

**THE IMPACT OF EDUCATIONAL INTERVENTIONS ON  
INFLUENZA AND PNEUMOCOCCAL VACCINATION RATES  
IN PRIMARY CARE**

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## **ABSTRACT**

**Background.** Influenza and pneumococcal vaccinations are important therapies supported by national and international guidelines for preventing morbidity and mortality from respiratory illnesses in high-risk groups. The responsibility for delivering these vaccinations in the United Kingdom lies with primary care. Little is known about how rates of influenza and pneumococcal vaccination can be increased in high-risk groups in primary care.

**Aim.** To research methods of improving rates of influenza and pneumococcal vaccination in high-risk groups in primary care.

**Objectives.** To investigate the impact of educational interventions for primary care teams on influenza and pneumococcal vaccination rates in high-risk groups.

**Method.** The research had the following components:

- a. Literature search examining current practice and policy in relation to influenza and pneumococcal vaccination and studies undertaken to improve performance, both in general and specifically in relation to improving adult vaccination rates.
- b. Pilot study of targeting influenza and pneumococcal vaccination to high-risk groups in a single general practice.
- c. Effect of audit and feedback with an information pack to primary care teams on influenza and pneumococcal vaccination in primary care: before-and-after multipractice study.
- d. Effect of audit and feedback with an information pack to primary care teams, as part of a clinical governance programme, on influenza and pneumococcal vaccination in a primary care trust: before-and-after multipractice study.

- e. Randomised controlled study of an educational outreach intervention partly nested within primary care trust study with audit, feedback and information (passive dissemination of guidelines and recommendations) directed at primary health care teams compared with audit feedback and information alone using multifaceted interventions to increase influenza and pneumococcal vaccine uptake in high-risk groups in primary care.

**Results.** The studies demonstrated significant improvements in influenza and pneumococcal vaccination rate in high-risk groups in primary care, showed the levels of improvement that could be expected from these types of intervention and described how primary care teams responded to direct and indirect educational interventions supported by measurement of performance.

**Conclusions.** Education to multiprofessional teams is an important method for diffusion of innovations in the highly professionalised organisations of primary care and general practice. Educators need to understand the complex nature of primary care organisations and teams, when and how education for teams is likely to be successful, the barriers to implementation of new ideas and how to address these. Education when applied appropriately can have important effects in improving health care. This is more likely to occur when careful assessments are made around the nature of the evidence, clear outcomes are sought and measured and the healthcare intervention is understood from the perspective of the patient, the healthcare team and other stakeholders.

## DECLARATION

On the basis of the research conducted for this thesis I have published a number of peer reviewed articles, letters and conference presentations for which I was the principal author. The pilot study and countywide studies began before registration for the degree but were continued as part of this work and are therefore included.

Siriwardena, A. N. (1999) Targeting pneumococcal vaccination to high-risk groups: a feasibility study in one general practice. *Postgrad.Med.J.* **75**, 208-212.

Siriwardena, A. N., Rashid, A. & Johnson, M. R. D. Educating for change. *eBMJ* . (created 28-8-2002, accessed 28-8-2002).

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Siriwardena, A. N., Rashid, A., Johnson, M. R. D. & Dewey, M. E. (2002) Education to improve vaccination uptake. *Br.J Gen.Pract.* **52**, 1021-1022.

Siriwardena, A. N., Hazelwood, L., Wilburn, T., Johnson, M. R. D. & Rashid, A. (2003) Improving influenza and pneumococcal vaccination uptake in high risk groups in Lincolnshire: a quality improvement report from a large rural county. *Quality in Primary Care* **11**, 19-28.

Siriwardena, A. N., Wilburn, T. & Hazelwood, L. (2002) Increasing influenza and pneumococcal vaccination rates in high risk groups in one primary care trust as part of a

clinical governance programme. *Accepted for publication by the British Journal of Clinical Governance.*

### **Presentations**

Siriwardena, A. N. Does education of primary health care teams improve patient outcomes? Cluster randomised controlled trial of an educational outreach visit to improve influenza and pneumococcal vaccination uptake in high-risk groups. Oral presentation at WONCA Europe 2002, Queen Elizabeth II Conference Centre, London 9-13 June 2002.

Siriwardena, A. N., Rashid, A., Johnson, M. R. D. & Dewey, M. Improving influenza and pneumococcal vaccination rates in primary care. Poster presentation at the 2<sup>nd</sup> Asia Pacific Forum on Quality Improvement in Health Care, Singapore 11-13 September 2002.

# CHAPTER 1 INTRODUCTION

## 1.1 Aim

This thesis explores the interrelationship between education, quality of care and performance in health care. It seeks to illuminate the processes of continual professional development, quality improvement and change in practice by examining the delivery of influenza and pneumococcal vaccinations to high-risk patients in primary care. Education includes the various processes by which individual health workers and healthcare organisations continue to learn and develop their craft. Quality is the drive to apply evidence in health care to improve patient and population outcomes, to enhance the consumer experience of health, to lessen inequalities and to reduce unacceptable variations in care. Performance describes the measured outcomes of health care activity whether these are qualitative or quantitative. The quality agenda is a key priority in today's health service and defining the methods to improve quality and performance continues to be a central theme (Department of Health 1998a; NHS Executive 1998).

The research question proposed is: "How and to what extent do educational interventions improve the performance of primary healthcare teams in increasing influenza and pneumococcal vaccination rates in high-risk groups?"

The background to influenza and pneumococcal vaccination in terms of the scientific basis of the health technology and the organisational structures needed to promote its implementation is described. This draws on evidence of interventions to improve

professional practice in general, and to implement effective vaccination strategies in particular. In a series of field studies a number of strategies to improve influenza and pneumococcal vaccination rates in high-risk groups are investigated in the primary care setting.

## **1.2 Rationale**

Influenza and pneumococcal vaccination are important therapeutic strategies supported by national guidelines for preventing morbidity and mortality in high-risk groups. The responsibility for delivering influenza and pneumococcal vaccination in the United Kingdom, as set out through national guidance and recommendations, lies predominantly with primary care, through primary care organisations, general practices and the teams of doctors and nurses working in them. Because of the considerable overlap between risk groups for influenza and pneumococcal vaccination it seemed appropriate to look at both these vaccinations in conjunction. There has been a limited amount of previous research on how rates of influenza and pneumococcal vaccination can be effectively increased in high-risk groups in primary care in the United Kingdom. This work sets out to explore the technical, structural and behavioural factors underlying influenza and pneumococcal vaccination programmes and how rates for these vaccinations can be improved in practice.

## **1.3 Background**

Despite guidelines for delivery of influenza and pneumococcal vaccination from the Department of Health there was evidence of poor coverage of high-risk groups and limited evidence on practical methods of improving vaccinations rates in the late 1990s

when this work began. Less than a quarter of those at risk were being vaccinated for influenza (Watkins 1997) in the United Kingdom and surveys here around the same time also showed very low uptakes of pneumococcal vaccination (McDonald *et al.* 1997a). This situation may have been due partly to poor knowledge and negative attitudes amongst doctors and patients (Wiselka 1994) but it seemed likely that many other factors were involved.

At the start of this work I had been a general practitioner for over ten years, working in a group practice in Lincoln. Lincoln is a cathedral city in the large rural county of Lincolnshire, which is situated in the East Midlands of the United Kingdom. My interest in influenza and pneumococcal vaccination began whilst undertaking a survey of vaccination rates across Lincolnshire practices during my tenure, initially as a member and subsequently as chair of Lincolnshire Medical Audit Advisory Group, an organisation set up in the early 1990s and tasked with improving the quality of primary care in the county. Medical Audit Advisory Groups (MAAGs) at that time formed part of every Family Health Services Authority (FHSA), the body that coordinated practice activity and funding. MAAGs were “accountable to the FHSA for the institution of regular and systematic medical audit in which all practitioners take part” (Department of Health 1990).

The survey revealed large variations in influenza and pneumococcal vaccination, and poor average immunisation rates across practices. I was therefore interested in understanding why this should be and how this situation could be improved. After

reviewing the literature, I decided to look at the practical strategies for improvement of vaccine uptake through a series of field studies. Initially this would take place in my own practice and later investigations would focus on whether and how this experience could be transferred to other practices.

The origins of this work therefore lie partly in the quality initiatives in the health service that began in 1990 with the new contract (Department of Health and Welsh Office 1989), the preceding white papers which laid the groundwork for it (Secretaries of State for Health 1987; Secretaries of State for Health 1989a; Secretaries of State for Health 1989b) and the introduction of medical audit in primary care (Secretaries of State for Health 1989c; Department of Health 1990).

Although the effects of clinical audit in improving quality of care have been intensely debated (Lord and Littlejohns 1997), spin offs from systematic audit have included recognition of issues of data quality (Scobie *et al.* 1995), appropriate design of multipractice audits (Khunti *et al.* 1999), benchmarking and routine feedback of performance (Kendall *et al.* 1999; Pringle 1991). These issues are also explored in this thesis.

Recent National Service Frameworks for Coronary Heart Disease (Department of Health 2000a) and the Elderly (Department of Health 2001b), both of which refer to influenza and pneumococcal vaccination for over 65 year olds and high-risk patients, are part of the most recent health service reforms (Department of Health 1998a) which have continued

the movement towards improving quality and reducing variations in health. With the introduction of clinical governance,<sup>\*</sup> which incorporates a number of quality and regulatory frameworks including the National Service Frameworks, quality assurance, lifelong learning and accountability for standards of clinical care, education as a means of improving quality has come to the forefront of the health research agenda. In particular the problems of shifting continuing professional development to being multidisciplinary and translating directly into benefits for patient care have been highlighted (Department of Health 1998b; Elwyn 1998) and these are key themes which run through this thesis.

#### **1.4 Structure**

The literature review consists of two chapters. The first, Chapter 2, focuses on influenza and pneumococcal vaccines, including the reasons behind their development and promotion, together with evidence of their effectiveness and adverse effects. An analysis of current guidelines for vaccination and the rationale behind targeting of high-risk groups leads to international comparisons of vaccination policies and targets. The second part of the literature review, Chapter 3, examines the literature on barriers to and promoters of vaccination, including physician and patient attitudes. This lays the foundation for a review of strategies to improve professional performance, vaccination rates in general and influenza and pneumococcal vaccination uptake in particular. The behavioural and organisational perspectives of vaccination implementation are considered in relation to patient-directed, provider-orientated, systems-mediated and combined strategies.

<sup>\*</sup> “A system through which NHS organisations are accountable for continuously improving the quality of their services and safeguarding high standards of care, by creating an environment in which clinical excellence will flourish.” Definition taken from ‘A first class service – quality in the new NHS’ (Department of Health 1998a).

The fieldwork is described in the succeeding chapters in terms of methodology (Chapter 4) and results (Chapter 5). The fieldwork begins with the pilot study that looks at improving influenza and pneumococcal vaccination rates in a single general practice and which explores patient, provider and organisational factors affecting vaccination uptake in this setting. This knowledge is applied to two uncontrolled before and after studies investigating improvements in vaccination rates across groups of practices. The first of these examines the effect of audit, feedback and written advice on vaccination behaviour and rates in volunteer practices across one English county. The second looks at vaccination rates in a single primary care organisation when audit, feedback and written advice are used but additionally underpinned by clinical governance. Finally an experimental study that uses lessons learned from the literature search, pilot study and observational studies is undertaken. This was a cluster randomised controlled study to investigate the effect of an educational outreach intervention directed at primary health care teams on vaccination rates in high-risk groups compared with audit, feedback and passive dissemination of guidelines and information alone.

In the discussion (Chapter 6), these studies are analysed in relation to existing conceptual frameworks in order to develop a new model for understanding, analysing and predicting the effects of educational interventions designed to improve quality of care and performance in primary health care. The discussion also explores areas for future study.

The conclusion (Chapter 7) summarises the work and examines the relevance of this thesis to future health education policy.

## **CHAPTER 2 INFLUENZA AND PNEUMOCOCCAL VACCINES:**

### **LITERATURE REVIEW (I)**

#### **2.1 Introduction**

This chapter reviews the literature relating to influenza and pneumococcal vaccination. The review demonstrates the scarcity of work done in the field of adult vaccinations in British general practice despite its current importance in government policy. It seeks to establish that respiratory infections, and in particular those due to influenza and pneumococcal infections, are important causes of morbidity and mortality with considerable implications for patients, populations and both primary and secondary health care systems. It explores the importance of influenza and pneumococcal vaccination in preventive health policy, both generally and specifically today, in the management of winter pressures. It examines possibilities to treat or prevent influenza and pneumococcal infections, including the relative effectiveness of different strategies, and looks at the evidence of benefits, harms and cost-effectiveness of vaccination. The chapter draws on the evidence for vaccination of high-risk groups<sup>\*</sup>, how these high-risk groups have been determined, whether vaccination is effective in high-risk groups and considers other groups, not currently considered high-risk, who may benefit from vaccination. An analysis of guidelines on vaccinating high-risk groups and international variations in recommendations is undertaken.

The review will include the following sections: sources and methodology; a historical

<sup>\*</sup> These are groups of patients at higher risk of developing or succumbing to these infections.

perspective of the importance of influenza and pneumococcal infections on health; epidemiology discussing the impact of influenza and pneumococcal infections on health and social care systems; the place of antibiotics and antivirals; and how antibiotic resistance and ineffectiveness and the limitations of newer antiviral drugs impacts on the importance of vaccination as a strategy to prevent infection. There are also sections on influenza and pneumococcal vaccines and their development; evidence of effectiveness of influenza and pneumococcal vaccination including an evaluation of meta-analyses, randomised controlled studies, case control and cohort studies and their relevance; cost analysis studies exploring whether influenza and pneumococcal vaccinations are cost effective; side effects of the vaccinations; evidence on what constitutes a high-risk group and on vaccine efficacy in high-risk groups; vaccination uptake rates in high-risk groups in the United Kingdom and international comparisons.

## **2.2 Sources**

The articles for this review came from a range of sources including computerised searches of the MEDLINE database from 1976 to 2002; EMBASE database; the Cochrane Database of Systematic Reviews; Database of Abstracts of Reviews of Effectiveness (DARE); Health Management Consortium Database on CD-ROM which combines the Department of Health, King's Fund and Health Management Information Centre at Leeds University databases; Health Promis - database of the Health Education Authority; English National Board (ENB) for Nursing Midwifery and Health Visiting database; CINAHL (Cumulative Index to Nursing and Allied Health Literature) database on the Internet; National Centre for Clinical Audit database on the Internet; recent articles, letters and reviews from the British Medical Journal, British Journal of General

Practice, Postgraduate Medical Journal and the Lancet; citations in the articles found above; citations provided by my supervisor and other colleagues.

### **2.3 Method**

Searches were carried out on computerised databases using the following search terms as Medical Subject Headings or keywords: Streptococcus pneumoniae; pneumonia, pneumococcal; pneumococcal infections; pneumococcal pneumonia; influenza; vaccination, immunization, immunization programs, immunization schedule; risk factors, utilisation, cost-effectiveness. In addition, pneumococcal or influenza vaccine or vaccination was used as a free text search. Abstracts from the searches were examined for relevance and stored on an electronic database (Reference Manager).

### **2.4 Historical perspective**

Influenza has been a cause of epidemics and massive pandemics throughout history. An epidemic is defined as a case rate of 100 per 100,000 population whereas a pandemic involves epidemics across more than one country. Pandemics have had devastating consequences. Influenza was responsible for the decimation of native populations in the New World (Sessa *et al.* 1999) as well as more recent pandemics, notably the Spanish flu pandemic in 1918-19 which caused 40 million deaths worldwide, more than deaths from the First World War. Closer to the present day the most recent epidemic in the United Kingdom, during the winter of 1989-90, was estimated to be responsible for twenty-nine thousand excess deaths (Ashley *et al.* 1991). Due to influenza A, B and C viruses, epidemics are due to significant minor alterations in the virus termed antigenic drift, whereas pandemics are caused by larger genetic transformations called antigenic shift. It

is the ability of the virus to change, which reduces the capacity of the body's immune system to recognise it, and causes the characteristic patterns of infections (Fry 1969). Influenza is often complicated by pneumonia, including pneumococcal pneumonia, and this is often fatal.

At the turn of the century, the mortality from pneumococcal pneumonia was said to be seventy five per cent. Optochin (a drug which was toxic to the eyes), pneumococcal antisera from horse, sulpha drugs and oxygen improved this situation (Macfarlane 1995), but it was penicillin, introduced in 1940, that reduced mortality from pneumococcal pneumonia to its current level of twenty five per cent. There has been no improvement in this mortality rate in the past five decades despite the development of new antibiotics and other medical advances (Obaro *et al.* 1996) and this is an important reason for the continuing interest in preventing pneumococcal infection by vaccination.

## **2.5 Epidemiology**

Respiratory infections, such as influenza and pneumonia, are the commonest cause of presentation to British general practitioners with over thirty per cent of the population consulting with this group of illnesses at least once each year. Rates of illness vary from just under one in five per annum in those aged 45 to 64 years to almost two thirds of under fives consulting each year. In a study of the United Kingdom general practice research database, 20 per cent of consultations were for minor respiratory illness, 13 per cent for moderate illness and 6 per cent for more severe conditions with a proportion of patients presenting with a combination of these (McCormick *et al.* 1995).

Influenza is a common winter pathogen<sup>\*</sup>. In one prospective study it was responsible for almost a third of cases of winter respiratory infections in general practice, with influenza B accounting for 22 per cent and influenza A for 9 per cent of cases. No pathogen was found in a third of cases, in common with other studies, with multiple pathogens in another third (Lieberman *et al.* 1998). Patterns of influenza and influenza-like illness are determined in the United Kingdom using ‘spotter’<sup>†</sup> practices of the Royal College of General Practitioners (RCGP) (Campbell *et al.* 1988), mortality data from the Office of Population Census and Surveys (OPCS) and weekly reports from the Public Health Laboratory Service (PHLS) (Chakraverty 1994). Weekly returns (Fleming 1999) from these practices identify whether influenza like illness exceeds 100 consultations per 100,000 population per week, which is the definition of an epidemic. This compares with the reported baseline rate of influenza-like illness of 28 per 100,000 per week. During epidemics consultations increase, peaking at four weeks and lasting ten weeks each winter with 1.7% of the population consulting in 1989/1990 compared to 0.4% in 1991/2 (Fleming *et al.* 1999). Many countries both in Europe and the United States use similar systems of sentinel practices with laboratory backup (Uphoff 1998; Carrat *et al.* 1998; Schattner *et al.* 1992) to detect epidemics.

Pneumococcal respiratory infections are common in general practice accounting for a quarter of cases of community acquired pneumonia and over one third of severe pneumonia admissions (MacFarlane *et al.* 1982). The greatest morbidity and mortality arises from *Streptococcus pneumoniae* bacteraemia which has an incidence of 8.7 per

<sup>\*</sup> A pathogen is a germ producing infection.

<sup>†</sup> ‘Spotter practices’ are general practices that collect data on influenza.

thousand per year, 92% from bacteraemic pneumococcal pneumonia (George 1995) with the most of the rest from pneumococcal meningitis and less commonly other infections such as osteomyelitis, septic arthritis, sinusitis, bronchitis and middle ear infection.

Complications of both influenza and pneumococcal sepsis\* are commoner in elderly people and those with pre-existing disease. For influenza, complications include lower respiratory infections particularly bronchitis which affects up to a fifth of patients presenting to general practitioners (Connolly *et al.* 1993). Less common complications include influenza viral pneumonitis, secondary bacterial pneumonia due to *Streptococcus pneumoniae*, *Haemophilus influenzae* and *Staphylococcus aureus* and middle ear infections as well as a number of rarer sequelae including febrile convulsions, toxic shock, cardiac, neurological and other complications.

Pneumonia as a consequence of influenza has a high mortality reaching almost forty per cent in one series (Jones *et al.* 1991). The last large epidemic in the winter of 1989/90 was estimated to have caused almost thirty thousand deaths (Ashley *et al.* 1991). Influenza also leads to disability, particularly in elderly at-risk patients. A case control study of elderly nursing home patients before and four months after an influenza epidemic showed that 25 per cent of those with serologically confirmed influenza suffered a major functional loss in bathing, dressing or mobility compared to 15.7 per cent in control subjects (Barker *et al.* 1998). Hospital admissions are also increased because of influenza epidemics although actual rates are dependent on the size of the epidemic and the virulence of the organism. One prospective study of epidemics in the

\* Sepsis is another term for infection.

United States between 1970-78 showed an average excess of about 172,000 hospitalisations per epidemic at a cost in excess of \$300 million (Barker 1986).

Pneumonia in a British multicentre study (Macfarlane 1995) was responsible for seven per cent of adult admissions and a median hospital stay of 11 days. A quarter of those affected were unable to return to normal activity by six weeks. It results in a mortality rate of three per cent rising to eleven per cent with bacteraemia (British Thoracic Society and Public Health Laboratory Service 1987) and is the fifth most common cause of death in England and Wales. There is also a higher risk of death for some time following recovery (Koivula *et al.* 1999). The mortality rate from bacteraemic pneumococcal pneumonia has remained unchanged over the last fifty years (Obaro *et al.* 1996).

The huge burden of illness and death from influenza and pneumococcal infection has stimulated research into treatment and prevention of these conditions.

## **2.6 Treatment**

Influenza can be treated with antiviral agents like amantadine and rimantidine, so called ion channel inhibitors, which are active against influenza A. They are hampered in their use by problems with viral resistance and side effects (Nicholson 1996) and a reluctance of practitioners to use them because of these problems and through lack of awareness. More recently the neuraminidase inhibitors, zanamivir (Relenza) (Hayden *et al.* 1997) and oseltamivir have been shown to be effective against influenza. They are active against both influenza A and B reducing clinical cases by 74% (95% confidence interval: 50 to 87%), laboratory cases by 60% (33 to 76%), duration of symptoms by one day (0.6

to 1.3 days) and time to return to normal activities by half a day (0.1 to 1.1. days) in laboratory confirmed cases (Jefferson *et al.* 2000). In influenza positive patients over the age of fifty or in high-risk groups they reduce symptoms by up to three days (Monto *et al.* 1999). The National Institute of Clinical Effectiveness\* in England has approved the use of zanamivir for use in at-risk individuals during near epidemic rates of illness equivalent to 50 consultations per 100,000 population per week. There are potential problems with arranging for patients to receive a prescription within the 36 hours required for the drug to be effective due to increased workload, a lack of resources and capacity during an epidemic and doubts over accuracy of diagnosis or the efficacy of the drug (Nguyen-Van-Tam 1999). Also, only 11 per cent of respiratory infections during influenza epidemics have been found in community surveillance studies to be due to influenza, the rest being caused by other organisms including respiratory syncytial, parainfluenza and other viruses (Barker *et al.* 1995), even in hospitalised elderly people (Falsey *et al.* 1995). Considerable uncertainty therefore exists about the feasibility of using neuraminidase inhibitors in general practice. Antibacterials have also been used to prevent secondary infection during influenza epidemics and were shown to reduce rates of pneumonia in a randomised placebo controlled study from 16.3% in the placebo group to 2.4% in the antibiotic group (Maeda *et al.* 1999). These problems of diagnosis and treatment have resulted in influenza vaccination emerging as the chief public health strategy to combat influenza.

\* The National Institute of Clinical Effectiveness (NICE) is a national body set up to produce guidance for doctors in England and Wales to reduce unacceptable variations in care and prevent postcode (or area specific) prescribing.

Although most pneumococcal infections in this country were still sensitive to antibiotics, particularly penicillin and erythromycin, the problems of increasing bacterial resistance (see 2.7), a static mortality rate of bacteraemic pneumonia of up to twenty five per cent (Kramer *et al.* 1987), and the large burden of illness, hospitalisation and mortality from pneumococcal pneumonia encouraged the use of vaccination as a preventative measure.

## **2.7 Antibiotic resistance**

Penicillin resistant strains were recognised *in vitro* in 1940 but first appeared *in vivo* in 1960 in the United States. The problem of increasing antibiotic resistance was another significant reason for the interest in vaccination to prevent pneumococcal infections (Butler *et al.* 1998; Sanford 1994; Nuorti *et al.* 1998). Surveys of pneumococcal isolates from public health laboratories in England and Wales showed that resistance of pneumococci to antibiotics was increasing. Penicillin resistance, either full or intermediate (Ward 1981), increased from 1.5% in 1990 to 3.9% in 1995 whereas erythromycin resistance increased from 2.8% to 8.6% in pneumococcal isolates (Johnson *et al.* 1996). In some areas of the United Kingdom, the problem was even greater. For example, in East London for a six-month period between 1994 and 1995 12% of isolates were found to be resistant to penicillin. The prevalence of penicillin resistance is greater in the United States, with 30% of pneumococcal isolates resistant in some areas (Moolenaar *et al.* 2000), France with resistance rates over 40% (Geslin *et al.* 1998) and with resistance endemic in Spain (57% of isolates) presumably due to greater availability and use of antibiotics (Linares *et al.* 1992). Although penicillin in adequate doses was still effective for many partially resistant infections (Wilson *et al.* 1996) antibiotic resistance continued to be an important concern whereas ninety six per cent of

pneumococcal isolates sent to the PHLS in England and Wales belonged to the serotypes contained in the current vaccine (George *et al.* 1997).

## **2.8 Influenza vaccine**

Influenza virus consists of a single-stranded segmented ribonucleic acid genome with eight genes. Six of these genes code for viral proteins in the core and the other two for the surface antigens, haemagglutinin (H) and neuraminidase (N). These glycoproteins attached to the lipid coat effectively mediate virulence and antibody response. It is this structure that allows exchange of genes between different strains of the virus leading to antigenic shift as well as smaller genetic mutations leading to antigenic drift (Shann 1990). Salk first used killed vaccine using whole virus treated with formalin in 1945 (Wiselka 1994). Later subunit virion vaccines were produced consisting of only the surface antigens H and N. The newer split virion vaccines use a solvent such as ether to disrupt the viral envelope. They are usually trivalent, containing two subtypes of influenza A and one of influenza B and produce a rapid antibody response that lasts three to six months. This decline in antibodies and the need to vary the composition of the vaccine depending on the subtypes prevalent each year are the reasons for annual revaccination. Apart from these killed or inactivated vaccines, live vaccines have been trialled but are unlicensed.

## **2.9 Pneumococcal vaccine**

There are at least ninety different serotypes of pneumococcus differentiated by typing of the polysaccharide capsule of the diplococcus (Kalin 1998). The vaccine contains bacterial capsular polysaccharides and induces antibodies against the protective capsule,

which allow opsonisation (preparation) and phagocytosis (ingestion by white blood cells) of invading pneumococci. Neufeld and Rimpeau first discovered the idea of vaccination against pneumococcus in 1904 when they found the bacterium more susceptible to attack after injecting the serum of animals injected with killed pneumococci (Taussig 1979). Early studies showed trivalent, hexavalent, 12 and 13-valent vaccines to be effective at preventing pneumococcal pneumonia and are summarised in an earlier review (Requejo 1993). Antibodies were found to persist for up to eight years in vaccinees (Heidelberger *et al.* 1950). The antibody response is likely to be lower and attenuate more quickly in the elderly and patients with splenectomy but advice on reimmunisation is inconsistent (Bird 1995). The first of these vaccines in common use, the 14-valent pneumococcal vaccine, which contained capsular polysaccharides from the fourteen commonest infecting strains of the bacterium, was first introduced in 1977 and licensed in 1978. The 23-valent vaccine replaced this in 1983 (Fiebach and Beckett 1994). It was first recommended in the United Kingdom in 1992 (Begg and Salisbury 1992). The current vaccines, Pneumovax II (Merck, Sharpe & Dohme) and Pnu-Immune 23 (Lederle-Praxis) consists of purified capsular polysaccharide from 23 serotypes of pneumococci, types 1, 2, 3, 4, 5, 6B, 7F, 8, 9N, 9V, 10A, 11A, 12F, 14, 15B, 17F, 18C, 19F, 19A, 20, 22F, 23F and 33F. Most pneumococcal isolates from the Public Health Laboratory Service in England and Wales (92% in 1995) were from serotypes or serogroups included in the current 23 valent vaccine (Johnson *et al.* 1996).

An important advance was the development of new conjugate vaccines, in which the polysaccharide component is linked to a protein, resulting in greater immunogenicity and

effectiveness, particularly in children (Hattotuwa and Hind 1997; Shann 1990) and possibly in the immunocompromised. This innovation has not yet been translated into the current adult vaccine.

## **2.10 Effectiveness of influenza vaccination**

The evidence for effectiveness of influenza vaccination comes largely from systematic reviews and meta-analyses in adults and elderly people. More recent evidence from observational studies also suggests greater effectiveness of repeated influenza vaccination. These studies are described in more detail below. The issue of influenza vaccine effectiveness in high-risk groups is explored later (see 2.14).

Systematic reviews and meta-analysis are methods for systematically collating, assessing, combining and presenting results from more than one study. The advantages of this approach are to enable a more transparent and objective review of the data, to combine data to reduce the possibility of false negative results due to inadequate power, and to generate questions and sample sizes for future research, particularly when the evidence is unclear or controversial (Egger and Smith 1997). There are a number of potential problems with this methodology. These include heterogeneity, with differences in study populations, geographical location, timing, treatments and outcomes of studies. Publication bias involves English language and positive studies, particularly randomised controlled studies, being more likely to be published and therefore included in a systematic review whereas negative studies are less likely to appear in print or more likely to be delayed. Salami publication may result in data being included more than once in a meta-analysis because of duplicate publication of data. Poor quality, small and

methodologically weak studies can also lead to bias (Naylor 1997; Greenhalgh 1997; Hopayian 2001). Some of these problems can lead to false conclusions but others may sometimes be avoided by careful quality assessment (Sterne *et al.* 2001).

In a meta-analysis of influenza vaccine effectiveness in young adults (Demicheli *et al.* 2000), 14 randomised or quasi-randomised studies of sufficient quality were included. The study subjects were healthy adults aged 14 to 60 years and the outcome used was confirmed or clinical influenza compared against placebo or non-influenza vaccine. Inactivated vaccine reduced cases of clinical influenza A with virological confirmation (serologically or with viral isolation or both) by 68% (95% confidence interval 49 to 79%). Vaccines that matched the circulating strain were more effective. The vaccine was less effective (with an efficacy of 24%) in reducing cases of flu-like illness without virological confirmation. Vaccination also significantly reduced time off work, but only by 0.4 days (0.1 to 0.8 days). The absolute risk of clinically defined influenza was 1034/5953 (17%) with influenza vaccine and 791/2798 (28%) in controls. The number needed to treat, which is a measure of the number of persons needing to be vaccinated to prevent one case of clinical influenza, was calculated as the inverse of the absolute risk reduction to be 9.1.\*

The systematic review by Gross of vaccine effectiveness in elderly adults (Gross *et al.* 1995) included patients of sixty-five years or older and incorporated the findings from studies of adequate quality including twenty cohort studies with mortality data, three case

\* Number needed to treat (NNT) = one divided by absolute risk reduction (1/ARR or 100/ARR%) or, in the example quoted, 1 divided by 0.11.

control studies and a single randomised controlled study. The outcomes included death, hospital admission, pneumonia or respiratory illness. A meta-analysis of the cohort studies showed percentage reductions of 56% (95% confidence interval 39 to 68%) for respiratory illness, 53% (35 to 66%) for pneumonia, 50% (28 to 65%) for hospitalisation and 68% (56 to 76%) for death in vaccinated compared to non-vaccinated subjects. These studies were subject to confounding factors from using patients refusing vaccine as controls, lack of matching of the vaccine and virus strain and failure to confirm the diagnosis of influenza with serological tests. A further retrospective cohort study has been carried out in the United Kingdom since this meta-analysis. Using computerised general practitioner records on nearly 10,000 patients aged 55 years and over during the 1989-90 epidemic and after adjusting for confounding factors the investigators found that recent influenza vaccination conferred a protective effect of 75% (95% confidence interval: 21 to 92%) against death. This effect was present irrespective of age or the presence of underlying chronic disease (Fleming *et al.* 1995).

The three case control studies in the meta-analysis by Gross showed comparable rates of vaccine efficacy, ranging from 32 to 45% to prevent hospitalisation, 31 to 65% for reduction in deaths from influenza and pneumonia and 27 to 30% for all deaths from all causes. A subsequent case control study of influenza deaths from Leicestershire used primary care records for 315 patients who died of influenza and 777 controls, matched for age, sex and area of residence that died within a year of the 1989-90 epidemic. It showed that influenza vaccination reduced mortality by 41% (95% confidence interval 13 to 60%) for all subjects, 9% (0 to 59%) for first time vaccinees and 75% (31 to 91%) in those who

had been vaccinated on more than one occasion. The vaccine was as effective in subjects who lived in institutions or in community and for those with high-risk medical conditions as those without (Ahmed *et al.* 1995). The same group of investigators undertook a case control study of hospital admissions with influenza and related respiratory conditions including pneumonia, bronchitis and emphysema (Ahmed *et al.* 1997b). The researchers looked at 156 admissions and 289 controls matched for age and sex. The odds ratio for hospital admission among vaccinees was 0.67 (95% confidence interval 0.39 to 1.12) giving an estimate of vaccine effectiveness of 33% (95% confidence interval 0 to 61%). In institutionalised and chronically ill patients, the effect was even greater with influenza vaccination reducing hospital admissions by 63% (17- 84%).

A single randomised controlled trial that was carried out in general practice in the Netherlands with previously vaccinated healthy adults aged over sixty gave the best measure of influenza vaccine effectiveness in the elderly. Inactivated vaccine was compared with intramuscular saline with nine hundred patients in each group. The outcome used was influenza-like illness up to five months after vaccination, whether self-reported influenza in postal questionnaires or influenza confirmed by serology. The incidence of serological influenza was 4% in the vaccine group and 9% in the placebo group (relative risk [RR] 0.50, 95% confidence interval [CI] 0.35 to 0.61) and for clinical influenza 2% and 3%, respectively (RR 0.53, 95% CI 0.39 to 0.73). This gave a number to treat (inverse of the absolute risk reduction) of 20 for serologically proven and 100 for clinical influenza respectively (Govaert *et al.* 1994).

A recent systematic review and meta-analysis looked at studies for influenza vaccine effectiveness for elderly people aged sixty-five and over living in the community but excluding institutionalised elderly. This again showed vaccine efficacy in preventing influenza-like illness (35%, 95% confidence interval 19 to 47%), hospitalisation for influenza or pneumonia (33%, 27 to 38%), mortality following hospitalisation (47%, 25 to 62%) and all cause mortality (50%, 45 to 56%) (Vu *et al.* 2002).

The possibility that influenza vaccination may have other benefits, such as protection against stroke has been raised by a case-control study from France (Lavallee *et al.* 2002). In this study, elderly patients admitted to Paris hospitals with cerebral infarction were compared with controls, matched for age, sex and residency. Vaccination, either in the previous season or in the previous five years was associated with a reduced incidence of stroke. However, a healthy user effect may have been a confounding factor here.

### **2.11 Effectiveness of pneumococcal vaccine**

There have already been four published meta-analyses of randomised controlled studies (Fine *et al.* 1994; Hutchison *et al.* 1999; Moore *et al.* 2000; Cornu *et al.* 2001) and a protocol for a further systematic review on pneumococcal vaccine was available in the Cochrane Database of Systematic Reviews (Holden *et al.* 1997). It is beyond the remit of this review to repeat this work. However, it may be useful to comment on the findings of these meta-analyses in the context of pneumococcal vaccination use in United Kingdom primary care.

The meta-analysis of Fine *et al.* from 1994 reviewed 164 articles from a comprehensive

review of the literature. Articles were identified from a rigorous search of MEDLINE and articles identified by lead authors of the randomised controlled and case control trials as well as the vaccine manufacturers. Randomised controlled trials using vaccine valences of four or fewer, case control, observational, cost-effectiveness studies, and review articles were excluded. The authors subjected all articles to independent review and assessed them for quality assigning each a quality score. The final list included nine randomised controlled trials, three of which had two distinct vaccine and study groups producing twelve studies in all for analysis. The meta-analysis looked at ten outcomes. These were definitive pneumococcal pneumonia, definitive pneumococcal pneumonia for vaccine serotypes, presumptive pneumococcal pneumonia, presumptive pneumococcal pneumonia for vaccine serotypes, and pneumococcal disease (bacteraemia), which five were referred to as pneumococcal infection related outcomes. The other five outcomes were pneumonia (all causes), bronchitis, all cause mortality, pneumonia mortality and pneumococcal infection mortality. The analysis of effectiveness was based on odds ratios (ratio of the odds of the study outcome in the vaccine group compared to the study outcome in the control group) and rate differences (probability of having an outcome in the control group minus probability of the same outcome in the vaccine group). The authors found a statistically significant protective effect for the first four pneumococcal infection related outcomes, that is definitive or presumptive pneumococcal pneumonia for all serotypes or vaccine types only. They found no effect in preventing pneumococcal bacteraemia, pneumonia, bronchitis or mortality. Subgroup analysis in this meta-analysis also showed that the benefit was for low-risk rather than high-risk patients.

A subsequent Canadian meta-analysis summarised the thirteen randomised and quasi-randomised trials involving over 65,000 patients published before 1996 that were of sufficient quality. The paper concluded that pneumococcal polysaccharide vaccine could be expected to reduce the risk of systemic infection due to pneumococcal types included in the vaccine by 83% and systemic infection due to all pneumococci by 73%. It also found no evidence that the vaccine was less effective for the elderly, institutionalised, or those with chronic disease. It also gave a number needed to treat of 2520 to prevent one case of pneumococcal bacteraemia per year (Hutchison *et al.* 1999).

The next review included only recent randomised controlled trials and excluded some of the earlier randomised controlled trials because they used atypical populations of young adults with high-risk of pneumococcal pneumonia (Moore *et al.* 2000). These early studies were conducted on healthy South African gold miners (Austrian 1980; Smit *et al.* 1977) and New Guinea subsistence farmers (Riley *et al.* 1977) and despite the poor quality of these studies they provided the evidence for licensing of pneumococcal vaccination in the United States. These three early studies using atypical populations showed most benefit from pneumococcal vaccine and may have had a disproportionate effect on the earlier meta-analyses. They showed that pneumococcal vaccination was effective in reducing the incidence of all-cause pneumonia (relative risk 0.56, 95% confidence interval 0.47 to 0.66), pneumococcal pneumonia (0.16, 0.11 to 0.23), pneumonia deaths (0.70, 0.50 to 0.96) and bacteraemia (0.18, 0.09 to 0.34) (Moore *et al.* 2000).

**Table 1: Conclusions from the meta-analysis of randomised controlled trials of pneumococcal vaccine efficacy in adults (adapted from Fine et al. 1994)**

Outcome	Summary odds ratios* (95% CI)	Summary rate differences† for all patients (95% CI)	Summary odds ratios‡ for low risk§ (95% CI)	Summary rate differences for low risk (95% CI)	Summary odds ratios for high-risk (95% CI)	Summary rate differences for high-risk (95% CI)
Definitive pneumococcal pneumonia	0.34 (0.24 to 0.48)	4 (0 to 7)	0.32 (0.22 to 0.46)	11 (2 to 19)	1.23 (0.28 to 5.43)	0 (-1 to 2)
Definitive pneumococcal pneumonia (vaccine types only)	0.17 (0.09 to 0.33)	8 (1 to 16)	0.16 (0.09 to 0.31)	15 (-14 to 45)	1.00 (0.06 to 16.06)	0 (-2 to 2)
Presumptive pneumococcal pneumonia	0.47 (0.35 to 0.63)	13 (21 to 47)	0.40 (0.29 to 0.56)	41 (29 to 54)	0.98 (0.51 to 1.89)	-3 (-21 to 15)
Presumptive pneumococcal pneumonia (vaccine types only)	0.39 (0.26 to 0.59)	16 (-3 to 35)	0.35 (0.23 to 0.55)	25 (15 to 35)	0.86 (0.29 to 2.56)	1 (-5 to 7)
Pneumonia (all causes)	0.9 (0.77 to 1.04)	6 (-1 to 13)	0.89 (0.76 to 1.05)	6 (-2 to 14)	0.92 (0.63 to 1.35)	5 (-5 to 16)
Bronchitis	0.84 (0.69 to 1.02)	6 (0 to 15)	0.84 (0.69 to 1.02)	8 (0 to 15)	-	-
Mortality (all causes)	1.02 (0.90 to 1.14)	1 (-6 to 8)	0.84 (0.70 to 1.01)	2 (-2 to 7)	1.16 (1.00 to 1.35)	-18 (-47 to 11)
Mortality (due to pneumonia)	0.78 (0.57 to 1.06)	2 (-2 to 5)	0.79 (0.57 to 1.08)	2 (-2 to 5)	0.51 (0.09 to 2.92)	
Mortality (due to pneumococcal infection)	4.59 (0.54 to 38.81)	-3 (-6 to 0)			4.59 (0.54 to 38.81)	-3 (-6 to 0)

\* Confidence intervals straddling 0 for rate differences and 1 for odds ratios are not significant at p=0.05.

† Rate differences and confidence intervals expressed as number per 1000.

‡ The odds ratio is the ratio of odds of the outcome with vaccination to the odds without vaccination.

§ For definitions of low and high risk see 2.13.

Two of the early studies were quasi-randomised, by alternate allocation, and so were not randomised studies in the true sense. They were carried out with relatively low valence vaccines (6 to 13 pneumococcal serotypes) compared to the current vaccine. This may have underestimated their effectiveness compared to the 23-valent vaccine.

The characteristics of the patients in these early studies, young immunocompetent adults, were too unlike United Kingdom patients within the current recommendations to allow a useful comparison. Indeed there have been no studies of patients from this country. The miners in particular suffered from high rates of pneumococcal pneumonia due to dust inhalation and overcrowding. Moore *et al.* (2000) therefore excluded these earlier trials or those that did not look at true outcomes and only included trials after 1996 in their meta-analysis. It showed that in the ten later studies of over 24,000 people who were elderly or likely to have impaired immune systems, pneumococcal vaccination had no effect for important clinical outcomes, such as rates of pneumonia, pneumococcal pneumonia, lower respiratory tract infections, pneumonia deaths or bacteraemia.

The fourth and latest meta-analysis looked at randomised controlled trials in immunocompetent adults (Cornu *et al.* 2001). In the fourteen trials totalling 48,837 patients retrieved, pneumococcal vaccination prevented definite pneumococcal pneumonia by 71%, presumptive pneumococcal pneumonia by 40%, and mortality due to pneumonia by 32%, but not all-cause pneumonia or death. The authors found no preventive effect in the subgroup of patients aged 55 years or more and argued that this may have been due to lack of statistical power.

In support of these four meta-analyses, the constituent randomised controlled trials minimised bias due to patient selection, subject migration, vaccine exposure and ascertainment of vaccination status and outcome (Shapiro and Clemens 1984). However these meta-analyses may have introduced other forms of bias including publication bias such as duplicate publication, non-publication or delayed publication of negative results, language bias, problems with heterogeneity, matching and pooling with different populations, interventions, settings and time periods (Egger *et al.* 1997). Individual trials included in these meta-analyses have also been criticised. For example, the Swedish study (Ortqvist *et al.* 1998) which showed no evidence of efficacy was criticised for lack of statistical power, low numbers (339 vaccinees and 352 controls), problems with case ascertainment, failure to assess blinding and an underestimate of immunocompromised patients subjected to the vaccine. The study was stopped after two years because of lack of efficacy although post hoc analysis showed that it was underpowered. It led to a wealth of critical correspondence (Butler *et al.* 1998b; (Steinhoff *et al.* 1998; Hak *et al.* 1998b; Gold 1998; Obaro 1998) In comparison, a Finnish study, which used larger numbers of patients, showed a beneficial effect, over and above influenza vaccine alone (Koivula *et al.* 1997). Patients in high-risk groups given pneumococcal vaccination in addition to influenza vaccine benefited from protective efficacy of 59% (95% confidence interval, 6% to 82%). Another potential weakness was that studies other than randomised controlled trials were excluded (Hasselblad *et al.* 1995). Because these studies contribute to the evidence, the observational studies, both case control and cohort studies, are described below.

There have been six case control studies of pneumococcal vaccine efficacy; one of these was a follow-up investigation of an earlier study. These investigations were carried out in four different sites in the United States and all involved cases admitted to hospital. They used different inclusion criteria (see Table 2), slightly different definitions of at-risk groups (see Table 3), and patients were vaccinated with either the 14 or 23-valent vaccine. All the studies defined cases as patients with systemic pneumococcal infections diagnosed on blood culture or culture of other sterile body fluids, e.g. cerebrospinal fluid or joint aspirate. It is worth describing the salient points of the different studies in this group.

The New Haven study (Shapiro and Clemens 1984) excluded younger patients aged between 2 and 17 years. The initial results were published in 1984 and a follow up report in 1988. Patients were divided into three groups according to underlying illness for matching controls. These were highest-risk immunocompromised (including asplenia, malignancy and SLE), moderately increased risk immunocompetent (chronic pulmonary disease, chronic heart failure, diabetes, alcoholism, chronic renal failure requiring dialysis) and mildly increased risk (including age  $\geq 55$ ). The results showed the vaccine to be very effective overall (61%, confidence interval 42 to 73%) and in those with moderately increased risk (60%, 37 to 75%) but not in patients aged 55 years and above with no other risk factors (64%, -5 to 87%). Subgroup analysis in the initial study also showed that the vaccine was not effective in the highest-risk immunocompromised group (efficacy 0 %, -1228 to 93%). The effect was specific to vaccine serotypes in that for non-vaccine type infections the protective efficacy was -11%. Influenza vaccine had been

administered in similar proportions to both cases (30%) and controls (33%).

The Colorado study showed no effect of pneumococcal vaccination (vaccine efficacy -21%, -221 to 55%). Controls were matched for age, admission date and underlying illness. However, the study may not have had sufficient power to eliminate type 2 errors (false negative results) because of the small numbers used. This study examined the older 14-valent vaccine (containing 14 pneumococcal serotypes), which was subsequently replaced by the 23-valent vaccine (Forrester *et al.* 1987).

The study by Sims *et al.* from Philadelphia used two controls per patient, matched according to date of admission, hospital site and underlying illness. Exclusion criteria included age less than 55 years, immunosuppressive disease (dysglobulinaemia, lymphoma, haematological malignancies, organ transplantation, nephrotic syndrome), immunosuppressive drugs (chemotherapy, steroids >20mg/day of prednisolone or equivalent within a year of inclusion) or incomplete medical records (23%). Vaccine efficacy in this study of low risk older patients was 70% (37 to 86%) (Sims *et al.* 1988). These results may be an overestimate because of exclusion due to incomplete records.

**Table 2: Case control studies reviewed listed by author etc.**

Study	Vaccine	Number	Case selection	Pneumococcal strain	Vaccine efficacy (95% CI)
New Haven, Connecticut (Shapiro and Clemens 1984)	14-valent*	543 cases, 543 controls	Positive sterile body fluid or blood culture	Vaccine serotype & related	61 (42,73)
Denver, Colorado (Forrester <i>et al.</i> 1987)	14-valent	89 cases, 89 matched controls	Positive blood culture	Vaccine serotype & related	-21 (-221,55)
Philadelphia (Sims <i>et al.</i> 1988)	14 & 23 valent	122 cases, 244 matched controls	Positive sterile body fluid culture, hospitalised, aged >55, immunocompetent, complete records	All serotypes	70 (37,86)
Connecticut (Shapiro <i>et al.</i> 1991)	14 & 23 valent	1054 cases, 1054 controls matched for age, hospital site and underlying illness	Positive sterile body fluid culture, hospital-based, >18, at-risk groups	Vaccine serotypes & related	47 (30,59)
				Immunocompromised	56 (42,67)
				Not vaccine serotypes	61 (47,72) 21 (-55,60)
Charlottesville, Virginia (Farr <i>et al.</i> 1995)	14 & 23 valent	85 cases, 152 matched controls	Positive blood culture, hospitalised patients, > 65 or >2 with risk factor	All serotypes	-73 (-263,18) 81 (34,94)
Alaska (unpublished observations) (Davidson <i>et al.</i> 1994)	14 & 23 valent	87 cases, 87 controls		Vaccine serotype & related	79 (45,92)
		159 cases, 159 controls		All serotypes	64 (32,81)

\* 14-valent refers to the number of pneumococcal strains contained within the vaccine

**Table 3 Risk groups used in case control studies\***

	DHSS risk groups for pneumococcal vaccination	Shapiro et al, New Haven, Connecticut 1984	Forrester et al, Denver, Colorado 1987	Sims et al, Philadelphia 1988	Shapiro et al, Connecticut 1991	Farr et al, Charlottesville, Virginia 1995
Asplenia / splenectomy						
Chronic renal disease						
Immuno-suppression						
HIV						
Chronic heart disease		†				‡
Chronic lung disease						
Diabetes						
Chronic liver disease						
Alcoholism						
Age ≥ 65						
Age ≥ 55						
Stroke						
Dementia						
Disseminated cancer						
Local cancer						§
Lymphoma						
Myeloma						
Leukaemia						
Lupus erythematosus						
Rheumatoid disease						

\* Shaded areas signify which risk groups were included in the guideline or study.

† Chronic heart failure.

‡ Includes coronary disease, congestive heart failure, and valvular heart disease.

§ Lung cancer

A follow up study in Connecticut excluded young patients between 2 and 17 years. Again patients were divided into two groups according to underlying illness for matching controls, highest-risk immunocompromised (including asplenia, malignancy and SLE) or moderately increased-risk immunocompetent (age  $\geq$  55, chronic pulmonary disease, chronic heart failure, diabetes, alcoholism, chronic renal failure requiring dialysis). Subgroup analysis showed that vaccine was not effective in the immunocompromised group (efficacy 21%, -55 to 60%), patients aged  $\geq$  55 with no other risk factors (efficacy 40%, -23 to 71%) and those not infected by vaccine type viruses (Shapiro *et al.* 1991).

In another study (Farr *et al.* 1995), patients over 65 years or over 2 years with a risk factor admitted to hospital were selected as cases. The investigators used three matched controls for each case with matching for eight variables: admission date, age, sex, race, type and duration of major risk factor (categorised into high, moderate and low risk), number of vaccine indications, number of hospitalisations since pneumococcal vaccine licensed and type of primary medical care. They used matching to ensure that cases and controls had an equal likelihood of exposure to pneumococcal vaccine. Vaccine efficacy was 81% (34 to 94%) in this study.

An unpublished study from Alaska investigating the 14-valent vaccine with 87 cases and 87 controls showed a vaccine efficacy in vaccine and vaccine-related serotypes of 79% (45 to 92%). The investigators subsequently found a vaccine efficacy of 64% (32 to 81%) in all serotypes with the 23-valent vaccine (Davidson *et al.* 1994).

In summary five out of six case control studies demonstrated a protective effect of the vaccine. The smallest study, which lacked power, was the only negative study. These five studies showed a positive effect of pneumococcal vaccine, from pneumococcal serotypes contained in the vaccine, in low risk elderly. They used the older 14-valent vaccine (which has since been superseded), although the four later studies, which used both the 14 and 23-valent vaccines, also showed a benefit of vaccination. Case control studies, although having a greater power to detect effects of interventions on rare events, are more susceptible to bias due to ascertainment and selection. However, the consistent finding of benefit from these case control studies supported a protective effect of vaccination. This influenced the policy decisions taken in both the United States and United Kingdom to implement national recommendations for pneumococcal vaccination. Although this included low risk elderly in the United States, the recommendation was to vaccinate high-risk patients, including the elderly, in the United Kingdom.

There have been four cohort studies of pneumococcal vaccination and these also showed a beneficial effect of pneumococcal vaccination (Table 4). The CDC studies and cohort study of Butler et al. (1993) used surveillance data from blood and cerebrospinal fluid cultures sent to United States laboratories and submitted to the Centers for Disease Control over several years. They compared rates of positive cultures in vaccinated as opposed to unvaccinated subjects. The study by Christenson et al. (2001) was a 3-year prospective study following an influenza and pneumococcal vaccination programme for all patients aged 65 years or older (259,627) in Stockholm County, Sweden. Patients aged 65 years and over admitted to hospital in Stockholm County with influenza and

pneumonia related diagnoses were identified over a six-month period. The incidence (per 100,000 inhabitants per year) of hospital treatment was lower in the vaccinated than in the unvaccinated cohort for all outcomes including influenza, pneumonia, pneumococcal pneumonia and invasive pneumococcal disease. The total mortality was 57% (55 to 60%) lower in vaccinated than in unvaccinated individuals (15.1 vs. 34.7 deaths per 1000 inhabitants) giving a number needed to treat (see page 36) of 51 (Christenson *et al.* 2001).

Pneumococcal vaccination was therefore shown to be effective in immunocompetent patients in systematic reviews and meta-analyses of randomised controlled studies. There was also supportive evidence for efficacy in immunocompetent and high-risk groups from some case-control and cohort studies. Pneumococcal vaccination had effects additional to influenza vaccination in preventing pneumococcal bacteraemia (Honkanen *et al.* 1999) particularly in high-risk groups (Koivula *et al.* 1997). There was also good evidence from observational studies that it protected healthy adults against pneumonia and bacteraemia whilst shielding high-risk groups against bacteraemia (Nguyen-Van-Tam and Neal 1999), hospitalisation and death (Nichol *et al.* 1999b). Uncertainty about effectiveness may have persisted because of the negative results from some studies, lack of generalisability of older studies and inherent weaknesses in case control and cohort study methods. In particular, it was unclear whether pneumococcal vaccine was effective in elderly or younger people in high-risk groups.

**Table 4 Cohort studies of pneumococcal vaccine**

<b>Study</b>	<b>Vaccine</b>	<b>Subjects</b>	<b>Pneumococcal strain</b>	<b>Vaccine efficacy (95% CI)</b>
CDC* -1 (Bolan <i>et al.</i> 1986)	14 valent	249 vaccinated, 1638 unvaccinated	Vaccine type only	64 (47,76)
CDC-2 (Spika <i>et al.</i> 1990)	14 valent	240 vaccinated, 1527 unvaccinated	Vaccine type only	60 (45,70)
Indirect cohort (Butler <i>et al.</i> 1993)	14 & 23 valent	515 vaccinated, 2322 unvaccinated	Vaccine type and vaccine related	57 (45,66)
Swedish Prospective Study (Christenson <i>et al.</i> 2001)	23 valent and influenza	100,242 vaccinated 159,385 unvaccinated	Hospital admission for: Influenza Pneumonia Pneumococcal pneumonia Invasive pneumococcal disease Death	46 (34,56) 29 (24,34) 36 (3,58) 52 (1,77) 57 (55,60)

\* Communicable Disease Centers

Ethical problems were considered a barrier to conducting new randomised controlled trials (McDonald *et al.* 1997b) since national guidelines were already in place for pneumococcal vaccination of high-risk groups (Begg and Salisbury 1996). However, the uncertainty over efficacy for high-risk groups did lead to reasoned arguments for a well designed randomised controlled study of pneumococcal vaccination in at-risk groups in the United Kingdom but also the healthy elderly who were, in any case, being routinely vaccinated in other countries.

## **2.12 Side effects of influenza and pneumococcal vaccination**

Safety was another very important aspect for successful introduction of vaccines and considerable research has been carried out in this area for both immunisations. Influenza vaccination has low side effect rates despite patient concerns about side effects. Initial evidence from one observational study suggested that the vaccine might be associated with an increased rate of influenza-like illness. The study compared side effects in patients within one week of influenza vaccination and three weeks after vaccination. The frequency of fever (5.3% versus 5.1%,  $p = 0.91$ ) was similar in the two groups but a significantly higher proportion of subjects reported a flu-like illness within seven days of vaccination compared to the group interviewed 3 weeks later (14.2% versus 8.7%,  $p = 0.03$ ) (Margolis *et al.* 1990b). This gave a number needed to harm (NNH) of 18.\* This study may have been flawed because of lack of blinding and recall bias, since those questioned closer to their vaccination date may have been more likely to recall possible side effects.

\* The number needed to harm (NNH) is analogous to the NNT but for adverse events and is the inverse of the absolute increase in risk ( $1/\text{ARI}$  or  $100/\text{ARI}\%$ ).

Three randomised placebo controlled studies later confirmed a low rate of adverse effects. One, a randomised crossover trial, compared influenza vaccine with saline placebo in 336 outpatients aged sixty-five years or over. Patients were recruited by post and were randomised to receive vaccine followed two weeks later by placebo injection or placebo followed two weeks later by vaccine and there was no significant difference in disability or systemic symptoms such as fever, malaise, fatigue, muscle pain or headache (Nichol *et al.* 1996b). A randomised double blind placebo controlled study in Dutch general practice with eighteen hundred patients aged sixty or older looked at postal questionnaire reporting of side effects completed four weeks after vaccination. Twenty three per cent of patients given vaccine reported one or more adverse reactions compared with 14% given placebo. Local reactions, such as redness or soreness at the injection site, were significantly greater (17.5% vs. 7.3%,  $p < 0.001$ ) in the vaccine group but there was no difference in systemic reactions (11% vs. 9.4%,  $p = 0.34$ ) (Govaert *et al.* 1993). An earlier randomised placebo controlled crossover study showed a rate of side effects of less than five per cent and no difference in side effects compared to placebo (Margolis *et al.* 1990a).

Researchers have also looked at side effects in specific groups of patients. Nicholson and co-workers looked at possible side effects of influenza vaccination in asthmatics. Although initial studies showed no effect (Nicholson *et al.* 1977; Ahmed *et al.* 1997a), a randomised placebo-controlled crossover trial found a small increase in exacerbations of asthma (defined as fall of over 20% in peak flow rate within 72 hours of injection) in those asthmatics receiving influenza vaccine for the first time (Nicholson *et al.* 1998).

Occasional rare side effects such as vasculitis (Kelsall *et al.* 1997) or Guillain-Barre syndrome (Piyasirisilp and Hemachudha 2002) have been described in case reports (Mader *et al.* 1993). Drug interactions have been postulated for influenza vaccine, which as an interferon-inducer could inactivate liver enzymes (specifically the hepatic cytochrome P-450 system) causing reduced metabolism and clearance of drugs such as warfarin (an anticoagulant), theophyllines (used for asthma or chronic obstructive lung disease), and phenytoin (used for epilepsy) (D'Arcy 1984). However, there was no evidence for this in studies involving warfarin (Farrow and Nicholson 1984) or theophyllines (Jonkman 1986). Paracetamol, used to treat fever post-vaccination, also did not impair (or improve) the immune response (Gross *et al.* 1994). One recent case report linked influenza vaccination to carbamazepine (another antiepileptic drug) toxicity (Robertson, Jr. 2002). These side effects are potential problems for anyone receiving influenza vaccine, but particularly in some risk groups, such as asthma, and also elderly people who are more likely to be on several drugs.

Reactions to pneumococcal vaccine tended to be mild discomfort or fever and short-lived lasting from 4 hours to 4 days with more severe local reactions of redness, pain, induration at the injection site or fever being much less common. Local reactions occurred in 28% but in 9 out of 10 patients these were mild and did not affect use of the arm (Nichol *et al.* 1997). Two studies showed little difference in reaction from simultaneous administration of influenza and pneumococcal vaccine at different sites. In one large study in the elderly over 65 years, the rate of local reactions was 28.4% in an influenza-vaccinated group compared to 44.1% with simultaneous vaccination (Govaert

*et al.* 1993). Fever was over twice as common with simultaneous vaccination, 2.4% compared to 1.4% with influenza alone. In another study of patients with chronic lung disease comparing simultaneous vaccination with influenza vaccine followed three weeks later by pneumococcal vaccination local reactions occurred in 38% and 36% of patients respectively (Fletcher *et al.* 1997).

Revaccination within five years had little benefit in terms of raising antibody titres and was more likely to lead to local reactions (Hilleman *et al.* 1981). Revaccination after five years was reported in one study to cause a similar rate of reaction to initial vaccination although the rates quoted of 4-8% for systemic and 40-60% for local reactions did seem higher than those quoted by other sources (Rodriguez and Dyer 1995). A small case control study showed no evidence that revaccination led to an increase in hospitalisation (Snow *et al.* 1995). In general, reactions to influenza or pneumococcal vaccination tend to be minor, although their frequency would tend to deter patients from being vaccinated or revaccinated.

### **2.13 High-risk groups for influenza and pneumococcal vaccination**

The elderly and those with specific diseases, particularly chronic heart and lung disease, had been identified as high-risk for respiratory illness, hospital admission and death from influenza and pneumococcal infections (Barker and Mullooly 1980) and this led to the notion that certain groups might benefit more than others from influenza and pneumococcal vaccination. For example, in one study of hospitalisations (310 patients) and deaths (38) from a large group practice in Rochester, New York State (United States) 30 patients who died (79%) had flu-like symptoms, 26 patients (68%) were older than 65

years and 36 patients (95%) had chronic disease. Death from pneumonia and influenza ranged from fewer than 10 per 100,000 in healthy adults to more than 600 per 100,000 in chronically ill patients. The highest rates (870 per 100,000) occurred in persons with both cardiovascular and pulmonary disease (Barker and Mullooly 1982). Patients with these and other high-risk conditions were therefore recommended for influenza and pneumococcal vaccination in national guidelines. However, practitioners were unsure about risk groups for vaccination (James 2000) and guidelines varied in their definition of high-risk groups (Siriwardena 1997). It was therefore important (Walters and Weightman 1997) to look at the research base for selection of high-risk groups.

A prospective cohort study in the Finnish town of Varkhaus to determine which conditions were independent risk factors for pneumonia, pneumonia hospitalisations and pneumonia deaths (Koivula *et al.* 1994) found six conditions which were independent risk factors for pneumonia. These were lung disease (chronic obstructive airways disease, bronchiectasis, pulmonary fibrosis, lung cancer), heart disease (heart failure, valvular or congenital heart disease associated with pulmonary hypertension, cor pulmonale), asthma (on medication), immunosuppression (with steroids, cytotoxics or radiotherapy), institutionalisation (in residential or hospital care) and alcoholism (see Table 5). In addition, two thirds of pneumonia sufferers were over seventy years of age. This study did not show an increased risk of pneumonia in diabetes or ischaemic heart disease in the absence of heart failure. One third of the population fell into a risk group but forty five per cent of those who contracted pneumonia did not fall into one of these.

A case control study in over three thousand clinic patients from Seattle identified 63 men with serologically proven pneumococcal infection and compared 130 non-infected controls. The study found that dementia (relative risk, 5.82), epilepsy (4.38), current smoking (4.00) congestive cardiac failure (3.83), cerebrovascular disease (3.82), institutionalisation (3.13) and chronic obstructive pulmonary disease (2.38) were statistically significant independent risk factors for pneumonia. Lung cancer (2.24), previous smoking (2.14), corticosteroid use (1.81), alcoholism (1.35), diabetes (0.99) and ischaemic heart disease (0.58) had a non-significant or no increase in relative risk (Lipsky *et al.* 1986).

Another prospective cohort study showed that diabetes and myocardial infarction as well as congestive cardiac failure, chronic obstructive pulmonary disease in smokers, stroke, cancer and age over sixty five years were associated with higher death or hospitalisation rates (LaCroix *et al.* 1989). A systematic review of factors affecting mortality from radiographically confirmed community-acquired pneumonia showed that mortality was associated with diabetes, cancers and neurological conditions (Fine *et al.* 1996).

One group known to be at particular risk of severe pneumococcal infections were those patients who had had their spleen removed by surgery, termed splenectomy (Deodhar *et al.* 1993), or because they had a disease that caused the spleen to stop functioning normally, so-called functional asplenia (Kobel *et al.* 2000). This is because the spleen forms an important component of the immune system and prevents bacterial infection particularly from capsulated bacteria such as pneumococcus.

**Table 5 Risk factors for pneumonia, pneumonia admissions and death (adapted from Koivula et al. 1994)**

Risk factor	Pneumonia		Pneumonia admission		Pneumonia death	
	RR <sup>*</sup>	95% CI <sup>†</sup>	RR	95% CI	RR	95% CI
<b>Lung disease</b>	3.0	2.3-3.9	5.0	3.4-7.3	NS <sup>‡</sup>	
<b>Heart disease</b>	1.9	1.7-2.3	1.2	1.1-1.3	5.0	2.9-8.6
<b>Asthma</b>	4.2	3.3-5.4	6.0	4.1-9.0	NS	
<b>Alcoholism</b>	9.0	5.1-16.2	NS		NS	
<b>Immunosuppressants</b>	3.1	1.9-5.1	6.8	3.8-12.3	13.5	5.1-35.9
<b>Institutionalisation</b>	NS		NA		9.0	5.0-16.3
<b>Age</b>	1.07	1.04-1.09	1.07	1.05-1.10	1.08	1.01-1.17

\* Relative risk

† Confidence interval

‡ Not significant

The effect of an absent or dysfunctional spleen in such patients was therefore the susceptibility to overwhelming bacterial infection, so called overwhelming post-splenectomy infection (OPSI) (Waghorn and Mayon-White 1997). The infection was most often due to pneumococcus but also other microbial organisms such as salmonella (Workman *et al.* 1996). This was known to have a mortality of forty-five per cent and could be prevented by pneumococcal vaccination as well as other measures such as regular antibiotic prophylaxis with penicillin.

A study in Leicestershire, England during the 1989-90 influenza epidemic showed that influenza deaths occurred predominantly in very elderly people, those in residential care and in patients with underlying diseases, particularly cardiac and respiratory disease. The risk increased substantially with the number of underlying medical conditions, which also tended to increase with age. Institutionalised patients, particularly in nursing and residential homes formed an important risk group, partly because of age but also due to increased morbidity, often with multiple illnesses and also because of the increased likelihood of close contact and spread in this setting (Nguyen-Van-Tam and Nicholson 1992).

In addition to these factors nursing home and long stay patients were at increased risk from respiratory complications, particularly nosocomial (institution acquired) pneumonia, with failing general health, poor nutrition, confusion, diminished level of consciousness, aspiration and upper respiratory infections (Harkness *et al.* 1990). Similar factors, particularly poor nutrition, neuromuscular disease leading to weakness, reduced

consciousness and aspiration, were risk factors for nosocomial pneumonia in hospital populations (Hanson *et al.* 1992).

Age was an independent risk factor for pneumococcal infection. Age was associated with increased risk in the studies of Koivula *et al.* (1994) and Lipsky *et al.* (1996) described above. A small retrospective survey from East Sussex looked at records of 125 patients with microbiologically proven pneumococcal infection (over ninety per cent with septicaemia) and found seventy per cent of cases in patients over 65 years, two thirds of these not having any other disease risk factors. Most patients (over eight out of ten) had a reasonable quality of life before infection. The case fatality rate was forty per cent whether or not a risk factor was present and the authors therefore argued that an age-based policy would be more appropriate than one based on pre-existing disease (Steven and Wright 1992). However, this was a very small survey, with patients identified from hospital laboratory records over a relatively long period of eight years, who may have been unrepresentative of the general population. Analysis of another retrospective cohort study of pneumococcal infections also suggested that age had an independent association with risk of pneumococcal infections (Sims *et al.* 1992). This small study (63 cases and 126 controls) suggested a linear increase in risk with increasing age for patients aged 50 years and above. Those over 80 years old were at particularly high risk compared with patients under 50 (odds ratio 4.3,  $p < 0.03$ ) and the likelihood of pneumococcal infection increased by an estimated factor of 1.33 (95% confidence interval 1.03 to 1.71) for each decade increase in age. When the researchers tried to control for other risk factors this did not alter the overall effect of age, but statistical significance was lost suggesting that a

proportion of patients over 50 are at increased risk because of disease risk factors.

The contradictory findings arising from these different studies explain the confusion amongst general practitioners about whom to vaccinate and the differences in risk groups between published studies and current United Kingdom guidelines (see Table 6). Because at-risk groups have a higher incidence of morbidity, mortality and hospitalisation from pneumococcal infections it has been advocated that influenza and pneumococcal vaccine should be administered to these groups (Bruyn 1992). If these vaccines were equally effective in high-risk groups, it would be more cost effective to vaccinate these patients because of greater absolute reductions in adverse outcomes.

Influenza vaccine has now been offered to patients over 65 years in the United Kingdom because of the evidence of age-related risk and efficacy in this age group. It has also been argued that it would also be better to offer pneumococcal vaccination to all those over sixty five in the United Kingdom (Neal 1993), as already happens in the United States, rather than just those in disease risk groups. This is because of the age-related risk, the fact that the case fatality rate for patients over sixty five is equivalent to those with high-risk diseases and because most episodes (up to 64% in one small series) of clinically proven pneumococcal disease occur in healthy elderly (Steven and Wright 1992). This policy has already been introduced in some areas of the United Kingdom (Elton and Panigrahi 1992) but has not been advocated by the Department of Health.

**Table 6 Risk factors for pneumonia, pneumonia admissions and death from research compared to United Kingdom (DHSS) guidelines**

Indication	Varkaus (Koivula 1994)			Seattle Lipsky 1989)			NIH (LaCroix, 1989)			DHSS Pneumococcal	DHSS Influenza
	P <sup>*</sup>	H <sup>†</sup>	D <sup>‡</sup>	P	H	D	P	H	D		
Age	+ <sup>§</sup>	+	+	+				+	+	0	+
Chronic heart disease <sup>**</sup>	+	+	0	+				+	+/-	+	+
Ischaemic heart disease	0	0	0	0				+		+	+
Chronic lung disease	+	+	+	+					+	+	+
Asthma	+	+	0							0	+
Diabetes	0	0	0	0				0	+/-	+	+
Asplenia/splenectomy										+	+
Chronic renal disease	0	0	0							+	+
Immunosuppressants	+	+	+	+/-						+	+
HIV										+	+
Chronic liver disease										+	+
Alcoholism	+	0	0	+/-						0	0
Institutionalised	+	+	+	+						0	+
Lung cancer				+/-							
Other cancers	0	0	0	0					+/-		
Hypertension	0	0	0					0			
Thyroid dysfunction	0	0	0								
Stroke				+					+/-		
Dementia				+							
Radiotherapy											
Epilepsy				+							
Hip fracture									+		
Cigarette smoking				+				+			
Black American				0							

\* Pneumonia or pneumococcal infection.

† Hospitalisation.

‡ Death.

§ + Indicates a positive association (or indication for vaccination), 0 lack of an association (or indication) and +/- a possible association.

\*\* Congestive cardiac failure, valvular heart disease, cor pulmonale.

Other evidence exists for possible target groups for influenza and pneumococcal vaccination that has not yet been translated into policy recommendations in the United Kingdom. Previously hospitalised patients, particularly those admitted with respiratory illnesses, are one such high-risk group. A retrospective cohort study using data from Oxford showed that hospital admission in the previous five years was also an important risk factor for subsequent pneumonia deaths and hospitalisation (Fedson and Baldwin 1982) and these findings were supported by the study of LaCroix et al. (1989). Acquired immune deficiency syndrome (AIDS) is another risk factor for influenza and pneumonia (Lin and Nichol 2001). Another intriguing possibility is to vaccinate those who may not be at increased risk themselves but who may, as vectors, infect older people. In Japan, a policy of vaccinating children against influenza was introduced from 1962 to 1987 and this led to most Japanese schoolchildren being vaccinated. This policy was withdrawn in 1994 and vaccination rates fell. During the school vaccination program, excess mortality rates in elderly Japanese dropped from three to four times those in the United States to values similar to those in the United States. By vaccinating children there may have been increased herd immunity and the policy may have reduced the likelihood of children to act as vectors, infecting grandparents and other unsuspecting elderly contacts. This programme was estimated to prevent about 37,000 to 49,000 deaths per year, or about one death for every 420 children vaccinated. Since the policy was revoked the mortality rate amongst elderly people from influenza in Japan has increased to previous levels (Reichert *et al.* 2001).

Health workers caring for elderly and high-risk patients are considered another potential target group for influenza vaccination. This is because they are key staff at times of epidemics and also because they are potential vectors of influenza. It has been argued that vaccinating healthcare workers against influenza may lead to benefits in terms of reduced morbidity and mortality in elderly and at-risk patients as well as reduced sickness absence amongst staff and there is some, albeit limited, evidence for this. One randomised controlled trial from Baltimore in health workers showed a reduction in serologically confirmed influenza A and B, with 24 (13.4%) of 179 control subjects and 3 (1.7%) of 180 influenza vaccine recipients affected during three years. There was also a reduction of reported febrile respiratory illness, 28.7 per 100 subjects vs. 40.6 per 100 subjects in controls ( $p = 0.57$ ) and days of absence, 9.9 per 100 subjects vs. 21.1 per 100 subjects in controls ( $p = 0.41$ ). The failure to show significant differences in sickness absence may have been due to lack of statistical power from an inadequate sample size. In a randomised controlled study from Glasgow, influenza vaccination of staff in long stay geriatric wards was associated with reduced mortality from 17% to 10% in elderly long stay patients (Potter *et al.* 1997). In another randomised controlled study of influenza vaccination in long stay geriatric facilities, health care workers were randomised to influenza vaccine (fifty per cent uptake) or control (5 per cent uptake). Over a six-month period the mortality rate amongst patients was 102 of 749 (13.6%) in vaccine hospitals compared with 154 of 688 (22.4%) in no-vaccine hospitals (odds ratio 0.58, 95% confidence interval 0.40-0.84,  $p=0.014$ ). This difference occurred despite the two groups having a similar proportion of patients positive for influenza infection (5.4% and 6.7%, respectively) (Carman *et al.* 2000). The Department of Health has commissioned a series

of studies to investigate the evidence for vaccinating this group (personal communication).

#### **2.14 Evidence for influenza vaccine efficacy in high-risk groups**

A cohort study in a health maintenance organisation in the United States demonstrated that influenza vaccination was associated with reductions in hospitalisations for influenza, pneumonia and other respiratory conditions in high-risk groups. Vaccination resulted in significant reductions in mortality for high-risk groups. Vaccination was also associated with direct and total cost savings for both healthy and at-risk elderly aged 65 to 74 years (Nichol and Goodman 1999). Studies have also revealed reduced illness, hospitalisation and death in chronic lung disease (Nichol *et al.* 1999a) and diabetes (Colquhoun *et al.* 1997). Influenza vaccination was also effective for nursing home patients. In a Japanese study of nursing home residents there were 950 cases of influenza infection diagnosed clinically, with virus isolation or serology in a six-month period. There were statistically significantly fewer cases of influenza, hospital admissions due to severe infection and deaths due to influenza in the vaccinated cohort (256 cases, 32 hospital admissions, 1 death) than in the unvaccinated controls (694 cases, 150 hospital admissions, 5 deaths) with rate reductions of 59.8%, 76.9% and 79.1% for the three outcomes respectively (Deguchi *et al.* 2000).

#### **2.15 Evidence for pneumococcal vaccine efficacy in high-risk groups**

A number of studies have also shown that pneumococcal vaccination is effective in high-risk groups.

A quasi-cohort (or indirect cohort) study comparing pneumococcal serotypes in vaccinated and unvaccinated patients suffering from invasive pneumococcal disease showed vaccine efficacy in high-risk patients. This study showed that in patients over 65 years with diabetes, chronic heart disease and pulmonary disease, efficacy was 61% (95% confidence interval 1 to 85%) (Bolan *et al.* 1986). Another indirect cohort study provided further evidence of vaccine effectiveness in high-risk groups (Butler *et al.* 1993). This study showed vaccine efficacy overall of 57% (95% confidence interval, 45 to 66%) and also demonstrated efficacy for disease groups included diabetes (84%, 50 to 95%), ischaemic heart disease (73%, 23 to 90%), congestive cardiac failure (69%, 17 to 88%), chronic obstructive pulmonary disease (65%, 26 to 83%), splenectomy (77%, 14 to 95%) and immunocompetent patients over 65 years (75%, 57 to 85%). The study did not demonstrate vaccine efficacy for patients with alcoholism, cirrhosis, sickle cell disease, chronic renal failure, leukaemia, lymphoma or myeloma but had insufficient power to do so.

An initial study (Shapiro and Clemens 1984) and subsequent New Haven case control study (Shapiro *et al.* 1991) showed that the vaccine was effective in a subgroup of patients with chronic lung or heart disease, alcoholism or diabetes with an efficacy of 61% (47 to 72%). Other studies have shown effectiveness of pneumococcal vaccination in specific diseases, for example chronic lung disease (Nichol *et al.* 1999b).

## **2.16 Guidelines for influenza and pneumococcal vaccination**

Guidelines are ‘systematically developed statements to assist practitioner and patient decisions about appropriate healthcare for specific clinical circumstances’ (Effective

Health Care 1994). Although the various guidelines for influenza and pneumococcal vaccination are broadly similar, there are important differences in indications for the two vaccines, international differences in high-risk groups targeted, and several areas of confusion in the guidelines on disease groups recommended for immunisation (Table 7).

For influenza vaccination the most significant differences relate to age based policies. The Advisory Committee on Immunisation Practices (ACIP) in the United States (Centers for Disease Control 1989) and the World Health Organisation (WHO) (Fedson *et al.* 1989) have recommended vaccinating healthy elderly as well as high-risk groups against influenza and pneumococcal infection for over a decade. The Department of Health (DOH) in the United Kingdom (Begg and Salisbury 1996) until recently had a policy for vaccinating only high-risk groups although this has changed recently for influenza vaccination. The DOH guidance to vaccinate patients of 75 years and over against influenza was introduced in August 1998 (Department of Health 1998c) and this was reduced to age 65 years and over in May 2000 (Department of Health 2000c). The advice was reiterated more recently in the National Service Framework for Older People (Department of Health 2001b). In the latest guidance, there was also a recommendation to achieve a target of 60% uptake in patients over 65 in the year 2000 and 65% in the year 2001 (Department of Health 2001a). This compared with the Year 2000 target set in the United States in 1989 of 60% of patients over 65 years and the Year 2010 target of 90% for patients over 50 set in 2001 (Zimmerman 1999). The reasons for these differences are complex.

It is interesting to compare national policy for influenza and pneumococcal vaccination in the United Kingdom with that in the United States. The United States began their age-based policy for influenza vaccine funded by Medicare after the successful nationwide demonstration projects in the 1980s (Barker *et al.* 1999). The Healthy People 2000 targets in the United States were published in 1990. These set national targets for vaccinating the elderly (aged sixty-five and over) aiming for sixty per cent coverage (or eighty per cent in institutionalised elderly) and were identical for influenza and pneumococcal vaccine. The Healthy People 2010 goal set in the year 2000 was ninety per cent coverage for both vaccines. For pneumococcal vaccine, the age to be targeted is still sixty-five and over but for influenza the lower age has dropped to fifty years. The main reason for this is the low influenza vaccination rate in high-risk adults aged fifty to sixty-four and the greater likelihood of an age based policy improving this situation. Some American public health experts believe that universal flu vaccination is the future policy direction for the United States and predict that this will be introduced within the next decade (Nancy Bennett – personal communication).

The difficulties of achieving these targets for influenza vaccination are not to be underestimated given worldwide vaccine shortages due to manufacturing problems, problems with patient and population registers as well as implementation research suggesting that there is an upper ceiling to vaccination rates which falls below this ninety per cent level (Buffington and LaForce 1991).

The 1996 guidance on pneumococcal vaccination of high-risk groups was underlined by the Chief Medical Officer's update in the Autumn of 1997 (Department of Health 1977) which recommended simultaneous administration of pneumococcal vaccine to 'those for whom it is indicated and who have not already been immunised.' In the United Kingdom this did not include pneumococcal vaccination of institutionalised elderly or those over 65 years in contradistinction to the ACIP or WHO guidelines. The 1989 WHO recommendations defined elderly as patients older than 60-65 and included all persons at high-risk but did not specify these other than referring to chronic heart and lung disease, institutionalised elderly and asplenia as specific risk groups.

Even within the risk categories, there is considerable scope for confusion about who should be given pneumococcal vaccine. With chronic heart disease some authors translated this to include patients with ischaemic heart disease and congestive heart failure (McDonald *et al.* 1997a) whereas other authorities interpreted this to mean only patients with congestive cardiac failure on regular medication (Bro Taf Audit Group 1996). The National Service Framework for coronary heart disease (Department of Health 2000a) also advises pneumococcal vaccination for chronic heart failure but not other forms of heart disease.

**Table 7 Comparison of clinical indications for pneumococcal and influenza vaccination in clinical guidelines and recommendations\***

Indication	ACIP 2001 Pneumococcal	ACIP 2001 Influenza	WHO 1989 Pneumococcal	DHSS 2001 Pneumococcal	DHSS 2001 Influenza
Chronic heart disease					
Chronic lung disease					†
Diabetes					
Splenectomy					
Chronic renal disease					
Immunosuppression					
HIV					
Chronic liver disease					
Alcoholism					
Age ≥ 65					
Age ≥ 50					
Institutionalised					
CSF fluid leaks					
Stroke					
Dementia					
Radiotherapy					
Disseminated cancer					
Local cancer					
Lymphoma					
Myeloma					
Leukaemia					

\* Shaded areas signify which risk groups are included in the corresponding guideline.

† Includes asthma

In the case of chronic lung disease the Department of Health guidelines did not specify pneumococcal vaccination for asthmatics (whereas it did for influenza vaccination). In contrast, most United States authorities did include asthma as an indication for pneumococcal vaccination (Fiebach and Beckett 1994). With the overlap between chronic asthma and chronic obstructive airways disease (COAD), underdiagnosis of the latter due to poor access to lung function testing and misclassification of chronic obstructive airways disease as asthma on chronic disease registers excluding asthma as an indication for pneumococcal vaccination is a debatable policy (Siriwardena 1997).

Hodgkin's disease is another example where there is confusion. The ACIP recommendations include Hodgkin's disease. The DOH includes immunosuppression as an indication but comments that the vaccine is less effective in immunocompromised patients including those with Hodgkin's disease, especially during treatment. The vaccine datasheet cites as a contraindication patients with Hodgkin's disease who have been treated with extensive chemotherapy, nodal irradiation or both (Walters and Weightman 1997). DOH and ACIP guidelines advise pneumococcal vaccination at least two weeks before splenectomy, chemotherapy or radiotherapy. If this is not possible, the DOH recommends vaccination as soon as possible after splenectomy or after at least six months after completing chemotherapy or radiotherapy.

## **2.17 Cost effectiveness of influenza and pneumococcal vaccination**

A number of studies have demonstrated the cost effectiveness of influenza vaccination in the elderly (Mullooly *et al.* 1994) and even shown cost savings when compared with the higher costs of hospitalisation in the United States (Nichol *et al.* 1994). A recent study

from the Netherlands showed costs of 1820 euro per life year gained (Postma *et al.* 1999). This figure hid cost savings in high-risk elderly and higher costs (6900 euro) in low risk older patients. Some analyses have even suggested cost savings in healthy working adults from annual influenza vaccination but this was based on United States costs and highly dependent on wages, absenteeism and influenza attack rates (Nichol 2001). Similar analyses using United Kingdom data have failed to show definite cost-benefit for influenza vaccination of young adults (Demicheli *et al.* 2000). Earlier studies from the United States also suggested that pneumococcal vaccination might be cost saving, but these were based on the assumption that the vaccine prevented pneumonia (Gable *et al.* 1990; Willems 1982; Willems *et al.* 1980). This flaw was also apparent in more recent European studies (Ament *et al.* 2000; De Graeve *et al.* 2000). With increasing evidence that the vaccine prevented pneumococcal bacteraemia rather than non-bacteraemic illness, a re-evaluation of cost-effectiveness took place (Simberkoff 1993). Although the absolute benefits for pneumococcal vaccine are smaller than those for influenza vaccine, the greater costs of hospitalisation for pneumococcal bacteraemia and pneumonia (even pneumonia with bacteraemia) mean that pneumococcal vaccine has also been shown to be cost-effective, particularly in the elderly aged sixty-five years and over (Fedson 1993). Sisk estimated that the overall savings for elderly vaccinees would amount to \$8.30 with 1.2 life years gained (Sisk *et al.* 1997). Comparable studies in European countries have also shown cost-effectiveness of pneumococcal vaccination for prevention of invasive disease alone with estimates of 10000 (6000 to 16000) euro per life year gained (Postma *et al.* 2001) and other studies have also shown cost savings in patients with chronic lung disease (Nichol *et al.* 1999b; Hak *et al.* 1998a). There was also evidence that the cost-

effectiveness of both vaccines, but particularly pneumococcal vaccine, could be increased by delivering the vaccines together (Weaver *et al.* 2001).

## **2.18 Conclusion**

Influenza and pneumococcal vaccines were introduced to address the significant burden of respiratory illness in the community, particularly in high-risk groups including the elderly. The studies reviewed have demonstrated the efficacy, safety, and cost-effectiveness of both influenza and pneumococcal vaccines in elderly people (aged over sixty-five years) and high-risk populations. Recommendations on eligibility for the two vaccines were similar but not identical. There were important differences in national and international recommendations for both of these vaccines but these differences did not always relate to the evidence or practical issues for implementation. Because of the different incidence and severity of influenza and pneumococcal infections there were also important differences in vaccine effectiveness in terms of absolute risk reductions for outcomes, numbers needed to treat and costs prevented, such as hospitalisation. These differences, as well as some of the negative individual studies and systematic reviews may have caused some confusion and uncertainty amongst practitioners about who to vaccinate. Combined administration of influenza and pneumococcal vaccination had been advocated in national guidance, particularly as a means of improving uptake of pneumococcal vaccine and was shown to be safe and more cost-effective than giving vaccines separately.

## **CHAPTER 3 IMPROVING VACCINATION RATES: LITERATURE REVIEW (II)**

### **3.1 Introduction**

This chapter reviews the literature on variations in vaccination rates, barriers and facilitators (also termed enablers or incentives) to vaccination and methods to improve vaccination rates in high-risk groups. Barriers and facilitators, including doctor and patient attitudes to vaccination, and how they influence vaccination uptake are explored. The range of methods used to improve vaccination rates and the evidence of effectiveness of these techniques is reviewed within the more general context of studies of methods designed to improve professional performance. A detailed discussion of educational interventions to improve performance, particularly educational outreach (or academic detailing) is presented below (see 3.10).

### **3.2 Sources**

The articles for this review came from a range of sources including computerised searches of the MEDLINE database from 1976 to 2002; EMBASE database; the Cochrane Database of Systematic Reviews; Database of Abstracts of Reviews of Effectiveness (DARE); Health Management Consortium Database on CD-ROM which combines the Department of Health, King's Fund and Health Management Information Centre at Leeds University databases; Health Promis - database of the Health Education Authority; English National Board (ENB) for Nursing Midwifery and Health Visiting database; CINAHL (Cumulative Index to Nursing and Allied Health Literature) database

on the Internet; National Centre for Clinical Audit database on the Internet; recent articles, letters and reviews from the British Medical Journal, British Journal of General Practice, Postgraduate Medical Journal and the Lancet; citations in the articles found above; citations provided by my supervisors and other colleagues.

### **3.3 Method**

Searches were carried out on computerised databases using the following search terms as Medical Subject Headings or keywords: Streptococcus pneumoniae, pneumonia, pneumococcal, pneumococcal infections, pneumococcal pneumonia, influenza vaccination, immunization, immunization programs, immunization schedule; risk factors, utilisation, cost-effectiveness, evaluation studies; attitudes; organization development, organization and administration, organizational case studies, organizational change, organizational culture, organizational effectiveness, organizational innovation, organizational objectives, organizational efficiency and organizational policy; patient education, compliance; education, learning, interprofessional relations, nursing, models, motivation, practice guidelines; evaluation studies, outcome and process assessment (health care), program development, program evaluation; primary health care. Abstracts from the searches were examined for relevance and stored on an electronic database (Reference Manager).

### **3.4 Vaccination rates in high-risk groups**

There have been a number of studies looking at influenza and pneumococcal vaccination rates in the various high-risk groups (see also 2.13). This section examines major surveys carried out in the United Kingdom before and around the time that the field studies in this

thesis were conducted. In the early 1990s, influenza and pneumococcal vaccination rates were generally low in high-risk groups in the United Kingdom, running below fifty per cent overall, although this figure was higher in some groups of patients. Rates have increased since then due to a number of initiatives that were introduced, partly as a result of this research, and more generally due to wider national initiatives to improve vaccination uptake. These initiatives will be described in later chapters.

Many surveys of vaccination uptake depended on patients remembering whether they had been vaccinated or on vaccine records. These were unreliable methods due to recall bias, forgetfulness or poor recording. Self-reported vaccination history has been shown to be a highly sensitive but only moderately specific guide to vaccination status, i.e. if patients reported that they had been vaccinated they were very likely to have been; but a proportion of those who reported that they had not been vaccinated had been. In one study the proportion of patients who had been vaccinated despite believing that they had not varied between 20 to 30% for influenza vaccination and 30 to 40% for pneumococcal vaccination, the latter rate being partly dependent on length of time from immunisation (MacDonald R. *et al.* 1999). Vaccination rates quoted in the studies reviewed below need to be interpreted in light of this.

Overall, vaccination rates in high-risk groups were disappointing. A survey of sixty-four computerised practices in Gwent in the United Kingdom in 1994 showed that less than 50% overall of those patients at high-risk were receiving influenza vaccine. This investigation showed vaccination rates of 63% for heart disease, 39% for patients with

diabetes, 41% for asthma sufferers and 33% in elderly aged 75 years and over (Watkins 1997). Although rates have gradually increased since then, younger high-risk patients were less likely to receive vaccination than those elderly people aged sixty-five years or over. A national survey conducted between 1989 and 1997 showed vaccination rates from 33.2% to 43.9% in high-risk patients aged 65 years and over, but rates of 10% to 12.4% in high-risk patients under 65 years and 19.2% to 23% in high-risk individuals more generally (Irish *et al.* 1998). Both of these surveys were carried out before the age related targets for vaccination of the elderly were introduced in the United Kingdom.

Studies of vaccination rates in individual disease groups showed similar deficiencies. A survey of vaccine coverage for serious heart disease at around the same time (just before 1990) showed very poor results. Influenza vaccination rates were 17% in the previous five years for patients on waiting lists for heart surgery in Leicester (Kurinczuk and Nicholson 1989). Patients attending secondary care with diabetes in the Northern Region of the United Kingdom showed slightly higher rates of vaccine uptake. However, despite the ten-year gap between these studies, only 35% (93 of 268) of patients with diabetes received both influenza and pneumococcal vaccines, 24% (64 of 268) received only influenza vaccine, and none received pneumococcal vaccine alone. Vaccination rates improved with increasing age and the presence of chronic pulmonary disease (Wahid *et al.* 2001). Encouragingly, studies in patients with diabetes have shown gradual increases in vaccination rates since then, at least for influenza vaccination (Lewis-Parmar and McCann 2002).

The importance of pneumococcal vaccination in patients with an absent or poorly functioning spleen was described above (see 2.13). Despite this, in one survey, only 36% of patients post-splenectomy had received pneumococcal vaccination (Deodhar *et al.* 1993). Given the clear guidelines for vaccination post-splenectomy (Working Party of the British Committee for Standards in Haematology Clinical Haematology Task Force 1996), the harm resulting from failure to vaccinate (Waghorn and Mayon-White 1997) and the likelihood of litigation in cases where vaccination had not been undertaken this represented worrying underperformance.

Nursing and residential home patients were another important high-risk group. A survey from Nottingham in 1993 showed influenza vaccine uptake of around 40 per cent (Warren *et al.* 1995). Nursing and residential home patients in South Wales in 1991-2 fared better with influenza vaccination rates of 67% for all homes, 65% for residential, 76% for dual registered and 82% for nursing homes (Evans and Wilkinson 1995).

High-risk hospitalised patients were a further group that frequently failed to have influenza or pneumococcal vaccination. A survey of patients discharged from medical wards showed that 40% (161 of 400) were in a high-risk group for pneumococcal vaccination but only half had been vaccinated (Turner and Finch 1999). Another small survey of a random sample of patients admitted to hospital with severe chronic obstructive pulmonary disease showed that only 14% (4 out of 28) had been offered pneumococcal vaccine (Doherty *et al.* 1997).

Co-morbidity was associated in some studies with increased vaccination rates. In diabetics influenza vaccination rates doubled (odds ratio 1.99, confidence interval 1.07-14.12) and pneumococcal vaccination almost quadrupled when chronic pulmonary disease was also present (odds ratio 3.77, confidence interval 1.69-21.76) (Wahid *et al.* 2001).

Rural communities may be expected to have particular problems with adult vaccination programmes due to geographical spread of the population and the resultant problems of access to healthcare. There was little evidence from the literature that the particular problem of rurality had been addressed, although one study from rural Canada did note a very low level of pneumococcal vaccination in high-risk patients who were admitted to hospital (Doyle *et al.* 2001) but another study from rural Alberta, also in Canada, showed a higher rate of influenza vaccination than urban populations (Russell 1997).

In summary, these studies showed marked variations in vaccination rates and poor uptake of influenza and pneumococcal vaccines overall in these groups of high-risk patients, with rates for pneumococcal vaccination being generally lower than those for influenza vaccination.

### **3.5 Barriers and facilitators of vaccination**

To understand why vaccination rates were low and why there was a wide variation in rates it is important to appreciate the barriers and facilitators to improving rates. The main barriers and facilitators of vaccination were knowledge and attitudes of patients and healthcare workers about influenza and pneumococcal vaccination, together with logistic

considerations such as the ability of the healthcare provider to have adequate vaccine supplies, storage facilities and systems to encourage vaccination (Mieczkowski and Wilson 2002). Such systems included practice protocols, reminders to doctors and nurses, special clinics and home vaccination of housebound elderly people, at-risk registers and patient reminders through call and recall systems amongst others. These barriers and facilitators are discussed in detail below.

### **3.6 Patient knowledge, attitudes and behaviour to vaccination**

Patients failed to take up influenza or pneumococcal vaccination because of lack of awareness, a perception that they may not be at risk and negative beliefs including worries about safety. A consistent finding from the literature was that patients were far less aware of pneumococcal vaccine compared with influenza vaccine.

For example, in a study of geriatric admissions from Aberdeen (Findlay *et al.* 2000) most patients (74%) had heard of influenza vaccination but only few (13%) knew of pneumococcal vaccination. Many patients were ambivalent about vaccination. Most of those surveyed (87%) considered influenza a serious infection but only half the patients thought that were at risk from it. Many patients (72%) thought that the vaccination was effective but half also thought that they would become ill because of the vaccine.

This perception amongst the elderly that they were healthy, and therefore not at risk from influenza, together with fear of side effects was a potent cause of non-vaccination (Cornford and Morgan 1999; van Essen *et al.* 1997). Some elderly patients were uncertain whether they fell into a risk group (Nexoe 1998). A particular concern for many

patients was that the influenza vaccine might cause 'flu' itself (Bedford *et al.* 1997). A lack of belief in the vaccine or perception that a health care worker had not recommended it were also strongly associated with refusal of vaccination (Bedford *et al.* 1997; Fiebach and Viscoli 1991). Although most elderly individuals were aware of influenza vaccine, fewer patients realised that influenza vaccine was indicated for high-risk groups of any age and in particular in younger age groups (Russell 1997), thereby leading to poorer vaccination rates in the latter.

There were no studies of ethnic differences in vaccination rates from the United Kingdom but ethnicity had been shown to affect vaccine uptake, for example in African-American (Marin *et al.* 2002; Armstrong *et al.* 2001), Hispanic (Centers for Disease Control 1997) and Native American (Buchwald *et al.* 2000) populations in the United States. A particular concern amongst low income African Americans was in relation to undisclosed substances in the vaccine as well as more universal concerns such as inconvenience, fear of pain and previous side effects, all of which predicted failure to be vaccinated. Social factors such as poverty, lack of health insurance, reduced access to health care and poor education leading to lower awareness of vaccines also contributed to lower vaccination rates in these minority groups.

Elderly patients who used primary care facilities less frequently were also less aware of the benefits of vaccination (Hershey and Karuza 1997). Reduced access may also have been associated with risk taking behaviour such as smoking, since smokers also had lower vaccine uptake even in well-organised managed care systems (Fowles and Beebe

1998). Where age based policies were in place, as was the case in North America, patients were usually more aware of age as an indication for vaccination than other disease risk groups (Russell 1997). Financial factors were also a deterrent to vaccination in healthcare systems where patients were expected to pay for vaccination (Nexoe 1998), although this was not relevant to the United Kingdom. Interestingly, factors such as perception of low risk, confidence of fighting off the infection naturally and doubts about the efficacy of the vaccine were also barriers for some healthcare workers who were recommended for vaccination (Harbarth *et al.* 1998).

Conversely, a number of factors predicted increased vaccine uptake. These factors included previous vaccination, prior knowledge of the vaccine, positive attitudes to vaccination, perceived need (perception of risk), intention to be immunised and most importantly recommendation from a general practitioner or other health care worker (Kyaw *et al.* 1999; Armstrong *et al.* 2001; Honkanen *et al.* 1996; Gianino *et al.* 1996; Nichol *et al.* 1996a; Ganguly and Webster 1995; Duclos and Hatcher 1993; Gene *et al.* 1992; Nichol *et al.* 1992). Portrayal of side effects positively (as a proportion of patients who remain free from side effects) or negatively (proportion who develop side effects) did not seem to affect vaccine uptake but in one study did affect expectation of side effects, systemic effects and absenteeism (O'Connor *et al.* 1996). Unfortunately, many patients could not remember being recommended pneumococcal vaccination by their doctor or nurse (Mieczkowski and Wilson 2002).

This delicate balance of perceived benefits, barriers, risk and severity has been shown to

predict the likelihood that patients would accept vaccination (Nexoe *et al.* 1999).

### **3.7 Practitioner knowledge, attitudes and behaviour to vaccination**

Practitioners were generally supportive of influenza vaccination (Meynaar *et al.* 1992). There were a number of reasons why this may have been so. The evidence for effectiveness of influenza vaccination had been widely publicised. This was achieved through the literature (DiGiuseppi 1996), national guidance (Begg and Salisbury 1996), regular updates from the Chief Medical Officer (Department of Health 2001a), evidence based journals which were known to be widely read by general practitioners (Coleman and Nicholl 2001) such as Effectiveness Matters (NHS Centre for Reviews and Dissemination 1996), Bandolier (Moore 1995) and Clinical Evidence (Marrie 2001) as well as the mass media. There was some dissent to these views including the argument that influenza may comprise only a small proportion of winter respiratory infections responsible for illness, admission or death compared with other viruses (Long *et al.* 1997; Nicholson *et al.* 1997) or that excess winter deaths could be due more to the effect of cold weather than to influenza (Donaldson and Keatinge 2002).

There was less support amongst practitioners for pneumococcal compared to influenza vaccination (Kyaw *et al.* 2001; Bovier 2002). Whilst national guidance promoted pneumococcal vaccination (Begg and Salisbury 1996), and advice issued from the Chief Medical Officer to give pneumococcal vaccination together with influenza vaccine (Department of Health 1997) this direction was contradicted by the suggestion that there was little evidence to pursue the policy of pneumococcal vaccination (British Thoracic Society 2001), advice that was also publicised in evidence based journals such as

Bandolier\* (Moore 2000) and peer-reviewed journals (Keeley 2002).

The benefits of influenza vaccine had been publicised in Bandolier using the concept of numbers needed to treat (Moore 1995). For elderly patients aged 60 years and over, between 9 and 20 patients needed to be vaccinated to prevent one case of influenza. In contrast, the incidence of pneumococcal infection, particularly so-called invasive pneumococcal infection, such as bacteraemia or septicaemia was known to be much smaller. As a result, although relative risk reductions with pneumococcal vaccination were comparable or even greater in some studies compared with influenza vaccination the absolute benefits were at least two orders of magnitude smaller. In the Canadian systematic review for example, risk reductions for vaccine-type pneumonia and systemic pneumococcal infections were 73% but because the baseline risk of pneumococcal bacteraemia was much lower, at around 50 cases per 100,000 people over 65 years of age, the number needed to treat<sup>†</sup> was considerably higher. Hutchison calculated that 2520 elderly people would need to be vaccinated to prevent one case of pneumococcal bacteraemia each year (Hutchison *et al.* 1999). This meant that assuming vaccine costs of £10 per pneumococcal vaccine compared to £5 per influenza vaccine the cost per case prevented was £25,000 and £40 respectively. This illustration excluded hospital and other indirect costs which were often much greater for a case of pneumococcal bacteraemia because this was a more severe illness, likely to require more time in hospital and require greater resources, such as intensive care, for treatment. However, this calculation

\* Bandolier is particularly quoted here because it was one of the flagship periodicals of the evidence based medicine movement and the debate on the efficacy of pneumococcal vaccination highlighted here.

<sup>†</sup> The number needed to treat is calculated as the inverse of the absolute risk reduction and is a useful standardised and readily understandable measure of clinical effectiveness because it incorporates disease prevalence.

strikingly demonstrated the basis for the broad difference in perceptions about the cost-effectiveness of the two vaccines.

Despite the importance of patient and practitioner barriers, such as knowledge and attitudes to vaccination, positive attitudes were not always translated into improvements in care (Hulscher *et al.* 1997a). Another important reason for failure to vaccinate was a lack of systems to identify or contact those patients who were eligible for vaccination (Bedford *et al.* 1997). One common reason why doctors and nurses did not vaccinate patients was that they forgot to. Indeed, in one study this factor correlated most closely with the doctor's vaccination rate (Metersky *et al.* 1998). Vaccination was forgotten for two main reasons. Firstly, practitioners believed they were vaccinating more patients than they actually were, so were overconfident in their estimate of how well they were doing and this reduced the pressure to vaccinate. Practitioners' overestimation of their own performance has been a consistent finding from many audit studies looking at a variety of health care activities. Secondly, practitioners' attention was diverted away from the issue of vaccination by the presenting medical problem (Noe and Markson 1998) or other more important clinical issues (Hershey and Karuza 1997; Rushton *et al.* 1994). Another reason for practitioners being unable to vaccinate was that the problem presented to the doctor by the patient was an acute illness which necessitated postponing vaccination (Szilagyi *et al.* 1994). There were also many occasions when the patient refused vaccination (Hershey and Karuza 1997; Metersky *et al.* 1998) for the various reasons cited above (see 3.6) despite practitioners attempts to persuade them of the benefits.

Some health care workers were also concerned about side effects of influenza and pneumococcal vaccine and uncertain about guidelines or vaccine effectiveness (Ballada *et al.* 1994), negative attitudes which were prevalent even amongst respiratory physicians (Sockrider *et al.* 1998). These negative attitudes may have reduced the likelihood that health workers offered vaccination to their patients and such attitudes were also shown to adversely affect vaccine uptake amongst health care staff themselves (Nafziger and Herwaldt 1994; Beguin *et al.* 1998; Yassi *et al.* 1994; Watanakunakorn *et al.* 1993). There were also differences between influenza and pneumococcal vaccination in this respect with less support amongst practitioners for pneumococcal than influenza vaccination (Kyaw *et al.* 2001; Bovier 2002).

### **3.8 Organisational, social and behavioural models to improve performance**

The dynamics of change in healthcare organisations have been extensively studied. There are a number of organisational, social, behavioural and psychological theories, which applied to both individuals and groups, are valuable to understanding and successfully implementing change in healthcare. These theories encompass different components of change such as the receiver, source, innovation and information channel (Lomas 1991).

Early epidemiological models of improving performance, which assumed that practitioners (or receivers) wished to change their behaviour in light of sound evidence or credible evidence-based guidelines, focused on providing information to bridge gaps in practitioner knowledge but were spectacularly unsuccessful in bringing about change (Kanouse and Jacoby 1988).

The influential work of Rogers on innovation diffusion (Rogers 1962) has been developed and extended more recently to present day healthcare organisations (Fitzgerald *et al.* 1999; Ferlie *et al.* 2000). Innovation diffusion has been defined as “the intentional introduction and application within a role, group or organisation, of ideas, processes, products or procedures, new to the relevant unit of adoption, designed to significantly benefit the individual, the group, or wider society” (West and Wallace 1991). Rogers’ original model of innovation diffusion was a linear five-step model from acquisition of knowledge, persuasion and decision to adopt a change, through implementation and finally confirmation of the innovation. The propensity to adopt change was expressed in this model as adopter type, which ranged from those most likely to adopt, so-called innovators, through early adopter, early majority, and late majority to laggards or those least likely to change. Other factors, such as the information source or agent of change and the nature of the innovation including its advantages, complexity, trialability (or the extent to which it could be tried out, modified, adapted or reinvented) and outcomes were also recognised as important. Despite the simplicity and attractiveness of this model, it failed to adequately describe the complexity of many of the processes involved in innovation diffusion in healthcare and other settings (Rogers 1995). A number of other complementary models have been developed to try to describe the varied interplay of human processes which affect the translation of knowledge into improvements in performance (West and Farr 1990) and the more recent edition of Rogers’ seminal work acknowledged this.

Another useful paradigm is the transtheoretical model, which describes the psychological process of behaviour change in terms of different motivational states during adoption of an innovation. The process begins with precontemplation (not yet ready for change) and progresses through contemplation (thinking about change), preparation (for change), action (to implement change) and finally maintenance of change (Prochaska and Diclemente 1983). Although this model was largely used to describe behaviour change in relation to individual addictive behaviours, such as smoking, it also helps us to understand the behaviour of individuals and organisations involved in change management. An adaptation of the transtheoretical model was used to describe psychological stages of professional change in primary care, from orientation (awareness and information), insight (understanding and awareness of gaps), acceptance (positive attitude, intention to change and confidence in a successful outcome), change (implementation and experimentation with change) and finally maintenance of change (Grol 1992).

Learning theory includes adult educational theory, which emphasises the importance of competence-driven motivation, and the value of interactive problem-based learning methods to stimulate this (Knowles 1990). In a wider sense, learning also encompasses social cognition theory, which recognises personal and environmental factors in determining ability to change depending on attitudes, beliefs and intentions (Conner and Norman 1996) and the social influence or interaction model, which stresses the importance of peer influence and modelling in the learning process (Mittman *et al.* 1992). Finally, behavioural theory recognises the importance of environmental cues such as

feedback and reminders to reinforce and maintain behaviour (Skinner 1938). Marketing models describe the importance of the source, channel, content, receiver characteristics and setting in communicating change rather than awareness, with change being more readily brought about by influential sources delivering a personalised message, based on experience to opinion leaders in an informal environment (Kotler and Roberto 1989).

From an organisational behavioural perspective, recent large-scale health service reforms have also employed a number of key theoretical concepts to effect change including the use of a broad brush approach at the developmental stage, emphasis on local leadership, utilising test sites and focusing on sites that were likely to be more receptive to change to begin with (Ferlie 1997).

An understanding of barriers and facilitators of change at individual and organisational level and utilising a combination of approaches using the models described above tailored to address barriers to change, has been advocated on theoretical grounds (Grol 1992; Grol 1997) and a protocol for a systematic review for this is available on the Cochrane Database (Baker *et al.* 1999).

These models suggested various strategies to improve performance, such as elucidating barriers to change, identifying with the concerns of practitioners and patients, using practice-based active and motivational learning methods, delivered by opinion leaders preferably peers, utilising collaboration and teamwork, and employing reinforcing strategies such as reminders to maintain change (Moulding *et al.* 1999).

In broad terms, interventions to improve performance may be classified as patient-directed, provider-orientated, systems-mediated and mixed or multifaceted interventions. Patient-directed interventions include health promotion and education directly to patients in the form of media campaigns, reminders, leaflets and posters and strategies such as financial incentives. Provider-orientated interventions include educational strategies, financial and other incentives or sanctions. Systems-mediated interventions include guidelines, practitioner reminders, computerised decision support and recall systems. There is often considerable overlap between these interventions in relation to their intended target, which target they do affect and how they ultimately cause change. Multifaceted interventions include various combinations of the above. These intervention types are now considered in more detail, initially looking at studies and reviews to improve performance in general, and then to improve vaccination rates in particular.

### **3.9 Patient directed interventions to improve performance**

Direct approaches to patients, providing health information, health promotion and specific advice to access particular health interventions is an important potential method for increasing awareness of healthcare amongst patients, which in turn can influence demand for and subsequent uptake of healthcare. A recent Cochrane review showed significant benefits of patient education through mass media campaigns on patients' uptake of health care. Mass media include newspaper, television, Internet, large fixed public posters, posters on vehicles or other methods of advertising health care to a large audience, either nationally or locally. The seventeen studies that were included in the review used interrupted time series designs and were mainly focused around immunisation or cancer screening. However, they were often of poor quality with thirteen

of the studies having absent or flawed statistical analyses. All but one of the studies showed increased patient uptake of preventive health care. The authors reanalysed the data using studies of higher quality and this showed positive effects of mass media campaigns (Grilli *et al.* 2000).

A variety of financial incentives to patients including money, vouchers, lottery tickets or gifts were shown in another systematic review of eleven randomised controlled studies to improve patient compliance with medical advice or therapy (Giuffrida and Torgerson 1997). Patient directed interventions to improve vaccination rates are described in greater detail below (see 3.14).

### **3.10 Provider orientated interventions to improve professional performance**

#### ***3.10.1 Types of provider orientated interventions***

A number of individual studies and systematic reviews have investigated methods that can effectively improve professional practice. These studies have looked at a broad range of healthcare workers and methods, which can be broadly termed educational interventions. These have used a diverse range of techniques such as educational materials, conferences, educational outreach visits and marketing (academic detailing), local opinion leaders, local consensus processes, interprofessional learning and audit and feedback. Provider prompts and recall systems although sometimes directed at individual practitioners are often used across a local health system or team, involving several doctors, nurses or administrative staff and therefore will be primarily discussed under

systems mediated interventions. The same is true for financial incentives for providers. Multifaceted interventions may be defined as a combination of any two of the above (Oxman *et al.* 1995). These educational interventions are based on a number of theoretical models.

It is worth outlining these methods in more detail before describing their effects. Educational materials for health practitioners include printed or published recommendations, clinical guidelines, audiovisual materials and electronic publications. Conferences consist of group education involving lectures, workshops, seminars or skills training outside practice settings. Educational outreach (or academic detailing) visits are contacts by a trained visitor who meets with practitioners in their practice to provide information on specific issues and sometimes feedback on performance in relation to these. Local opinion leaders are influential colleagues who are identified by their colleagues as being educationally influential. Audit and feedback has been a popular way to return information on performance to general practice since the inception of Medical Audit Advisory Groups (Department of Health 1990), which arose from the 1990 New Contract for Primary Care (Department of Health and Welsh Office 1989). The method of feedback involves supplying information obtained from clinical audit processes about practitioners' performance and comparing this with the performance of others, with or without recommendations on how to improve practice. This may include reminder systems, which may be either manual (such as tagging or labelling of medical records) or computerised prompts that trigger a particular treatment action or advice from the practitioner. Marketing describes the use of personal interviews, group discussion or a

questionnaire survey of practitioners to identify barriers to change and methods of overcoming these. A particular type of marketing, termed educational outreach (or academic detailing) is described in more detail below. Local consensus processes entail the participation of providers in a discussion to establish the importance of a particular health problem and agree an appropriate intervention to tackle it.

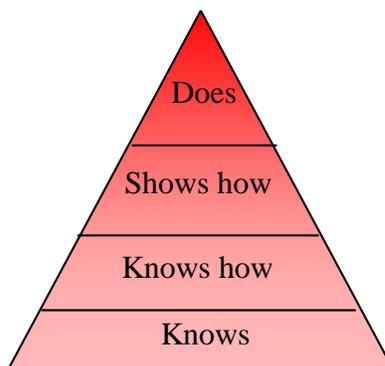
### ***3.10.2 Passive versus active educational methods***

Printed educational materials including published guidelines, when delivered passively, seemed to have no effect on the behaviour of doctors or the health outcomes of their patients in a recent systematic review (Freemantle *et al.* 2000). Traditional continuing medical educational methods alone also seemed to have little effect on health outcomes or the performance of doctors, and this lack of effect is probably also true for other professional groups (Davis *et al.* 1995). In general, passive approaches appeared to have limited effects, a finding which has been confirmed in experimental studies (Flottorp *et al.* 2002), whereas active learning, which is essentially interactive and participatory, has been shown to be more effective in producing change. Systematic reviews have also shown that interactive educational activities were more likely to improve practitioner performance and patient health whereas passive didactic lectures had little effect (Davis *et al.* 1999).

This has been a well-known problem with continuing medical education and is summarised in the concept of the competence-performance gap or Miller's pyramid (van der Vleuten 2000) (Figure 1). Simply stated this is the notion that education to increase knowledge ('knows') often does not translate into improved performance ('does').

Locally delivered strategies such as educational outreach (academic detailing), and practice initiatives such as reminders to practitioners or patients or multifaceted interventions were successful, whilst audit with feedback was weaker and formal conferences and educational materials without other strategies had little impact (Davis 1998).

**Figure 1 Miller's pyramid of competence**



### ***3.10.3 Educational outreach (academic detailing)***

Educational outreach, sometimes termed academic detailing, is the use of an educator who meets with learners in their work setting to provide information about a particular topic using a number of specific techniques. This method has been shown to have positive effects on clinical behaviour of doctors and other health workers. Based on the work of Soumerai and Avorn and developed in a number of later studies, the principles of this approach include an assessment of baseline behaviour and attitudes, focusing on all the stakeholders within an organisation to produce an educational process with clearly defined learning and behavioural objectives. The technique also depends on the academic credibility of those delivering the education, provision of reliable and unbiased information, presenting both sides of controversial issues, encouraging active learning, using simple educational materials such as graphs, emphasising the essential messages, and providing positive reinforcement of improved performance in follow-up visits (Soumerai and Avorn 1990). A systematic review of educational outreach included eighteen studies all of which had positive effects. Thirteen showed a reduction in inappropriate prescribing; three showed increased preventive activities such as smoking cessation and the others improved management of common clinical problems such as asthma. The outreach visits in these studies usually included discussion and educational materials and some included practitioner reminders, audit or feedback. However, only one study measured a patient outcome and none evaluated cost-effectiveness (Thomson O'Brien *et al.* 2000c). Since this systematic review two further studies have shown academic detailing to improve prescribing (Ilett *et al.* 2000; van Eijk *et al.* 2001).

Although evidence from the literature was largely in favour of educational outreach (Grimshaw *et al.* 2001) there was also some contradictory evidence. Some studies failed to show any improvement in practitioner performance (Watson *et al.* 2001), whilst others revealed a lack of a sustained benefit (Smeele *et al.* 1999; Lin *et al.* 1997). One study suggested that educational outreach was more costly than simpler alternatives (Gomel *et al.* 1998). In some settings the method was ineffective in improving patient outcomes. A landmark study teaching cognitive-behavioural therapy skills to general practitioners, for example, failed to improve depression scores in patients at six months (King *et al.* 2002). Several features characterised these studies in which educational outreach was less effective. These included the complexity of the educational intervention and the outcome that it was aimed at improving. Cognitive-behavioural therapy, for example, was a complex process, which may have been difficult to teach or learn (Spira 2002) and despite the enthusiasm of practitioners for this treatment, it may have been difficult to implement in primary care perhaps because of competing demands for time or other constraints within the traditional consultation. Many other factors, such as therapeutic relationship with the doctor, social factors or secular trends may have also affected patient outcomes in this study.

Unidisciplinary education was used in the majority of previous studies. Although it could have been argued that unidisciplinary education was appropriate to some of the interventions being tested, the reduced the opportunity for a team approach, particularly important in preventive health and chronic disease management, may have prevented the improvements in care that were sought. Finally, the perceived lack of benefit over

existing practices, a failure to address barriers to implementation or lack of opportunity to observe or try innovations before adopting them may have been other reasons for failure (Rogers 1995).

Most of these studies were conducted in North America and there has been little research into their effectiveness or cost-effectiveness in this country or in the primary care setting. The educator in educational outreach can be an educationalist, a professional change agent such as a manager or external consultant or a local opinion leader and each may have varying effects on performance. The use of educational outreach and local opinion leaders were partly based on social intervention theory, which argues that factors such as local norms and peer acceptance are important drivers for change (Mittman *et al.* 1992).

#### ***3.10.4 Opinion leaders***

Local opinion leaders have been shown to have variable effects on outcomes. A local opinion leader may be defined as an educationally influential individual who is well respected in their social system and who has a high degree of credibility amongst peers, due to factors such as technical competence or a position of leadership within the locality (Rogers 1995). Despite this apparently clear definition, researchers have often found it difficult to identify opinion leaders or the characteristics that distinguish them from other individuals in their local networks. Early adopters of an innovation who are also local opinion leaders are likely to have a beneficial effect on adoption by others, a fact which is extensively used by the pharmaceutical industry to promote their products. Opinion leaders who oppose innovations are likely to have the opposite effect. A systematic review identified eight methodologically acceptable studies and found variable effects of

opinion leaders on the performance of doctors and on patient outcomes (Thomson O'Brien *et al.* 2000d). Six out of seven trials that measured practice performance demonstrated some improvement for at least one variable, but only two trials had results that were statistically significant and clinically important. In the three trials that measured patient outcomes only one, showing a higher vaginal birth rate after previous caesarean section, achieved practically useful results. It was also not clear from many of the studies what exactly was done by the opinion leader and the authors felt that further research was needed into identifying local opinion leaders and seeing how they might improve performance of their peers in a reproducible way.

### ***3.10.5 Audit and feedback***

Audit and feedback may also be considered a systems-mediated intervention but is discussed here with other educational interventions since important components of audit include learning and the implementation of change. Audit may be defined as the “systematic, critical analysis of the quality of medical care, including the procedures used for diagnosis and treatment, the use of resources and the resulting outcome for the patient” (Secretaries of State for Health 1989c). Audit requires the establishment of criteria and standards against which performance can be measured (Donabedian 1966) but the audit cycle critically requires change to be implemented for improvements in performance to occur. Feedback is an integral part of the audit process and involves the presentation of summary information about performance to those whose performance is being measured. Studies of audit and feedback have been hampered by failure to correctly address various key aspects of methodology such as randomisation, statistical power and data analysis. An early review found no evidence of benefit (Mugford *et al.* 1991). A

further systematic review of feedback, specifically benchmarking against peers (termed physician profiling), had a statistically significant but clinically unimportant effect on performance (Balas *et al.* 1996). Thirty-seven studies were included in a recent Cochrane review looking at a range of performance including diagnostic test ordering, prescribing, preventive care, and management of common conditions, for example hypertension. Twenty-eight studies measured physician performance, one study examined patient outcomes in diabetes and the remaining eight studies measured both performance and patient outcomes. Many of these studies showed improvements in performance or outcomes but the clinical importance of these improvements was not always clear. The authors concluded that the effects were small to moderate and potentially worthwhile but that audit and feedback probably should not be used alone as a method of improving performance (Thomson O'Brien *et al.* 2000b). A further review found little evidence of additional benefit in adding another complementary intervention to audit and feedback (Thomson O'Brien *et al.* 2000a). Whether feedback was graphical or tabular also made no difference (Szczepura *et al.* 1994). The current evidence is that there is limited evidence of benefit of audit and feedback by itself for improving professional performance. However, it could be argued that this is because the most important aspect of the audit process, which is the change instigated to produce improvement, has been neglected because of the excessive focus on measurement and feedback.

### ***3.10.6 Addressing barriers to change***

One randomised controlled trial addressing barriers to change (Cranney *et al.* 1999) showed improvements in self-reported thresholds for treating hypertension in the elderly but failed to demonstrate improvements in performance. Baker showed that educational

methods that addressed barriers to change could be effective in modifying individual practitioner behaviour and patient outcomes for managing depression (Baker *et al.* 2001). This type of tailored outreach has also been used successfully in the Netherlands to improve preventive care for coronary heart disease (Hulscher *et al.* 1998). Both groups went on to suggest that addressing obstacles to change at team and organisational levels might also be important (Hulscher *et al.* 1997a). Multifaceted interventions involving more than one diffusion strategy have been argued to be more effective than single interventions because theoretically they may overcome more barriers to change. An early systematic review appeared to confirm this view (Wensing and Grol 1994) and more recently a Cochrane review of fifty five randomised controlled, before-and-after controlled, and interrupted time series studies showed improvements in preventive care with increasing effectiveness when comparing group education, reminders and multifaceted interventions. However, there were substantial variations in the improvements achieved, which were typically small or moderate. Multifaceted interventions appeared to be more effective than single interventions, perhaps because barriers to change were more readily addressed. The authors suggested that future studies should explore how particular interventions relate to specific barriers and should include an economic analysis since more complex interventions were also likely to be more costly (Hulscher *et al.* 2001).

### ***3.10.7 Interprofessional learning***

Interprofessional learning in health care is generally taken to mean learning that takes place involving one or more professional groups, aimed at increasing interprofessional understanding, collaboration and ultimately improvement in patient outcomes. This

definition excludes passive methods, such as lectures, or dissemination of educational materials (paper or electronic) that do not involve interaction between professionals. Many studies of interprofessional education in healthcare were found, in a recent systematic review, to be weak in design, to originate from North America and to use proxy outcomes such as learner satisfaction, change in attitude, knowledge or skill and behavioural or organisational change rather than true patient outcomes (Freeth *et al.* 2002). Half the studies showed that interprofessional learning led to organisational change and a handful demonstrated change in patient outcomes, such as satisfaction. Only one study used a specific clinical outcome (Glanz *et al.* 1992). The bias towards before-and-after designs called into doubt any conclusions about cause and affect. The predominance of studies from the United States prevented any true extrapolation of these findings to the United Kingdom, particularly in primary care, with its different traditions and structures.

### ***3.10.8 Learning in primary care settings***

When one focuses on primary care as a substrate for educational interventions, the research evidence is more limited. One systematic review of educational interventions found fifty-one studies of which twenty-six satisfied methodological criteria for inclusion (Freudenstein and Howe 1999). These studies included a wide range of interventions such as mailed guidelines or educational materials, educational visits, small group teaching, facilitators attached to practices and identification and training of local opinion leaders. Most of the studies used volunteer practitioners or particular geographical locations. Again economic analyses were lacking in these studies and the authors argued that future studies should include costs, target geographical areas, use patient outcomes and employ

an ‘intention to educate’ analysis. The latter is likely to be difficult to achieve given that practices that do not volunteer to participate would be unlikely to submit data for this type of study. This would necessitate reliance on externally available data, for example prescribing information or hospital admission figures.

In summary, traditional didactic education and mailings were weak, audit and feedback, teaching delivered by peers or opinion leaders moderately effective and reminder systems, educational outreach and multifaceted strategies relatively stronger in their effects on practitioner behaviour and patient outcome (Davis and Taylor-Vaisey 1997). However all these strategies were varied in their outcomes and highly dependent on the setting and individual circumstances of each study.

### **3.11 Systems mediated interventions to improve performance**

Systems-mediated interventions are those that are primarily directed at healthcare organisations or systems. They include guidelines (or protocols) and standing orders, practitioner reminders and recall systems, computerised decision support, as well as audit and feedback. Other strategies to improve access to care such as expanding access through reorganised services are discussed below (see 3.16).

#### ***3.11.1 Guidelines, protocols and standing orders***

A systematic review of guidelines showed that most (55 out of 59) improved the process of care (Grimshaw and Russell 1993). The effect sizes were very variable, probably due to the different implementation strategies employed. In the United States and Canada, the term ‘standing order’ is used to describe guidelines for nurse practitioners, nurses or

healthcare assistants and these have been successfully used to administer treatments to patients including vaccines in the absence or direct recommendation of a doctor (Centers for Disease Control and Prevention 2000). The nearest equivalent of this in the United Kingdom is the 'patient group directive.'

### ***3.11.2 Prompts, reminders and recall systems***

Prompts for doctors, nurses and administrative staff to indicate to patients that a procedure is due or overdue have been tried using a variety of methods. Prompts are sometimes classified according to whether the preventive measure is due (reminders) or overdue (recall) although these terms are used interchangeably. Prompts include paper reminders (stickers on case notes, printed checklists), computerised prompts and mailed recall lists. The detailed content and presentation of these methods can also vary. Prompts were more effective when they were specific and giving advice relating to individual patients (Wyatt 2002). Reminders to practitioners have been shown to improve preventive care in randomised controlled studies. In a systematic review, Wyatt (2002) showed that manual reminders were very effective and although manual systems were easily implemented, they run contrary to plans for a paperless health system in the United Kingdom. Computerised reminders have also been shown to improve preventive care, including vaccinations, in primary care settings (Shea *et al.* 1996). Computerised prompts are sometimes contained within decision support systems which were also shown to improve the performance of clinicians (Johnston *et al.* 1994).

## **3.12 Studies to improve influenza and pneumococcal vaccination uptake**

### ***3.12.1 Rationale for conducting a review***

The aim of this review is to summarise and appraise the research on improving influenza and pneumococcal vaccination uptake. This examines current practice, variations in practice and interventions that are likely to lead to increases in vaccine uptake. The review informs the methodology of the single practice pilot study, multipractice audit studies and randomised controlled study for improving influenza and pneumococcal vaccination rates.

### ***3.12.2 Deciding to conduct a review***

A number of previous reviews (Gyorkos *et al.* 1994; Hulscher *et al.* 1999; Hulscher *et al.* 2001; Briss *et al.* 2000; Stone *et al.* 2002) have been published. The reviews have varied in content and emphasis, looking at prevention overall, immunization alone, or immunization and screening. They have examined different settings from primary care alone, to a variety of primary care, community and secondary care. Many of the constituent studies have come from North America, reducing the applicability of the findings to the United Kingdom. The bias towards North America reflects its larger geographical and population size, a greater number of researchers, better funding for research, more peer reviewed publications, language bias, journals abstracted by Medline and CINAHL, as well as the greater tendency to evaluation in the United States compared to Europe and elsewhere. Many of the larger and higher quality studies were also from the United States and Canada. The emphasis, in these reviews, on interventions more appropriate to the United States system of medical care, and failure to include recent

work from and models appropriate to the United Kingdom was a drawback of these reviews. The various reviews also used slightly different criteria and arrived at conflicting conclusions. It was therefore important to reappraise the evidence with an emphasis on interventions relevant to British primary care to arrive at an appropriate conceptual model for use here.

### ***3.12.3 Existing or ongoing reviews – grey literature***

Apart from the aforementioned reviews, a search for ongoing reviews or related work in the Cochrane Database of Systematic Reviews (The Cochrane Collaboration 1995), the CRD Database of Abstracts of Reviews of Effectiveness (The NHS Centre for Reviews and Dissemination. 1995) and the NHS National Research Register (a database of commissioned research which was accessed through the National Institute of Clinical Excellence database) was conducted. The search terms influenza or pneumococcal alone and influenza or pneumococcal and vaccination were used. No similar reviews were being undertaken although there were a number of studies being undertaken into pneumococcal vaccination (Table 8).

### **3.13 Reviews of methods to improve vaccination uptake – overall findings**

A Canadian systematic review of vaccine delivery studies (Gyorkos *et al.* 1994) found that system-orientated (e.g. standing orders for nurses) and provider-orientated interventions (education and/or reminders for doctors and nurses) were more effective at improving vaccination rates than patient-directed interventions (leaflets, posters and mailshots to patients) for influenza vaccination. Patient-directed interventions were more effective for pneumococcal vaccine studies presumably because of the lack of awareness

of pneumococcal vaccination amongst patients relative to influenza vaccination. The strength of this review was that it appraised the evidence for each vaccine individually, including influenza and pneumococcal vaccine, individually and separately listed all the studies that were included. However, this was review of predominantly North American studies before 1991 and, despite some attempt at assessment of study quality, included several studies with weak design such non-randomised studies or before-and-after studies without a control group.

Hulscher et al. from the Netherlands reviewed studies of preventive services in primary care, including immunisation (Hulscher *et al.* 1999) and this was updated in a Cochrane review (Hulscher *et al.* 2001). Studies were categorised according to the type of intervention employed. These were classified into professional interventions such as passive information transfer (with educational materials, and off-site educational activities), locally sensitive educational approaches (through educational outreach, quality improvement groups and opinion leaders), feedback, reminders and other organisation, financial and regulatory methods. Fifty-five studies were included in the Cochrane review. The clear message from this systematic review was that effect sizes were small to moderate whichever intervention was being used. It was also unclear whether and in what circumstances a particular strategy was likely to be successful.

**Table 8 Ongoing studies on pneumococcal vaccination from the National Research Register**

<b>Title</b>	<b>Research question</b>	<b>Methodology</b>	<b>Lead researcher</b>	<b>Status</b>
Missed opportunities for pneumococcal and influenza vaccination	Are we missing opportunities in hospital to vaccinate elderly patients against influenza and pneumococcus?	Retrospective case-note study Questionnaires to doctors.	Mrs Jackie Colligan North Tyneside General Hospital, Rake Lane North Shields Tyne & Wear NE29 8NH	Complete
A study of the safety and immunogenicity of combining a pneumococcal conjugate vaccine other vaccines.	Is the immunogenicity of pneumococcal conjugate vaccines compromised when administered in infancy simultaneously with other vaccines or does the pneumococcal conjugate vaccine interfere with the immunogenicity of existing childhood vaccines?	Randomised controlled trial.	Dr D Goldblatt Immunobiology Unit Institute of Child Health London WC1N 1EH	Ongoing
Pneumococcal vaccination among patients admitted as acute medical emergencies: a survey of risk factors and vaccine uptake.	( 1 ) To identify the proportion of patients admitted to hospital as medical emergencies who could be regarded as high-risk for pneumococcal disease. ( 2 ) To quantify vaccine uptake in this group of patients and to explore the reasons for acceptance or non - receipt.	Descriptive study.	Mr MH Kyaw General Medicine Queen Elizabeth Hospital Birmingham B15 2TH Telephone: 0121 472 1311	Complete
Study of burden of illness from influenza and pneumococcal disease.	What is the burden of illness from flu and pneumonia to patients and health services? What is the value of vaccination	X sectional study	Dr P Mangtani London School of Hygiene and Tropic London WC1E 7HT	Ongoing
Detection of susceptibilities to severe invasive pneumococcal disease.	As title.	Immunological parameters. Antibody/cellular levels and functions.	Dr DC Henderson Immunology Chelsea & Westminster Hospital London SW10 9NH	Ongoing

The authors felt that tailoring interventions to barriers, particular using multifaceted interventions, was more likely to be effective than using single generic interventions. In favour of this review was that it examined research from primary care and included European as well as North American studies, including studies published in Dutch and German. Despite this, almost ninety per cent of those studies that were included were from the United States or Canada. On the negative side, the review concentrated on studies of interventions directed at clinicians and therefore excluded important patient-orientated approaches. Many of the studies suffered from bias such as allocation bias, lack of blinding, and failure to account for clustering and contamination in the analysis, which latter would have resulted in inflated effect sizes.

Briss et al. undertook an extensive and comprehensive review of interventions to improve vaccinations in different age groups for the United States Task Force on Community Preventive Services (Briss *et al.* 2000). They categorised interventions according to whether they increased community demand (patient-oriented), enhanced access (systems-oriented) or focused on providers. The interventions relevant to influenza and pneumococcal vaccination that were effective included patient-orientated strategies such as patient education as part of multifaceted interventions and patient reminder and recall systems. Enhanced access using extra clinics, evening or weekend or drop-in clinics and clinics attached to other providers (such as emergency departments) as part of multifaceted interventions improved vaccination rates. Home visiting and the reduction of out-of-pocket expenses for patients to attend clinics were also effective. Provider-orientated interventions such as provider reminders or audit and feedback were effective

too. Interventions that showed little or no evidence of effectiveness included community education alone, practice based education, direct financial incentives for patients, patient-held vaccine records, and stand-alone provider education.

The most recent review by Stone et al. reviewed interventions that were used to improve cancer screening or influenza and pneumococcal vaccination rates. It identified interventions according to three features (Stone *et al.* 2002). These included the target of the intervention (patient, provider, organisation or community), the type of intervention (reminders, feedback, education, financial incentive, regulation, organisational change or media campaign) and the theoretical basis for the intervention (social influence, marketing and outreach, visual appeal, teamwork, barriers and incentives, management support and active learning strategies). The studies included here were of higher quality, mainly randomised controlled studies or controlled trials, but they again suffered from failure to take clustering into account. The analysis also failed to identify influenza and pneumococcal vaccination separately.

Previous reviewers were unable to tease out the effect of individual interventions in many of the studies that used multiple interventions whereas Stone used complex statistical techniques to evaluate the effect of individual components in multifaceted interventions, a very useful feature of his review. It is helpful to examine some of these strategies in detail.

### **3.14 Patient directed strategies to improve vaccination rates**

Patient-directed vaccine strategies are those methods that are designed to lead to greater patient awareness and demand for vaccination.

#### ***3.14.1 Patient education***

Raising awareness and educating patients about vaccinations can be undertaken using national or local mass media or in healthcare settings using leaflets or posters. There were few studies looking at the effect of media campaigns for influenza and pneumococcal vaccination or other types of vaccination and all five of these were of insufficient quality to provide evidence. One study of a health clinic based education failed to show significant effects of combined provider education and educational leaflets or education alone to improve influenza or pneumococcal vaccination in elderly patients (Herman *et al.* 1994). As a result, there was not enough evidence to support community-wide education or practice-based education and information campaigns alone. In contrast, education as part of a multifaceted intervention had been shown to be effective for improving influenza and pneumococcal vaccination in primary care settings (Briss *et al.* 2000) suggesting that the positive effect of awareness raising methods needs to be combined with other methods to make a significant difference to vaccination rates.

#### ***3.14.2 Patient reminder/recall***

Szilagyi *et al.* in a Cochrane systematic review found strong evidence that patient reminders increased immunisation rates (Szilagyi *et al.* 2000). Out of 41 randomised controlled studies, before-and-after controlled studies and interrupted time series studies in English language journals that met the inclusion criteria for this review, 33 (80%)

showed that patient reminder systems were effective. Reminders were equally effective in a variety of settings including primary care, in children or adults, with different baseline immunisations rates and common vaccines, including influenza vaccination and pneumococcal vaccination for patients at risk. The eight studies that showed no significant improvement in immunisation rates used mail reminders in seven and an autodialer in one. They had methodological problems including inadequate power, reminders focusing on a range of preventive measures rather than vaccination alone and ceiling effects (high influenza immunisation rates in controls). On closer inspection, it was apparent that changes in immunisation rates varied considerably and that reminders were less effective for older patients with chronic illness for influenza and pneumococcal vaccination (Table 9). Telephone reminders were most effective but also more costly than mailings and this was also true for repeated or more intensive reminders.

A range of reminder systems was used in these studies including postcards, letters and telephone or autodialer calls. The autodialer was a computerised system designed to generate multiple telephone calls over a short period. The relative effectiveness of the different methods for influenza vaccination is shown below (Table 10). Despite the appearance that telephone reminders were more effective than mailed reminders, in the two studies that directly compared these methods there was no difference in performance (Brimberry 1988; McDowell *et al.* 1986). Reminders that were specific (to a single preventive measure), personalised and signed by a doctor were more likely to be effective (Briss *et al.* 2000). Reminders require a comprehensive database of patients at high-risk including age-sex and disease registers and administrative support to implement them.

Whilst successful in improving vaccination rates, a negative effect of patient reminders was that over a period of time patients became dependent on them, and this was particularly so in older patients at highest risk (McDowell *et al.* 1990).

### ***3.14.3 Patient incentives***

Direct financial incentives have not found favour in the United Kingdom, for both ethical and financial reasons. A number of incentives have been tried in the United States such as cash, discount coupons or lottery type gifts. Only one study looked at incentives for influenza vaccination, comparing an educational brochure, a lottery-type incentive for a \$50 grocery voucher (on vaccination), both together or control. The educational brochure was more effective than the lottery ticket, each being significantly more effective than the control group but both together being no more effective than the control (Moran *et al.* 1996). In countries where patients are charged for services, up to ten per cent of patients will refuse influenza vaccination because of cost (Merkel and Caputo 1994) and the provision of free vaccines is one factor which has been shown to improve vaccination rates for influenza and pneumococcal vaccines (Bennett *et al.* 1994; Satterthwaite 1997).

**Table 9 Effectiveness of patient reminder/recall for influenza and pneumococcal vaccination (adapted from Szilagyi et al. 2000)**

<b>Patient characteristics</b>	<b>Number of Studies</b>	<b>Odds ratio (95% Confidence Interval)</b>	<b>% Change in immunisation rates, median (range)</b>
Children (influenza)	2	4.25 (2.10, 8.60)	24.5 (23.0 to 26.0)
Adults (influenza):			
≥ 65years	11	2.25 (1.45, 3.50)	17.0 (-2.5 to 36.0)
With chronic illness	7	3.11 (2.50, 3.86)	14.5 (-5.9 to 47.0)
≤ 65years with chronic illness	3	1.42 (0.70, 2.87)	4.4 (-8.5 to 31.2)
Adults (pneumococcal)	2	2.79 (0.85, 9.12)	10.0 (0.0 to 20)

**Table 10 Effectiveness of different types of patient reminder/recall for influenza vaccination (adapted from Szilagyi et al. 2000)**

<b>Reminder types</b>	<b>Number of Studies</b>	<b>Odds ratio (95% Confidence Interval)</b>	<b>% Change in immunisation rates, median (range)</b>
<i>Children (influenza)</i>			
Vaccination letter reminder	2	4.25 (2.10, 8.60)	24.5 (23.0 to 26.0)
<i>Adults (influenza)</i>			
Postcard	5	1.82 (1.12, 2.98)	10.6 (2.9 to 31.2)
Letter	11	2.25 (1.53, 3.32)	7.0 (-8.5 to 47.0)
Telephone	5	4.27 (2.99, 6.08)	25.6 (5.5 to 27.2)
All reminder/recall systems	18	2.29 (1.69, 3.10)	7.0 (-8.5 to 47.0)
Patient and practitioner reminders	2	3.42 (2.11, 5.54)	22.5 (16.0 to 28.9)

### **3.15 Provider orientated strategies to improve vaccination rates**

#### ***3.15.1 Audit and feedback to improve vaccination rates***

There were two systematic reviews of the effect of audit and feedback on vaccination (Briss *et al.* 2000; Bordley *et al.* 2000). Interestingly both reviews found evidence to support audit and feedback alone, or as part of a multifaceted intervention to increase immunisation levels. This was in contrast to the lack of evidence for audit and feedback in improving professional performance in general (see 3.10.5). There were two possible reasons for this. The process of audit and feedback might have changed the behaviour of doctors and nurses to vaccinate more patients per se; it may also have encouraged them to implement system or process changes, such as reminder systems, to improve vaccination rates. Whatever the reason, it seems self-evident that any quality improvement process for increasing influenza and pneumococcal vaccination rates in high-risk patients requires measurement of vaccination rates as a prerequisite. In the review by Bordley *et al.* (2000), twelve of the fifteen studies that met the quality criteria showed improvements in vaccination performance using audit and feedback alone or with other interventions. The increase in vaccination rate using audit and feedback alone was sixteen per cent (9 to 41%) (Briss *et al.* 2000). A variety of methods may be used to provide feedback in audit studies, including tabular, graphical or verbal feedback, the latter as part of an educational outreach visit. An attractive method was the use of a practice poster showing weekly cumulative influenza vaccination rates which led to a thirty per cent increase in vaccination rates, over and above those in control practices in one study (Buffington *et al.* 1991).

### ***3.15.2 Education for healthcare staff***

Although education was effective at increasing knowledge about influenza, pneumococcal and other vaccinations (Zimmerman *et al.* 1997) there was very limited evidence for the effectiveness of education alone in improving vaccination rates (Briss *et al.* 2000). This was due to the dearth of studies rather than a failure to address the competence-performance gap. One Australian study showed no evidence of change in influenza vaccination rates in elderly patients over 65 years, although there were improvements in some healthy behaviours and quality of life (Kerse *et al.* 1999). The educational intervention in this study was to general practitioners alone and focused on prevention care in general rather than solely on vaccination. Education to providers (and, or) patients as part of a multifaceted intervention was studied much more often and shown to be effective (Briss *et al.* 2000).

### ***3.15.3 Financial incentives for providers***

Financial incentives for providers had variable effects. Some studies showed small positive effects. For example, one study of financial incentives to practitioners showed an increase in influenza immunisation rate of seven per cent above controls (Kouides *et al.* 1998). Another cross-sectional study showed no association between the receipt of additional funding and influenza vaccination (Wee *et al.* 2001).

## **3.16 Systems mediated strategies to improve vaccination rates**

### ***3.16.1 Vaccine guidelines***

Clinical guidelines and written support materials led to an increase in pneumococcal vaccination in one before and after study (McDonald *et al.* 1997a). Pneumococcal

vaccination rates increased from three per cent to thirty three per cent during the six months of the study. However, this was not a controlled study and no comparison group was available to show secular trends or account for confounding factors.

### ***3.16.2 Standing orders for vaccination***

Standing orders for vaccination are widely used in North America and have been adopted in the United Kingdom as patient group directions. They are designed to increase the flexibility and professional autonomy of nursing staff to administer influenza and pneumococcal vaccinations to high-risk individuals. They have been shown to be effective both alone and in conjunction with other interventions. Increases in vaccination rates of fifty per cent (31-81%) were found with standing orders alone (Briss *et al.* 2000). To be effective they required good interprofessional working, adequate nursing capacity, and doctors and nurses to be willing to give and take responsibility for decision-making respectively.

### ***3.16.3 Registers***

Age-sex and disease registers for high-risk patients were essential for audit, feedback, patient and practitioner reminders and often as a component of education for providers. General practice in the United Kingdom has benefited from the lifelong patient record, the integrity of this system having considerable advantages for the development and maintenance of registers. This is in stark contrast to the fragmentation of patient information in other health systems (Stokley *et al.* 2001). Historical problems with data consistency in the National Health Service (Scobie *et al.* 1995) are slowly being addressed through additional funding for computer hardware, developments in software,

data collection and analysis. Despite these improvements and the move towards paperless systems, in line with the trajectory towards the electronic patient record, further improvements need to be made (McColl *et al.* 2000).

#### ***3.16.4 Provider prompts to vaccinate***

Case-control studies suggested that recommendation from a doctor or nurse was strongly associated with higher influenza and pneumococcal vaccination rates (Kyaw *et al.* 1999). Because practitioners frequently forgot to vaccinate patients during busy surgeries, prompts were a good method of reminding doctors and nurses to recommend and administer vaccination.

Manual prompts were effective and cheap (Wyatt 2002) but were unwieldy in an increasingly computerised primary care system, particularly when considering the administrative burden of implementing an influenza and pneumococcal vaccination programme. One study using a written checklist for junior hospital staff increased influenza and pneumococcal vaccination rates in outpatients from two to forty per cent (Cohen *et al.* 1982). Computerised prompts require good systems and data on age and diseases to be useful but have been shown to be effective (Gill and Saldarriaga 2000; Hak *et al.* 1998c; Hutchison 1989). Practitioners, like patients, were also been found to become dependent on reminders, and prompts are therefore most effective when available at every visit (Chambers *et al.* 1991).

### ***3.16.5 Improved access***

Access to influenza and pneumococcal vaccinations can be improved in existing healthcare settings, by using alternative locations or by providing home visits to vaccinate the housebound. Possibilities for improving access in existing settings include extra clinics at additional times, such as lunchtimes, evenings or weekends and by providing drop-in or 'quick-fire' express clinics. Alternative settings include vaccinating in residential or nursing homes, satellite clinics or branch surgeries nearer the patients' homes. Opportunistic vaccination during disease management clinics is another option. In the United States, vaccination has been contracted out to health care providers other than the family doctor, including public health or emergency departments, outpatient clinics and even nurses employed in pharmacists, grocers or supermarket chains. Problems with alternative settings or providers include difficulties accessing health records, fragmentation of health information and patients' difficulties remembering vaccination status or eligibility. Alternative providers have not been used in the United Kingdom because of these problems. Vaccination during home visiting by district nurses and health visitor is carried out, although staff may have some concerns over resuscitation in case of vaccine reactions and home injections are more costly than vaccination at the surgery or clinic. Improved access was undoubtedly an effective way of improving vaccine uptake (Briss *et al.* 2000).

## 3.17 General findings and concepts

### 3.17.1 Ceiling effect

Analysis of pooled vaccination rates showed that improvement in vaccination uptake when baseline vaccination rates were high (over 50 per cent) was less compared to when they were low (less than 20 per cent) (Gyorkos *et al.* 1994). This ceiling effect (Table 11) may have been due to a number of factors. It could simply have been due to the greater capacity for improvement resulting from low initial vaccine coverage rates. It could have been partly due to selection bias where practitioners or organisations that took part in vaccine studies were more predisposed to improving vaccination rates and had already implemented immunisation strategies, thereby reducing their capacity to benefit from additional interventions. It would be important to consider this effect when designing experimental studies for improving vaccination rates.

**Table 11 Variation in improvement in influenza immunisation according to baseline vaccination rate (adapted from Gyorkos et al. 1994)**

<b>Baseline immunisation rate</b>	<b>Number of comparisons</b>	<b>Pooled effect (%)</b>	<b>95% Confidence interval</b>
<20%	17	20.5	19.0, 21.9
20%-50%	15	19.3	17.5, 21.2
>50%	4	14.8	12.3, 17.3

### ***3.17.2 Relative success of interventions***

It can be seen that certain interventions seemed to be better than others and some combinations were synergistic rather than additive, leading to a greater improvement than would have been expected from using each intervention separately. An early review found that feedback, education and reminders were most effective as single interventions and education and feedback with or without other strategies was the most effective combined approach (Wensing and Grol 1994).

However, most studies employed a variety of techniques rather than a single approach to improve vaccination rates. It was also apparent that some interventions, such as education, would have naturally led to others, such as reminder systems. It was difficult for many researchers and reviewers to dissect the effect of individual interventions from these studies of multifaceted interventions. Stone et al. (2002) used a specialised statistical technique of meta-analysis, called meta-regression to measure the effect of individual interventions in studies using combinations of techniques (Table 12).

Using this technique Stone found that the most effective interventions for improving immunisation rates were those that involved organisational change. Organisational change was defined as a change in work processes to improve vaccination rates and included job redesign, altering clinical procedures or modifying facilities or infrastructure. Examples of this may have been allocating additional staff such as district nurses or health visitors to administer vaccines, putting on additional clinics or implementing vaccination at home for housebound elderly.

Reminders for patients and providers, provider education and financial incentives for patients (in fee paying health systems) were moderately effective across the range of studies. Patient education, provider feedback and financial incentives to providers showed weak effects. The reviewers also found evidence to support the hypothesis that combining effective interventions was synergistic, mixing effective with weak interventions was usually positive, whereas adding weak interventions together often did not produce additional benefits to using each separately.

**Table 12 Effectiveness of individual interventions within 29 single method and multifaceted studies to improve immunisation rates (adapted from Stone et al. 2000)**

<b>Intervention component</b>	<b>Adjusted odds ratio</b>	<b>95% Confidence interval</b>
<b>Organisational change</b>	16.0	11.2, 22.8
<b>Provider reminder</b>	3.80	3.31, 4.37
<b>Patient financial incentive*</b>	3.42	2.89, 4.06
<b>Provider education</b>	3.21	2.24, 4.61
<b>Patient reminder</b>	2.52	2.24, 2.82
<b>Patient education</b>	1.29	1.14, 1.45
<b>Provider financial incentive</b>	1.26	0.83, 1.90
<b>Provider feedback</b>	1.23	0.96, 1.58

\*This refers to reduction or waiving fees in healthcare systems which charge for services and so is not directly applicable to the United Kingdom.

In addition, when similar statistical techniques were applied to the key features of these interventions they were also found to have differential effects. The most effective intervention feature for improving immunisation rates was that involving collaboration and teamwork between all those involved in administering and delivering the vaccination programme including doctors, nurses and administrative staff. This conclusion emphasised the importance of teamwork to a successful immunisation programme (Table 13).

These findings whilst elegant may only apply to preventive care and may not be the complete picture because of the heterogeneity of the studies, the larger number of multifaceted interventions and effect of publication bias.

**Table 13 Effectiveness of individual intervention features in single method and multifaceted studies to improve immunisation rates (adapted from Stone et al. 2000)**

<b>Intervention component</b>	<b>Adjusted odds ratio</b>	<b>95% Confidence interval</b>
<b>Collaboration and teamwork</b>	17.9	10.4, 30.9
<b>High visual appeal and clarity</b>	3.25	2.09, 5.06
<b>Designed to address barriers and incentives</b>	1.61	1.52, 1.71
<b>Social influence</b>	1.35	0.78, 2.34
<b>Active learning strategies</b>	1.29	0.68, 2.42

### ***3.17.3 Economic considerations***

Before considering economic analysis of interventions to improve influenza and pneumococcal vaccination rates, it was important to determine that the vaccines themselves had also been shown to be cost-effective (Sculpher 2000) (see 2.17). Very few of the intervention studies described above included an economic analysis. The few studies that did include an economic evaluation were mostly from North America (Briss *et al.* 2000). Many of these studies were inadequate or had important gaps in analysis (Carande-Kulis *et al.* 2000). A robust health economic analysis would have contained detailed information on costs (and how these had been obtained) of the intervention (such as the educational programs, reminder systems, postage etc.), additional professional time (e.g. to attend courses, give vaccination advice or administer vaccines to patients etc.), and additional costs of the extra vaccines given as well as costs to the patient. The benefits in terms of adverse outcomes prevented or a measure of utility such as quality adjusted life years would have been needed (Kernick 1998). In a cost effectiveness analysis additional data on vaccine effectiveness in terms of adverse outcomes prevented would have been included. In a cost-utility analysis a measurement of utility such as quality of life would have been compared with the costs. Cost-benefit analysis would require costs and benefits in monetary costs (Palmer *et al.* 1999). Barriers to health economic analysis may have included a scarcity of health economists, problems with funding studies that required economic evaluations and a failure of healthcare researchers to understand the importance of an economic evaluation as an integral part of their research and have had appropriate training to address this (Brown *et al.* 2002).

### **3.18 Conclusion**

This review of the literature around improving professional performance and vaccination rates formed the basis for a series of field studies into improving influenza and pneumococcal vaccination rates in the setting of British general practice. These investigations took into account the ideas and lessons from previous studies of complex organisational interventions (Rogers *et al.* 2000) by using multiple approaches to effect change, tailored specifically to improving influenza and pneumococcal vaccination rates, within a primary care setting.

## **CHAPTER 4 METHODOLOGY**

### **4.1 Introduction**

This chapter describes the series of experimental studies that were undertaken to investigate implementation of a systematic influenza and pneumococcal vaccination programme in primary care. A variety of settings and methods were used to increase the validity and generalisability of the results and these are described below.

The initial pilot study employed an action research methodology (Hampshire 2000), with a cross sectional survey and an uncontrolled before and after experimental study carried out in one practice to promote and explore change. The main findings and experience gained from the pilot phase were applied to two further uncontrolled before and after studies. The first of these was a multipractice audit conducted in volunteer Lincolnshire practices as part of a countywide initiative. The same methodology was subsequently refined and applied to a multipractice audit, which formed part of a clinical governance programme in West Lincolnshire Primary Care Trust, one of the new primary care organisations. Finally, a cluster randomised study was carried out in volunteer practices from West Lincolnshire Primary Care Trust (who participated in the primary care trust audit) and also from the Trent Focus Collaborative Research Network to investigate the effects on vaccination rates of an educational outreach visits to primary healthcare teams.

This series of studies broadly followed the Medical Research Council framework for the design and evaluation of complex interventions as its basis (Medical Research Council

2000; Campbell *et al.* 2000a). This consisted of a phased approach, which involved preclinical (theoretical), modelling (Phase I), exploratory (Phase II) and definitive (Phase III) phases. It was beyond the remit of the study to undertake the final long-term implementation phase (Phase IV) described in the framework. In the preclinical phase, evidence was obtained from the literature review that the proposed interventions might be effective. The pilot study formed the modelling phase, which through an action research methodology sought to establish the components of the intervention, how they would work, and potential or actual barriers to change. The exploratory phase was conducted through two multipractice audits, which using an uncontrolled before and after design, investigated the feasibility of improving influenza and pneumococcal vaccination rates across a range of general practices, tested outcome measures, helped to define the control intervention and enabled an estimate of effect size which was subsequently used for the power calculation in the randomised controlled study. The final definitive study conducted as part of this thesis was a cluster randomised study, which used the experience of the previous studies and extended this to a complex intervention involving an educational outreach intervention for primary healthcare care teams to use multiple methods to improve influenza and pneumococcal vaccination.

## **4.2 Pilot study: Feasibility study targeting influenza and pneumococcal vaccination to high-risk groups in a single general practice**

### ***4.2.1 Introduction***

The first step in this research after undertaking a literature review was to undertake a pilot study. The broad aims of this pilot phase were to implement an influenza and

pneumococcal vaccination programme in an existing practice and to observe, investigate and document the problems, barriers, effects and consequences of this change. The pilot used an action research method that actively involved practitioners in the research process, integrated education into the research process, focused on change to increase vaccination rates and used audit to feedback and to generate knowledge (Elliott 1991; Hart and Bond 1995).

#### ***4.2.2 Setting***

The pilot study was conducted in my own practice. This practice was chosen because of convenience of access, to minimise disruption to patients and staff, facilitate feedback and enable closer observation of the process elements of the pilot. The practice was in many respects a typical general (family) practice with four partners (three and three quarter whole time equivalents), three practice nurses and a variety of employed and ancillary (attached to the practice but employed by the local community trust) staff including district nurses, health visitor and nursing assistants. The practice was engaged in training general practitioners. Training practices, which comprised about a quarter of practices in Lincolnshire, were linked in previous studies to greater levels of organisational development (Baker 1992). The practice had approximately seven thousand five hundred patients giving a list size of two thousand patients per partner. This was slightly above the average for general practices in England and Wales at the time of the study. Because this was a single practice the results were not generalisable. However, as this was a pilot study and because it was the process of change and its implementation that was the subject of study the choice of a single practice was appropriate for the purposes of the investigation.

### ***4.2.3 Background***

We had already been conducting an annual influenza vaccination programme for several years in line with many other practices but had not previously instigated a pneumococcal vaccination programme. The existing practice influenza vaccination programme was targeted at high-risk groups as defined by the Department of Health (Begg and Salisbury 1996) at that time. This pilot study was conducted between 1996 and 1997 before the Department of Health guidance to vaccinate patients over 75 years against influenza introduced in August 1998 (Department of Health 1998c) and for those over 65 years in May 2000 (Department of Health 2000c). However, as part of our practice policy, patients specifically requesting influenza vaccination, usually aged sixty-five years or over, who were not in a disease risk group were not refused influenza vaccination. As a result, we were also uncertain of the effectiveness of our current influenza vaccination campaign in reaching high-risk groups.

### ***4.2.4 Introducing change***

Prior to the pilot study a programme for pneumococcal vaccination had not been considered at the practice except for a small number of asplenic patients, i.e. those patients with an absent spleen, through surgery or disease. These individuals were at particular risk of contracting overwhelming septicaemia or overwhelming post-splenectomy infection (Waghorn and Mayon-White 1997) (see also 2.13). Expert guidelines recommended measures to reduce this complication including pneumococcal vaccination (Working Party of the British Committee for Standards in Haematology Clinical Haematology Task Force 1996) and these guidelines had been largely accepted because of fear of litigation.

After a preliminary discussion it became clear that the main reason for the failure to consider a more general pneumococcal vaccination programme at the practice was because of lack of knowledge about the vaccine amongst doctors and nurses and a lack of awareness of the current guidelines. A preliminary review of the literature on pneumococcal vaccination was undertaken and the findings presented at a primary healthcare team meeting involving doctors, nurses and practice manager. A practice policy of vaccinating high-risk groups with pneumococcal vaccine was formulated and agreed in midyear 1996 after reviewing the evidence and a discussion within the primary healthcare team. This policy was endorsed by the Chief Medical Officer's update on influenza and pneumococcal vaccination prior to our programme which was introduced in the Autumn of 1997 (Department of Health 1977).

The recommendations for influenza and pneumococcal vaccination were discussed again with doctors, nurses, health visitor and practice manager at a monthly primary healthcare team meeting in August 1996. The group considered how the existing influenza vaccination programme might be improved and how a pneumococcal vaccination programme could be implemented. We recognised the possibility and advantages of linking the two vaccination programmes because of the overlap between patient groups recommended for the vaccines, the possibility of additive effects and the evidence that they were effective and safe when administered together. It was thought likely that many patients given influenza vaccination would also be eligible for pneumococcal vaccination because of the similarities between at-risk groups so we discussed the possibility of administering pneumococcal vaccine to those patients receiving influenza vaccination.

The largest group of patients who were eligible for influenza but not pneumococcal vaccine in the United Kingdom were nursing home or institutionalised patients so it was important that we avoided giving pneumococcal vaccination to this group unless they had an additional reason for receiving it.

#### ***4.2.5 Unanswered questions***

It became clear that there were a number of other issues that needed to be clarified before undertaking a combined vaccination programme. To what extent were patients aware of pneumococcal vaccination? Were patients fully informed about the benefits and risks of vaccination? Did patients know of the high-risk groups eligible for vaccination and whether they fell into one of these groups? Even if patients were aware of the vaccine and eligible risk groups, would they accept vaccination as part of a preventive programme? How positive were patients to influenza and pneumococcal vaccine and how positive were they to vaccination in general? What factors influenced whether patients would agree to be vaccinated? Were we correct in assuming that the right patients were being vaccinated against influenza? These questions can be summarised as patient knowledge, attitudes, current behaviour and intended behaviour in relation to influenza and pneumococcal vaccination.

It was important to find the answers to these questions in order to gauge the likelihood of success of improving the existing (influenza) vaccination programme, introducing an additional vaccination (pneumococcal vaccine), and also from a purely logistical point of view, for example to determine how much vaccine was needed so that we could prepare appropriately for vaccine storage and stock control.

Alternative ways of answering these questions in relation to our practice population were considered. Possible solutions included exploring the existing literature; using qualitative methods such as individual interviews or focus groups; or using a self-completed patient questionnaire. A patient questionnaire would also enable a quantitative estimate of patients' intention to be vaccinated. Although there had been some reference in the literature to patient attitudes to influenza and pneumococcal vaccination this was mainly derived from studies in North America, where there had been greater private provision of healthcare, so the results may not have been generalisable to the general practice setting in the United Kingdom. There were limited resources, time and expertise to conduct interviews or focus groups. It was decided the most appropriate method to achieve the aims of this study was to develop a questionnaire for self-completion and administer this to a suitable sample of patients.

#### ***4.2.6 Questionnaire development and sampling frame***

There were a number of issues that needed to be considered in adopting this approach. These included defining the purpose of the questionnaire, developing a valid and reliable questionnaire instrument for assessing attitudes, refining, piloting and testing the questionnaire, gaining a valid and representative sample, ensuring adequate response rates and assessing non-responders.

The purpose of the questionnaire was to assess patient awareness of pneumococcal vaccine, to ascertain whether patients were able to identify whether they fell into a risk group and which risk groups these were, to gauge attitudes to vaccination in general and pneumococcal vaccination in particular, and to determine the acceptability of

pneumococcal vaccination amongst those patients already attending for influenza vaccination.

A self-administered questionnaire was used as the instrument for measuring attitudes and gathering other data for this study. A suitable questionnaire was devised after searching the literature on questionnaire design and pneumococcal vaccination. The questionnaire was modified after a small pilot study to a sample of twelve patients. There was accompanying explanation included at the beginning outlining the purpose of the questionnaire with information at the beginning on pneumococcal vaccination and at the end for patients who wished to have the vaccination (Appendix 1).

The questionnaire was devised using published guidelines and considering the various stages of questionnaire design including data content, question selection and wording, coding, presentation and layout (Stone 1993; Lydeard 1991). It included an initial section outlining the reasons and indications for pneumococcal vaccination and possible side effects. Information about the benefits and side effects of pneumococcal vaccine was included so that the questionnaire itself served as a method of raising awareness in the target group. Patients were asked to complete questions on general attributes such as age and sex as well as beliefs such as whether they thought they were in a risk group, prior knowledge of pneumococcal vaccine and the source of this information.

The second part of the questionnaire consisted of a series of statements reflecting attitudes about vaccination in general and pneumococcal vaccination in particular. These

attitudinal statements were derived from five dimensions or areas of concern identified from the literature review. The attitude statements, which included underlying beliefs (cognition), feelings (emotion) and what patients reported that they would do as a result of their beliefs and feelings, sometimes termed resultant behaviour or action tendency, were developed using recognised techniques (Oppenheim 1966). These techniques included assembling a pool of relevant items, constructing a questionnaire instrument from these, applying this to an appropriate sample, developing the instrument based on the response to questions and item analysis, assessing reliability and validity and modifying the instrument on the basis of this if necessary (Proctor 1993).

Because respondents were more likely to reply in the affirmative leading to acquiescent bias (Martin 1964), paired statements were employed expressing opposite attitudes, i.e. a 'balanced' questionnaire. Some of the statements were simply reversed in wording to produce their negative counterpart whereas others used recognised negative concepts identified from the preliminary exploration (Figure 2). This technique had been used previously in general practice (Pringle *et al.* 1984) to counter bias due to 'response acquiescence'. The five pairs of statements were ordered to avoid paired questions occurring together giving an item pool of ten questions in all. A Likert-type (Likert 1932) format with five response codes numbered one to five, ranging from "strongly agree" to "strongly disagree" with a central "not sure" numbered three was used for each statement. Care was taken to avoid ambiguous statements, double questions and loaded questions and the questionnaire was developed with awareness of the various types of respondent bias that could operate in this type of questionnaire including acquiescence (central

tendency), skewed responses and social desirability bias (Lydeard 1991) whilst acknowledging that some of these could only be detected at the analysis stage. A suitable coding frame was developed for the questionnaire responses so that the data could easily be entered onto a database for analysis.

The sample that was selected was patients attending, or being visited for, influenza vaccination. This included vaccinations administered by practice and district nurses or doctors during a single influenza vaccination season. This set of patients was chosen because of the overlap between risk groups for the two vaccines, because those attending for influenza vaccine would be generally positive to vaccination and because it was felt that targeting them would lead to the greatest rise in coverage for pneumococcal vaccine. An alternative would have been to select a random sample from all patients in the practice or those above a certain age or those in particular risk categories. An advantage of this approach would have been that it targeted a wider, more representative group of patients who might have been eligible for influenza and pneumococcal vaccination. The disadvantages would have included the additional costs of postage and the risk of a low response rate that often occurs with postal questionnaires.

Nursing and residential homes or similar institutions were excluded because patients within these establishments did not fall within the recommendations for pneumococcal vaccination per se but also because it was known that a proportion of nursing home patients were unable to complete the questionnaire because of illness or disability, for example dementia.

Although this sampling strategy might have led to selection bias, i.e. excluding patients who did not attend for influenza vaccine for whatever reason, this was felt to be a legitimate pragmatic approach for the purposes of this study as it was the patients who were sampled who would subsequently be targeted for pneumococcal vaccination.

A small initial sample of twelve patients attending the practice diabetic clinic was chosen to pilot the questionnaire. Patients attending this clinic were handed the questionnaire before their appointment and had an opportunity to complete and return the questionnaire before leaving. This allowed the investigator to check whether questions were understood and that the format, layout, wording and responses were adequately accounted for by directly checking with each patient.

After minor modifications the questionnaire was distributed to patients attending or being visited for influenza immunisation by receptionists and district nurses. The questionnaire was not strictly anonymised. Patients who were interested in receiving pneumococcal vaccination in addition to influenza vaccination, after receiving the patient information, were given an opportunity to record their name on the questionnaire so that they could be contacted at a later date when the vaccination programme had begun. Those patients who did not wish to have the additional vaccine or preferred not to give their name could return the form anonymously.

#### **4.2.7 *Ethical issues***

It was also important to consider the ethical issues arising from this project. After seeking informal advice from the local research ethics committee at the time of the pilot it was

felt that this was primarily an audit rather than a research study. The patient questionnaire also informed patients about the vaccine and its side effects and provided an invitation for patients to seek vaccination when this became available. The subsequent additional medical intervention of pneumococcal vaccination was an existing health technology that was advocated by national guidelines. Patients were informed as to the purpose of the questionnaire by the receptionist or nurse and also in the preliminary information. They were not under any obligation to complete the questionnaire and it was returned after completion to a box in the reception area. On the balance of this advice formal ethical approval was not sought.

#### ***4.2.8 Data collection and analysis of patient questionnaire***

Questionnaires were distributed to patients attending for influenza vaccine during the first available vaccination season between September and December 1996. Practice receptionists collected the collected completed questionnaires. Data from the questionnaires was coded and entered onto Microsoft Excel version 5 by a practice receptionist trained in data entry. Analysis was performed using EPI INFO version 6 (EPI INFO version 6 DOS, 1996) and SPSSPC version 10 (Norusis 1990). SPSS was used to generate correlation coefficients, item and scale statistics and the reliability coefficient (Cronbach's alpha) for the attitudinal statements. Questionnaire reliability and validity were evaluated using techniques described in the methods section. Subgroups differentiated according to age, sex, previous vaccination behaviour and risk groups, were compared using the chi square test for nominal data and the Kruskal-Wallis test for total attitude scores (Brown and Beck 1990) since the data were non-parametric.

#### ***4.2.9 Changes introduced***

As a direct result of analysing the questionnaire it was possible to estimate and purchase sufficient vaccines for the subsequent vaccination programme. A number of measures were undertaken to improve the logistics of the vaccination programme, based on the literature review, in order to increase uptake of both influenza and pneumococcal vaccines to high-risk groups.

In order to comply with recommendations for storage an additional dedicated vaccine refrigerator with an inbuilt thermometer was purchased. Practice protocols were devised for practice nurses, district nurses and doctors. These were discussed and agreed at a primary healthcare meeting. Agreement of shared protocols was considered important in order to raise awareness amongst healthcare staff and to ensure that vaccine was being correctly delivered to target groups (Figure 3 and 4). Practice and district nurses ensured that they had access to a 'shock box' and that this was stocked with emergency drugs, including adrenaline, in case of allergic reactions to the vaccine. The 'shock box' was a box containing the necessary equipment required in case of a potentially fatal severe allergic reaction to the vaccine. The box contained an airway to help the patient breathe and drugs such as adrenaline and hydrocortisone that if correctly used can treat this condition, which is also known as anaphylactic shock. Patients were informed about the pneumococcal vaccine through poster displays in the surgery and about both influenza and pneumococcal vaccines during the annual influenza vaccination round. Automated prescription messages were printed onto prescriptions informing patients about the two vaccines and risk groups.

**Figure 2 Attitude statements: values and beliefs about vaccination**

**Safety**

1. I think that vaccinations are generally safe
2. I am worried about the side effects of vaccination

**Prevention**

3. Prevention is better than cure
4. I do not believe in prevention

**Susceptibility to infection**

5. I never get colds or chest infections
6. I am worried about getting chest infections

**General health**

7. I believe that I am a healthy person
8. I would say overall that I am unwell

**Pneumococcal vaccination**

9. I feel that I would like pneumococcal vaccination
10. I don't think that I need pneumococcal vaccination

Pneumococcal vaccine was administered to high-risk patients between January and December 1997 opportunistically by general practitioners and practice nurses during routine surgery attendances, attendance at specialised clinics (e.g. diabetic and asthma clinics), district nurse visits to the housebound elderly, after discharge from hospital and most importantly during the subsequent influenza vaccination programme. The influenza vaccination programme was conducted between September and December 1997. Special nurse clinics were set up during this time for influenza and combined influenza and pneumococcal vaccination.

#### ***4.2.10 Completing the cycle***

The effect of the vaccination programme was evaluated after one year by conducting a complete audit cycle of vaccine uptake in risk groups. Five tracer conditions (Kessner *et al.* 1973), ischaemic heart disease, diabetes, splenectomy, chronic obstructive airways disease (including asthma) and chronic renal failure were chosen to measure vaccine uptake. As well as being high-risk groups for both influenza and pneumococcal vaccination, these were the most accurately recorded of the high-risk conditions on the practice disease register and were conditions that were relatively clearly defined. Asthma and chronic obstructive pulmonary disease (COPD) were grouped together because of difficulties with classification. Many older patients on inhalers, particular smokers, were wrongly classified as having asthma rather than COPD. Although chronic heart disease was stated as a risk group for pneumococcal vaccination, most patients with heart failure (which was usually taken to mean chronic heart disease) had coronary disease. It was known that heart failure registers were unreliable in general practice at that time because of misdiagnosis, either false positives (Remes *et al.* 1991) or under diagnosis (Sutton and

Poole-Wilson 1996; Morgan *et al.* 1999) and so coronary heart disease rather than heart failure was used as a tracer for this audit.

#### ***4.2.11 Final data collection and analysis***

The rate of influenza and pneumococcal vaccination in each target group was calculated using the reporting function of the general practice computing system. Patients who fell into more than one target group were treated separately for each part of the audit. The rate of vaccine delivery to high-risk groups was calculated by searching the patients who had received influenza and pneumococcal vaccine for each of these risk groups. The results of the pilot are presented below (see 5.1).

**Figure 3 Protocol for influenza vaccination**

**TARGET GROUPS**

1. Asplenia or severe splenic dysfunction including sickle cell disease.
2. Chronic lung disease and asthma: COAD, bronchiectasis.
3. Chronic heart disease: coronary disease, heart failure.
4. Diabetes mellitus.
5. Chronic renal disease: chronic renal failure, nephrotic syndrome, dialysis or transplant.
6. Chronic liver disease.
7. Immunodeficiency or immunosuppression: HIV, drugs, lymphoma, myeloma.
8. Patients in residential or nursing homes.

**Contraindications**

1. Pregnancy (unless there is a specific indication).
2. Anaphylactic hypersensitivity to hens' egg products.

**Clinical Responsibility**

6. Ultimate responsibility rests with GP.
7. Can be delegated to suitably trained nurses.
8. Practice nurse must adhere to practice guideline.
9. Advise patient of purpose and possible side effects of vaccination.
10. Method of administration: IM or SC 0.5 ml into deltoid (adult) or lateral aspect of mid thigh (children); 0.5 ml for children 4 to 12 years repeated 4-6 weeks later if receiving vaccine for the first time; 0.25 ml for children 3 months to 6 years repeated 4-6 weeks later if receiving vaccine for the first time. NOT intradermal or iv. Separate site if given at the same time as pneumococcal vaccine.
11. Record site, lot number, expiry date in notes.
12. Flag computer record.
13. Emergency drugs and equipment available for anaphylaxis.

**Outcome**

All patients who fall into 'risk categories' will have been offered and given influenza vaccine if appropriate.

**Reference**

Department of Health, Welsh Office, Scottish Home and Health Department, Department of Health and Social Services Northern Ireland. *Immunisation against infectious disease*. London: HMSO, 1996: 167-72.

## Figure 4 Protocol for pneumococcal vaccination

### TARGET GROUPS

Age 2 years and over with the following conditions:

1. Asplenia or severe splenic dysfunction including sickle cell disease.
2. Chronic lung disease: COAD, bronchiectasis, chronic asthma.
3. Chronic heart disease: coronary disease, heart failure.
4. Diabetes mellitus.
5. Chronic renal disease: chronic renal failure, nephrotic syndrome, dialysis or transplant.
6. Chronic liver disease.
7. Immunodeficiency or immunosuppression: HIV, drugs, lymphoma, myeloma.

### Contraindications

1. Previous pneumococcal vaccine (within 5-10 years) - consult doctor if unsure.
2. Previous severe reaction to vaccine.
3. Pregnancy, breast feeding.
4. Children under 2 years (vaccine ineffective).
5. High dose steroids.

### Clinical responsibility

6. Ultimate responsibility rests with GP.
7. Can be delegated to suitably trained nurses.
8. Practice nurse must adhere to practice guideline.
9. Advise patient of purpose and possible side effects of vaccination.
10. Method of administration: IM or SC 0.5 ml into deltoid or lateral aspect of mid thigh.  
NOT intradermal or iv. Separate site if given at the same time as influenza vaccine.
11. Record site, lot number, expiry date in notes.
12. Flag computer record.
13. Emergency drugs and equipment available for anaphylaxis.

### Outcome

All patients who fall into 'risk categories' will have been offered and given pneumococcal vaccine if appropriate.

### Reference

Department of Health, Welsh Office, Scottish Home and Health Department, Department of Health and Social Services Northern Ireland. *Immunisation against infectious disease*. London: HMSO, 1996: 167-72.

### **4.3 Lincolnshire-wide multipractice study: multipractice audit to assess influenza and pneumococcal vaccination uptake in high-risk groups**

#### ***4.3.1 Background and aims***

The next step was to apply the findings of the pilot study more widely by conducting a quality improvement study across a number of general practices in Lincolnshire. The aim of this study was to compare vaccination coverage between practices, assess practices' ability to target vaccination to high-risk groups and to improve vaccination of these risk groups. As well as exploring the feasibility of improving influenza and pneumococcal vaccination rates across a range of general practices, it helped to define the control intervention and enabled a power calculation in the randomised controlled study.

#### ***4.3.2 Outline of problem***

Lincolnshire is a large rural county. Primary healthcare teams were responsible for delivery of influenza and pneumococcal vaccinations to high-risk groups. At the time of the study there had been little support for practices to improve influenza and pneumococcal vaccination rates. Improving the uptake of these vaccines was becoming increasingly important as evidence on efficacy, reduced mortality, morbidity and hospital admission, and the prospect that they may help to reduce winter pressures, was growing. This was undertaken as part of a Primary Care Audit Group (PCAG) initiative. Lincolnshire PCAG was the successor to the Medical Audit Advisory Group and a key organisation responsible for organising audit and achieving quality improvement in the county and took an initiative to improve rates of these adult vaccinations. Membership of this group helped considerably in providing access to practices for this project.

The aims of this study were to compare vaccination coverage between practices, assess practices' ability to target vaccination to high-risk groups and to improve vaccination rates in risk groups by advising on interventions that addressed these barriers and to see how practices changed their vaccine delivery and performance as a result.

#### ***4.3.3 Key measures for improvement***

The objective was to increase influenza and pneumococcal vaccination rates in high-risk groups. We chose patients with coronary heart disease, diabetes and splenectomy to reflect these groups. These 'tracer' conditions (Kessner *et al.* 1973) were chosen because they were the most accurately recorded of the high-risk conditions on practice disease registers.

There were six audit criteria. In summary these were that patients with coronary heart disease, diabetes or splenectomy should receive annual influenza vaccination and have received pneumococcal vaccination at least once previously.

#### ***4.3.4 Gathering information and strategies for change***

In July 1998, all practices in the county of Lincolnshire (n=105) were invited by letter to participate in a multipractice audit of influenza and pneumococcal vaccination in high-risk groups (Appendix 2). A core group comprising a general practitioner, nurse and audit staff from the PCAG developed the audit package. This was further refined by the wider membership of the PCAG comprising several general practitioners including educationalists (general practice trainers), practice and district nurses, a consultant physician, public health physician and audit managers and staff. It was also piloted by

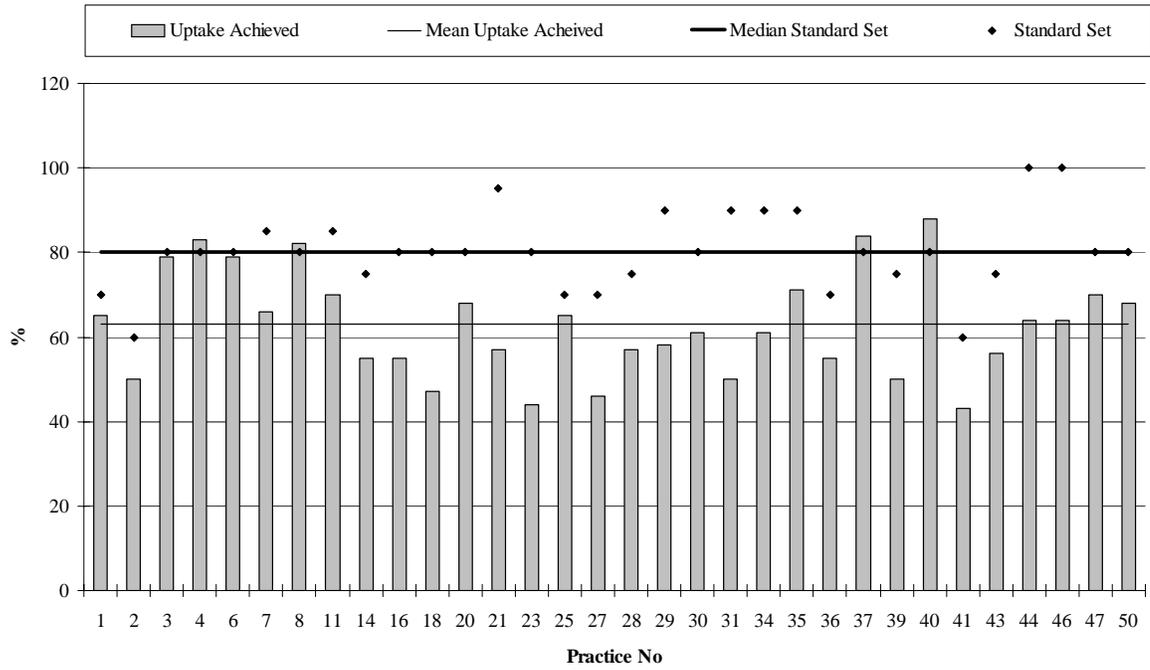
two practices before being disseminated. The baseline data collection was carried out in September to November 1998. Practices were asked to collect vaccination data for patients with coronary heart disease, diabetes and splenectomy. These three conditions were chosen because they were more likely to be accurately recorded on disease registers than asthma and chronic obstructive pulmonary disease or chronic renal failure, which were included in the single practice study. There was also some controversy as to whether asthmatic patients should receive pneumococcal vaccination (Siriwardena 1997). Patients over 65 years were not included in this countywide audit as this was not national policy at that time. Reducing the number of conditions also simplified the data collection process although this was not a primary consideration. For each condition, practices recorded if patients had received influenza vaccine in the previous year or pneumococcal vaccination ever. Practice receptionists or nurses collected data on structured data collection forms and sent these together with their target standards to the Primary Care Audit Group (PCAG) office for analysis. To ensure patient confidentiality practices completed these data collection forms using patient identification numbers only and held the patient reference sheet with names of patients against those numbers. There was some potential for bias in this process with the potential for staff to generate inaccurate lists of high-risk patients or those that had been vaccinated. This was minimised by giving clear instructions on how to produce these lists or to generate computer reports of the relevant data.

#### ***4.3.5 Data analysis and feedback***

Data were analysed to produce summary data, graphs and results for feedback to practices. We returned anonymised graphical feedback of performance in January 1999

(Appendix 4). The feedback of practice results was done in graphical form as a bar chart (Figure 5). Each bar represented a single practice's individual vaccine uptake for a single high-risk group compared with other practices, mean uptake and standard set. The feedback was anonymised so that practices were given their own results and could compare this with those of other practices without having knowledge of other practices' individual performance. We also distributed information on good practice (Figure 6), example protocols for influenza (Figure 3) and pneumococcal vaccination (Figure 4), an explanation of how to undertake computer searches, and claim reimbursement for vaccines dispensed. Practices were encouraged to disseminate their results within their primary healthcare teams and discuss how they could increase vaccination rates in their high-risk patients.

**Figure 5 Example of feedback to practices: Percentage of diabetic patients who received influenza vaccination**



### **Figure 6 Advice given to practices after the first audit**

Initiating, updating and maintaining chronic disease registers are essential if practices wish to improve targeting of high-risk groups.

Use and implement written protocols for adult vaccination.

Ensure adequate vaccine supplies and stock control, especially pneumococcal vaccine; sufficient refrigerator space and maintenance of the cold chain are important.

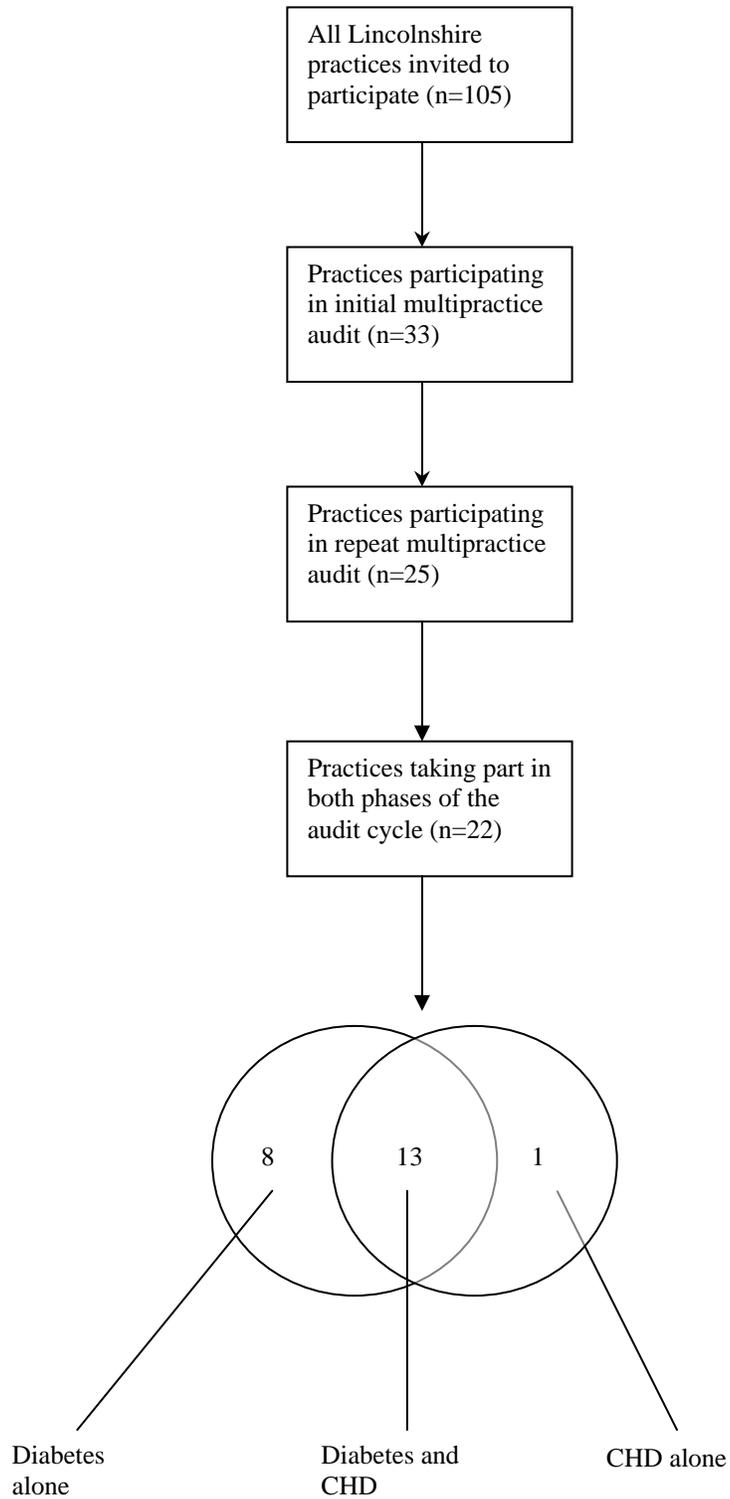
When presenting for flu jabs, check pneumococcal status in at-risk patients and advise vaccination if appropriate. Simultaneous vaccination is a good way of increasing coverage of high-risk groups.

A co-ordinated approach, agreed on by all personnel in the practice, including doctors, practice and district nurses, receptionists and practice manager works best.

A poster campaign and advice printed on repeat prescriptions each winter will help raise patient awareness.

Recommendation by a health professional and a consistent message has been shown consistently to improve vaccination rates.

**Figure 7 Flow of practices through Lincolnshire-wide multipractice study**



#### **4.3.6 *Measuring change***

The audit was repeated in January 2000, just a year after the initial data collection was completed and feedback sent to practices. This allowed just a year for practices to assess and compare their vaccination rates, discuss and implement change, conduct a pneumococcal vaccination programme and complete a further winter vaccination programme for influenza. Twenty-one practices took part in both phases for diabetes and fourteen of these for coronary heart disease and splenectomy. All the practices that undertook the baseline assessment completed both phases but a number of practices joined for the second phase. Figure 7 shows the flow of practices through the audit.

Data were analysed using SPSSPC version 10 (Norusis 1990). Mean values for vaccination uptake were calculated between the two phases of the audit for practices that completed the audit cycle. Performance was compared with standards that practices set themselves (expressed as a median standard). The data were approximately normally distributed so a paired t-test was used to assess improvement in performance. A Wilcoxon rank sum test showed similar results. Although a number of practices joined the audit at the re-evaluation phase these were not included in the analysis.

A postal questionnaire was used at baseline (Appendix 3) and a semistructured postal questionnaire after the first phase of the audit (Appendix 5) to survey organisational changes that occurred in practices as a result of the audit.

#### **4.4 West Lincolnshire Primary Care Trust study: multipractice audit to assess influenza and pneumococcal vaccination uptake in high-risk groups**

##### ***4.4.1 Aim and setting***

Following the multipractice study a similar study was conducted to assess the effect of audit and feedback on vaccination performance within two Primary Care Groups that amalgamated in April 2001 to form a Primary Care Trust. This study coincided with the new recommendation to vaccinate patients aged over 65 years as well as those in high-risk groups. In addition the Department of Health set health communities a target of achieving a minimum 60% uptake of vaccination in these groups in the year 2000 and advised them to monitor the immunisation programme and provide data for national monitoring. As part of this study practices were approached to participate in a randomised controlled study of an educational intervention for primary care teams aimed at improving influenza and pneumococcal vaccination rates (see 4.5 below).

In July 2000 all practices from both North West Lincoln and South Lincoln Primary Care Groups (PCGs), subsequently West Lincolnshire Primary Care Trust, were invited to participate in an audit of influenza and pneumococcal vaccination (Appendix 6). The aim of the audit was to improve the uptake of influenza and pneumococcal vaccination in patients aged 65 years and over and those in high-risk disease groups. Patients aged over 65 years were included in this audit following the Chief Medical Officer's guidance (Department of Health 2000b) and subsequent letter (Department of Health 2000c).

Twenty-seven practices took part in this initial audit, sixteen from North West Lincolnshire PCG and eleven from South Lincoln PCG. Twenty of these practices also consented to participate in the randomised controlled study by returning the signed consent (Appendix 6).

The audit pack was adapted from that used for the countywide audit and remained consistent from the initial audit undertaken in July 2000 to the re-audit in April 2001. To facilitate comparison between the two data collection phases, practices were required to collect data for the same target group of patients, i.e. over 65s and the three tracer conditions, coronary heart disease, diabetes and splenectomy. The practices were not required to use exactly the same patients for both of the audit phases, as any changes implemented following the initial audit would affect the entire target population. Again, it was recommended to the practices that their entire target population were audited. However, information was included in the audit pack on how to select a representative audit sample.

#### ***4.4.2 Data analysis and feedback***

Data were analysed to produce summary data, graphs and results for feedback to practices. As a result of the audit we distributed information on good practice, example protocols for influenza and pneumococcal vaccination and feedback of audit results after the first cycle as for the Lincolnshire-wide audit.

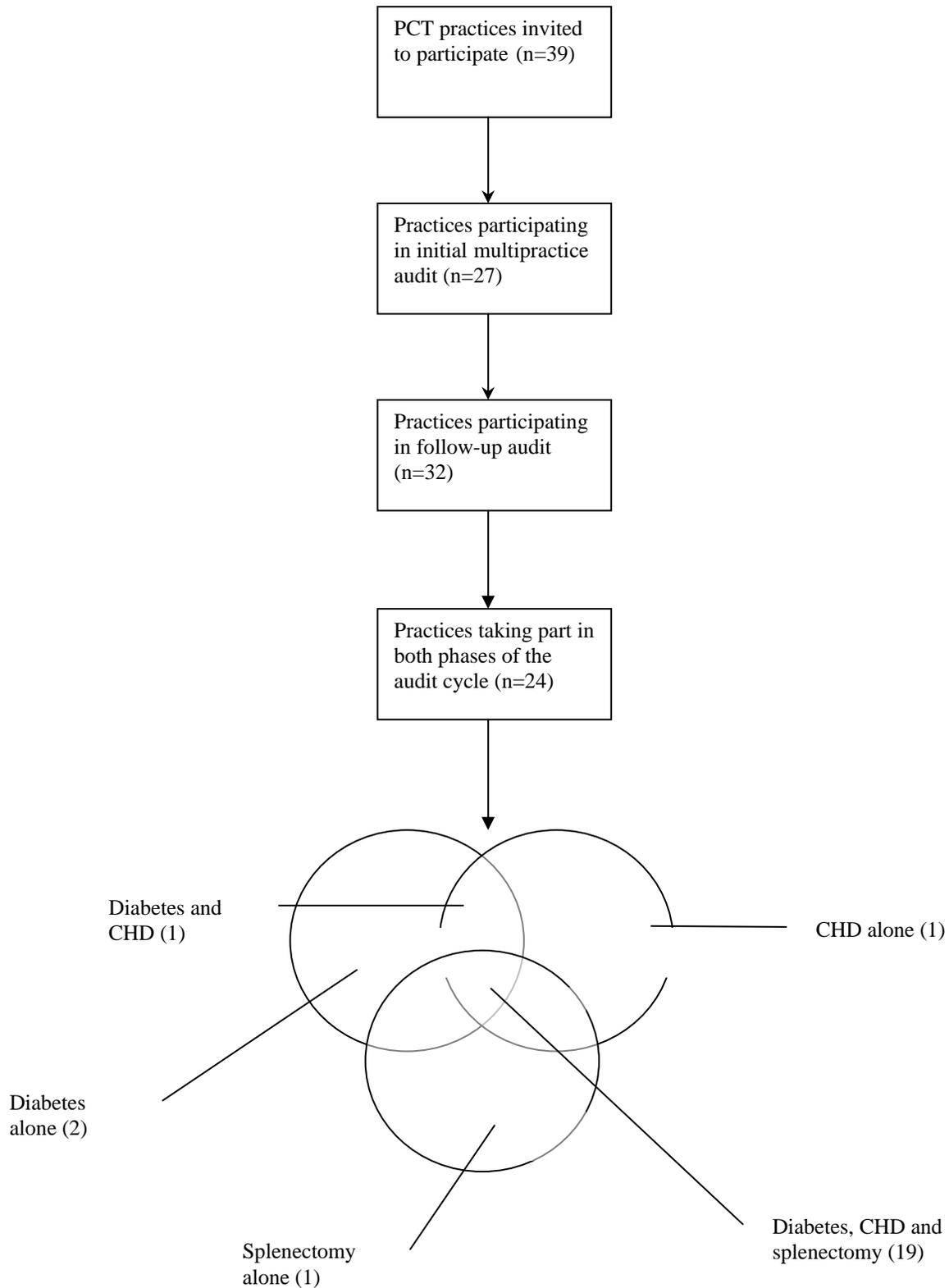
Practices from both PCGs were invited to re-audit their influenza and pneumococcal vaccination rates in April 2001 to complete the audit cycle and evaluate whether the

changes implemented as a result of the initial audit had been effective. Twenty-four of the original twenty-seven practices took part in the re-audit, with an additional eight practices taking part in the audit for the first time. In total thirty-two practices took part in the re-audit (fourteen from South Lincoln PCG and eighteen practices from North West Lincoln PCG). It was recommended to the practices that the standards that they had set in the initial audit should remain the same in the re-audit, unless they had achieved the initial standard and wished to aim higher.

Once the practices had completed the data collection they were instructed to return their data to the primary care audit group (PCAG) office. As in previous PCAG audits, for patient confidentiality purposes, practices completed data collection forms using patient ID numbers only and held their own patient reference sheet with the names of the patients audited against those numbers. Those practices that were able to access the audit data from their practice computer systems were encouraged to return computerised data collection forms, which were also designed to protect patient confidentiality.

Data analysis was performed using SPSSPC version 10 (Norusis 1990). Mean values for vaccination uptake were calculated between the two phases of the audit for the twenty practices that undertook two phases of the audit cycle. A paired t-test was then used to assess improvement in performance between the two phases of the audit because the data were approximately normally distributed. A non-parametric tests (Wilcoxon rank sum) showed similar results suggesting that the t-test was robust for this data.

**Figure 8 Flow of practices through Primary Care Trust multipractice study**



## **4.5 Trent Influenza and Pneumococcal study: cluster randomised controlled trial of the effect of an educational intervention directed at primary healthcare teams to improve influenza and pneumococcal vaccination uptake in high-risk groups**

### ***4.5.1 Introduction***

Although the countywide audit and Primary Care Trust audit could demonstrate improvements in vaccination rates the uncontrolled nature of these studies could not account for secular trends. By secular trends is meant changes that occur naturally over time in the process of healthcare. Such changes can occur because of increased awareness of new processes, local and national influences for change, demographic changes or non-specific temporal effects. Pneumococcal vaccination rates would be expected to gradually increase with time because of these factors. The mere fact of being observed during an audit study would also tend to alter the behaviour under observation due to awareness of being observed, the so-called “Hawthorne effect” (Holden 2001).

One way of accounting for secular trends would have been to have a non-randomised comparison group for the multipractice studies where feedback of audit results and written advice was withheld. This was not possible because of resource and ethical constraints. There was not a suitable county to act as a comparison as in the United States demonstration projects (Barker *et al.* 1999) because of lack of funding and the absence of an interested partner. It may have been unethical to use a control group of practices in a multipractice audit since the purpose of such an audit would be to improve current practice according to predetermined criteria and standards rather than for research

purposes. There may also have been problems of bias and contamination, depending on how practices were chosen for intervention or comparison groups and whether they were in sufficient proximity to share information on what was being done in intervention practices. Since each practice would also collect their own audit data it would have been relatively simple for them to analyse their own performance and act on it accordingly.

Another way of accounting for secular trends would have been to use an interrupted time series design, taking data at several points in time before and after the intervention and analysing the data to see if there was significant increase in immunisation rate following the intervention. This would have necessitated multiple data points and with many more sets of data to be collected was not feasible in this type of unfunded study, for pragmatic reasons.

A key finding from the literature review was that audit and feedback by itself was of limited benefit in improving practitioner performance or patient outcomes but that in combination with other, particularly educational, techniques it could lead to greater improvements in performance, particularly in relation to vaccination rates. Methods that were used in the multipractice audits and had been shown to be effective in systematic reviews included the use of protocols or clinical guidelines.

A more effective way of improving performance included educational outreach with education being delivered to practitioners at or close to their place of work. Previous studies of educational outreach had been directed at single professional groups, usually

general practitioners, rather than multidisciplinary practice teams. An influential report on the future of continuing professional development in primary care suggested that greater emphasis should be placed on multidisciplinary practice-based learning (Department of Health 1998b) in order to stimulate change in practice and real improvements in patients care. Despite this and theoretical support from adult learning theory (Knowles 1990) that small group learning, relevant to practice and delivered at the workplace could improve the performance of primary healthcare teams there had been little research undertaken on the effectiveness of multidisciplinary education for primary healthcare teams the United Kingdom.

It was therefore decided to undertake a study that sought to combine these concepts by using an educational outreach intervention directed at primary care teams. The purpose of the educational intervention was to identify barriers to vaccination and implement evidence based methods for improving vaccine uptake. The methods used were based on information and experience from the literature search, pilot and interpractice studies but were tailored according to the needs of practices. A randomised controlled trial was conducted to assess the effect of an educational outreach visit to primary healthcare teams on influenza and pneumococcal vaccination rates.

#### ***4.5.2 Design***

The study used a cluster randomised controlled design. The study was partly nested within the primary care trust audit (see 4.5.3). The aim of the study was to measure the effect of an educational intervention on influenza and pneumococcal vaccination uptake in high-risk groups (patients aged 65 years and over and those with coronary heart

disease, diabetes or splenectomy). Intervention and control practices also received audit feedback and written guidance. The hypothesis being tested was that volunteer practices undergoing a primary care team based educational outreach session would have greater influenza and pneumococcal vaccination rates as a result. The null hypothesis was that an educational outreach visit to volunteer primary healthcare teams would have no effect on increasing influenza and pneumococcal vaccination rates in high-risk groups. A randomised controlled design was chosen to reduce the effect of confounding factors and to account for secular trends. Baseline imbalance in the intervention and control practices was corrected for by stratifying according to baseline vaccination rate.

The use of clusters was an important feature of the design. Cluster randomised designs are those where social units rather than individuals are randomly allocated to two or more intervention strategies. This type of design, where in this case the general practice was the preferred cluster, was chosen for several reasons (Bland and Kerry 1997). Firstly, the general practice team was the target of the educational intervention. Because the intervention was directed at practices rather than individual patients and because the primary outcome was the influenza or pneumococcal vaccination rate in the high-risk population from each practice, a cluster design, using clusters of high-risk patients from individual practices, was most appropriate for this study (Grimshaw *et al.* 2000). Secondly, it would not have been possible to randomise patients within a practice to the organisational changes that would affect the whole practice and its primary care team, because the changes were likely to have affected all individuals including staff and patients belonging to the organisation. Thirdly, outcomes in each cluster would tend to be

correlated because of similarities between patients (registering with each practice), other influences exerting effects on vaccination rate across the whole practice population (such as local media campaigns), and interaction between patients in each practice (for example, personal recommendation from friends and relatives to have vaccination) (Ukoumunne *et al.* 1999b). Finally, data was collected at practice level, the same level as the intervention, and therefore the general practice was naturally the correct unit of analysis (Altman and Bland 1997).

Cluster randomisation was also chosen to reduce contamination (Torgerson 2001). Contamination is said to occur when subjects, either patients or in this case healthcare staff, randomised to a control group are inadvertently subject to the intervention. This is most likely to occur when patients in the same practice are allocated to both intervention and control groups. Cluster randomisation would reduce this possibility, unless it could be shown that practices in the control group were able to implement the intervention themselves, or had learnt the lessons of the educational intervention from nearby intervention practices through informal communication. However, the control practices in this study did not receive a practice based educational session on methods of improving influenza and pneumococcal vaccination rates during the period of the study. Contamination may have inadvertently occurred in neighbouring practices. This would have tended to reduce the effect of the intervention.

A number of other potential sources of bias and possible problems with the internal validity of this type of design were recognised at this stage. These included the possibility

of selection bias in which practices or patients with different characteristics might be allocated to intervention or control groups, external events affecting changes in vaccination rate between baseline and follow-up (termed “history”), changes in practice clusters independent of the intervention perhaps due to staff changes (“maturation”), effect of baseline measurements alone on behaviour as an example of the Hawthorne effect (“testing”), loss of clusters from the study related to the intervention (“attrition”) and the tendency of high or low vaccination rates to exhibit regression to the mean (Ukoumunne *et al.* 1999b). The design and analysis took into account many of these problems.

This type of complex design had important implications for the sample size calculation, randomisation, stratification and subsequent analysis of the study. There were also important ethical considerations (see 4.5.11). Expert statistical advice was therefore sought and gained at all stages of the study. The study also complied with internationally accepted conventions on the design and reporting of randomised controlled trials (Begg *et al.* 1996) and cluster randomised controlled studies (Elbourne and Campbell 2001).

#### ***4.5.3 Recruitment of practices***

All practices in West Lincolnshire Primary Care Trust (n=39) and Trent Focus Collaborative Research Network (n=50) were invited to participate in the study in June 2000. There were no explicit exclusion criteria but an agreement to provide baseline and follow-up data was a prerequisite of recruitment. Practices from the primary care trust who were already participating in the trust wide multipractice audit were approached by letter for consent to the study (Appendix 6) and provided with a practice briefing and

consent to participate (Appendix 7). Practices from the collaborative research network were also approached by letter through the Trent Focus research network office with an outline of the study (Appendix 8) and consent to participate. Following this invitation, twenty practices from the primary care trust and ten practices from the research network agreed to participate. The first thirty practices to volunteer for the study were selected to participate and written to (Appendices 9 and 10). All subsequently undertook the study. Practices who expressed an interest after the recruitment process were informed that the study was closed to further selection (Appendix 11). The involvement of practices in the trial is summarised in Figure 9. Demographic data for non-participating practices were obtained from the respective organisations.

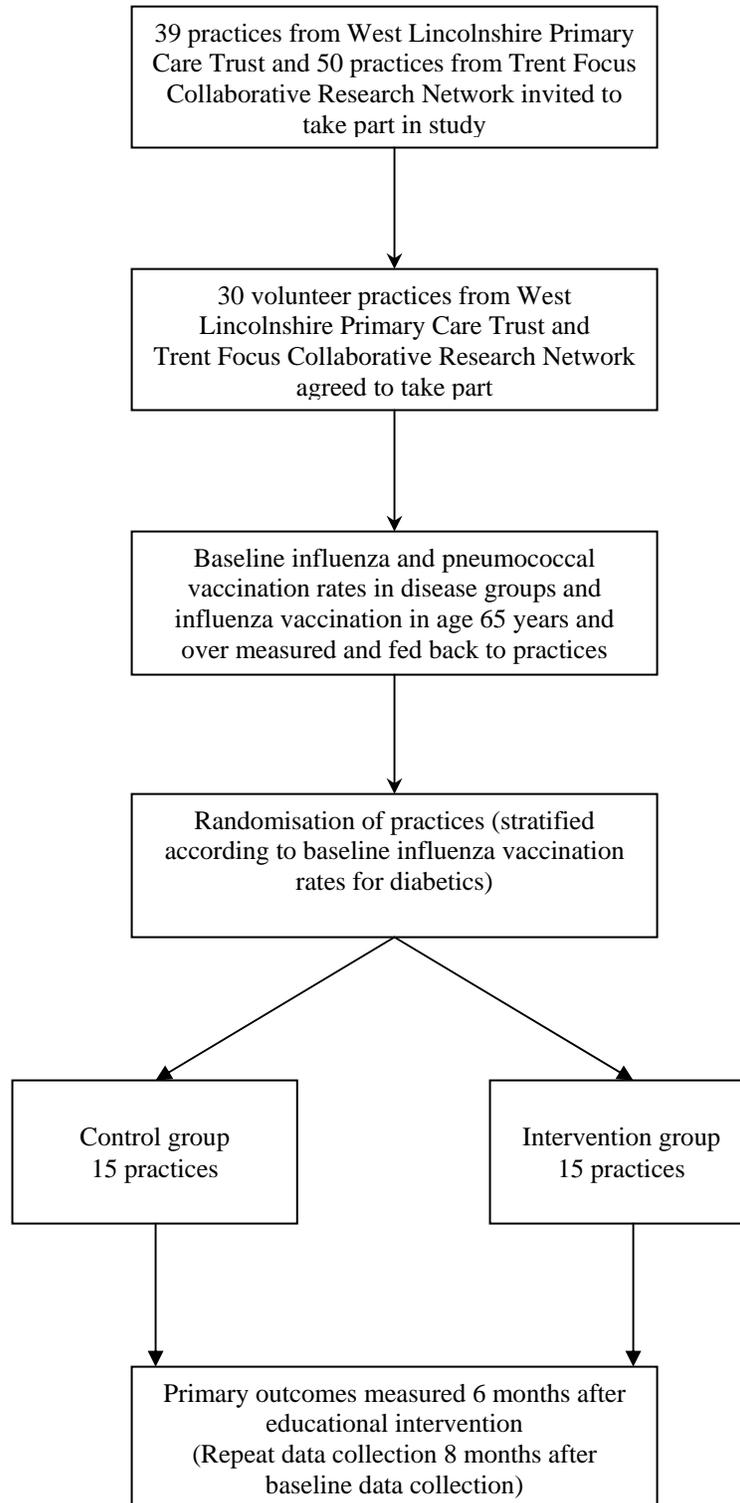
Practices were selected on a pragmatic basis. There were a number of issues around recruitment, which may have affected the external validity or generalisability of this study. Some of the Lincolnshire practices (n=5) that participated were known to have taken part in previous multipractice audits. They were likely to have already implemented some changes to improve vaccination rates. The research network practices may have been different from the Lincolnshire practices in terms of organisational or patient characteristics (like training status, deprivation etc.) or other factors that might have affected vaccination rates. The research practices in this study were known to be more likely to be involved in training, tended to be larger and to have a female partner but with fewer single-handed and younger doctors compared to other practices in the Trent region. However their patient populations were similar in hospital admission, morbidity and mortality compared with other practices in Trent (Hammersley *et al.* 2002). All these

factors, whether organisational or patient related were important in that they may have affected a general practice's baseline vaccination rate or its ability to increase vaccination rate, and therefore it was important to include some means of accounting for this in the randomisation process. This was achieved as shown below by using stratification based on baseline vaccination rate prior to randomisation. Since other organisational factors such as training status or patient factors such as deprivation were important because of their potential effect on the outcome of interest it could be postulated that selection bias, although present, could be partly offset by including practices with a broad range of organisational characteristics and baseline vaccination rates.

#### ***4.5.4 Baseline data collection***

The initial baseline data collection was carried out in August 2000 with thirty volunteer practices. Practices were sent a letter outlining the purpose of the study (Appendices 9 and 10). A detailed audit protocol was sent to all practices (Appendix 12). Practices were asked to complete their baseline data together with a questionnaire of vaccination practice (Appendix 3). The data collection method had been previously piloted in both the single practice and countywide study. The data collection was carried out by Lincolnshire Primary Care Audit Group (PCAG) on behalf of the Primary Care Trust (PCT) as part of a multipractice audit and additionally (by the researcher) for the Collaborative Research Network practices. Practices were asked to collect vaccination data for those aged 65 years and over and patients with coronary heart disease, diabetes or a previous splenectomy using Read codes onto a standardised data collection sheet (Appendix 13). Coronary heart disease, diabetes and splenectomy were again selected as so-called tracer conditions.

**Figure 9 Flow chart summarising involvement of practices in randomised controlled trial**



For patients aged sixty-five years and over and for each disease group participating practices recorded if patients had received influenza vaccination in the previous year, or for the disease groups only, pneumococcal vaccination ever. In order to ensure patient confidentiality practices completed these data collection forms using patient identification numbers only and held the patient reference sheet with names of patients against those numbers.

Practices used their own staff to collect data on pre-printed forms, with clear instructions for on how this should be done, and sent these to the PCAG for analysis. Alternatively, practices sent details of number vaccinated and denominators for each target group obtained from searching the practice computer database. Practices were sent one reminder letter (Appendix 14). Data were analysed to produce summary data, graphs and results for initial feedback to practices.

#### ***4.5.5 Randomisation***

Randomisation was carried out in September 2000 with the general practice as the unit of randomisation. Because of the possibility of ceiling effects (see 3.17.1), stratified randomisation was used, based on initial rate, so that intervention and control practices would have similar baseline vaccination rates. Baseline influenza vaccination rate for diabetes was chosen as the stratifying variable since all the rates were correlated. Within strata, practices were randomly allocated to intervention or control. This was carried out by listing all thirty practices in order of vaccination rate (for diabetes) and allocating each to odd or even and tossing a coin to decide which group they should be in. No method of allocation concealment was employed and this was a weakness in the design of this study.

Failure to conceal allocation, despite the randomisation process being explicit would have inflated effect sizes.

Intervention and control practices were written to, informing them whether they had been randomised to intervention or control groups. Intervention practices were told that they would receive an educational outreach visit to discuss their influenza and pneumococcal immunisation programmes, focusing on methods of increasing vaccination rates based on the research evidence. Intervention practices were asked to arrange to have at least one doctor, one nurse and the practice manager at this meeting and any other key members of staff that they felt appropriate (Appendix 15). Control practices were asked to continue their immunisation programme as planned and informed about a short semistructured questionnaire which they would be asked to complete at the end of their campaign (Appendix 16).

#### **4.5.6 Intervention**

The intervention was an educational outreach visit by the researcher to practice teams based on the principles of academic detailing (Thomson O'Brien *et al.* 2000c; Soumerai and Avorn 1990). The visit took place at the practice, lasted no longer than one hour and usually took place during a primary healthcare team meeting at which at least one general practitioner, practice nurse and practice manager but often the majority of the primary care team were present. The researcher acted as facilitator for the meeting, stating the ground rules, which included timing and confidentiality, and outlining the purpose and task of the meeting. The educational elements of this method were an initial assessment of the issues that were of interest to or difficulty for the practice team by generating a

dialogue around perceived barriers to vaccination within the organisation. Feedback of practice vaccination rates and comparison with other practices in the study and national targets was then provided. Following this there was a discussion about practice policy and methods for delivering the vaccination programme. A discussion around techniques employed to improve adult vaccination rates ensued with a summary of the evidence of effective interventions emphasising patient reminders and recall (Szilagyi *et al.* 2000), professional recommendation (Kyaw *et al.* 1999), reminder systems for practitioners (Austin *et al.* 1994), audit and feedback (Thomson O'Brien *et al.* 2000b) and emphasis on teamwork and a multifaceted approach. The aim was to provide reliable and unbiased information, presenting both sides of controversial issues, encouraging active learning, using simple overheads and graphs and emphasising the essential messages from the evidence on how to address specific barriers to improving immunisation rates. The educational session, whilst following academic detailing principles described above, sought to enable teams to identify barriers to change and begin to try and address these within their own practice. The role of the educational outreach was to try and facilitate this rather than to standardise the dialogue or impose an external set of solutions. There was ample opportunity for group discussion and interaction allowing the practice team to begin to think about how they might improve their immunisation programme. Both intervention and control practices also received written feedback of audit results comparing their performance with other participating practices together with written guidance for vaccination and recommendations for improvement.

#### ***4.5.7 Repeat data collection***

The repeat data collection was carried out eight months after the baseline data collection

and six months after the educational outreach visit. Letters were sent to practices asking then to repeat the data collection (Appendices 17 and 18) and also asking them to provide data on what repeat or additional interventions had been used during their recent influenza and pneumococcal vaccination campaigns using a semistructured questionnaire format (Appendix 19). A single reminder letter was sufficient to collect data from all the participating practices (Appendix 20).

#### ***4.5.8 Study outcomes***

The study outcomes were increase in vaccination rate by practice for those aged sixty-five years and over, patients with coronary heart disease, diabetes and splenectomy, six months after the educational outreach visit. The groups were treated separately for the analysis although they were overlapping. Practices were also surveyed using a semistructured questionnaire to find out what existing and new strategies had been used to improve vaccination rates.

#### ***4.5.9 Sample size***

Sample size was calculated with vaccination rate per practice as the primary outcome. Using preliminary data from the countywide multipractice audit of vaccination uptake conducted by Lincolnshire PCAG in 1998 control rates and standard deviations of these rates were estimated. In the audit, practices achieved an increase in uptake of 10% for influenza vaccination and over 20% for pneumococcal vaccination from a baseline of 40%, in patients with coronary heart disease and diabetes with audit and feedback. An increase in vaccination uptake of 20% would move vaccination rates towards or above the government target of 60% from a baseline rate of 40%. To detect a difference

between control rates and the desired targets of at least one standard deviation using Student's t test with 80% power and 5% significance level would have required seventeen practices per group. With most of the comparisons being effects of at least 1.5 standard deviations would have required nine practices per group to detect differences between intervention and control groups with the same power.

An alternative method would have been to calculate the power for a patient randomised controlled trial and adjust for clustering. This was because patients in clusters do not behave independently of one another. They tend to behave similarly owing to practice characteristics, some of which could be accounted for such as age-sex distribution or deprivation, but others which are less quantifiable such as the physical qualities of the practice (e.g. adequate car parking and access), type of healthcare workers employed (e.g. age, sex, training or skill-mix), or the type of patient attracted to the list (e.g. student populations for practices close to further education institutions) (Underwood *et al.* 1998).

This method gave similar results to that of inflating the sample size for individual patients using an intraclass correlation coefficient. The intraclass coefficient was estimated at 0.05 using data from a similar study and practice population (Yudkin and Moher 2001). Assuming an average cluster size of one hundred (diabetic patients per practice), baseline pneumococcal vaccination rate of 40%, effect size in the intervention group of 20% and an estimated intraclass correlation coefficient of 0.05 would give a sample size of 1200 patients in 12 practices (Campbell *et al.* 2000b).

Fifteen practices for each of the intervention and control groups, i.e. thirty practices in total, were chosen as sufficient to achieve statistical power and to allow for dropouts.

#### ***4.5.10 Statistical methods***

Data analysis was carried out using Egret and SPSS version 10 (Norusis 1990). Analysis was carried out at practice (cluster) level with outcomes expressed as proportions of patients in each risk group vaccinated before and after the intervention, mean improvement in vaccination rate and 95% confidence intervals for mean improvement. Analysis was also carried out at individual patient level using regression to account for clustering, baseline rates and stratification (Campbell *et al.* 2000c). Poisson regression was used to detect significant differences between intervention and control groups in vaccination rate change using population at risk as an offset and taking account of the stratification. Strata were included as fixed effects rather than as a random effect. Baseline rates were included as a covariate. Rates were expressed as mean vaccination rates, risk ratios and confidence intervals. The regression analysis was carried out with the help of an expert in statistics (Dr Michael Dewey, Senior Lecturer, Nottingham University and Deputy Director, Trent Institute).

#### ***4.5.11 Ethical issues***

A number of ethical issues were considered in relation to the study design (Hutton 2001). Approval was required both from the University ethics committee and through the Multicentre Research Ethics Committees, the latter since it was anticipated that the study might involve practices in more than two counties. Consent was also required from general practitioners before enlisting their practice on the study. General practitioners

consented on behalf of their practice teams and patients for collection of anonymised routine vaccination and morbidity data, exposure to the educational intervention and additional data on how the practice changed as a result of the educational intervention. There was a small but definite risk of harm to patients in the intervention group from vaccine side effects due to increased influenza or pneumococcal vaccination rates. However, the vaccines and the risk groups targeted were those that were nationally recommended and patients were asked and able to give individual informed consent to vaccination. Practices who were randomised to the control group were not disadvantaged and were allowed to organise their vaccination programmes in whichever way they chose. They also had the benefit of national guidance, information sent with the study pack and feedback of anonymised data. Individual informed patient consent was explicitly stated as a prerequisite for vaccination but not for the study itself since this would not have affected care, except possibly in the case of intervention practices to improve the delivery of routine care. However this would have been in line with accepted medical practice and national guidelines. Patients were informed about the study using a poster in the waiting room.

Ethical approval was obtained for the study from Trent Multicentre Research Ethics Committee and De Montfort University School of Nursing and Midwifery Human Research Ethics Sub-Committee. Trent Focus Collaborative Research Network also approved the study. Consent from gained from the clinical governance leads, chief executives and chairs of both primary care groups and from individual general practices. The advice of an expert in statistics and research methodology was sought throughout the

study.

#### **4.6 Conclusion**

The studies described here broadly followed the framework of Campbell (Campbell *et al.* 2000a). The stages described by Campbell included a preclinical or theoretical stage (literature review to develop a theoretical framework), a modelling phase (case studies, qualitative, descriptive, or survey studies), an exploratory trial (to define and develop the interventions and outcomes of interest) followed by a definitive randomised controlled study (to compare the intervention with a valid control group in an appropriately powered study).

The methods used in the pilot study and the multipractice audits were more sensitive to individual practices preferences for how they might go about improving their vaccination rates compared to the use of an externally imposed educational intervention as in the randomised study. No account was taken of differences in practice preference to the educational outreach in the randomised study although it was assumed that practices, by consenting to participate, were by definition those that were more likely to accept this type of intervention. The effect of including practices that were less predisposed to this type of educational intervention, although such practices would have been randomly distributed in both the intervention and control arms, would have been to underestimate the benefits of the intervention (Black 1996).

Issues of randomisation and confounding were addressed by the randomised controlled trial. The randomised study compared a control group (provided with audit and feedback)

with an intervention group given an educational intervention (which included audit and feedback) so that genuine uncertainty or equipoise existed in the study. The process of randomisation, after baseline stratification, allowed comparison between these groups with confounding factors likely to be equally distributed between the intervention and control group. However, Hawthorne effects may have operated to a greater extent in the intervention practices, since it was not possible for practices to be blinded (Prideaux 2002a). Despite the debate around which methods are most appropriate designs for evaluating educational interventions the benefits of randomisation were that the hypothesis could be properly tested (Fitz-Gibbon 2002), minimising confounders, reducing the effect of secular trends (Torgerson 2002) and providing an estimate of the true effect of the educational intervention.

## **CHAPTER 5 RESULTS**

### **5.1 Pilot study: Feasibility study targeting influenza and pneumococcal vaccination to high-risk groups in a single general practice**

#### ***5.1.1 Questionnaire respondents***

551/747 (73.8%) patients who attended for influenza vaccination between September and the end of December 1996 (excluding nursing or residential home patients) returned completed questionnaires. This was a high response rate for patient surveys. 58.5% (321/549, data missing for 2 patients) of these were female. Most respondents, 67% (392/509, data missing for 42), were aged 65 or over. Most 90.6% (461/509, data missing for 42) were receiving repeat influenza vaccination. Only 4.5% of respondents (20/442, data missing for 10) stated that they had received pneumococcal vaccine previously.

#### ***5.1.2 Risk groups***

Less than half the respondents (44.1%, 243/551) considered themselves to be in a high-risk group. Table 14 shows the risk groups that vaccinees identified. 7% (38/551) considered themselves to be in two risk groups and 1% (6/551) identified themselves to be in three risk groups. An analysis of patient records of a randomly selected sample of respondents showed that more patients (50.9%, 55/108) were actually in a risk group than identified themselves as so in the questionnaire (46.3%, 50/108). Most patients, 71% (39/55), who were at risk were correct in identifying themselves to be in a risk group (Table 15).

**Table 14 Risk groups identified by questionnaire respondents \***

<b>Risk group</b>	<b>Number of patients n=551</b>	<b>(%)</b>
Chronic lung disease	106	(19.2)
Angina/heart disease	107	(19.4)
Kidney disease	8	(1.5)
Liver disease	0	(0)
Diabetes	45	(8.2)
Spleen removed	0	(0)
Drugs that lower immunity	21	(3.8)
Chemotherapy/radiotherapy	6	(1.1)

\* 44 patients identified more than one risk group and of these 6 patients ticked three risk groups.

**Table 15 Patients perceptions of risk versus actual situation using a random sample of 108 patients taken from the questionnaire respondents**

	True risk (%): n = 108	
	Not at risk	At risk
<b>Perceived risk:</b>		
<b>Not at risk</b>	50 (46.3) <sup>§§§§§§§§</sup>	14 (13.0) <sup>*****</sup>
<b>At risk</b>	3 (2.8) <sup>††††††††</sup>	41 (38.0) <sup>††††††††</sup>

§§§§§§§§ Patient correctly identified themselves as not being in a risk group

\*\*\*\*\* Patient in a risk group but unaware that they were or did not tick a category

†††††††† Patient not in a risk group but thought they were

†††††††† Patient correctly identified themselves to be in a risk group (n=39) or patient in a risk group but chose the incorrect group (n=2)

**Table 16 Sources of information stated by those who had heard about pneumococcal vaccine** §§§§§§§§§§

<b>Source</b>	<b>Number of patients n=133</b>	<b>(%)</b>
General practitioner	34	(26)
Practice nurse	14	(10)
Hospital doctor	1	(1)
Relative	14	(10)
Friend	21	(16)
Newspaper/magazine	30	(22)
Television	3	(2)
Other	9	(7)
Not stated	8	(6)

§§§§§§§§§§ This question allowed multiple responses, therefore the number of responses exceeds the number of patients

### ***5.1.3 Sources of information***

26.1% of respondents (133/509, data missing for 42) stated that they had heard of pneumococcal vaccine. Table 16 shows the sources that they had heard about it from. Thirteen patients had heard about it from two sources and three patients stated three sources. Most who had heard about the vaccine did so from a health professional, either their general practitioner or practice nurse (36%) but a significant proportion had heard about the vaccine from the media (24%) or a relative (10%).

### ***5.1.4 Questionnaire reliability***

By reliability is meant the degree to which patients responded in a consistent way to the attitude questionnaire. It was important to test whether the attitude questions were measuring broadly the same attitude, i.e. whether patients were positive (or negative) towards vaccines in general and pneumococcal vaccines in particular.

The ten attitude statements consisted of five positive and five negative statements with responses ranging from “strongly agree” to “strongly disagree” in a five-point Likert type scale, giving 1 (strongly agree), 2 (agree) and so on up to 5 (strongly disagree), with 0 for no response. Scoring was reversed for positive statements so that a high score always meant a positive attitude to guidelines with one indicating a negative attitude and five a positive attitude. Mean scores showing the overall attitude among respondents towards guidelines for each statement were calculated (see Table 17).

Reliability analysis was completed using SPSSPC version 10 (Norusis 1990). Even

though scores were derived from ordinal scales and distributions were not normal parametric tests are routinely applied to such data (Bryman and Cramer 1999). Pearson product moment correlation coefficients between items are shown (see Table 18). Most of the correlations were very low (up to 0.19) or low (0.2 to 0.39) with the strongest being only modest (0.4 to 0.69) at 0.57 and none high (0.70 to 0.89) or very high (0.9 to 1.0) (Cohen and Holliday 1982).

The items with the smallest correlation compared with other items were Q8, “I am worried about the side effects of vaccination”, with correlation coefficients less than 0.1 for 7 items and including 4 negative correlations, Q5, “I would say overall that I am unwell”, with correlation coefficients less than 0.1 for 6 items and including 4 negative correlations and Q2, “I do not believe in prevention”, with correlation coefficients less than 0.1 for 5 items and including 2 negative correlations.

The covariance matrix (see Table 19) showed how individual items tended to move or vary with each other and confirmed a similar pattern of association between responses to the correlation matrix.

The relationship between attitude statements was further evaluated (see Table 20). The column labelled ‘Corrected item-total correlation’ shows the correlation between scores for individual items with the sum of the scores on all the other items, using the Pearson correlation coefficient. The items with the lowest correlations were Q2, “I do not believe in prevention,” (0.1350), Q5, “I would say overall that I am unwell,” (0.1202) and

particularly Q8, “I am worried about the side effects of vaccination,” (0.0009) confirming the poorer relationship between these and the other items. Conversely, Q3 (“I am worried about getting chest infections”), Q4 (“I feel that I would like pneumococcal vaccination”) and Q7 (“I don’t think that I need pneumococcal vaccination”) had the highest correlations of 0.3521, 0.4779 and 0.4718 respectively. It is important to reiterate that positive and negative statements were positively correlated because the scoring was reversed for positive statements.

The internal consistency of attitude responses (again with positive statements recoded) was calculated. Cronbach’s alpha was 0.55. The standardised item alpha, which is the value of  $\alpha$  when all items are standardised to have a variance of 1 was 0.56. The moderate degree of consistency between the elements showed a satisfactory but not high level of test-retest reliability for this questionnaire. This showed that the questionnaire may have been adequate for assessing attitudes in general but could not be used to clearly discriminate between respondent types, such as those who were positive or negative towards vaccination.

Alpha if item deleted (see Table 20) showed little change in Cronbach’s alpha for the combined statements when any of the items was excluded indicating that omitting any of the statements would not appreciably alter the reliability of the attitude questionnaire as a whole. The slight increase in  $\alpha$  when Q2, Q5 and Q8 were deleted reflected the poorer correlation of these statements with respondents’ attitudes towards guidelines.

**Table 17 Coding system for attitude statements**

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<b>Code</b>	<b>Attitude statement</b>
Q1 SAFE	I think that vaccinations are generally safe
Q2 EFFECTS	I am worried about the side effects of vaccination
Q3 PREVENT	Prevention is better than cure
Q4 BELIEVE	I do not believe in prevention
Q5 NOCOLDS	I never get colds or chest infections
Q6 CHESTINF	I am worried about getting chest infections
Q7 HEALTHY	I believe that I am a healthy person
Q8 UNWELL	I would say overall that I am unwell
Q9 LIKEPN	I feel that I would like pneumococcal vaccination
Q10 NONEED	I don't think that I need pneumococcal vaccination

---

**Table 18 Correlation matrix for attitude statements\*\*\*\*\***

	SAFE	BELIEVE	CHESTINF	LIKEPN	UNWELL
SAFE	1.0000				
BELIEVE	.1214	1.0000			
CHESTINF	.1041	.0184	1.0000		
LIKEPN	.1386	.0861	.4823	1.0000	
UNWELL	.0357	-.2095	.2061	.1752	1.0000
PREVENT	.1147	.1859	.0955	.1678	-.0853
NONEED	.1706	.2900	.2482	.4670	-.0152
EFFECTS	.1056	.0826	-.1492	-.0653	-.1259
HEALTHY	.0754	-.0409	.1882	.1720	.5699
NOCOLDS	.0545	.1213	.2411	.2427	-.0289

	PREVENT	NONEED	EFFECTS	HEALTHY	NOCOLDS
PREVENT	1.0000				
NONEED	.2859	1.0000			
EFFECTS	.1432	.0497	1.0000		
HEALTHY	.0291	.1467	.0491	1.0000	
NOCOLDS	-.0452	.2333	-.0215	.0420	1.0000

\*\*\*\*\* Coding key: - SAFE: I think that vaccinations are generally safe; EFFECTS: I am worried about the side effects of vaccination; PREVENT: Prevention is better than cure; BELIEVE: I do not believe in prevention; NOCOLDS: I never get colds or chest infections; CHESTINF: I am worried about getting chest infections; HEALTHY: I believe that I am a healthy person; UNWELL: I would say overall that I am unwell; LIKEPN: I feel that I would like pneumococcal vaccination; NONEED: I don't think that I need pneumococcal vaccination (from Table 17).

**Table 19 Covariance matrix for responses to attitude statements** ††††††††††

	<b>SAFE</b>	<b>BELIEVE</b>	<b>CHESTINF</b>	<b>LIKEPN</b>	<b>UNWELL</b>
<b>SAFE</b>	.5182				
<b>BELIEVE</b>	.1215	1.9325			
<b>CHESTINF</b>	.0848	.0290	1.2817		
<b>LIKEPN</b>	.1020	.1224	.5585	1.0461	
<b>UNWELL</b>	.0292	-.3311	.2652	.2037	1.2919
<b>PREVENT</b>	.0608	.1903	.0796	.1264	-.0714
<b>NONEED</b>	.1369	.4497	.3134	.5327	-.0193
<b>EFFECTS</b>	.0779	.1176	-.1730	-.0684	-.1466
<b>HEALTHY</b>	.0599	-.0627	.2352	.1942	.7149
<b>NOCOLDS</b>	.0415	.1783	.2885	.2625	-.0348

	<b>PREVENT</b>	<b>NONEED</b>	<b>EFFECTS</b>	<b>HEALTHY</b>	<b>NOCOLDS</b>
<b>PREVENT</b>	.5422				
<b>NONEED</b>	.2348	1.2439			
<b>EFFECTS</b>	.1080	.0567	1.0494		
<b>HEALTHY</b>	.0237	.1806	.0555	1.2178	
<b>NOCOLDS</b>	-.0352	.2751	-.0233	.0490	1.1178

†††††††††† Coding key: - **SAFE**: I think that vaccinations are generally safe; **EFFECTS**: I am worried about the side effects of vaccination; **PREVENT**: Prevention is better than cure; **BELIEVE**: I do not believe in prevention; **NOCOLDS**: I never get colds or chest infections; **CHESTINF**: I am worried about getting chest infections; **HEALTHY**: I believe that I am a healthy person; **UNWELL**: I would say overall that I am unwell; **LIKEPN**: I feel that I would like pneumococcal vaccination; **NONEED**: I don't think that I need pneumococcal vaccination (from Table 17).

**Table 20 Item-total statistics for pilot study**\*\*\*\*\*

	Scale mean if item deleted	Scale variance if item deleted	Corrected item-total correlation	Squared multiple correlation	Alpha if item deleted
Q1 SAFE	32.9957	20.4826	.2194	.0572	.5360
Q2 BELIEVE	33.4026	18.8676	.1350	.1465	.5699
Q3 CHESTINF	33.3853	17.7857	.3521	.2853	.4950
Q4 LIKEPN	33.4329	17.3161	.4779	.3812	.4626
Q5 UNWELL	34.6407	19.9182	.1202	.4045	.5630
Q6 PREVENT	32.7403	20.4540	.2153	.1377	.5365
Q7 NONEED	33.7706	16.8645	.4718	.3401	.4581
Q8 EFFECTS	33.8961	21.3718	.0009	.0865	.5885
Q9 HEALTHY	34.4848	18.3117	.3071	.3665	.5092
Q10NOCOLDS	33.4459	19.3090	.2156	.1253	.5352

\*\*\*\*\* Coding key: - SAFE: I think that vaccinations are generally safe; EFFECTS: I am worried about the side effects of vaccination; PREVENT: Prevention is better than cure; BELIEVE: I do not believe in prevention; NOCOLDS: I never get colds or chest infections; CHESTINF: I am worried about getting chest infections; HEALTHY: I believe that I am a healthy person; UNWELL: I would say overall that I am unwell; LIKEPN: I feel that I would like pneumococcal vaccination; NONEED: I don't think that I need pneumococcal vaccination (from Table 17).

### 5.1.5 *Questionnaire validity*

By validity is meant the extent to which the questionnaire measured what it purported to. Responses to each attitude statement pair were tabulated (see Table 21). Mean scores showed the extent to which respondents were positive in their attitude towards guidelines, a score greater than three indicating a positive attitude overall. Responses were also represented graphically (Figures 10-12). The shape of the graphs and degree and direction of skewness showed the level of agreement with a particular statement. There was the expected inverse relationship for some question pairs (see Figures 10 and 11) but an equivocal pattern of response for others (see Figure 12).

There was certainly a diversity of opinions expressed with the proportion of “strongly agree” and “strongly disagree” responses varying considerably. “Strongly agree” responses varied from 3 to 70 per cent and “strongly disagree” from 1 to 49 percent. Similarly the proportion of “neutral” responses varied from 4 to 42 per cent. It was inevitable with the number of questionnaires returned and the usual reluctance to use the extremes of the scale, sometimes referred to as central tendency or end-aversion, that some respondents would not always identify strongly with the statement or its opposite pair.

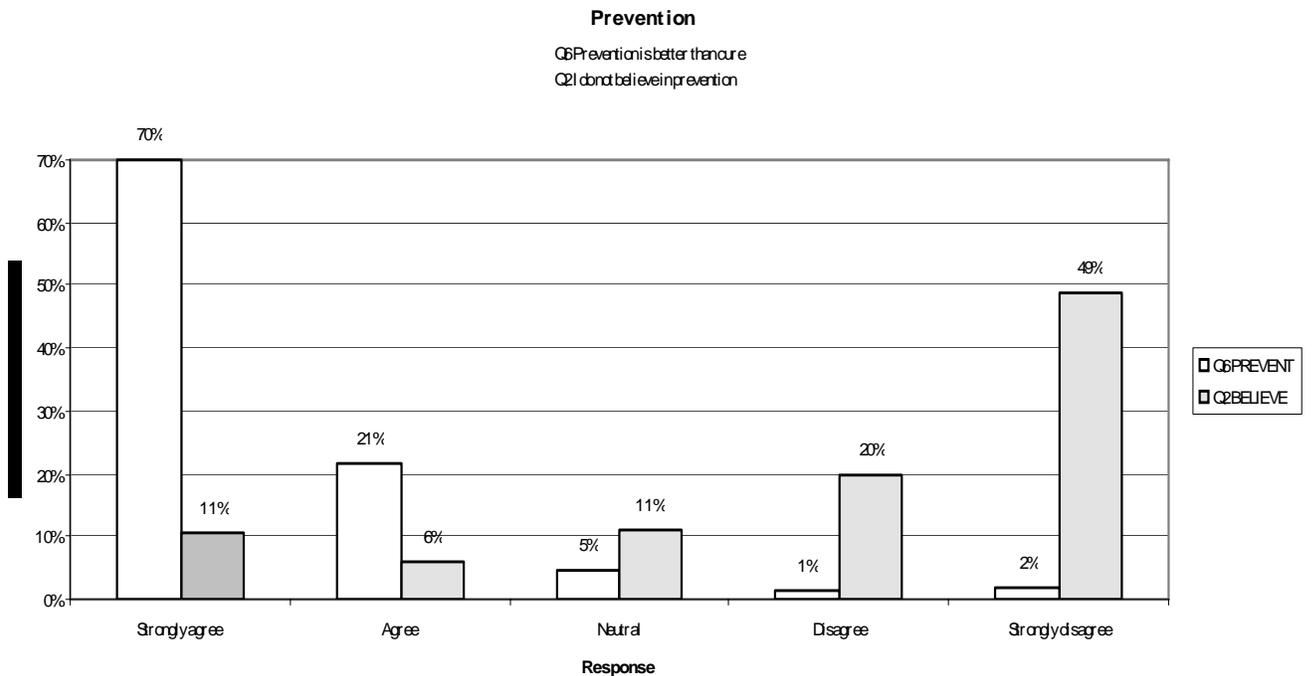
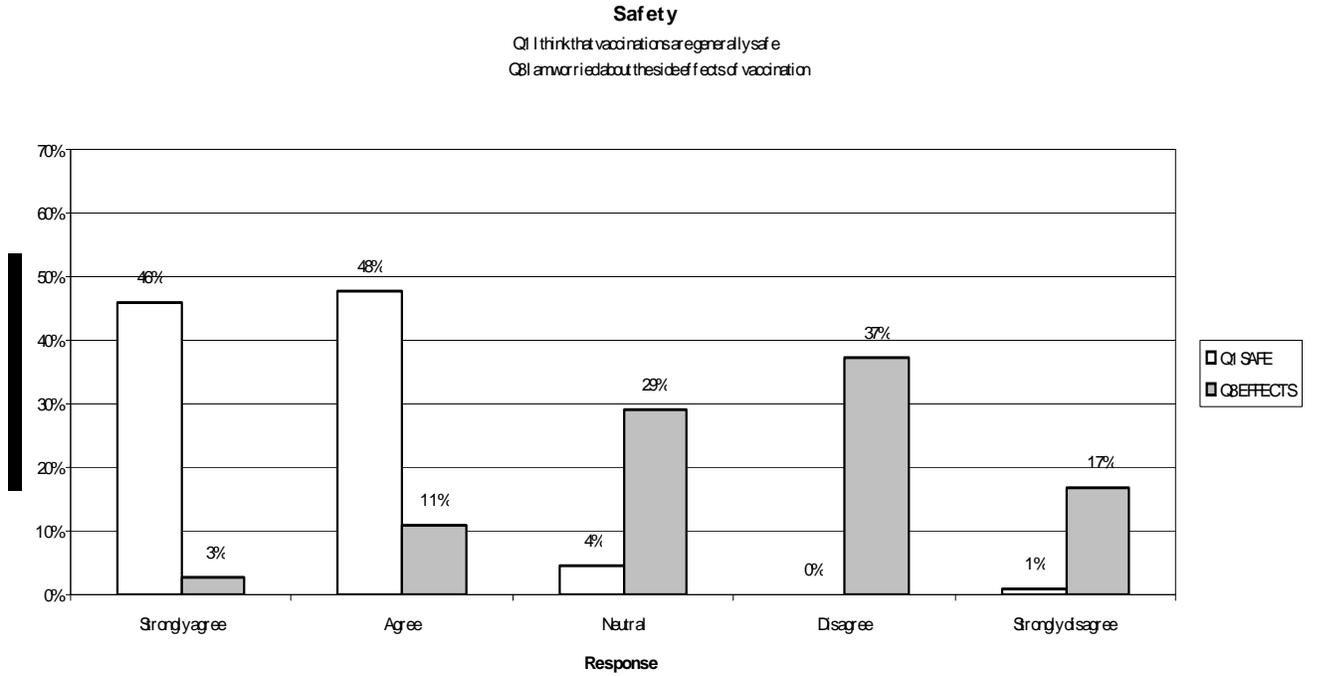
Most patients responded to all the individual attitude statements implying that none of the statements were poorly understood and establishing the *face validity* of the questionnaire.

**Table 21 Attitude score for patients responding to questionnaire**

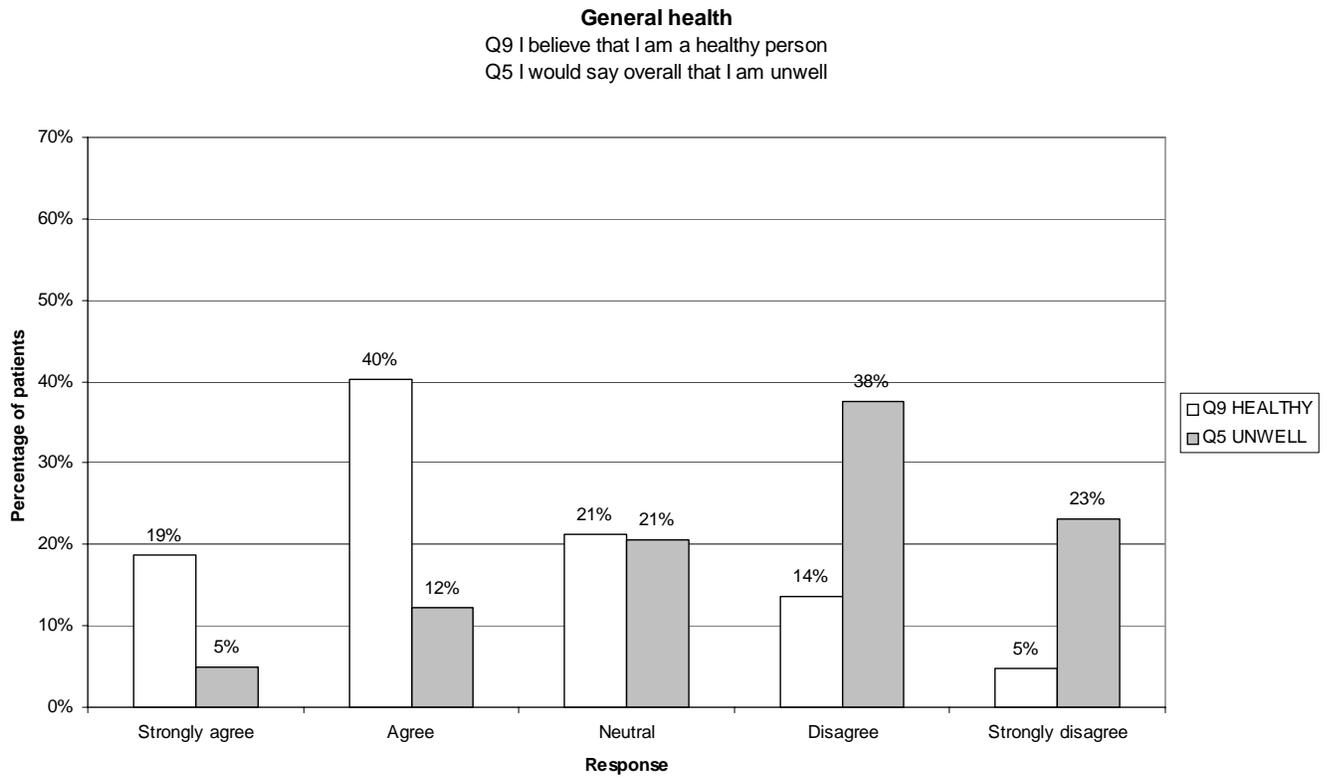
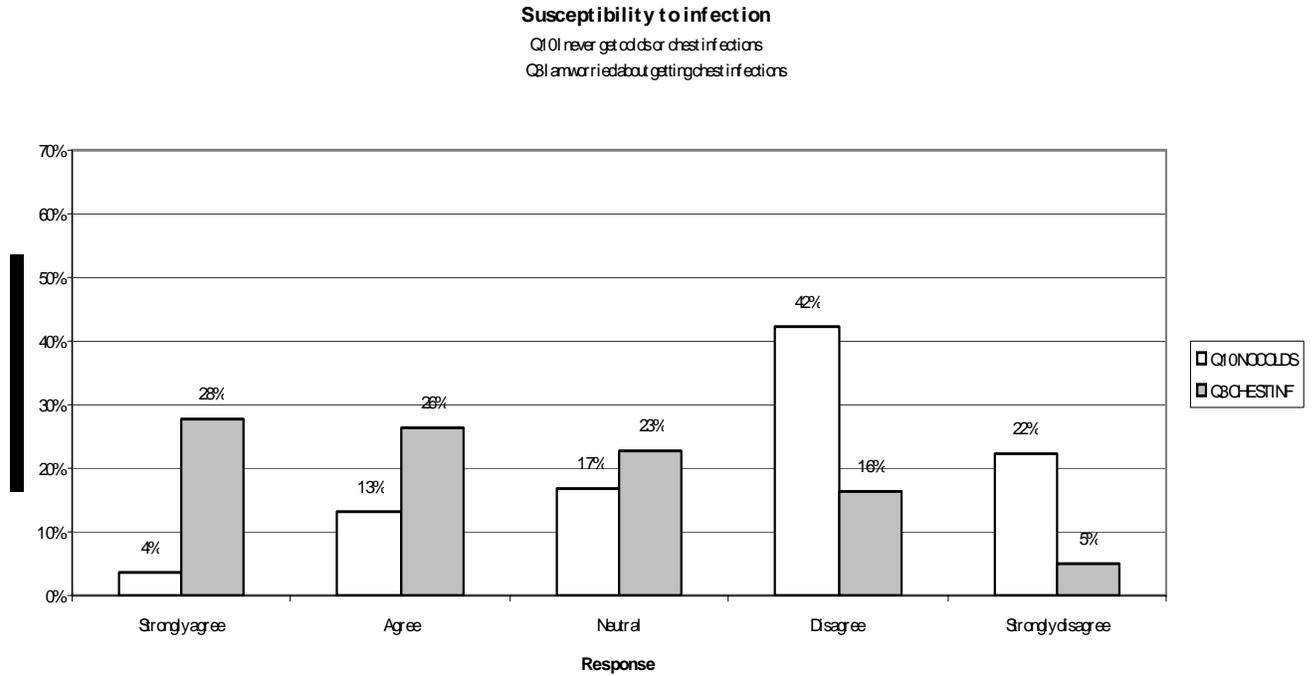
Attitude statement	Number (%) of patients responding N=551			Mean score*
	Agree or strongly agree	Neutral	Disagree or strongly disagree	
1. I think that vaccinations are generally safe	517 (93.8)	24 (4.8)	7 (1.3)	4.4
2. I do not believe in prevention	93 (16.9)	62 (11.3)	379 (68.8)	3.9
3. I am worried about getting chest infections	297 (53.9)	125 (22.7)	117 (21.2)	3.6
4. I feel that I would like pneumococcal vaccination	258 (46.8)	203 (36.8)	77 (14.0)	3.6
5. I would say that overall I am unwell	94 (17.1)	113 (20.5)	334 (60.6)	2.4
6. Prevention is better than cure	503 (91.3)	25 (4.5)	18 (3.3)	4.6
7. I don't think that I need pneumococcal vaccination	113 (20.5)	229 (41.6)	191 (34.7)	3.3
8. I am worried about the side effects of vaccination	77 (14.0)	161 (29.2)	297 (53.9)	3.6
9. I believe that I am a healthy person	325 (59.0)	117 (21.2)	101 (18.3)	2.5
10. I never get colds or chest infections	92 (16.7)	92 (16.7)	354 (64.2)	3.7

\*Positive statements i.e. those more likely to encourage vaccination were recoded so that a high score means a generally positive attitude towards vaccination, a score of three is neutral and a score less than three signifies a negative attitude overall

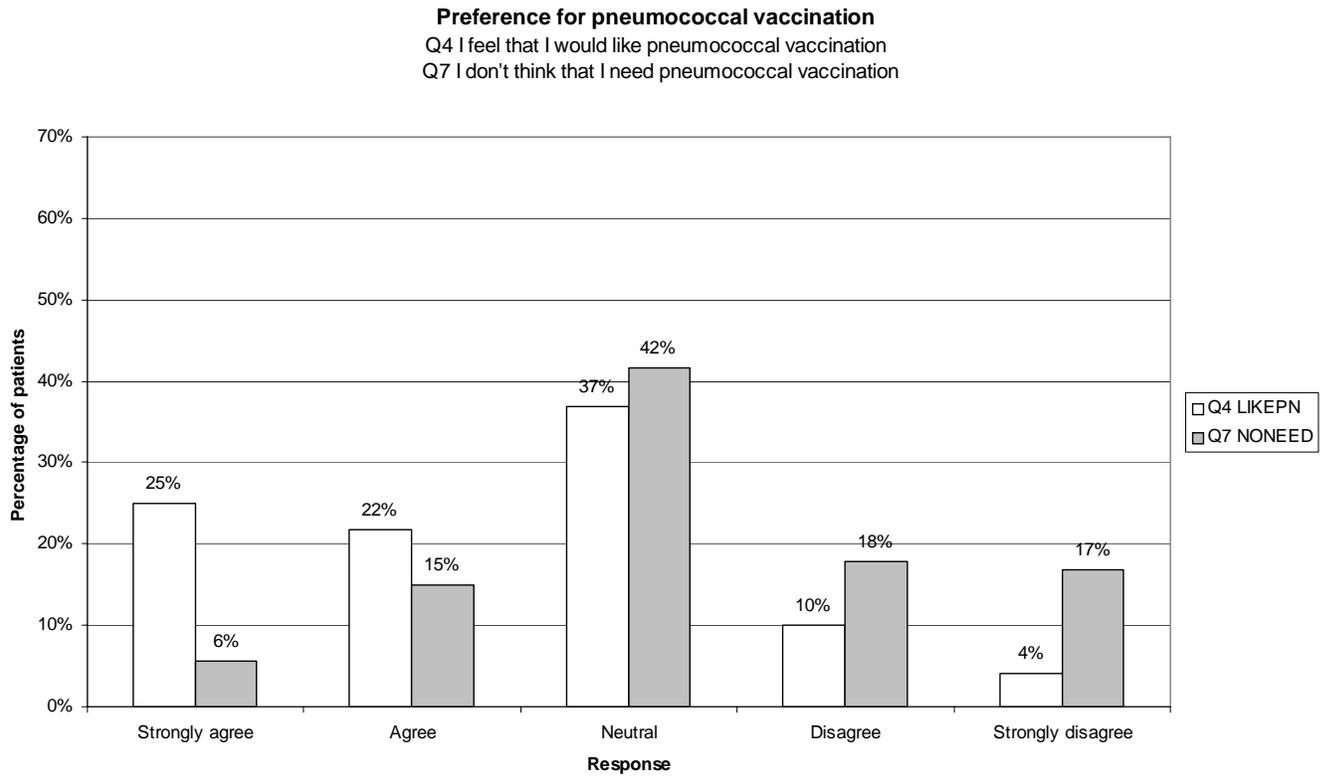
**Figure 10** Graphs showing responses to attitude statement pairs on safety and prevention



**Figure 11 Graphs showing responses to attitude statement pairs on susceptibility to infection and general health**



**Figure 12 Graph showing responses to attitude statement expressed preference for pneumococcal vaccination**



There were very few amendments, deletions or additional comments quibbling with the statements demonstrating a good *content validity*. By measuring the correlation between an individual patients response and their expressed preference for pneumococcal vaccine it was possible to assess the *construct validity* of the questionnaire since patients who say they will accept the vaccine are more likely to do so.

As there was no other validated instrument for measuring patient attitudes towards vaccination there was no way of comparing the results with another accepted measure or confirming the *criterion validity* of the attitude questionnaire.

Attitudes to vaccination were generally positive. Positive statements, that is those more likely to encourage vaccination, were recoded so that a score greater than three meant a generally positive attitude, a score of three neutral and a score less than three signified an overall negative attitude towards vaccination. Responses to each attitude statement and mean scores were shown in Table 21. Patients who identified themselves to be in a risk group were significantly more likely to have a positive attitude towards vaccinations than those who did not recognise themselves to be in a risk group (total score 32.9 vs. 36.8; Kruskal-Wallis  $H = 72.1$ , 1 degree of freedom (df),  $p < 0.000$ ). Patients who stated that they had previously heard about pneumococcal vaccination were also more positive towards vaccination (total score 36.9 vs. 34.0; Kruskal-Wallis  $H = 28.2$ , 1 df,  $p = 0.000000$ ). Patients who identified themselves to be in an at-risk group were significantly more like to agree or strongly agree that they would like pneumococcal vaccine than those who did not (145/238 [60.9%] versus 113/300 [37.7%];  $\chi^2 = 46.1$ , 4 df,  $p = 0.000$ ).

As one would expect patients who had already received pneumococcal vaccine were significantly more significantly more like to agree or strongly agree that they would accept pneumococcal vaccine than those who had not (16/19[84.2%] versus 198/418 [47.4%];  $\chi^2 = 12.1$ , 4 df,  $p = 0.017$ ).

A targeted vaccination campaign over one year resulted in the following proportions of patients in at risk groups being vaccinated with pneumococcal vaccine (Table 9): coronary disease 144/312 (46%), diabetes 79/132 (60%), splenectomy 2/2 (100%), chronic obstructive airways disease and asthma 135/700 (19%), chronic renal failure 5/9 (56%). Baseline rates for influenza vaccine were higher than for pneumococcal vaccination because of the existing annual influenza vaccination programme but these also increased in the first year of the pilot study.

Most doses of pneumococcal vaccine 336/463 (73%) were delivered to patients in high-risk groups. This figure increased to 365/463 (79%) when nursing home patients without other risk factors were included.

Vaccination rates for pneumococcal and influenza vaccination continued to rise in subsequent years with the continued implementation of the systems that had been set up as part of this study (Table 22 and 23).

**Table 22 Pneumococcal vaccine uptake, Minster Practice 1997-1999**

Criteria	Standards	1997	1998	1999
		n (%)	n (%)	n (%)
Coronary disease	60	16/276 (6)	144/312 (46)	148/279 (53)
Diabetes	60	13/124 (10)	79/132 (60)	96/146 (66)
Splenectomy	100	1/2 (50)	2/2 (100)	2/2 (100)
COAD/Chronic asthma	60	13/647 (2)	135/700 (19)	126/419 (31)
Chronic renal failure	60	0/7 (0)	5/9 (56)	9/13 (69)

**Table 23 Influenza vaccine uptake, Minster Practice 1997-1999**

Criteria	Standards	1997	1998	1999
		n (%)	n (%)	n (%)
Coronary disease	60	142/276 (51)	191/312 (61)	179/279 (64)
Diabetes	60	71/124 (57)	86/132 (65)	92/146 (63)
Splenectomy	100	2/2 (100)	2/2 (100)	2/2 (100)
COAD/Chronic asthma	60	158/647 (24)	187/700 (27)	168/419 (40)
Chronic renal failure	60	4/7 (57)	7/9 (78)	11/13 (85)
Over 75s	60		(53)	(59)

### *5.1.6 Lessons from the pilot study*

The pilot study laid the groundwork for the subsequent multipractice audit studies and randomised controlled trial. The pilot practice was subsequently included in the multipractice audits but was excluded from the randomised controlled study. It employed an action research methodology, which included education, change, evaluation, and involvement of the practice team and the patients who were involved in the change (Hart and Bond 1995). The pilot study had three main components, a cross sectional survey, an audit of vaccination rates and included in the latter a practice based intervention to improve vaccination rates in high-risk patients. There were a number of important issues and lessons learnt from the pilot study that impacted on the subsequent investigations and theoretical framework for this thesis.

The cross-sectional survey in patients attending for influenza vaccination provided an assessment of patients' knowledge and beliefs about influenza and pneumococcal vaccination. There were a number of key findings, which are summarised here and expanded below. Many patients responding to the survey were unaware of these vaccinations, particularly pneumococcal vaccination. If they had heard about the vaccination, this knowledge had usually come from primary care staff, but the media was also an important source of knowledge. Patients who were positive to vaccination or felt themselves to be at increased risk from respiratory infections were more likely to accept pneumococcal vaccination in addition to influenza vaccination.

The audit of vaccination rates together with a combination of organisational changes was

successful in improving vaccination rates. The changes were directed at increasing practitioners' and patients' awareness and knowledge of vaccines, reminders for frontline clinical staff, a team approach, together with audit and feedback of performance.

The questionnaire had a high response rate for this type of survey of 73.8%. Factors that may have helped to increase the response rate included the fact that it was from the general practitioner and that the questionnaire was handed to eligible patients by the practice reception or clinical staff (Smith *et al.* 1985). The high response rate would in itself have helped to reduce bias (Goudy 1976). However, the chosen sampling frame and the use of a self-completion questionnaire may have led to a number of biases. The sampling frame was chosen to include all patients who received influenza vaccination in the autumn of the pilot study since these patients should also have been eligible for pneumococcal vaccination. It was expected that these patients would be more positive to vaccination, by virtue of already accepting one, than the general population. This included patients who received the vaccine at the surgery or at home but would have excluded patients who refused influenza vaccine. Therefore patients in the sample would have been more positive to vaccination than all those eligible for influenza vaccination.

Risk groups for influenza and pneumococcal vaccination were virtually identical at the time of the pilot study except for the recommendation to immunise residential, nursing home and other patients in long stay institutions. Institutionalised patients were therefore excluded from the survey although a number of these patients may have been eligible for pneumococcal vaccination by virtue of being in a risk group. It is difficult to predict

whether these patients would have been more or less positive in their attitudes to vaccinations, although there is a notion that the elderly tend to be more accepting of medical advice in general and vaccine recommendations in particular.

That there was a degree of bias towards more positive attitudes to vaccination in the sample was reflected in the high degree of agreement with attitude statements related to prevention and vaccine safety. However, this sampling strategy was adopted precisely because these patients were more likely to accept vaccination. Thus, although the results may not have been generalisable to the whole practice population they were apposite to the group that were most likely to accept pneumococcal vaccination and who we intended to target. Other possible sources of bias include respondent bias related to ability to read and write. Prestige or social desirability bias and acquiescent bias were taken in to account by the use of a balanced questionnaire. Limited resources precluded an analysis of non-responders although this would have been desirable (Lydeard 1991).

Overall, about half the patients receiving influenza vaccination were in a risk group, mostly chronic chest or heart disease and diabetes, and so were eligible for pneumococcal vaccination. Although one could argue that this shows that the practice policy for influenza vaccination did not fit well with Department of Health guidance (Department of Health 1997) at the time it may also have reflected practical problems with the guidelines. Although influenza vaccination was recommended for those with specific medical indications and institutionalised patients there was evidence at that time supporting a policy of vaccinating all patients aged over sixty-five (NHS Centre for Reviews and

Dissemination 1996) and research from the United States demonstrating the vaccine's cost-effectiveness even in healthy adults (Nichol *et al.* 1995). In the United States Medicare had been funding influenza vaccine for all patients over sixty-five years and had demonstrated this to be a cost-effective use of resources (Nichol *et al.* 1994). Experts in the United Kingdom were also arguing for a change to an age based policy around this time (DiGuiseppi 1996). General practitioners, although positive in their attitudes to guidelines in general, were also concerned that guidelines might stifle innovation and preferred to use them flexibly to suit the needs of patients in line with changing evidence (Siriwardena 1995). With the considerable financial penalties for practices that purchased but did not use vaccine there was justifiable scope for more lax interpretation of the guidelines based on the evidence.

However, almost half (49.1%, n=551) of the patients from a random sample undergoing influenza vaccination in this study did not fall into a high-risk group such as chronic heart disease, diabetes, splenectomy (absent spleen), chronic renal disease, chronic liver disease, immune system suppression or institutionalisation. Similar results had been found contemporaneously in Gwent (South Wales), with a quarter of all influenza vaccine doses being given to patients at low risk as defined at the time (Watkins 1997). If pneumococcal vaccination had been offered to all patients receiving influenza vaccine then half of these patients would have been inappropriately immunised. As well as being medically unjustified this would waste valuable resources of medical time and vaccine.

Attitude towards vaccination, self-identification as high-risk and intention to be

immunised had been shown in previous studies to predict subsequent vaccine uptake. Subgroup analysis of responses in the pilot study showed that patients in at-risk groups did indeed have more positive attitudes to vaccination and in particular pneumococcal vaccination than those who were not in a risk group. Patients with more positive attitudes to vaccination and preventive health were more likely to agree to have pneumococcal vaccination than those who were not in a risk group. As the majority of patients in a random sample (79%, n=108) were also good at identifying whether they were at risk the notion of targeting patients who were being immunised for influenza appeared to be a good method for getting initial coverage of pneumococcal vaccination. This was subsequently used as an effective element of our strategy for improving pneumococcal vaccination rates. The downside of this approach was that a proportion of patients (21%, n=108) were unable to identify whether they were in a risk group and would have inadvertently received or overlooked the vaccine unless other methods to inform them or prevent inappropriate vaccination were used.

The guidelines for pneumococcal vaccination at the time of the pilot study recommended vaccination at routine consultations, after discharge from hospital and when immunising against influenza vaccination. The pilot study integrated and built on this approach as a method of targeting influenza and pneumococcal vaccination to patients in high-risk groups in the practice. National guidelines changed significantly during the course of the subsequent research and this presented a number of problems that will be addressed later.

Studies had also shown that recommendation for vaccination by a health worker was a

key factor that influenced uptake (Centers for Disease Control and Prevention 1988). Agreeing a practice policy had also been shown to improve vaccination rates. We found the development of a practice guideline to be a useful educational tool for practice staff and enabled a clear and consistent message to be given by doctors, nurses and reception staff recommending vaccination to suitable patients. A poster display all year round for pneumococcal vaccine and expanded to include influenza vaccine to coincide with the winter influenza campaign was used to increase patient awareness and encourage uptake of the vaccines. Vaccination reminders on records, prescriptions or appointment lists were other methods that could have been but were not in the pilot.

The difficulties that were encountered in running this type of programme were similar to those for running any successful immunisation programme. These included identifying and targeting eligible patients, which required a good, preferably computerised, chronic disease register. Correctly estimating vaccine requirements, good stock control and storage of vaccines were found to be vital. Nursing and medical time to inform patients and vaccinate and opportunity costs required good organisation of available nursing time and sufficient nursing hours to provide such a programme. On the plus side the vaccination programme demonstrated good risk management, particularly in vaccinating patients with an absent spleen who were at high-risk of serious complications from pneumococcal infection, improved preventive care through higher vaccine rates for other high-risk patients in accordance with current recommendations and generated income for the practice.

Clinical audit of immunisation rates proved to be an effective and acceptable component of monitoring and improving vaccine uptake. The audit of immunisation rates conducted in this study showed a good uptake in high-risk groups but would have tended to overestimate uptake because of denominator deficiencies. The pilot study helped to develop a sound audit methodology, which would be used as a component of the later studies. The other aspect of the process of health care delivery that improved as a result of the pilot project was teamwork. Although it appeared that teamwork improved in general, it particularly improved in respect of the influenza and pneumococcal vaccination programme. Various elements of the change management process benefited teamwork in the organisation. The discussions of practice policies with all the staff at primary health care meetings improved input into and ownership of the practice policies, guidelines and operational matters relating to influenza and pneumococcal vaccination. Clinical staff were also clear about their own responsibilities in delivering the vaccination programme.

In summary the pilot study, including the patient questionnaire, demonstrated the importance of promoting awareness of influenza and pneumococcal vaccination through poster and media campaigns, leaflets and prescription reminders, recommendation from a doctor or nurse and encouraging pneumococcal vaccination during the influenza campaign. Patients were good at identifying whether they were at risk. A team approach with excellent organisation was important with audit and benchmarking being a good way of monitoring and encouraging performance. These lessons were applied to the later studies.

## **5.2 Lincolnshire-wide multipractice study: multipractice audit to assess influenza and pneumococcal vaccination uptake in high-risk groups**

### ***5.2.1 Participating practices***

Twenty-one practices took part in both phases for diabetes and fourteen of these for coronary heart disease and splenectomy. All the practices that undertook the baseline assessment completed both phases but a number of practices joined for the second phase. Although a number of practices joined the audit at the re-evaluation phase these were not included in the analysis. Practices who participated in both phases of the audit were reflective of practices across Lincolnshire in terms of partnership and list size (Table 24).

### ***5.2.2 Presentation of data***

Practice performance was compared with standards that practices set themselves (expressed as a median standard in Table 25). A paired t-test was used to compare mean vaccination rates between the two phases and assess improvement in performance. Improvements in vaccination uptake occurred in coronary heart disease, diabetic and splenectomy patients for both vaccinations (Table 25).

**Table 24 Lincolnshire wide multipractice study: characteristics of practices participating (in both phases of audit) compared to all Lincolnshire practices**

<b>Characteristics</b>	<b>Number</b>	<b>Participating practices n (%) (n=22)</b>	<b>All Lincolnshire practices n (%) (n=105)</b>	<b><math>\chi^2</math> p value</b>
<b>List size</b>	<b>&lt;3000</b>	5 (23)	22 (21)	0.53
	<b>3000-6000</b>	10 (45)	33 (31)	
	<b>6001-9000</b>	5 (23)	32 (30)	
	<b>&gt;9000</b>	2 (9)	18 (17)	
<b>Number of partners</b>	<b>1-3</b>	16 (73)	63 (60)	0.32
	<b>4-6</b>	6 (27)	34 (32)	
	<b>7-11</b>	0	8 (8)	

**Table 25 Lincolnshire wide multipractice study: vaccination uptake**

<b>Vaccine and risk group (Number of practices)</b>	<b>Vaccination uptake</b>		<b>Median Standard (Phase 1, Phase 2)</b>	<b>Mean improvement (95% CI)</b>	<b>Significance (p value, 2-tailed t-test)</b>
	<b>Phase 1 % (Range: min, max)</b>	<b>Phase 2 % (Range: min, max)</b>			
<b>Influenza vaccine uptake in CHD (n=14)</b>	63.6 (30,87)	74.4 (38,100)	80, 80	10.8 (5.3 to 16.1)	0.001
<b>Pneumococcal vaccine uptake in CHD (n=14)</b>	31.1 (1,74)	58.6 (16,89)	68, 75	27.5 (12.6 to 42.3)	0.002
<b>Influenza vaccine uptake in diabetes (n=21)</b>	62.1 (43,88)	70.6 (50,100)	80,80	8.6 (1.5 to 15.7)	0.02
<b>Pneumococcal vaccine uptake in diabetes (n=21)</b>	35.2 (0,76)	64.0 (5,100)	75, 80	28.8 (17.2 to 40.3)	<0.001
<b>Influenza vaccine uptake for splenectomy patients (n=14)</b>	66.1 (20,100)	83.4 (43,100)	90,100	17.3 (4.8 to 29.8)	0.01
<b>Pneumococcal vaccine uptake for splenectomy patients (n=14)</b>	79.6 (33,100)	95.6 (67,100)	95,100	15.9 (1.8 to 30.1)	0.03

**Table 26 Lincolnshire wide multipractice study: organisational strategies used by practices to improve influenza and pneumococcal vaccination at baseline**

Organisational strategy	Practice response (n=21)			
	Yes		No	
	n	%	n	%
Did you discuss the influenza vaccination programme in your primary care team last year?	19	(90)	1	(5) §§§§§§§§§§
Did you discuss the pneumococcal vaccination programme in your primary care team last year?	15	(71)	5	(24)
Do you have practice guidelines for influenza vaccination?	19	(90)	1	(5)
Do you have practice guidelines for pneumococcal vaccination?	16	(76)	4	(19)
Do you have a dedicated vaccine refrigerator?	17	(81)	3	(14)
Does this vaccine refrigerator have an in-built thermometer?	18	(86)	2	(10)
Do you have sufficient refrigeration space for your needs?	17	(81)	3	(14)
Do you purchase vaccine from your suppliers at a discount?	20	(95)	0	(0)
Do you have a method for stock control of vaccines?	20	(95)	0	(0)
Do you conduct dedicated clinics for influenza vaccination?	19	(90)	1	(5)
Do you conduct dedicated clinics for pneumococcal vaccination?	8	(38)	12	(57)
Do you undertake simultaneous administration of influenza and pneumococcal vaccine when appropriate?	19	(90)	0	(0)
Which members of your practice team undertake influenza/pneumococcal vaccination:				
Doctors	17	(81)	3	(14)
Practice nurses	18	(86)	2	(10)
District nurses	20	95)	0	(0)
Health visitor	2	(10)	18	(86)
Do you have a computerised disease (morbidity) register?	17	(81)	3	(14)
Do you have a computerised vaccine register?	19	(90)	1	(5)
Do you use computer prescription reminders for vaccinations?	11	(52)	9	(43)
Did you have a poster campaign for influenza vaccination last year?	19	(90)	1	(5)
Do you contact and liase with nursing homes regarding winter vaccinations?	20	(95)	0	(0)
Do you provide printed advice about vaccination e.g. side effects?	11	(52)	9	(43)
Do you use call and recall letters for influenza or pneumococcal vaccination?	7	(33)	13	(62)
Have you audited the success of uptake of influenza or pneumococcal	7	(33)	13	(62)

§§§§§§§§§§ Missing data accounts for percentages not adding up to 100.

**Figure 13 Lincolnshire wide multipractice study: methods used by participating general practices to increase influenza and pneumococcal vaccination rates**

**Registers**

Develop accurate registers for coronary disease, diabetes, splenectomy and other high-risk groups.

Check vaccination status at new patient medicals.

Maintain records and registers of vaccination status.

Keep manual records of vaccination as well as computer records so all staff have instant access to data.

**Patient reminders**

Display posters prominently in reception area before vaccination programme.

Information leaflets in reception area.

Attached information promoting vaccinations to repeat prescriptions.

Target letters to high-risk patients.

Offer open clinics for vaccinations.

**Practitioner protocols and reminders**

Increase staff awareness within the practice i.e. keep on PHCT meeting agenda. Introduce protocols for vaccination of high-risk patients.

Use reminders on computer screens to prompt clinicians.

### ***5.2.3 Effect of change***

Participating practices used a range of techniques to improve immunisation rates at the beginning of the study (Table 26). Whereas most practices discussed their influenza vaccination programme and had practice guidelines for influenza immunisation with their primary healthcare teams fewer practices addressed the issue of pneumococcal vaccination. This was reflected in the lack of dedicated clinics for pneumococcal vaccination. Most participating practices had a computerised vaccine register and the majority also had disease registers. Although most practices used poster campaigns to increase patient awareness and liaised with nursing homes to vaccinate institutionalised patients fewer used prescription reminders or call and recall letters. Despite practices stating that they had vaccine registers few practices had undertaken an audit of influenza or pneumococcal vaccination rates. A semistructured postal questionnaire was used to survey organisational changes that occurred in practices as a result of the audit. These examples of good practice were shared with other primary care teams (Figure 13).

### ***5.2.4 Implications of the countywide multipractice audit***

The countywide multipractice audit, which took the form of a quality improvement study (Moss and Thompson 1999), showed improvements in influenza and pneumococcal vaccination uptake in high-risk groups using audit, feedback and written advice on strategies for organisational change. There were substantial and significant changes in vaccination rates. The audit demonstrated that practices could achieve influenza and pneumococcal vaccination rates for disease-specific risk groups comparable to current

national targets for influenza vaccination. The study also showed that practices were able to demonstrate improvement in outcomes rather than process.

This was a multipractice audit in volunteer practices. For diabetes, one-fifth of the practices in Lincolnshire participated in both cycles. Although it was disappointing that more practices did not participate, and that those who did were likely to be more motivated to change, the level of uptake was not surprising given previous participation rates in countywide multipractice audits and other demands in the health service at the time. The data were independently analysed but relied on information sent by practices. Although anonymity of practice and patient was preserved there was a possibility of bias. We could not account for secular trends. The analysis demonstrated the capability and extent to which participating practices were able to improve performance with the aid of audit, feedback and written advice. Although practices did not achieve the median standards that they set they did exceed national targets for influenza vaccination and achieved comparable levels of pneumococcal vaccination.

The improvement in vaccine uptake in the high-risk groups was a finding that invited further analysis. In particular, it was clear that the audit methodology and feedback of anonymised vaccination rates to practices was welcomed by participating practices. Only a third of the practices had undertaken an audit of influenza or pneumococcal vaccination previously. It was clear from the organisational strategies that practices stated that they used at baseline and after the first phase of the audit that there were opportunities to employ additional interventions that had been shown in previous studies to increase

vaccination rates. Despite the considerable efforts to increase influenza and pneumococcal vaccination rates many patients remained unvaccinated at the end of the campaign for many of the reasons discussed above (see 3.5 to 3.8).

It was not clear to what extent factors known to promote vaccine uptake had been promoted by individual practices although the semistructured survey showed that practices had implemented change as a result of the project. Practices were encouraged to promote increased knowledge of the vaccine and positive attitudes to vaccination through various methods including recommendation from a general practitioner, all of which were known to be good predictors of vaccination uptake. Although practices did claim to use a variety of methods to achieve this, it was not clear to what extent they succeeded. This information could have been gleaned from the use of qualitative methods, either observation of practices or interviews, but was precluded by lack of resources.

### **5.3 West Lincolnshire Primary Care Trust study: multipractice audit to assess influenza and pneumococcal vaccination uptake in high-risk groups**

#### ***5.3.1 Participating practices and presentation of data***

We compared practice performance for each criterion in the two phases of the audit. There were high levels of participation with 24 out of 39 practices in both phases of the audit. Practices who participated in the audit were reflective of practices across the trust in terms of partnership and list size (Table 27).

There were improvements in vaccination rates for patients over 65 and patients with coronary heart disease and diabetes but not those with a history of splenectomy who already had high initial vaccination rates. The greatest improvement of 24.0% occurred for influenza vaccination of patients over 65 years with the mean vaccination rate across the trust of 73.0% exceeding the following year's national target of 70%. The primary care trust achieved high rates of influenza and pneumococcal vaccination in patients with coronary heart disease, diabetes and splenectomy. Median standards set were similar for both phases of the audit (Table 28).

**Table 27 West Lincolnshire PCT study: characteristics of practices participating compared to all West Lincolnshire Primary Care Trust practices** \*\*\*\*\*

<b>Characteristics</b>	<b>Number</b>	<b>Participating practices n (%) n=24 (%)</b>	<b>All West Lincs PCT practices n = 39 (%)</b>	<b><math>\chi^2</math> p value</b>
<b>List size</b>	<b>&lt;3000</b>	7 (22)	9 (23)	
	<b>3000-6000</b>	11 (34)	14 (36)	
	<b>6001-9000</b>	11 (34)	13 (33)	0.99
	<b>&gt;9000</b>	3 (9)	3 (8)	
<b>Number of partners</b>	<b>1-3</b>	21 (67)	27 (69)	
	<b>4-6</b>	10 (31)	11 (28)	0.94
	<b>7-11</b>	1 (3)	1 (3)	

\*\*\*\*\* The p values indicate that participating practices were similar to non-participating practices with respect to list and partnership size.

**Table 28 West Lincolnshire PCT study: improvement in vaccination uptake of practices taking part in both phases of the audit**

n = number of practices participating	Vaccination uptake		Median Standard (Phase 1, Phase 2)	Mean improvement (95% CI)	Significance (p value, 2-tailed t-test)
	Phase 1 % (Range: min, max)	Phase 2 % (Range: min, max)			
<b>Influenza vaccination uptake in CHD (n=20)</b>	58.3 (41,100)	77.5 (63,100)	70, 70	19.2 (14.4 to 24.0)	<0.001
<b>Pneumococcal vaccination uptake in CHD (n=19)</b>	26.9 (6,69)	41.5 (9,69)	70, 70	14.6 (9.3 to 20.0)	<0.001
<b>Influenza vaccination uptake in diabetes (n=21)</b>	57.6 (32,100)	74.5 (60,100)	75,70	16.9 (10.2 to 23.6)	<0.001
<b>Pneumococcal vaccination uptake in diabetes (n=20)</b>	40.2 (3,88)	53.5 (6,86)	70, 70	13.4 (4.8 to 22.0)	.004
<b>Influenza vaccination uptake in splenectomy patients (n=18)</b>	70.6 (0,100)	76.6 (0,100)	100,100	6.1 (-2.5 to 14.7)	.155
<b>Pneumococcal vaccination uptake in splenectomy patients (n=17)</b>	81.7 (0,100)	83.4 (0,100)	100,100	1.8 (-4.3 to 7.8)	.546
<b>Influenza vaccination uptake in over 65 year olds (n=24)</b>	48.9 (26,90)	73.0 (62,90)	60,60	24.0 (19.7 to 28.4)	<0.001

### ***5.3.2 New developments and findings from the Primary Care Trust audit***

The countywide study showed that practices were able to improve vaccination rates through participation in a multipractice audit, feedback of performance and written advice encouraging organisational change that had been shown to improve vaccination rates. Because of this success a similar methodology was applied to a new primary care organisation, the Primary Care Trust (PCT). Incorporating the audit into the clinical governance programme of the trust increased participation. Another aspect of this study was to incorporate an educational intervention to consenting practices as part of a cluster randomised controlled study. During the study national guidelines were changed to include vaccination of all over sixty-five year olds and above in addition to patients in high-risk groups. This change in policy presented a number of issues that had to be addressed.

Firstly the audit methodology had to be changed to include patients aged sixty-five years and over. Secondly, it had to be considered whether the national campaign would confound the results of the randomised controlled study to the extent that the study would be unnecessary or fail to show any benefit. It was felt that any effects of a national campaign would affect influenza vaccination to a greater extent than pneumococcal vaccination and this was subsequently shown to be true.

The practices that participated in this study demonstrated that they could exceed national goals for influenza vaccination rates for patients aged 65 year old and above. In addition, patients in disease risk groups were also vaccinated to national targets levels for influenza

vaccination. This was an important aim over and above the need to immunise patients over sixty-five years (Nguyen-Van-Tam *et al.* 1998).

This was a multipractice audit in volunteer practices conducted in the context of the national influenza vaccination campaign. The majority of practices, 32 out of 39, in the primary care trust participated in the audit. The study, as for the countywide audit, could not account for secular trends or the Hawthorne effect and participating practices may have been more enthusiastic about vaccination compared to those who did not participate. Although the national influenza campaign was likely to have had an important effect on influenza vaccination rates, the increase in pneumococcal vaccinations rate was unlikely to have been affected.

It was important to consider the various methods that the practices employed to overcome barriers to vaccination. A number of evidence-based interventions were used to improve immunisation rates. Practices combined audit and feedback with a number of other interventions. National media and local newspaper drives were used to increase patient awareness and foster positive attitudes towards influenza vaccination. Practices used leaflet and poster campaigns to increase awareness for both influenza and pneumococcal vaccination amongst patients attending the surgery. In addition to recommendation from general practitioners and nurses during consultations, patient reminders were mailed to at-risk patients (through a health authority initiative providing extra funding for reminder letters to patients) and also sent to patients as messages on repeat prescriptions. Financial incentives to general practitioners, which showed some success in influenza vaccination

programmes in the United States, were also a significant part of the government initiative during this study (Department of Health 2000c) with an item of service fee for every vaccination given to patients over 65 years.

Finally practices were given advice on standardised Read codes for diseases using a simple desktop reference, computer templates for management of diabetes and coronary heart disease which included influenza and pneumococcal vaccination as a prompt and information on search strategies to monitor vaccination uptake during the vaccination season to ensure that they would maximise rates.

Although this was an uncontrolled study in a self-selected group of practices there were again significant improvements in vaccine uptake in high-risk groups. The lack of a control group may have led to an overestimate of any effect of the intervention by not taking into account the influence of secular trends, i.e. changes over time, or the Hawthorne effect, i.e. the tendency of organisations to improve performance simply by virtue of being observed. The study also suggested that adult vaccination rates might also be used as a performance indicator for primary care organisations, as was previously suggested (McColl *et al.* 2000). The opportunity was used to superimpose an educational intervention onto this multipractice audit as part of a randomised controlled study investigating the effect of an educational intervention to practice teams.

#### **5.4 Cluster randomised controlled trial of an educational outreach visit to improve influenza and pneumococcal vaccination uptake in high-risk groups**

Thirty practices took part in this study which was, as described earlier, partly nested within the primary care trust study. Participating practices were similar to non-participating practices with respect to partnership size, list size, dispensing status and rurality (Table 29). The twenty practices from the primary care trust were significantly more likely to participate than those from the research network. This may have been due in large part to the fact that these practices were already taking part in a multipractice audit of influenza and pneumococcal vaccination rates as part of an annual clinical governance programme. There was no reason to believe that patients or practices from the primary care trust differed from practices in general and indeed it has been shown that patients from the Trent Focus Collaborative Research Network were similar to other general practice patients (Hammersley *et al.* 2002) in terms of morbidity, mortality and hospital admission rates. However, research network practices may have been unrepresentative of practices because data quality, disease registers and willingness to participate in research were a prerequisite for membership. Other patient, organisational or quality measures such as deprivation, training status, age or qualifications of clinical or other staff were not collected and this was a potential weakness of the study. However, it was likely that these features would be correlated with baseline vaccination rate and that they would have been accounted for by a spread in baseline vaccination rate. Baseline (phase 1) and follow up (phase 2) vaccination rate ranges were also similar for primary care trust and collaborative research network practices. Practices included in the study,

whether in the intervention or control group, indeed had a wide range of baseline vaccination rates in the high-risk groups under consideration (Table 30).

Practices were randomised to intervention or control groups depending on their baseline vaccination rate for influenza vaccination in diabetic patients (as baseline rates for each vaccination and risk group were correlated) so that baseline vaccination rates were similar for both groups. Baseline characteristics of intervention and control practices were similar in respect of numbers of partners, list size, rurality and prevalence of coronary heart disease, diabetes, splenectomy and patients aged sixty-five years and over (Table 31). However, intervention practices were significantly more likely to be non-dispensing.

Practices in both study (intervention and control) groups were also similar in their stated strategies for improving vaccination uptake at baseline. This was assessed by means of a postal questionnaire to each practice. Items included questions on strategies that were likely to improve influenza and pneumococcal vaccination rates such as practice guidelines on vaccination, discussion within primary care teams, disease and vaccine registers, patient reminders such as poster campaigns, prescription reminders, call and recall letters and organisational policies such as dedicated vaccine refrigerators, vaccination clinics, stock control systems and previous audit of vaccination uptake (Table 32).

Practice performance was compared at baseline (August 2000) and six months after the educational intervention took place. The educational visit was carried out in October

2000, two months after the baseline assessment and at the beginning of the influenza vaccination campaign. Only one control practice did not submit data for splenectomy patients because they lacked a computer register for this group of patients. Improvements in vaccination uptake occurred in coronary heart disease, diabetic and splenectomy patients for both vaccinations and in both intervention and control groups. Baseline uptake was lower for pneumococcal vaccination than influenza vaccination. Median targets set by practices for the audit were at or higher than national targets for patients aged 65 and over. Significant improvements occurred in the intervention group compared to the control group for pneumococcal vaccination in coronary heart disease and diabetic patients (Table 33).



**Table 30 Randomised controlled study: baseline vaccination rate ranges of participating practices**

<b>High risk group</b>	<b>Vaccination rate range at baseline</b>	
	<b>Intervention practices (%)</b>	<b>Control practices (%)</b>
	<b>Minimum, maximum</b>	<b>Minimum, maximum</b>
<b>Influenza vaccination uptake in CHD</b>	39,80	41,87
<b>Influenza vaccination uptake in diabetes</b>	32,84	40,97
<b>Influenza vaccination uptake in splenectomy</b>	0,100	33,100
<b>Influenza vaccination uptake in over 65 year olds</b>	34,67	26,76
<b>Pneumococcal vaccination uptake in CHD</b>	11,53	6,69
<b>Pneumococcal vaccination uptake in diabetes</b>	22,77	8,88
<b>Pneumococcal vaccination uptake in splenectomy</b>	0,100	50,100

**Table 31 Randomised controlled study: characteristics of participating practices** §§§§§§§§§§§§

<b>Characteristics</b>		<b>Intervention practices n=15 (%)</b>	<b>Control practices n = 15 (%)</b>
<b>Practice</b>	<b>CRN</b> §§§§§§§§§§§§	5	5
	<b>PCT</b> ††††††††††††	10	10
<b>Number of partners</b>	<b>1</b>	2	3
	<b>2-3</b>	7	5
	<b>4-6</b>	6	3
	<b>7+</b>	0	3
	<b>List size</b>		
	<b>&lt;3000</b>	2 (13)	5 (33)
	<b>3000-5999</b>	7 (47)	4 (27)
	<b>6000-8999</b>	5 (33)	3 (20)
	<b>&gt;9000</b>	1 (7)	3 (20)
<b>Prevalence (%)</b>	<b>CHD</b>	3.66	3.60
	<b>Diabetes</b>	2.38	2.52
	<b>Splenectomy</b>	0.076	0.11
	<b>Over 65</b>	16.1	15.9

§§§§§§§§§§§§ There were no significant differences between intervention and control groups using Chi square.

§§§§§§§§§§§§ Trent Focus Collaborative Research Network

†††††††††††† West Lincolnshire Primary Care Trust

**Table 32 Randomised controlled study: baseline organisational strategies used by intervention and control practices to improve influenza and pneumococcal vaccination**

<b>Organisational strategy</b>	<b>Intervention practices</b>		<b>Control practices</b>	
	<b>Yes</b>	<b>No</b>	<b>Yes</b>	<b>No</b>
Did you discuss the influenza vaccination programme in your primary care team last year?	14	0 <sup>#####</sup>	12	1
Did you discuss the pneumococcal vaccination programme in your primary care team last year?	12	2	10	3
Do you hold regular primary care team meetings?	11	3	11	2
Do you have practice guidelines for influenza vaccination?	10	4	10	3
Do you have practice guidelines for pneumococcal vaccination?	10	4	10	3
Do you have a dedicated vaccine refrigerator?	14	0	12	1
Does this vaccine refrigerator have an in-built thermometer?	12	2	12	1
Do you have sufficient refrigeration space for your needs?	12	2	11	2
Do you purchase vaccine from your suppliers at a discount?	14		13	
Do you have a method for stock control of vaccines?	13	1	12	1
Do you conduct dedicated clinics for influenza vaccination?	12	2	11	2
Do you conduct dedicated clinics for pneumococcal vaccination?	3	11	2	11
Do you undertake simultaneous administration of influenza and pneumococcal vaccine when appropriate?	14	0	12	1
Which members of your practice team undertake influenza/pneumococcal vaccination: Doctors	13	1	12	1
Practice nurses	14		13	
District nurses	13	1	12	1
Health visitor	5	9	4	9
Do you have a computerised disease (morbidity) register?	13	1	12	1
Do you have a computerised vaccine register?	13	0	11	2
Do you use computer prescription reminders for vaccinations?	9	4	10	3
Did you have a poster campaign for influenza vaccination last year?	13	1	13	0
Do you contact and liaise with nursing homes regarding winter vaccinations?	14	0	12	1
Do you provide printed advice about vaccination e.g. side effects?	8	6	4	8
Do you use call and recall letters for influenza or pneumococcal vaccination?	9	5	9	4
Have you audited the success of uptake of influenza or pneumococcal vaccination in at risk groups before?	6	8	9	4

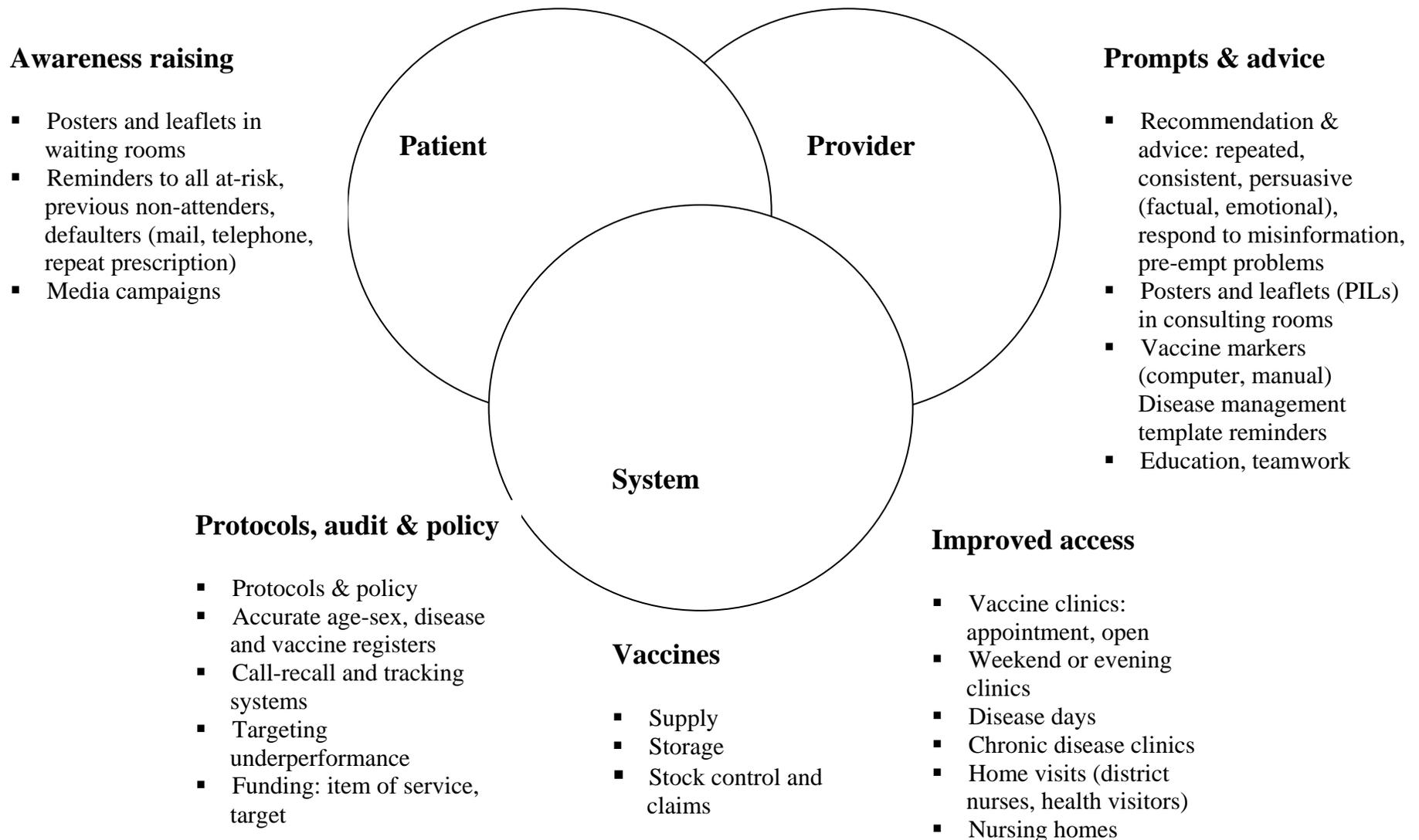
##### Missing data explains totals less than 15 for intervention or control practices

**Table 33 Randomised controlled study: improvement in vaccination uptake of intervention and control practices at baseline and six months after the educational intervention**

n = number of patients in each group at phase 2	Vaccination uptake		Median standard set (Phase 1, Phase 2)	Mean improvement (%)	Risk ratio <sup>§§§§§§§§§§§§§§§§</sup> (95% CI)
	Phase 1 (%)	Phase 2 (%)			
<b>Influenza vaccination uptake in CHD</b>					
Intervention (n=3025)	58.0	76.1	70,70	18.1	1.06 (0.99, 1.12)
Control (n=3182)	59.4	72.5	70,75	13.1	
<b>Influenza vaccination uptake in diabetes</b>					
Intervention (n=2059)	58.9	74.4	70,75	15.5	1.07 (0.99, 1.16)
Control (n=2268)	58.2	70.2	70,80	12.0	
<b>Influenza vaccination uptake in splenectomy</b>					
Intervention (n=62)	64.5	80.6	100,100	16.1	1.22 (0.78, 1.93)
Control (n=107)	55.1	58.0	100,100	2.9	
<b>Influenza vaccination uptake in over 65 year olds</b>					
Intervention (n=13633)	48.6	69.3	60,60	20.7	0.99 (0.96, 1.02)
Control (n=13947)	44.7	70.1	60,60	25.4	
<b>Pneumococcal vaccination uptake in CHD</b>					
Intervention (n=3025)	30.6	44.8	70,70	14.8	1.23 (1.13, 1.34)
Control (n=3182)	33.2	39.7	70,70	6.5	
<b>Pneumococcal vaccination uptake in diabetes</b>					
Intervention (n=2059)	43.3	58.8	70,70	15.5	1.18 (1.08, 1.29)
Control (n=2268)	40.6	47.4	70,75	6.8	
<b>Pneumococcal vaccination uptake in splenectomy</b>					
Intervention (n=62)	79.0	85.5	100,100	6.5	0.96 (0.65, 1.42)
Control (n=107)	86.0	90.7	100,100	4.7	

§§§§§§§§§§§§§§§§ From the Poisson regression controlling for initial level and stratification.

**Figure 14 Randomised controlled study: techniques employed by practices to improve influenza and pneumococcal vaccination rates**



A semistructured questionnaire after the visit showed the range of approaches by which practices augmented their existing organisational strategies (Figure 14). This included awareness raising through poster campaigns and information leaflets in the waiting room as well as patient reminders and media campaigns (both local and national) for influenza. The education and training to practice teams also encouraged practitioner reminders such as templates and vaccine prompts to trigger health professionals to advise high-risk patients to be immunised. Finally, practice systems were also modified to increase vaccination rates using improved vaccine supply and storage, risk registers and call-recall systems and better access through special clinics, home vaccination for the housebound by community staff and vaccine clinics in nursing homes.

#### *5.4.1 Discussion of results from the randomised controlled study*

This study showed that an educational outreach visit to primary health care teams led to an improvement in pneumococcal vaccination rates in patients with coronary heart disease and diabetes. It was not possible to demonstrate an improvement in influenza vaccination rates or vaccination rates in splenectomy patients as a result of the intervention. However, vaccination rates were generally better in the intervention practices for all treatment groups, except for those aged sixty-five and above.

Although the effect size of the intervention in the randomised controlled trial for influenza and pneumococcal vaccination in diabetes and coronary heart disease seemed small (risk ratio 1.22) this was similar to effect sizes seen for other educational interventions (risk ratio 1.5 on average), healthcare interventions in general (often less than this) and therefore had a theoretical and practical basis (Albanese 2000).

There were a number of reasons why the study demonstrated improvements for some high-risk groups and vaccines and not others. The most obvious, given the marked increase in vaccination rates in both the intervention and control groups, was that the national and local campaigns for influenza vaccination of patients aged sixty-five and above might have swamped any effect of the educational visit. The national vaccination campaign, which coincided with this study, used media advertising together with financial incentives, consisting of a fee for service for each vaccine administered to the target age group.

There was also a massive nationwide health education campaign using television and other media to raise public and professional awareness. Local media campaigns and initiatives were also encouraged by the Department of Health. In Lincolnshire this took the form of a radio and newspaper promotion. The local health authority also provided an additional financial incentive to encourage invitation of patients for vaccination, in which general practitioners were paid a fee for each patient in the target age group invited for and subsequently vaccinated. Overall, these campaigns were highly successful in improving vaccine uptake as demonstrated by the primary care trust audit.

Splenectomy patients were numerically a small group. They had a much greater vaccination rate at baseline, particularly for pneumococcal vaccination. This may have been because of the medicolegal imperative to vaccinate this risk group. As a result our study was underpowered to demonstrate significant improvements in this subset.

Factors increasing the validity of the results were the careful design of the study, (Education Group for Guidelines on Evaluation 1999; Begg *et al.* 1996) randomisation by practice dependent on baseline immunisation rates, analysis of clusters and the absence of dropouts.

This study lends support to the trend towards practice based multidisciplinary education for general practice teams as a method of improving delivery of care and outcomes for patients. This is likely to be particularly so where an intervention involves more than one professional group or benefits from a team approach.

Practice based education has been shown to improve the process of care in some studies (Feder *et al.* 1995) whereas we have demonstrated improvement in one particular outcome of care, specifically pneumococcal vaccination rates in high-risk groups.

Methodological issues that were considered in conducting this study were appropriate recognition of the cluster, in this case the general practice, as the unit of intervention, allocation and analysis with sufficient clusters, matched for baseline characteristics and allowing for clustering in the sample size calculation and analysis (Ukoumunne *et al.* 1999a).

There were also a number of potential methodological traps. The significance of the results was dependent on other aspects of the methodology. Key features that may have affected the study's validity were generation of the allocation sequence, allocation concealment, double blinding and follow-up. If any of the first three steps

were inadequately performed this would have led to an exaggeration of the intervention effect (Kjaergard *et al.* 2001). The allocation sequence was decided after appropriate statistical advice. Practices after being arranged in order of baseline pneumococcal vaccination rate for diabetic patients were allocated to intervention or control group depending on the toss of a coin. Practices therefore had an equal chance of being allocated to either group.

There was no attempt at allocation concealment, i.e. to separate the process of allocation to intervention or control group from the investigator. However, the investigator had no means of predicting which practices would respond well or less well to the educational intervention. Indeed, initial matching and stratification had corrected for the baseline variable of vaccine uptake, which was most likely to affect subsequent performance. However, it would have been better that allocation was concealed, and ideally conducted at a site remote from the investigator, to avoid bias (Torgerson and Roberts 1999).

Blinding or double blinding were not possible in this type of study. It may have been possible to blind an investigator undertaking the analysis to the identity of practices and which study group they were in. Follow up could have been extended to longer than six months given adequate resources.

The costs of the intervention were not formally evaluated. Costs would have included healthcare and non-healthcare costs (Johnston *et al.* 1999) based on additional resource use and unit or marginal costs. Healthcare costs included costs of the education, additional vaccines administered and future health service costs due to

patients living longer. Costs to the practice included time for team members to meet with the outreach visitor. However, this cost was minimised by integrating visits into primary health care team meetings. There may also have been additional meetings or discussions stimulated by the educational intervention. Costs of the educational intervention included time to prepare the presentation (at the rate of about three hours preparation time overall), travel time and an hour per practice for delivery of the educational outreach. The marginal costs of additional influenza and pneumococcal vaccinations administered in the intervention practices, over and above those in the control practices, would have included vaccine and item of service costs, staff time to administer the vaccines, other administration costs (vaccine ordering, stock control, refrigeration, receptionist to arrange appointments) and running costs of providing weekend or other special clinics. There may have been additional consultations generated after vaccination because of side effects or illness indirectly related to or made worse by vaccination. Non-health service costs may have included patient travel costs and the costs to the patient of time spent receiving the vaccination. Patients living longer as a result of the vaccine may also have generated future health service costs. Effectiveness of the additional vaccines administered, in terms of hospital admissions, illness or deaths prevented could have been estimated from previous research. Costs and effects presented separately constitute a cost-consequence analysis, whereas the ratio of additional costs to related effects are described as a cost-effectiveness analysis. Further work needs to be done to address the cost effectiveness of this approach. It may be argued that the incentive payments for influenza introduced by the government and previously used successfully in the United States (Kouides *et al.* 1998) were more effective at improving influenza immunisation rates but it is not clear whether this may have been at a higher cost than the effect of the

educational intervention on pneumococcal vaccination. Since any educational intervention or programme would have both direct costs and opportunity costs for healthcare professionals, patients and society, a cost benefit analysis would have provided information on whether this type of intervention should be undertaken with regard to competing priorities (Brown *et al.* 2002). Lack of resources precluded such an analysis.

This study demonstrated that education delivered to practice teams, addressing areas relevant to practice and using audit, feedback, discussion of barriers to change and how to overcome these may lead to improved outcomes for patients.

## **5.5 Conclusion**

The fieldwork demonstrated improvements in vaccination rates in high-risk groups in participating practices. The methods included (a) a pilot study employing action research in a single practice to implement a number of organisational changes using a team approach (b) audit and feedback with written educational materials to practice teams on effective interventions across several practices across a county, (c) audit, feedback and written advice in several practices across a primary healthcare organisation underpinned by a regulatory agreement as part of the trusts' clinical governance framework (d) an educational outreach visit to primary care teams to implement a set of interventions tailored to barriers in each practice.

The largest increases in vaccination rates occurred in the uncontrolled before and after studies, which included the pilot study and multipractice audits. In the pilot study for example, vaccine rates increased by about 10% for influenza and 40-50% for pneumococcal vaccination for coronary heart disease and diabetes. In the audit studies

influenza vaccination rates increased by 10-15% and pneumococcal vaccination rates by 20-40% for the same risk groups. The comparable figures for the randomised controlled study were that influenza vaccination rates increased by about 10% (similar to controls) and pneumococcal vaccination by 15% (compared to 7% in controls).

Although it could be argued that the volunteer practices in these studies were more motivated to increase vaccination rates than those practices that did not participate the wide diversity of practice types and large numbers of practices that took part supported the validity of these improvements in performance. It was interesting that the increase in pneumococcal vaccination rates in the audit studies was of a similar or greater magnitude to the large increase in influenza vaccination rates in patients aged sixty-five years and over that occurred in participating practices as a result of the huge national vaccination campaign. This comparison suggests that motivated practice teams can produce similar increases in vaccination rates using simple interventions to improve teamwork compared to large and costly national initiatives.

## CHAPTER 6 DISCUSSION

### 6.1 Introduction

At the beginning of the twenty-first century education, quality and performance continue to be central and related themes in the modernisation agenda of the British health service (Department of Health 1998a). This thesis set out in previous chapters to investigate these fundamental themes and interrelationships. The discussion, by considering existing theoretical frameworks and examining findings from the preceding field studies seeks to develop a conceptual model for understanding the link between education, quality and performance and to examine the potential for educational interventions for primary care.

The thesis is essentially a diffusion study or a study of how a new idea is adopted. However, there are a number of key differences and special conditions that distinguish this work from previous diffusion studies. Rogers describes the four main elements in the diffusion of innovations as the *innovation* itself and its *communication over time* to members of a *social system* (Rogers 1995). Rather than a single innovation this series of studies involved two similar and closely related innovations (sometimes termed an innovation cluster) of influenza and pneumococcal vaccination that allowed comparison between the two health technologies. The communication of these innovations occurred at various levels through the healthcare system, which included primary care, and how this occurred is examined. The methods of communication and implementation were innovations in themselves and this enabled a further layer of study. The opportunity was taken to systematically observe the change in influenza and pneumococcal vaccination rates over time, rather than using a cross-sectional

method with a single point in time, as has been the case for many previous diffusion studies. Finally the social system that was being studied was primary care, a setting that is unusual in many respects. The primary care setting was highly professionalised, having a structure with a mixture of hierarchical and non-hierarchical relationships between professionals and consisting of a number of general practices and community nursing teams that function as interdependent but virtually independent organisations. Qualitative studies have shown that innovations diffuse slowly and unpredictably across professional, structural and cultural barriers and that a model based on professional ownership of change through continuing professional development might be more successful in implanting change than alternatives such as financial and contractual levers (Ferlie *et al.* 1999). The field studies embraced this model of professional ownership by using educational interventions as a method for promoting change.

The following research question was proposed in the introduction to this thesis (1.1):  
“How and to what extent do educational interventions improve the performance of primary healthcare teams in increasing influenza and pneumococcal vaccination rates in high-risk groups?”

The discussion considers a number of closely related subsidiary questions:

- Did the educational methods employed in the field studies improve performance?
- How did the outcome of interest (i.e. improved vaccination rates) affect these methods?
- Under what circumstances is education more effective at improving performance when directed at primary care teams compared with individual practitioners?

- Which features of the education are important to successful outcomes?
- What special features does general practice offer as a substrate for education?

The analysis also looks at educational interventions compared with other methods of improving outcomes such as financial incentives or contractual levers. Organisational systems to improve performance at different levels of the health service, ranging from individual general practices to primary care trusts to national systems are examined. How these organisational systems could be disseminated, whether they succeed or fail to address promoters and barriers to vaccination and how they may be improved are considered. The lessons from these studies for diffusion of innovations and adoption of new techniques for improving performance in primary care and the National Health Service are explored. The discussion also deals with the relevance of these studies to current trends in multidisciplinary practice-based learning. It explores the potential of educational outreach as a method of learning for primary health care teams as well as the wider opportunities that this may provide for educational initiatives in the developing health service. The discussion by drawing these questions and concepts together seeks to position them in the context of current practice and future opportunities and challenges for education and educational research in healthcare.

## **6.2 A conceptual framework**

The studies described in earlier chapters have demonstrated the effectiveness of educational interventions to primary care teams for improved health outcomes, specifically influenza and pneumococcal vaccinations in high-risk groups. To understand the complexity, range and effects of interventions in improving health outcomes three conceptual frameworks are drawn on. These frameworks are

examined, combined and reformulated to form a new model that seeks to reconcile the findings from the fieldwork and other literature.

In the first framework to be considered, interventions are classified according to the target of the intervention (e.g. patients, providers, or systems), the type of intervention (e.g. education, reminders, feedback), or the social theory (e.g. social influence, marketing) that underpins the intervention (Stone *et al.* 2002). This framework (Figure 15) conveniently describes many of the different intervention types that were operating in the field studies and begins to explain how and why they affected their targets. It also begins to show how one intervention type, for example a media campaign, can potentially affect more than one target.

A criticism of this framework is that it does not consider the outcome of the intervention or the evidence base for it despite the importance of these factors demonstrated in the field studies. The use of influenza and pneumococcal vaccination as outcomes directly affected the educational method used to promote them, and this is discussed below (see 6.3.1). The role of evidence is highlighted in the next conceptual model and explored in more detail later (see 6.4). Also, despite its usefulness in describing and classifying a number of important components, this type of structure by being linear and somewhat mechanistic in the way it implies cause and effect does not fully convey the complex interactions between the elements. Another drawback of the model is that it portrays the targets of the intervention as passive recipients when in fact patients, providers and systems are also agents of change in the process. Therefore, Stone's model, although a useful starting point, fails to adequately

show the complicated relationships and interactions between the various intervention types, targets or agents of change.

As an example, in the randomised controlled study, media campaigns targeted at patients also affected healthcare professionals, both directly and indirectly. The campaign directly affected practitioners by increasing their awareness of the new goal of vaccinating patients aged sixty-five and above. Indirect effects were also noticeable through the observed increased patient demand for vaccination by patients aged sixty-five years and over and the effect that this patient demand had on practitioner awareness.

Another instance of the interaction between interventions was that financial incentives to health workers to some extent determined whether practices sent reminders to patients. However, other factors, such as previous experience within the organisation, determined whether practices used patient reminders at all, and if so whether they did this by sending letters to patients, used reminders linked to repeat prescriptions, telephoned patients directly or employed a combination of methods. The factors that determined which interventions were used and how they were applied are an example of organisational learning (Carroll and Edmondson 2002). These factors were linked to previous practice (i.e. whether patients were usually telephoned or written to in the past), belief systems (what practitioners believed was most effective and appropriate from previous experience), feedback (how practices compared with their peers and particularly how results compared with peers who might have been employing different strategies), relative costs (of using alternative arrangements) as well as specific learning about these issues from literature, media and team discussions.

**Figure 15 Conceptual framework for interventions to improve adult vaccination rates (adapted from Stone et al. 2002)**

<b>Target</b>	<b>Intervention type</b>
Patient(s)	Patient education (leaflets, posters, advice) Media and advertising Patient reminders Financial incentives to patients
Provider(s)	Practitioner education Practitioner prompts: reminders, recall Financial incentives to health workers Media and advertising Teamwork Feedback
System (practice, primary care organisation, national health service)	Team based education (organisational learning) Practitioner prompts: reminders, recall Media and advertising Teamwork Feedback Policy (practice, national) Regulation
<b>Theoretical basis</b>	
Social theory underlying intervention types	Social influence Marketing & outreach Active learning Visual appeal Barriers and facilitators Teamwork Management support

The previous model failed to acknowledge the outcome of the intervention or its underlying evidence base as an element. A useful model which does include evidence as a key component is the Promoting Action on Research Implementation in Health Services (PARIHS) framework (Rycroft-Malone *et al.* 2002). The three components of this model are evidence, context and facilitation. Evidence includes not only the strength of the science in relation to the research question being asked but also takes into account patient need and the acceptance of the evidence by professionals and patients. The context describes the setting in which the health technology, in this case vaccination, is delivered. This includes the organisations, teams and individuals involved in delivering the vaccine and the vaccination programme, together with their culture, which refers to the motivation and beliefs of the individuals and organisations. Rycroft-Malone also includes health policy as part of this context. Facilitation incorporates the various types of interventions, which may be internal or external to the organisation, that are used to implement the health technology. These components are discussed in relation to the field studies and literature later (see 6.4 to 6.7).

The advantages of this model are that it recognises the importance of evidence and moreover how it might affect the beliefs of patients and practitioners. Also, by having these groupings of evidence, context and facilitation enables us to see more clearly the possibilities for interaction within and between them. A drawback of this framework is that the centrality of the patient, both as the recipient and the motivator for increasing vaccination uptake is not adequately addressed. Another anomaly is that health policy, from the experience of the field studies, is more easily seen as an intervention or facilitator rather than part of the context. The context, in this regard, is

better used to describe the various organisations and individuals involved in delivering vaccinations and as we have seen, this should also include the patients who are being targeted to receive vaccination.

Both these models, whilst recognising that the various components interact, provide little explanation of how they might do so. The third model, that more fully considers this interaction, is based on complexity theory. This theory has been explored in the primary care setting by Miller and others in the United States (Miller *et al.* 1998). The model sees general practice, its users, and health professionals, together with its supporting organisations (or the 'context' in the previous model) as a complex adaptive system. Complex adaptive systems could be seen as ever changing webs, containing many organisms and threads, each interacting uniquely with one another and each affecting the whole structure, leading to change in the system, sometimes in an unpredictable manner. The potential changes in the web depend on its initial boundaries (organisational mission, priorities and history), the agents within it (patients, practitioners, health workers, pharmaceutical representatives, administrators etc.) who are both targets and initiators of change, their pattern of interaction (relationships), the immediate surroundings (neighbouring or related complex adaptive systems existing in the same environment), together with wider influences (from the health organisations, national bodies, culture, finances and regulation) (Miller *et al.* 2001).

This theory depicts more accurately the complex relationships between patients, practitioners and organisations and their different belief systems, motivations and cultures that begin to accurately describe the primary care settings in which the field

studies were conducted. This model, however, lacks the detail of evidence, context and facilitation, together with the specific interventions described in the previous frameworks, needed to show how and why vaccination performance improved in these studies.

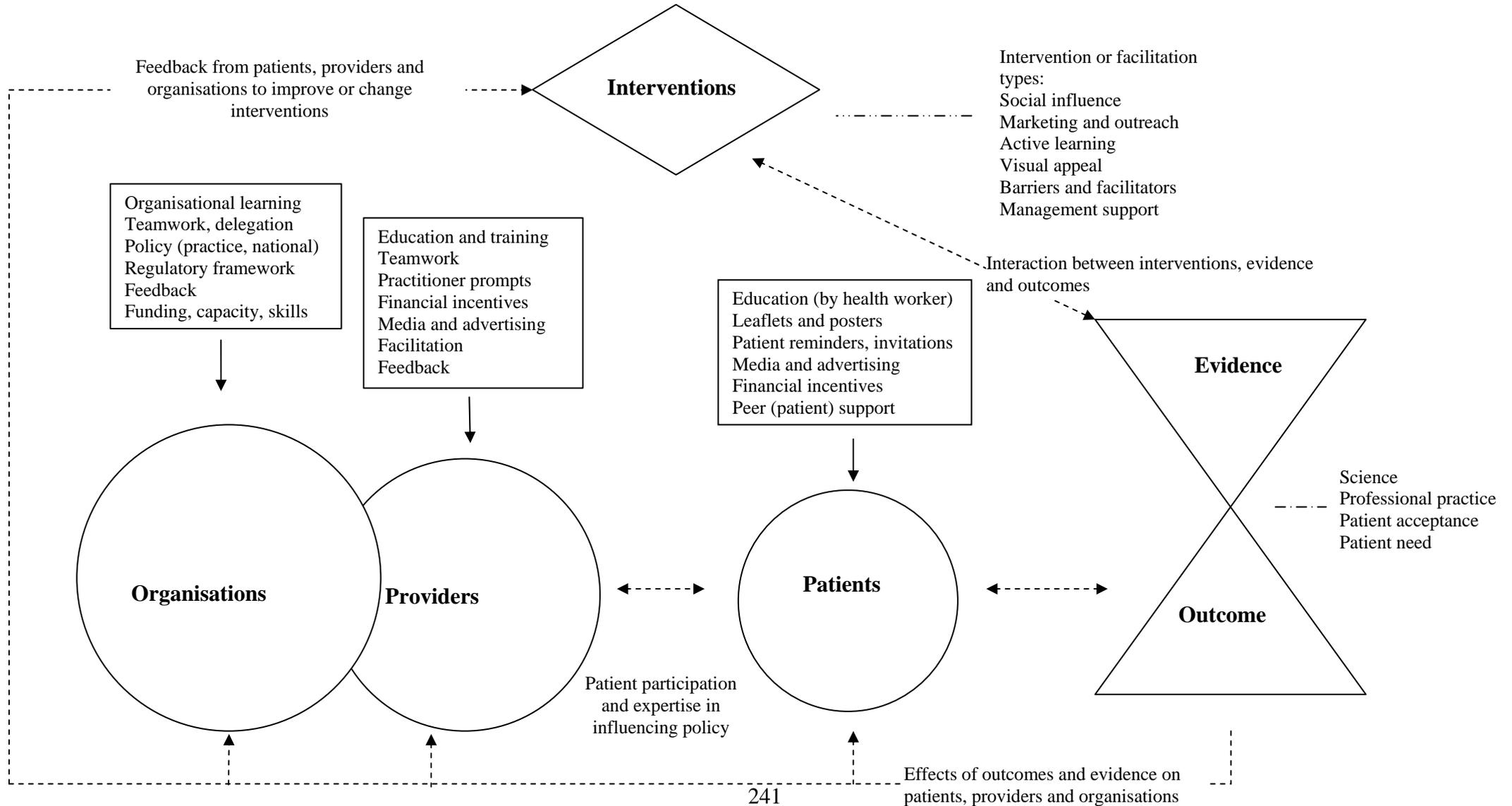
Taken together, these conceptual frameworks help to describe the various elements, serve to emphasise that the different elements are closely interwoven and, as each agent learns from and influences the other, are all underpinned by learning. Combining elements of Stone's model, the PARIHS framework and complexity theory therefore leads us to a model that more closely represents the findings described in the fieldwork.

In this new model (Figure 16) the three main elements are the context, interventions (or facilitators) and evidence. The context includes the change agents or various individuals and organisations involved in producing changes in performance (items shown within circles). This ranges from the patient, the provider (healthcare professional) working in a general practice team to the various supporting organisations such as the primary care trust and Department of Health. The outcome of interest and evidence are also shown (both as triangles). The overlap between providers and organisations is depicted by the overlap between their respective circles. This is because providers, such as general practitioners and nurses, as well as being individual agents also function within larger teams, general practices, community nursing teams, primary care trusts or at even higher organisational levels of the health service. The interactions between the components that form the context are shown as dashed arrows.

The final element, represented at the top of the diagram by a diamond, is the intervention or facilitator of change. The specific interventions are shown in boxes and where they impact on the various change agents are shown as solid arrows. The interventions are also classified as to their nature to the right of the rhomboid. These intervention types and the specific interventions themselves are predominantly, and it will be argued most importantly, educational in their nature. They are educational in that they mostly involve learning, questioning (or iteration) and interaction. Interaction occurs between the agents, interventions and outcomes in an organic and complex way rather than in simple linear manner (Fitzgerald *et al.* 2002). The importance of education lies in the fact that learning is fundamental to change in a highly professionalised organisation such as primary care. Professionals, because of their background of learning, competence and expertise are likely to be highly influenced by rationality, and although political influences may also be a significant factor in change these can also be seen as part of the learning process. The model also acknowledges that the various change agents, particularly providers and professionals but also patients are able to influence the intervention types through feedback. Although practitioners within primary care organisations will learn from various sources, including their patients, the organisation and professionals within it ultimately have the power to block change from occurring.

This model, its components and interactions are now examined in greater depth in light of the fieldwork and other evidence from the literature.

**Figure 16 Diagrammatic representation of conceptual framework for interventions to improve prevention**



## 6.3 Education for teams

### 6.3.1 *Influenza and pneumococcal vaccination as outcomes*

The effect of using influenza and pneumococcal vaccination rates as outcomes and how using these specific outcomes impacted on both the interventions used and the methods that organisations employed to improve performance are an important area for consideration and analysis.

Successful immunisation programmes required a coordinated team approach. The key team involved in vaccine delivery was demonstrated in the field studies to be the primary healthcare team. Other teams such as audit and clinical governance groups were also operating to improve vaccination rates but this was at a level further removed from the patient. It followed from this that the most appropriate educational method to improve vaccination rates should be one directed at teams rather than individuals and more specifically the primary healthcare team as a whole rather any single professional group within it. The educational methods used in this series of studies, which ranged from action research in the single practice pilot study, audit and feedback across many practices in the multipractice audit studies, to an educational outreach intervention for practice healthcare teams in the randomised controlled study, each developed this idea of education for teams and the notion of teamwork for improving vaccination rates. This idea accords with previous evidence advocating a team approach to vaccine implementation (Tannenbaum *et al.* 1994). The concept of teamwork is further developed below (see 6.3.2).

Using vaccination rates as an outcome also affected the type and scope of interventions that practices subsequently employed. Vaccination is a preventive procedure and because it is targeted at patients who are not acutely unwell, population strategies such as identifying the target group, increasing awareness of benefits, reducing concerns and fears, and systematically or opportunistically inviting those in the high-risk population to attend for vaccination differ somewhat from the individual approaches required for treatment of acute or chronic illness. The interventions used also depended on the response of the target population to these techniques.

This can be seen, for example, in the differences that were shown between influenza and pneumococcal vaccination rates. The pilot study, showed, for example, that patients and practitioners were relatively more aware of influenza than pneumococcal vaccination. Between and during the field studies awareness of influenza vaccine also increased amongst both groups due to successive local and national media campaigns. As a result, many practitioners explicitly stated in their written feedback that they concentrated greater efforts in raising awareness of pneumococcal vaccination amongst patients through poster campaigns and leaflets than promoting influenza vaccination awareness. This was borne out by the results of the fieldwork where all the studies showed lower baseline rates and a greater increase in pneumococcal vaccination uptake compared to influenza vaccination.

The use of vaccination rates as outcomes, as well as lending itself to a team approach and particular kinds of intervention, also encouraged specific types of organisational change. Teams tended towards a systems approach and multifaceted strategies to effect organisational change. How and why this happened is described next.

### 6.3.2 *Learning in teams*

The notion of the primary healthcare team as the target of educational interventions in the field studies warrants further consideration, both from a theoretical and practical point of view. From a theoretical standpoint, the importance of systems change in improving medical care is encapsulated in the mantra of the quality improvement movement, ‘every system is perfectly designed to get the results it achieves’ (Nolan 1998). The crucial organisational structure for delivering vaccines is the primary healthcare team itself and those systems operating at this level. From a practical perspective, we have seen how previous research had confirmed that organisational or system change was most likely to result in an improvement in health outcomes (Gyorkos *et al.* 1994; Stone *et al.* 2002) and that such changes, which invariably involved the whole team, were best implemented using a team approach (Clemmer *et al.* 1998). Historically, many practices had used just such a team approach to develop other successful vaccination programmes, for example for childhood immunisation, and would therefore be familiar with a multiprofessional approach.

Factors that were seen in the field studies to encourage teamwork were regular primary care team meetings, good communication within the practice and clear role and task definition for team members through discussion, delegation and written protocols. These same organisational factors had been shown previously to be linked to good preventive care (Hulscher *et al.* 1997a). As well as lack of these factors, conflicts between professionals in some practices undermined good teamwork and this was mentioned in discussions around practice barriers to vaccination during the educational outreach visits.

The educational outreach intervention demonstrated that team members meeting with a facilitator to discuss, learn about and coordinate their approach to vaccination could improve vaccination rates. Learning in teams helped practitioners to share knowledge, both evidence-based and practical. It also enabled teams to understand the processes required for effective vaccine delivery and encouraged them to develop systems where individuals could contribute in a coordinated way to the outcome. Good teamwork was therefore essential to improve vaccination rates. The notion of interdisciplinary education to improve teamwork (Cunningham 1997) and the importance of teamwork in delivering high quality care has previously been recognised (Stevenson *et al.* 2001; Campbell *et al.* 2001b). Stevenson (2001) suggested that, “Experimental studies are required to determine whether the development of teamwork enables practice teams to identify and overcome systematically the obstacles to improved quality of patient care that face them.” Campbell (2001b) stated that good teamworking was a “key part of providing high quality care” and that teamworking “may need specific support if quality of care is to be improved.” Both these ideas were developed in the field studies and are considered further below.

### ***6.3.3 Supporting and developing teamwork***

Effective teamworking was especially demonstrated in those practices that were able to improve vaccination rates. Various members of such practice teams were delegated specific roles in their vaccination programmes. Practices determined these roles and their operationalisation through discussion of previous practice, appraisal of the evidence (such as patient reminders and provider prompts) and how it could be applied locally, recognising the needs of particular patient groups such as nursing home and housebound patients, and analysis of resource issues including availability

of time, personnel and funding. Sometimes, the development of practice systems was informal and implicit rather than by using explicit methods to formally analyse and map the process (Plsek 1997). However, the end result was conceptually the same with practices designing a process with clearly defined tasks and roles for delivering the vaccination programme.

Practice managers usually organised and directed the programme, ordered sufficient vaccines, negotiated discounts with pharmaceutical companies, addressed stock control issues and systems, and arranged for patient and prescription reminders, poster displays and leaflets in the surgery. Practice nurses helped develop the protocols for administering the vaccines, decided which patients should or should not be vaccinated, informed and persuaded appropriate patients to have the vaccine, gave vaccine shots, recorded vaccine details in patient records, managed the stock control process, ensured that the 'shock box',<sup>\*\*\*\*\*</sup> was stocked in case of allergic reactions to the vaccine and set up dedicated vaccine clinics at the surgery and in nursing homes. District nurses fulfilled similar roles to practice nurses but were also required to administer vaccines in the patient's home or residential homes. Doctors and nurses also reminded high-risk patients to have the vaccine and persuaded those who were reluctant of the benefits of vaccination as well as occasionally administering vaccines opportunistically. Receptionists checked whether patients were in high-risk groups, handed out vaccine information leaflets, set up dedicated clinics, informed patients about vaccine clinics and booked appointments for vaccinations. Many of these roles were interchangeable between team members and indeed involved different members in the various practices (Table 34).

<sup>\*\*\*\*\*</sup> The 'shock box' was a box containing adrenaline to be given by intramuscular injection, together with a number of other drugs and instructions for their use in the unlikely event of a severe allergic reaction to the vaccine.

**Table 34 Process mapping for adult vaccination programme**

<b>Process</b>	<b>Concept</b>	<b>Method</b>	<b>Team member</b>
<b>Evidence</b>	Assimilation and appraisal of evidence for vaccination per se or process	Reading Course Lecture	<b>Clinician (nurse more often than GP)</b> External facilitator
<b>Communication</b>	Lead discussion of process	Primary healthcare team meeting Partnership meeting	<b>Practice manager</b> General practitioner Nurse (practice nurse, district nurse, auxiliary nurse or health visitor) Whole team External facilitator
<b>Delegation</b>	Coordination of activities	Nomination or self selection	<b>Practice manager</b> Clinician
<b>Supply</b>	Ordering sufficient supply of vaccine	Incremental (based on previous uptake) Systematic (based on practice data) Derived (estimate from national data)	<b>Practice manager</b> Nurse
<b>Storage</b>	Storage of vaccine	Dedicated vaccine refrigerator	<b>Practice manager</b> Nurse
<b>Identification</b>	Identification of high-risk groups	Age-sex register Disease register Vaccine register Self-identification	<b>IT 'clerk'</b> Patient
<b>Patient reminder</b>	Strategies to communicate need and invite patient for vaccination	Posters, leaflets, prescription reminders Letters Telephone	<b>Receptionist</b>
<b>Provider prompt</b>	Device to remind practitioner to advise or deliver vaccine	Template reminders Protocols, guidelines	<b>IT 'clerk'</b> Receptionist Clinician
<b>Arrival</b>	Bringing the patient and provider together	Attendance at surgery Home visit	<b>Receptionist</b> Patient Clinician
<b>Check-in</b>	Recognising the patient	Previous knowledge Visit chart Drop-in Appointment	<b>Receptionist</b> Clinician
<b>Setting</b>	Place of vaccination	Surgery Home Nursing or residential home	<b>Clinician</b>
<b>Timing</b>	Timing of vaccine clinic	Saturday clinics Week-day nurse clinic Opportunistic (doctor or nurse)	<b>Practice manager</b> Clinician
<b>Complications</b>	Dealing with serious complications	Shock-box Resuscitation training	<b>Clinician</b>
<b>Feedback</b>	Monitoring and feedback on success of vaccination programme	Vaccination rates from audit	<b>Audit staff</b>

All of these professional activities needed to be organised, harmonised and systematised for a successful vaccination programme, a feature that has been noted in other studies (Mangtani and Roberts 2000). The quality of teamwork in the practice was therefore an important determinant of the success of the vaccination programme. The whole team functioning well together were crucial to the success of the vaccination programme and each member, either through individual failure or through a lack of teamworking was a potential barrier to improved performance.

#### ***6.3.4 Other factors affecting performance***

As well as teamwork and organisation, both general and specifically related to vaccination programmes, a number of other factors could have affected baseline and subsequent performance in the practices being studied. These include previous knowledge of and belief in vaccination and the specific vaccines in question, as well as financial factors, which affected the ability or willingness of general practitioners to invest in vaccines and the vaccination process. These features as well as affecting baseline performance could also have impacted on practices ability to change in response to the interventions that they were subject to, readiness to change having already been recognised as an important factor leading to change in the literature review and experimental studies (Cohen *et al.* 1994).

The practices that participated in these studies, by virtue of being volunteers, may have enjoyed better teamwork, been more interested in tackling their vaccination programmes and more willing to adopt interventions to improve immunisation uptake. Non-participating practices may have suffered from primary healthcare teams that were less functional, with poorer participation, and less committed to innovation (West and Wallace 1991). This ability of organisations to change, sometimes termed

‘reflexivity’ in this context (Firth-Cozens 1998), is one of a number of features of teams that has been shown to lead to sustained quality improvement (Hearnshaw *et al.* 1998).

It is possible that the methods used in this study might have had less impact if they were imposed on less motivated or reluctant practices and this needs to be considered when assessing the generalisability of the findings. However there were a number of reasons to believe that the participating practices were representative and that the findings from the field studies were generalisable. There was a high degree of participation of practices in the primary care trust and these practices were similar to other practices in the county in terms of list or partnership size. There was also considerable variation in baseline vaccination rates, which may have reflected practices’ patchy initial enthusiasm for vaccination, and this suggested that not only those practices previously enthusiastic for vaccination were participating.

#### **6.4 Evidence, understanding and motivation**

Uncertainty, doubts, controversy or confusion surrounding the evidence for vaccination were seen to affect the adoption of this evidence by both practitioners and patients in the field studies. There appeared to be a growing sophistication amongst practitioners as to how they dealt with guidance and recommendations. One practitioner during the educational outreach visit for example, who had read the relevant chapter from *Clinical Evidence* (Marrie 2001), a recently published and widely publicised synopsis of evidence compiled by the British Medical Journal for busy doctors to keep up to date, wanted to discuss whether pneumococcal vaccine was effective. In written feedback he also reported that he had concluded from his reading that “[there was] little evidence that [pneumococcal vaccination was] cost effective

except in Chronic Obstructive Pulmonary Disease” and decided to focus his efforts on this risk group rather than the groups investigated as outcomes for these studies. Similar concerns were expressed during some of the other educational visits and this was an area of controversy that was openly aired as part of the outreach. Despite these doubts many practices still went along with national guidance and previous experience to conduct a pneumococcal vaccination programme.

The tension between evidence and practice demonstrated here and in other studies (Freeman and Sweeney 2001) may also have increased when evidence conflicted with tacit knowledge based on experience (Ferlie *et al.* 1999). This tension was seen to affect the implementation of influenza and pneumococcal vaccination programmes as shown by the differences in performance between practices and varying attitudes of individual practitioners towards vaccination. Factors concerned with evidence that were likely to enhance adoption of vaccination were confirmed here and have been described in other studies (Fitzgerald *et al.* 1999). These included strength of evidence, discussion of benefits and harms, ease of implementation, accordance with norms and values of practitioners, acceptability and satisfaction amongst patients together with cost neutrality or savings. Barriers to implementation, on the other hand, included complexity of decision-making or implementation, requirement for new knowledge or skills, changes in organisation or routines and negative reactions in patients.

In relation to the strength of evidence it is interesting to compare and contrast the situation for influenza and pneumococcal vaccination. There was little evidence from the studies presented here that practitioners questioned the value of influenza

vaccination. As a result, there tended to be good agreement amongst general practitioners, other primary healthcare staff and patients that influenza vaccination was a good thing. The situation for pneumococcal vaccination was less clear and this was evidenced in the written comments from the practitioner above and other comments during discussions with doctors and nurses during the educational outreach visits. Controversy and uncertainty around pneumococcal vaccination was well publicised and this conflicting evidence had given rise to confusing advice to general practitioners. Those practitioners who questioned the effectiveness of pneumococcal vaccination also identified cost-effectiveness as an issue. This area of controversy was also raised during the educational outreach visits. Practitioners had become more familiar with the different ways of expressing outcomes and the advantages of expressing outcomes as absolute risk reductions or numbers needed to treat rather than relative risk reduction. Although not all general practitioners understood these terms (Young *et al.* 2002) awareness of evidence-based concepts had gradually increased. In general, the discussions with study participants during educational sessions showed that they believed in the cost-effectiveness of influenza vaccination although at times this seemed to be more influenced by national recommendations than a detailed understanding of the evidence.

The case made for influenza vaccination was therefore far stronger than that for pneumococcal vaccination and although the evidence for pneumococcal vaccination was less clear, there was continued support for it from national guidelines, endorsed by the pharmaceutical industry and some of the research evidence. Uncertainty about evidence, in this case conflicting ideas about the benefits of pneumococcal vaccine may have been a factor affecting baseline and subsequent performance (Tomlin *et al.*

1999). In all the studies presented here, for example, baseline rates were lower for pneumococcal than for influenza vaccination and the greatest increase in vaccination rates was for influenza vaccination for patients aged sixty-five and over, which was the group that received most attention from the national vaccination campaign.

## **6.5 Educational method and performance**

### ***6.5.1 Impact of educational method on performance***

Before any other consideration, for an educational intervention in health care to be effective it needs to educate to implement health technologies that have shown themselves to be effective in improving health. Allowing for problems described above this was demonstrably the case for influenza and pneumococcal vaccination.

Next, it is important to consider the relative advantages and disadvantages of the educational methods that were employed in the field studies and weigh these up against alternative methods of improving outcomes. The earlier multipractice audit studies appeared to demonstrate improvements in vaccination rates comparable to those of the randomised controlled study. If this were true one could argue that a complex intervention such as educational outreach was unnecessary and that the same outcome might have been achieved more cost-effectively with a more simple approach using audit, feedback and written advice.

However, this conclusion fails to take into account secular trends and other confounding factors, which might have partly or wholly explained the improvements in vaccination rates resulting from written advice, audit and feedback used in the multipractice audit studies. Secular trends were shown in studies conducted at around

the same time as the field studies, with year on year improvements in vaccination rates in risk groups of around 2.5 to 5% (Lewis-Parmar and McCann 2002). Audit and feedback or education through written information were unlikely to have effected change unsupported by other strategies (Davis 1998; Freemantle *et al.* 2000). Although one could not directly compare the effects of the field studies described here with each other or with other studies from the literature, a general conclusion could be drawn that the improvement in the intervention practices in the randomised controlled trial more accurately represented the true effect of the intervention, in this case educational outreach, whereas the effects of audit, feedback and written advice in the multipractice audit studies also included secular trends.

The randomised controlled study showed that educational outreach to healthcare teams did improve performance, at least for pneumococcal vaccination. The theoretical and practical basis for this approach and the reason for this method being unsuccessful in some settings have been described above (see 3.10). The likely basis for success of educational outreach intervention in the randomised controlled study in improving outcomes for pneumococcal vaccination, on the other hand, was that it focused on a simple outcome, built on the knowledge and experience of the team members, addressed barriers to change and advocated practical methods for improvement and overcoming barriers that had been shown to work in the pilot and multipractice audit studies. The role of the educational facilitator was important. Certain features may have been key to the effectiveness of the educational facilitator. These included the similar professional and primary care background to learners, so called homophily. Expertise, credibility, professional and social status were also important. The quality and effort of contact with primary care teams, with particular

emphasis on seeing problems from the learners' perspective and relating to their concerns was also essential (Rogers 1995). Social learning theory emphasises the importance of learners modelling change on practical examples of success brought by the facilitator and this was another technique that was actively employed.

The field studies did not compare the benefits of uniprofessional versus team-based education, and this forms a potential area for future investigation.

### **6.5.2 *Overcoming barriers to change***

The notion of addressing barriers to change has formed the basis for many educational intervention studies. The field studies conducted as part of this thesis also sought to address this fundamental issue. In the pilot study this was achieved using an action research methodology addressing barriers in one practice. In the multipractice audits there was an attempt to overcome obstacles to change by using written information and advice to practices on various methods and techniques of improving vaccination rates. However, this did not allow specific difficulties for individual practices to be addressed directly but provided written information that addressed the common barriers. The educational intervention in the randomised controlled study, on the other hand, was designed to identify and address barriers to change by means of a facilitated discussion with practice teams.

This approach has a theoretical basis in the ideas of 'forcefield analysis.' In forcefield theory reducing forces resisting change is considered to be more effective than strengthening driving forces (Lewin 1947). Identifying and overcoming barriers to change has previously been recognised as important (Grol 1997) and effective (Cranney *et al.* 1999) in changing doctors behaviour. Practice teams, in the field

studies here identified a number of barriers to implementing their immunisation programmes. Individual, team and organisational barriers to change became apparent. These included barriers relating to patients such as lack of awareness, failure to self-identify as high-risk, fear of side effects including contracting influenza or doubts about effectiveness. There were also barriers arising from practitioners' lack of awareness or familiarity with the vaccines, doubts about vaccine effectiveness or guidelines, missed opportunities to vaccinate because of workload, time, stress or lack of motivation, appropriate resources and systems (Cabana *et al.* 1999). Practitioners also cited the difficulties of overcoming patient beliefs and the importance of avoiding conflict (Tomlin *et al.* 1999) to maintain a good doctor-patient relationship as a barrier (Freeman and Sweeney 2001). Practice or system factors including lack of reminders, protocols, audit, feedback, call and recall, vaccine supply storage and stock control and access may also have been responsible for poor uptake.

Educational outreach in the randomised controlled study provided an active rather than passive way for teams to identify barriers to change and begin to try and address these within their own practice. The role of the educational outreach visitor was to try and facilitate this situation specific approach rather than impose an external set of barriers and solutions. This approach also recognised the professional dominance model of behaviour change and acknowledged that identifying and modifying tacit expert knowledge and promoting ownership of the process of change amongst the individual professionals within teams was a key factor in influencing change (Ferlie *et al.* 2000). The success of this method contrasts with the limited effect of passive approaches to overcoming barriers using generic methods (Flottorp *et al.* 2002).

### ***6.5.3 Single vs. combined methods for implementing change***

The studies that contribute to this thesis used a variety of methods to increase vaccination rates rather than employing a single technique. The educational outreach intervention, in particular, encouraged practices to use a range of different but complementary approaches to achieve higher influenza and pneumococcal vaccination rates. Interventions like this, which involve several components combined together, are often termed complex or multifaceted interventions. The use of such complex interventions, directed at a number of barriers, has been suggested to be more likely to lead to change (Hulscher *et al.* 2001) than a single intervention.

The rationale for this seems understandable and intuitive. Given the number and complexity of process elements and team members involved, together with the range of possible barriers to implementing a successful immunisation programme, it followed that encouraging practices to employ a combination of strategies in developing their programmes would be more effective than concentrating on a single intervention.

Moreover, to employ a complex intervention, certainly in the context of increasing influenza and pneumococcal vaccination rates, also required good teamworking and communication, at the least to identify how and by whom in the team each of the interventions would be undertaken. It could be argued that educational outreach was the most effective method for helping teams to implement this type of complex intervention because it used an approach that was appropriate to the practice teams' history, working practices and existing systems and at the same time helped facilitate the communication and teamwork required.

However, this mechanistic approach failed to explain the unpredictability of healthcare professionals and systems in producing outcomes, which as shown in these studies led to substantial differences in performance between practices. This unpredictability can be explained by returning to chaos theory and the theory of complex adaptive systems that was touched on earlier in the discussion (Kelley and Tucci 2001). In this theory healthcare professionals are agents within the complex adaptive system. They are highly adaptable elements of the system, which individually and through their relation with other elements lead to unpredictable changes. Inputs or interventions in such systems characteristically produce non-linear or disproportionate effects because of 'strange attractors'. Strange attractors are hidden or ill understood motivations, which in addition to the normal facilitators (or 'attractors') and barriers of change continuously produce 'emergent' or new behaviours that bring about change in a seemingly random or unpredictable way. A number of these strange attractors may have been operating in the field studies. These included the profit motive, response to patient demand, the need to prevent future work by reducing influenza and influenza-related illness, personal and team needs to demonstrate a successful influenza vaccination programme in competition with other practices and a myriad of other possibilities. These hidden and unpredictable factors begin to explain the wide differences between practices' baseline and final vaccination rates.

#### ***6.5.4 Intensive versus brief methods of educational outreach***

Another notable feature was the short duration of the educational intervention used in the randomised controlled study. This was a time limited facilitative approach with the educational outreach visit lasting only up to an hour in each practice. The use of

brief focused education delivered over such a short timescale contrasts widely with the idea that more intensive interventions over a longer period might be more likely to effect change in health outcomes. However, the evidence for prolonged intensive interventions is controversial.

This can be illustrated by comparing the approach taken in the randomised controlled study described here with other studies that have used more intensive efforts at outreach. Training packages in other educational outreach intervention studies have varied from single short sessions delivering focused education lasting one hour (Benincasa *et al.* 1996) to repeated visits over many weeks (Hulscher *et al.* 1997b). Although some prolonged educational interventions have been successful, for example to improve adolescent health care (Sanci *et al.* 2000), it does not always follow that an intensive educational approach using leads to success (King *et al.* 2002). The largest study of intensive educational outreach (for cardiovascular prevention in general practice in the Netherlands) did show improvements in the process of care but at a cost of 25 (13-59) visits or 31 (10-96) hours per practice to 33 practices. Even with this degree of input, training and discussion with individuals and practice groups, 5 of the 33 practices showed only very limited improvements in process and this was due to interpersonal conflicts, problems of teamworking or illness (Hulscher *et al.* 1998).

With regard to influenza and pneumococcal vaccinations and similar preventive care or disease management processes in primary care it can be seen how it is possible for brief interventions to be used to great effect. Where the competencies required to deliver the particular outcome are likely to be already present within the primary care

team, it seems more appropriate for the educational process to focus on enhancing existing knowledge and capability within the team rather than using external expert resources to teach specific competencies (Fraser and Greenhalgh 2001). In other words, it may be more productive for an educational facilitator to support learners to find their own solutions to problems thus increasing their capability or the extent to which they can ‘adapt to change, generate new knowledge, and continue to improve performance.’ Using brief small group methods with reflective learning and feedback on performance rather than providing intensive or lengthy educational programmes shows practice teams how they can continue to learn for themselves.

#### ***6.5.5 Meeting educational objectives***

One of the advantages of educational outreach, as used in the randomised controlled study, was that it allowed practice teams and members of them to articulate their own learning needs during the process (Grant 2002). In the pilot study learning needs were generated iteratively throughout the project. It was assumed that the knowledge and skills to improve influenza and pneumococcal vaccination rates was a learning need of practices participating in the multipractice audits and the randomised controlled study since they had volunteered to participate. In the audit studies, learning needs of practices were assumed to centre on the audit process as well as evidence for the vaccines and their delivery. The use of a general practice trainer, experienced in small group methods, as the educational resource may have helped to elicit learning needs in the randomised controlled study. Practices stated that they welcomed the educational visit at the time. Even though the visit did not lead to a significant improvement in influenza vaccination uptake in intervention compared to control practices, one health visitor who had attended the educational outreach session in her practice, upon hearing of the results during a later presentation, felt that the visit “had

contributed to the successful influenza vaccine programme the previous year” in her practice. An important part of the educational session was to discover individual and organisational barriers specific to the general practice team, and to address the learning needs of participants to overcome these. This was achieved through discussion of the baseline audit results, comparison with standards that practices had set themselves and the performance of other participating practices, a review of current practice and a facilitated group discussion on the main issues for individuals and practice teams on overcoming barriers to change and improving performance using evidence based strategies.

Practice teams were encouraged to develop their own solutions to the problem of improving vaccination rates through small group discussion. Individual team members were able to share their personal strategies for responding to specific difficulties, for example when addressing patients’ beliefs about mild viral infections occurring around the same time as influenza vaccination. Most practitioners preferred a rational explanation, e.g. that the two events were coincidental, whereas one nurse preferred to tell patients that the infection signified ‘that the vaccine had taken’. The practice team, as a complex adaptive system, was therefore able to generate its own ideas and solutions to the problem of increasing vaccination rates and this was a significant part of the educational process (Fraser and Greenhalgh 2001).

## **6.6 Alternatives to education**

We should also compare the effects and appropriateness of educational interventions for healthcare workers with other methods of improving outcomes. One of the problems encountered in the fieldwork was to differentiate between the effects of practice-based educational interventions and the various national and local initiatives

that were being used to promulgate awareness of and ideas around increasing influenza vaccine uptake.

### ***6.6.1 Direct health promotion to the public through the media***

The most dramatic increase in influenza vaccination rates in the randomised controlled study was for patients aged sixty-five years and above. The national media campaign in the autumn of 2000 was likely to have raised awareness amongst patients and practitioners and this was likely to have led to an increase in vaccination rates given the previous evidence (Grilli *et al.* 2000). This may have been partly through a direct effect, rather appropriately in this case termed the hypodermic needle model (Rogers 1995). It might also have been due to a two-step process in which the media affected opinion leaders, both patients and practitioners, to directly influence the rest of the population to have the vaccine. Considerable publicity was also given to influenza following the winter admission and bed crisis around 1999/2000 and this was thought to be partly inflamed by government and media exaggeration of the extent of the influenza epidemic or non-epidemic as it later turned out to be (Abbasi 2000). Although there were alternative and arguably more likely explanations for the winter bed crisis, such as hospital bed blocking due to deficiencies in discharge procedures and social services during the Christmas period (Vasilakis and El Darzi 2001) this additional adverse publicity may have fuelled patient fears and also contributed to the success of the campaign.

### ***6.6.2 Financial incentives***

Financial incentives were also used to support the national influenza vaccination programme and were also likely to have played a significant part in the improvements in influenza vaccination rates in the primary care trust and randomised controlled

studies. These inducements were introduced in 2000 for the winter of 2000/2001. In addition to a national incentive paid directly to general practitioners\* administered to those aged sixty-five years and above, there were a number of local initiatives. In Lincolnshire this took the form of an extra incentive payment to practices†. General practitioners overwhelmingly welcomed these fees, which were introduced to help general practices implement call and recall systems and were over and above any profits from discount purchasing of vaccines. Practitioners were ambivalent in their attitudes to pharmaceutical companies, who produced and sold these vaccines, and their representatives. On the one hand they welcomed help with vaccine supply and purchase but on the other hand some were suspicious about the profit motive of companies and their promotional material. Some were at ease with the accepted practice of buying vaccines at a discount and legitimately claiming back the higher fee whereas others were worried about maximising profits from dispensing vaccines when these might adversely affect indicative prescribing budgets.‡

Financial incentives linked to vaccination targets had had a remarkable effect in improving childhood immunisation rates in the United Kingdom (Salisbury 1998) and some settings in the United States (Morrow *et al.* 1995) and they had also been shown to work with influenza vaccination (Kouides *et al.* 1998). However, financial incentives for practitioners do not invariably lead to change, and this is particularly so

\* £6.50 per vaccination.

† £1.50 for each patient aged sixty-five and over invited for vaccination that subsequently took up the offer.

‡ The indicative prescribing budget is the amount of money allocated to a practice each year for the cost of drugs prescribed to their patients. The budget, although nominally allocated to the practice, is administered by the primary care organisation.

when an incentive conflicts with practitioners beliefs about the effectiveness or appropriateness of particular interventions (Wee *et al.* 2001).

Some practices in the randomised controlled study used low cost incentives for patients, such as a ‘coffee morning’, to encourage patients to attend for vaccination. Financial incentives for patients were not used beyond this although this tactic had been shown to be effective (Giuffrida and Torgerson 1997).

Overall financial incentives were likely to have had a positive effect in supporting practitioners’ efforts to improve influenza vaccination rates.

### **6.6.3 Performance targets**

Policy changes underpinning the national vaccination campaign were also likely to have impacted on the field studies. The introduction of national targets for influenza immunisation supported by the national advertising campaign and financial incentives for general practitioners had a marked effect on influenza vaccination rates in patients aged sixty-five years and above.

Although national targets for childhood immunisations had been used since the new contract for general practitioners and national targets for influenza and pneumococcal vaccination had also been in place in the United States since the early 1990s it took a decade for targets to be introduced for influenza vaccination in the United Kingdom with targets still not in place for pneumococcal vaccination. The national target, when it was introduced in 2000/2001 was for sixty-five per cent of elderly aged sixty-five and above to be vaccinated against influenza.

Performance targets, at least for childhood vaccinations, seem to have drawn grudging acceptance by many general practitioners and practice managers. However, with negative patient attitudes increasing, particularly in relation to measles, mumps and rubella vaccine after recent media scares on a possible link with autism and Crohn's disease, and falling immunisation rates directly affecting general practitioners' incomes, the attitudes of general practitioners seem to be hardening against linking income to targets.

#### ***6.6.4 Clinical governance***

The primary care trust audit and to some extent the randomised controlled study recruited practices within the trust as a voluntary part of a clinical governance programme. Clinical governance has been described as a 'framework through which NHS organisations are accountable for continually improving the quality of their services, safeguarding high standards by creating an environment in which excellence in clinical care will flourish (Department of Health 1998a).' Despite the many complex definitions, explanations and confusion around what clinical governance really means, it is essentially a combination of two basic ingredients, namely quality and accountability. The concept of quality includes the many quality improvement strategies that could and have been used to improve performance, many of which have already been described above in relation to improving adult vaccinations. Accountability, a concept arising most significantly from the Bristol enquiry and Kennedy report<sup>\*</sup>, reaffirms the idea that everyone in a healthcare organisation is both responsible and accountable for delivering quality care with clear lines of

<sup>\*</sup> This was the high profile General Medical Council professional conduct committee hearing which found serious professional misconduct against two Bristol heart surgeons and the medical director of the unit where they worked together with the subsequent public enquiry conducted by Professor Ian Kennedy.

accountability running through organisations and ultimately to chief executives of trusts.

#### **6.6.5 *Combining other methods***

Combining together these alternatives to educational methods such as media campaigns and financial incentives underpinned by national policy, targets and clinical governance did appear to have a significant effect on influenza vaccination resulting in an average 20-25% increase in vaccination rate in those aged sixty-five years and over in the randomised controlled study. This was achieved at a considerable cost however, compared to the educational intervention, which achieved a 15% increase in pneumococcal vaccination rates with a brief educational intervention.

### **6.7 The organisational perspective**

There are a number of lessons from these studies for primary health care and related health service organisations. Firstly, the process of implementation of influenza and pneumococcal vaccination did not follow the linear process from initiation through to implementation described by Rogers (1995). The processes of agenda setting (whether and to what extent to implement vaccination programmes), matching (fitting a programme to the existing structure) to redefining (modification), clarifying (defining the role of the organisation) and routinising where the programme becomes integral to the work of the organisation did not follow in an orderly sequence.

These processes can be viewed from various perspectives ranging from the general practice unit to primary care trusts to regional and national levels. How these systems succeed or fail to improve care and how this may be addressed through systems or

policy initiatives are discussed next.

### **6.7.1 Primary health care teams**

Preventive procedures, illustrated here by influenza and pneumococcal vaccination, as well as many other processes in primary care are delivered through primary healthcare teams. The primary care team forms the basic organisational building block for delivery of most primary care services. Such teams are multidisciplinary and often lack a hierarchical structure. This lack of hierarchy is exemplified by general practitioner partnerships, which are based on consensus decision-making, general practitioners' relationships with attached staff employed by community or primary care trusts, and the capacity of many employed staff in practices to function with considerable independence. Individuals in these teams often come from diverse backgrounds and the practices in which they work are characterised by complex interdependent structures and systems (Fitzgerald *et al.* 1999).

For services to be delivered effectively and for innovations to be adopted requires a multidisciplinary team approach characterised by interprofessional dialogue and a shared approach to implementation. An educational approach to innovation enables teams to meet, discuss and agree on how to bring about change. Education for teams, both from studies presented here and the wider literature, therefore presents an elegant way to deliver organisational change. The educational methods used, which included setting clear objectives, using appropriate methods and applying an assessment tool such as audit to feed results back to teams, were fundamental to achieving a successful outcome. Because of the potential of individuals in teams to block efforts at change, a key ingredient was that participants should have ownership of the educational process. Educational interventions that fail to acknowledge the expert

knowledge of participants, which ignore professional power or are seen as a convenient means of attempting to micromanage the performance of doctors or other healthcare workers are likely to be subverted and fail.

### **6.7.2 Primary care trusts**

At the next organisational level the primary care organisation or trust also played a key role in helping practices to achieve improvements in influenza and pneumococcal vaccination rates. This came about through a variety of means, which included setting local priorities and targets for vaccination rates, providing systems for audit and feedback, enabling practices to benchmark against each other, sharing good practice by providing appropriate education, training and forums for discussion, communicating these elements and providing leadership. With the large numbers of practices involved the primary care trust was also able to provide practical help such as bulk purchasing vaccines at a discount.

The use of a quality agreement between the practices and the trust as part of clinical governance arrangements, together with funding to support this underpinned local policy to improve vaccination rates in practices in the primary care trust (Siriwardena and Middlemass 2000). Written agreements linked to financial incentives, like this, were also being used to drive quality improvements in other primary care trusts (Campbell *et al.* 2001a). Positive methods rather than sanctions are favoured to engage general practitioners particularly in the prevailing climate within primary care of increasing workload and poor morale.

There is emerging evidence that providing community care services under the umbrella of primary care trusts, combining nursing, medical and social service

representation together with management on the boards of these organisations will strengthen and promote the shared agenda of primary care in delivering services (Wilkin *et al.* 2001). However there are also signs, particularly in relation to implementation of complex interventions and budgetary control that primary care trusts are failing to deliver. This may be partly because primary care organisations have failed to understand the nature and complexities of the change management process.

### **6.7.3 National systems**

As well as clinical governance being endorsed on a national scale, a number of other nationwide systems were put in place to improve influenza and pneumococcal vaccination rates. This included a high profile media campaign for patients. For primary care there was the annual guidance and national targets from the Chief Medical Officer (Department of Health 2001a) and Department of Health. Patient leaflets and posters together with additional financial, administrative and educational support were funded nationally but provided through primary care trusts. The central support therefore consisted primarily of a national media campaign and a number of other interventions aimed at supporting local implementation.

## **6.8 Implications for educational research in health**

The studies here demonstrate a number of challenges and opportunities for educational research in today's health service. These include the importance of developing appropriate models for research into complex interventions and the issue of cost-benefit in educational research.

Complex interventions are particularly difficult to evaluate because of the problems of

identifying, documenting and reproducing the intervention. The literature review helped shape the theoretical framework; the pilot study was used to develop the model and provided an exploratory trial using action research methods; the multipractice audit studies helped define various components of the multifaceted intervention for improving vaccination uptake and clarified the outcomes of interest and their measurement using qualitative and quantitative methods; the randomised controlled study provided definitive evidence of improvement in outcomes. The final phase of long-term implementation seeks to discover whether an intervention can be reproduced in other settings over the longer term (Campbell *et al.* 2000a). It is also concerned about continuing demand for the intervention, sustainability of outcomes and possible adverse effects. Time and resource constraints precluded extension of the fieldwork to examine long-term effects.

By using a combination of methods the studies here both highlight and address some of the problems of educational research. These include the relative advantages and disadvantages of uncontrolled and experimental designs, the specific methodological difficulties of randomisation, confounding, bias, and blinding as well as more general issues relating to reliability, validity and generalisation (Prideaux 2002b).

Other methods such as a case study approach or other qualitative methods, including focus groups or interviews, would have been valuable in examining in detail the reactions to the educational intervention and the attitudes, knowledge and behaviour of practice teams in response to the educational outreach visit in the intervention practices or to the audit, feedback and information provided to both intervention and control practices.

One important area that was not fully addressed by this research was cost-effectiveness. This was simply because the resources for a full health economic analysis was not available. Clearly for educational interventions to be cost-effective the target of the educational intervention needs to be cost effective also. Though this may have been so for influenza vaccination, it was less clear for pneumococcal vaccination (see 6.4). An economic evaluation would have added to the research, by using cost-effectiveness analysis to help decide which approach should be used, or cost-benefit analysis to determine whether a particular approach should be used at all rather than directing resources elsewhere (Brown *et al.* 2002). Unfortunately, as Brown *et al.* (2002) demonstrated there is a general lack of high quality cost analysis being built into educational interventions. Although there was a limited analysis of the potential costs involved as part of the randomised controlled study (see 5.4), this research was unable to address in detail the issue of cost-effectiveness or cost-benefit.

One area for future research would be to explore the different outcomes and costs of unidisciplinary versus multidisciplinary research, using an appropriate context, good evidence and robust outcomes.

## **CHAPTER 7 CONCLUSION**

### **7.1 Education, teams and outcomes - current practice and future trends**

Directing educational interventions to primary care teams is crucial where teamwork is an important aspect of delivery for specific healthcare interventions. One of the most important features of interventions in the field studies was that they were directed at primary healthcare teams. There are strong arguments for developing paradigms that develop and strengthen the relationship between organisational learning, practice systems designed to deliver better healthcare and outcomes that realistically measure organisational performance.

With increasing evidence from the studies here together with others that effective teamwork is associated with quality of care (Campbell *et al.* 2001b; Stevenson *et al.* 2001) and that multidisciplinary learning enhances teamwork, it is vital that primary care organisations and funding bodies for higher professional education should reflect on how this type of learning might be supported to improve outcomes of care for patients. The notion of practice based multidisciplinary education to improve teamwork and delivery of healthcare to patients (Cunningham 1997; Toghil 1998) is not new. However, effective interprofessional learning is more than different professional groups sitting at the same lecture. It encompasses a clear aim to improve quality of care for patients, a focus on patients' unmet needs and professionals' educational needs, an opportunity for healthcare workers to learn from, with and about each other, and interprofessional collaboration to improve the service provided

to patients (Headrick *et al.* 1998). The concept of education for multidisciplinary teams focused on patient care relevant to the learning and development needs of the healthcare organisation is therefore rightly central to current policy developments in primary care education (Department of Health 1998b; Department of Health 1998a).

There is also increasing potential for learning to occur at other levels in primary care. The recent trend towards protected learning time schemes at primary care group level enables larger groups of practices to address shared educational needs. These schemes, which originated from the TARGET (Time for Audit, Review, Guidelines, Education and Training) format in the Yorkshire region of the United Kingdom, are an extension of the notion of primary care education centres first expounded by Smith (Smith 1998). The advantages of this format are that learning is done in protected time (i.e. work time) where practices' work is covered by out-of-hours groups or their equivalent; it opens boundaries between people in healthcare and enables wider groups of practices, practitioners and administrators to share experience of good practice; there is a forum for regular interaction between innovators, opinion leaders and their peers; it also allows economies of scale which enables experts, innovators and opinion leaders, from within and outside the organisation, to be available to larger groups. There are also opportunities for this type of educational activity to address problems of interprofessional communication and patient pathways between primary and secondary care (Marshall *et al.* 2002). On the downside, depending on how the schemes are organised, there may be problems within these larger groups for dealing with individual learning needs, allowing sufficient participation and discussion or adequate time to enable practice teams to develop their own systems.

It may be argued that the concept of the learning organisation has been eroded by rhetoric and lack of clarity surrounding it. The original description as a place where “people continually expand their capacity to create the results they truly desire, where new and expansive patterns of thinking are nurtured, where collective aspiration is set free, and where people are continually learning how to learn together” (Senge 1990) although laudable seems high on philosophy and low on relevance in today’s far from Utopian health system. We begin to see how the example of influenza and pneumococcal vaccination demonstrates in a practical and understandable way the concept of the learning organisation. The educational triangle, which has objectives (related to learning needs), methods (of innovation diffusion) and assessment (of knowledge, attitudes and beliefs, skills and outcomes) as its three points, is a useful concept here. For a learning organisation to occur an organisational learning need must be apparent to the stakeholders. Learning needs often derive from innovative health technologies resulting from research or transfer from other settings. They also arise through demonstrable patient need, either from patients themselves or through demonstration of a competence-performance gap. These needs may be nationally driven (national guidance on influenza and pneumococcal vaccination), locally derived (multipractice audits showing variations between practices and low vaccination rates overall) or both (winter pressures). For a learning need to be effectively addressed the outcome arising from learning should be clear, specific, measurable, applicable and acceptable in terms of relative efficacy, side effects and cost to patients, practitioners and healthcare organisations. Learning organisations then become groups of individuals, that are interconnected in some way but which may change over time, that seek to identify and address specific organisational learning needs using a variety of methods, the attributes of which have been discussed

above, and who are prepared to measure their results. For learning organisations to be successful they need to understand what they might achieve, in which situations to try and how best to go about it. Learning organisations were arguably seen to operate at practice, local, regional and national levels in relation to influenza and pneumococcal vaccination.

## **7.2 Summary**

Educational interventions were effective at improving influenza and pneumococcal vaccination rates in high-risk groups. Educational approaches for quality improvement in primary health care accord with the highly professionalised nature of primary healthcare teams and the complex nature of the processes and outcomes that they are trying to achieve. Learning in teams is particularly important when the process or outcome require a team approach, although this is increasingly becoming the norm in many aspects of healthcare delivery. Perhaps the ultimate goal is to develop effective organisational learning in primary care (Fox and Bennett 1998), to promote an understanding and culture of lifelong learning for organisations and their individual members and to transform primary care organisations into real learning organisations (Watkins and Marsick 1993) where learning is translated into improved processes for staff and better care and outcomes for patients. Future research should deal with differences in outcomes and costs of unidisciplinary versus multidisciplinary research, using appropriate contexts, evidence and outcomes.

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## **APPENDICES**