking regular anti-asthma medication.

Table 8: Continued.

Authors	Title	Reference	Study type			Summary
8. Delivery of inhaled therapy						
Ducharme FM, Hicks GC.	Anti-leukotriene agents compared to inhaled corticosteroids in the management of recurrent and/or chronic asthma	Cochrane Library: Update Software, 2001	Systematic review	C	1	No significant difference in exacerbation rate, but symptom control was better with inhaled corticosteroids.
Fish JE, Israel E, Murray JJ *et al.*	Salmeterol powder provides significant better benefit than monteleukast in asthma patients receiving concomitant inhaled corticosteroid therapy	*Chest* 2001; **120**: 423–30	RCT	A	1	Adding salmeterol to inhaled corticosteroids produces greater benefit than adding monteleukast to inhaled corticosteroids.
Cates C	Holding chambers versus nebulisers for beta-agonist treatment of acute asthma	Cochrane Library: Update Software	Systematic review	A	1	Holding chambers produce outcomes at least equivalent to nebulisers, and may have some advantages over nebulisers in children.
Turner M, Patel A, Ginsburg S, Fitz J Gerald	Bronchodilator delivery in acute airflow obstruction	*Arch Int Med* 1997; **157**: 1736–44	Systematic review	A	1	Bronchodilator delivery using metered dose inhaler with spacer are equivalent to use of nebuliser in adults with airflow obstruction.
Muers M, Corris P (eds)	Nebuliser Project Group of the British Thoracic Society Standards of Care Committee. Current best practice for nebuliser treatment	*Thorax* 9 1997; **52** (Suppl. 2): S1–S104	Guideline	C	5	Evidence-based guideline suggests large volume spacers as effective as nebulisers for many patients. Need for large study to determine in which patients use of nebulisers are beneficial.

Other treatments

A summary of available evidence for non-drug therapy, including psychoeducational interventions, is given in **Table 9** (*see* overleaf). There have recently been a number of trials and systematic reviews of psychoeducational care including self-management plans in the field of asthma management which are summarised in **Table 9**. The general conclusion is that the benefit is dependent on the type of educational process used, and is generally modest (BI). Interventions may be cost-effective but the net saving is small (BI).[278,279]

Desensitisation using allergen immunotherapy is popular in some other European countries but is not generally recommended because of relative ineffectiveness and dangers.[280] Physiotherapy is prescribed for some patients but its rationale in asthma has been questioned[281] and there have been no controlled trials. Acupuncture has attracted interest but a meta-analysis of trials indicates that it is not effective.[282] Many years ago an MRC working party concluded that hypnotherapy is not indicated. There is insufficient evidence for the effectiveness of homeopathy.[283] Recent guidelines reviewed evidence for a wide range of complementary and alternative therapies for asthma including traditional Chinese medicine, acupuncture, air ionisers, homeopathy, hypnosis, spinal manipulation, physical training, breathing exercises, speleotherapy, dietary interventions and weight reduction for obese patients. There is very little evidence for effectiveness of any of these interventions,[140] although some merit further investigation.

Investigations

The use of lung function tests in the assessment of asthma is variable. There is even more variability in the use of lung function monitoring. The same applies to chest X-ray. Both of these procedures seem clinically appropriate but their use has never been tested by means of a trial. Similarly, allergen skin tests have never been shown to improve outcome.

Organisation of care

GPs vary in their use of specialist referral and in their reasons for requesting it.[148,149] They also differ in their preferences and dependence on specialist outpatient clinics for the continuing care of the patient. An increasing proportion of practices are providing special asthma clinics in primary care. The longer term care of asthmatics in hospital outpatients has never been supported by evidence of benefit. A considerable proportion of long-term outpatients have no clinical reason for continuing to attend (DI).[284]

A systematic review of asthma care concluded that there was no conclusive evidence to favour one type of care (specialist or generalist) over another. However, specialist care tended to be of higher quality, and shared care between hospital and primary care can be as good as hospital-led care, and also cheaper by about £40 per annum (BI).[285] Another trial of integrated care between hospital and primary care showed no benefit to patients, but the patients preferred it, and there were small savings to the patients and health service (BI).[286] There is thus evidence to support shared care for patients with asthma between hospital and primary care and limited evidence that this care should involve a specialist. However, the optimum balance for ongoing care between primary and secondary care, and between generalists and specialists within each of these settings has not been clearly established. Trials that have been published to date vary in their design, but overall suggest limited benefit may accrue from specialisation of care within primary care (**BI to BIII**).[287–290]

Another organisational variant is the provision of an asthma nurse with responsibility for education and training in the use of medications. There is insufficient evidence to conclude that this type of provision is more effective than standard care,[287] but there is evidence that this type of care is safe.[289] A recent trial

Table 9: Summary of recent evidence of effectiveness of non-drug therapy for asthma, including psychoeducational interventions.

Authors	Title	Reference	Study type			Summary
1. Psychoeducational interventions including written self-management programs						
Gibson P, Coughlan J, Wilson A *et al.*	Self management education and regular practitioner review for adults with asthma	Cochrane Library: Update Software, 2001	Systematic review	B	1	Self-management reduces hospital admissions and attendance, visits to the doctor, days off work or school and nocturnal symptoms, but does not affect lung function. A written plan has greater effect on hospitalisation and lung function. Best results occur with written care plans.
Devine E	Meta-analysis of the effects of psychoeducational care in adults with asthma	*Res Nursing Health* 1996; **19**: 367–76	Systematic review	B	1	Education and relaxation-based behavioural therapy improve multiple measures of functioning and well-being in adults with asthma. Effect estimates could not be reliably calculated for other interventions.
Madge P, McColl J, Paton J	Impact of a nurse-led home management training programme in children admitted to hospital with acute asthma: a randomised controlled study	*Thorax* 1997; **52**: 223–8	RCT	B	1	Re-admissions reduced from 25% to 8% if asthma education follows acute admission in children.
Lahdensuo A, Haahtela T, Herrala J *et al.*	Randomised comparison of guided self-management and traditional treatment of asthma	*BMJ* 1996; **312**: 748–52	RCT	B	1	Confers benefit on absence from work, attacks, need for treatment, emergency consultations and hospital admissions.
Taitel M, Kotses H, Bernstein I, Bernstein D, Creer T	A self management program of adult asthma Part II: cost benefit analysis	*J Allergy Clin Immunol* 1995; **95**: 672–6	Economic evaluation	B	1	The intervention reduced asthma attacks, improved self-management and cognitive measures at six months. Not analysed by intention to treat. Net saving was US$267 per patient.

Osman L, Abdalla M, Beattie J *et al.*	Reducing hospital admission through computer supported education for asthma patients	*BMJ* 1994; **308**: 568–71	Randomised trial	B	2.2.	Severe patients had lower hospitalisation rates when they received enhanced education with personalised computerised booklets compared to normal education, and also less sleep disturbance. No difference in drug use, GP consultations was found.
Trautner C, Richter B, Berger B	Cost effectiveness of a structured treatment and teaching programme on asthma	*Eur Resp J* 1993; **6**: 1485–91	Economic evaluation	B	5	Case series. Reduction in severe asthma attacks noted, reduced hospital days and days of absence from work. Savings were DM12850 per year (all) and DM5900 per year direct. Likely to overestimate benefit.
Gibson P, Coughlan J, Wilson A *et al.*	Limited (information only) patient education programs for adults with asthma	Cochrane Library: Update Software, 1999	Systematic review	C	1	Use of limited asthma education appears to be of no benefit, although there may be a minor effect when used in emergency departments.
Bernard-Bonnin A, Stachenko S, Bonin D, Charette C, Rousseau E	Self management teaching programs and morbidity of paediatric asthma: a meta-analysis	*J Allergy Clin Immunol* 1995; **95**: 34–41	Systematic review	C	1	Effect sizes were very small. Self-management teaching had no effect on emergency visits, hospital admissions, hospital days, asthma attacks and time off school.
Kauppinen R, Sintonen H, Tukiainen H	One year economic evaluation of intensive versus conventional patient education and supervision for self management of new asthmatic patients	*Resp Med* 1998; **92**: 300–7	Economic analysis	C	1	Lung function measures were better at one year in the intervention group. No improvement in quality of life measures. Intervention cost more and overall was not more cost-effective than conventional education.
Drummond N, Abdalla M, Beattie J *et al.*	Effectiveness of routine self monitoring of peak flow in patients with asthma	*BMJ* 1994; **308**: 564–7	Randomised trial	C	3	Prescribing a peak flow meter slightly increased GP consultations. In severe asthmatics, oral steroid use increased. No other significant difference in wide range of clinical and symptomatic outcomes.

Table 9: Continued.

Authors	Title	Reference	Study type			Summary
2. Exercise and physical training						
Scholtz W, Haubrock M, Lob-Corzilius T, Gebert N, Wahn U, Szczepanski R	Cost effectiveness studies of ambulatory educational programs for children with asthma and their families	*Pneumologie* 1996; **50**: 538–43	Economic evaluation	B	5	Exercise training was effective overall in reducing a weighted score derived from clinical and quality of life criteria. Training saves DM97 per unit of effectiveness per year.
Ram F, Robinson S, Black P	Physical training in asthma	Cochrane Library: Update Software, 1999	Systematic review	C	1	Improved cardiopulmonary fitness at the expense of more exacerbations.
3. Complementary therapies						
Linde K, Jobst K	Homeopathy for chronic asthma	Cochrane Library: Update Software	Systematic review	C	1	Minor effects on lung function, symptoms, and drug use, but insufficient evidence to assess role of homeopathy in asthma.
Abramson M, Puy R, Weiner J	Allergen immunotherapy for asthma	Cochrane Library: Update Software, 1999	Systematic review	C	1	Immunotherapy may reduce symptoms and medication use, but the possibility of severe adverse reactions must be considered.
Linde K, Jobst K, Panton J	Acupuncture for chronic asthma	Cochrane Library: Update Software, 1999	Systematic review	C	1	Trials of poor quality. Only one trial showed possible improvement in lung function. The role of acupuncture in treatment of asthma is uncertain.
4. Other therapies						
Abramson MJ, Puy RM, Weiner JM	Is allergen immunotherapy effective in asthma: a meta-analysis of randomised controlled trials	*Am J Resp Crit Care Med* 1995; **151**: 969–74	Systematic review	C	1	Meta analysis suggested benefit on symptoms, medication use and lung function, but many adverse reactions. No anaphylaxis but risk of 1 in 500. Recommendation to treat balanced by need for care.

showed that an asthma nurse providing intervention according to the British Thoracic Society guidelines on the role of such a nurse had no impact on any patient-related outcome measures, although a marginal improvement in prescribing occurred.[288] This study also showed improvements in diagnosis of asthma.

Care of chronic asthma in primary care is based around the use of guided self-management incorporating educational interventions together with self-management plans. Guided self-management reduces morbidity and the need for hospital services (BI).[321] (*See* Table 10 overleaf.)

Clinical care of acute asthma

Drug treatment

Acute asthma causes great distress and may lead to death; it is one of the classic medical emergencies. Many attacks are of lesser severity. No controlled trials of treatment versus non-treatment have been done though some trials comparing different treatments have been reported and there is one instance of an uncontrolled trial of no treatment (AIII).[292] Doctors vary in the way they treat acute asthma in general practice,[147] at A&E, and in hospitals.[19,268,270,293] Evidence-based guidelines are now becoming available for the management of acute and chronic asthma.[25,140] These give clear guidance on when referral to hospital is required, and on procedures once at hospital for admission to hospital and to intensive care. It is acceptable to treat a relatively mild episode intensively because of the known unpredictability of attacks. Confidential enquiries always identify a proportion of patients who have been treated inadequately though it is not known whether, if proper care had been instituted, these patients would have survived.

Available recent evidence on effectiveness of drug treatment in acute asthma is summarised in **Table 8**. It is now clear that oral corticosteroids are as effective as intravenous steroids in patients able to take oral medication (AI).[294–296] A single dose of intravenous magnesium sulphate is now incorporated into guidance on treatment of acute severe asthma (AI).[297]

It has been observed that in spite of advances in medical care of asthma the death rate remains at the level of the late 1950s and may be increasing slightly in young adults. All other things being equal, this might be interpreted evaluatively to indicate that little can be done to alter asthma mortality. If this is the case, the reason for treating asthma should be to relieve distress. It is accepted that it does so and no trial would be ethical. The length of stay for asthma has decreased markedly over recent years, which might indicate either more effective treatment or a lower threshold of admission.

Other treatment

Antibiotics are sometimes given but a randomised trial of hospital patients demonstrated that they are of no value.[298] Physiotherapy is often ordered in hospital but this is variable, its rationale is unclear, and it has never been evaluated.[281] Oxygen administration improves oxygenation and is one reason for admitting patients with acute asthma. Ventilation is required in seriously ill patients to maintain oxygenation and can be shown to do so.

Investigations

Lung function tests are accepted as essential for assessment and monitoring of acute attacks but are not regularly done in general practice and only variably in hospitals. Blood gases give important information about the state of the patient although their use is variable and, in children, uncommon. Recently non-invasive measures of oxygenation using pulse oximetry have been introduced. Trial evidence indicates that there is no benefit in taking a chest X-ray of a patient who has been X-rayed on a previous occasion.[299] Microbiology of throat or sputum is often ordered in admitted patients but has not been evaluated. Other

Table 10: Steps in the treatment of chronic asthma in adults and children.

Asthma severity	Treatment (adults)	Alternatives (adults)	Treatment (children)	Alternatives (children)
STEP 1: Intermittent. *Symptoms less than once a week, FEV1 or PEF > 80% predicted with < 20% variability*	Inhaled $®_2$ agonists as required (also used at all subsequent steps)	Inhaled ipratropium, oral $®_2$ agonists, theophyllines	Inhaled $®_2$ agonists as required (also used at all subsequent steps)	Inhaled ipratropium
STEP 2: Mild Persistent. *Symptoms more than weekly but less than daily. FEV1 or PEF > 80% predicted, variability 20–30%*	Inhaled glucocorticoid 200 to 800 ⇐ g beclomethasone equivalent	Sustained release theophylline or Cromone or leukotriene modifier	Inhaled glucocorticoid 200–400 ⇐ g beclomethasone equivalent	As for adults
STEP 3: Moderate Persistent. *Symptoms daily, FEV1 or PEF 60–80% predicted, variability > 30%*	ADD long-acting inhaled $®_2$ agonists (LABA) If ineffective increase glucocorticoid up to 800 ⇐ g beclomethasone equivalent If ineffective stop LABA and try other therapies	Sustained-release theophylline or long-acting oral $®_2$ agonists or leukotriene modifier	ADD long-acting inhaled $®_2$ agonists (LABA) If ineffective increase glucocorticoid up to 400 ⇐ g beclomethasone equivalent If ineffective stop LABA and try other therapies If under 5 consider referral to respiratory paediatrician	Sustained release theophylline (if over 5) or leukotriene modifier
STEP 4: Severe Persistent. *Symptoms daily with frequent exacerbations and limitations of physical activities. FEV1 or PEF < 60% predicted and variability > 30%*	Higher dose inhaled glucocorticoid (> 1000 ⇐ g beclomethasone equivalent) plus one or more of the following: sustained release theophylline; leukotriene modifier; long-acting $®_2$ agonists		If under 5 refer to respiratory paediatrician. For children aged 5 and over, consider higher dose inhaled glucocorticoid (800 ⇐ g beclomethasone equivalent) plus one or more of the following: sustained release theophylline; leukotriene modifier; long-acting $®_2$ agonists	
STEP 5: Continuous use of oral corticosteroids	ADD oral corticosteroids and refer to specialist care		ADD oral corticosteroids and refer to respiratory paediatrician	

Adapted from British Thoracic Society Guidelines[140] and GINA guidelines.[25]

general medical work-up tests (full blood count, urine microscopy and culture, and electrolytes) may be done but the level varies from hospital to hospital. The rationale for this practice is weak and the effect on outcome has not been evaluated.

Hospitalisation

Criteria for admission to hospital vary considerably. Evidence-based guidelines provide indications as to when hospitalisation in acute asthma is appropriate.[25,140] As a form of treatment, hospitalisation has never been evaluated. Studies into the appropriateness of admission may be useful in answering this question. A randomised controlled trial investigating the use of an asthma liaison nurse in children admitted to hospital found that this intervention increased re-admissions.[300] Another study of nurse-led education following admission in children showed improvements in re-admission rates, therefore the evidence for effectiveness is conflicting (CI).[301] A controlled trial among adults had a more successful outcome.[302]

Organisation of care

The different routes of referral to hospital have rarely been evaluated. On the basis of an uncontrolled evaluation, the Edinburgh 'self-admission' arrangements were considered to reduce mortality.[149] The benefits of the marked shift towards self-referral to hospital in recent years have not been demonstrated, though parents appear to be satisfied with such arrangements.[145] The British Thoracic Society Guidelines recommend that all patients with hospitalisation due to acute asthma should be under the care of a respiratory specialist.[140]

Education

The role of education has been reviewed[303] and a meta-analysis of trials is available.[304] Trial evidence suggests that education alone, while it may increase knowledge, does not improve outcome.[305] Interventions which are effective are those which are more intensive (and expensive) and behaviourally rather than educationally based. The effectiveness of psychoeducational interventions is summarised in **Table 9**. In general the evidence that educational interventions in adults with asthma is effective is limited but suggests they are effective (BI). Educational interventions have been adopted into widespread practice in the care of both acute and chronic asthma.

One trial of education to improve the care of children admitted to hospital did not improve outcome and increased re-admissions,[300] another reduced re-admissions.[301] Guided self-management plans for patients with asthma reduce exacerbation rates and overall morbidity.[290]

Chronic obstructive pulmonary disease

COPD is incurable and progressive. Assessment of the effectiveness of different forms of management is difficult because the relationship between lung function and morbidity, as measured by quality of life indices, is complex and not particularly close. Indeed the emotional state of the patient suffering with COPD is probably as important as lung function in determining well-being. The degree and rate of deterioration in lung function, however, is a good predictor of mortality.

Management of COPD is centred around initial diagnosis and monitoring, reduction of risk factors for deterioration (cigarette smoking), the management of stable COPD (using bronchodilators, inhaled glucocorticoids, pulmonary rehabilitation and long-term oxygen therapy where indicated), and the management of acute exacerbations.

Investigations

There is a general debate on the costs and benefits of direct general practitioner access to radiology departments.[306] There are now guidelines laid down by radiologists regarding criteria for X-rays which are likely to reduce the frequency of unnecessary X-rays.[307]

Bronchoscopy is often indicated to exclude other diseases, particularly lung cancer.

Spirometry with reversibility is essential for the diagnosis and monitoring of patients with COPD. Sophisticated pulmonary function tests are probably only required in a minority of patients but there has been no formal evaluation of their use.

Drug treatment

Long-term bronchodilator drugs and steroids may give symptomatic relief but have not been shown to affect prognosis.[308] There have been a number of large recent studies on effect of inhaled corticosteroids in COPD, some of which have yet to report in full. In general the evidence suggests that long-term inhaled corticosteroids have either no or marginal effect on lung function decline or exacerbations (DI), but may have positive effect on quality of life (BI).[309–311] Oral corticosteroids improve lung function and quality of life in the short term in a proportion of patients with COPD, but cannot be used long-term because of unacceptable side effects (CI).[312]

The place of bronchodilator therapy in COPD also remains unclear. A systematic review of long-acting bronchodilators concluded that there was no effect on exacerbations or exercise tolerance, little effect on lung function but greater effects on symptoms and quality of life (BI). Individual trials of regular inhaled bronchodilator therapy have demonstrated both beneficial effects[312–317] (on lung function and quality of life) and detrimental effects.[318] A systematic review suggests that there are overall beneficial effects on symptoms, lung function and quality of life, at least in the short term.[319] There is little if any evidence that ipratropium combined with beta-2 agonists may be more effective than beta-2 agonists alone (CI).[320]

Long-term domiciliary oxygen has been shown to reduce mortality in a number of studies (AI), but patients with hypoxaemic disease, i.e. those who might benefit from the provision of oxygen, represent a minority of cases.[321,322] A systematic review has concluded that long-term oxygen therapy only improves survival in COPD patients with moderate to severe hypoxaemia (AI).[323] At present there is little evidence to support its use in patients with milder hypoxaemia. A study in the UK revealed a geographical mismatch between the issue of oxygen equipment and anticipated need.[324]

Antibiotics and oxygen therapy in acute exacerbations probably reduce risk of death (BII-2). A systematic review of antibiotics for acute exacerbations of COPD concluded that antibiotics improve symptoms, reduce their duration and improve lung function, and that the effect is greater for hospital inpatients than outpatients (AI).[325] A systematic review suggests there is reasonably good evidence to support the use of mucolytic agents in COPD and chronic bronchitis (BI). The place of theophyllines in management of acute exacerbations and stable COPD is also unclear, there being evidence of modest benefit in some patients but balanced by adverse side effects (CI).[327–329] Guidelines have been produced for the management of COPD in the United Kingdom, which incorporate guidance on investigation and diagnosis, assessment, management of chronic disease and acute exacerbations and organisation and management of care (BIII).[330]

Other treatments and services

The appropriate balance between primary and secondary care remains controversial: there have been no formal trials. Some audits of outpatient clinics suggest that up to 30% of follow-up visits may be inappropriate.[284,331] There has been little research on criteria for hospital admission. In severe hospitalised

cases a decision on whether a patient should be ventilated has to be made, but little research has taken place on the necessary criteria. Most hospitalised patients are treated by general physicians rather than respiratory specialists. Evidence in asthmatics suggest that generalists are less likely to monitor and follow up patients, which may also be true in COPD.[21]

There has been little evaluative research on GP hospital versus district hospital admissions.

There has been some work comparing regular surveillance by a nurse specialist with a demand-led service (BI).[332,333] This approach may prolong the life of severe cases at greater expense to the health service.

Observational studies and controlled trials indicate that stopping smoking slows the progression of disease (AI).

There remains debate over the benefits of chest physiotherapy.[84] A systematic review suggests no evidence of effect (CI).[334]

Nocturnal non-invasive positive pressure ventilation has recently been introduced for the management of hypercapnic patients with COPD. However, at present there is insufficient evidence to determine its benefit – some patients appear to derive great benefit but these cannot be identified a priori.[335]

There have been a number of recent evaluations of both educational interventions and formal pulmonary rehabilitation programs in patients with COPD. Education alone reduced hospital admission and GP attendance, and produced cost savings (BI).[336] Several systematic reviews suggest there is some evidence for clinically significant benefit from pulmonary rehabilitation, particularly that which incorporates exercise training (AI),[337–342] but there was no evidence of cost savings in an economic evaluation (DI).[343]

Tuberculosis

Drug therapy for tuberculosis has been shown to be effective in numerous randomised controlled trials (AI), but regimens shorter than six months have not been shown to be as effective as those of six months' duration.[344] Guidelines for both prevention and control, and for chemotherapy of tuberculosis in the United Kingdom have been produced (AIII).[154,159,161] Because of the duration of treatment, non-compliance is a problem.[164]

A systematic review of strategies to improve compliance with treatment showed that reminder cards, monetary incentives, lay worker involvement and clinic staff supervision increased completion, but directly observed therapy did not[345] (BI). However, the place of directly observed therapy is not yet clear, with more than one consensus statement considering it to be both effective and cost-effective.[346,347]

Cystic fibrosis

The treatment of cystic fibrosis is complicated, because of the multi-system nature of this condition, although is usually undertaken by a respiratory specialist (adult or paediatric) because lung disease is responsible for most of the mortality associated with the condition. Care of patients with cystic fibrosis requires a partnership between patient, family, the specialist doctor and multidisciplinary team, and the general practitioner. There have been no formal evaluations of the role that the general practitioner can play in management of cystic fibrosis, and the majority of care is provided by the hospital, usually as an outpatient or supported in the community by hospital staff. There is evidence from observational studies that survival is improved for patients who are treated in specialist centres with specialist multidisciplinary teams, that there is some clinical benefit, and that patients and families prefer this mode of treatment (AIII). The evidence for benefit where care is shared between a specialist clinic and a local hospital is less clear, although this form of care is frequently recommended as a method of delivering specialist care to patients who live at a distance from a main centre (CIII).

Antibiotics

Three systematic reviews have all concluded that treatment of patients chronically colonised with *Pseudomonas aeruginosa* using nebulised antibiotics is beneficial. This benefit may be demonstrated in terms of improved lung function, reduced hospital admissions, fewer intravenous antibiotic courses and improved survival (AI).[348–350]

There is also evidence from a well-designed trial that early treatment with oral and inhaled antibiotics can prevent chronic colonisation with *Pseudomonas aeruginosa* if given when the organism is first detected (AI). Since chronic colonisation with this organism is an adverse prognostic indicator, this treatment is likely to prove beneficial.[318]

Continuous oral anti-staphylococcal antibiotics, when given from infancy for two years, reduce cough, hospital admissions and length of stay (AI).[352] However, there is little evidence as to effectiveness of this treatment beyond two years of age.

The Cystic Fibrosis Trust is producing guidelines for antibiotic treatment in cystic fibrosis (AIII), which will be published in 2000.

Other drug therapy

Both oral steroids and non-steroidal anti-inflammatory drugs have been evaluated to see if they reduce the progression of lung disease in cystic fibrosis. In a systematic review of oral steroid therapy, high dose oral corticosteroids at a dose of 1–2 mg/kg on alternate days, appear to slow the progression of lung disease in children (CI),[353] but at the expense of serious side effects including growth retardation, cataracts and abnormalities in glucose metabolism. A systematic review of non-steroidal anti-inflammatory drugs[354] essentially covered a single trial, which demonstrated that lung function decline was reduced in children aged 5–13, the use of antibiotics reduced and nutritional status improved (CI).[355] Although no serious side effects were seen, the trial had low power to detect these, and their use was not recommended.

Two systematic reviews have been produced concerning the effects of dornase alpha in cystic fibrosis. Both concluded that the drug produces small but significant gains in lung function when used for a short period (six months) in patients with moderate impairment, and without serious adverse effects (BI).[356,357] The long-term effects are, as yet, unknown. The drug is expensive, and an economic evaluation has not yet been published. Hypertonic saline produces similar gains when given over a period of two weeks, and direct comparison with dornase alpha is needed (CI).[358]

There is evidence that enteric-coated microsphere preparations of pancreatic enzyme supplements improve fat absorption when compared to non-enteric coated preparations (AI).[359] However, the dose should not exceed 10 000 lipase units per kilogram, and should be adjusted until steatorrhoea is controlled (AI).[360] Higher doses may lead to colonic strictures (EIII).[361]

Physiotherapy

Three systematic reviews were identified that evaluated the effectiveness of physiotherapy in the treatment of cystic fibrosis. Two suggested that physiotherapy was effective when compared to no treatment (AI), reducing decline in lung function.[362,363] One review suggested that there was no significant difference between the modalities of physiotherapy treatment tested, but the other suggested that the forced expiration technique was probably less effective than the positive expiratory pressure mask, exercise and directed coughing in the acute exacerbation. The reviews did not test the same modalities, however, so it is still unclear as to which type of treatment is preferable. One review suggested that exercise plus physiotherapy is superior to physiotherapy alone.[362]

The third systematic review evaluated the new mechanical vibrator device that has recently become available in North America. It concluded that the vibrator was not significantly better than other forms of physiotherapy, and its use is not recommended (DI).[364]

Other non-drug therapy

Although the use of enteral tube feeding, and oral calorie supplements in cystic fibrosis is widespread, systematic reviews of the evidence shows trials to be of poor quality and evidence for the use of these forms of treatment lacking.[365,366]

Observational studies show that for some patients, heart–lung, lung or liver transplantation can increase survival and quality of life (AIII).

Management of care

One study has examined the effectiveness and cost of home intravenous antibiotic therapy in cystic fibrosis, when compared to hospital treatment. The randomised trial found no difference in clinical outcome. Improved family life and personal life was offset by increased fatigue in patients. The cost was approximately half that of an inpatient course of intravenous antibiotic therapy (BI).[367]

Cost-effectiveness

Studies of cost-effectiveness are rare. The most useful lines of enquiry are likely to be:

- shifts towards ambulatory and primary care
- the use of formal shared care protocols
- identification and study of high users, and
- shifting of costs between public sectors and between the public and private sectors.

Except for asthma (*see* below), available evidence of the cost-effectiveness of individual interventions are discussed above in the relevant disease sections of clinical effectiveness.

Asthma

The costs of asthma have been described in an number of reports.[370,371] Some of the issues are covered in a recent review.[372] In the community, the chief costs relate to doctor time and drugs. One controlled trial of the effects of clinical standard setting in general practice found improvements in outcome were associated with increased use of resources.[266] The other focus of interest has been the potential savings on hospital care arising from more adequate primary care. A descriptive study among adult asthmatics admitted to hospital concluded that 73% of admissions could have been avoided by better ambulatory care with proportionate savings.[373] Other techniques of examining cost-effectiveness have been tried but are not convincing methodologically.[374,375] In the US cost-effectiveness estimations are being built into some programmes.[374]

7 Models of care

The prevention, treatment and rehabilitation of lower respiratory disease is complex, but of the various models available, the two considered most relevant for purchasers for these conditions are the natural

history model and the service model. Decision points within these models focus upon the balance between preventive and therapeutic services, between primary and secondary care, and between specialist and generalist care within each of these settings.

In the natural history model, the central concept is the chain of events:

aetiology → pathophysiology → manifestations of disease → consequences of disease

In this model the concern is to achieve an appropriate balance between interventions at different points of the chain.

In the service model, the focus of interest is the use of health services and the main concern is that patients be treated in an appropriate way in an appropriate place by appropriate personnel.

It is argued that the direction of marginal shifts in provision of health services for most lower respiratory conditions should probably be:

treatment → prevention

secondary/tertiary care → primary care and patient enablement

However, *within* each of these settings there is a general view that treatment should be provided by specialists in respiratory conditions, rather than generalists. These specialists are usually specialist respiratory physicians in the hospital setting, and in the primary care setting, general practitioners with a specialist interest, or nurses with specialist training. That is to say, within each care setting, the general marginal shift should be:

generalist care → specialist care

For some conditions, such as cystic fibrosis, increasing specialisation of care can produce significantly better clinical outcomes, and there is a clear need for increased specialisation and more tertiary care provision.

The diagnosis and management of difficult or unusual cases, including those not covered by this review, and of cystic fibrosis, should continue to be the responsibility of an accredited respiratory specialist. There is some evidence that management of acute exacerbations of chronic lower respiratory conditions (asthma and COPD) requiring hospitalisation should also be undertaken by a respiratory specialist.

A useful feature of these models is that they allow the collapsing of most lower respiratory conditions into only two groups: lower respiratory infections, which tend to be acute and limited in duration, and asthma and COPD, which are chronic diseases with acute exacerbations. Cystic fibrosis forms a third special case due to its different aetiology and need for specialist management.

Lower respiratory infections

Natural history model

Given the lack of specific treatment for most lower respiratory infections in children, and the strong observational evidence implicating environmental tobacco smoke, greater emphasis on prevention by reducing parental smoking can be justified. Among adults, there should be greater emphasis on smoking reduction.

A policy of immunising patients over 60 admitted to hospital with pneumococcal vaccine should be considered. This may mean shifting resources from primary care towards hospital. A policy of immunising all elderly against influenza is very important.

Service model

The main resource implications of lower respiratory infection arise from inpatient care. Its high incidence in the community, of which only a minority of episodes reach hospital, implies that small shifts in the threshold of referral and admission could have a major impact on hospital resources. In the absence of a comprehensive evaluation of the clinical and economic costs and benefits of different balances between primary and secondary care, there should be caution in recommending any major shifts in activity. However, given that few patients who are admitted receive intensive supportive care, the direction of any marginal shift should be towards primary, rather than inpatient care. Guidelines are now available which should improve the marginal shift towards management of lower respiratory infections in the community.

Parental anxiety and expectations are often an important determinant of the threshold of referral (including self-referral) of children to accident and emergency departments, and of subsequent admission. This may or may not be deemed appropriate. Key policy decisions to be made relate to the extent to which clinical considerations should prevail over parental choice, and whether general practitioners or accident and emergency departments are better placed to assess clinical severity.

There is scope for developing a degree of consensus about the criteria for 'appropriateness' of admission, and of subsequent continuation of inpatient care (marginal bed-days). There is scope to reduce the reliance on intravenous antibiotic therapy in hospitalised patients, and thus reduce length of stay.

There is evidence to suggest that if pneumonias are treated correctly at an early stage by general practitioners, then fewer patients will be admitted to hospital. This may mean a changing role for respiratory physicians towards providing more advice to general practitioners on the epidemiology of pneumonias and on their treatment in the primary care setting.

Asthma and chronic obstructive pulmonary disease

Natural history model

There are a number of points in the natural history of asthma where it is possible to intervene. At present, the main thrust of activity is to use asthma drugs to reduce morbidity associated with chronic asthma and to prevent or reduce the intensity of acute exacerbations. Although the scope for primary prevention using existing knowledge is not altogether clear, there might be benefits in expanding this aspect, but not at the expense of treatment. It is possible that with more determined efforts to uncover underdiagnosis and inadequate treatment; there may be a need to expand primary care further. Within the domain of treatment there is a shift towards a model in which asthma is viewed as a chronic disorder which should be treated in a proactive or anticipatory fashion, rather than as a series of episodes, each of which is managed reactively. All of these shifts will require more resources at the primary care level though they might lead to savings through reductions in hospital care.

While a minority of COPD cases are caused by mainly genetic factors, the majority are the result of smoking which is not only a primary cause, but is detrimental at all points of the chain. The shift must therefore be towards smoking control.

Service model

The care of both asthma and COPD implies a dual relationship between the patient and doctor or even, in more severe cases, a triangular relationship between patient, general practitioner and hospital doctor.

Patients with acute asthma may need to short-circuit the referral system to hospital by self-referral. The latter may be ad hoc or formalised as an agreed 'open access' policy and backed up by written self-management plans for individual patients. Whatever the arrangement, it is clear that the dominant service

model is one of reliance on community care with backup from specialist and inpatient facilities. Because of the severity 'pyramid', a small shift in referral towards hospital will have a disproportionate effect on hospital workload. There is evidence that the balance of care of acute asthma in children is shifting towards the hospital but since this is not accompanied by evidence of benefit, further increases should be questioned.

The health service 'career' patterns of patients may not be well represented by examination of available utilisation data. All kinds of patterns exist and there is room for some shifting towards those which are more appropriate, and although the marginal shift should probably be away from hospital care for the management of chronic asthma, within both primary and secondary care, at least for some patients, a shift towards specialist care may be of benefit. In particular, the reduction of inappropriate use of hospital services would lead to considerable savings in that sector. Empowerment of patients through education, review and written self-management plans may reduce morbidity and the use of all levels of health services. The optimum methods of organising asthma and COPD services in primary care are still to be determined. There is some evidence that care can be effectively delivered by specially trained asthma and respiratory nurses working in primary care. The consequent increase in resources required by primary care services needs examination. These resources include trained personnel (medical and nursing), and provision of and training in the use of spirometric equipment. Some patients will continue to require assessment and ongoing management under a respiratory specialist.

There is some evidence that for acute exacerbations of asthma and COPD, patients fare better when under the care of a respiratory specialist than a general physician.

Tuberculosis

Natural history model

Because most patients with tuberculosis are infected in other countries, the direction is away from prevention through BCG, or early detection through mass X-ray, towards detection through clinical services, screening of immigrants and good contact tracing. However, BCG is still recommended for high-risk groups and for schoolchildren.

Service model

Treatment of tuberculosis needs to be overseen by a respiratory or infectious disease specialist. However, there is scope for developing further community and ambulatory care interventions to improve completion of therapy, which in turn will reduce antibiotic resistance.

Cystic fibrosis

Natural history model

As an inherited condition, there is potential to prevent the disease by population screening for carriers and antenatal detection with termination of affected pregnancy. At present it is not clear whether this will be beneficial or cost-effective. There is also potential to prevent decline in lung function by screening newborn infants and instituting early therapy, and there is some evidence that this is effective. There is therefore scope to move towards prevention and early intervention.

There is also evidence that exacerbations of disease may be prevented and clinical progress improved by the use of a number of drugs. In this instance, treatment is seen as both therapeutic and preventive, in that it reduces the consequences of disease.

Gene therapy is currently undergoing trials, and may in future form a method of intervening in the natural history of the disease. At present, it is still in the early trial phase.

Service model

Cystic fibrosis is the single condition in this review where there is good evidence that care directed by specialists is of benefit. However, much of this care can be successfully delivered in the community, with the patient and family taking responsibility for self-management, including delivery of quite complex forms of treatment such as intravenous antibiotic therapy and enteral feeding. The majority of support for such community-based treatment is provided by specialist hospital-based teams, and community services and primary care are rarely actively involved in care delivery. There is scope for further involvement of primary care and community care teams, but the opportunity cost of educating these professionals to care for a very small number of patients should be considered – it might be more cost-effective to use hospital-based community support unless the patient lives at a great distance from the treatment centre. The clinical nurse specialist plays an important role in delivery of hospital-based community support, although the role has not been subjected to formal trial. In general, there should be a marginal shift towards management of uncomplicated respiratory exacerbations at home, which may require provision of additional hospital-based and primary-care based support.

Care may be shared between a large specialist centre and a local hospital, particularly for patients who would otherwise have to travel long distances, but the optimum method of delivery of shared care is not known – there are various models, including alternating visits, annual assessments and peripatetic visiting clinics.

Infection control is a major issue in cystic fibrosis, and provision of inpatient facilities and outpatient clinic facilities that permit segregation of patients infected with certain types of organism is increasingly being recommended, which may have implications for capital building programmes in hospitals.

8 Outcome measures

General points

We interpret outcome measures loosely to include either indicators that directly measure the effects of health care on the respiratory status and subsequent health of an individual or population ('true outcomes' or 'health gain'), or indirect indicators of progress towards the achievement of those goals through changes in policy, service provision or reduction of risk factors.

To measure outcome requires not only the existence of good measures of respiratory health status but also a means by which the level of these measures can be related to planned interventions. Because of the present lack of outcome measures it is often necessary to rely on measures of the structure and process of care, particularly if targets are contemplated.

The British Thoracic Society Guidelines for treatment of acute asthma have recently identified a number of specific areas for detailed monitoring of routine and emergency care in both a primary care and hospital setting.[140]

Prevention

A Structure:

1 National and local policies to reduce smoking.
2 Housing fitness standards and building regulations.
3 Air pollution control (including sources of *Legionella*).
4 Availability of effective means of anti-smoking help.
5 Regulation of inhaled hazards in the workplace.
6 Policies for immunisation (pneumococci, influenza, whooping cough).
7 Hospital control of infection policies.
8 Neonatal and possibly antenatal screening programmes for cystic fibrosis.

B Process:

1 Implementation of anti-smoking policies and other policies related to the quality of inhaled air to include reducing environmental tobacco smoke exposure.
2 Achievement of coverage by immunisation which is adequate for control of the disease in question.

C Outcome:

1 Reduction in smoking.
2 Reduction in occupational lung disease.
3 Reduction in diseases amenable to control by immunisation – whooping cough, influenza, pneumococcal pneumonia.
4 Reduction in hospital-acquired pneumonia.
5 Reduction in notifications of communicable diseases.
6 Reduction in mortality.

Clinical services

A Structure:

1 Agreed management guidelines for drug treatment, investigation, outpatient referral and discharge, hospital admission and discharge criteria. Increasingly, these should be based on evidence of efficacy.
2 Access to general practitioners, paediatric and adult medicine specialists and to specialists trained in respiratory medicine.
3 Access to nurse-run structured care for patients with asthma in primary care. Use of structured record in primary care for patients with asthma.
4 Access to specialists in paediatric and adult respiratory medicine who specialise in cystic fibrosis. Adequate facilities to allow segregation of inpatients and outpatients in cystic fibrosis clinics. Access to home intravenous therapy with appropriate support for patients with cystic fibrosis.
5 Access to the full range of respiratory diagnostic facilities, including lung function tests, microbiology, radiology, endoscopy and pathology.
6 Access to appropriate drugs, delivery systems and respiratory function self-monitoring equipment such as peak flow meters.
7 Access to an intensive care unit.
8 Ambulance services trained in the emergency care of acute asthma.
9 Policies and protocols for reducing spread of communicable respiratory disease from affected patients. Designated individual in district responsible for the control of TB.

B Process:

1 Adherence to protocols and guidelines. Audit, including of selected deaths.
2 Equity. Investigation of variations between areas, social classes and ethnic groups which are not justified by differences in need for care.
3 Levels of unmet need in the community to include access to tertiary specialist centres for patients with cystic fibrosis.
4 Level of education and self-management.
5 Proportion of patients inappropriately using hospitals.
6 Proportion of patients with self-management plans for asthma and COPD in whom these are appropriate (those with moderate to severe symptoms, with frequent exacerbations, requiring emergency interventions, seeing different doctors).
7 Proportion of patients with asthma or COPD and persisting or severe symptoms who are referred for specialist assessment.
8 Proportion of practices using a structured (guideline-based) recording system for clinical care of asthma.

C Outcome:

1 Reduction in morbidity. For chronic respiratory disease, this could be measured using simple self-completed questionnaires. These could be used in the service context or on a community basis.
2 Improved patient-assessed disease control and quality of life. This can be assessed using a variety of existing methods.
3 Patient satisfaction with care.
4 School absence, work absence.
5 Mortality. Deaths in young and even middle-aged persons should, in principle, be amenable to prevention by reducing case fatality.
6 Proportion of patients with active asthma that is well controlled – the British Thoracic Society Guidelines suggest patients should have few symptoms, be able to use inhalers correctly, be taking inhaled steroids, have normal lung function (> 80% predicted FEV1), and with an asthma action plan.

9 Targets

Targets are used to quantify the rate of change or to specify a desired level of the target indicator. Some will have been shown to be achievable and some may be achievable only in theory. Often it will be easier to obtain consensus about the desired direction of change (perhaps more appropriately termed 'goals') than to set quantitative targets.

Measures of the outcome of health service intervention usually reflect other influences, such as epidemiological factors or the intervention of other agencies. For example, the prevalence of disabling asthma probably reflects both epidemiological and medical care influences. Similar limitations apply to some risk factors, such as smoking where the influence of the NHS may be partly at a national policy level and also involve other agencies. Furthermore, at a local or regional level many 'true' outcome indicators may be based on small numbers and therefore be inappropriate for target setting at these levels. This limits the utility of outcome targets and implies that measures of process will be more credible targets. This, however, presupposes that a link between process and outcome has been established by other means (e.g. randomised controlled trial). This is rarely the case for respiratory disease.

The social class gradient found in most respiratory diseases raises the question: should this be seen as a mitigating factor or as a failure to meet targets of equity?

Prevention

1 **Smoking:** A significant reduction (of 35% in men, 29% in women and 33% in 11–15-year-olds) in smoking was proposed by government.[375] These targets have been modified in the *Smoking Kills* document. For children, a reduction from 13% to 11% by 2005 and 9% by 2010 is now proposed. For adults, a reduction from 28% to 26% by 2005 and 24% by 2010 is proposed. In pregnancy, a reduction from 23% to 18% by 2005 and 15% by 2010 is proposed.
2 **Immunisation:** The FPHM has proposed a 1995 target of 95% pertussis immunisation by the age of one year, and of 95% measles immunisation by the age of two years. The World Health Organisation also recommends this target. This has been achieved in the UK and efforts to continue this level of coverage should continue with this as the target.
3 **Air quality:** Air Quality Guidelines for Europe have been published and should be observed. The Expert Panel on Air Quality Standards produces air quality guidelines for the United Kingdom and efforts should be made to adhere to these targets, and the targets outlined in the National Air Quality Strategy.
4 **Cooling systems:** There should be monitoring of cooling systems which are potential sources of *Legionella* dissemination. A perhaps ambitious target could be that none are contaminated.
5 **Pneumococcal immunisation:** A target of immunisation of all patients over 60 who have been admitted to hospital with pneumococcal vaccine was suggested in the last edition. The evidence that this is effective is weak. However, all groups for whom immunisation is suggested in the current edition of *Immunisation for Infectious Disease* should receive such immunisation.
6 **Influenza immunisation:** All at-risk groups should be immunised.

Morbidity

1 **Reduction in morbidity in the population:** Reduction in morbidity from asthma is certainly a goal and in theory it is achievable because surveys indicate considerable under-treatment. There is recent evidence which suggests that reductions are possible in practice (in children) but it would be inappropriate to set a quantified target without much better epidemiological information on determinants and time trends. The current uncertainty about adverse effects of treatment on morbidity needs to be kept in mind.
2 **Notifications of whooping cough:** A target of at least 50% reduction by 1995 was suggested (FPHM), and this has been achieved – there was a 93% reduction in three-year moving average notifications between 1982 and 1998. There is no target set by the World Health Organisation, but it would seem reasonable to set a target of at least maintaining with progress towards a further 50% reduction in notifications by 2010.
3 **Notifications of measles:** A target of 80% reduction by 1995 was suggested (FPHM) and achieved, with a 95% reduction in three-year moving average notifications between 1982 and 1998. The World Health Organisation has set a target of eradication, but no target date has been set. Eradication is theoretically achievable, and a target of a further 50% reduction in notifications by 2010 should be attainable.
4 **Reduction in re-admissions for asthma:** This would be measurable and may be achievable. The question is whether it is desirable. Further evaluation is needed before a target can be set.

The following are goals, but quantifiable targets cannot be set:

5 **Reduction in nosocomial infections.**
6 **Improved quality of life and disease control in chronic disease.**
7 **Satisfaction with services.**
8 **Reduction in unscheduled use of primary care for asthma and COPD.**

Mortality

At a district level, mortality from the conditions listed below is too low to monitor.

1 **Tuberculosis:** A target of zero is achievable except for immune-deficient patients.
2 **Pertussis:** Mortality is already low but case-fatality is higher in children with other serious diseases. Immunisation is not wholly protective. While a further reduction is desirable, a quantifiable target is difficult to define.
3 **Asthma:** In theory there is scope for a reduction in mortality because acute asthma is treatable and a proportion of deaths has been associated with inadequate care. For this reason asthma mortality in ages 5–44 has been listed as avoidable. It is not known to what extent this may be possible in practice. Neither do we know enough about trends and geographical variations in epidemiological influences to be able to interpret trends. Thus a reduction of mortality in this age group, though desirable, may not be achievable. Deaths are too few for targets to be set locally.
4 **Cystic fibrosis:** In theory a target of no deaths between the ages of 1 year and 16 years may be achievable, but would be difficult to monitor at local level due to small numbers of patients in individual districts. Therefore a target cannot be set. However, mortality in the paediatric age group should be minimised, and survival could be monitored at regional level.

Clinical and service targets

1 **Distribution of respiratory specialists:** The distribution of doctors accredited in respiratory medicine together with necessary laboratory and investigative backup should be arranged so that all patients requiring such services have access to them. Whether specialists should be in groups or single-handed needs discussion.
2 **Setting up and adherence to guidelines for clinical management:** These should be evidence-based where evidence exists, the methodology be adequately described, and ideally they should be drawn up by multidisciplinary teams and regularly reviewed.
3 **Level of uptake of peak flow meters:** Until more is understood about the benefits of self-monitoring, a target cannot be set.
4 **Implementation of self-management plans:** These appear to be promising in the management of asthma. Further evaluation is required before setting a target that all chronic asthmatics should have them. However, all patients with moderate to severe asthma should have these plans and every patient with asthma should have written advice on when to seek help.
5 **Improved levels of patient education and self-care skills:** It would be reasonable to set a target that all patients with chronic respiratory disease should have a basic understanding of their illness and its treatment, and that they should know what to do in an emergency, and how to reduce exposure to exacerbating factors.
6 **Appropriateness of admissions and other hospital utilisation:** Appropriateness protocols are still in the development stage but have potential. In time it may be possible to set target levels for the proportion of appropriate admissions and distribution of length of stay.

7 **Notifications of tuberculosis:** These should be complete and within a set time, to enable an appropriate response.
8 **Setting up and adherence to protocols for management of outbreaks of TB, and for contact tracing, chemoprophylaxis and completion of courses of treatment**.
9 **Cystic fibrosis services:** All patients with cystic fibrosis should have access to a specialist in cystic fibrosis (tertiary level service) supported by a specialist multidisciplinary team.

Changes in information required to facilitate needs assessment at a local level

The information changes suggested below refer not only to improvements or additions to the standing systems but to methods which might be applied on a sample basis when required. Operationally, there are three categories:

1 routine data as they are at present, or in a modified form
2 new data to be collected at the point of service use and
3 data to be collected from community surveys.

Changes in information required to enable targets to be met in future and to enable outcomes to be monitored

1 **Local assessment of needs:** Will often (particularly in the short term) involve extrapolation from national data. It is therefore desirable that, where possible, local developments in information use standard methods so that comparison with national figures can continue.
2 **Maintain and improve communicable disease notification system:** In particular there is a need to improve feedback to districts to enable rapid response to problems.
3 **Improve and standardise diagnostic recording of deaths and admissions:** This applies not only to the underlying cause but to co-morbidity revealed by other causes recorded.
4 **Support, extend and standardise general practitioner systems for recording clinical activity:** This would provide at the primary care level a basis for assessing demand for care and the response to it.
5 **Develop methods of obtaining diagnostic data from Accident and Emergency departments and outpatient clinics:** These are being developed at present. A national minimum data set would improve ability to make comparisons between districts.
6 **Linkage of hospital admissions:** Use of the NHS number, which is also being considered, would facilitate linkage. This information would not only give information about demand and patterns of use, it would also be a useful focus for audit.
7 **Modify existing prescription analysis (PACT) to include the recording and coding of age:** The existing system codes only whether the patient is exempt or not (though age of the child is recorded on the prescription) and even these data cannot be linked to specific drug data. Some respiratory drugs are disease-specific and data improved in this way would give better information about the use of medicines for these illnesses.
8 **Improve information obtained from schools:** There are two main possibilities. The first would be to adopt a standard structured school medical examination. The second would be to include in school absence records a suitable comment about the medical cause of absence e.g. 'chest illness'.
9 **Develop simple, practical and valid methods of measuring morbidity in the community by questionnaires:** Such procedures could also obtain data on treatment, service use and satisfaction.

10 **Develop practical methods of measuring severity of illness at service interfaces:** This would enable variations in process and outcome to be interpreted.
11 **Develop simple, standard and comparable measures of respiratory risk factors at a local level:** These would enable variations in morbidity to be interpreted, and risk factor intervention to be prioritised and monitored. Factors include smoking, industrial exposures, air pollution, indoor hazards, social class and ethnic composition.
12 **Maintain the national cystic fibrosis case register and national cystic fibrosis clinical database:** This would allow local service planning, and provide information for local audit.
13 **Develop standardised templates for respiratory disease across GP computer systems and standardise use of coding:** This would allow collection of data on incidence, prevalence and use of services in primary care at the population level and facilitate monitoring, audit and needs assessment.

Health outcomes

1 **Audit of deaths:** Numbers of deaths are routinely available but some simple means of auditing care and prevention prior to the death should be considered. This exercise would concentrate on 'premature' deaths with the aim of learning more about both immediate and more distant factors contributing to death and using such knowledge to improve and monitor care and prevention locally. Confidential enquiries have been undertaken for asthma deaths, and could usefully be undertaken for other causes, including deaths from cystic fibrosis in the paediatric age group, to identify service-related factors contributing to the deaths.
2 **Surveys of morbidity, treatment and patient satisfaction:** The main chronic respiratory diseases are common and easily measured by simple survey techniques.
3 **Admissions and re-admissions:** These are an important outcome of ambulatory care in conditions where it is believed that hospitalisation may be avoided by appropriate care. Similarly, re-admissions may also reflect a lack of appropriate arrangements following the earlier admission.

Process

1 **Analysis of variability between districts in process and outcome measures:** This is one level up from measurement of individual clinical process and outcome. If it is possible to assume that underlying morbidity is broadly similar across districts, large variations in outcome indicate different levels of care, whereas large variations in process indicate inefficiency or unmet need.
2 **Measures of the appropriateness of admission:** This concept has been developed in the US and is based on consensus criteria of appropriateness. It need not be disease-specific.
3 **Audit of adherence to protocols or clinical guidelines**.
4 **Surveys of risk factors for disease, in so far as these are targets for intervention**.

System factors and balance of care

1 **Range and level of severity at service interfaces:** This can be measured and is necessary if district variations or trends are to be interpreted adequately.
2 **Mode of referral for acute illness:** This is easily measured and of great importance in acute severe illness.

3 **Ratio of regular to short-term attenders at outpatients:** This would not be an appropriate outcome measure for patients with cystic fibrosis, or those with rare chronic respiratory diseases, including diffuse parenchymal lung disease, not assessed in this chapter.
4 **Analysis of the service 'careers' of patients to describe, explain and compare patterns of use at the patient level rather than relying on 'spells' as at present.**

Research priorities

1 Development of standard methods suitable for monitoring at a community level morbidity and quality of life, treatment, and patient factors such as satisfaction with care, stigma and self-care skills.
2 Measurement and monitoring of the incidence of acute respiratory illness. For certain conditions with acute exacerbations there is very little epidemiological data on acute illness. Without this, it is difficult to assess need or interpret utilisation data.
3 Identification of the scope for prevention through environmental control of known precipitants in the home and outdoor environment.
4 Aetiological research directed at preventable factors.
5 Continued development and evaluation of vaccines especially those against pneumococci and respiratory syncytial virus, and *Pseudomonas aeruginosa* in cystic fibrosis.
6 Evaluation of the prevention and treatment of hospital-acquired pneumonia.
7 Investigation of the impact of treatment on the natural history of obstructive lung disease including iatrogenesis.
8 Case–control studies of adverse outcomes such as deaths, re-admissions, etc. The fact that confidential enquiries into circumstances of death are not controlled limits their conclusions.
9 Appraisal of the extent to which population mortality and morbidity can be reduced by treatment.
10 Investigation of the reasons for the variability which exists between doctors and hospitals in the approach to diagnosis and management and the use of investigations and services.
11 Development of simple and standard ways of measuring disease severity at service interfaces and of ensuring uniform diagnostic recording.
12 Evaluation of those elements of consensus guidelines for which evidence of efficacy is lacking.
13 Assessment of the benefits and costs of various models of care, including marginal shifts to and from primary, secondary and tertiary care. This could include assessment of cost-effectiveness of GP asthma clinics, peripatetic clinics in primary care, various models of shared care, and models of care for patients with cystic fibrosis (tertiary, secondary and primary balance).
14 The role of specialist nurses and the most cost-effective use of their time and skills need further defining.
15 Evaluation of factors that lead to appropriate and inappropriate use of hospital admission, discharge, outpatient referral and outpatient discharge.

Appendix A: Classification of respiratory diseases

Mode of presentation of respiratory disease

The respiratory tract has a limited range of responses to infection, irritation, allergy or structural change. The symptoms encountered are therefore rarely disease-specific, posing problems for clinical diagnosis and epidemiological surveys. For example, cough may be a symptom of self-limiting upper respiratory infection, asthma, bronchitis, pneumonia, tuberculosis or lung cancer, whereas chronic breathlessness on exertion may indicate disease of the cardiovascular system rather than airflow limitation, emphysema or fibrosis of the lung.

The detection of rare but serious pathology in patients presenting with common symptoms poses a diagnostic task for respiratory medicine services. Respiratory illnesses may progress rapidly from an apparently innocuous 'common cold' to life-threatening pneumonia or bronchospasm. Although this occurs rather infrequently, it influences both clinical attitudes to the management of acute episodes and lay expectations of the services that should be provided.

Diagnostic labels

A wide range of apparently site-specific diagnostic terms are used in acute respiratory disease (e.g. bronchitis, bronchiolitis, laryngotracheobronchitis). These are rarely supported by any direct evidence of the site of involvement, and the ability to discriminate disease affecting different parts of the lower respiratory tract by clinical examination is poor. Consolidation of the lung seen on X-ray confirms the presence of pneumonia, but this diagnosis may be applied on clinical grounds alone.

The diagnosis of chronic obstructive lung disease is equally problematic. A conceptual distinction between potentially reversible airflow obstruction (due to bronchospasm) and irreversible airflow obstruction (associated with structural lung disease) is widely accepted, although many patients appear to have both. Clinical fashion in the labelling of these conditions has changed substantially in recent years. Historically, 'chronic bronchitis' and 'emphysema' were used interchangeably to describe adult patients with chronic lung disease. During the 1980s, the less specific (but perhaps more honest) terms 'Chronic Obstructive Airways Disease' (COAD) or 'Chronic Obstructive Pulmonary Disease' (COPD) have become increasingly popular.

The term COPD is now the internationally-accepted term embracing all of the clinical labels or acronyms shown below, either alone or in combination:

- emphysema
- chronic bronchitis
- chronic obstructive bronchitis
- chronic airflow limitation (CAL)
- chronic airflow obstruction (CAO)
- chronic airways obstruction (CAO)
- non-reversible obstructive airways disease (NROAD)
- chronic obstructive pulmonary disease (COPD)
- chronic obstructive lung disease (COLD)
- some cases of chronic asthma.

Diagnostic fashions in paediatric practice have led to increasing use of the asthma label as a replacement for the previously more popular 'wheezy bronchitis'.

These issues have major implications for the interpretation of data coded to ICD classifications.

Site of involvement

Respiratory diseases are broadly divided into those affecting the 'upper' respiratory tract (nose, pharynx and larynx) and 'lower' respiratory diseases (affecting the trachea, bronchi or lungs). Diseases of the middle ear, although anatomically part of the respiratory tract, are generally excluded.

Episodes of illness may progress from upper respiratory involvement to lower respiratory symptoms, either due to physiological response (e.g. asthma), or invasion of the intrathoracic airways by the primary pathogen (e.g. viral pneumonia) or secondary bacterial infection (e.g. exacerbation of chronic bronchitis by influenza).

Infections and allergies affecting the upper respiratory tract are extremely common and pose a substantial burden of minor morbidity, loss of productivity, school absence, etc. Few episodes progress to lower respiratory involvement, but when they do they generate much of the respiratory inpatient workload.

Chronicity

The distinction between acute episodes and chronic disease (or susceptibility) is important in assessing epidemiological information and planning service provision. Much of the workload posed by respiratory disease, particularly in general practice, comprises relatively brief, often self-limiting episodes of illness. These may be superimposed on chronic morbidity, typically in patients with chronic bronchitis or obstructive pulmonary disease (including asthma), but also as a result of rarer conditions such as cystic fibrosis, bronchiectasis or immune deficiency states (including AIDS).

Cause

Several respiratory syndromes may be described or subdivided in terms of presumed cause. This is not always of relevance to clinical management or service provision. For example, the distinction between 'extrinsic' and 'intrinsic' asthma is poorly defined and does not influence choice of treatment, and subdivision of infectious from non-infectious illness may be difficult because infectious episodes are a common cause of acute exacerbations in patients with allergic asthma or COPD.

An attempt to distinguish between viral and bacterial infection forms part of the clinical investigation and management of acute episodes, particularly of lower respiratory illness in hospital. The need to make this distinction is not always clear (e.g. acute lower respiratory illness in children). Even when specific organisms are sought (e.g. in patients hospitalised with pneumonia), they are identified in only a minority of cases. Most common respiratory pathogens are associated with a variety of syndromes, involving both upper and lower respiratory tract.

Classification by specific infectious agent is of public health importance where immunisation is available (e.g. pertussis, measles, tuberculosis) or anticipated (e.g. respiratory syncytial virus). Wards for patients with tuberculosis have historically been located at a distance from other medical units and this separation sometimes persists in current arrangements for chest medicine services.

Prevention of non-infectious respiratory disease may usefully be planned by grouping diseases according to presumed cause (e.g. smoking-related diseases, occupational lung diseases).

Age

The distinction between paediatric and adult respiratory disease, although arbitrary, may be of some relevance for planning purposes. Special respiratory problems arise in the neonatal period, which are not part of this review. General paediatric services handle most of the respiratory disease requiring hospitalisation in childhood, whereas in adults the workload may be split between general medical units and specialist chest medicine services.

Classification for health service planning

The International Classification of Diseases (ICD) is extensively used for classifying mortality, morbidity and service use statistics, but several factors affect the interpretation of data coded to the ICD classifications. First, fashions in diagnostic labelling may result in shifts from one ICD code to another over time and the possibility of diagnostic transfer needs to be considered carefully when reviewing epidemiological information, particularly relating to diseases of the lower respiratory tract. Second, the ICD classification emphasises the aetiology of diseases and, in line with this, routine mortality statistics are tabulated by underlying cause. This tends to underplay the importance of those respiratory conditions which exacerbate other conditions and/or commonly arise as complications e.g. pneumonia. Different coding conventions apply to hospital admission and other service use statistics which are commonly coded and tabulated by the main condition treated or investigated, rather than by underlying cause. Finally, the ICD code does not reflect the severity of a condition which for a number of respiratory diseases, e.g. asthma, may range from subclinical to life threatening.

Other ICD-compatible systems have been developed for use in specific settings e.g. Read codes for classifying primary care episodes and Health care Resource Groups (HRGs) for classifying hospital resource use, but these are as yet not widely used in the UK.

ICD-9 and ICD-10 codes relating to lower respiratory disease

Codes relating to respiratory disease from both the 9th and 10th revisions of the International Classification of Diseases are presented, since the data covered by this review was collected during the period of changeover between the two revisions of the classification. There is not an exact overlap between the two classifications, but the list below where possible gives equivalent coding for each condition.

Codes presented here refer *only* to those conditions referred to in this review, either in the overall review, in analysis of health service and mortality data, or in the individual appendices.

Disease	ICD-9 codes	ICD-10 codes	ICD-10 description (where different)
Pulmonary tuberculosis	011	A15	Respiratory tuberculosis, bacteriologically and histologically confirmed
		A16	Respiratory tuberculosis not confirmed bacteriologically or histologically
Whooping cough	032	A37	
Malignant neoplasm of trachea, bronchus and lung	162	C33	Malignant neoplasm of trachea
		C34	Malignant neoplasm of bronchus or lung
Malignant neoplasm of pleura	163	C38.4	
Malignant neoplasm of other or ill-defined sites in the respiratory system and intra-thoracic organs	165	C39	
Cystic fibrosis	277.0	E84	
Acute respiratory infections	460–465	J01–J06	
Other disorders of the upper respiratory tract	470–478	J01–J06	
Acute bronchitis and bronchiolitis	466	J20	Acute bronchitis
		J21	Acute bronchiolitis
		J40	Bronchitis not specified as acute or chronic
Viral pneumonia	480	J12	
Pneumococcal pneumonia	481	J13	Pneumonia due to *Streptococcus pneumoniae*
Other bacterial pneumonia	482	J14	Pneumonia due to *Haemophilus influenzae*
		J15	Pneumonia due to other bacteria and mycoplasma
Pneumonia due to other specified organism	483	J16	Chlamydial pneumonia Pneumonia due to other specified infectious organisms
		J17	Pneumonia in diseases classified elsewhere
Bronchopneumonia, organism unspecified	484	J180	
Pneumonia, organism unspecified	485	J181–189	
Influenza (with and without pneumonia)	487	J10	Influenza, virus identified
		J11	Influenza, virus not identified
Bronchitis, not specified as acute or chronic	490	J40	
Chronic bronchitis	491	J41	Chronic bronchitis, type specified
		J42	Chronic bronchitis, unspecified
Emphysema	492	J43	
Asthma	493	J45	Asthma, specified or unspecified
		J46	Status asthmaticus
Bronchiectasis	494	J47	
Extrinsic allergic alveolitis	495	J66	Airway diseases due to organic dusts
		J67	Hypersensitivity pneumonitis due to organic dusts

Disease	ICD-9 codes	ICD-10 codes	ICD-10 description (where different)
Chronic airways obstruction, not elsewhere classified	496	J44	Chronic obstructive pulmonary disease
Coalworkers pneumoconiosis	500	J60	
Asbestosis	501	J61	Pneumoconiosis due to asbestos and other mineral fibres
		J92	Pleural plaque with or without presence or asbestos
Pneumoconiosis due to other silica or silicates	502	J62	Pneumoconiosis due to talc dust
			Pneumoconiosis due to other dust containing silica
Pneumoconiosis due to other inorganic dust	503	J63	
Pneumopathy due to inhalation of other dust	504	J67	Hypersensitivity pneumonitis due to organic dusts
Pneumoconiosis, unspecified	505	J64	Pneumoconiosis unspecified
		J65	Pneumoconiosis associated with tuberculosis
Respiratory conditions due to fumes and vapours	506	J68	Respiratory conditions due to chemicals, gases, fumes and vapours
Pneumonitis due to solids and liquids	507	J69	Pneumonitis due to food and vomit, oils and essences and other solids and liquids
Respiratory conditions due to other unspecified external agents	508	J70	(includes radiation, drug-induced interstitial lung disorders, and other or unspecified external agents)
Empyema	510	J86	Pyothorax
Pleurisy	511	J90	Pleural effusion not elsewhere classified
Pneumothorax	512	J93	
Abscess of lung and mediastinum	513	J85	
Pulmonary congestion and hypostasis	514	J80	Adult respiratory distress syndrome
		J81	Pulmonary oedema
Postinflammatory pulmonary fibrosis	515	J84	
Other alveolar and parietoalverolar pneumopathy	516	J84	
Other diseases of the lung	518	J95	Post-surgical pulmonary disorders
		J96	Acute and chronic respiratory failure
		J98	Other diseases of the lung, mediastinum, diaphragm and respiratory tract, specified and unspecified respiratory disorders
Other diseases of the respiratory system	519	J98	Other diseases of the lung, mediastinum, diaphragm and respiratory tract, specified and unspecified respiratory disorders
		J99	Respiratory disorders in diseases classified elsewhere
Respiratory distress syndrome	769	P28.0	Primary atelectasis of newborn
Other respiratory conditions of newborn and foetus	770	P28.1–P28.9	

Health care-related groups relating to lower respiratory disease

HRG	Description
D01	Lung transplant
D02	Complex thoracic procedures
D03	Major thoracic procedures
D04	Intermediate thoracic procedures with complicating condition
D05	Intermediate thoracic procedures without complicating condition
D06	Minor thoracic procedures
D07	Fibreoptic bronchoscopy
D08	Rigid bronchoscopy
D09	Pulmonary embolus – died
D10	Pulmonary embolus > 69 or with complicating condition
D11	Pulmonary embolus < 70 or without complicating condition
D12	Lung abscess or empyema
D13	Lobar, atypical or viral pneumonia > 69 or with co-morbid condition
D14	Lobar, atypical or viral pneumonia < 70 without co-morbid condition
D15	Bronchopneumonia
D16	Bronchiectasis
D17	Cystic fibrosis
D18	Pulmonary or pleural tuberculosis
D19	Other tuberculosis
D20	Chronic obstructive pulmonary disease or bronchitis
D21	Asthma > 49 years or with co-morbid condition
D22	Asthma < 50 years without co-morbid condition
D23	Pleural effusion or pleurisy > 69 or with co-morbid condition
D24	Pleural effusion or pleurisy < 70 without co-morbid condition
D25	Respiratory neoplasms
D26	Fibrosis or pneumoconiosis
D27	Extrinsic allergic alveolitis or pulmonary eosinophilia
D28	Granulomatous or other lung disease
D29	Inhalation lung injury or foreign body aspiration
D30	Pneumothorax
D31	Sleep-disordered breathing
D32	Respiratory failure
D33	Other respiratory diagnosis > 69 or with co-morbid condition
D34	Other respiratory diagnosis < 70 without co-morbid condition
E01	Heart and lung transplant
P01	Asthma/recurrent wheeze
P03	Upper respiratory tract disorder
P04	Lower respiratory tract disorder

Appendix B: Main tables and figures

Tables

Table B.1: Percentage of all deaths, GP consultations, finished consultant episodes and bed-days due to lower respiratory disorders, both sexes, all ages combined.

Category			Mortality by underlying cause (England and Wales 1999)		GP consultations (England 1991–92)		Finished consultant episodes (England 1998–99)		Occupied bed-days (England 1998–99)	
Cause	**ICD-9**	**ICD-10**	**Deaths**	**Percentage**	**Consult-ations per 10,000 pyar**	**Percentage**	**FCE**	**Percentage**	**Bed-days**	**Percentage**
Pulmonary TB	011–012	A15–16	299	0.05	2	0.03	1,942	0.02	43,478	0.07
Whooping cough	033	A37	2	0.00	1	0.01	1,001	0.01	4,375	0.01
Ca trachea bronchus lung and pleura	162	C33–34	29,493	5.30	8	0.10	90,831	0.76	518,474	0.83
Cystic fibrosis	277.0	E84	119	0.02	3	0.04	12,037	0.10	73,426	0.12
Upper respiratory	460–465, 470–478	J01–06	37	0.01	2,131	27.31	64,589	0.54	130,331	0.21
Acute bronchitis and bronchiolitis	466	J20–21	487	0.09	719	9.21	25,016	0.21	85,901	0.14
Other upper respiratory tract	470–478	J01–06	47	0.01	430	5.51				
Pneumonia	480–486	J12–17	59,273	10.66	29	0.37	122,312	1.02	1,692,778	2.70
Influenza	487	J10–11	585	0.11	205	2.63	3,449	0.03	22,580	0.04
Chronic and unspecified bronchitis	490–491	J40–42	1,736	0.31	91	1.17	7,672	0.06	69,941	0.11
Emphysema and COPD	492+496	J43–44	24,378	4.38	56	0.72	18,372	0.15	127,115	0.20
Asthma	493	J45–46	1,364	0.25	425	5.45	300,613	2.51	1,085,960	1.73
Other COPD	494–495	J47	768	0.14	5	0.06	7,931	0.07	48,661	0.08

Table B.1: Continued.

Category			Mortality by underlying cause (England and Wales 1999)		GP consultations (England 1991–92)		Finished consultant episodes (England 1998–99)		Occupied bed-days (England 1998–99)	
Cause	**ICD-9**	**ICD-10**	**Deaths**	**Percentage**	**Consult-ations per 10,000 pyar**	**Percentage**	**FCE**	**Percentage**	**Bed-days**	**Percentage**
All COPD excl. asthma	490–496	J40–44, 47	26,882	4.83	538	6.89	241,145	2.01	1,989,908	3.17
Pneumoconioses*	500–508	J60–67	1,023	0.18	1	0.01	3,469	0.03	23,355	0.04
Other respiratory	510–519	J68–99	8,057	1.45	34	0.44	137,142	1.15	1,382,152	2.21
All Chapter VIII	460–519	J01–99	97,755	17.58	3,070	39.34	897,735	7.50	6,412,965	10.23
Total Chapter VIII lower resp (i.e. excludes upper resp J01–06)			97,671	17.56	939	12.03	833,146	6.96	6,282,634	10.02
Total non Chapter VIII lower resp (A15–16 + 37, C33–34, E84)			29,913	5.38	14	0.18	105,811	0.88	639,753	1.02
Total lower respiratory			127,584	22.94	953	12.21	938,957	7.84	6,922,387	11.04

* Includes diseases due to organic dust in ICD-10

Table B.2: Mortality and service use for 1998–99 in hypothetical district with population 500,000 with similar population structure to England and Wales.

Cause	ICD-9	ICD-10	Number of deaths	Number of GP consult-ations	Number of finished consultant episodes	Number of bed-days per year	Average occupied hospital beds per day
Pulmonary TB	011–012	A15–16	3	100	20	437	1
Whooping cough	033	A37	0	50	10	44	0
Ca trachea bronchus lung and pleura	162	C33–34	280	400	913	5,211	14
Cystic fibrosis	277.0	E84	1	150	121	5,738	16
Upper respiratory	460–465, 470–478	J01–06	2	106,550	649	1,310	4
Acute bronchitis and bronchiolitis	466	J20–21	5	35,950	251	863	2
Pneumonia	480–486	J12–17	562	1,450	1,229	17,012	47
Influenza	487	J10–11	6	10,250	35	227	1
Chronic and unspecified bronchitis	490–491	J40–42	16	4,550	77	703	2
Emphysema and COPD	492+496	J43–44	231	2,800	185	1,277	3
Asthma	493	J45–46	13	21,250	3,021	10,914	30
Other COPD	494–495	J47	7	250	80	489	1
All COPD	490–496	J40–47	255	26,900	2,423	19,998	55
Pneumoconioses*	500–508	J60–67	10	50	35	235	1
Other respiratory	510–519	J68–99	76	1,700	1,378	13,890	38
All Chapter VIII	460–519	J01–99	928	153,500	9,363	66,918	183

Source: Tables B.1, B.4, B.5 and B.6.
* Includes diseases due to organic dust in ICD-10.

Table B.3: Summary of the principal findings from ad hoc surveys of prevalence and incidence of lower respiratory disease.

Respiratory condition		Prevalence	Incidence	Cumulative incidence	Modifying factors
Acute lower respiratory tract infections in childhood	acute bronchitis			20%	males > females and north > south; associated with poor socio-economic status, large families, parental smoking, low birth weight (27–32)
	pneumonia			1–5%	
	whooping cough			1.6%	
				see Table 1	
Adult respiratory infections	community-acquired pneumonia		230–360 per 100,000 (470 per 100,000 adults only) (9–12)(37)(42)		social class V > I, associated with smoking, alcohol and pre-existing illness (10–12)(42)
	nosocomial pneumonia		0.5–1% all hospital admissions, 12–22% ICU admissions (43)(44)		
Tuberculosis		notifications (annual rate): Indian, Pakistani and Bangladeshi communities 169–178 per 100,000; whites 6.9 per 100,000			ethnicity, HIV infection
Asthma	requiring treatment (46)(47), Tables 2, 3	0–14 years: 6% 15–64: 4% 65+: 4% all ages: 4%			south > north (65)
	current wheezing (any severity)	0–14 years: 12–15% 15–64: 10% 65+: 15–20%		30%	
COPD (81)(82), Table 4	symptomatic	17% men, 6% women			north > south, urban > rural, social
	significant impairment of lung function	5% men, 3% women			class V > I (82)

Table B.4: Death rate per million for selected respiratory causes, England and Wales 1999.

		Number					Rate per million				
Ages		**0–14**	**15–44**	**45–64**	**65+**	**Total**	**0–14**	**15–44**	**45–64**	**65+**	**Total**
Pulmonary TB	Male	0	20	39	145	204	0.0	1.8	6.4	42.1	7.9
011	Female	0	8	9	76	93	0.0	0.7	1.5	15.7	3.5
	Total	0	28	48	221	297	0.0	1.3	3.9	26.7	5.6
Other respiratory TB	Male	0	0	0	2	2	0.0	0.0	0.0	0.6	0.1
012	Female	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0
	Total	0	0	0	2	2	0.0	0.0	0.0	0.2	0.0
Whooping cough	Male	1	0	0	0	1	0.2	0.0	0.0	0.0	0.0
033	Female	1	0	0	0	1	0.2	0.0	0.0	0.0	0.0
	Total	2	0	0	0	2	0.2	0.0	0.0	0.0	0.0
Lung cancer	Male	0	154	3,969	14,219	18,342	0.0	13.6	651.0	4,132.0	705.9
162	Female	0	136	2,337	8,678	11,151	0.0	12.6	379.2	1,790.3	417.6
	Total	0	290	6,306	22,897	29,493	0.0	13.1	514.4	2,762.6	559.7
Cystic fibrosis	Male	5	48	1	0	54	1.0	4.3	0.2	0.0	2.1
277.0	Female	7	55	2	1	65	1.4	5.1	0.3	0.2	2.4
	Total	12	103	3	1	119	1.2	4.7	0.2	0.1	2.3
Acute respiratory infections	Male	1	4	3	7	15	0.2	0.4	0.5	2.0	0.6
460–465	Female	3	2	1	16	22	0.6	0.2	0.2	3.3	0.8
	Total	4	6	4	23	37	0.4	0.3	0.3	2.8	0.7
Acute bronchitis and bronchiolitis	Male	22	9	34	117	182	4.3	0.8	5.6	34.0	7.0
466	Female	10	5	34	256	305	2.0	0.5	5.5	52.8	11.4
	Total	32	14	68	373	487	3.2	0.6	5.5	45.0	9.2
Other upper respiratory tract	Male	0	3	12	9	24	0.0	0.3	2.0	2.6	0.9
470–478	Female	1	2	4	16	23	0.2	0.2	0.6	3.3	0.9
	Total	1	5	16	25	47	0.1	0.2	1.3	3.0	0.9
Pneumonia	Male	70	299	1,481	21,536	23,386	13.6	26.5	242.9	6,258.3	900.0
480–486	Female	52	198	947	34,690	35,887	10.6	18.3	153.7	7,156.9	1,343.8
	Total	122	497	2,428	56,226	59,273	12.1	22.5	198.1	6,783.8	1,124.9
Influenza	Male	6	4	17	181	208	1.2	0.4	2.8	52.6	8.0
487	Female	2	3	15	357	377	0.4	0.3	2.4	73.7	14.1
	Total	8	7	32	538	585	0.8	0.3	2.6	64.9	11.1

Table B.4: Continued.

Ages		Number					Rate per million				
		0–14	15–44	45–64	65+	Total	0–14	15–44	45–64	65+	Total
Chronic and unspecified bronchitis	Male	4	3	123	946	1,076	0.8	0.3	20.2	274.9	41.4
490–491	Female	3	9	61	587	660	0.6	0.8	9.9	121.1	24.7
	Total	7	12	184	1,533	1,736	0.7	0.5	15.0	185.0	32.9
Emphysema	Male	0	8	166	985	1,159	0.0	0.7	27.2	286.2	44.6
492	Female	1	2	79	475	557	0.2	0.2	12.8	98.0	20.9
	Total	1	10	245	1,460	1,716	0.1	0.5	20.0	176.2	32.6
Asthma	Male	17	61	127	291	496	3.3	5.4	20.8	84.6	19.1
493	Female	6	78	162	622	868	1.2	7.2	26.3	128.3	32.5
	Total	23	139	289	913	1,364	2.3	6.3	23.6	110.2	25.9
Bronchiectasis and alveolitis	Male	0	3	68	267	338	0.0	0.3	11.2	77.6	13.0
494–495	Female	0	4	77	349	430	0.0	0.4	12.5	72.0	16.1
	Total	0	7	145	616	768	0.0	0.3	11.8	74.3	14.6
Chronic airways obstruction	Male	2	11	1,015	11,595	12,623	0.4	1.0	166.5	3,369.5	485.8
496	Female	1	12	792	9,234	10,039	0.2	1.1	128.5	1,905.1	375.9
	Total	3	23	1,807	20,829	22,662	0.3	1.0	147.4	2,513.1	430.1
Pneumoconioses	Male	3	9	56	639	707	0.6	0.8	9.2	185.7	27.2
500–508	Female	4	9	19	284	316	0.8	0.8	3.1	58.6	11.8
	Total	7	18	75	923	1,023	0.7	0.8	6.1	111.4	19.4
Other respiratory diseases	Male	51	47	296	3,159	3,553	9.9	4.2	48.5	918.0	136.7
510–519	Female	27	40	192	4,245	4,504	5.5	3.7	31.2	875.8	168.7
	Total	78	87	488	7,404	8,057	7.8	3.9	39.8	893.3	152.9
Respiratory symptoms	Male	0	1	2	4	7	0.0	0.1	0.3	1.2	0.3
786	Female	0	0	2	3	5	0.0	0.0	0.3	0.6	0.2
	Total	0	1	4	7	12	0.0	0.0	0.3	0.8	0.2
All Chapter VIII	Male	176	461	3,398	39,732	43,767	34.1	40.8	557.3	11,546.0	1,684.3
460–519	Female	110	364	2,383	51,131	53,988	22.4	33.7	386.7	10,548.8	2,021.6
	Total	286	825	5,781	90,863	97,755	28.4	37.4	471.6	10,962.8	1,855.3
All causes	Male	2,973	11,953	42,309	207,064	264,299	576.6	1,058.7	6,939.4	60,172.0	10,171.4
	Female	2,229	6,309	27,060	256,221	291,819	454.9	5,84.4	4,391.2	52,860.7	10,927.3
	Total	5,202	18,262	69,369	463,285	556,118	517.3	8,26.9	5,658.5	55,896.3	10,554.5

Table B.5: Number and rate per million for finished consultant episodes for selected respiratory diagnoses.

		Number (where sex is known)					Rate per million				
Ages		**0–14**	**15–44**	**45–64**	**65+**	**Total**	**0–14**	**15–44**	**45–64**	**65+**	**Total**
Pulmonary TB	Male	10	223	166	201	600	2.1	20.8	28.9	62.2	24.4
A15	Female	15	197	68	102	382	3.2	19.3	11.7	22.4	15.2
	Total	25	420	234	303	982	2.6	20.1	20.3	38.9	19.7
Other respiratory TB	Male	10	231	136	201	578	2.1	21.6	23.7	62.2	23.6
A16	Female	15	197	68	102	382	3.2	19.3	11.7	22.4	15.2
	Total	25	428	204	303	960	2.6	20.5	17.7	38.9	19.3
Whooping cough	Male	463	2	0	1	466	95.1	0.2	0.0	0.3	19.0
A37	Female	528	6	1	0	535	114.1	0.6	0.2	0.0	21.2
	Total	991	8	1	1	1,001	104.4	0.4	0.1	0.1	20.1
Lung cancer	Male	24	1,017	19,378	37,129	57,553	4.9	95.1	3,373.7	11,493.3	2,345.0
C33-C34	Female	21	976	11,981	20,298	33,278	4.5	95.4	2,064.4	4,461.0	1,320.0
	Total	45	1,993	31,359	57,427	90,831	4.7	95.2	2,715.7	7,380.5	1,825.6
Cystic fibrosis	Male	2,667	3,260	35	15	5,977	547.7	304.7	6.1	4.6	243.5
E84	Female	2,680	3,310	64	5	6,060	579.2	323.6	11.0	1.1	240.4
	Total	5,347	6,570	99	20	12,037	563.0	313.9	8.6	2.6	241.9
Acute respiratory infections	Male	32,174	1,466	790	1,619	36,050	6,607.4	137.0	137.5	501.2	1,468.9
J01–J06	Female	22,546	2,437	1,114	2,435	28,539	4,872.5	238.2	191.9	535.2	1,132.1
	Total	54,720	3,903	1,904	4,054	64,589	5,762.0	186.5	164.9	521.0	1,298.2
Acute bronchitis and bronchiolitis	Male	13,665	128	205	484	14,484	2,806.3	12.0	35.7	149.8	590.2
J20–J21	Female	9,416	197	207	711	10,532	2,034.9	19.3	35.7	156.3	417.8
	Total	23,081	325	412	1,195	25,016	2,430.4	15.5	35.7	153.6	502.8
Pneumonia	Male	7,253	6,027	8,850	38,952	61,117	1,489.5	563.3	1,540.8	12,057.6	2,490.2
J12–J18	Female	5,515	4,725	6,042	44,897	61,195	1,191.9	461.9	1,041.1	9,867.3	2,427.4
	Total	12,768	10,752	14,892	83,849	122,312	1,344.5	513.8	1,289.6	10,776.3	2,458.4
Influenza	Male	337	406	307	440	1,493	69.2	37.9	53.4	136.2	60.8
J10–J11	Female	284	748	299	622	1,956	61.4	73.1	51.5	136.7	77.6
	Total	621	1,154	606	1,062	3,449	65.4	55.1	52.5	136.5	69.3
Chronic and unspecified bronchitis	Male	132	291	846	2,594	3,863	27.1	27.2	147.3	803.0	157.4
J40–J42	Female	70	377	839	2,522	3,809	15.1	36.9	144.6	554.3	151.1
	Total	202	668	1,685	5,116	7,672	21.3	31.9	145.9	657.5	154.2

Table B.5: Continued.

		Number (where sex is known)					Rate per million				
Ages		**0–14**	**15–44**	**45–64**	**65+**	**Total**	**0–14**	**15–44**	**45–64**	**65+**	**Total**
Emphysema	Male	14	255	2,774	9,231	12,275	2.9	23.8	482.9	2,857.5	500.1
J43–J44	Female	33	169	1,424	4,471	6,097	7.1	16.5	245.4	982.6	241.8
	Total	47	424	4,198	13,702	18,372	4.9	20.3	363.5	1,761.0	369.3
Asthma	Male	38,074	30,781	24,570	29,400	122,869	7,819.0	2,877.0	4,277.6	9,100.8	5,006.3
J45–J46	Female	21,539	70,322	38,665	46,894	177,744	4,654.9	6,874.8	6,662.2	10,306.1	7,050.6
	Total	59,613	101,103	63,235	76,294	300,613	6,277.2	4,831.0	5,476.1	9,805.3	6,042.1
Bronchiectasis and alveolitis	Male	139	403	1,063	1,402	3,008	28.5	37.7	185.1	434.0	122.6
J47	Female	131	614	2,151	2,027	4,923	28.3	60.0	370.6	445.5	195.3
	Total	270	1,017	3,214	3,429	7,931	28.4	48.6	278.3	440.7	159.4
Chronic obstructive pulmonary	Male	163	965	23,515	109,231	133,891	33.5	90.2	4,093.9	33,812.4	5,455.4
disease (COPD)	Female	78	1,307	18,383	87,465	107,254	16.9	127.8	3,167.5	19,222.7	4,254.4
J40–J47	Total	241	2,272	41,898	196,696	241,145	25.4	108.6	3,628.3	25,279.3	4,846.9
Pneumoconioses	Male	0	7	357	3,041	3,406	0.0	0.7	62.2	941.3	138.8
J60–J67	Female	0	1	10	52	63	0.0	0.1	1.7	11.4	2.5
	Total	0	8	367	3,093	3,469	0.0	0.4	31.8	397.5	69.7
Other respiratory diseases	Male	3,684	9,540	18,765	43,885	75,902	756.6	891.7	3,266.9	13,584.6	3,092.6
J68–J99	Female	2,637	6,618	13,876	38,097	61,240	569.9	647.0	2,390.9	8,372.8	2,429.2
	Total	6,321	16,158	32,641	81,982	137,142	665.6	772.1	2,826.7	10,536.3	2,756.5
All Chapter VIII	Male	95,635	50,269	82,042	240,279	468,358	19,640.0	4,698.5	14,283.3	74,378.3	19,083.3
	Female	62,249	87,515	83,010	230,193	463,352	13,452.8	8,555.6	14,303.2	50,590.8	18,379.8
	Total	157,884	137,784	165,052	470,472	931,710	16,625.1	6,583.8	14,293.3	60,465.0	18,726.7
All causes	Male	943,612	1,124,583	1,266,584	1,833,105	5,172,521	193,784.0	105,111.0	220,509.4	567,436.9	210,755.1
	Female	758,658	2,689,907	1,276,045	2,057,819	6,800,957	163,956.2	262,968.7	219,871.3	452,258.0	269,773.3
	Total	1,702,270	3,814,490	2,542,629	3,890,924	11,973,478	179,248.6	182,269.0	220,188.7	500,060.9	240,658.9

Table B.6: Average bed-days per year per million population, and average number of beds in use per day per million population for selected respiratory diagnoses.

England 1998–99

		Bed-days (where sex is known)					Bed-days per million					Avg beds in use per day per million population				
Ages		**0–14**	**15–44**	**45–64**	**65+**	**Total**	**0–14**	**15–44**	**45–64**	**65+**	**Total**	**0–14**	**15–44**	**45–64**	**65+**	**Total**
Pulmonary TB	Male	74	2,456	2,630	3,279	8,439	15.2	229.6	457.9	1,015.0	343.8	0.0	0.6	1.3	2.8	0.9
A15	Female	60	1,497	666	5,285	7,508	13.0	146.3	114.8	1,161.5	297.8	0.0	0.4	0.3	3.2	0.8
	Total	134	3,953	3,296	8,564	15,947	14.1	188.9	285.4	1,100.6	320.5	0.0	0.5	0.8	3.0	0.9
Other respiratory TB	Male	208	6,108	4,320	6,677	17,313	42.7	570.9	752.1	2,066.9	705.4	0.1	1.6	2.1	5.7	1.9
A16	Female	262	3,424	1,757	4,775	10,218	56.6	334.7	302.7	1,049.4	405.3	0.2	0.9	0.8	2.9	1.1
	Total	470	9,532	6,077	11,452	27,531	49.5	455.5	526.3	1,471.8	553.4	0.1	1.2	1.4	4.0	1.5
Whooping cough	Male	1,823	2	0	0	1,825	374.4	0.2	0.0	0.0	74.4	1.0	0.0	0.0	0.0	0.2
A37	Female	2,535	14	1	0	2,550	547.8	1.4	0.2	0.0	101.2	1.5	0.0	0.0	0.0	0.3
	Total	4,358	16	1	0	4,375	458.9	0.8	0.1	0.0	87.9	1.3	0.0	0.0	0.0	0.2
Lung cancer	Male	127	3,973	75,434	234,437	314,010	26.1	371.3	13,132.9	72,569.9	12,794.4	0.1	1.0	36.0	198.8	35.1
C33–C34	Female	96	3,810	47,726	152,815	204,464	20.7	372.5	8,223.5	33,585.0	8,110.5	0.1	1.0	22.5	92.0	22.2
	Total	223	7,783	123,160	387,252	518,474	23.5	371.9	10,665.5	49,769.6	10,421.0	0.1	1.0	29.2	136.4	28.6
Cystic fibrosis	Male	13,971	22,028	281	156	36,436	2,869.1	2,058.9	48.9	48.3	1,484.6	7.9	5.6	0.1	0.1	4.1
E84	Female	16,098	20,533	303	56	36,990	3,479.0	2,007.3	52.2	12.3	1,467.3	9.5	5.5	0.1	0.0	4.0
	Total	30,069	42,561	584	212	73,426	3,166.3	2,033.7	50.6	27.2	1,475.8	8.7	5.6	0.1	0.1	4.0
Acute respiratory	Male	37,734	5,273	4,317	15,943	63,269	7,749.2	492.8	751.6	4,935.1	2,577.9	21.2	1.4	2.1	13.5	7.1
infections	Female	26,662	5,547	4,848	30,003	67,062	5,762.0	542.3	835.3	6,593.9	2,660.1	15.8	1.5	2.3	18.1	7.3
J01–J06	Total	64,396	10,820	9,165	45,946	130,331	6,780.9	517.0	793.7	5,905.0	2619.6	18.6	1.4	2.2	16.2	7.2
Acute bronchitis and	Male	37,677	283	980	5,918	44,862	7,737.5	26.5	170.6	1,831.9	1,827.9	21.2	0.1	0.5	5.0	5.0
bronchiolitis	Female	28,331	4,778	762	7,158	41,039	6,122.7	467.1	131.3	1,573.2	1,627.9	16.8	1.3	0.4	4.3	4.5
J20–J21	Total	66,008	5,061	1,742	13,076	85,901	6,950.6	241.8	150.9	1,680.5	1,726.6	19.0	0.7	0.4	4.6	4.7
Pneumonia	Male	26,955	38,499	84,846	590,380	740,980	5,535.6	3,598.4	14,771.5	182,751.9	30,191.3	15.2	9.9	40.5	500.7	82.7
J12–J18	Female	21,996	26,165	61,212	842,268	951,798	4,753.6	2,557.9	10,547.2	185,109.8	37,754.9	13.0	7.0	28.9	507.2	103.4
	Total	48,951	64,664	146,058	1,432,648	1,692,778	5,154.5	3,089.9	12,648.5	184,123.7	34,023.7	14.1	8.5	34.7	504.4	93.2
Influenza	Male	1,237	656	1,869	5,910	9,696	254.0	61.3	325.4	1,829.4	395.1	0.7	0.2	0.9	5.0	1.1
J10–J11	Female	966	2,717	942	8,252	12,884	208.8	265.6	162.3	1,813.6	511.1	0.6	0.7	0.4	5.0	1.4
	Total	2,203	3,373	2,811	14,162	22,580	232.0	161.2	243.4	1,820.1	453.8	0.6	0.4	0.7	5.0	1.2
Chronic and	Male	177	1,774	3,632	17,326	22,909	36.3	165.8	632.3	5,363.3	933.4	0.1	0.5	1.7	14.7	2.6
unspecified bronchitis	Female	154	23,877	4,011	18,990	47,032	33.3	2,334.2	691.1	4,173.5	1,865.6	0.1	6.4	1.9	11.4	5.1
J40–J42	Total	331	25,651	7,643	36,316	69,941	34.9	1,225.7	661.9	4,667.3	1,405.8	0.1	3.4	1.8	12.8	3.9
Emphysema	Male	52	1,197	14,686	66,729	82,668	10.7	111.9	2,556.8	20,655.9	3,368.3	0.0	0.3	7.0	56.6	9.2
J43–J44	Female	128	768	8,235	35,316	44,447	27.7	75.1	1,418.9	7,761.6	1,763.1	0.1	0.2	3.9	21.3	4.8
	Total	180	1,965	22,921	102,045	127,115	19.0	93.9	1,984.9	13,114.8	2,554.9	0.1	0.3	5.4	35.9	7.0

Table B.6: Continued.

Ages		Bed-days (where sex is known)					Bed-days per million					Avg beds in use per day per million population				
		0–14	15–44	45–64	65+	Total	0–14	15–44	45–64	65+	Total	0–14	15–44	45–64	65+	Total
Asthma	Male	67,331	89,395	87,114	156,946	400,901	13,827.4	8,355.5	15,166.4	48,582.6	16,334.8	37.9	22.9	41.6	133.1	44.8
J45–J46	Female	33,740	178,922	148,659	323,426	685,059	7,291.7	17,491.6	25,615.0	7,1081.1	27,174.2	20.0	47.9	70.2	194.7	74.4
	Total	101,071	268,317	235,773	480,372	1,085,960	10,642.7	12,821.1	20,417.7	61,737.3	21,827.1	29.2	35.1	55.9	169.1	59.8
Bronchiectasis	Male	512	1,601	5,486	10,416	18,017	105.1	149.6	955.1	3,224.3	734.1	0.3	0.4	2.6	8.8	2.0
J47	Female	576	2,648	10,597	16,823	30,644	124.5	258.9	1,825.9	3,697.3	1,215.6	0.3	0.7	5.0	10.1	3.3
	Total	1,088	4,249	16,083	27,239	48,661	114.6	203.0	1,392.8	3,500.8	978.1	0.3	0.6	3.8	9.6	2.7
Chronic obstructive	Male	735	3,934	137,599	913,549	1,055,909	150.9	367.7	23,955.7	282,788.7	43,023.2	0.4	1.0	65.6	774.8	117.9
pulmonary disease	Female	277	5,662	106,256	821,633	933,999	59.9	553.5	18,308.6	180,574.7	37,048.9	0.2	1.5	50.2	494.7	101.5
(COPD) J40–J47	Total	1,012	9,596	243,855	1,735,182	1,989,908	106.6	458.5	21,117.6	223,005.3	39,995.8	0.3	1.3	57.9	611.0	109.6
Pneumoconioses	Male	0	13	1,563	21,192	22,768	0.0	1.2	272.1	6,560.0	927.7	0.0	0.0	0.7	18.0	2.5
J60–J67	Female	0	18	55	514	587	0.0	1.8	9.5	113.0	23.3	0.0	0.0	0.0	0.3	0.1
	Total	0	31	1,618	21,706	23,355	0.0	1.5	140.1	2,789.7	469.4	0.0	0.0	0.4	7.6	1.3
Other respiratory	Male	28,494	72,603	171,806	462,123	735,355	5,851.6	6,786.0	29,911.0	143,050.0	29,962.1	16.0	18.6	81.9	391.9	82.1
diseases J68–J99	Female	22,937	54,702	120,590	448,441	646,797	4,957.0	5,347.7	20,778.5	98,556.3	25,656.5	13.6	14.7	56.9	270.0	70.3
	Total	51,431	127,305	292,396	910,564	1,382,152	5,415.7	6,083.1	25,321.2	117,025.5	27,780.3	14.8	16.7	69.4	320.6	76.1
All Chapter VIII	Male	200,904	215,228	513,898	2,266,432	3,197,334	41,258.5	20,116.6	89,468.5	701,573.1	130,275.8	113.0	55.1	245.1	1,922.1	356.9
J01-J99	Female	135,767	305,804	466,167	2,552,824	3,461,348	29,341.1	29,895.8	80,323.8	561,047.9	137,301.1	80.4	81.9	220.1	1,537.1	376.2
	Total	336,671	521,032	980,065	4,819,256	6,658,682	35,451.4	24,896.6	84,872.5	619,370.0	133,835.1	97.1	68.2	232.5	1,696.9	366.7
All Causes	Male	3,976,642	6,756,253	5,450,803	12,325,963	28,549,223	816,659.5	631,484.5	948,972.5	3,815,497.0	1,163,242.3	2,237.4	1,730.1	2,599.9	10,453.4	3,187.0
	Female	2,569,791	7,646,858	5,053,527	18,796,077	34,127,493	555,366.3	747,566.5	870,757.3	4,130,915.1	1,353,733.8	1,521.6	2,048.1	2,385.6	11,317.6	3,708.9
	Total	6,546,433	14,403,111	10,504,330	31,122,040	62,676,716	689,337.7	688,228.6	909,662.7	3,999,799.5	1,259,760.1	1,888.6	1,885.6	2,492.2	10,958.4	3,451.4

Source: HES Statistics, England, 1998–99.
Note: This sheet refers to bed-days where a respiratory diagnosis is mentioned anywhere.

Table B.7: GP consultation rates per 10,000 person-years at risk.

England 1991–92

		Consultation rate per 10,000 person years at risk								
Ages		**0–4**	**5–15**	**16–24**	**25–44**	**45–64**	**65–74**	**75–84**	**85 and over**	**Total**
Pulmonary TB	Male	0	0	0	1	3	6	5	0	1
011	Female	0	0	0	1	1	2	1	2	1
	Total	0	0	0	1	2	4	2	1	1
Other respiratory TB	Male	0	0	0	0	0	0	0	0	0
012	Female	0	0	0	0	0	0	0	0	0
	Total	0	0	0	0	0	0	0	0	0
Whooping cough	Male	9	3	0	0	0	0	0	0	1
033	Female	15	5	0	1	0	0	0	0	2
	Total	12	4	0	0	0	0	0	0	1
Lung cancer	Male	0	0	0	0	14	45	61	71	9
162	Female	0	0	0	0	9	15	17	16	5
	Total	0	0	0	0	11	29	33	30	7
Cystic fibrosis	Male	5	4	5	2	2	2	1	0	3
277.0 (includes other and	Female	7	3	3	2	1	2	1	2	3
unspecified metabolic disorders)	Total	6	4	4	2	2	2	1	1	3
Acute respiratory infections	Male	4,527	2,180	1,426	1,015	781	788	747	803	1,410
460–465	Female	4,478	2,713	2,452	1,896	1,359	1,065	928	892	1,980
	Total	4,504	2,439	1,941	1,454	1,067	940	861	870	1,701
Acute bronchitis and bronchiolitis	Male	1,664	440	358	374	632	1,148	1,521	1,913	643
466	Female	1,488	402	502	615	894	1,136	1,242	1,588	792
	Total	1,578	422	430	494	762	1,142	1,346	1,669	719
Other upper respiratory tract	Male	349	697	529	354	265	313	243	190	398
470–478	Female	306	581	684	528	359	330	215	118	460
	Total	328	641	607	441	311	322	225	136	430
Pneumonia	Male	43	19	7	12	23	69	185	269	30
480–486	Female	29	10	8	11	18	48	143	247	28
	Total	37	15	8	12	21	41	126	313	29
Influenza	Male	216	164	193	194	172	148	156	190	181
487	Female	188	180	262	255	248	185	491	150	228
	Total	202	172	227	224	209	168	178	160	205

Table B.7: Continued.

Ages		Consultation rate per 10,000 person years at risk								
		0–4	**5–15**	**16–24**	**25–44**	**45–64**	**65–74**	**75–84**	**85 and over**	**Total**
Chronic and unspecified bronchitis	Male	106	21	12	25	90	303	367	416	80
490–491	Female	92	18	20	38	101	181	221	250	78
	Total	99	19	21	31	95	236	275	292	79
Emphysema	Male	0	0	0	1	9	28	26	24	5
492	Female	0	0	0	1	4	7	3	2	2
	Total	0	0	0	1	6	16	12	7	4
Asthma	Male	1,017	626	249	157	150	197	158	125	300
493	Female	742	460	301	224	215	244	194	104	295
	Total	883	545	275	190	182	223	180	109	297
Bronchiectasis and alveolitis	Male	1	0	1	1	4	4	10	6	2
494–495	Female	1	0	0	2	7	12	5	10	3
	Total	1	0	0	1	5	8	7	9	3
Chronic airways obstruction	Male	1	0	0	2	39	158	172	178	29
496	Female	0	0	0	3	32	35	90	61	20
	Total	0	0	0	2	35	107	121	90	24
Pneumoconioses	Male	0	0	0	0	2	6	9	6	1
500–508	Female	0	0	0	0	0	1	1	0	0
	Total	0	0	0	0	1	4	4	1	1
Other respiratory diseases	Male	43	10	19	22	34	62	97	107	31
510–519	Female	33	11	27	35	44	59	66	71	37
	Total	38	10	23	28	39	60	78	80	34
Respiratory symptoms	Male	1,114	327	165	202	309	459	519	630	339
786	Female	1,077	364	241	268	379	484	512	498	392
	Total	1,096	345	203	235	344	473	514	531	366
All Chapter VIII	Male	6,643	3,552	2,524	1,956	1,979	2,743	3,192	3,714	2,722
460–519	Female	6,290	3,814	3,712	3,140	2,838	2,877	2,837	1,498	3,404
	Total	6,471	3,680	3,120	2,546	2,405	2,817	2,970	3,273	3,070
All Causes	Male	10,245	7,026	6,192	6,072	6,922	8,127	9,001	9,086	6,999
	Female	10,197	7,452	8,942	8,651	8,310	8,389	9,079	9,228	8,575
	Total	10,221	7,234	7,572	7,357	7,610	8,271	9,050	9,193	7,803

Source: Morbidity statistics from general practice, 1991–2.
Number of patients consulting GP for condition within 12 months × 10,000 divided by number of patients at risk.

Table B.8: Analysis of Respiratory Health Care Resource Groups: Rates per million, number of episodes in each group in a hypothetical district with population 500,000 and population structure similar to England and Wales, and proportion of total recorded FCEs and bed-days attributable to each group.

HRG	Code	Total FCEs	Rate per million	FCEs in hypothetical district	% total FCE	Total bed-days	Bed-days per million	Bed-days in typical district	Daily occupied beds in typical district	% total bed-days
Lung transplant	D01	90	1.7	1	0.0	2,394	46.0	23	0	0.0
Thoracic procedures complex to intermediate	D02–D05	18,811	361.1	181	0.4	170,965.3	3,281.5	1,641	4	1.1
Minor thoracic surgical procedures	D06	5,822	111.7	56	0.1	2,900.3	55.7	28	0	0.0
Fibreoptic bronchoscopy	D07	28,813	553.0	277	0.6	1,174.4	22.5	11	0	0.0
Rigid bronchoscopy	D08	6,937	133.1	67	0.1	1,328.6	25.5	13	0	0.0
Lung abscess or empyema	D12	1,282	24.6	12	0.0	15,011.8	288.1	144	0	0.1
Pneumonia – lobar atypical or viral	D13–D14	39,166	751.7	376	0.8	334,313.3	6,416.8	3,208	9	2.1
Bronchopneumonia	D15	15,455	296.6	148	0.3	160,300.1	3,076.8	1,538	4	1.0
Bronchiectasis	D16	4,346	83.4	42	0.1	34,437.3	661.0	330	1	0.2
Pulmonary tuberculosis	D18	1,385	26.6	13	0.0	15,789	303.1	152	0	0.1
COPD and bronchitis	D20	86,399	1,658.3	829	1.8	700,820.2	13,451.4	6,726	18	4.4
Asthma	D21–D22	114,210	2,192.1	1,096	2.4	771,593.2	14,809.9	7,405	20	4.8
Pleural effusion	D23–D24	10,981	210.8	105	0.2	82,934.2	1,591.8	796	2	0.5
Pneumoconiosis	D26	4,404	84.5	42	0.1	32,095.4	616.0	308	1	0.2
Other interstitial lung disease	D27–D28	1,545	29.7	15	0.0	14,121.8	271.1	136	0	0.1
Foreign body	D29	1,674	32.1	16	0.0	15,415.6	295.9	148	0	0.1
Pneumothorax	D30	4,033	77.4	39	0.1	20,046.3	384.8	192	1	0.1
Respiratory failure	D32	3,643	69.9	35	0.1	25,254	484.7	242	1	0.2
Other respiratory disorder	D33–D34	33,932	651.3	326	0.7	172,645.2	3,313.7	1,657	5	1.1
Chemotherapy with respiratory diagnosis	D98	11,335	217.6	109	0.2	24,151.3	463.6	232	1	0.2
Complex elderly with respiratory diagnosis	D99	39,633	760.7	380	0.8	503,732.6	9,668.6	4,834	13	3.1
Heart and lung transplant	E01	53	1.0	1	0.0	1,526.4	29.3	15	0	0.0
Asthma/Recurrent wheeze	P01	32,631	626.3	313	0.7	56,670.8	1,087.7	544	1	0.4
Upper respiratory tract disorder	P02	69,968	1,343.0	671	1.5	92,218.7	1,770.0	885	2	0.6
Lower respiratory tract disorder	P03	45,667	876.5	438	1.0	147,728.3	2,835.5	1,418	4	0.9
Total respiratory		582,215	11,175.0	5,587	12.3	3,399,568.1	65,250.8	32,625	89	21.3
Total all diagnoses (HRG data)		4,719,186				15,991,997				

Table B.9: Analysis of HRG Information – proportion of HRG episodes within each specialty attributable to selected respiratory HRGs.

England, 1996

HRG	Code	Total FCEs	General medicine		Respiratory medicine		Paediatrics		Geriatric medicine		Cardiothoracic surgery		General surgery		All the previous specialties		All other specialties	
			FCEs	% speciality total	FCEs	% speciality total	FCEs	% speciality total	FCEs	% speciality total	FCEs	% speciality total	FCEs	% speciality total	FCEs	% speciality total	FCEs	% speciality total
Lung transplant	D01	90	0	0.0	0	0.0	0	0.0	0	0.0	90	0.2	0	0.0	90	0.0	0	0.0
Thoracic procedures complex to intermediate	D02–D05	18,811	4,154	0.7	727	1.9	303	0.1	597	0.4	9,568	17.9	1,704	0.2	17,053	0.9	1,758	0.1
Minor thoracic surgical procedures	D06	5,822	3,110	0.5	864	2.3	45	0.0	169	0.1	408	0.8	160	0.0	4,756	0.3	1,066	0.0
Fibreoptic bronchoscopy	D07	28,813	19,027	3.2	7,974	20.9	33	0.0	495	0.3	675	1.3	21	0.0	28,225	1.6	588	0.0
Rigid bronchoscopy	D08	6,937	4,089	0.7	1,240	3.3	85	0.0	13	0.0	1,325	2.5	7	0.0	6,759	0.4	178	0.0
Lung abscess or empyema	D12	1,282	650	0.1	170	0.4	66	0.0	96	0.1	164	0.3	31	0.0	1,177	0.1	105	0.0
Pneumonia – lobar atypical or viral	D13–D14	39,166	24,369	4.0	1,261	3.3	463	0.2	9,060	6.2	59	0.1	521	0.1	35,733	2.0	3,433	0.1
Broncho-pneumonia	D15	15,455	7,226	1.2	322	0.8	7	0.0	5,842	4.0	14	0.0	277	0.0	13,688	0.8	1,767	0.1
Bronchiectasis	D16	4,346	2,217	0.4	1,580	4.1	2	0.0	306	0.2	42	0.1	10	0.0	4,157	0.2	189	0.0
Pulmonary tuberculosis	D18	1,385	1,385	0.2	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1,385	0.1	0	0.0
COPD and bronchitis	D20	86,399	56,035	9.3	6,043	15.9	82	0.0	18,056	12.3	149	0.3	249	0.0	80,614	4.5	5,785	0.2
Asthma	D21–D22	114,210	67,865	11.2	5,291	13.9	9,354	4.4	21,741	14.9	74	0.1	473	0.1	104,798	5.8	9,412	0.3
Pleural effusion	D23–D24	10,981	6,535	1.1	719	1.9	90	0.0	1,609	1.1	335	0.6	370	0.0	9,658	0.5	1,323	0.0
Pneumoconiosis	D26	4,404	1,985	0.3	1,445	3.8	21	0.0	575	0.4	143	0.3	15	0.0	4,184	0.2	220	0.0
Other interstitial lung disease	D27–D28	1,545	1,031	0.2	554	1.5	44	0.0	59	0.0	66	0.1	17	0.0	1,771	0.1	−226	0.0
Foreign body	D29	1,674	881	0.1	44	0.1	44	0.0	399	0.3	30	0.1	51	0.0	1,449	0.1	225	0.0
Pneumothorax	D30	4,033	2,889	0.5	262	0.7	7	0.0	313	0.2	231	0.4	85	0.0	3,787	0.2	246	0.0
Respiratory failure	D32	3,643	1,598	0.3	723	1.9	219	0.1	249	0.2	59	0.1	128	0.0	2,976	0.2	667	0.0
Other respiratory disorder	D33–D34	33,932	14,703	2.4	1,760	4.6	7,567	3.5	5,015	3.4	576	1.1	359	0.0	29,980	1.7	3,952	0.1
Chemotherapy with respiratory diagnosis	D98	11,335	2,174	0.4	858	2.3	35	0.0	32	0.0	0	0.0	34	0.0	3,133	0.2	8,202	0.3
Complex elderly with respiratory diagnosis	D99	39,633	16,420	2.7	1,027	2.7	0	0.0	19,537	13.4	10	0.0	291	0.0	37,285	2.1	2,348	0.1
Heart and lung transplant	E01	53	0	0.0	0	0.0	0	0.0	0	0.0	53	0.1	0	0.0	53	0.0	0	0.0
Asthma/Recurrent wheeze	P01	32,631	725	0.1	207	0.5	31,417	14.7	13	0.0	5	0.0	18	0.0	32,385	1.8	246	0.0
Upper respiratory tract disorder	P02	69,968	215	0.0	68	0.2	67,324	31.5	0	0.0	13	0.0	292	0.0	67,912	3.8	2,056	0.1
Lower respiratory tract disorder	P03	45,667	360	0.1	142	0.4	44,236	20.7	16	0.0	44	0.1	122	0.0	44,920	2.5	747	0.0
Total respiratory		582,215	239,643	39.7	33,281	87.3	161,444	75.5	84,192	57.6	14,133	26.4	5,235	0.7	537,928	29.7	44,287	1.5
Total all diagnoses (HRG data)		4,719,186	603,406	100.0	38,121	100.0	213,973	100.0	146,236	100.0	53,578	100.0	753,553	100.0	1,808,867	100.0	2,910,319	100.0

Figures

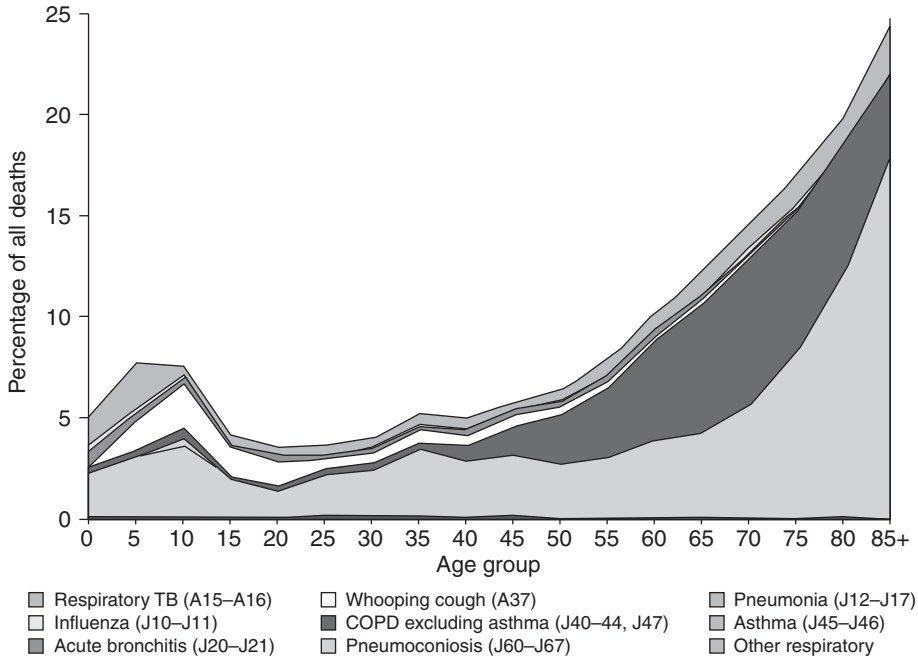

Figure B.1: Proportion of all deaths due to various lower respiratory conditions by age group.
Source: Mortality Statistics, cause, England and Wales, 1999. Office for National Statistics.

Figure B.2: Proportion of all deaths due to lower respiratory conditions and other important respiratory diseases by age group.
Source: Mortality Statistics, cause, England and Wales, 1999. Office for National Statistics.

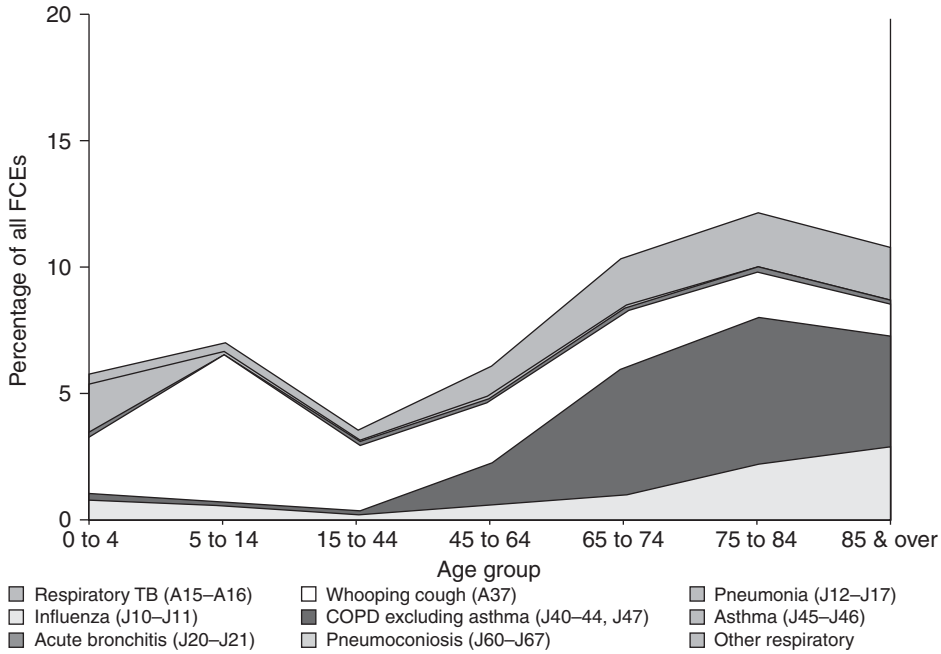

Figure B.3: Proportion of finished consultant episodes due to various lower respiratory conditions by age group.
Source: HES Data, England 1998–99.

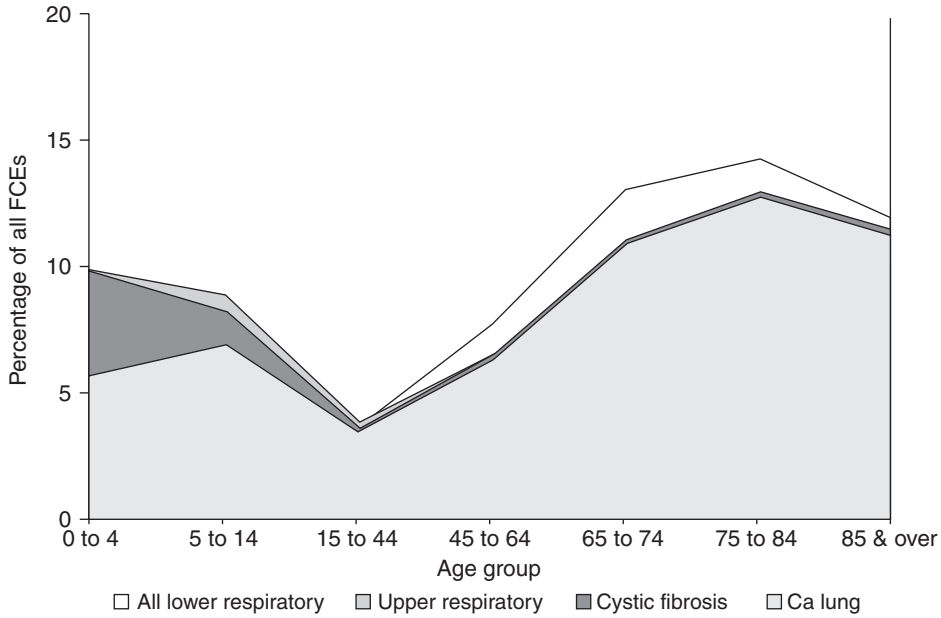

Figure B.4: Proportion of finished consultant episodes due to lower respiratory conditions and other important respiratory diseases.
Source: HES Data England 1998–99.

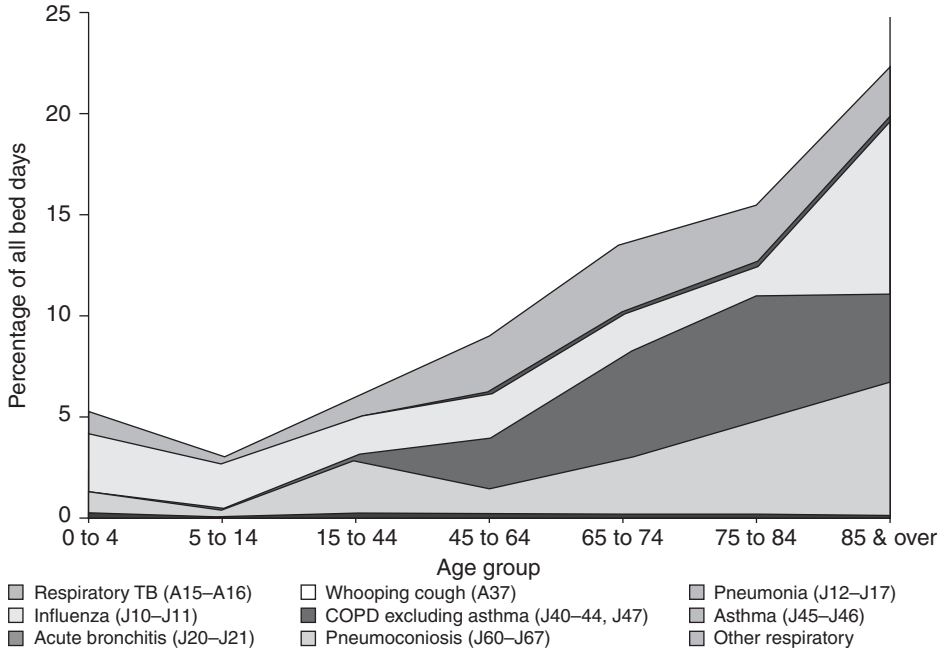

Figure B.5: Proportion of bed-days due to various lower respiratory conditions by age group.
Source: HES Data, England 1998–99.

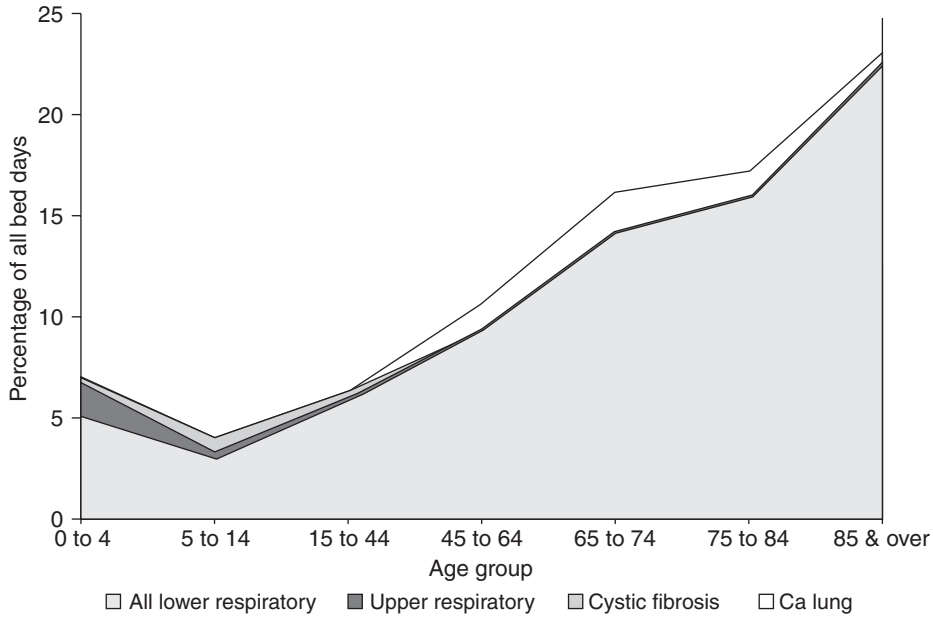

Figure B.6: Proportion of bed-days due to various lower respiratory conditions and other important respiratory diseases by age group.
Source: HES Data, England 1998–99.

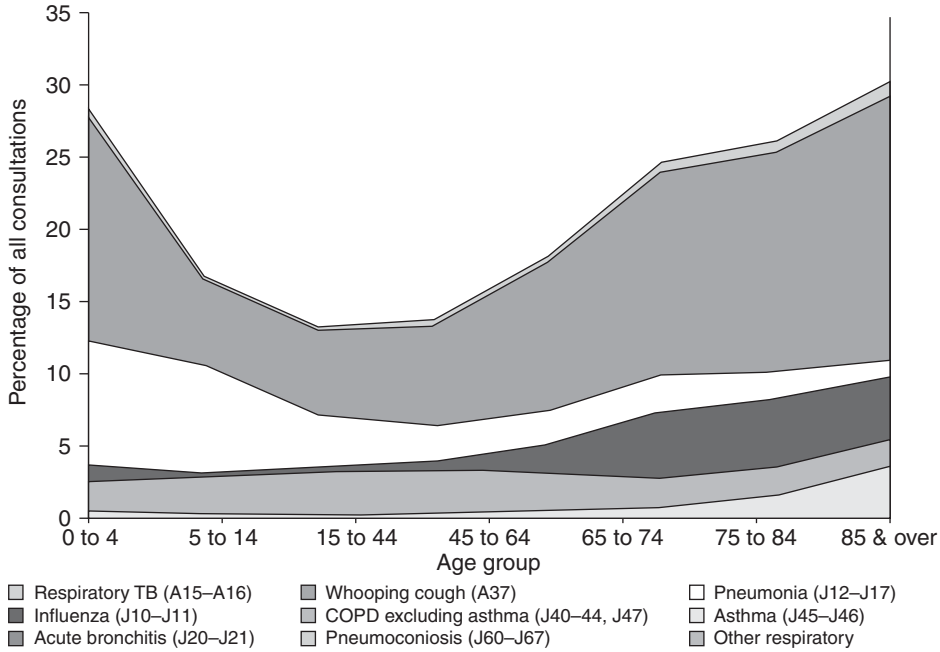

Figure B.7: Proportion of GP consultations due to various lower respiratory conditions by age group. *Source*: Morbidity statistics in general practice, 1991–2.

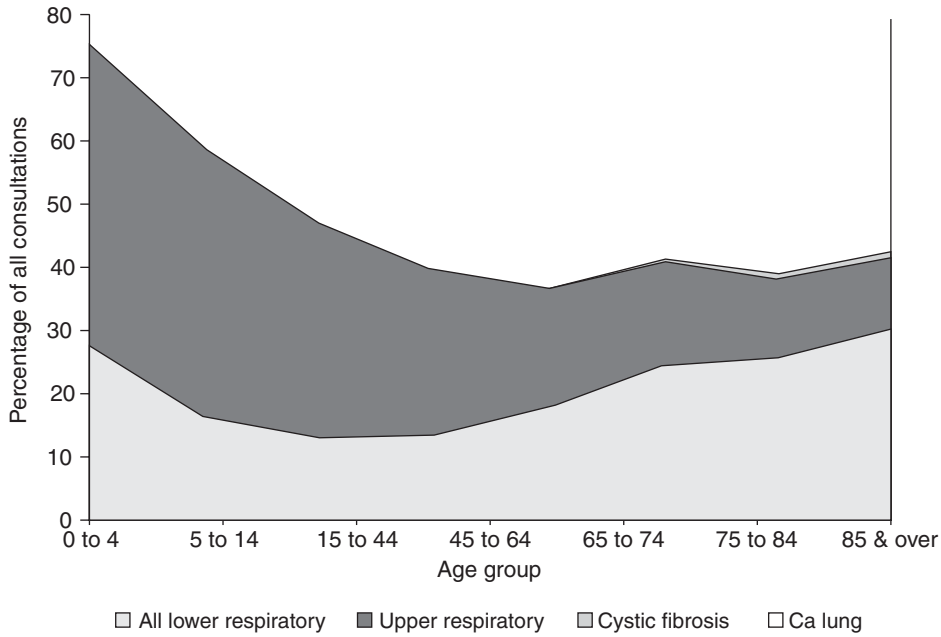

Figure B.8: Proportion of GP consultations due to lower respiratory conditions and other important respiratory diseases by age.

References

1 Barker DJP, Osmond C. Childhood respiratory infection and adult chronic bronchitis in England and Wales. *BMJ* 1986; **293**: 1271–5.
2 Denny FW. Acute respiratory infections in children: etiology and epidemiology. *Pediatr Rev* 1987; **9**: 135–46.
3 Pneumonia in childhood. Editorial. *Lancet* 1988; **1**: 741–3.
4 Milner AD, Murray M. Acute bronchiolitis in infancy: treatment and prognosis. *Thorax* 1989; **44**: 1–5.
5 Black DAK, Pole JD. Priorities in biomedical journal. Indices of burden. *Br J Prev Soc Med* 1975; **29**: 222–7.
6 Antibiotics and respiratory illness. Editorial. *BMJ* 1974; **3**: 1.
7 OPCS. *Communicable Disease Statistics 1980*. Series MB2 No. 7. London: HMSO, 1980.
8 Charlton JRH, Hartley RM, Silver R, Holland WW. Geographical variation in mortality from conditions amenable to medical intervention in England and Wales. *Lancet* 1983; **1**: 691–6.
9 Macfarlane JT, Finch RG, Ward MJ, Macrae AD. Hospital study of adult community acquired pneumonia. *Lancet* 1982; **2**: 255–8.
10 Woodhead MA, Macfarlane JT, McCracken JS, Rose DH, Finch RG. Prospective study of the aetiology and outcome of pneumonia in the community. *Lancet* 1987; **1**: 671–4.
11 British Thoracic Society, Public Health Laboratory Service. Community-acquired pneumonia in adults in British hospitals in 1982–1983: A survey of aetiology, mortality, prognostic factors and outcome. *Q J Med* 1987; New Series **62**, No. 239: 195–220.
12 OPCS. *Hospital Inpatient Enquiry 1980*. Series MB4 1985 No. 27. London: HMSO, 1987.
13 National Institutes of Health, National Heart, Lung and Blood Institute. *Global Initiative for Asthma, Global strategy for asthma management and prevention*. NIH Bethesda, Revised 2002.
14 Holgate ST, Finnerty JP. Recent advances in understanding the pathogenesis of asthma and its clinical implications. *Q J Med* 1988; **66**: 5–19.
15 Barnes PJ. A new approach to the treatment of asthma. *NEJM* 1989; **321**: 1517–27.
16 British Thoracic Society Research Unit of Royal College of Physicians of London, King's Fund Centre. Guidelines for management of asthma in adults: 1. Chronic persistent asthma. *BMJ* 1990; **301**: 651–3.
17 Scadding JG. Definitions and clinical categories of asthma. In: Clark TJH, Godfrey S (eds). *Asthma*. London: Chapman and Hall Medical, 1983, pp. 1–10.
18 Brown PJ, Greville HW, Finucane KE. Asthma and irreversible obstruction. *Thorax* 1984; **39**: 131–6.
19 Speight ANP, Lee DA, Hey EN. Underdiagnosis and undertreatment of asthma in childhood. *BMJ* 1983; **286**: 1253–6.
20 Anderson HR, Bailey PA, Cooper JS, Palmer JC. Influence of morbidity, illness label, and social, family and health service factors on drug treatment of childhood asthma. *Lancet* 1981; **2**: 1030–2.
21 Bucknall CE, Robertson C, Moran F, Stevenson RD. Differences in hospital asthma management. *Lancet* 1988; **1**: 748–50.
22 Gellert AR, Gellert SL, Iliffe SR. Prevalence and management of asthma in a London inner city general. *Br J Gen Pract* 1990; **40**: 197–201.
23 Littlejohns P, Ebrahim S, Anderson R. Prevalence and diagnosis of chronic respiratory symptoms in adults. *BMJ* 1989; **298**: 1556–60.
24 *Allergic Rhinitis and its Impact on Asthma. Management of Allergic Rhinitis and its Impact on Asthma. Pocket Guide*. ARIA (2001) in conjunction with the World Health Organisation. Downloaded from http://www.whiar.com/.
25 National Institutes of Health, National Heart, Lung and Blood Institute. Global Initiative for Chronic Obstructive Lung Disease, Global strategy for the diagnosis, management and prevention of chronic

obstructive lung disease. NHLBI/WHO Workshop Report. NIH Bethesda, 2001. Available from http://www.goldcopd.com/.
26 Joint IUT/WHO Study Group. *Tuberculosis control*. WHO Technical Report Series no. 671, *JAMA*.
27 Medical Research Council Tuberculosis and Chest Diseases Unit. National survey of notifications of tuberculosis in England and Wales. *BMJ* 1985; **291**: 658–61.
28 Barnes PF, Bloch AB, Davidson PT, Snider DE. Tuberculosis in patients with human immunodeficiency virus infection. *NEJM* 1991; **324**: 1644–50.
29 Watkins CJ, Burton P, Leeder S, Sittampalam Y, Wever AMJ, Wiggins R. Doctor diagnosis and maternal recall of lower respiratory illness. *Int J Epidemiol* 1982; **11**: 62–6.
30 Golding J. Bronchitis and pneumonia. In: Butler NR, Golding J (eds). *From birth to five. A study of the health and behaviour of Britain's five-year-olds*. Oxford: Pergamon, 1986.
31 Strachan DP (unpublished). Analyses of original data from Colley and Reid (1970), and Strachan *et al.* (1987).
32 Colley JRT, Reid DD. Urban and social origins of childhood bronchitis in England and Wales. *BMJ* 1970; **2**: 213–17.
33 Melia RJW, Chinn S, Rona RJ. Respiratory illness and home environment of ethnic groups. *BMJ* 1988; **296**: 1438–41.
34 Weiss ST, Tager IB, Schenker M, Speizer FE. The health effects of involuntary smoking. *Am Rev Respir Dis* 1983; **128**: 933–42.
35 Fielding JE, Phenow KJ. Health effects of involuntary smoking. *NEJM* 1988; **319**: 1452–60.
36 Holland WW, Bailey P, Bland JM. Long-term consequences of respiratory disease in infancy. *J Epidemiol Community Health* 1978; **32**: 256–9.
37 Strachan DP, Anderson HR, Bland JM, Peckham C. Asthma as a link between chest illness in childhood and chronic cough and phlegm in young adults. *BMJ* 1988; **296**: 890–3.
38 Miller DL. Collaborative studies of acute respiratory disease in patients seen in general practice and in children admitted to hospital. *Postgrad Med J* 1973; **49**: 749–62.
39 Weekly Returns Service of the Royal College of General Practitioners. *Report for 1988*. Birmingham: RCGP Research Unit, 1989.
40 OPCS. *Communicable Disease Statistics 1988*. Series MB2 No. 15. HMSO, 1988.
41 McNabb WR, Shanson DC, Williams TDM, Lant AF. Adult community acquired pneumonia in central London. *J R Soc Med* 1984; **77**: 550–5.
42 Noah ND. Mycoplasma pneumoniae infection in the United Kingdom – 1967–1973. *BMJ* 1974; **1**: 544–6.
43 White RJ, Blainey AD, Harrison KJ, Clarke SKR. Causes of pneumonia presenting to a district general hospital. *Thorax* 1981; **36**: 566–70.
44 Curwen M, Dunnell K, Ashley J. Hidden influenza deaths: 1989–90. In: OPCS, *Population Trends No. 61*. London: HMSO, 1990; 31–3.
45 Fine M, Smith M, Carson C *et al.* Prognosis and outcomes of patients with community acquired pneumonia. *JAMA* 1996; **275**: 134–41.
46 Wenzel RP. Hospital-acquired pneumonia: Overview of the current state of the art for prevention and control. *Eur J Clin Microbiol Infect Dis* 1989; **8**: 56–60.
47 Celis R, Torres A, Gatell JM, Almela M, Rodriguez-Roisin R, Augusti-Vidal A. Nosocomial pneumonia. A multivariate analysis of risk and prognosis. *Chest* 1988; **93**: 318–24.
48 Gross PA. Epidemiology of hospital acquired pneumonia. *Semin Respir Infect* 1987; **2**: 2–7.
49 *Health Survey for England 1996*. London: The Stationery Office, 1996. Also available on http://www.official-documents.co.uk/document/doh/survey96.
50 *The Health of Young People 1995–1997*. London: The Stationery Office, 1997. Also available on http://www.official-documents.co.uk/document/doh/survey97.

51 Anderson HR, Bland JM, Patel S, Peckham C. The natural history of asthma in childhood. *J Epidemiol Community Health* 1986; **40**: 121–9.
52 Goodall JF. *The natural history of common respiratory infection in children and some principles in its management*. Wheezy children. *J R Coll Gen Pract* 1958; **1**: 51–9.
53 Strachan DP. The prevalence and natural history of wheezing in early childhood. *J R Coll Gen Pract* 1985; **35**: 182–4.
54 Strachan DP, Butland BK, Anderson HR. Incidence and prognosis of asthma and wheezing illness from early childhood to age 33 in a national British cohort. *BMJ* 1996; **312**: 1195–9.
55 Markowe HLJ, Bulpitt CJ, Shipley MJ, Rose G, Crombie DL, Fleming DM. Prognosis in adult asthma: a national study. *BMJ* 1987; **295**: 949–52.
56 Burr ML, Butland BK, King S, Vaughan-Williams E. Changes in asthma prevalence: two surveys 15 years apart. *Arch Dis Child* 1989; **64**: 1452–6.
57 Burney PG, Chinn S, Rona RJ. Has the prevalence of asthma increased in children? Evidence from the national study of health and growth 1973–86. *BMJ* 1990; **300**: 1306–10.
58 Strachan DP, Anderson HR. Trends in hospital admission rates for asthma in children: change in prevalence or medical care? *BMJ* 1991; **304**: 819–20.
59 Anderson HR. Is the prevalence of asthma changing? *Arch Dis Child* 1989; **64**: 172–5.
60 Sears MR. Editors: Fitzgerald JM, Ernst P, Boulet LP, O'Byrne PM. Evidence-based asthma management. Hamilton, Ontario: BC Decker Inc, 2000; Chapter 1, Natural history and epidemiology, 1–12.
61 Hill R, Williams J, Tattersfield A, Britton J. Change in use of asthma as a diagnostic label for wheezing illness in schoolchildren. *BMJ* 1989; **299**: 898.
62 Fleming DM, Crombie DL. Prevalence of asthma and hay fever in England and Wales. *BMJ* 1987: **294**: 279–83.
63 Anderson HR. Increase in hospital admissions for childhood asthma: trends in referral, severity and readmissions from 1970 to 1985 in a health region of the United Kingdom. *Thorax* 1989; **44**: 614–19.
64 Department of Health. *Asthma, an epidemilogical overview*. Central Health Monitoring Unit. London: HMSO, 1995.
65 Kaur B, Anderson HR, Austin J, Burrn M, Harkins LS, Strachan DP, Warner JO. Prevalence of asthma symptoms, diagnosis and treatment in 12–14 year old children across Great Britain (international study of asthma and allergies in childhood, ISAAC UK). *BMJ* 1998; **516**: 118–24.
66 Burney PG. Asthma mortality in England and Wales: evidence for a further increase, 1974–84. *Lancet* 1986; **2**: 323–6.
67 Inman WHW, Adelstein AM. Rise and fall of asthma mortality in England and Wales in relation to use of pressurised aerosols. *Lancet* 1969; **2**: 279–83.
68 Anderson HR, Strachan DP. Asthma mortality in England and Wales, 1979–89 (letter). *Lancet* 1991; **337**: 1357.
69 Strachan DP, Golding J, Anderson HR. Regional variations in wheezing illness in British children: effect of migration during early childhood. *J Epidemiol Community Health* 1990; **44**: 231–6.
70 Burney PGJ, Papacosta AO, Withey CH, Colley JRT, Holland WW. Hospital admission rates and the prevalence of asthma symptoms in 20 local authority districts. *Thorax* 1991; **46**: 574–9.
71 Leeder SR, Corkhill R, Irwig LM, Holland WW, Colley JRT. Influence of family factors on the incidence of lower respiratory illness during the first year of life. *Br J Prev Soc Med* 1976; **30**: 302–12.
72 Burr ML, Miskelly FG, Butland BK, Merrett TG, Vaughan-Williams E. Environmental factors and symptoms in infants at high risk of allergy. *J Epidemiol Community Health* 1989; **43**: 125–32.
73 Weitzman M, Gortmaker S, Sobol A. Racial, social, and environmental risks for childhood asthma. *Am J Dis Child* 1990; **144**: 1189–94.

74 Graham PJ, Rutter JL, Yule W, Pless IB. Childhood asthma: A psychosomatic disorder? Some epidemiological considerations. *Br J Prev Soc Med* 1967; **21**: 78–85.
75 Hamman RF, Halil T, Holland WW. Asthma in schoolchildren: Demographic associations with peak expiratory flow rates compared with children with bronchitis. *Br J Prev Soc Med* 1975; **29**: 228–38.
76 Peckham C, Butler N. A national study of asthma in childhood. *J Epidemiol Community Health* 1978; **32**: 79–85.
77 Blaxter M. Evidence on inequality in health from a national survey. *Lancet* 1987; **2**: 30–2.
78 Connolly CK, Chan NS, Prescott RJ. The influence of social factors on the control of asthma. *Postgrad Med J* 1989; **65**: 282–5.
79 Sibbald B, McGuigan S, Anderson HR. Asthma and employment in young adults. *Thorax* 1992; **47**: 19–24.
80 OPCS. *Decennial supplement on occupational mortality 1982–83*. London: HMSO, 1986.
81 Johnston ID, Bland JM, Anderson HR. Ethnic variation in respiratory morbidity and lung function in childhood. *Thorax* 1987; **42**: 542–8.
82 Ayres GJ. Acute asthma in Asian patients: hospital admissions and duration of stay in a district with a high immigrant population. *Br J Dis Chest* 1986; **80**: 242–8.
83 Cook DG, Kussick SJ, Shaper AG. The respiratory effects of smoking. *J Smoking Related Dis* 1990; **1**: 45–58.
84 College Committee on Thoracic Medicine. Disabling chest disease: prevention and care. *J R Coll Physicians London* 1981; **15**: 69–87.
85 Burr ML, Charles TJ, Roy K, Seaton A. Asthma in the elderly: an epidemiological survey. *BMJ* 1979; **1**: 1041–4.
86 Cullinan P. Respiratory disease in England and Wales. *Thorax* 1988; **43**: 949–54.
87 Higgins ITT, Oldham PD *et al*. Respiratory symptoms and pulmonary disability in an industrial town. *BMJ* 1956; **ii**: 904–9.
88 Respiratory Diseases Study Group of the Royal College of General Practitioners. Chronic bronchitis in Great Britain. *BMJ* 1961; **11**: 973–9.
89 Higgins ITT. Respiratory symptoms, bronchitis and ventilatory capacity in a random sample of an agricultural population. *BMJ* 1957; **ii**: 1198–1203.
90 Higgins ITT, Cochran JB. Respiratory symptoms, bronchitis and disability in a random sample of an agricultural community in Dumfriesshire. *Tubercle* 1958; **39**: 296.
91 Higgins ITT, Cochrane AL. Chronic respiratory symptoms in a random sample of men and women in the Rhondda Fach in 1958. *Br J Ind Med* 1961; **18**: 93.
92 Mcnab GR, Slator EJ, Stewart CJ. Response to a questionnaire on chronic bronchitic symptoms in East Anglia. *Br J Prev Soc Med* 1966; **20**: 181–8.
93 Lambert PM, Reid DD. Smoking air pollution and bronchitis in Britain. *Lancet* 1970; **i**; 853–7.
94 Hawthorne VM, Fry JS. Smoking and health: the association between smoking behaviour. Total mortality and cardiorespiratory disease in West Central Scotland. *J Epidemiol Community Health* 1978; **32**: 260–6.
95 Dean G, Lee PN, Todd GF *et al*. Factors related to respiratory and cardiovascular symptoms in the United Kingdom. *J Epidemiol Community Health* 1978; **32**: 86–96.
96 Cullinan P. Persistent cough and phlegm: prevalence and clinical characteristics in South East England. *Respir Med* 1992; **86**: 143–9.
97 Tuberculosisi Notification Rates per 100 000 Population, England and Wales, by Region, 1993–1998. Public Health Laboratory Service web site. www.phls.co.uk/facts/TBRates/Region.htm.
98 Watson JM. Tuberculosis in perspective. *Commun Dis Rep CDR* 1991; **1**(12): 129.
99 Watson JM, Gill ON. HIV infection and tuberculosis. *BMJ* 1990; **300**: 63–4.

100 Department of Health, Scottish Office, Welsh Office. *Interdepartmental working group on tuberculosis: Prevention and control of tuberculosis in the United Kingdom. UK Guidance on Prevention and Control of Transmission of 1. HIV related tuberculosis 2. Drug resistant including multi-drug resistant tuberculosis.* London: The Stationery Office, 1998.
101 Watson JM *et al.* Tuberculosis and HIV infection in England and Wales. *Thorax* 1991; **46**: 311 (proceedings of the BTS winter meeting 1990).
102 Kumar D, Watson JM, Charlett A, Nicholas S, Darbyshire JH *et al.* Tuberculosis in England and Wales in 1993: results of a national survey. *Thorax* 1997; **52**: 1060–7.
103 Springett VH *et al.* Changes in tuberculosis notification rates in the white ethnic group in England and Wales between 1953 and 1983. *J Epidemiol Community Health* 1988; **42**; 370–6.
104 Nunn AJ *et al.* Changes in annual tuberculosis notification rates between 1978/79 and 1983 for the population of Indian subcontinent ethnic origin resident in England. *J Epidemiol Community Health* 1986; **40**: 357–63.
105 Pablos-Mendez A, Raviglione MC, Laszlo A *et al.* Global surveillance for antituberculosis drug resistance, 1994–1997. *NEJM* 1998; **338**: 1641–9.
106 United Kingdom Cystic Fibrosis Survey (1998). Personal Communication.
107 Dodge JA, Morison S, Lewis PA *et al.* Incidence, population and survival of cystic fibrosis in the UK, 1968–1995. *Arch Dis Child* 1997; **77**: 493–6.
108 OPCS. Mortality statistics, cause: England and Wales 1989. Series DH2 no.16. London: HMSO, 1991.
109 OPCS. Occupational mortality, childhood supplement. The Registrar General's decennial supplement for England and Wales, 1979–80, 1982–83. Series DS no.8. London: HMSO, 1988.
110 Gregg I. Epidemiological aspects. In: Clark TJH, Godfrey S (eds). *Asthma.* London: Chapman and Hall Medical, 1983, pp. 242–78.
111 Anderson HR, Bailey PA, Cooper JS, Palmer JC, West S. Morbidity and school absence caused by asthma and wheezing illness. *Arch Dis Child* 1983; **83**: 777–84.
112 Golding J, Butler N. Wheezing and asthma. In: Butler NJ, Golding J (eds). *From birth to five. A study of the health and behaviour of Britain's five-year-olds.* Oxford: Pergamon Press, 1986, pp. 158–70.
113 Strachan DP. Damp housing and childhood asthma: validation of reporting of symptoms. *BMJ* 1988; **297**: 1223–6.
114 Clifford RD, Radford M, Howell JB, Holgate ST. Prevalence of respiratory symptoms among 7 and 11 year old schoolchildren and association with asthma. *Arch Dis Child* 1989; **64**: 1118–25.
115 Hill RA, Standen PJ, Tattersfield AE. Asthma, wheezing, and school absence in primary schools. *Arch Dis Child* 1989; **64**: 246–51.
116 Leck I. Falling death rates from bronchitis. *Lancet* 1988; **ii**: 694.
117 Wiggins J, Lyster W. Will falling death rates from acute and chronic bronchitis continue? *Lancet* 1988; **1**: 286–7.
118 Backhouse A, Holland WW. Trends in mortality from chronic obstructive airways disease in the United Kingdom. *Thorax* 1989; **44**: 529–32.
119 Nisar M, Davies PDO. Current trends in tuberculosis mortality in England and Wales. *Thorax* 1991; **46**: 438–40.
120 Elborn JS *et al. Thorax* 1991; **46**: 881–5.
121 Everett MT. Major chest infection managed at home. *Practitioner* 1983; **227**: 1743–54.
122 Haley RW, Culver DH, White JW, Morgan WM, Emori TG, Munn VP, Hooton TM. The efficacy of infection surveillance and control programs in preventing nosocomial infections in US hospitals. *Am J Epidemiol* 1985; **121**: 182–205.
123 British Thoracic Society. Guidelines for the management of community-acquired pneumonia in adults. *Thorax* 2001; **56** (Suppl. 4).

124 Royal College of General Practitioners Office of Population Censuses and Surveys, Department of Health and Social Security. *Morbidity statistics from general practice: third national study 1981–82*. Series MB5 No.1. London: HMSO, 1986.
125 Anderson HR, Bailey PA, Cooper JS, Palmer JC, West S. Medical care of asthma and wheezing illness in children: a community survey. *J Epidemiol Community Health* 1983; **37**: 180–6.
126 Littlejohns P, Ebrahim S, Anderson HR. Treatment of adult asthma: is the diagnosis relevant? *Thorax* 1989; **44**: 797–802.
127 Fleming DM, Sunderland R, Cross KW, Ross AM. Declining incidence of episodes of asthma: a study of trends in new episodes presenting to general practitioners in the period 1989–98. *Thorax* 2000; **55**: 657–61.
128 Alderson MR. Trends in morbidity and mortality from asthma. *Pop Trends* 1987; **49**: 18–23.
129 Burney P. Why study the epidemiology of asthma. *Thorax* 1988; **43**: 425–8.
130 Platts-Mills TA, Chapman MD. Dust mites: immunology, allergic disease, and environmental control. *J Allergy Clin Immunol* 1987; **80**: 755–75.
131 Platts-Mills TA. Allergens and asthma. *Allergy Proc* 1990; **11**: 269–71.
132 Weitzman M, Gortmaker S, Walker DK, Sobol A. Maternal smoking and childhood asthma. *Pediatrics* 1990; **85**: 505–11.
133 Wood RD, Wu JM, Witorsch RJ, Witorsch P. Environmental tobacco smoke exposure and respiratory health in children: an updated critical review and analysis of the epidemiological literature. *Indoor Environ* 1992; **1**: 19–35.
134 International Workshop Report. Dust mite allergens and asthma: a worldwide problem. *Bull WHO* 1988; **66**: 769–80.
135 Department of Health Advisory Group on the Medical Aspects of Air Pollution Episodes. *Ozone*. London: HMSO, 1991.
136 American Thoracic Society. Screening for adult respiratory disease. *Am Rev Respir Dis* 1983; **128**: 768–74.
137 British Thoracic Society Research Unit of Royal College of Physicians London, King's Fund Centre. National Guidelines for management of asthma in adults: II. Acute severe asthma. *BMJ* 1990; **301**: 797–800.
138 Warner JO, Gotz M, Landau LI, Levison H, Milner AD, Pederson S, Silverman M. Management of asthma: a consensus statement. *Arch Dis Child* 1989; **64**: 1065–79.
139 British Thoracic Society. Revised Guidelines on Management of Asthma 1997. *Thorax* 1997; **52** (Suppl. 1); S2–S21.
140 British Thoracic Society/Scottish Intercollegiate Guidelines Network. British Guideline on the Management of Asthma. *Thorax* 2003; **58** (Suppl. 1).
141 British Thoracic Association. Death from asthma in two regions of England. *BMJ* 1982; **285**: 1251–5.
142 Johnson AJ, Nunn AJ, Somner AR, Stableforth DE, Stewart CJ. Circumstances of death from asthma. *BMJ* 1984; **288**: 1870–2.
143 Fletcher HJ, Ibrahim SA, Speight N. Survey of asthma deaths in the Northern region, 1970–85. *Arch Dis Child* 1990; **65**: 163–7.
144 Sibbald B. Patient self care in acute asthma. *Thorax* 1989; **44**: 97–101.
145 Storr J, Barrell E, Lenney W. Rising asthma admissions and self referral. *Arch Dis Child* 1988; **63**: 774–9.
146 AARC Clinical Practice Guideline Spirometry, 1996 Update, *Respir Care* 1996; **41**(7): 629–36.
147 Anderson HR, Freeling P, Patel SP. Decision-making in acute asthma. *J R Coll Gen Pract* 1983; **33**: 105–8.
148 Henry RL, Milner AD. Specialist approach to childhood asthma: does it exist? *BMJ* 1983; **287**: 260–1.

149 Crompton GK, Grant IWB, Bloomfield P. Edinburgh emergency asthma admission service: report on 10 years' experience. *BMJ* 1979; **2**: 1199–1201.
150 Price DB, Wolfe S. Patient's use and views on the service provided. *Asthma J* 2000; **5**: 141–4.
151 Holland WW. Chronic obstructive lung disease prevention. *Br J Dis Chest* 1988; **82**: 32–44.
152 Anthonisen N, Connett J, Kiley J, Altose M *et al.* Effects of smoking intervention and the use of an inhaled anticholinergic bronchodilator on the rate of decline of FEV1: The lung health study. *JAMA* 1994: **272**; 1497–505.
153 Sinclair DJM, Ingram CG. Controlled trial of supervised exercise training in chronic bronchitis. *BMJ* 1980; **280**: 519–21.
154 Interdepartmental Working Group on Tuberculosis. *The prevention and control of tuberculosis in the United Kingdom: Recommendations for the prevention and control of tuberculosis at the local level.* London: Department of Health, 1996.
155 Joseph CA, Watson JM, Fern KJ. BCG immunization in England and Wales: a survey of policy and practice in schoolchildren and neonates. *BMJ* 1992; **305**: 495–8.
156 Frankenburg RA, Mayon-White RT. The effect of a policy non-vaccination of schoolchildren on the incidence of tuberculosis in Oxfordshire. *J Public Health Med* 1991; **13**(3): 209–13.
157 Omerod LP. *Childhood tuberculosis: public health aspects.* Communicable Disease Report 1991. Vol. 1, review number 12.
158 Subcommittee of the Joint Tuberculosis Committee of the British Thoracic Society. Control and prevention of tuberculosis in Britain: an updated code of practice. *BMJ* 1990; **300**: 995–9.
159 Joint Tuberculosis Committee of the British Thoracic Society. Control and prevention of tuberculosis in the United Kingdom: code of practice 1994. *Thorax* 1994; **49**: 1193–1200.
160 Omerod LP for a subcommittee of the Joint Tuberculosis Committee. Chemotherapy and management in the United Kingdom: recommendations of the joint Tuberculosis Committee of the British Thoracic Society. *Thorax* 1990; **45**: 403–8.
161 Joint Tuberculosis Commitee of the BritishThoracic Society. Chemotherapy and management of tuberculosis in the United Kingdom: recommendations 1998. *Thorax* 1998; **53**: 536–48.
162 Toman K. *Tuberculosis case finding and chemotherapy.* Geneva: World Health Organization, 1979.
163 Chemotherapy of pulmonary tuberculosis in Britain. *Drugs Ther Bull* 1988; **26**(1): 1–4.
164 The British Thoracic Society Research Committee and the Medical Research Council Cardiothoracic Epidemiology Group. The management of pulmonary tuberculosis in adults notified in England and Wales in 1988. *Respir Med* 1991; **85**: 319–23.
165 Walters S, Jordan D. *D Clinical Standards Advisory Group: Cystic Fibrosis Revisited – Access and availability of specialist services.* 1996. Available via http://www.cfstudy.com/sarah/csag2.pdf
166 Walters S. *Association of Cystic Fibrosis Adults Survey (1994).* London: Cystic Fibrosis Trust, 1995.
167 Clinical Standards Advisory Group. *Access and Availability of Specialist Services: Cystic Fibrosis.* London: HMSO, 1992.
168 *Clinical Guidelines for cystic fibrosis case: Recommendations of a working group.* London: Royal College of Physicians, 1996.
169 Cystic Fibrosis Trust. *Standards of Care – Standards for the Clinical Care of Children and Adult with Cystic Fibrosis in the UK 2001.* London: Cystic Fibrosis Trust, May 2001.
170 Cystic Fibrosis Trust. *Pseudomonas aeruginosa infection in cystic fibrosis. Suggestions for prevention and infection control.* London: Cystic Fibrosis Trust, May 2001.
171 Cystic Fibrosis Infection Control Group. *A Statement on Burkholderia Cepacia.* London: Cystic Fibrosis Trust, July 1999.
172 Cystic Fibrosis Trust. *Antibiotic Treatment for Cystic Fibrosis. Report of the UK Cystic Fibrosis Trust Antibiotic Group.* London: Cystic Fibrosis Trust, September 2002.

173 Cystic Fibrosis Trust. *Clinical Guidelines for the Physiotherapy Management of Cystic Fibrosis. Association of Chartered Physiotherapists in Cystic Fibrosis*. London: Cystic Fibrosis Trust, January 2002.
174 Cystic Fibrosis Trust. *Nutritional Management of Cystic Fibrosis. UK Cystic Fibrosis Trust Nutrition Working Group*. London: Cystic Fibrosis Trust, April 2002.
175 Campbell IA. Stopping patients smoking. *Br J Dis Chest* 1988; **82**: 9–15.
176 Maynard A. Logic in medicine: an economic perspective. In: Philips C (ed.). *Logic in Medicine*. London: British Medical Journal, 1988.
177 Barker DJP, Godrey KM, Fall C, Osmond C, Winter PD, Shaheen SO. Relationship of birth weight and childhood respiratory infection to adult lung function and death from chronic obstructive airways disease. *BMJ* 1991; **303**: 671–5.
178 DiFranzaJ , Lew R. Morbidity and mortality in children associated with the use of tobacco products by other people. *Pediatrics* 1996; **97**: 560–8.
179 Walshaw MJ. Mite control: is it worthwhile? Editorial. *Respir Med* 1990; **84**: 257–8.
180 Gotzche P, Hammarquist C, Burr M. House dust mite control measures in the management of asthma: a meta-analysis. *BMJ* 1998; **317**: 1105–10.
181 Hammarquist C, Burr M, Gotzche P. *House dust mite control measures for asthma*. Cochrane Library: Update Software, 1999.
182 Kramer M. *Maternal antigen avoidance during pregnancy for preventing atopic disease in infants of women at high risk*. Cochrane Library: Update Software, 1999.
183 Faculty of Public Health Medicine. *UK levels of health. First report of a working party*. London: FPHM, 1991, pp. 36–44.
184 Miller DL *et al*. Pertussis immunization and serious acute neurological illness in children. *BMJ* 1981; **282**: 1595.
185 Cherry JD. *The epidemiology of pertussis and pertussis immunization in the United Kingdom and the United States: a comparative study*. MSc epidemiology dissertation. London: School of Hygiene and Tropical Medicine, 1983.
186 Rudd PT. Childhood immunization in the new decade. *BMJ* 1991; **302**: 481–2.
187 Fine M, Smith M, Carson C *et al*. Efficacy of pneumococcal vaccine in adults: a meta analysis of randomised controlled trials. *Arch Int Med* 1994; **154**: 2666–77.
188 Butler J, Breiman R, Campbell J *et al*. Pneumococcal polysaccharide vaccine efficiency. A evaluation of current recommendations. *JAMA* 1993: **270**(15): 1826–31.
189 Ortqvist A, Hedlund J, Burman L-A *et al*. Randomised controlled trial of 23 valent pneumococcal capsular polysaccharide vaccine in prevention of pneumonia in middle aged and elderly people. *Lancet* 1998; **351**: 399–403.
190 Leads from the MMWR. Recommendations of the immunization practices and advisory committee. Pneumococcal polysaccharide vaccine. *JAMA* 1989; **261**: 1265–7.
191 Salisbury D, Begg N. *Immunisation against infectious disease*. London: Department of Health, 1996.
192 Austrian R, Douglas RM, Schiffman G. Prevention of pneumococcal pneumonia by vaccination. *Trans Assoc Am Phys* 1976; **89**: 184–94.
193 Smit P, Oberholzer D, Hayden-Smith S, Koornhof HJ, Hilleman MR. Protective efficacy of pneumococcal polysaccharide vaccines. *JAMA* 1977; **238**: 2613–16.
194 Riley ID, Tarr PI, Andrews M. Immunization with a polyvalent pneumococcal vaccine: reduction of adult respiratory mortality in a New Guinea Highlands community. *Lancet* 1977; **1**: 1338–41.
195 Ammann AJ, Addiego J, Wara DW, Lubin B, Smith WB, Mentzer WC. Polyvalent pneumococcal polysaccharide immunization of patients with sickle-cell anaemia and patients with splenectomy. *NEJM* 1977; **297**: 897–900.

196 Simberkoff MS, Cross AP, Al-Ibrahim M, Baltch AL, Geiseler PJ, Nadler J, Richmond AS, Smith RP, Schiffman G, Shepard DS, van Eeckhout JP. Efficacy of pneumococcal vaccine in high-risk patients. Results of a Veterans Administration cooperative study. *NEJM* 1986; **215**: 1318–27.
197 Forrestor HL, Jahnigen DW, LaForce FM. Inefficacy of pneumococcal vaccine in a high-risk population. *Am J Med* 1987; **83**: 425–30.
198 Simms RV, Steinmann WC, McConville JH, King LR, Zwick WC, Schwartz JS. The clinical effectiveness of pneumococcal vaccine in the elderly. *Ann Intern Med* 1988; **108**: 653–7.
199 LaForce FM. Adult immunizations: Are they worth the trouble? *J Gen Int Med* 1990; **5** (Suppl.): 557–61.
200 Shapiro ED, Austrian R, Adair RK, Clemens JD. The protective efficacy of pneumococcal vaccine (abstract). *Clin Res* 1988; **36**: 470A.
201 Shapiro ED, Berg AT, Austrian R, Schroeder BA, Parcells V, Margolis A, Adair RK, Clemens JD. The protective efficacy of polyvalent pneumococcal polysaccharide vaccine. *NEJM* 1991; **325**: 1453–60.
202 Williams WW, Hickson MA, Kane MA, Kendal AP, Spika JS, Hinman AR. Immunization policy and vaccine coverage among adults. *Ann Intern Med* 1988; **108**: 616–25.
203 Fedson DS, Baldwin JA. Previous hospital care as a risk factor for pneumonia. *JAMA* 1982; **248**: 1989–95.
204 Fedson DS. Hospital-based pneumococcal immunization: the epidemiologic rationale and its implementation. *Infect Control* 1982; **3**: 303–9.
205 Fedson DS, Harward MP, Reid RA, Kaiser DL. Hospital-based pneumococcal immunization. Epidemiologic rationales from the Shenandoah study. *JAMA* 1990; **264**: 1117–23.
206 Sisk JE, Riegelman RK. Cost-effectiveness of vaccination against pneumococcal pneumonia; an update. *Ann Intern Med* 1986; **104**: 79–86.
207 Department of Health. *Immunization against infectious disease*. London: HMSO, 1990.
208 Poole PJ, Chacko E, Wood-Baker RWB, Cates CJ. *Influenza vaccine for patients with chronic obtructive pulmonary disease* (Cochrane Review). In: Cochrane Library Issue 4, 2002. Oxford: Update Software.
209 Cates CJ, Jefferson TO, Bara AI, Rowe BH. *Vaccines for preventing influenza in people with asthma* (Cochrane Review). In: Cochrane Library, Issue 4, 2002. Oxford: Update Software.
210 Gross P, Hermogenes A, Sacks H, Lau J, Levandowski R. The efficacy of influenza vaccine in elderly persons: a meta-analysis and review of the literature. *Ann Int Med* 1995; **123**: 518–27.
211 Mullooly J, Bennett M, Hornbrook M, Barker W, Williams W, Patriarca P, Rhodes P. Influenza vaccination programs for elderly persons: cost-effectiveness in a health maintenance organisation. *Ann Int Med* 1994; **121**: 947–52.
212 Nichol K, Margolis K, Wuorenma R, Von Sternberg T. The efficacy and cost-effectiveness of vaccination against influenza among elderly persons living in the community. *NEJM* 1994; **331**: 778–84.
213 Colditz G, Brewer R, Berkey C *et al*. Efficacy of BCG vaccine in the prevention of tuberculosis: a meta-analysis of the published literature. *JAMA* 1994; **271**: 698–702.
214 Colditz G, Berkey C, Mosteller F *et al*. Efficacy of bacillus Calmette-Guerin vaccination of new-borns and infants in the prevention of tuberculosis: a meta-analysis of the published literature. *Pediatrics* 1996; **96**: 29–35.
215 Rodrigues L, Diwan V, Wheeler J. Protective effect of BCG against tuberculous meningitis and miliary tuberculosis: a meta-analysis. *Int J Epidemiol* 1993; **22**: 1154–8.
216 Keogan M, Johansen H. *Vaccines for preventing infection with Pseudomonas aeruginosa in people with cystic fibrosis*. Cochrane Library: Update Software, 1999.
217 Colver AF. Community campaign against asthma. *Arch Dis Child* 1990; **59**: 449–52.

218 Hill R, Williams J, Britton J, Tattersfield A. Can morbidity associated with untreated asthma in primary school children be reduced?: a controlled intervention study. *BMJ* 1991; **303**: 1169–74.
219 Hall DMB. *Health for All Children: a Programme for Child Health Surveillance*. Oxford: Oxford Medical Publications, 1989.
220 Coultas DB, Mapel D, Gagnon R, Lydick E. The health impact of undiagnosed airflow obstruction in a national sample of United States adults. *Am J Respir Crit Care Med* 2001; **164**: 372–7.
221 McIvor RA, Tashkin DP. Underdiagnosis of chronic obstructive pulmonary disease: a rationale for spirometry as a screening tool. *Can Respir J* 2001; **8**: 153–8.
222 van den Boom G, Rutten-van Molken MP, Folgering H, van Weel C, van Schayck CP. The economic effects of screening for obstructive airway disease: an economic analysis of the DIMCA program. *Preventive Medicine* 2000; **30**: 302–8.
223 Van Schayk CP, Loozen JMC, Wagena A, Akkermans P, Wesseling GJ. Detecting patients at a high risk of developing chronic obstructive pulmonary disease in general practice: cross sectional case finding study. *BMJ* (2002); **324**: 1370.
224 Badgett RG, Tanaka DJ. Is screening for chronic obstructive pulmonary disease justified? *Preventive Medicine* 1997; **26**: 466–72.
225 Gorecka D, Bednarek M, Kislo A, Zalewska A, Czechowska U, Jedrzejczak M, Zielinski J. Awareness of airflow obstruction together with antismoking advice increases success in cessation of smoking. *Pneumonologia i Alergologia Polska* 2001; **69**: 617–25.
226 Murray J, Cuckle H, Taylor G *et al*. Screening for Cystic Fibrosis. *Health Technology Assessment* 1999; **3**(8).
227 Pollitt RJ, Leonard JV, Green A, Nicholl J, McCabe CJ, Nicholson P, Booth A, Tunaley JR, Cooper NJ, Virdi NK. Neonatal screening for inborn errors of metabolism: cost, yield and outcome. *Health Technology Assessment* 1997; **1**(7).
228 Seymour CA, Thomason MJ, Chalmers RA, Addison GM, Bain MD, Cockburn F, Littlejohns P, Lord J, Wilcox AH. Neonatal screening for inborn errors of metabolism: a systematic review. *Health Technology Assessment* 1999; **1**(11).
229 http://www.info.doh.gov.uk/doh/intpress.nsf/page/2001–0208?OpenDocument. Department of Health Web Site. April 2001.
230 Farrell PM, Kosorok MR, Rock MJ, Laxova A, Lan Zeng, Hui-Chuan Lai, Hoffman G, Laessig RH, Splaingard ML, and the Wisconsin Cystic Fibrosis Neonatal Screening Study Group. Early diagnosis of cystic fibrosis through neonatal screening prevents severe malnutrition and improves long-term growth. *Pediatrics* 2001; **107**: 1–13.
231 Merelle M, Nagelkerke A, Lees C, Dezateux C. *Newborn screening for cystic fibrosis*. Cochrane Library: Update Software, 1999.
232 Rowley P, Loader S, Kaplan R. Prenatal screening for cystic fibrosis carriers: an economic evaluation. *Am J Hum Genet* 1998; **63**: 1160–74.
233 Arroll B, Kenealy T. *Antibiotics for the common cold*. Cochrane Library: Update Software, 1999.
234 *UK Antimicrobial Resistance Strategy and Action Plan*. London: NHSE, 2000. Also available at http://www.gov.uk/arbstrat.htm.
235 Gordon M, Lovell S, Dugdale AB. The value of antibiotics in minor respiratory illness in children – a controlled trial. *Med J Aust* 1974; **9**: 304–6.
236 Sutrisna B, Frerichs RR, Reingold AL. Randomised controlled trial of effectiveness of ampicillin in mild acute respiratory infections in Indonesian children. *Lancet* 1991; **338**: 471–4.
237 Becker L, Glazier R, McIsaac W, Smuchny J. *Antibiotics for acute bronchitis*. Cochrane Library: Update Software, 1999.
238 Jefferson T, Demicheli V, Deeks J, Rivetti D. *Neuraminidase inhibitors for preventing and treating influenza in healthy adults*. Cochrane Library: Update Software, 1999.

239 National Institute for Clinical Excellence. *Guidance on the use of zanamivir (Relenza) in the treatment of influenza*. Technology Appraisal Guidance no. 15. London: NICE, 2000.
240 Welliver R, Monto AS, Carewicz O, Schattemann E, Hassman M, Hedrick J, Jackson HC, Huson L, Ward P, Oxford JS. Effectiveness of oseltamivir in preventing influenza in household contacts: a randomized controlled trial. *JAMA* 2001; **285**: 748–54.
241 Hayden FG, Gubareva LV, Monto AS, Klein TC, Elliott MJ, Hammond JM, Sharp SJ, Ossi MJ. Inhaled zanamivir for the prevention of influenza in families. *NEJM* 2000; **343**: 1282–9.
242 Monto AS, Robinson DP, Herlocher ML, Hinson JM Jnr., Elliott MJ, Crisp A. Zanamivir in the prevention of influenza among health adults: a randomized controlled trial. *JAMA* 1999; **282**: 31–5.
243 Hayden FG, Atmar RL, Schilling M, Johnson C, Poretz D, Paar D, Huson L, Ward P, Mills RG. Use of the selective oral neuraminidase inhibitor oseltamivir to prevent influenza. *NEJM* 1999; **341**: 1336–43.
244 Haley RW. Surveillance by objective: A new priority directed approach to the control of nosocomial infections. *Am J Infect Control* 1985; **13**: 78–89.
245 Esmonde TFG, Petheram IS. Audit of tuberculosis contact tracing procedures in South Gwent. *Respir Med* 1991; **85**: 421–4.
246 British Thoracic Association. A study of standardised contact procedures in tuberculosis. *Tubercle* 1978; **59**: 245–59.
247 Smieja M, Marchetti C, Cook D, Smaill F. *Isoniazid for preventing tuberculosis in non-HIV infected persons*. Cochrane Library: Update Software, 1999.
248 Snider D, Caras G, Koplan J. Preventive therapy with isoniazid: cost-effectiveness of different durations of therapy. *JAMA* 1986; **255**: 1579–83.
249 Rose D, Chechter C, Fahs M, Silver A. Tuberculosis prevention: Cost-effectiveness analysis of isoniazid chemoprophylaxis. *Am J Prev Med* 1988; **4**: 102–9.
250 Kellner J, Ohlsson A, Gadomski A, Wang E. *Bronchodilators for bronchiolitis*. Cochrane Library: Update Software, 1999.
251 Garrison MM, Christakis DA, Harvey E, Cummings P, Davis RL. Systemic corticosteroids in infant bronchiolitis: a meta-analysis. *Pediatrics* (2000): **105**; E41–E446.
252 Bisgaard H, Hermansen M, Vrang C, Andersen EA, Dybmose G, Braendholt V, Nielsen KG, Fog E, Pedersen LV, Smidth B, Klug B, Henriksen J, Jorgensen M, Bonnelykke K. Leukotriene receptor antagonist reduces lung symptoms following respiratory syncytial virus bronchiolitis in infants. *Am J Respir Crit Care Med* (2002)[Abstract]: **165** (Suppl. 8); 838.
253 Fine M, Auble T, Yearly D *et al.* A prediction rule to identify low-risk patients with community acquired pneumonia. *NEJM* 1997; **336**: 243–50.
254 Drug and Therapeutic Bulletin. Antibiotics for community-acquired pneumonia in adults. *Drug Ther Bull* 1988; **26**: 13–16.
255 Chan R, Hemeryck L, O'Regan M *et al.* Oral versus intravenous antibiotics for community acquired lower respiratory tract infection in a general hospital: open randomised controlled trial. *BMJ* 1995; **27**: 1360–2.
256 Omidvari K, de Boisblanc B, Karam G, Nelson S, Haponik E, Summer W. Early transition to oral antibiotic therapy for community acquired pneumonia: duration of therapy, clinical outcomes and cost analysis. *Resp Med* 1998; **92**: 1032–9.
257 Siegel R, Halpern N, Almenoff P, Lee A, Cashin R, Greene J. A prospective randomised study of inpatient IV antibiotics for community acquired pneumonia: the optimal duration of therapy. *Chest* 1996; **110**: 965–71.
258 Rhew D, Hackner D, Henderson L, Ellrodt A, Weingarten S. The clinical benefit of in-hospital observation in low-risk pneumonia patients after conversion from parenteral to oral antimicrobial therapy. *Chest* 1998; **113**: 142–6.

259 Hirani N, MacFarlane J. Impact of management guidelines on the outcome of severe community acquired pneumonia. *Thorax* 1997; **52**: 17–21.
260 Jones A, Sykes A. The effect of symptom presentation on delay in asthma diagnosis in children in a general practice. *Respir Med* 1990; **84**: 139–42.
261 Sears MR, Taylor DR, Print DC *et al*. Regular inhaled beta-agonist treatment in bronchial asthma. *Lancet* 1990; **336**: 1391–6.
262 Page CP. One explanation of the asthma paradox: inhibition of natural anti-inflammatory mechanism by beta 2-agonists. *Lancet* 1991; **337**: 717–20.
263 Cates C. *Holding chambers versus nebulisers for beta-agonist treatment of acute asthma*. Cochrane Library: Update Software, 2002.
264 Turner M, Patel A, Ginsburg S, FitzGerald J. Bronchodilator delivery in acute airflow obstruction. *Arch Int Med* 1997; **157**: 1736–44.
265 Muers M, Corris P (eds). Nebuliser Project Group of the British Thoracic Society Standards of Care Committee. Current best practice for nebuliser treatment. *Thorax* 1997; **52** (Suppl. 2): S1–S104.
266 White PT, Pharoah CA, Anderson HR, Freeling P. Improving the outcome of chronic asthma in General Practice: a randomised controlled trial of small group education. *J R Coll Gen Pract* 1989; **39**: 182–6.
267 Horn CR, Clark TJH, Cochrane GM. Compliance with inhaled therapy and morbidity from asthma. *Respir Med* 1990; **84**: 67–70.
268 Arnold AG, Lane DJ, Zapata E. Current therapeutic practice in the management of acute severe asthma. *Br J Dis Chest* 1983; **77**: 123–35.
269 Bucknall CE, Robertson C, Moran F, Stevenson RD. Management of asthma in hospital: a prospective audit. *BMJ* 1988; **296**: 1637–9.
270 Osman J, Ormerod P, Stableforth D. Management of acute asthma: a survey of hospital practice and comparison between thoracic and general physicians in Birmingham and Manchester. *Br J Dis Chest* 1987; **81**: 232–41.
271 North of England Study of Standards and Performance in General Practice. North of England Study of Standards and Performance in General Practice. *Final report. Vol III – the effects of setting and implementing clinical standards*. Newcastle upon Tyne: Health Care Research Unit, University of Newcastle upon Tyne, 1990.
272 Johnston IDA, Bland JM, Anderson HR, Lambert HP. Respiratory sequelae of whooping cough (correspondence). *BMJ* 1985; **291**: 482–3.
273 Feder G, Griffiths C, Highton C, Eldridge S, Spence M, Southgate L. Do clinical guidelines introduced with practice based education improve care of asthmatic and diabetic patients? A randomised controlled trial in general practices in East London. *BMJ* 1995; **311**: 1472–8.
274 Habbick B, Baker M, McNutt M, Cockcroft D. Recent trends in the use of inhaled beta 2 adrenergic agonists and inhaled corticosteroids in Sakatchewan. *CMAJ* 1995; **153**: 1437–43.
275 Worrall G, Chaulk P, Freake D. The effects of clinical practice guidelines on patient outcomes in primary care; a systematic review. *Can Med Assoc J* 1997; **156**: 1705–12.
276 Beasley R, Cushley M, Holgate ST. A self management plan in the treatment of adult asthma. *Thorax* 1989; **44**: 200–4.
277 Charlton I, Charlton G, Broomfield J, Mullee MA. Evaluation of peak flow and symptoms only self management plans for control of asthma in general practice. *BMJ* 1990; **301**: 1355–9.
278 Taitel M, Kotses H, Bernstein I, Bernstein D, Creer T. A self management program of adult asthma. Part II: cost benefit analysis. *J Allergy Clin Immunol* 1995; **95**: 672–6.
279 Trautner C, Richter B, Berger M. Cost-effectiveness of a structured treatment and teaching programme on asthma. *Eur Resp J* 1993; **6**: 1485–91.

280 Eiser N. Desensitization today. *BMJ* 1990; **300**: 1412–13.
281 Selsby DS. Chest physiotherapy. *BMJ* 1989; **298**: 541–2.
282 Kleijnen J, ter Reit G, Knipschild P. Acupuncture and asthma: a review of controlled trials. *Thorax* 1991; **46**: 799–802.
283 Linde K, Jobst KA. *Homeopathy for chronic asthma*. Cochrane Library: Update Software, 2002.
284 Leitch AG, Parker S, Currie A, King T, McHardy GJR. Do chest physicians follow-up too many patients? *Respir Med* 1989; **83**: 329–32.
285 Eatwood A, Sheldon T. Organisation of asthma care: what difference does it make? A systematic review of the literature. *Qual Health Care* 1996; **5**: 134–43.
286 Drummond N, Abdalla M, Buckingham J *et al*. Integrated care for asthma: a clinical, social and economic evaluation. *BMJ* 1994; **308**: 559–64.
287 Charlton I, Charlton G, Broomfield J, Mullee MA. Audit of the effect of a nurse run asthma clinic on workload and patient morbidity in a general practice. *Br J Gen Pract* 1991; **41**: 227–31.
288 Premaratne U, Sterne J, Marks G, Webb J, Azima H, Burney P. Clustered randomised trial of an intervention to improve the management of asthma: Greenwich asthma study. *BMJ* 1999; **18**: 1251–5.
289 Heard AR, Richards IJ, Alpers JH, Pilotto LS, Smith BJ, Black JA. Randomised controlled trial of general practice based asthma clinics. *Med J Aust* 1999; **171**: 68–71.
290 Gibson PG, Coughlan J, Wilson AJ, Abramson M, Bauman A, Hensley MJ *et al. Self management education and regular practitioner review for adults with asthma*. Cochrane Library: Update Software, 2002.
291 Fay JK, Jones A, Ram FSF. *Primary care based clinics for asthma*. Cochrane Library: Update Software, 2002.
292 Roe W. 'Science' in the practice of medicine: its limitations and dangers. *Perspect Biol Med* 1984; **27**: 386–400.
293 Anderson HR. Trends and district variations in the hospital care of childhood asthma: results of a regional study 1970–85. *Thorax* 1990; **45**: 431–7.
294 Stein LM, Cole RP. Early administration of corticosteroid in the emergency room treatment of acute asthma. *Ann Intern Med* 1990; **112**: 822–7.
295 Pietroni MAC, Milledge JS. IV steroids in acute severe asthma. *Bandolier* 1995; **May**: 15–5.
296 Harrison B, Hart G, Ali N, Stokes T, Vaughan D, Robinson A. Need for intravenous hydrocortisone in addition to oral prednisolone in patients admitted to hospital with severe asthma without ventilatory failure. *Lancet* 1986; **i**: 181–4.
297 Rowe BH, Breatzlaff JA, Boudon C *et al. Magnesium sulphate for treating exacerbations of acute asthma in the emergency department* (Cochrane Review). Oxford: Update Softare, Issue 1, 2003.
298 Graham VAL, Milton AF, Knowles GK, Davies RJ. Routine antibiotics in hospital management of acute asthma. *Lancet* 1982; **1**: 418–20.
299 Gershel JC, Goldman HS, Stein REK, Shelov SP, Ziprkowski M. The usefulness of chest radiographs in first asthma attacks. *NEJM* 1983; **309**: 336–9.
300 Mitchell EA, Ferguson V, Norwood M. Asthma education by community child health nurses. *Arch Dis Child* 1986; **61**: 1184–9.
301 Madge P, Mc JColl, Paton J. Impact of a nurse-led home management training programme in children admitted to hospital with acute asthma: a randomised controlled study. *Thorax* 1997; **52**: 223–8.
302 Mayo PH, Richman J, Harris HW. Results of a program to reduce admissions for adult asthma. *Ann Intern Med* 1990; **112**: 864–71.
303 Hilton S. Patient education in asthma. *Family Pract* 1986; **3**: 44–8.
304 Mazzuca SA. Does patient education in chronic disease have therapeutic value. *J Chron Dis* 1982; **35**: 521–9.

305 Hilton S, Sibbald B, Anderson HR, Freeling P. Controlled evaluation of the effects of patient education on asthma morbidity in general practice. *Lancet* 1986; **1**: 26–9.
306 Bury RF. General practice radiology – the poor relation. *Clin Radiol* 1990; **42**: 226–7.
307 Chisholm R. Guidelines for radiological investigations: make the best use of your department of radiology. *BMJ* 1991; **303**: 797–9.
308 Callahan C, Dittus R, Katz B. Oral corticosteroids therapy for patients with stable chronic obstructive pulmonary disease: a meta analysis. *Ann Intern Med* 1991; **114**: 216–23.
309 van Grunsven P, van Schayck C, Derenne J, Kersjens H *et al.* Long term effects of inhaled corticosteroids in chronic obstructive pulmonary disease: a meta-analysis. *Thorax* 1999; **54**: 7–14.
310 Piaggiaro P, Dahle R, Bakran I *et al.* Multicentre randomised placebo controlled trial of inhaled fluticasone propionate in patients with chronic obstructive pulmonary disease. *Lancet* 1998; **357**: 773–80.
311 Burge P. EUROSCOP, ISOLDE and the Copenhagen City Lung Study. *Thorax* 1999; **54**: 287–8.
312 Callahan C, Dittus R, Katz B. Oral corticosteroid therapy for patients with stable chronic obstructive pulmonary disease. *Ann Int Med* 1991; **114**: 216–23.
313 Anthonisen N, Wright E, IPPB Trial Group. Bronchodilator response in chronic obstructive pulmonary disease. *Am Rev Resp Dis* 1986; **133**: 814–19.
314 Boyd G, Moice A, Pounsford J, Siebert M, Peslis N, Crawford C. An evaluation of salmeterol in the treatment of chronic obstructive pulmonary disease. *Eur Resp J* 1997; **10**: 815–21.
315 Jones P, Bosh T. Quality of life changes in COPD patients treated with salmeterol. *Am J Resp Crit Care Med* 1997; **155**: 1283–9.
316 Levin D, Little K, Laughlin K, Galbraith J, Gustman FP, Murphy D *et al.* Addition of anticholinergic solution prolongs bronchodilator effect of beta 2 agonists in patients with chronic obstructive pulmonary disease. *Am J Med* 1996; **100**: 40–85.
317 Ulrik C. Efficacy of inhaled salmeterol in the management of smokers with chronic obstructive pulmonary disease: a single centre randomised double blind placebo controlled crossover study. *Thorax* 1995; **50**: 750–4.
318 Van Schayk C, Dompeling E, van Herwaarden C, Folgering H *et al.* Bronchodilator treatment in moderate asthma or chronic bronchitis: continuous or on demand? A randomised controlled study. *BMJ* 1991; **303**: 1426–31.
319 Sestini P, Renzoni E, Rominson S, Poole P, Ram FSF. *Short-acting beta-2 agnoists for stable chronic obstructive pulmonary disease.* Cochrane Library: Update Software, 2002.
320 McCrory DB, Brown CD. *Anti-cholinergic bronchodilators versus beta2-sympathomimetic agents for acute exacerbations of chronic obstructive pulmonary disease.* Cochrane Library: Update Software, 2002.
321 Intermittent Positive Pressure Trial Group. Intermittent positive pressure breathing therapy of chronic obstructive pulmonary disease. *Ann Intern Med* 1983; **99**: 612–20.
322 Nocturnal Oxygen Therapy Trial Group. Continuous or nocturnal oxygen therapy in hypoxaemic chronic obstructive lung disease. *Ann Intern Med* 1980; **93**: 391–8.
323 Crockett A, Moss J, Cranston J, Alpers J. *Domiciliary oxygen for chronic obstructive pulmonary disease.* Cochrane Library: Update Software, 1999.
324 Williams BT, Nicholl JP. Prevalence of hypoxaemic chronic obstructive lung disease with reference to long term oxygen therapy. *Lancet* 1985; **ii**: 369–72.
325 Saint S, Bent S, Vittinghoff E, Grady D. Antibiotics in chronic obstructive pulmonary disease exacerbations: a meta analysis. *JAMA* 1995; **273**: 957–60.
326 Poole P, Black P. *Mucolytic agents for chronic bronchitis.* Cochrane Library: Update Software, 2002.
327 Fink G, Kaye C, Sulkes J, Gabbay U, Spitzer S. Effect of theophylline on exercise performance in patients with severe COPD. *Thorax* 1994; **49**: 332–4.

328 Karpel J, Kotch A, Zinny M, Pesin J, Alleyne W. A comparison of inhaled ipratropium, oral theophylline plus inhaled B agonist and combination of all three in patients with COPD. *Chest* 1994; **105**: 1089–94.
329 Kirsten D, Wegner R, Jorres R, Magnussen H. Effects of theophylline withdrawal in severe chronic obstructive pulmonary disease. *Chest* 1993; **104**: 1101–7.
330 British Thoracic Society. BTS Guidelines for the management of chronic obstructive pulmonary disease. *Thorax* 1997; **52** (Suppl. 5): S1-S28.
331 Leitch AG, Parker S, Currie A, King T, McHardy GJR. Evaluation of the need for follow-up in an outpatient clinic. *Resp Med* 1990; **84**: 119–22.
332 Littlejohns P, Baveystock CM, Parnell H, Jones WP. Randomised controlled trial of the effectiveness of a respiratory health worker in reducing impairment, disability, and handicap due to chronic airflow limitation. *Thorax* 1991; **46**: 559–64.
333 Cockcroft A, Bagnell P, Heslop A, Andersson N, Heaton R, Bathlone J *et al*. Controlled trial of respiratory health worker visiting patients with chronic respiratory disability. *BMJ* 1987; **294**: 225–8.
334 Jones A, Rowe B. *Bronchopulmonary hygiene physical therapy for chronic obstructive pulmonary disease and bronchiectasis*. Cochrane Library: Update Software, 1999.
335 Wijkstra PJ, Lacasse Y, Uyatt GH, Goldstein RS. *Nocturnal non-invasive positive pressure ventilation for stable COPD*. Cochrane Library: Update Software, 2002.
336 Tougaard L, Krone T, Sorknaes A, Ellegaard H, the PASTMA Group. Economic benefits of teaching patients with chronic obstructive pulmonary disease about their illness. *Lancet* 1992; **339**: 1517–20.
337 Lacasse Y, Wong E, Guyatt G, King D, Cook D, Goldstein R. Meta analysis of respiratory rehabilitation in chronic obstructive pulmonary disease. *Lancet* 1996; **348**: 1115–19.
338 Ries A, Carlin B, Carrieri-Kohlman V *et al*. Pulmonary rehabilitation: joint ACP/AACVPR evidence-based guidelines. *Chest* 1997; **112**: 1363–96.
339 Devine E, Pearcy J. Meta analysis of the effects of psychoeducational care in adults with chronic obstructive pulmonary disease. *Patient Educ Couns* 1996; **29**: 167–78.
340 Lacasse Y, Guyatt G, Goldstein R. The components of a respiratory rehabilitation program: a systematic review. *Chest* 1997; **1**(11): 1077–88.
341 Ries A, Kaplan R, Limberg T, Prewitt L. Effects of pulmonary rehabilitation on physiologic and psychosocial outcomes in patients with chronic obstructive pulmonary disease. *Ann Int Med* 1995; **122**: 823–32.
342 Lacasse Y, Brosseau L, Milne S, Martin S, Wong E, Guyatt GH, Goldstein RS, White J. *Pulmonary rehabilitation for chronic obstructive pulmonary disease*. Cochrane Library: Update Software, 2002.
343 Goldstein R, Gort E, Guyatt G, Feeny D. Economic analysis of respiratory rehabilitation. *Chest* 1997; **112**: 370–9.
344 Gelband H. *Regimens of less than six months for treating tuberculosis*. Cochrane Library: Update Software, 1999.
345 Volmink J, Garner P. *Interventions for promoting adherence to tuberculosis treatment*. Cochrane Library: Update Software, 1999.
346 Chaulk C, Kazandjian V. Directly observed therapy for treatment completion of pulmonary tuberculosis: Consensus statement of the public health tuberculosis guidelines panel. *JAMA* 1998; **279**: 943–8.
347 Moore R, Chaulk C, Griffiths R, Cavalcane S, Chaisson R. Cost-effectiveness of directly observed versus self administered therapy for tuberculosis. *Am J Resp Crit Care Med* 1996; **154**: 1013–19.
348 Mukhopadhyay S, Sing M, Cater J, Ogston S, Franklin M, Oliver R. Nebulised antipseudomonal antibiotic therapy in cystic fibrosis: a meta-analysis of benefits and risks. *Thorax* 1996; **51**: 364–8.
349 Touw J, Brimicombe R, Hodson M, Heijerman H, Bakker W. Inhalation of antibiotics in cystic fibrosis. *Eur Resp J* 1995; **8**: 1594–1604.

350 Ryan G, Mukhopdhyay S, Singh M. *Nebulised anti-pseudomonal antibiotics for cystic fibrosis*. Cochrane Library: Update Software, 1999.
351 Valerius N, Koch C, Hoiby N. Prevention of chronic Pseudomonas aeruginosa colonisation in cystic fibrosis by early treatment. *Lancet* 1991; **338**: 725–6.
352 Weaver LT, Green MR, Nicholson K *et al*. Prognosis in cystic fibrosis treated with continuous flucloxacillin from the neonatal period. *Arch Dis Child* 1994; **70**: 84–9.
353 Cheng K, Ashby D, Smyth R. *Oral seroids for cystic fibrosis*. Cochrane Library: Update Software, 1999.
354 Dezateux C, Crighton A. *Oral non-steroidal anti-inflammatory drug therapy for cystic fibrosis*. Cochrane Library: Update Software, 1999.
355 Konstan M, Byard P, Hoppel C, Davis P. Effect of high-dose ibuprofen in patients with cystic fibrosis. *NEJM* 1995; **332**: 848–54.
356 Kearney C, Wallis C. *Deoxyribonuclease for cystic fibrosis*. Cochrane Library: Update Software, 1999.
357 Cramer G, Bosso J. The role of dornase alfa in the treatment of cystic fibrosis. *Ann Pharmacotherapy* 1996; **30**: 656–61.
358 Wark P, MacDonald V. *Nebulised hypertonic saline for cystic fibrosis*. Cochrane Library: Update Software, 1999.
359 Dutta S, Hubbard V, Appler M. Critical examination of therapeutic efficacy of a pH-sensitive enteric-coated pancreatic enzyme preparation in treatment of exocrine pancreatic insufficiency secondary to cystic fibrosis. *Digestive Disease and Sciences* 1988; **33**: 1237–44.
360 Beker L, Fink R, Shamsa F *et al*. Comparison of weight-based dosages of enteric-coated microtablet enzyme preparations in patients with cystic fibrosis. *J Paed Gastro and Nutrition* 1994; **19**: 191–7.
361 Smyth RL, vanVelzen D, Smyth A, Lloyd D, Heaf D. Strictures of the ascending colon in cystic fibrosis and high-strength pancreatic enzymes. *Lancet* 1994; **343**: 85–6.
362 Thomas J, Cook D, Brooks D. Chest physical therapy management of patients with cystic fibrosis: a meta-analysis. *Am J Resp Crit Care Med* 1995; **151**: 846–50.
363 Boyd S, Brooks D, Agnew-Coughlin J, Ashwell J. Evaluation of the literature on the effectiveness of physical therapy modalities in the management of children with cystic fibrosis. *Ped Phys Therapy* 1994; **6**: 70–4.
364 Thomas J, DeHueck A, Kleiner M, Newton J, Crowe J, Mahler S. To vibrate or not to vibrate: usefulness of the mechanical vibrator for clearing bronchial secretions. *Physiotherapy Canada* 1995; **57**: 120–5.
365 Smyth R, Walters S. *Oral calorie supplements for cystic fibrosis*. Cochrane Library: Update Software, 1999.
366 Conway S, Morton A, Wolfe S. Enteral tube feeding for cystic fibrosis. Cochrane Library: Update Software, 1999.
367 Wolter J, Bowler S, Nolan P, McCormack J. Home intravenous therapy in cystic fibrosis: a prospective randomised trial examining clinical, quality of life and cost aspects. *Eur Resp J* 1997; **10**: 896–900.
368 Office of Health Economics. *Asthma*. London: OHE, 1990.
369 Clark TJH. *The Occurrence and Cost of Asthma*. London: Camb Med Publications, 1990.
370 Buxton MJ. Economic evaluation studies in respiratory medicine. *Respir Med* 1991; **85** (Suppl.): 43–6.
371 Blainey D, Lomas D, Beale A, Partridge M. The cost of acute asthma – how much is preventable? *Health Trends* 1991; **22**: 151–3.
372 Ross RN, Morris M, Sakowitz SR, Berman BA. Cost-effectiveness of including cromolyn sodium in the treatment program for asthma: a retrospective, record-based study. *Clin Ther* 1988; **10**: 188–203.
373 Carswell F, Robinson EJ, Hek G, Shenton T. A Bristol experience: benefits and cost of an 'asthma nurse' visiting the homes of asthmatic children. *Bristol Medico-Chirurg J* 1989; **104**: 11–12.

374 Wilson-Pessano SR, Scamagas P, Arsham GM, Chardon L, Coss S, German DF, Hughes GW. An evaluation of approaches to asthma self-management education for adults: the AIR/Kaiser-Permanente Study. *Health Educ Q* 1987; **14**: 333–43.

375 Secretary of State. *The Health of the Nation.* CM1986. London: HMSO, 1992.

376 Mitchell EA, Anderson HR, Freeling P, White PT. Why are hospital admission and mortality rates for childhood asthma higher in New Zealand than in the United Kingdom. *Thorax* 1990; **45**: 176–82.

377 British Thoracic Society. BTS Guidelines for the management of community acquired pneumonia in childhood. *Thorax* (2002): **57** (Suppl. 1).