

Research papers

Improving influenza and pneumococcal vaccination uptake in high-risk groups in Lincolnshire: a quality improvement report from a large rural county

Aloysius Niroshan Siriwardena MMedSci FRCGP DCH DRCOG

Honorary Clinical Research Fellow, Primary Care, Faculty of Health and Applied Social Sciences

Aly Rashid MD FRCGP

Head of Division, Primary Care, Faculty of Health and Applied Social Sciences

Mark Johnson PhD

Director, Centre for Evidence in Ethnicity, Health and Diversity, Mary Seacole Research Centre

De Montfort University, Leicester, UK

Louise Hazelwood BTEC HND Cert ITD Cert in Clinical Audit

Clinical Audit Coordinator, Lincolnshire South West Teaching Primary Care Trust, Sleaford, UK

Tracy Wilburn

Clinical Governance Facilitator, West Lincolnshire Primary Care Trust, Bracebridge Heath, Lincoln, UK

ABSTRACT

Background The delivery of influenza and pneumococcal vaccine to high-risk groups remains an important preventive care responsibility for primary care. There is a lack of evidence about influenza and pneumococcal vaccination rates in high-risk groups in UK general practice and methods to improve this.

Design Two-stage multipractice audit of influenza and pneumococcal vaccination rates in high-risk groups before and after graphical anonymised feedback and written advice on improving vaccination rates.

Setting 22 out of 105 Lincolnshire practices volunteered to participate. The study period for the baseline data collection was September to December 1998 and re-evaluation took place in January to February 2000 after the next annual influenza vaccination programme.

Key measures for improvement Influenza and pneumococcal vaccination rates in high-risk groups, specifically in patients with coronary heart disease, diabetes and post-splenectomy.

Methods A combination of strategies for change were used including dissemination of guidelines,

advice on setting up disease and vaccine registers, organisational strategies for improving vaccination rates including call and recall systems and benchmarking of performance.

Results For practices participating in both phases of the audit cycle, mean annual influenza vaccination uptake increased by 10.8% (95% confidence interval [CI] = 5.3% to 16.1%, $P = 0.001$) to 74.4% in coronary heart disease patients by 8.6% (CI = 1.5% to 15.7%, $P = 0.02$) to 70.6% in patients with diabetes and by 17.3% (CI = 4.8% to 29.8%, $P = 0.01$) in post-splenectomy patients. Mean pneumococcal vaccination rates improved by 27.5% (CI = 12.6% to 42.3%, $P = 0.002$) to 58.6% in coronary heart disease patients by 28.8% (CI = 17.2% to 40.3%, $P < 0.001$) to 64.0% in patients with diabetes and by 15.9% (CI = 1.8% to 30.1%, $P = 0.03$) in post-splenectomy patients. These improvements occurred prior to the current national programme for influenza vaccination of patients over 65 years old.

Conclusions Improvements in influenza and pneumococcal vaccination uptake occurred in patients with coronary heart disease, diabetes and

post-splenectomy at re-evaluation. Practices were able to achieve and exceed national targets for influenza immunisation of high-risk groups. Quality of care improved through organisational change, audit and feedback with benchmarking of performance.

Keywords: audit, clinical governance, family practice, feedback, general practice, immunisation, influenza, pneumococcal, primary healthcare, vaccination

Background

The government set a target in 2000/1 to immunise 65% of patients aged 65 years and above and those in high-risk groups against influenza each year by the year 2002.¹ The national vaccination campaign promoted influenza vaccination through media campaigns for patients, guidance for professionals and a payment for each vaccine delivered. However, this did not cover pneumococcal vaccination of at-risk patients or risk groups for influenza vaccination below age 65 although this was also a key target for vaccine delivery.²

There is clear evidence for the effectiveness of influenza vaccination of high-risk populations from systematic reviews and observational studies.^{3,4} Systematic reviews for pneumococcal vaccination reach varying conclusions depending on the quality and age of studies included, but pneumococcal vaccination has been shown to have additional benefits to influenza vaccination in preventing pneumococcal bacteraemia, protects high-risk groups against bacteraemia, hospitalisation and death and saves direct medical costs.^{5–10} The two vaccines are often considered together because of the overlap in high-risk groups and the recommendation for simultaneous administration of these vaccines.¹¹

Little has been published in the United Kingdom on current performance and methods of improving influenza and pneumococcal vaccination uptake in high-risk groups and there is limited evidence of the extent to which practices are implementing the current guidelines for influenza and pneumococcal vaccination and the success or otherwise of targeting high-risk patients.

The problem

Lincolnshire is a large rural county. Primary healthcare teams are 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. Lincolnshire Primary Care Audit Group (PCAG) was 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.

There was evidence of poor coverage of high-risk groups. Previous studies had shown that less than a quarter of those at risk were being vaccinated against influenza.¹² Published audit results have also shown poor pneumococcal vaccination rates.¹³ A study of pneumococcal vaccination showed an uptake of 4% prior to a public health campaign and an estimated uptake of only 33% afterwards.¹⁴

Vaccination rates are low because of poor knowledge and negative attitudes amongst doctors and patients.¹⁵ Doctors and nurses do not vaccinate patients because they forget, the patient refuses, they are worried about side-effects or uncertain about guidelines or vaccine effectiveness.^{16,17} Patients do not take up influenza or pneumococcal vaccination because of worries about safety and perception of risk, whereas previous knowledge of the vaccine, positive attitudes to vaccination and recommendation from a general practitioner are good predictors of vaccination uptake.^{18–20}

We wanted 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.

Key measures for improvement

Our 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 were chosen because they were

the most accurately recorded of the high-risk conditions on our practice disease registers.²¹

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

Gathering information and strategies for change

All Lincolnshire practices ($n = 105$) were invited to participate in the audit. Practices who took part were offered and received help with staff costs for the data collection and were given anonymised feedback on performance together with information on how to improve vaccination rates. The baseline data collection was carried out from September to December 1998. Practices were asked to collect vaccination data for patients with coronary heart disease, diabetes and splenectomy. For each condition, practices recorded if patients had received influenza vaccine in the previous year or if they had ever had pneumococcal vaccination, since the latter is required only once for most conditions and five- to ten-yearly for patients with an absent spleen. Practice receptionists or nurses collected data on structured data collection forms and sent these together with their target standards to the PCAG office for analysis. To ensure patient confidentiality, practices completed these data collec-

tion forms using patient identification numbers only and held the patient reference sheet with names of patients against those numbers.

We analysed data to produce summary data, graphs and results for feedback to practices. We returned anonymised graphical feedback of performance in January 1999 (see Figure 1). We also distributed information on good practice (see Box 1), example protocols for influenza (see Box 2) and pneumococcal vaccination (see Box 3), explanation of how to undertake computer searches and information on current levels of reimbursement. 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.

Effects of change

The audit was repeated between January and February 2000. This allowed just over 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 14 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. Practices who participated in both phases of the audit

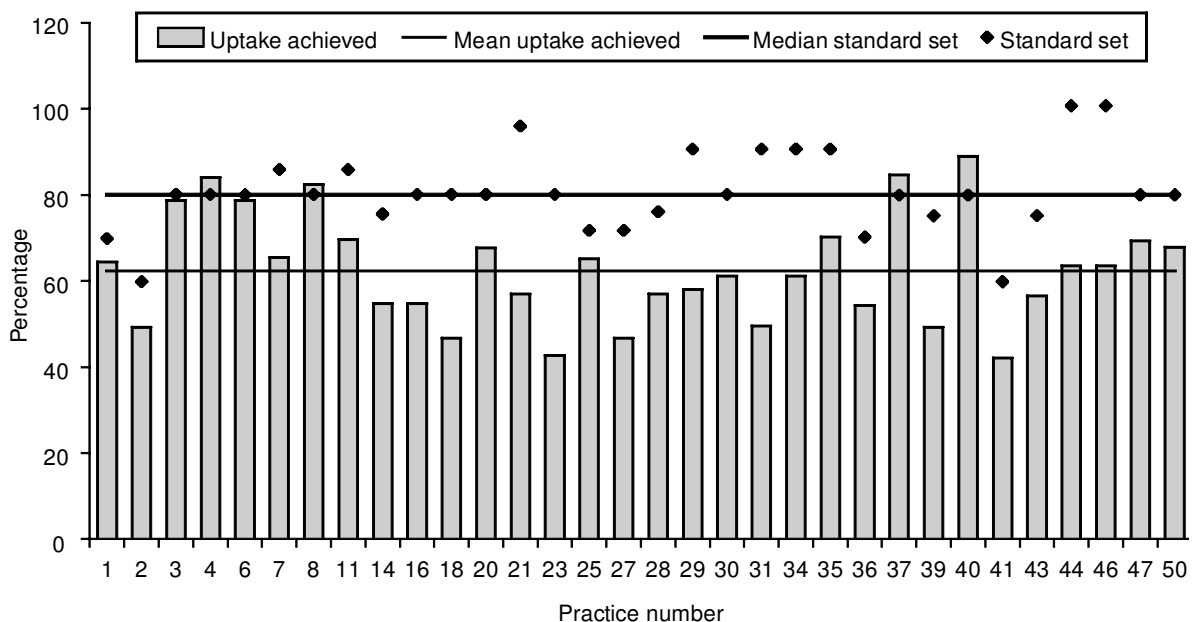


Figure 1 Example of feedback to practices: percentage of diabetic patients who received influenza vaccination (January 1999)

Box 1 Advice given to practices at the first audit

- Initiating, updating and maintaining chronic disease registers is essential if practices wish to improve targeting of high-risk groups
- Use and implement written protocols for adult vaccination
- Ensure adequate vaccine supplies, 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
- Tight stock control and efficient discounting of and claiming for vaccines ensures that the vaccination programme is profitable
- 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

Box 2 Example protocol for influenza vaccination¹¹

Target groups

- Asplenia or severe splenic dysfunction including sickle cell disease
- Chronic lung disease and asthma: chronic obstructive airways disease (COAD), bronchiectasis
- Chronic heart disease: coronary disease, heart failure
- Diabetes mellitus
- Chronic renal disease: chronic renal failure, nephrotic syndrome, dialysis or transplant
- Chronic liver disease
- Immunodeficiency or immunosuppression: HIV, drugs, lymphoma, myeloma
- Patients in residential or nursing homes
- Patients aged over 65 years

Contraindications

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

Clinical responsibility

- Ultimate responsibility rests with GP
- Can be delegated to suitably trained nurses
- Practice nurse must adhere to practice guideline
- Advise patient of purpose and possible side effects of vaccination
- Method of administration:
 - intramuscular or subcutaneous 0.5 ml into deltoid (adult) or lateral aspect of mid thigh (children)
 - 0.5 ml for children 4–12 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 intravenous
 - separate site if given at the same time as pneumococcal vaccine
- Record site, lot number, expiry date in notes
- Flag computer record
- 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

Box 3 Example protocol for pneumococcal vaccination¹¹**Target groups**

Age 2 years and over with the following conditions:

- Asplenia or severe splenic dysfunction including sickle cell disease
- Chronic lung disease: COAD, bronchiectasis, chronic asthma
- Chronic heart disease: coronary disease, heart failure
- Diabetes mellitus
- Chronic renal disease: chronic renal failure, nephrotic syndrome, dialysis or transplant
- Chronic liver disease
- Immunodeficiency or immunosuppression: HIV, drugs, lymphoma, myeloma

Contraindications

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

Clinical responsibility

- Ultimate responsibility rests with GP
- Can be delegated to suitably trained nurses
- Practice nurse must adhere to practice guideline
- Advise patient of purpose and possible side effects of vaccination
- Method of administration:
 - intramuscular or subcutaneous 0.5 ml into deltoid or lateral aspect of mid thigh
 - *not* intradermal or intravenous
 - separate site if given at the same time as influenza vaccine
- Record site, lot number, expiry date in notes
- Flag computer record
- 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

Table 1 Characteristics of practices participating (in both phases of audit) compared to all Lincolnshire practices

Characteristics	Number	Participating practices <i>n</i> (%) (<i>n</i> = 22)	All Lincolnshire practices <i>n</i> (%) (<i>n</i> = 105)	χ^2 <i>P</i> value
List size	< 3000	5 (23)	22 (21)	0.53
	3000–6000	10 (45)	33 (31)	
	6001–9000	5 (23)	32 (30)	
	> 9000	2 (9)	18 (17)	
Number of partners	1–3	16 (73)	63 (60)	0.32
	4–6	6 (27)	34 (32)	
	7–11	0	8 (8)	

were reflective of practices across Lincolnshire in terms of partnership and list size (see Table 1). There were no data for non-participating practices on other criteria such as baseline vaccination rate or deprivation.

Data were analysed using SPSSPC version 10.²² 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 in Table 2). A paired *t* test was used to assess improvement in performance. Fourteen practices undertook both phases of the audit for coronary heart disease and splenectomy and 21 practices did so for diabetes. Although a number of practices joined the audit at the re-evaluation phase these were not included in the analysis. Improvements in vaccination uptake occurred in coronary heart disease, diabetic and post-splenectomy patients for both vaccinations (see Table 2).

Practices were already using a range of techniques to improve immunisation rates at baseline (see

Table 3). We used a semi-structured postal questionnaire to survey organisational changes that occurred in practices as a result of the audit and shared these examples of good practice with other primary care teams (see Box 4).

Lessons learnt

Our data 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 volunteer practices could achieve influenza and pneumococcal vaccination rates for disease-specific risk groups comparable to current national targets for influenza vaccination.

This was a multipractice audit in volunteer practices. For diabetes, one-fifth of the practices in

Table 2 Improvement in vaccination uptake

Vaccine and risk group (number of practices)	Vaccination uptake				
	Phase 1 (%)	Phase 2 (%)	Median standard (Phase 1, Phase 2)	Mean improvement (95% CI)	Significance (<i>P</i> value, two-tailed <i>t</i> test)
Influenza vaccine uptake in CHD (<i>n</i> = 14)	63.6	74.4	80, 80	10.8 (5.3 to 16.1)	0.001
Pneumococcal vaccine uptake in CHD (<i>n</i> = 14)	31.1	58.6	68, 75	27.5 (12.6 to 42.3)	0.002
Influenza vaccine uptake in diabetes (<i>n</i> = 21)	62.1	70.6	80, 80	8.6 (1.5 to 15.7)	0.02
Pneumococcal vaccine uptake in diabetes (<i>n</i> = 21)	35.2	64.0	75, 80	28.8 (17.2 to 40.3)	< 0.001
Influenza vaccine uptake for splenectomy patients (<i>n</i> = 14)	66.1	83.4	90, 100	17.3 (4.8 to 29.8)	0.01
Pneumococcal vaccine uptake for splenectomy patients (<i>n</i> = 14)	79.6	95.6	95, 100	15.9 (1.8 to 30.1)	0.03

Table 3 Organisational strategies used by practices to improve influenza and pneumococcal vaccination at baseline

Organisational strategy	Practice response (<i>n</i> = 21)			
	Yes		No	
	<i>n</i>	(%)	<i>n</i>	(%)
Did you discuss the influenza vaccination programme in your primary care team last year?	19	(90)	1	(5) ^a
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 inbuilt 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 liaise 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 vaccination in at-risk groups before?	7	(33)	13	(62)

^a Missing data account for percentages not adding up to 100

Box 4 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
- Attach 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 primary healthcare team meeting agenda; introduce protocols for vaccination of high-risk patients
- Use reminders on computer screens to prompt clinicians

Lincolnshire participated in both cycles. We were disappointed that more practices did not participate. It was likely that those who did take part were more motivated to change. It was possible that non-participating practices may have differed in terms of deprivation or case-mix where the need for immunisation may have been greater but those practices that took part comprised rural, suburban and inner city practices including those serving areas of deprivation. We were not surprised at this level of uptake given previous participation rates in county-wide 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 or the Hawthorne effect. The analysis demonstrates the capability and extent to which participating practices were able to improve performance with the aid of audit, feedback and written advice. Although many 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. Audit and feedback have been shown to improve immunisation uptake especially when combined with other interventions.^{23,24} Practices in this study used a range of interventions to improve influenza and pneumococcal vaccination rates. In a systematic review of North American studies system-orientated (e.g. standing orders for nurses), provider-orientated (education and/or reminders for doctors and nurses) and patient-directed interventions (leaflets, posters and

mailshots to patients) all improved influenza and pneumococcal vaccination rates.²⁵ A combination of interventions tailored to overcome practice-specific barriers may be more effective than individual measures particularly when these are focused on organisational change.²⁶

Next steps

There is scope for using influenza and pneumococcal immunisation rates as an outcome measure in further rigorous studies to improve vaccine uptake. One opportunity for future research would be to use educational outreach for primary care teams to implement a raft of evidence-based interventions to overcome barriers identified in the practice setting.²⁷ Benchmarking of practice performance is an important component of clinical governance and will be used increasingly by primary care trusts to monitor and improve performance.²⁸

ACKNOWLEDGEMENTS

We thank the Lincolnshire practices that participated in this study, Lincolnshire Primary Care Audit Group and Dr Michael Dewey of Trent Institute for statistical advice and comments.

ANS had the initial idea, designed the study, undertook the data analysis, participated in feedback to practices and prepared the paper. LH and TW helped design the audit protocol and carried out the

analysis and collation of audit data and feedback to practices. AR and MJ contributed to the methodology, design and discussion. All authors contributed to the final analysis, revision and approval of the final version of the paper. ANS is the guarantor for the paper.

Trent Focus assisted with funding for ANS and Lincolnshire Health funded the PCAG. Competing interests: None.

REFERENCES

- Department of Health (2001) *Influenza Immunisation Programme 2001/2002*. CMO's letter PL/CMO/2001/4, 16 July 2001. HMSO: London, pp. 1–8.
- Nguyen-Van-Tam JS, Kyaw MH and Pearson JC (1998) Age is not only criterion for flu vaccine. *British Medical Journal* **317**: 946.
- Gross A, Hermogenes AW, Sacks HS, Lau J and Levandowski RA (1995) The efficacy of influenza vaccine in elderly persons: a meta-analysis and review of the literature. *Annals of Internal Medicine* **123**: 518–27.
- Fleming DM, Watson JM, Nicholas S, Smith GE and Swan AV (1995) Study of the effectiveness of influenza vaccination in the elderly in the epidemic of 1989–90 using a general practice database. *Epidemiology and Infection* **115**: 581–9.
- Moore RA, Wiffen PJ and Lipsky BA (2000) Are the pneumococcal polysaccharide vaccines effective? Meta-analysis of the prospective trials. *Family Practice* **1**: 1.
- Hutchison BG, Oxman AD, Shannon HS, Lloyd S, Altmayer CA and Thomas K (1999) Clinical effectiveness of pneumococcal vaccine. Meta-analysis. *Canadian Family Physician* **45**: 2381–93.
- Fine MJ, Smith MA, Carson CA *et al.* (1994) Efficacy of pneumococcal vaccination in adults: a meta-analysis of randomized controlled trials. *Archives of Internal Medicine* **154**: 2666–77.
- Honkanen PO, Keistinen T, Miettinen L *et al.* (1999) Incremental effectiveness of pneumococcal vaccine on simultaneously administered influenza vaccine in preventing pneumonia and pneumococcal pneumonia among persons aged 65 years or older. *Vaccine* **17**: 2493–500.
- Nguyen-Van-Tam JS and Neal KR (1999) Clinical effectiveness, policies, and practices for influenza and pneumococcal vaccines. *Seminars in Respiratory Infections* **14**: 184–95.
- Nichol KL, Baken L, Wuorenma J and Nelson A (1999) The health and economic benefits associated with pneumococcal vaccination of elderly persons with chronic lung disease. *Archives of Internal Medicine* **159**: 2437–42.
- Begg NT and Salisbury DM (eds) (1996) *Immunisation Against Infectious Disease*. HMSO: London.
- Watkins J (1997) Effectiveness of influenza vaccination policy at targeting patients at high risk of complications during winter 1994–5: cross-sectional survey. *British Medical Journal* **315**: 1069–70.
- Sheikh A (1998) Pneumococcal vaccination: a practice based audit. *Audit Trends* **6**: 93–5.
- McDonald P, Friedman EH, Banks A, Anderson R and Carman V (1997) Pneumococcal vaccine campaign based in general practice. *British Medical Journal* **314**: 1094–8.
- Wiselka M (1994) Influenza: diagnosis, management and prophylaxis. *British Medical Journal* **308**: 1341–5.
- Metersky ML, Mennone JZ and Fine JM (1998) Factors inhibiting use of the pneumococcal polysaccharide vaccine: a survey of Connecticut physicians. *Connecticut Medicine* **62**: 649–54.
- Hershey CO and Karuza J (1997) Delivery of vaccines to adults: correlations with physician knowledge and patient variables. *American Journal of Medical Quality* **12**: 143–50.
- Findlay PF, Gibbons YM, Primrose WR, Ellis G and Downie G (2000) Influenza and pneumococcal vaccination: patient perceptions. *Postgraduate Medical Journal* **76**: 215–17.
- Siriwardena AN (1999) Targeting pneumococcal vaccination to high-risk groups: a feasibility study in one general practice. *Postgraduate Medical Journal* **75**: 208–12.
- Kyaw MH, Nguyen-Van-Tam JS and Pearson JC (1999) Family doctor advice is the main determinant of pneumococcal vaccine uptake. *Journal of Epidemiology and Community Health* **53**: 589–90.
- Kessner DM, Kalk CE and Singer J (1973) Assessing health quality – the case for tracers. *New England Journal of Medicine* **288**: 189–94.
- Norusis MJ (1990) *SPSS Base Manual 4.0*. SPSS Inc: Chicago, IL.
- Bordley WC, Chelminski A, Margolis PA, Kraus R, Szilagyi PG and Vann JJ (2000) The effect of audit and feedback on immunization delivery: a systematic review. *American Journal of Preventive Medicine* **18**: 343–50.
- Thomson O'Brien MA, Oxman AD, Davis DA, Haynes RB, Freemantle N and Harvey EL (2002) Audit and feedback: effects on professional practice and health care outcomes (Cochrane Review). *The Cochrane Library, Issue 4, 2002*. Update Software: Oxford.
- Gyorkos TW, Tannenbaum TN, Abrahamowicz M *et al.* (1994) Evaluation of the effectiveness of immunization delivery methods. *Canadian Journal of Public Health* **85** (Suppl 1): S14–30.
- Stone EG, Morton SC, Hulscher ME *et al.* (2002) Interventions that increase use of adult immunization and cancer screening services: a meta-analysis. *Annals of Internal Medicine* **136**: 641–51.
- Freudenstein U and Howe A (1999) Recommendations for future studies: a systematic review of educational interventions in primary care settings. *British Journal of General Practice* **49**: 995–1001.
- Department of Health (1998) *A First Class Service: quality in the new NHS*. Department of Health: London.

ADDRESS FOR CORRESPONDENCE

Dr AN Siriwardena, North Dene, Langworth
Road, Scothern, Lincoln LN2 2UP, UK. Tel: +44
(0)1522 568838; fax: +44 (0)1572 546740; email:
niro@siriwardena.freeserve.co.uk.

Accepted September 2002