Epidemiol. Infect. (2002), **128**, 445–455. © 2002 Cambridge University Press
DOI: 10.1017/S0950268802006891 Printed in the United Kingdom

Influenza and pneumococcal vaccine distribution and use in primary care and hospital settings in Scotland: coverage, practice and policies

M. H. KYAW[1,3]*, B. WAYNE[3], J. CHALMERS[2], I. G. JONES[3] AND H. CAMPBELL[1]

[1] *University of Edinburgh, Department of Public Health Sciences, Edinburgh*
[2] *Information and Statistics Division of the Common Services Agency, Edinburgh*
[3] *Scottish Centre for Infection and Environmental Health, Clifton House, Clifton Place, Glasgow G3 7LN*

(*Accepted 9 January 2002*)

SUMMARY

A survey of the coverage, distribution and the factors associated with use of influenza and pneumococcal vaccines among general practitioners (GPs) in primary care and in hospital settings was carried out in 53 general practices in Scotland taking part in the 'Continuous Morbidity Recording' (CMR) programme. The annual vaccine distribution increased substantially among 53 general practices from 1993 to 1999 and in Scotland as a whole from 1984 to 1999. From the questionnaire, overall coverage was 43% (95% CI 38–48) for influenza vaccine in the 2000–1 season and 13% (95% CI 9–16) for pneumococcal vaccine in the last 5 year period, in high-risk patients recommended for these vaccines by the Department of Health (DoH). Influenza vaccine coverage was highest in the elderly (65 years of age and above) at 62% (95% CI 59–74). Although pneumococcal vaccination is not currently recommended for all elderly, coverage of this vaccine was also higher in this group (22%, 95% CI 16–29). In the majority of patients (influenza vaccine, 98% and pneumococcal vaccine, 94%), vaccination was carried out in general practice. Only 2% of patients had received pneumococcal vaccination in a hospital setting. The level of influenza and pneumococcal vaccination varied with the level of deprivation. Most GPs considered that the responsibility for influenza and pneumococcal vaccination lay with them. Forty-five percent of GPs reported having a written policy with set target for influenza vaccination and 11% for pneumococcal vaccination.

INTRODUCTION

Influenza and pneumococci are important causes of hospitalization and deaths in the United Kingdom [1]. Influenza and pneumococcal vaccination reduces hospitalization and death in the elderly and persons with chronic medical conditions [2–4]. Influenza vaccine is effective in preventing at least 50% of severe respiratory illnesses, hospitalizations and deaths in the elderly and those living in long stay facilities [4, 5]. The current 23-valent pneumococcal polysaccharide vaccine covers over 88% of serotypes which cause disease in the United Kingdom [6, 7] and is reported to be 50–80% effective against invasive pneumococcal disease [8]. Both vaccines are currently recommended for persons at increased risk of influenza and pneumococcal disease and may be administered simultaneously at different sites [9]. Annual vaccination is required for influenza vaccine but not for pneumococcal vaccine which lasts for 5–10 years.

Information on the actual use of these vaccines in primary care and hospital settings is poor but limited evidence suggests that influenza vaccine and pneumococcal vaccines are underused in the United Kingdom. Estimated coverage for influenza vaccine has been reported to be 20–45% and 4–15% for pneumococcal vaccine among at-risk patients [10–12]. Only 0·5% of immunizations for influenza or pneumococcal vaccine

* Author for correspondence: Clifton House, Clifton Place, Glasgow G3 7LN.

were given in hospital settings [11, 13]. No studies have compared their distribution patterns, use and coverage among high-risk individuals in the primary care and hospital settings. We therefore report on the distribution of influenza and pneumococcal vaccines in 53 general practices in Scotland. We also examine views on vaccine indications, policies and responsibilities for vaccination among GPs and use of influenza and pneumococcal vaccines in primary care and hospital care. Since the CMR practices record diagnostic codes, it is possible to identify all patients meeting high-risk criteria and therefore be able to measure vaccination rates in these groups.

Data from this study should aid in the development of appropriate vaccination strategies and policies for improving coverage of influenza and pneumococcal vaccines among at-risk patients.

METHODS

The practice data were collected from 53 general practices which contribute to the 'Continuous Morbidity Recording' (CMR) system (which include more than 5% of the population of Scotland). Information obtained from CMR system is considered to be representative of the Scottish population in terms of sex, age, deprivation and rural/urban mix and geographic locations [14] and became part of the national 'core data set' on 1 April 1998. The CMR system requires at least one diagnosis to be recorded at each face-to-face contact between a GP and patient. The diagnoses are Read coded and all data are internally linked to build up a continuous record for each patient. The number of high-risk patients registered in the CMR practices was determined by searching for the specific diagnosis codes for chronic medical conditions. Data on the number of high-risk patients were based on persons rather than GP consultations, to ensure that patients who had more than one high-risk condition for influenza or pneumococcal vaccine were not counted more than once.

Information on the number of doses of influenza and pneumococcal vaccines distributed obtained from prescribing returns from the Primary Care Unit, Information and Statistics Division (ISD), NHS in Scotland. Data were examined for the whole of Scotland during 1984–99 and for the CMR practices during 1993–9. Based on the total number of high-risk patients and the total number of influenza and pneumococcal vaccine doses distributed in the CMR practices, we estimated the likely overall coverage of this vaccine in all high-risk patients and in patients who are recommended for vaccination by the Department of Health (DoH).

Using computer generated random selection, ten high-risk patients were selected from each of the 53 CMR practices. As the CMR system is completely anonymous, we do not know the names of the patients, but we supplied other details (date of birth, sex and postcode) of these patients which allowed GPs to identify them and their medical records. A questionnaire was sent to each GP asking them to review the medical records to identify whether these individuals had been vaccinated with influenza and/or pneumococcal vaccines in either a primary care or hospital setting. In addition, information on their views on vaccine indications, policies and responsibilities for vaccination programme was also requested. Each GP was offered a set fee for establishing and recording the vaccination status of their patients, to compensate for their time taken to review the (10) records and to answer the questionnaire.

We were able to check data on coverage of pneumococcal vaccine based on vaccine distribution statistics. We then made an estimate of total numbers of high-risk patients or required immunizations for influenza and pneumococci in Scotland based on the total numbers of high-risk patients registered in the CMR practices. We used the Carstairs Deprivation Scores [15] to determine whether deprivation status of the patient's area of residence was associated with the coverage of these vaccines. This measurement is based on postcode sector which is assigned a deprivation category, ranging from 1 to 7, 1 being the most affluent and 7 being the most deprived.

The annual number of influenza vaccine doses prescribed was calculated as the number of doses dispensed per 1000 population [16]. Pneumococcal vaccine use is presented as the number of doses dispensed per 10000 population as in the previous report [17]. Data analyses were carried out using SPSS version 10. χ^2 test for trend was used to determine the association between vaccine coverage and deprivation index. 95% confidence intervals and χ^2 tests for trends were calculated for vaccine coverage using the CIA programme (Gardner SB, Winter PD, Gardner MJ: London 1991).

RESULTS

A substantial increase in the annual distribution of both influenza and pneumococcal vaccines occurred

https://doi.org/10.1017/S0950268802006891 Published online by Cambridge University Press

Table 1. *Number of influenza and pneumococcal vaccine dispensed in the 53 CMR* practices, 1993–9*

	Influenza vaccine		Pneumococcal vaccine	
Year	No. of dose dispensed	Dose distributed per 1000 population	No. of dose dispensed	Dose distributed per 10000 population
1993	22180	72·2	58	1·9
1994	22618	73·6	237	7·7
1995	26813	87·3	768	25·0
1996	24955	81·2	196	6·4
1997	32624	106·2	1000	32·6
1998	33151	107·9	2092	68·1
1999	34106	111·0	1538	50·1

* An estimated population 307215 in 53 CMR practices.

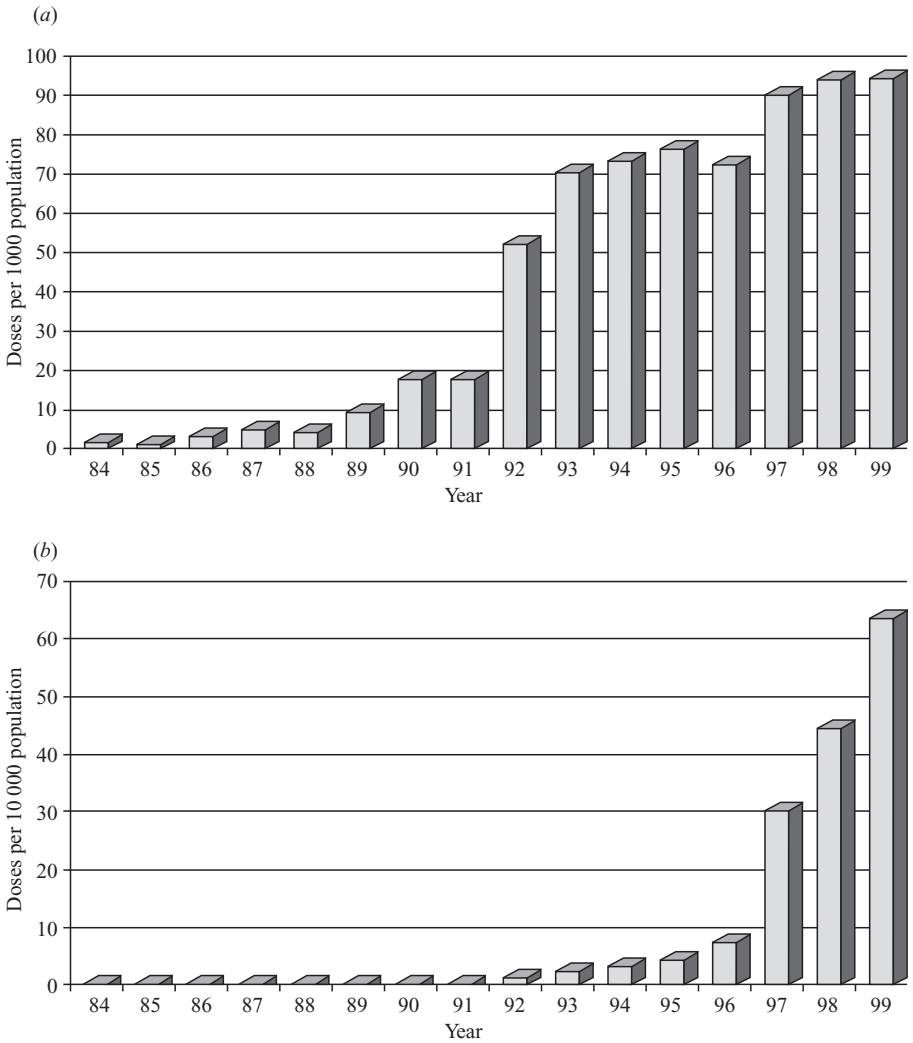

Fig. 1. (*a*) Annual numbers of doses of influenza vaccine distributed per 1000 population in Scotland, 1984–99. (*b*) Annual numbers of pneumococcal vaccine distibuted per 10000 population in Scotland, 1984–99.

over the period 1984–99 in Scotland and in 1993–9 in the CMR practices (Fig. 1, Table 1). Of the 53 questionnaires sent out to GPs within the CMR practices, 45 (84·9%) were returned and completed. The selected patients fell into eight categories; chronic pulmonary, heart, liver, renal disease, or diabetic

https://doi.org/10.1017/S0950268802006891 Published online by Cambridge University Press

Table 2. (*a*) *Influenza vaccine coverage,* (*b*) *pneumococcal vaccine coverage* (*1999–2000*), *in high-risk patients*

High-risk conditions	No	Yes	Total	Coverage in all ages	(95% CI)	Coverage in < 64 years of age	Coverage in ⩾ 65 years of age
(*a*) Influenza vaccine coverage in high-risk patients, 1999–2000							
Chronic pulmonary disease*	156	83	239	34·7	(29–41)	22·2	69·8
Chronic heart disease*	51	59	110	53·6	(44–63)	36·1	60·8
Chronic liver disease	3	4	7	57·1	(18–90)	25	100
Chronic renal disease*	2	4	6	66·7	(22–96)	60	100
Diabetic mellitus*	24	43	67	64·2	(52–76)	53·1	74·3
Asplenic disorders*	5	1	6	16·7	(0–64)	0	16·7
Elderly (65 years of age and above)	54	108	162	66·7	(59–74)		
Elderly (75 years of age and above)*	31	51	82	62·2	(51–73)		
Overall coverage for conditions indicated by the DoH	232	174	406	42·9	(38–48)		
Overall coverage for all high-risk conditions	235	178	413	43·1	(38–48)		
(*b*) Pneumococcal vaccine coverage in high-risk patients							
Chronic pulmonary disease†	216	23	239	9·6	(6–14)	4	25·4
Canonic heart disease†	93	17	110	15·5	(9–22)	8·3	18·9
Chronic liver disease†	6	1	7	14·3	(0·4–58)	0	33·3
Chronic renal disease†	6	0	6	0	(0–41)	0	0
Diabetic mellitus†	53	14	67	20·9	(12–33)	15·6	25·7
Asplenic disorders†	6	1	7	14·3	(0·4–58)	20	16·7
Elderly (65 years of age and above)	126	36	162	22·2	(16–29)		
Elderly (75 years of age and above)	64	18	82	21·9	(14–33)		
Overall coverage for conditions indicated by the DoH	362	52	414	12·6	(9–16)		
Overall coverage for all high-risk conditions	362	52	414	12·6	(9–16)		

CI, confidence interval, * recommend by the DoH (all elderly 65 years of age and above include for vaccination from September 2000, current policy also includes immunosuppressed patients, those living in nursing homes and long-term care facilities).
† recommend by the DoH (current vaccine policy also includes patients with immunodeficiency or immunosuppression).

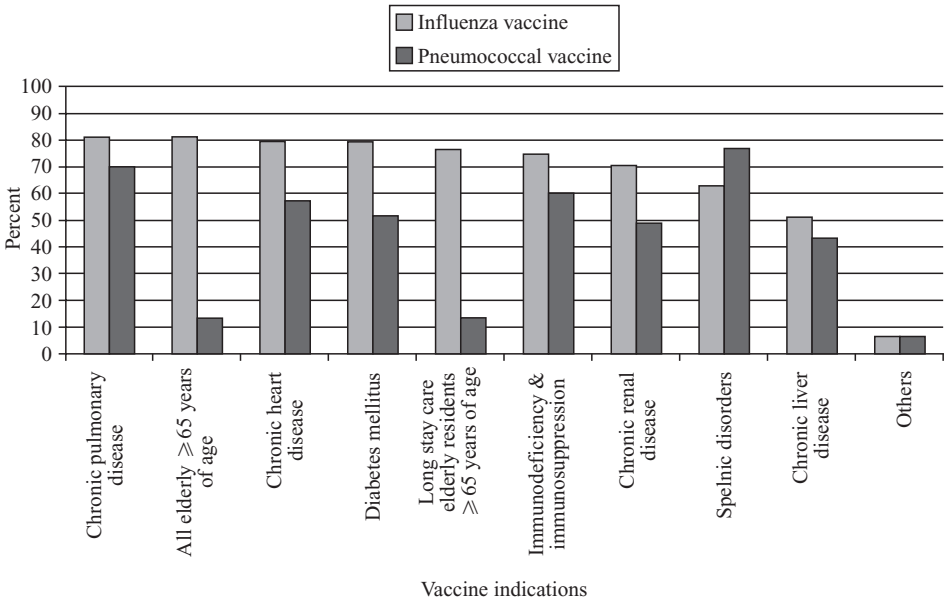

Fig. 2. Views on agreement of influenza and pneumococcal vaccine indications.

mellitus, asplenic disorders, the elderly (65 years of age and above) and the elderly (75 years of age and above) (Table 2).

Influenza vaccine

Distribution and coverage of vaccine among high-risk patients

Between 1984 and 1999, influenza vaccine distribution increased from 2 to 94 doses per 1000 population in Scotland, a 47-fold increase (Fig. 1a). The vaccine distribution substantially increased after 1991–2 and 1996–7. This improvement appears to be correlated with the official Department of Health (DoH) recommendations issued in 1992 and 1996. The distribution of influenza vaccine also increased in the CMR practices, from 72·2 to 111 per 1000 population, a 1·5 fold increase over the period 1993–9 (Table 1). Using patient-based data from the questionnaire, the overall coverage of influenza vaccine was 43% among high-risk patients recommended by the DoH. Coverage of influenza vaccine differed significantly in each category of patients, with higher coverage in the elderly and patients with chronic renal disease (67%) and lower coverage in patients with asplenic disorders (17%) and chronic pulmonary disease (35%) compared with other high-risk conditions (Table 2a).

Views on vaccine indications

Most GPs agreed that influenza vaccination should be targeted to the elderly and patients with chronic medical conditions. Nevertheless, patients with asplenic disorders and chronic liver disease were less likely to be considered as indications for influenza vaccination than other conditions (Fig. 2).

Vaccination policies

Figure 3 shows influenza vaccination policies among GPs. Forty-five percent of GPs indicated that they had written a policy with set target. Only 4% of GPs reported that they did not have any form of influenza vaccination policy.

Vaccination responsibility

GPs views on the primary responsibility for influenza vaccination are presented in Figure 4. Fifty-three percent of GPs thought that the primary responsibility for influenza vaccination should lie with GPs and 40% thought it should lie with the patient.

Pneumococcal vaccine

Distribution and coverage of vaccine among high-risk patients

There was no pneumococcal vaccine distribution until 1991. Annual distribution rates for pneumococcal vaccine increased from 0 to 63 doses per 10000 population during the period 1991–9 for the whole of Scotland (Fig. 1b). The vaccine distribution was very low, 1–7 doses per 10000 population during the period 1992–6. A substantial growth occurred after

https://doi.org/10.1017/S0950268802006891 Published online by Cambridge University Press

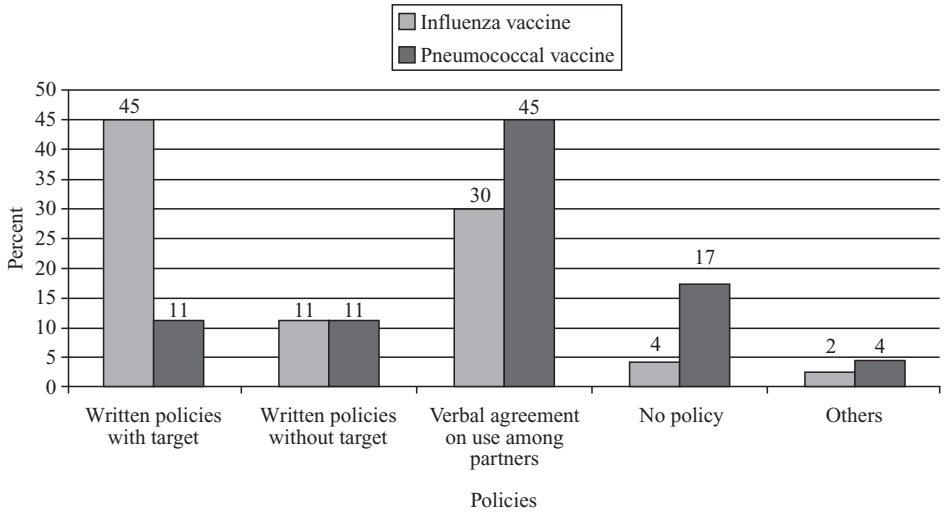

Fig. 3. Influenza and pneumococcal vaccination policies in primary care.

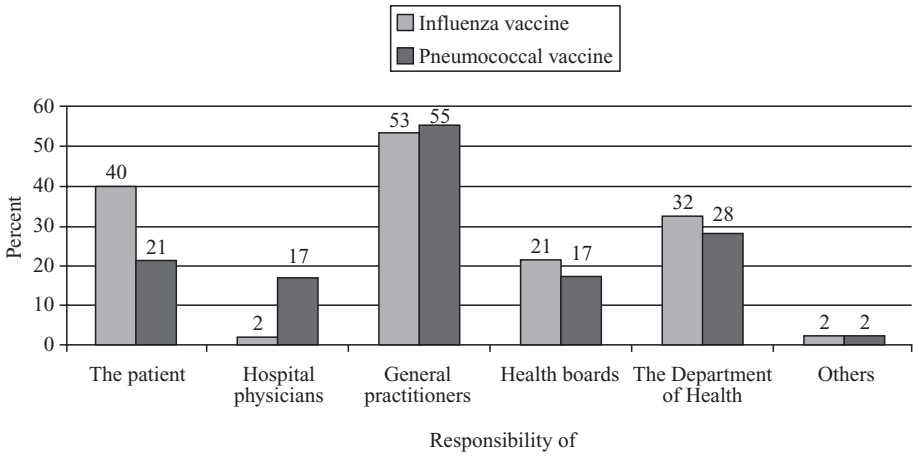

Fig. 4. Views on primary responsibility of influenza and pneumococcal vaccination.

1996, from 30 doses per 10000 population in 1997 to 63 doses per 10000 population in 1999. The improvement of vaccine distribution coincided with the DoH recommendations for pneumococcal vaccination in at-risk patients, issued in 1996. In the CMR practices, the levels of pneumococcal vaccine distribution rose from 1·9 doses to 50·1–68·1 doses per 10000 population during the period 1993–1998/9, a 26–36 fold increase (Table 1). The overall coverage of pneumococcal vaccine in the last 5 year period was 13% among patients who met DoH indications for the vaccine from the questionnaire survey. Coverage of pneumococcal vaccine was 0–22% among patients in the eight risk categories, with lower coverage in patients with chronic renal disease (0%) and chronic pulmonary disease (10%) and the higher level coverage in the elderly (22%) (Table 2b).

Views on vaccine indications

Figure 2 indicates views on pneumococcal vaccine indications among GPs. Patients with asplenic conditions (76%), and chronic pulmonary disease (70%) were more likely to be considered as indications for pneumococcal vaccination than other conditions. Only 13% of GPs felt that pneumococcal vaccination was indicated for all elderly (including those living in long-term care facilities).

Vaccination policies

Pneumococcal vaccination policies among GPs are shown in Figure 3. Eleven percent of GPs reported that they had a pneumococcal vaccination policy with or without a set target. A majority of GPs (45%)

https://doi.org/10.1017/S0950268802006891 Published online by Cambridge University Press

Table 3. *Number of patients indicated for influenza and pneumococcal vaccine and the estimated influenza and pneumococcal vaccine coverage in the CMR practices and the whole of Scotland, 1993–9*

High-risk conditions	No. of patients*
(*a*) Estimated number of high-risk patients in the CMR practices	
Chronic liver disease	265
Chronic pulmonary disease	13696
Chronic renal disease	318
Diabetes	3991
Chronic heart disease	6684
Immunosuppression/immunodeficiency	41
Asplenia	125
Elderly 65 years of age and above†	45495
Elderly 75 years of age and above	20150
(*b*) Estimated vaccine coverage based on the number of high-risk patients registered in the CMR practices and vaccine prescription data	
Pneumococcal vaccine coverage, 1993–9	
Conditions recommend by the DoH	23·4% (5889/25120)
All conditions (including all elderly)	8·3% (5889/70615)
Influenza vaccine coverage, 1999–2000	
Conditions recommend by the DoH (including the elderly aged 75 years and above but not include those 65 years of age and above)	75·8% (34106/45005)
All conditions (including all elderly)	48·5% (34106/70350)
(*c*) Estimated number of required influenza and pneumococcal vaccinations in Scotland	
Estimated number of high-risk patients (= Number of required influenza and pneumococcal vaccinations)	Influenza vaccine (rate per 1000 population)
All high-risk conditions	
418646	81
1202787 (including the elderly aged 65 years and above)	234·9
760948 (including the elderly aged 75 years and above)	148·6
Without chronic liver disease	
414229	80
1198370 (including the elderly aged 65 years and above)	234
756531 (including the elderly aged 75 years and above)	147·7

* Patients are based on person (patients with two high-risk conditions = 1374, three high-risk conditions = 78 and four high-risk conditions = 2).
DoH recommendations for pneumococcal vaccination include all listed high-risk conditions except the elderly.
DoH recommendations for influenza vaccine is recommended for all listed high-risk conditions (except chronic liver diseases), with persons with living in long-term care facilities († vaccination extend to all the elderly 65 years and above since September 2000).

reported that they had verbal agreement on its use among partners.

Vaccination responsibility

Figure 4 shows GPs' views on the primary responsibility for pneumococcal vaccination. Most GPs (55%) believed that the responsibility for pneumococcal vaccination should be taken by GPs. The responsibility of vaccination was not related to use of vaccine (105/255 (41%) *vs.* 73/158 (46%), $P = 0{\cdot}368$) for influenza vaccine) and (28/263 (11%) *vs.* 24/151 (16%), $P = 0{\cdot}126$ for pneumococcal vaccine).

https://doi.org/10.1017/S0950268802006891 Published online by Cambridge University Press

Table 4. *Level of influenza and pneumococcal vaccine coverage relation to socioeconomic statuses*

Deprivation* category	No (%)	Yes (%)	Total
Influenza vaccine			
1	10 (4·4)	9 (5·1)	19
2	26 (11·6)	24 (13·7)	50
3	56 (24·9)	55 (31·4)	111
4	86 (38·2)	59 (33·7)	145
5	14 (6·2)	12 (6·9)	26
6	26 (11·6)	14 (8)	40
7	7 (3·1)	2 (1·1)	9
$P = 0{\cdot}2293$ (χ^2 for trend = 1·445)	225 (100)	175 (100)	400
Pneumococcal vaccine			
1	15 (4·3)	4 (8)	19
2	43 (12·3)	7 (14)	50
3	90 (25·6)	22 (44)	112
4	132 (37·6)	13 (26)	145
5	24 (6·8)	2 (4)	26
6	38 (10·8)	2 (4)	40
7	9 (2·6)	– (0)	9
$P = 0{\cdot}0109$ (χ^2 for trend = 6·483)	351 (100)	50 (100)	401

* 1 being the most affluent and 7 being the most deprived.

Estimated number of high-risk patients, vaccine coverage based on vaccine prescription data in the CMR practices, the total required immunisations

A total estimated number of high-risk patients and the elderly population in the 53 CMR practices are given in Table 3*a*. The estimated influenza vaccine coverage in 2000–1 season and the estimate cumulative pneumococcal vaccine coverage in 1993–9 based on vaccine prescription data in the CMR practices show in Table 3*b*. The estimated number of people (with and without the elderly) recommended for vaccination and the projected total number of required immunizations for influenza and pneumococcal vaccines are displayed in Table 3*c*.

Place of vaccination

Most patients were vaccinated in general practice: accounting for 98·9% of influenza vaccine coverage and 94·2% of pneumococcal vaccine coverage. Very few patients had received these vaccines at home: 1·1% of influenza vaccine coverage and 3·8% of pneumococcal vaccine coverage. Only 2% of patients who received pneumococcal vaccine, were vaccinated in hospital care setting.

Socioeconomic status in relation to vaccine coverage

The level of influenza and pneumococcal vaccination varied with the level of deprivation (Table 4). However, the association between deprivation index and vaccination was noted for pneumococcal vaccine ($P = 0{\cdot}0109$, χ^2 for trend = 6·483) only, not influenza vaccine ($P = 0{\cdot}23$, χ^2 for trend = 1·45).

DISCUSSION

We found that patient-based data from the questionnaire, an estimated 43% and 13% of at-risk patients defined by the DoH guidelines received influenza vaccine in 2000–1 season and pneumococcal vaccine in the last 5 year period respectively. Since the CMR practices were selected to represent a fair cross-section of Scottish general practices and as there is no evidence to suggest GPs in the CMR practices may have different influenza and pneumococcal immunization characteristics compared to other GPs, our results should be reasonably representative of the whole of Scotland. Data on coverage of primary immunization coverage at 2 years old were the same in the CMR practices as in Scotland as a whole. Although influenza and pneumococcal vaccines coverage remains less than optimal, the annual vaccine distribution has increased substantially in the CMR practices and in Scotland as a whole in the last 3 years.

Vaccine distribution

Data on distribution of influenza [16, 18] and pneumococcal vaccine [17] in other developed countries have shown a similar pattern of increased vaccine distribution in recent years. We found that the increase in influenza and pneumococcal vaccine distribution appeared to be related to vaccination recommendations in 1992 and 1996. Reports on influenza [18] and pneumococcal [17] vaccination policies in Europe and North America also suggest that the presence of recommendations is strongly correlated with the levels of influenza and pneumococcal vaccine use and distribution. For patients recommended for vaccination by the DoH advice, there was over one and a half fold difference in coverage of pneumococcal vaccine, between the data from the survey and an estimated figure based on the total number of vaccines distributed in the CMR practices. These data suggest that not all total number of vaccines actually dispensed were used in current target groups. Our estimate shows that the number of required influenza

https://doi.org/10.1017/S0950268802006891 Published online by Cambridge University Press

vaccinations per 1000 population is 81 if persons with chronic medical conditions are considered. This rises to 234·9 if all the elderly, 65 years of age and above are also included. The latter rate is substantially higher than that reported from a previous study in Wales (148 per 1000 population) [19] and the influenza vaccine distribution rate from prescription data in Scotland.

Influenza vaccine coverage

Influenza vaccine coverage in the present survey was similar to previous United Kingdom studies, which reported vaccine coverage of 17–41% in patients with underlying medical conditions [13, 20] and 43–48% in the elderly [12, 20]. Coverage of influenza vaccine (also pneumococcal vaccine) was particularly low in patients with chronic pulmonary disease and asplenic conditions among the vaccine recommended groups and those aged < 64 years compared with $\geqslant 65$ years of age. This might have been influenced by the small number of patients included in each of the high-risk categories and the higher number of patients with chronic pulmonary disease in age group < 64 years. It is likely that the elderly ($\geqslant 65$ years) may have a higher number of GP visits than those $\leqslant 64$ years of age, leading to 4–6 fold higher influenza and pneumococcal vaccine coverage. Although the levels of influenza vaccine coverage have increased in the elderly, coverage of the vaccine remains suboptimal for other high-risk conditions. It has been recommended that to achieve herd immunity particularly in nursing homes, influenza coverage should exceed 80% [21]. Recently, the United Kingdom has adopted influenza vaccination policy for all elderly 65 years of age and above with fees payable to GPs [22]. This may encourage influenza vaccine use among GPs and could achieve high vaccination coverage in the future. Vaccination has shown to be associated with cost saving of $75 per elderly per year [23]. Thus vaccination is the most effective intervention to reduce the impact of influenza in at-risk groups.

Pneumococcal vaccine coverage

As in the surveys from England [10, 11], the overall coverage of pneumococcal vaccine in the last 5 year period appears low at 13% among recommended patients. This is very similar to influenza vaccine coverage in the late 1980s. Although target groups for influenza and pneumococcal vaccines overlap considerably, there was a remarkable difference in coverage of influenza and pneumococcal vaccine in the present survey. This indicates that many opportunities have been missed for pneumococcal vaccination during annual influenza vaccination. Many studies have reported that the incidence and case-fatality rates of pneumococcal disease are substantially higher in the elderly and high-risk groups [24, 25]. In addition, drug resistant pneumococci are increasing in the United Kingdom [26, 27]. Nevertheless, we found that over 70% of high-risk patients had not received pneumococcal vaccine. Studies have reported that low coverage of pneumococcal vaccine may be due to lack of advice from GPs [11, 28, 29]. This may be due to uncertainty regarding the benefits of pneumococcal vaccination, inadequate knowledge of risk and the impact of pneumococcal disease [30]. It appears that these factors are likely to influence the use of vaccine among GPs. Although the current United Kingdom policy does not advise GPs to vaccinate all elderly aged 65 years, vaccination coverage in this group is high relative to other high-risk conditions.

Vaccination strategies

In the present survey, GPs were more likely to target influenza vaccination than pneumococcal vaccination to at-risk patients, particularly the elderly. This may explain the lower levels of pneumococcal vaccine coverage in the elderly and other at-risk groups compared with influenza vaccine coverage. It appears that the protective benefits of pneumococcal vaccination have been largely unrecognized by GPs. Our data also suggest the need for education of adult vaccine preventable diseases in medical training. Variations of influenza and pneumococcal vaccination policies among GPs and disparities in coverage of both vaccines among various high-risk groups emphasize the need for improved guidelines and policies by the DoH. We also found that receipt of pneumococcal vaccine varied with level of deprivation in the area of residence. Therefore, improved strategies to increase vaccine-seeking behaviours are required to increase the coverage of these vaccines in all segments of population. Since lack of awareness on vaccine and the risk of disease are the principal reasons for not receiving the vaccines, particularly pneumococcal vaccine [28, 31–33], education of health care workers

(doctors, nurses and pharmacists) and patients, improved practice guidelines, and effective methods to identify high-risk patients such as letter/postcard/chart/computer reminder would help to enhance coverage of these vaccines [29]. Since coverage of both vaccines was lower in those aged < 64 years compared with $\geqslant 65$ years, attention should be paid to vaccinate the non-elderly with chronic medical conditions. A study from England has demonstrated that an organized public campaign of pneumococcal vaccination can increase coverage of vaccine, from 4·5% to 19·5% among at-risk patients and use of vaccine among GPs, from 17% to 89% [10]. The majority of patients accept influenza or pneumococcal vaccine when offered by a health care workers [29]. This emphasizes the critical role of heath care workers in increasing coverage of influenza and pneumococcal vaccines.

Although most GPs considered that the responsibility for influenza and pneumococcal vaccinations should lie with them, coverage of these vaccines remained inadequate. Vaccine cost may partially be responsible for low pneumococcal vaccine coverage among high-risk groups. At present, there are no payment mechanisms for pneumococcal vaccination in Scotland. The extent to which financial incentives and disincentives impact on adult vaccination coverage should be evaluated to assess to what extent improved vaccine coverage could be achieved with reimbursement policies. In addition, understanding of the factors involved in the reasons for receipt and non-receipt of pneumococcal vaccine among at-risk patients could be helpful in informing vaccination strategies. Given the current coverage of influenza and pneumococcal vaccine, primary care based influenza and pneumococcal vaccination alone may not be feasible to achieve optimal vaccine coverage among high-risk persons. Evidence from the United Kingdom and United States suggests that a majority of high-risk patients had a previous hospitalization in the last 5 years [34]. Therefore, hospital-based influenza and pneumococcal vaccination programmes have the potential to be an effective strategy to deliver the vaccines to those who have greatest need of them. In the present study, only 2% of patients had received pneumococcal vaccination in the hospital care setting, suggesting that very little effort has been made to improve coverage of these vaccines by health care workers in hospitals. In addition, most GPs did not have a written policy with a set target especially for pneumococcal vaccination. It appears that a clear vaccination policy and financial support for vaccination are necessary to achieve a higher coverage of influenza and pneumococcal vaccine among high-risk individuals [35].

In conclusion, although coverage of influenza and pneumococcal vaccines was suboptimal, the number of these vaccines distributed and reported coverage in general practice in the recent years has improved substantially. Since influenza and pneumococcal vaccination has been reported to be effective, improved coverage of these vaccines among at-risk patients can yield significant public health benefits. A clear vaccination policy, organized education and national campaign of influenza and pneumococcal vaccination could improve coverage of these vaccines. Clinicians in both general practice and hospital settings should ensure that their patients are aware of the risk of influenza and pneumococcal disease and benefit for both vaccines.

ACKNOWLEDGEMENTS

We would like to thank the staff, in particular to Patricia Cassels, Mark Getty, Matthew Armstrong, Bill Gold, James McNally, Ann Mochrie and Jean Goldie at the Scottish Centre for Infection and Environmental Health, the Information and Statistics Division and Scottish Executive. The Chief Scientist Office of the Scottish Executive Health Department funded this research.

REFERENCES

1. Nguyen-Van-Tam J, Neal KR. Clinical effectiveness, policies, and practices for influenza and pneumococcal vaccines. Seminar Resp Infect 1999; **14**: 184–95.
2. MMWR. Prevention of pneumococcal disease: recommendations of the Advisory Committee on Immunization Practices (ACIP). MMWR 1997; **46**: 1–24.
3. Nichol KL. The addictive benefits of influenza and pneumococcal vaccinations during influenza seasons among elderly persons with chronic lung disease. Vaccine 1999; **17**: S91–3.
4. MMWR. Prevention and control of influenza: recommendations of the Advisory Committee on Immunization Practices (ACIP). MMWR 2000; **49** (RR03): 1–38.
5. Gross PA, Hermogenes AW, Sacks HS, Lau J, Levandowski RA. The efficacy of influenza vaccine in elderly persons: a meta-analysis and review of the literature. Ann Intern Med 1995; **123**: 518–27.
6. Kyaw MH, Clarke S, Edwards G, Jones IG, Campbell H. Serotypes/groups distribution and antimicrobial

resistance of invasive pneumococcal isolates: implication for vaccine strategies. Epidemiol Infect 2000; **125**: 561–72.
7. Sleeman K, Knox K, George R, et al. Invasive pneumococcal disease in England and Wales: vaccination implications. J Infect Dis 2001; **183**: 239–46.
8. Fedson DS. The clinical effectiveness of pneumococcal vaccination: a brief review. Vaccine 1999; **17**: S85–90.
9. Department of Health. Immunisation against infectious disease London: HMSO, 1996.
10. McDonald P, Friedman E, Banks A, Anderson R, Carman V. Pneumococcal vaccine campaign based in general practices. BMJ 1997; **314**: 1094–8.
11. Kyaw MH, Nguyen-Van-Tam J, Pearson J. Family doctor advice is the main determinant of pneumococcal vaccine uptake. J Epidemiol Commun Hlth 1999; **53**: 589–90.
12. Irish C, Alli M, Gilham C, Joseph C, Watson J. Influenza vaccine uptake and distribution in England and Wales, July 1989–June 1997. Health Trends 1998; **30**: 51–5.
13. Nguyen-Van-Tam J, Nicholson K. Influenza immunization; vaccine offer, request and uptake in high-risk patients during the 1991/2 season. Epidemiol Infect 1993; **111**: 347–55.
14. Information and Statistics Division (ISD). Scottish Health Statistics 1998. UK (Edinburgh): ISD, 1999.
15. Registrar General Office (RGO). 1991 annual report: Registrar General Office (RGO), 1992.
16. Fedson DS, Hannoun C, Leese J, et al. Influenza vaccination in 18 developed countries, 1980–1992. Vaccine 1995; **13**: 623–7.
17. Fedson DS. Pneumococcal vaccination in the United States and 20 other developed countries, 1981–1996. Clin Infect Dis 1998; **26**: 1117–23.
18. Fedson DS, Hirota Y, Shin H, et al. Influenza vaccination in 22 developed countries: an update to 1995. Vaccine 1997; **15**: 1506–11.
19. Watkins J, Rogers C, Evans J. Implications of age-based policies for influenza immunisation. Lancet 1999; **353**: 208–9.
20. Gupta A, Makinde K, Morris G, Thomas P, Hasan M. Influenza immunization coverage in older hospitalised patients during winter 1998–99 in Carmarthenshire, UK. Age Ageing 2000; **29**: 211–3.
21. Patriarca P, Weber J, Parker R, et al. Risk factors for outbreaks of influenza in nursing homes: a case control study. Am J Epidemiol 1986; **124**: 114–9.
22. Chief Medical Officer (CMO). Major changes to the policy on influenza immunisation. CMO's update, 2000; **26**: 1.
23. Nichol K, Margolis K, Wuorenma J, Strenberg TV. The efficacy and cost effectiveness of vaccination against influenza among elderly persons living in the community. NEJM 1994; **331**: 778–84.
24. Butler JC, Schuchat A. Epidemiology of pneumococcal infections in the elderly. Drugs Aging 1999; **15**: 11–9.
25. Fedson D, Musher D, Eskola J. Pneumococcal vaccine. In: Plotkin SA, Orenstein WA, eds. Vaccines. Philadelphia: W. B. Saunder Company, 1999: 553–607.
26. Reacher MH, Shah A, Livermore DM, et al. Bacteraemia and antibiotic resistance of its pathogens reported in England and Wales between 1990 and 1998: trend analysis. BMJ 2000; **320**: 213–6.
27. Kyaw MH, Clarke S, Jones IG, Campbell H. Incidence of invasive pneumococcal disease in Scotland, 1988–1999. Epidemiol Infect 2002; **128**: 139–48.
28. MMWR. Reasons reported by Medicare beneficiaries for not receiving influenza and pneumococcal vaccinations – United States. MMWR 1999; **48**: 886–90.
29. MMWR. Adult immunization programs in national strategies: Quality standards and guidance for program evaluation and use of standing orders programs to increase adult vaccination rates. MMWR 2000; **49**: 1–28.
30. Fedson D. Adult immunization. Summary of the National Vaccine Advisory Committee Report. JAMA 1994; **272**: 1133–7.
31. Nicholson KG. Immunisation against influenza among people aged over 65 living at home in Leicestershire during winter 1991–2. BMJ 1993; **306**: 974–6.
32. Siriwardena A. Targeting pneumococcal vaccination to high-risk groups: a feasibility study in one general practice. Postgrad Med J 1999; **75**: 208–12.
33. Findlay PF, Gibbons Y, Primrose W, Ellis G, Downie G. Influenza and pneumococcal vaccination: patient perceptions. Postgrad Med J 2000; **76**: 215–7.
34. Fedson DS, Houck P, Bratzler D. Hospital-based influenza and pneumococcal vaccination: Sutton's Law applied to prevention. Infect Control Hosp Epidemiol 2000; **21**: 692–9.
35. Kyaw MH, Bramley JC, Chalmers J, Jones IG, Campbell H. Pneumococcal vaccination: opinion of general practitioners and hospital doctors in Scotland, 1999–2000. Commun Dis Publ Hlth 2001; **4**: 42–8.