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Vaccination coverage rates in eleven European countries during two consecutive influenza seasons

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Summary Objectives: This study assessed influenza vaccination coverage rates in eleven European countries during seasons 2006/07 and 2007/08. The aims were to analyse vaccine uptake rates in the general population and in high-risk groups, including children, as well as to understand the principal drivers and barriers towards vaccination.

Methods: Community-based face-to-face interviews, telephone surveys or mailed surveys were conducted in UK, Germany, Italy, France, Spain, Austria, Czech Republic, Finland, Ireland, Poland and Portugal. Approximately 2000 representative adult individuals per country and season were interviewed. Data on the vaccination status of children were obtained by proxy interviews. For the analysis, five target groups were defined.

Results: Vaccination coverage levels in the general population ranged from 9.5% (Poland) to 28.7% (UK) during season 2007/08. In comparison with the previous season, only minor increases were visible. The coverage in the elderly target group was highest at 70.2% in the UK and lowest at 13.9% in Poland. The vaccination rate of chronically ill persons ranged from 11.1% (Poland) to 56.0% (UK). Vaccination levels among health care workers were generally low. Vaccine uptake in children was lowest in Ireland (4.2%) and highest in Germany (19.3%). Respondents from all countries were aware of the seriousness of influenza as a disease. People who had never been vaccinated regarded being infected as unlikely. The advice from a family doctor or a nurse was deemed as the main encouraging factor for vaccination.

Conclusions: During 2007/08, influenza vaccination coverage rates differed widely between countries, not only in the general population but also in the predefined at-risk groups. Generally, the increases in coverage compared to the previous season were marginal. Overcoming

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the barriers and implementing the driving forces identified by our surveys may help to increase vaccine uptake and to reach the corresponding WHO goals.

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Introduction

Influenza is caused by a contagious respiratory virus that appears annually in the autumn through early spring, causing substantial morbidity and mortality.¹ The World Health Organisation (WHO) estimates three to five million cases annually, resulting in a mortality rate of 250,000–500,000 in the industrialized world.¹ In Europe, the rate of excess deaths due to influenza is estimated at 40,000–220,000 cases per season.²

The clinical and economic burden of the influenza epidemics is often undervalued. Incapacitating symptoms lead an increased demand in all health care systems, long-term illness and disability as well as mortality. Some individuals are more susceptible to develop severe disease due to an infection.^{3,4} Influenza-related complications occur more often and more severely in groups at higher risk of pneumonia or respiratory disease, cardiovascular diseases and metabolic disorders.^{5–8} These complications are responsible for a 50–100-times higher death rate among people with underlying illnesses.⁹ A further group exposed to higher risk of fatal complications are the elderly. The declining functioning of the immune system with age and the increasing presence of chronic medical conditions lead to increased susceptibility and mortality.¹⁰ The fact that the elderly are at higher risk for influenza is reported by the WHO and also by the literature.¹¹ Children pose a further target group where the existence of chronic underlying medical condition amplifies the risk of complications.¹² In the US, the yearly influenza cases among children are estimated at 10–40% resulting in hospitalisation in about one percent.^{12,13}

The cornerstone of influenza prevention is vaccination.^{1,14} Influenza vaccination has been demonstrated to be highly cost-efficient or cost saving.^{15,16} Vaccination leads to lower incidence of influenza-related respiratory diseases and severe complications, to lower health care costs for influenza treatment, prevention and hospitalisation as well as to reduced death cases especially among the elderly population. Employees who acquire influenza lose on average two days at their working place.¹⁷ However, lost (absenteeism) or condensed (presenteeism) productivity at the working place or at home can be reduced by the help of vaccinating the population.^{18–20}

In May 2003, the World Health Assembly (WHA) released recommendations for the usage of influenza vaccines. These recommendations are targeted at all people at risk, meaning the elderly population and individuals with underlying diseases.²¹ The Member states of the European Union are engaged to attain the goal of 75% vaccination coverage by 2010 in the elderly population.²² All European countries have official policies in regard to influenza vaccination. The actual national regulations in all countries recommend the vaccine to the elderly population (≥ 65 years in Czech Republic, Finland, France, Ireland, Italy, Portugal, Spain, UK; ≥ 60 years in Germany; ≥ 50 years in Poland; Austria recommends the vaccine to all age groups) and to patients with impairing medical

conditions like chronic pulmonary diseases (including asthma), cardiovascular diseases (except hypertension), renal or hepatic diseases (except Czech Republic, Italy, France), haematological or metabolic disorders (including diabetes mellitus) and immunologic disorders including HIV/AIDS (except Czech Republic). The vaccination of pregnant women is recommended in Austria, Italy, Portugal and Spain. Furthermore, vaccinating of health care professionals is also recommended.²³ The paediatric conventions recommend influenza vaccine to children older than six months with cardiac or renal diseases, diabetes, compromised immune system, HIV-positive status (with the exception of Austria, Czech Republic, Finland, Italy, Portugal) or under long-term aspirin usage (except Austria, Czech Republic, Germany, Poland, UK).^{24,25} Austria and Finland (since 2007/08) are the only European countries with a recommendation for healthy children aged 6–23 month of age.^{26,27}

Even though the vaccination coverage rates particularly among at-risk groups are increasing, the usage of influenza vaccines is still suboptimal. While some countries are on a good way to reach the targets of the WHO by 2010, others will not be able to follow.

The aim of this cross-sectional survey was to identify the disparities of influenza coverage rates in eleven European countries during two consecutive influenza seasons. Besides focusing the vaccine uptake among at-risk groups and children, the project also aimed at investigating the driving factors and barriers towards vaccination.

Methods

Study design

A population-based cross-sectional survey was carried out in the UK, Germany, Italy, France, Spain, Austria, Czech Republic, Finland, Ireland, Poland and Portugal. During the two consecutive influenza seasons 2006/07 and 2007/08, representative household surveys were conducted using telephone surveys, mailed questionnaires or face-to-face interviews. The method of the fieldwork was described earlier.²⁸ In brief, telephone interviews were conducted by TNS health care, using a computer-assisted telephone interviewing system (CATI), except in France. French data were collected via a postal questionnaire by GEIG (Groupe d'Etude et d'Information sur la Grippe). In Poland, telephone survey methodology was used during season 2006/07 and personal interviews in the following year. Persons with children also replied for each child (up to five children per interviewee), as proxy respondents.

To obtain a representative sample of the national non-institutionalized adult population, interviews were carried out according to quotas and to correct for residual deviations from these quotas, a weighting was applied with respect to gender, age, profession, geographic region and town size. Quotas and weighting factors were based on data from official national sources.²⁹

Subjects

The survey populations were representative of the adult population aged 14 years or older in Germany, Italy and Spain, 16 years or older in the UK and 15 years or older in the remaining countries. In Spain, individuals over 75 years of age were not included in the survey. The surveys were carried out in December and January. In 2007/08, as in the previous seasons, approximately 2000 interviews were conducted per country (UK: 2007, Germany, Czech Republic and Ireland: 2002, Finland: 2001, Italy, Spain, Austria, Poland and Portugal: 2000). In France, 4576 persons responded to the questionnaire. In order to adjust the sample size to that of the other countries, the French data were weighted according to standard criteria to represent 2000 individuals instead of 4576. The response rate (defined as valid interviews, refusals, interviews out of quotas and appointments in national households) across all countries was 56%, namely UK 33%, Germany 54%, Italy 72%, Spain 55%, France 76%, Austria 61%, Czech Republic 58%, Finland 54%, Ireland 41%, Poland 52% and Portugal 62%. Out of these telephone responses 18.6% valid interviews were completed in the nine countries which used telephone interviews (UK 4%, Germany 7%, Italy 22%, Spain 28%, Austria 20%, Czech Republic 15%, Finland 20%, Ireland 15%, Portugal 36%).

At the beginning of each telephone call, the agreement and explicit verbal consent of the interviewees was obtained. There was no study intervention and the anonymity of the participants was guaranteed. According to the Esomar World Research Codes and Guidelines this type of study is considered market research and does not require the approval of an ethics committee, as this survey is a research in people, who are deemed healthy and not in the medical system.³⁰

Cross-sectional survey

The survey questions have been published earlier.²⁹ Across all countries, the questionnaire remained basically the same during both study seasons.

In 2007/08, the questionnaire covered vaccination uptake, reasons for and against vaccination, as well as the vaccination intention for the coming winter 2008/09. In order to identify chronically ill persons, examples were provided to the respondents and since 2007/08, the type of the chronic disease was recorded. Moreover, questions were added to assess concerns about side effects from the vaccine and if travelling to regions with a high risk of influenza would encourage people to get vaccinated. The vaccination status of children was recorded in all countries except France.

Vaccination status was recorded for children up to the age of 13 years (Austria, Czech Republic, Germany, Italy, Portugal, Spain), 14 years (Finland, Ireland, Poland) or 15 years (UK). Besides the vaccination status, data collection on children covered age and the number of children per family.

Statistical analysis

Based on the national recommendations we defined four at-risk groups as follows: i) Individuals aged 65 years or older

not reporting to suffer from a chronic condition; ii) elders suffering from a chronic illness; iii) other individuals suffering from a chronic illness; and iv) individuals working in the medical field (health care workers).^{31–39} Persons belonging to none of the four above-defined target groups were classified as members of the non-target group. Children were treated separately.

Sample weights were applied to the annual dataset to correct for small deviations from the age and gender quotas required. SPSS[®] version 14 for Windows and version 16 for Macintosh was used for the statistical evaluation. To avoid double counting e.g. in those over 65 years who also have a chronic illness or those health care professionals who suffer from a chronic illness, we analysed the vaccination coverage rates in at-risk groups versus the non-target group (including individuals less than 65 years of age without a chronic disease and not working in the health care sector).

Bivariate associations of categorical variables were assessed with the Chi squared test and the Chi squared test for trend was used for evaluating time trends of these variables. For all statistical tests, a two-sided *p*-value below 0.05 was used as the level of statistical significance. Ninety-five percent confidence intervals (CI) are reported as appropriate. Due to the descriptive nature of this data, no corrections for multiple testing were made.

Covariates identified as potential predictors of influenza vaccination in univariate analysis were considered as candidates for multivariable analysis. Logistic regression was used to identify the independent explanatory value of correlates of the outcome of interest, i.e. vaccination coverage. The following variables were regarded as potential predictors of vaccination coverage: gender, age, chronic illness, working in the medical field, educational level, and household income. All covariates were included in initial models for the 2007/08 data from each country. Non-significant predictors (*p* > 0.05) were subsequently removed on a stepwise basis. Each country was analysed separately due to national differences in the definition of the variables income and education level.

Results

Vaccination and intention rates in the general population

Table 1 presents characteristics of the survey population of the season 2007/08. There were no unexpected data points.

Vaccination coverage rates for influenza seasons 2006/07 and 2007/08 are indicated in Fig. 1. During season 2007/08, the highest overall coverage was found in the UK (28.7%, 95% CI 26.7–30.7%), the lowest in Poland (9.5%, 95% CI 8.5–11.5%). Compared to the year before, statistically significant changes were found in UK (*p* = 0.008), Finland (*p* = 0.003) and Poland (*p* ≤ 0.001). The strong reduction in Poland can be attributed to the fact that the telephone survey approach was replaced with a survey using personal interviews (see Discussion).

A gap between intended and actual vaccination rates was visible in all countries but varied considerably in size.

Table 1 Overview of adult sample in season 2007/08.

	UK	Germany	Italy	France	Spain	Austria	Czech Republic	Finland	Ireland	Poland	Portugal
Sample size	2007	2002	2000	2000	2000	2000	2002	2001	2002	2000	2000
Mean age (years)	45.4	48.1	45.5	46.6	42.2	45.8	45.1	45.0	42.1	44.7	46.8
(95% CI)	(44.6; 46.2)	(47.3; 48.9)	(44.7; 46.2)	(45.8; 47.5)	(41.5; 43.0)	(45.0; 46.6)	(44.3; 45.9)	(44.3; 45.8)	(41.3; 42.8)	(43.9; 45.6)	(46.0; 47.6)
Male (95% CI)	48.5% (46.4%; 50.7%)	48.0% (45.8%; 50.2%)	48.7% (46.4%; 50.8%)	48.3% (46.0%; 50.5%)	49.6% (47.4%; 51.8%)	48.0% (45.8%; 50.2%)	48.4% (46.2%; 50.6%)	49.5% (47.3%; 51.7%)	49.0% (46.9%; 51.2%)	47.8% (45.6%; 50.0%)	48.0% (45.8%; 50.2%)
Age ≥ 65 years (95% CI)	19.6% (18.6%; 21.6%)	24.7% (22.7%; 26.7%)	17.4% (16.4%; 19.4%)	20.1% (18.1%; 21.1%)	12.3% (11.3%; 14.3%)	19.7% (17.7%; 20.7%)	19.4% (17.7%; 21.2%)	23.0 (21.2%; 25.0%)	11.2 (9.8%; 12.6%)	26.7 (25.0%; 29.0%)	19.2 (17.6%; 21.1%)
Work in the medical field (95% CI)	8.5% (7.3%; 9.8%)	8.5% (7.3%; 9.7%)	3.8% (2.9%; 4.6%)	6.3% (5.2%; 7.4%)	6.7% (5.6%; 7.8%)	9.2 (8.0%; 10.5%)	5.1 (4.1%; 6.0%)	6.7 (5.7%; 7.9%)	8.7 (7.5%; 10.0%)	3.0 (2.3%; 3.8%)	3.7 (2.9%; 4.6%)
Chronic illness (95% CI)	15.3% (13.7%; 16.9%)	24.9% (23.0%; 26.8%)	10.6% (9.3%; 12.0%)	16.3% (15.0%; 18.4%)	14.4% (12.9%; 16.0%)	13.6 (12.0%; 15.0%)	16.2 (15.2%; 18.2%)	15.6 (13.6%; 16.6%)	13.3 (12.3%; 15.3%)	16.4 (15.4%; 18.4%)	20.0 (18.0%; 22.0%)
Respondents with at least one child	22.4%	17.5%	24.4%	NA	21.9%	24.3%	20.2%	26.8%	31.4%	23.5%	20.8%
Children (N)	823	546	750	NA	646	809	611	979	1182	681	564
Households by number of children											
0	77.6%	82.5%	75.6%	NA	78.1%	75.7%	79.8%	73.2%	68.6%	76.5%	79.2%
1	8.6%	9.7%	13.5%	NA	12.6%	11.8%	11.6%	10.3%	11.7%	14.6%	14.0%
2	9.9%	6.1%	9.3%	NA	8.3%	9.3%	6.5%	11.9%	12.2%	6.9%	5.7%
3	3.1%	1.3%	1.4%	NA	0.8%	2.7%	1.6%	3.5%	5.6%	1.4%	1.0%
4	0.6%	0.3%	0.2%	NA	0.1%	0.4%	0.4%	0.9%	1.2%	0.4%	0.0%
5+	0.2%	0.1%	0.1%	NA	—	0.0%	0.0%	0.2%	0.6%	0.2%	0.0%

NA: not available.

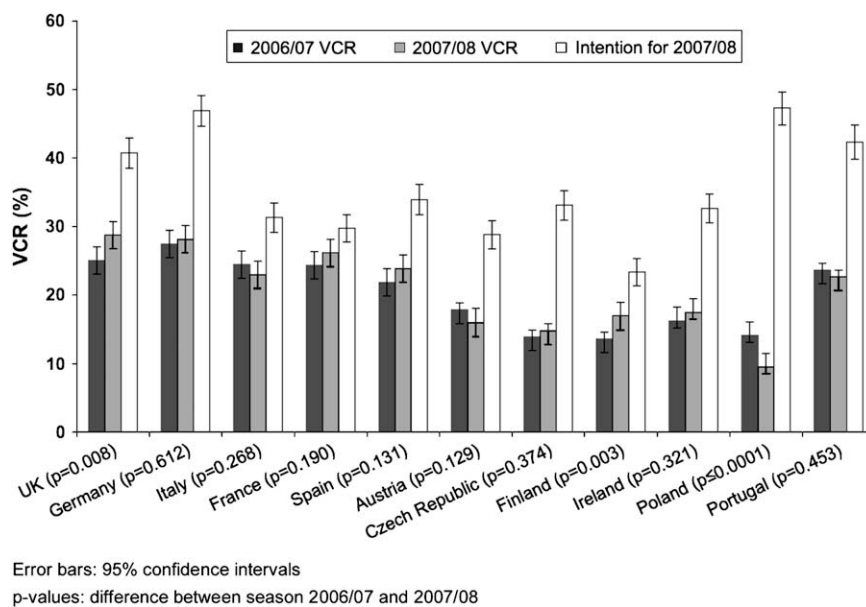


Figure 1 Vaccination coverage rates (VCR) in general population during two influenza seasons and vaccination intention rates. Error bars: 95% confidence intervals; p-values: difference between season 2006/07 and 2007/08.

This fact was already a matter of discussion in earlier studies.^{40,41} Interestingly, the actual immunization rate in France during 2007/08 reached 87.9% of the intended vaccination rate (as expressed in the 2006/07 survey). On the other hand, the answers of the Polish respondents indicated that only 20.1% of the intended influenza vaccinations were actually administered.

When grouping the sample into four different age groups, during season 2007/08, the lowest vaccination coverage was found in Individuals below 49 years of age in all countries (ranging 7.5% in Ireland to 13.9% in Germany). Vaccine uptake increased in the upper age groups.

Vaccination rates in at-risk groups

Age

The coverage in the elderly without any underlying chronic diseases is shown in Fig. 2a. The rates varied widely between the eleven countries. In 2007/08, the lowest coverage was found with 13.9% (95% CI 6.9–20.9%) in Poland, the highest in the UK (70.2, 95% CI 65.2–76.2%). We found in no country a statistical significant change over the two seasons.

In all countries, the vaccination coverage rates in the elderly group increased with age. The rates of the age group from 65 to 69 years ranged from 13.4% (95% CI 6.4–21.4%) to 65.3% (95% CI 57.3–73.3%). The age groups of 70–75 years and 75 years and above ranged from 16.1% (95% CI 8.1–24.1%) to 87.0% (95% CI 81.0–93.0%) and 16.6% (95% CI 11.6–23.6%) to 83.2% (95% CI 77.2–90.2%), respectively. In all age groups, the lowest rates were found in Poland, the highest in the UK.

Chronic illness

Most patients with underlying chronic diseases stated to suffer (regardless of their age) from diseases affecting the respiratory system (UK 49.7%, Italy 24.1%, Spain 37.7%,

Austria 32.0%, Czech Republic 60.3%, Ireland 48.8%, Portugal 42.1%) or the cardiovascular system (Germany 37.1%, Finland 32.3%, Poland 61.8%). No data were available for France.

In Fig. 2b vaccination coverage rates are presented for chronic disease patients under the age of 65 years. Low vaccination uptake was seen in Poland and Austria (11.1% and 18.4%, respectively). The highest coverage was found in the UK with 56.0% (95% CI 49.0–63.0%). Finland was the only country, which indicated a statistically significant increase from 2006/07 to season 2007/08 ($p = 0.023$).

Elderly with chronic illness

The prevalence of chronic diseases augmented exponentially with higher age. In the population below 50 years of age, 3.6% (Italy) to 14.5% (Germany) declared to suffer from a chronic illness. In those older than 65 years, the prevalence of chronic diseases reached between 24.6% in Italy and 66.4% in Poland.

The vaccination coverage in the combined risk group of the elderly with chronic disease was considerably increased compared to the non-target group (Fig. 2c). In 2007/08, the maximum was seen in the UK (91.4%, 95% CI 86.4–97.4%), whereas the minimum was found in Poland (16.8%, 95% CI 11.8–21.8%). Significantly augmented rates compared to 2006/07 were identified in Germany ($p \leq 0.001$).

Health care workers

The majority of health care professionals worked in the para-medical field (pharmacist, physiotherapist or masseur/masseuse) (Italy 28.5%, France 41.5%, Spain 30.8%, Czech Republic 34.7%), as a nurse (UK 39.4%, Germany 36.7%, Austria 33.6%, Finland 52.2%, Ireland 38.1%, Poland 33.6%, Portugal 24.0%). Across all countries, 17.8% of the health care workers were medical doctors (UK 22.0%, Germany 21.9%, Italy 28.1%, France 6.0%, Spain 12.7%,

Error bars: 95% confidence intervals
p-values: difference between season 2006/07 and 2007/08

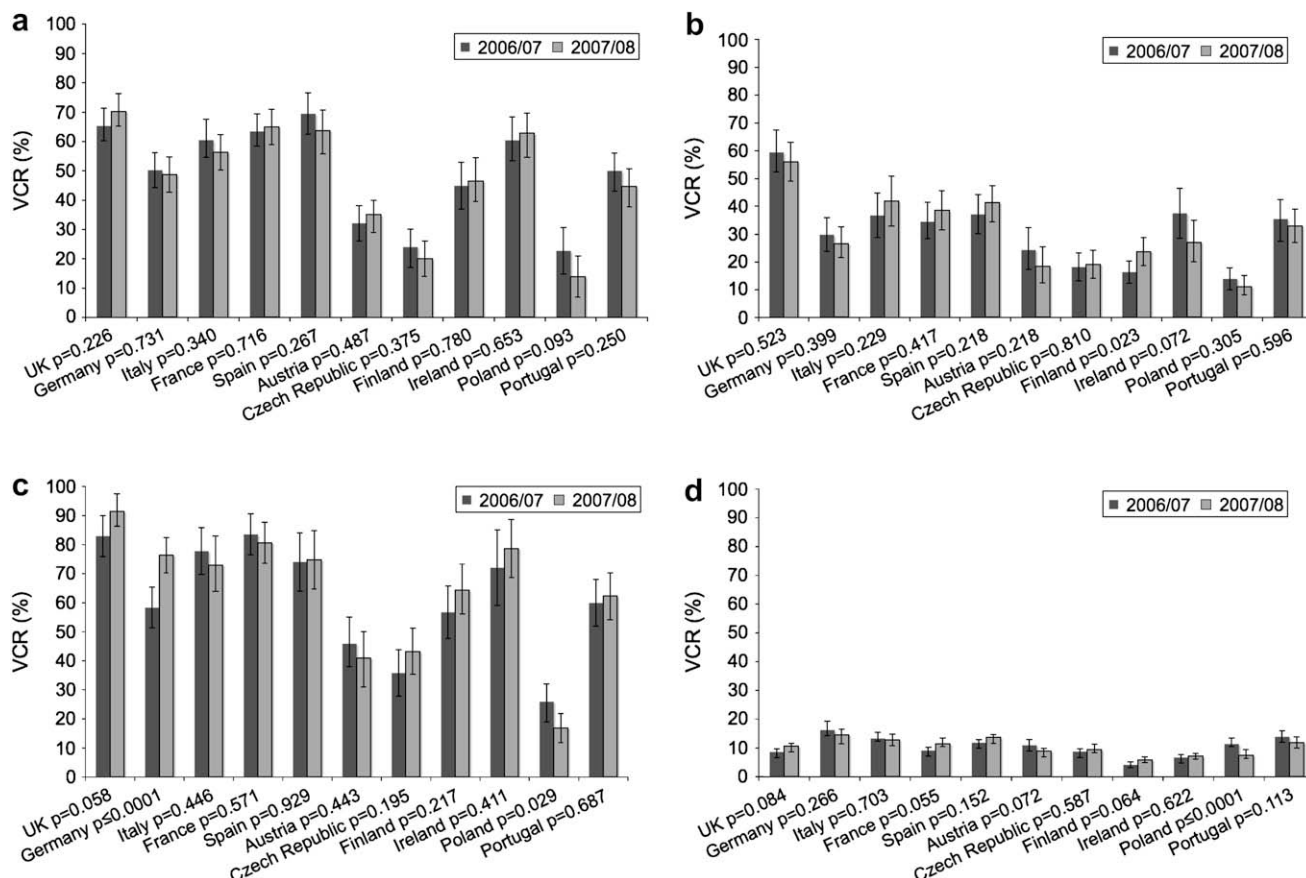


Figure 2 Vaccination coverage rates (VCR) in at-risk population during two influenza seasons. a) VCR 65 years and above without chronic conditions. b) VCR chronic ill younger than 65 years of age. c) VCR 65 years and above with chronic conditions. d) VCR of non-target group members. Error bars: 95% confidence intervals; p-values: difference between season 2006/07 and 2007/08.

Austria 18.1%, Czech Republic 17.3%, Finland 14.2%, Ireland 21.4%, Poland 8.1% and Portugal 13.1%.

Table 2 presents the vaccine uptake in the group of health care professionals during both seasons. The coverage rates

Table 2 VCR of health care workers (%) during two influenza seasons.

Country	2006/07	95% CI	2007/08	95% CI	p-value
UK	15.9	8.9–22.9	24.0	17.0–31.0	0.117
Germany	22.6	16.6–29.6	17.3	9.3–24.3	0.290
Italy	12.2	4.2–20.2	10.9	2.9–18.9	0.824
France	22.2	15.2–30.2	22.9	14.9–30.9	0.910
Spain	20.5	11.5–29.5	25.4	18.4–33.4	0.416
Austria	15.5	9.5–20.5	19.0	13.0–25.0	0.404
Czech Republic	23.5	14.5–32.5	26.3	16.3–36.3	0.688
Finland	7.8	2.8–12.8	19.4	12.4–27.4	0.009
Ireland	18.6	11.6–25.6	20.5	13.5–26.5	0.687
Poland	20.7	9.7–30.7	6.4	–1.4–14.4	0.038
Portugal	25.4	14.4–37.4	25.0	14.0–37.0	0.958

p-values: difference between season 2006/07 and 2007/08.

were generally low and ranged from the lowest rate in Poland (6.4%) to 26.3% in Czech Republic, in 2007/08. In Finland, a statistically significant increase was detectable during the two influenza seasons ($p = 0.009$). On the other hand, Poland showed a significantly lower coverage compared with the previous season ($p = 0.038$). However, the reason for this reduction is likely be a change in methodology.

Non-target group

Individuals belonging to no at-risk group were best vaccinated in Germany (14.5%, 95% CI 11.5–16.5%) and least vaccinated in Finland (5.8%, 95% CI 4.8–6.8%), during the influenza season 2007/08 (Fig. 2d). Changes compared with the season before were marginal in all countries except Poland ($p \leq 0.001$).

Multivariate logistic regression analysis of vaccination coverage

Potential predictors of getting vaccinated were evaluated in the final multivariate logistic regression models, for each country separately (Table 3). Each model included target group membership (age, chronic illness, working in the health care sector), whereas gender, household income

Table 3 Adjusted odds ratios of vaccination coverage in target groups in season 2007/08 (adjustment for age \geq 65 years, chronic illness, working in the medical field, income, education and gender).

Country	UK (n = 1650 ^a)	Germany (n = 1738 ^a)	Italy (n = 1257)	France (n = 4415 ^a)	Spain (n = 1169 ^a)	Austria (n = 1985 ^a)	Czech Republic (n = 1999 ^a)	Finland (n = 1600 ^a)	Ireland (n = 1775)	Poland (n = 1458 ^a)	Portugal (n = 1992 ^a)
Age ^b	23.7	5.3	6.0	14.3	6.6	5.7	2.4	17.5	15.8	2.6	5.2
(95% CI)	(16.0; 35.0)	(3.9; 7.3)	(4.1; 8.9)	(10.5; 20.0)	(4.0; 10.9)	(4.0; 7.6)	(1.6; 3.7)	(11.0; 27.7)	(10.7; 23.5)	(1.3; 3.6)	(3.8; 7.3)
p-value	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.006	<0.001
Chronic illness ^b	13.7	2.3	4.3	4.9	4.2	2.3	2.3	4.6	4.9	1.8	3.5
(95% CI)	(9.2; 20.3)	(1.6; 3.2)	(2.6; 7.0)	(3.5; 6.9)	(2.7; 6.3)	(1.5; 3.7)	(1.6; 3.4)	(3.1; 6.9)	(3.1; 7.6)	(1.1; 2.9)	(2.5; 4.9)
p-value	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.018	<0.001
Chronic illness and age ^b	120.1	19.2	10.3	31.7	13.3	7.1	7.4	34.0	51.3	3.1	11.2
(95% CI)	(53.2; 271.6)	(12.9; 28.6)	(5.6; 18.8)	(19.7; 51.0)	(6.6; 26.9)	(4.6; 10.9)	(5.2; 10.7)	(20.4; 56.6)	(25.2; 104.4)	(1.9; 5.1)	(7.5; 16.8)
p-value	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Work in medical field ^b	3.5	1.2	0.9	2.3	2.2	2.4	3.5	3.5	3.7	1.4	3.2
(95% CI)	(2.2; 5.6)	(0.7; 2.0)	(0.3; 2.6)	(1.4; 3.8)	(1.2; 4.2)	(1.5; 3.7)	(2.1; 5.9)	(1.9; 6.3)	(2.3; 6.0)	(0.5; 4.4)	(1.7; 6.0)
p-value	<0.001	0.495	0.841	0.001	0.013	<0.001	<0.001	<0.001	<0.001	0.567	<0.001
Income ^d											
(95% CI)											
1	1.1 (0.7; 1.7)	1.0 (0.7; 1.6)	0.9 (0.7; 1.4)	NA	0.7 (0.4; 1.0)	NI	NI	1.1 (0.6; 1.5)	0.5 (0.3; 0.9)	2.7 (0.6; 12.5)	NI
2	0.5 (0.3; 0.9)	1.5 (1.0; 2.2)	0.7 (0.4; 1.1)		0.4 (0.3; 0.7)			1.2 (0.7; 1.9)	0.5 (0.3; 0.8)	3.5 (0.8; 15.8)	
3	0.9 (0.5; 1.5)	1.0 (0.7; 1.6)	1.1 (0.6; 1.8)		0.7 (0.4; 1.2)			1.7 (1.0; 2.7)	0.4 (0.2; 0.8)	4.6 (1.0; 20.1)	
4	0.9 (0.6; 1.3)	0.8 (0.6; 1.2)	0.6 (0.3; 1.5)		0.4 (0.2; 0.7)			1.7 (0.8; 3.3)	0.3 (0.2; 0.5)	5.2 (1.0; 26.1)	
p-value											
1	0.782	0.859	0.786		0.062			0.835	0.009	0.212	
2	0.017	0.056	0.134		0.001			0.555	0.006	0.107	
3	0.649	0.890	0.853		0.153			0.038	0.011	0.046	
4	0.515	0.262	0.300		0.001			0.147	<0.001	0.045	
p-value for entire variable	<0.001	<0.001	0.014		<0.001			0.032	<0.001	0.044	
Education ^e											
(95% CI)											
1	NA	NI	0.5 (0.3; 0.9)	NA	0.7 (0.4; 1.4)	NI	NI	NI	NI	NI	1.0 (0.7; 1.4)
2			0.5 (0.3; 0.8)		0.7 (0.4; 1.4)						0.9 (0.6; 1.2)
3			0.6 (0.4; 1.0)		0.8 (0.5; 1.3)						0.7 (0.5; 1.0)
4					0.9 (0.6; 1.4)						0.6 (0.4; 0.9)
p-value											
1			0.013		0.356						0.817
2			0.003		0.355						0.435
3			0.042		0.382						0.048
4					0.621						0.022

(continued on next page)

Table 3 (continued)

	UK	Germany	Italy	France	Spain	Austria	Czech Republic	Finland	Ireland	Poland	Portugal
Country	(n = 1650 ^a)	(n = 1738 ^a)	(n = 1257)	(n = 4415 ^a)	(n = 1169 ^a)	(n = 1985 ^a)	(n = 1999 ^a)	(n = 1600 ^a)	(n = 1775)	(n = 1458 ^a)	(n = 1992 ^a)
p-value for entire variable	<0.001			0.001							<0.001
Gender ^c	1.3	NI	NI	1.4	1.4	NI	NI	NI	NI	NI	1.4
(95% CI)	(1.0; 1.7)			(1.1; 2.0)							(1.1; 1.7)
p-value	0.111			0.021							0.01

NA: not available; NI: Not included in the model.

^a N < total sample size for this season due to missing covariate values.

^b non-target group (persons who do not belong to any target group) – reference categories.

^c Females – reference categories.

^d Income classes – UK 1: 1001€–1499€; 2: 1500€–1999€; 3: 2000€–2499€; 4: 2500€+; Reference category: up to 1000€. Germany 1: 1001€–1499€; 2: 1500€–1999€; 3: 2000€–2499€; 4: 2500€+; Reference category: up to 1000€. Italy 1: 1501€–2000€; 2: 2001€–2500€; 3: 2501€–4000€; 4: 4000€+; Reference category: up to 1500€. Spain 1: 1001€–1499€; 2: 1500€–1999€; 3: 2000€–2499€; 4: 2500€+; Reference category: up to 1000€. Finland 1: 1251€–2500€; 2: 2501€–3750€; 3: 3751€–7083€; 4: 7084€+; Reference category: up to 1250€. Ireland 1: 834€–2500€; 2: 2501€–4167€; 3: 4168€–5000€; 4: 5001€+; Reference category: up to 165€.

^e Education classes – Italy 1: University degree; 2: High school; 3: middle school; Reference category: Primary school/no education. Portugal 1: Preparatory/secondary school (ancient 2/3; current 6/7); 2: Secondary school (ancient 5/7; current 9/11); 3: 12th years/medium school; 4: high school/university; Reference category: no studies/primary school.

and educational level were taken into account in selected countries (if $p < 0.05$). Data on the level of education were not available for the UK. In France, only gender and target group membership information was available for the modelling.

The predictors of being elderly, suffering from a chronic medical condition or belonging to both of these risk groups drastically enhanced the odds ratios (OR) in all countries. Working as health care professional was a less strong predictor of influenza vaccination. This variable was even non-significant in some countries (Germany, Italy and Poland).

Lower mid-range income of €1500–1999 (UK and Spain) or income levels higher than €2500 per month (Spain) was associated with a significantly decreased OR compared to the lowest income group (Table 3). Additionally, the tendency of getting vaccinated was reduced for all higher household incomes in Ireland. In contrast, in Finnish households with higher earnings between €3751 and €7083, the likelihood of getting vaccinated was significantly increased. In the Polish population, the probability of being vaccinated increased with the household income (OR between 4.6 and 5.2). In Italy and Poland, a higher educational level seemed to have a negative influence on the decision to get vaccinated (OR between 0.5 and 0.6).

Male appeared to be a predictive factor of vaccination in Spain and Portugal (ORs 1.4).

Vaccination coverage rates in children

Vaccination coverage in the children of the respondents is presented in Fig. 3 for both seasons. French data were not available. The total sample size of the children and the number of households grouped by number of children are contained in Table 1.

In 2007/08, German, Italian and Finnish parents vaccinated their children significantly more often than in the year before ($p = 0.016$, $p = 0.032$ and $p \leq 0.001$, respectively) (Fig. 3a). Best vaccinated were children in Germany, the lowest vaccination rates were seen in Ireland. In Fig. 3b, vaccination uptake rates are shown for different age groups, for 2007/08. Interestingly, 36.2% (95% CI 29.2–43.2%) of the Finnish infants (0–2 years of age) were vaccinated. The increase in Finland may be attributed to the new recommendation for children which was introduced in season 2007/08.

Reasons for and against vaccination

The issue of barriers and driving forces towards vaccination has been widely discussed in earlier publications for five European countries.^{29,40,42,43} In order to simplify the analysis of these factors, the three most important statements in each country were considered.

In Table 4, the principal motivating factors and reasons against vaccination are listed per country. The awareness that influenza is a serious illness was mentioned in all eleven countries as a major driving factor. Other important reasons for getting vaccinated were the advice from a family doctor (8/11) and the wish not to transmit influenza to family members and friends (7/11). On the other hand, non-vaccinated respondents from the majority of countries declared that they did not feel likely to catch influenza (10/11) or that they had never considered vaccination

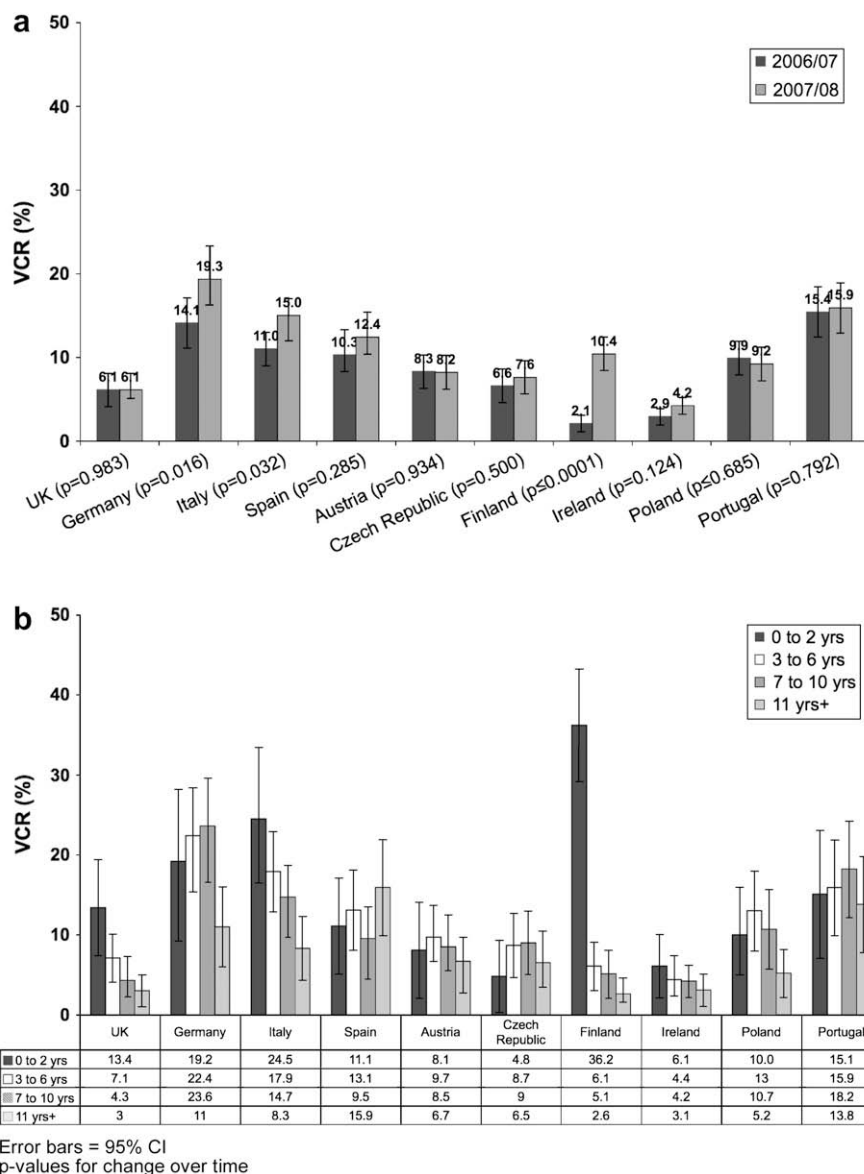


Figure 3 Vaccination coverage among children (0 to 13, to 14 or to 15 years of age) during 2006/07 and 2007/08. a) Vaccination coverage rates (VCR) in children by country. b) Vaccination coverage rates (VCR) among children by age groups (season 2007/08). Error bars = 95% CI; p-values for change over time.

before (9/11). Only Polish respondents declared they were suspicious of the effectiveness of the vaccine (Table 4).

The respondents of all countries, regardless of their vaccination status, regarded the advice from a family doctor as a major encouraging factor (11/11). The respondents from France, Poland, the Czech Republic and Portugal affirmed their willingness to get vaccinated if the vaccine would be reimbursed. Travelling to regions with a high risk of influenza would be encouraging for the Germans and the Finnish respondents.

Discussion and conclusion

Our survey showed that vaccination coverage rates in the general population of eleven European countries ranged

from 9.5% to 28.7% during season 2007/08. Compared to the year before, there were hardly any increases, except in the UK and Finland. The discrepancy between intended and real vaccination rates was considerable in all countries. In season 2007/08, belonging to one of the defined target groups for vaccination was a predictor for getting vaccinated. Individuals older than 65 years of age showed higher coverage rates compared to the non-target group (ranging from 13.9% in Czech Republic to 70.2% in UK). Individuals with underlying chronic diseases were less vaccinated than the elderly group, but still this target group reached a level of 11.1% (Poland) to 56.0% (UK) in our survey. The presence of both risk factors (age and chronic illness) boosted the odds ratio in all countries. Low coverage was found across all countries in the health care worker group (range: 6.4–26.3%). People not belonging to any of the defined risk

Table 4 The first three reasons for and against vaccination in the general population (season 2007/08).

Motivations for getting vaccinated among those vaccinated	UK	Germany	Italy	France	Spain	Austria	Czech Republic	Finland	Ireland	Poland	Portugal
	576	562	458	521	475	320	297	339	348	189	452
<i>N</i>	Rank (%)	Rank (%)	Rank (%)	Rank (%)	Rank (%)	Rank (%)	Rank (%)	Rank (%)	Rank (%)	Rank (%)	Rank (%)
My family doctor/nurse advised me to do it	2 (81.9)	2 (76.4)	1 (49.1)		1 (53.7)	2 (31.6)	2 (34.8)		2 (74.9)		1 (67.4)
Because the flu is a serious illness and I did not want to get it	1 (83.5)	1 (88.7)	3 (17.7)	2 (35.1)	3 (34.3)	1 (55.7)	1 (53.3)	1 (62.7)	1 (86.4)	1 (48.2)	3 (34.2)
Because of my age				3 (34.3)	2 (36.6)						2 (36.5)
So I do not pass the flu bug to my family/friends	3 (61.9)	3 (73.9)				3 (31.2)	3 (33.4)	2 (35.6)	3 (58.8)	2 (45.3)	
Because the social security system pays for it				1 (44.3)							
Because I am not in very good health			2 (19.1)					3 (33.5)		3 (22.8)	
Reasons for <u>not</u> getting vaccinated among those never vaccinated	UK	Germany	Italy	France	Spain	Austria	Czech Republic	Finland	Ireland	Poland	Portugal
	1152	910	1375	1231	1276	1299	1390	1259	1307	1547	1249
<i>N</i>	Rank (%)	Rank (%)	Rank (%)	Rank (%)	Rank (%)	Rank (%)	Rank (%)	Rank (%)	Rank (%)	Rank (%)	Rank (%)
I do not think I am very likely to catch the flu	3 (45.5)	1 (46.7)	2 (23.8)		1 (66.1)	1 (40.1)	2 (26.2)	1 (53.5)	1 (53.5)	1 (30.5)	3 (34.4)
I have never considered it before	2 (51.3)		1 (32.4)	2 (20.4)	2 (42.4)		1 (33.6)	3 (29.8)	2 (50.7)	3 (24.4)	2 (44.2)
My family doctor has never recommended it to me	1 (59.6)			3 (19)	3 (38.9)			2 (32.9)	3 (47.5)		1 (57.8)
I am too young to be vaccinated			3 (18.5)	1 (35)							
It is not a serious enough illness		3 (37.7)					3 (21.6)				
I thought about it but I did not end up getting it		2 (42.6)				2 (22.4)					
I am concerned of possible side effects from the vaccine						3 (19.5)					
I do not think the vaccine is effective enough										2 (26.8)	

groups showed vaccination rates between 5.8% (Finland) and 14.5% (Germany) in influenza season 2007/08. With respect to the vaccination of children, some countries showed significant differences between the two seasons of observation (Germany, Italy, Finland). In Finland, new vaccine guidelines could explain the raise in children's coverage rate. In 2007/08, the lowest rate was found in Ireland (4.2%), the highest in Germany (19.3%).

Our cross-sectional survey confirmed a consciousness of the severity of influenza for all countries. However, a high proportion of respondents considered the infection as highly unlikely to catch. The family doctors' advice was the most important encouraging factor.

A cross-sectional survey conducted in the European Union Member States presented results similar to ours, for the target groups during season 2006/07.²³ However, our data were generally smaller due to a different mode of calculation. In our analysis, the elderly group did not include those with underlying chronic diseases, whereas the VENICE survey did not take into account this bias.

There is ample evidence that people belonging to one of the target groups (≥ 65 years of age, chronic illness, health care workers, children) are at an elevated risk of an influenza infection. Vaccination has a large impact on reducing this risk. The efficacy and effectiveness of vaccination was particularly demonstrated for the elderly.⁴⁴ Still, our results for the at-risk population imply that several countries are still far away from reaching the goal of the WHO (75% coverage by 2010 in the elderly). This reality indicates that a huge proportion of elderly individuals or chronically ill patients do not receive an optimal protection to prevent influenza or minimise the occurrence of severe complications if infected. While the sales of influenza vaccines increase, there are still efforts required to ensure the implementation of national guidelines^{45,46} The single most important factor leading to enhanced usage of influenza vaccine is the recommendation of a health care professional and this was shown to be valid in all countries investigated by our surveys. Hence, health care workers could help to implement influenza vaccination programmes and contribute to increase vaccination coverage rates actively, especially in the at-risk population.

Children are regarded as a population extremely susceptible to develop severe complications, and furthermore, they are a principal vector of disease transmission to the community.²⁴ Especially infants and young children are vulnerable to the disease. This fact was underlined by a study which identified among 1308 children hospitalized of influenza, a proportion of 80% younger than five years and of 27% under the age of 6 months.⁴⁷ The influenza vaccines was shown to be efficacious in children older than two years, but the volume of data on vaccination of children is still insufficient.⁴⁸ According to the European Centre of Disease Prevention and Control (ECDC), information including coverage rates of children are urgently required.²⁵ If this group is regarded as at risk, the influenza vaccination coverage rates among children, as identified by our survey, were low. Even lower levels were found in a survey conducted by the Spanish National Health Survey (2006), which determined the coverage in healthy Spanish children, who were 6–23 months and 2–15 years old, to be 7.0% and 6.8%, respectively.⁴⁹

When grouping the eleven countries studied into lower per capita gross national product (US\$4253.33 to US\$14,575.70 in Spain, Portugal, Czech Republic, Poland) and higher per capita gross national income (US\$19,276.10 to US\$24,486.70 in UK, Austria, Finland, Germany, France, Ireland, Italy), there was an obvious difference between the overall coverage rates of both groups of countries (17.7% and 22.3%, respectively). However, a higher household income was not always predictive of vaccination, as was shown by the logistic regression models. In Finland and Poland, a statistical significant trend of better vaccination rates among people with larger salaries was found, whereas in other countries the contrary was true (Spain, Ireland). In the remainder of countries, no significant effect of household income was detected. The financing of the vaccine was named as an important problem in the group of poorer countries. In our survey, 40.0% of the Polish respondents declared that they would get vaccinated if the vaccine was reimbursed or for free. In Austria, Czech Republic and Poland, costs of influenza vaccine are not or only partially subsidised. It is not surprising that the vaccine coverage was low in these countries. Given that significant higher vaccine uptake rates among high-risk groups are achievable in other European countries, strong efforts should be made to improve the coverage especially in countries like Austria, Czech Republic and Poland.

In Poland, most data indicated a statistically significant decrease in coverage compared to the previous season (2006/07). This fact can be attributed to a change in survey methodology. The face-to-face interview survey system seemed to be more adequate, as not all Polish households have a telephone landline. Accordingly, the conducted telephone survey during 2006/07 may correspond rather to the population with a higher income and a higher presumption to get vaccinated. The Polish data for the 2006/07 season are likely to represent an overestimation, whereas the coverage results for 2007/08 are likely to adequately represent the real coverage levels in the population. A comparable face-to-face survey was carried out by Kroneman and van Essen in Poland during seasons 2003/04 and 2004/05.⁵⁰ While elderly persons above 65 years indicated vaccination rates of 16–18%, chronic ill patients (below 65 years of age) reported a coverage of 9–10%. These results were in line with our 2007/08 survey results, but do not explain the significantly higher coverage found during 2006/07 (telephone survey). In addition to this, the very similar vaccine uptake rates in 2003/04 and 2007/08 point out that hardly any change has been made during five years of national and international effort made in enhancing those numbers.

A similar problem of overestimation could be present in the data for the Czech Republic. This notion is supported by results from the Czech national influenza monitoring programme which estimated the current vaccination levels at 5–8%.³⁷ However, telephone surveys remain an accurate method for monitoring the levels of influenza vaccination coverage, in most countries, as long as telephone landlines are widespread and their lacking is not associated with socioeconomic reasons.^{51–53}

With respect to the present survey, some limitations need to be addressed. The self-reported vaccination uptake or chronic condition status could not be confirmed.

Nonetheless, the approach of analysing self-reported data was reported to be adequately trustworthy.^{29,54,55} The differences in the proportion of interviewees describing themselves as chronically ill may stem from local differences in the comprehension of the term chronic illness, e.g. due to cultural or religious influences. The phrasing of question was the same in all seasons and all countries. Regardless of accurate sampling non-response is a possible reason for selection bias. One rising challenge of telephone surveys is the increased use of answering machines, voicemail systems, caller IDs and mobile phones resulting in rising numbers of non-response rates.⁵⁶ Low response rates were found in Germany and UK, but the final sample was in all countries fully representative. Nevertheless, selection bias due to non-response cannot be entirely excluded.

In summary, strategies to achieve higher vaccination rates in Europe should not only be based on effective national guidelines, but also on successful information campaigns on influenza vaccination, on progress in vaccine accessibility in financial and logistical terms, on involvement of health care professionals in vaccination campaigns and on the education of doctors and nurses to identify the at-risk population and recommend the vaccination. The cornerstone of influenza control is vaccination and strong efforts have to be undertaken on the national and international level to realise the goal of the WHO to reach 75% coverage by 2010.

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