

# Promoting influenza vaccination of elderly patients in primary care

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**Background.** Though influenza is a serious health problem for elderly people, their influenza vaccination rate remains low in Switzerland.

**Objective.** Our aim was to assess the impact of an intervention combining multiple strategies to promote influenza vaccination of elderly patients in primary care.

**Methods.** We conducted a pre-/post-intervention study in a university-based primary care clinic in Geneva, Switzerland, where an annual community-wide campaign promotes influenza vaccination of people at high risk. We included 318 and 346 patients aged over 64 years attending the clinic during the last trimesters of 1995 and 1996, respectively. The intervention included: patient information by leaflets and posters, a walk-in vaccination clinic, a training workshop for physicians, record reminders and peer comparison feedback on vaccination performance. Using the computerized database, medical records and the vaccination register, we measured influenza immunization rates and relative benefits (RBs) of the intervention.

**Results.** Influenza vaccine uptake globally increased from 21.7% before the intervention to 51.7% thereafter. Among 144 patients attending in both phases, the immunization rate rose from 29.2 to 69.4% [matched RB estimate ( $\langle RB \rangle$ ) = 2.4; 95% confidence interval (CI) 1.9–3.0]; vaccine uptake increased particularly among all chronic patients ( $\langle RB \rangle$  = 3.2; 95% CI 2.2–4.6), cardiac patients ( $\langle RB \rangle$  = 3.4; 95% CI 2.1–5.4) and diabetics ( $\langle RB \rangle$  = 3.3; 95% CI 1.9–5.9). For 376 patients attending in a single phase, the vaccination rate rose from 15.5 to 39.1% (adjusted RB = 2.8; 95% CI 1.8–4.4), particularly among the elderly aged 65–75 years (adjusted RB = 5.7; 95% CI 2.7–12.4).

**Conclusion.** An intervention combining strategies targeting patients, physicians and care delivery significantly increased influenza vaccine uptake of elderly patients in primary care, particularly those at high risk.

**Keywords.** Aged, ambulatory care, influenza vaccine, quality of health care.

## Introduction

Influenza is a major health problem causing 100 000–230 000 illness cases, 1800 hospital admissions and 700–2600 deaths annually in Switzerland.<sup>1,2</sup> Most hospitalizations and deaths affect people aged over 60 years, who are the most susceptible to complications of influenza, such as pneumonia, or exacerbation of chronic diseases.<sup>2–4</sup> Influenza morbidity results in high health care costs, reaching 1 billion dollars in the USA for hospitalizations due to influenza.<sup>5</sup>

Several studies and a meta-analysis provide evidence that influenza vaccination of elderly people effectively reduces risks of influenza-like illness, pneumonia, hospitalizations, mortality and costs.<sup>6–9</sup> All elderly, regardless of their underlying chronic conditions, benefit from annual influenza vaccination, with the largest benefit for those at higher risk.<sup>9</sup> Like many public health services worldwide, Swiss health authorities recommend annual influenza immunization for all people aged over 65 years and have accepted its reimbursement by health insurance since 1996.<sup>10</sup>

Despite the evidence and recommendations supporting influenza vaccination, immunization rates were low in Switzerland during the 1990s. Vaccine sales remained among the lowest in Europe, suggesting low vaccine uptake by the general population.<sup>11</sup> In 1994, only 35% of the senior citizens of Geneva were immunized against influenza.<sup>12</sup> Since 1993, health authorities launch a community-wide campaign each autumn in the canton of

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Geneva to promote influenza vaccination, targeting mainly high-risk groups such as the elderly and people with chronic diseases.<sup>13</sup> This campaign uses print and electronic media to inform the public and involves various health professionals and organizations, including our Department of Community Medicine. In 1996, 45% of the elderly living in Geneva had received influenza vaccination.<sup>14</sup>

Primary care physicians play a major role in informing and motivating elderly patients about influenza vaccination.<sup>12,15</sup> Research showed that several interventions are effective to increase immunization rates of high-risk patients in primary care.<sup>16,17</sup> Postal or telephone patient reminders,<sup>16–19</sup> free vaccine<sup>19,20</sup> or a prevention card<sup>21</sup> are effective strategies focusing on patients. Computerized chart reminders,<sup>18,22</sup> audit and feedback on performance,<sup>23,24</sup> prevention protocols<sup>25,26</sup> and financial incentives<sup>27</sup> are effective strategies targeting physicians. Changes in care delivery such as a policy allowing vaccine prescription by nurses<sup>26,28</sup> or a health promotion clinic run by nurses<sup>29</sup> can also boost influenza immunization. One randomized trial and five non-randomized studies showed that interventions combining these three types of strategies were the most effective in improving influenza vaccination rates, but with large variations (+7–37%).<sup>30–35</sup> However, most studies were conducted in North America and in managed care or capitation payment systems.

We designed an intervention combining strategies directed at patients, physicians and care delivery to promote influenza vaccination among high-risk patients. We implemented it in a public university-based out-patient clinic caring for many patients of lower socio-economic status, in a health system with free access to physicians and fee-for-service payment. The present study assesses the impact of this intervention on the influenza immunization rate of elderly out-patients.

## Methods

### *Setting*

This study was conducted in the primary care clinic of the Department of Community Medicine in Geneva University Hospital, Switzerland. This university-based clinic offers postgraduate training in internal and family medicine to residents in their 3rd to 5th year. This public clinic provides emergency and continuity care to the population of Geneva, with a high proportion of patients of lower socio-economic and non-French-speaking backgrounds. In the Swiss health care system, citizens have free access at any time to primary care and specialist physicians, who receive a fee-for-service payment.

### *Design and subjects*

This pre-/post-intervention study included all patients aged  $\geq 65$  years who consulted our primary care clinic

during the fourth trimester of 1995 and/or 1996 (1 October to 31 December). A total of 346 subjects included in 1996 formed the intervention group, while 318 included before the intervention in 1995 represented a historical control group. One hundred and forty-four patients attended during both study phases, while 376 consulted during a single phase: 175 before the intervention and 202 during the intervention.

### *Intervention*

Until 1995, our clinic had neither a policy nor any activity to promote influenza vaccination. Physicians offered influenza immunization to patients according to their clinical judgement while very few patients attended to receive this vaccine. In 1996, on request of the Geneva health authorities, the Department of Community Medicine agreed to participate in the campaign promoting influenza vaccination and set up the intervention described below.

The intervention was implemented for the first time during the influenza vaccination period from 1 October to 31 December 1996 and combined several strategies directed at patients, physicians and practice organizations. (i) Leaflets and posters, designed and provided by the local health department, were placed at the reception desk and in waiting areas to inform patients about influenza vaccination. (ii) We set up a walk-in immunization clinic to provide an easy, quick and cheap service facilitating influenza vaccination after a brief medical interview to detect contra-indications and eventually provide further information. This procedure was charged at a low cost covering the vaccine and the injection without billing for a medical consultation. (iii) In early October, we organized a 1.5 hour training workshop based on clinical situations to teach all physicians about key aspects of influenza vaccination, particularly national recommendations and practical counselling strategies. All physicians received the Swiss guidelines on influenza immunization after the workshop.<sup>10</sup> (iv) Using data from appointment books and the vaccination register, researchers provided twice-monthly peer comparison feedback to residents on their individual and collective performance in the vaccination of elderly patients. (v) In all consultation rooms, reminder stickers were available for application on medical records of high-risk patients for whom influenza vaccination was recommended. (vi) Physicians, nurses and reception clerks agreed to implement standardized procedures facilitating vaccination and flow of patients. We implemented no other organizational change between both periods.

### *Data collection*

After the second phase, all data were abstracted retrospectively and independently by two of the authors (JPH and CRB) from the computerized patient database and a review of medical records, appointment books and the vaccination register. Divergences were resolved by

consensus. We recorded the following variables: influenza vaccination, age, gender, chronic diseases with higher risk of influenza complications (diabetes mellitus, cardiac disease, pulmonary disease, severe renal failure and acquired or iatrogenic immunosuppression), number of clinic visits during the vaccination period, previous clinic attendance (known or new patient) and visits for influenza immunization. One patient with only one visit was excluded because of missing data.

### Statistical analysis

To compare patient characteristics, we used paired or unpaired *t*-tests, McNemar or chi-square tests, respectively, for matched and independent data. Participants in each phase were viewed as cohorts of non-vaccinated subjects susceptible to being vaccinated during their clinic visits in the last trimester. Therefore, the cumulative probability of being immunized was the number of vaccinated patients divided by the number of elderly patients who consulted the clinic during the last trimester. The effects of intervention were expressed as relative benefits (RBs) with their 95% confidence intervals (95% CI) comparing vaccination rates before and after the intervention. RBs are equivalent to relative risks for beneficial events. For patients who attended in both phases, we computed estimates of RBs for matched data ( $\langle \text{RB} \rangle$ ) and their variance ( $\text{Var}[\ln \langle \text{RB} \rangle]$ ) using the following formulae:<sup>36</sup>

$$\langle \text{RB} \rangle = f_{11} + f_{10}/f_{11} + f_{01}$$

$$\text{Var}[\ln \langle \text{RB} \rangle] = f_{10} + f_{01}/(f_{11} + f_{10}) \times (f_{11} + f_{01})$$

where  $f_{10}$ ,  $f_{01}$  and  $f_{11}$  represent combinations of matched pairs and the subscripts indicate the vaccination status at each phase; e.g.  $f_{10}$  is the number of subjects who were vaccinated in phase 2 but not in phase 1. As patients were the same in both periods, the matched analysis accounted for confounding factors and, therefore, no multivariate analysis is needed. For patients who attended in a single period, we computed univariate RB for independent samples and adjusted RB obtained by Cox proportional hazard models controlling for other variables, which are potential confounders. SPSS software was used for all statistical analyses.<sup>37</sup>

## Results

### Patient characteristics

Characteristics of the 144 patients consulting in both phases were very similar before and during the intervention, except a significant and expected 1-year age increase (Table 1). Two-thirds of patients suffered from a chronic condition, with almost half having a cardiac disease and a third being diabetic; these proportions remained similar though a few new cases of chronic

diseases had been diagnosed between both phases. Nearly all patients had attended regularly over the previous years and a majority made several visits during the vaccination period. Characteristics of patients attending in a single phase were fairly similar before and during the intervention (Table 1). About half of the subjects had a chronic condition, mainly a cardiac disease, and had previously attended the clinic. Patients typically attended once during the fourth trimester. The proportion of new patients and of those attending only for influenza vaccination increased significantly during the intervention. Both groups had different profiles as patients of the former group were older, had more chronic diseases and consulted more often and over the long term. In the intervention period, significantly more patients of both groups attended the walk-in clinic for influenza immunization ( $P < 0.001$ ).

### Intervention effects

Influenza vaccination coverage of elderly patients globally increased from 21.7% before the intervention to 51.7% afterwards. Among the 144 patients attending in both phases (Table 2), influenza vaccine uptake rose from 29.2 to 69.4%, representing a clinically and statistically significant increase (+40.2%;  $\langle \text{RB} \rangle = 2.4$ ; 95% CI 1.9–3.0). After the intervention, immunization rates significantly improved to reach 65–75% in most subgroups and peak at 86% for patients with pulmonary diseases. Vaccination coverage improved particularly among the elderly with lower baseline rates despite their higher risk: patients with any chronic condition ( $\langle \text{RB} \rangle = 3.2$ ; 95% CI 2.2–4.6), cardiac diseases ( $\langle \text{RB} \rangle = 3.4$ ; 95% CI 2.1–5.4) or diabetes ( $\langle \text{RB} \rangle = 3.3$ ; 95% CI 1.9–5.9) and those aged 76–85 years ( $\langle \text{RB} \rangle = 3$ ; 95% CI 1.8–4.9). The improvement was not statistically significant for small subgroups such as patients older than 85 years and newcomers.

Among patients attending in a single phase (Table 2), influenza vaccine uptake was only 15.5% at baseline but reached 39.1% after the intervention, a clinically and statistically significant increase (+23.6%; adjusted RB = 2.8; 95% CI 1.8–4.4). Immunization rates rose in most subgroups but did not reach 50%. The largest and most significant increases in vaccination rates occurred among patients with lower initial coverage: 'younger' elderly aged 65–75 years (adjusted RB = 5.7; 95% CI 2.7–12.4), new patients (adjusted RB = 8.6; 95% CI 2.6–28.3) and men (adjusted RB = 3.9; 95% CI 1.9–7.9). For older age groups and patients with diabetes or a pulmonary disease, the increase was not statistically significant, probably because of small subgroups and higher baseline immunization rates. In multivariate analyses controlling for other characteristics, adjusted RBs measuring the effect of intervention were similar and even slightly superior to univariate RBs. These results confirm the independent effect of the intervention on influenza vaccine uptake in this group and its

TABLE 1 Characteristics of elderly primary care patients attending before and after a multifaceted intervention promoting influenza vaccination (Geneva, Switzerland, 1995–1996)

Patient characteristic	% of patients attending in two phases		% of patients attending in one phase	
	Pre-intervention ( <i>n</i> = 144)	Post-intervention ( <i>n</i> = 144)	Pre-intervention ( <i>n</i> = 174)	Post-intervention ( <i>n</i> = 202)
Male	55.6	55.6	50	53.5
65–75 years	45.8	40.3	54	61.9
76–85 years	38.2	39.6	36.8	32.2
>85 years	16.0	20.1	9.2	5.9
Mean age (SD), years	76.6 (7.3)*	77.7 (7.3)*	75.0 (6.9)	73.7 (6.9)
No chronic disease	36.1	33.3	50.6	53.3 <sup>a</sup>
One chronic disease	41.0	41.0	37.4	38.2 <sup>a</sup>
≥2 chronic diseases	22.9	25.7	12.1	8.5 <sup>a</sup>
Cardiac disease	44.4	46.5	32.2	30.2 <sup>a</sup>
Diabetes mellitus	31.3	31.9	16.1	11.6 <sup>a</sup>
Pulmonary disease	14.6	16.7	10.3	10.6 <sup>a</sup>
Other chronic disease <sup>b</sup>	2.1	4.2	5.7	4.5 <sup>a</sup>
Known patient	97.9	100 <sup>c</sup>	59.8**	48.5**
One visit in 4th trimester	36.1	38.9	47.1	55.4
Two visits in 4th trimester	25.0	29.9	21.8	19.8
≥3 visits in 4th trimester	38.9	31.3	31.0	24.8
Visit for influenza vaccine	2.1*	11.1*	2.9*	20.3*
Visit only for influenza vaccine	0	0	0.6*	11.4*

\**P* < 0.001; \*\**P* = 0.03.

<sup>a</sup> *n* = 199.

<sup>b</sup> Severe renal failure, acquired or iatrogenic immunosuppression.

<sup>c</sup> By design, all patients of this group were known patients in the post-intervention period.

various subgroups. The multivariate model for the whole group showed that previous attendance was also an independent predictor of influenza vaccination (adjusted RB = 1.6; 95% CI 1.1–2.5).

## Discussion

This study showed an ~2.5-fold increase in influenza vaccination coverage of elderly patients in primary care after implementation of various strategies directed at patients, physicians and care delivery. Vaccine uptake rose from 29 to 69% among patients attending before and during the intervention, but only from 15 to 39% for patients attending in a single phase. The absolute increase in vaccine uptake was larger in the first than in the second group because of different baseline vaccination rates, but the relative effect of the intervention was similar in both groups, as shown by the RBs of the same magnitude. The intervention improved the immunization rates in all age groups and, most importantly, had a stronger impact on patients at higher risk because of

chronic diseases, for whom influenza vaccination previously was overlooked. We also emphasize the importance of continuity of care as patients attending regularly were more likely to receive the influenza vaccine.

The effect found in our study is similar to the impact of multifaceted interventions (+20–37%) among patients with similar baseline vaccination rates (8–35%).<sup>30–32</sup> Other studies reached higher post-intervention uptake (63–83%) with smaller increases (+7–16%) because of higher immunization rates in control groups (50–75%), suggesting a ceiling effect.<sup>33–35</sup> We also reached higher vaccine uptake than most randomized trials of interventions based on a single strategy,<sup>17–29</sup> which are less effective than interventions with multiple components.<sup>16,38</sup>

Methodological differences limit comparisons as most studies tested different combinations of strategies, particularly postal reminders and vaccine prescription by nurses, which were not included in our intervention. Control groups also differed as some were pre-intervention groups and others parallel control groups without intervention. Some authors measured vaccination coverage of all patients registered in the practice

TABLE 2 *Influenza vaccination of elderly patients before and after a multifaceted intervention in primary care (Geneva, Switzerland, 1995–1996)*

Patient characteristics	Patients attending in two phases			Patients attending in one phase			
	% vaccinated pre-intervention (n = 144)	% vaccinated post-intervention (n = 144)	Matched relative benefit (95% CI)	% vaccinated pre-intervention (n = 174)	% vaccinated post-intervention (n = 202)	Univariate relative benefit (95% CI)	Adjusted relative benefit (95% CI)
All patients	29.2	69.4	2.4 (1.9–3.0)	15.5	39.1	2.5 (1.7–3.7)	2.8 (1.8–4.4)
Male	23.8	68.8	2.9 (2.0–4.2)	11.5	42.6	3.7 (2.0–6.9)	3.9 (1.9–7.9)
Female	35.9	70.3	2.0 (1.4–2.7)	19.5	35.1	1.8 (1.1–3.0)	2.2 (1.2–4.1)
65–75 years	33.3	75.8	2.3 (1.7–3.1)	8.5	42.4	5.0 (2.5–10.0)	5.7 (2.7–12.4)
76–85 years	21.8	65.5	3 (1.8–4.9)	21.9	35.4	1.6 (0.92–2.8)	1.8 (0.89–3.8)
>85 years	34.8	60.9	1.7 (0.97–3.1)	31.3	25.0	0.8 (0.24–2.7)	1.3 (0.24–7.4)
No chronic disease	42.3	69.2	1.6 (1.2–2.2)	12.5	42.5 <sup>a</sup>	3.4 (1.9–6.2)	3.5 (1.8–6.9)
≥1 chronic disease	21.7	69.6	3.2 (2.2–4.6)	18.6	34.4 <sup>a</sup>	1.8 (1.1–3.1)	2.4 (1.3–4.6)
Cardiac disease	20.3	68.8	3.4 (2.1–5.4)	17.9	33.3 <sup>a</sup>	1.9 (0.96–3.6)	2.5 (1.1–5.5)
Diabetes mellitus	20.0	66.7	3.3 (1.9–5.9)	25.0	43.5 <sup>a</sup>	1.7 (0.79–3.8)	3.0 (0.92–9.7)
Pulmonary disease	38.1	85.7	2.2 (1.3–3.8)	33.3	33.3 <sup>a</sup>	1 (0.41–2.4)	1.7 (0.45–6.1)
New patient	33.3	66.7	2 (0.50–8.0)	4.3	33.7	7.8 (2.5–24.5)	8.6 (2.6–28.3)
Known patient	29.1	69.5	2.4 (1.9–3.1)	23.1	44.9	1.9 (1.3–2.9)	2.0 (1.2–3.5)

<sup>a</sup> n = 199.

regardless of visits during the vaccination period, while others measured it only among patients attending during that period.

Although our study was not a randomized trial, several reasons suggest that this intervention effectively increased influenza vaccination among elderly patients. Vaccination rates and relative benefits showed a clinically and statistically significant effect which was consistent across groups and subgroups. Confounding was unlikely as matched and multivariate analysis controlled for patient characteristics and confirmed an independent effect of the intervention on influenza vaccination. The increased vaccine uptake cannot be attributed to another intervention in the clinic nor to the progression in training and clinical experience of residents, who had all changed between both periods.

The main limitation of this study is its non-randomized design, in which the observed effect might be due to factors other than the clinic intervention: secular trend, community campaign or reimbursement of vaccination for the elderly since 1996. Stable vaccine sales show no secular trend in influenza immunization between 1990 and 1996 in Switzerland.<sup>11</sup> It is unlikely that the media campaign, which started before and continued during our clinic intervention, had a major influence on our results. Until 1995, the campaign had a limited impact on our elderly patients, as their pre-intervention vaccination rate was lower than among the elderly living in the community (22% versus 35%).<sup>12</sup> This is probably due to the many patients of lower socio-economic and non-French-speaking backgrounds who attend our clinic.

The 2-year media campaign led to a 10% increase in the immunization rate of community-living elderly,<sup>12,14</sup> its impact is probably insufficient to explain the 30% increase in vaccine uptake observed in our clinic within a year. Therefore, the larger increase in vaccine uptake of patients less receptive to public health messages suggests a substantial and additional effect to the media campaign.

Our data cannot assess the effect of vaccine reimbursement which started in 1996 during our intervention period, but a major influence on our results is unlikely. In studies testing the impact of free vaccination, uptake was lower than after our intervention.<sup>19,20</sup> In Switzerland, reimbursement is not very attractive for the healthy elderly as it pays only when yearly medical expenses reach an excess of SFr 150 (~US\$ 100). The few patients attending only for influenza immunization confirm the absence of a significant financial incentive.

More new patients consulted during the intervention phase, but this would rather have underestimated its effect as they are less likely to be immunized. Prior influenza vaccination could have influenced our results, but this could be measured reliably only during the intervention for patients who had attended in both phases. Although 90.5% of previously immunized patients were re-vaccinated 1 year later, 60.8% of patients who were not vaccinated in 1995 also received the vaccine, suggesting that prior immunization is insufficient to explain the increased vaccine uptake. As we considered only vaccination performed in our clinic, the effect of intervention may have been underestimated because patients

could have been immunized by another care provider. However, this probably had a minimal influence on the intervention effect because data collection was identical in both study phases and similar proportions of patients would have been immunized elsewhere before and after the intervention in our clinic.

In a health care system with free access to any physician, it is impossible to define precisely for which patients our clinic is the usual source of care. Therefore, we chose a conservative option and included all patients who attended the clinic during the vaccination period. Our clinic is probably the usual source of care for most patients who consulted at least twice.

Finally, it would have been difficult to conduct a randomized controlled trial in our setting. Randomization of patients or physicians would not be relevant for an intervention implemented in an institution because of a major contamination bias. Comparison with other Swiss academic primary care clinics would be limited by the lower community awareness due to the absence of public campaigns in these areas.

Our study assesses the impact of this multifaceted intervention as a whole but cannot assess the specific impact of each strategy. We observed that the walk-in vaccination clinic had a limited impact on the immunization coverage in the community, as only 6.6% of patients in the intervention phase consulted solely for influenza vaccination. However, 10% of patients took this opportunity to have this immunization which they did not receive in visits to physicians.

The positive effect of this multifaceted intervention in promoting influenza vaccination of elderly patients is encouraging, particularly in a vulnerable population, which is not easily reached by public health actions. However, its impact is not optimal as vaccination coverage is still below 60%, which is the target set by some countries.<sup>39</sup> This intervention should be implemented yearly as repetition progressively improves immunization rates.<sup>40</sup> Addition of other effective strategies such as reminder letters<sup>16–19</sup> or a policy allowing vaccine prescription by nurses<sup>26,28</sup> could increase vaccine uptake further. Similar interventions should also be tested and implemented in private physician practices to reach more people in the community at high risk and have a stronger public health impact.

In conclusion, this study shows that an intervention combining multiple strategies directed at patients, physicians and care delivery was followed by an increase in influenza vaccine uptake by elderly primary care patients. Though this study was not randomized, our findings strongly suggest that this multifaceted intervention is effective in a university-based clinic serving patients of lower socio-economic status. Further research should develop and test similar interventions in various primary care settings and health care systems. Physicians should now consider using multiple strategies to promote influenza vaccination of their high-risk patients.

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## References

- Cloetta J, Zimmermann H and Sentinella Working Group. Influenza surveillance in Switzerland. *Soz Präz Med* 1997; **42** (Suppl 2): S88–S91.
- Egger M, Jennings S, Spuhler T, Zimmermann HP, Paccaud F, Somaini B. Sterblichkeit während Grippeepidemien in der Schweiz 1969–1985. *Schweiz Med Wschr* 1989; **119**: 434–439.
- Lui KJ, Kendal AP. Impact of influenza epidemics on mortality in the United States from October 1972 to May 1985. *Am J Public Health* 1987; **77**: 712–716.
- Barker WH. Excess pneumonia and influenza associated hospitalization during influenza epidemics in the United States, 1970–78. *Am J Public Health* 1986; **76**: 761–765.
- McBean AM, Babish JD, Warren JL. The impact and cost of influenza in the elderly. *Arch Intern Med* 1993; **153**: 2105–2111.
- Gross PA, Hermogenes AW, Sacks HS, Lau J, Levandowski RA. The efficacy of influenza vaccine in elderly persons. *Ann Intern Med* 1995; **123**: 518–527.
- Govaert ThE, Thijs CTMCN, Masurel N, Sprenger MJW, Dinant GJ, Knottnerus JA. The efficacy of influenza vaccination in elderly individuals. *J Am Med Assoc* 1994; **272**: 1661–1701.
- Nichol KL, Margolis KL, Wuorenma J, Von Sternberg T. The efficacy and cost effectiveness of vaccination against influenza among elderly persons living in the community. *N Engl J Med* 1994; **331**: 778–784.
- Nichol KL, Wuorenma J, Von Sternberg T. Benefits of influenza vaccination for low-, intermediate- and high-risk senior citizens. *Arch Intern Med* 1998; **138**: 1760–1776.
- Office Fédéral de la Santé Publique, Groupe de travail Influenza. Recommandations pour la prévention de la grippe 1996. *Bull OFSP* 1996; **38** (Suppl XIII): S1–S8.
- Fedson DS, Hannoun C, Leese J *et al*. Influenza vaccination in 18 developed countries, 1980–1992. *Vaccine* 1995; **13**: 623–627.
- Gauthey L, Toscani L, Chamot E, Larequi T, Robert CF. Influenza vaccination coverage in the geriatric population of the State of Geneva, Switzerland. *Eur J Public Health* 1999; **9**: 36–40.
- Direction Générale de la Santé Publique, Genève. *Vaccination Contre la Grippe: Campagne 1996*. Genève: Direction Générale de la Santé Publique, 1996.
- Gauthey L, Toscani L, Robert CF *et al*. Rapport de la campagne 'Unis pour la vaccination contre la grippe 96–97'. Genève: Direction Générale de la Santé Publique, 1997.
- Nichol KL, Mac Donald R, Hauge M. Factors associated with influenza and pneumococcal vaccination behavior among high-risk adults. *J Gen Intern Med* 1996; **11**: 673–677.
- Gyorkos TW, Tannenbaum TN, Abrahamowicz M *et al*. Evaluation of the effectiveness of immunization delivery methods. *Can J Public Health* 1994; **85** (Suppl 1): S14–S30.
- Szilagyi P, Bordley C, Vann JC *et al*. Effect of patient reminder/recall interventions on immunization rates. A review. *J Am Med Assoc* 2000; **284**: 1820–1827.

- <sup>18</sup> McDowell I, Newell C, Rosser W. Comparison of three methods of recalling patients for influenza vaccination. *Can Med Assoc J* 1986; **135**: 991–997.
- <sup>19</sup> Nexoe J, Kragstrup J, Ronne T. Impact of postal invitations and user fee on influenza vaccination rates among the elderly. *Scand J Prim Health Care* 1997; **15**: 109–112.
- <sup>20</sup> Ives DG, Lave JR, Traven ND, Kuller LH. Impact of Medicare reimbursement on influenza vaccination rates in the elderly. *Prev Med* 1994; **23**: 134–141.
- <sup>21</sup> Turner RC, Waivers LE, O'Brien K. The effect of patient-carried reminder cards on the performance of health maintenance measures. *Arch Intern Med* 1990; **150**: 645–647.
- <sup>22</sup> Chambers CV, Balaban DJ, Carlson BL, Grasberger DM. The effect of microcomputer-generated reminders on influenza vaccination rates in a university-based family practice center. *J Am Board Fam Pract* 1991; **4**: 19–26.
- <sup>23</sup> Kern DE, Harris WL, Boekeloo BO, Barker LR, Hogeland P. Changes in residents' performances over six years: use of an outpatient medical record audit to achieve educational objectives. *J Gen Intern Med* 1990; **5**: 218–224.
- <sup>24</sup> Buffington J, Bell KM, LaForce M. A target-based model for increasing influenza immunizations in private practice. *J Gen Intern Med* 1991; **6**: 204–209.
- <sup>25</sup> Cheney C, Ramsdell JW. Effect of medical records' checklists on implementation of periodic health measures. *Am J Med* 1987; **83**: 129–136.
- <sup>26</sup> Herman CJ, Speroff T, Cebul RD. Improving compliance with immunization in the older adult. Results of a randomized cohort study. *J Am Geriatr Soc* 1994; **42**: 1154–1159.
- <sup>27</sup> Kouides RW, Bennett N, Lewis BM, Capuccio JD, Barker WH, Laforce FM. Performance-based physician reimbursement and influenza immunization rates in the elderly. *Am J Prev Med* 1998; **14**: 89–95.
- <sup>28</sup> Margolis KL, Lofgren RP, Korn JE. Organizational strategies to improve influenza vaccine delivery. *Arch Intern Med* 1988; **148**: 2205–2207.
- <sup>29</sup> Belcher DW. Implementing preventive services. Success and failure in an outpatient trial. *Arch Intern Med* 1990; **150**: 2533–2541.
- <sup>30</sup> Korn JE, Schlossberg LA, Rich EC. Improved preventive care following an intervention during an ambulatory care rotation. *J Gen Intern Med* 1988; **3**: 156–160.
- <sup>31</sup> Barton MB, Schoenbaum SC. Improving influenza vaccination performance in a HMO setting. The use of computer-generated reminders and peer comparison feedback. *Am J Public Health* 1990; **80**: 534–536.
- <sup>32</sup> Nichol KL, Korn JE, Margolis KL, Poland GA, Petzel RA, Lofgren RP. Achieving the national health objective for influenza immunization. Success of an institution-wide vaccination program. *Am J Med* 1990; **89**: 156–160.
- <sup>33</sup> Margolis KL, Nichol KL, Wuorenma J, Von Sternberg TL. Exporting a successful influenza vaccination program from a teaching hospital to a community outpatient setting. *J Am Geriatr Soc* 1992; **40**: 1021–1023.
- <sup>34</sup> Hak E, Van Essen GA, Stalman WAB, De Melker RA. Improving influenza vaccination coverage among high-risk patients: a role for computer-supported prevention strategy. *Fam Pract* 1998; **15**: 138–143.
- <sup>35</sup> Karuza J, Calkins E, Feather J, Hershey CO, Katz L, Majeroni B. Enhancing physician adoption of practice guidelines: dissemination of influenza vaccination guideline using a small-group consensus process. *Arch Intern Med* 1995; **155**: 625–632.
- <sup>36</sup> Rothman KJ. *Modern Epidemiology*. Boston: Little, Brown & Co, 1986: 275–279.
- <sup>37</sup> SPSS Inc. [software]. SPSS for Windows 9.0. Chicago (IL): SPSS Inc., 1998.
- <sup>38</sup> Davis DA, Thomson MA, Oxman AD, Haynes RB. Changing physician performance. *J Am Med Assoc* 1995; **274**: 700–705.
- <sup>39</sup> US Public Health Service. *Healthy People 2000: National Health Promotion and Disease Prevention Objectives*. DHHS publication no. (PHS)91-50212. Washington (DC): US Department of Health and Human Services, Public Health Service, 1991.
- <sup>40</sup> Nichol KL. Long-term successes with the national health objective for influenza vaccination. *J Gen Intern Med* 1992; **7**: 595–600.