Trends in influenza vaccination coverage rates in the United Kingdom over six seasons from 2001-2 to 2006-7

P R Blank (patricia.blank@ifspm.unizh.ch)[1], A U Freiburghaus[2], M Schwenkglenks[2], T D Szucs[1]
1. Institute of Social and Preventive Medicine, University of Zurich, Switzerland
2. European Center of Pharmaceutical Medicine, University of Basel, Switzerland

In order to understand motivations and barriers to vaccination, and to identify people's intentions to get vaccinated for season 2007-8, influenza vaccination coverage was assessed in the United Kingdom (UK) from 2001 to 2007. Between 2001 and 2007 representative household surveys were performed by telephone interview with 12,143 individuals aged 16 or older. The overall influenza vaccination coverage rate dropped non-significantly from 25.9% in 2005-6 to 25.0% in 2006-7 (p=0.510). In the elderly (≥65 years) the rate decreased from 78.1% to 65.3% (p=0.001), and the odds ratio of being vaccinated compared to those not belonging to any of the risk groups targeted by vaccination decreased from 36.6 to 19.9. Healthcare workers and chronically ill persons had odds ratios of 2.0 and 15.5, respectively. The most important reason for getting vaccinated was a recommendation by the family doctor or nurse, and this was also perceived as the major encouraging factor for vaccination. No recommendation from the family doctor was the main reason for not getting vaccinated. A total of 38.4% of the respondents intended to get immunised against influenza in 2007-8. From 2001 to 2006 a slightly increasing trend (p for trend across seasons <0.0001) in vaccination coverage was observed in the UK, but in 2006-7 the rates returned to the level of 2004-5. Less media attention to the threat of avian influenza after 2005 may have contributed to the recent decrease of vaccination rates.

Introduction

Experts at the World Health Organization and elsewhere agree that the world is now closer to another influenza pandemic than at any time since the 1968 pandemic which was the last of the three influenza pandemics that occurred in the twentieth century [1]. This underlines the importance of achieving sufficiently high immunisation coverage in the general population and above all in sub-populations at high risk of influenza complications.

There is ample evidence in the medical literature that vaccination is an efficacious and safe preventive measure against seasonal influenza [2-4]. It not only provides substantial health benefits, but may also be associated with significant economic benefits [5,6], particularly among the elderly, healthy working adults and children. In the United Kingdom (UK), where complications of influenza cause 3,000 to 4,000 deaths every year, the government policy [7] is to vaccinate: i) all people aged 65 years and over (age-related policy introduced in 2000–1), ii) individuals aged 6 months and over who fall into a clinically defined risk group (chronic respiratory disease, including asthma, chronic heart disease, chronic renal disease, diabetes and immunosuppression), iii) individuals living in long-stay, residential-care institutions, iv) health and social-care professionals involved in direct care. Despite the relatively high influenza vaccination coverage of the target groups in UK, continuing efforts by physicians, the National Health Service and policy makers, are needed to contain the burden of the disease.

Earlier publications based on cross-sectional data have reported influenza vaccination rates in the UK [8-10]. However, the availability of a consistent dataset for six consecutive seasons permits us to expand the usual cross-sectional approach for the analysis of vaccination rates.

In this study we analyse influenza vaccination coverage and related trends in the UK over six consecutive vaccination seasons, with special regard to high-risk group coverage. Further objectives are to elucidate the motivations for being or not being vaccinated, and to reveal the intentions to get vaccinated for the season 2007-8.

Methods

The present survey is part of an ongoing international assessment of influenza immunisation uptake in five European countries, France, Germany, Italy, Spain and UK [11-14]. During six influenza seasons, from 2001-2 to 2006-7, a population–based telephone survey addressing different topics was carried out in December and January among UK households. Computer Assisted Telephone Interviews (CATI) were conducted, and the interviewees' consent was obtained at the beginning of each call. There was no study intervention. Using quotas and weights based on data from official national sources guaranteed that the reported sample of the survey (completed interviews) was representative of the non-institutionalised UK population aged 16 years or older [15]. The weighting was applied in terms of sex, age, profession, geographic region and town size.

Four target groups based on national recommendations were specified [7]:

1. Individuals aged 65 years or older
2. Individuals who suffer from a chronic illness
3. Individuals who work in the medical field
4. Individuals belonging to one or more of the above groups 1, 2 and 3 (composite target group)

The non-target group comprised individuals belonging to neither of groups 1, 2 and 3. The survey questionnaire has been published before [15]. The questions covered vaccination uptake, reasons for and against vaccination, as well as the intention to get vaccinated the next season. In order to assess the gap between actual and intended vaccination rates, the ratios between the actual coverage level in a given season and the intended level in the same or the next season were calculated. Since 2003-4, supplementary information on the chronic illness status of the interviewees was collected. Data comparing target groups with the non-target group were obtained from season 2003-4 to 2006-7. Starting with season 2005-6, the questionnaire also included questions on pandemic and avian influenza.

Sample weights were applied, and the annual datasets were pooled to correct for small deviations from the age and sex quotas requested. SPSS® version 14 for Windows was used for the statistical evaluation. The chi-square test was used to assess bivariate associations of categorical variables and the chi-square test for trends was used for assessing time trends of categorical variables. For all statistical tests two-sided $p \leq 0.05$ was set as the level of statistical significance. If available, exact p-values were displayed. Ninety-five percent confidence intervals (CI) were reported where appropriate. Expected predictor variables were considered candidates for multivariate analysis, and logistic regression was used to identify independent correlates of the outcome of interest, i.e. vaccination coverage. The following variables were regarded as potential predictors of vaccination coverage: sex, age, chronic illness, working in the medical field, educational level, and income. Multivariate logistic regression analysis was used to assess the independent explanatory value of these covariates. A full model (containing all covariates) was first fitted from the 2006-7 data. Non-significant predictors ($p > 0.05$) were subsequently removed on a stepwise basis. The regression models for all other seasons were based on the remaining set of influential covariates identified from the 2006-7 dataset. Due to the descriptive nature of this data, no correction for multiple testing was made.

Results

Response rate

In the 2006-7 coverage study 2,037 individuals completed the interview (6.0% of responses). A total of 12,143 persons were interviewed since 2001. An overview of the samples is shown in Table 1. The samples were composed similarly over the years and are representative of the population aged 16 or older [15,16].

Vaccination coverage rate

Figure 1 shows the actual as well as the intended influenza vaccination rates over time. Overall vaccination coverage rates declined non-significantly from 25.9% (95%CI: 23.9;27.9) in season 2005-6 to 25.0% (95%CI: 23.0;27.0) in season 2006-7 (p=0.510). With regard to the coming season of 2007-8, 38.4% (95% CI: 36.8-40.1) of the interviewees intended to get immunised against influenza (Figure 1). The ratio of actual and intended vaccination rates ranged between 0.58 and 0.69 over the years. Throughout, the intention to get vaccinated was much higher than the actual rate in the current or in the previous season (Figure 1).

In 2006-7, the proportion of vaccinated persons who had also been vaccinated in the past (22.4%) was very similar as in the previous season (22.6%), but significantly higher than in the seasons before 2005-6 (19.8% to 20.4%). At the same time, the proportion of individuals who had been vaccinated in the past, but not in the current season, decreased from 17.6% in 2005-6 to 16.9% in 2006-7 (not statistically significant), possibly a fluctuation of an increasing vaccination trend since season 2001-2. In 2006-7, the proportion of respondents who were vaccinated for the first time

Table 1

Overview of samples included in the influenza vaccination coverage surveys, United Kingdom, from 2001-2 to 2006-7 (n = 12,143)

	2001-2	2002-3	2003-4	2004-5	2005-6	2006-7
Total sample size (N)	2,023	2,028	2,026	2,005	2,024	2,037
Mean age (years)	44.5	45	44.9	45.2	44.8	45
(95% CI)	(43.7- 45.4)	(44.2- 45.8)	(44.1- 45.7)	(44.4- 46.0)	(44.0- 45.6)	(44.1- 45.8)
Male	48.8%	48.8%	48.9%	48.8%	48.9%	48.6%
(95% CI)	(48.3%- 49.1%)	(48.3%- 49.1%)	(48.4%- 49.4%)	(48.3%- 49.1%)	(48.4%- 49.4%)	(46.7%- 50.5%)
N	987	989	991	978	990	990
Age ≥ 65 years	18.1%	18.7%	19.2%	18.7%	19.0%	18.9%
(95% CI)	(17.9%- 18.3%)	(18.5%- 18.9%)	(19.0%- 19.4%)	(18.5%- 18.9%)	(18.8%- 18.9%)	(18.7%- 19.1%)
N	366	380	389	375	384	384
Work in the medical field	6.8%	8.2%	7.1%	6.8%	6.6%	6.4%
(95% CI)	(4.9%- 8.7%)	(6.3%- 10.1%)	(5.2%- 9.0%)	(4.9%- 8.7%)	(4.7%- 8.5%)	(4.5%- 8.3%)
N	138	167	144	136	133	130
Chronic illness	-	-	12.0%	14.0%	14.2%	14.4%
(95% CI)			(10.1%- 13.9%)	(12.1%- 15.9%)	(12.3%- 16.1%)	(12.6%- 16.3%)
N			243	281	288	294
Combined target group*	-	-	33.0%	33.2%	33.1%	33.2%
(95% CI)			(31.0%- 35.1%)	(31.1%- 35.2%)	(31.1%- 35.2%)	(31.1%- 35.2%)
N			669	665	671	676

*Includes people aged 65 years and over, suffering from chronic illnesses or working in medical field

(2.6%) was one fifth lower than in the preceding season (3.3%), whereas the proportion of those who had never been vaccinated increased from 57.1% to 58.1%. In spite of this small increase, there is no statistical evidence for a reversal of the decreasing trend in the long-term (p for trend across seasons <0.0001).

Vaccination coverage in target groups

For the target groups, changes in vaccination coverage over time are shown in Figure 2. In the group aged 65 years or older, coverage peaked in season 2005-6 at 78.1% (CI: 73.1%;83.1%), and then returned to 65.3% (95% CI: 60.3-71.3) in 2006-7 (p=0.001). Statistical significance in this case indicates that there may be a long-term upwards trend despite a substantial degree of yearly variation. In every season, coverage in this group was at a significantly higher level than in the non-target group (p<0.0001).

Figure 1

Actual vaccination rate and intended vaccination rate; influenza vaccination coverage surveys, United Kingdom, from 2001-2 to 2007-8

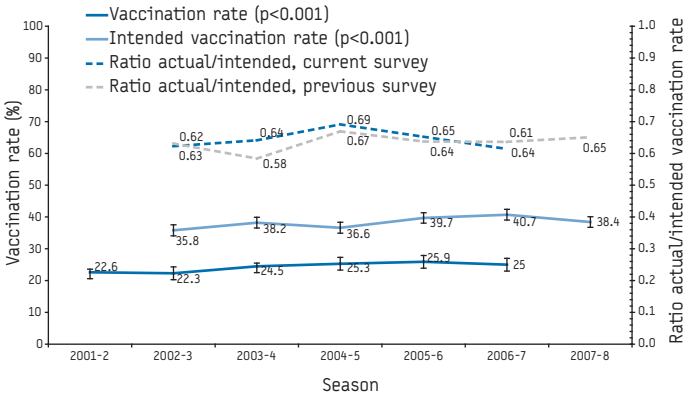
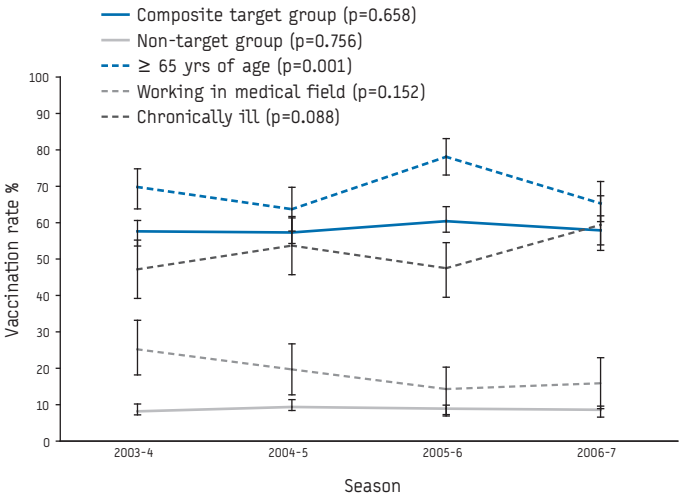


Figure 2

Trend curves of actual vaccination rates in high-risk target groups and in the non-target group; influenza vaccination surveys, United Kingdom, from 2003-4 to 2006-7 (p-values for trends across seasons)



Age-related differences in vaccination coverage over time were shown in Figure 3. Being elderly (≥65 years) was associated with the highest coverage (Figure 3). The lowest values were seen in the 16-39 years old.

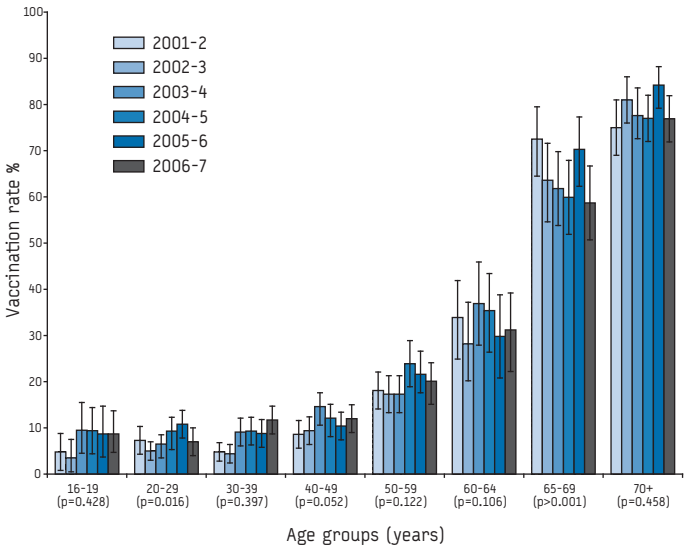
A question exploring the prevalence of chronic illness was included in the questionnaire from season 2003-4 onwards. Over the four observed seasons, significantly higher vaccination rates were found among the chronically ill, compared to the non-target group. In season 2006-7, an increase to 59.4% (95% CI: 52.4-67.4) was seen in this group, contrasting with values of 47.2% (95% CI: 39.2-55.2) in 2003-4 and 47.5 (95% CI: 39.5-54.5) in season 2005-6. Vaccination coverage in the group of healthcare professionals tended to decline over the years (p for trend = 0.152) but after the lowest value of 14.3 (95% CI: 7.3-20.3) in season 2005-6 rose to 15.9% (95% CI: 8.9-22.9) in season 2006-7. Even though the coverage in this group is the lowest among target groups, it still is about twice as high as in the non-target group (8.6%; 95% CI: 6.6-9.6). In the composite target group, vaccination coverage was essentially stable in the period from 2003-4 to 2006-7, with three seasons in the range from 57.3% to 57.9% and a peak of 60.4% (95% CI: 57.4-64.4) in season 2005-6.

Factors influencing vaccination coverage

Multivariate analysis of immunisation coverage accounted for membership in one or several target groups covering age, sex, educational level, and income. Since target group membership was the only covariate that showed a statistically significant effect in season 2006-7, the other potential influences (some of which suffered from considerable numbers of missing values) were excluded from the final logistic regression models (Table 2). A sex difference was apparent over time, with men being moderately less likely than women to be vaccinated (unadjusted odds ratio for women in season 2006-7: 1.2; CI 1.0; 1.5; p=0.062). However, no sex difference was present after adjusting for age, chronic illness, healthcare work and income. In 2006-7, the percentage of men in

Figure 3

Vaccinated population by age groups and influenza seasons; influenza vaccination coverage surveys, United Kingdom, from 2001-2 to 2006-7 (p-values for trends across seasons)



the non-target group was 52%, in the elderly it was 39.6%, in the chronically ill 48.5% and in the healthcare workers 30.8%.

Age 65 years or older was a significant predictor of vaccination (adjusted OR in 2006-7, compared to the non-target group: 19.9; odds ratios (ORs) ranging from 16.8 in season 2004-5 to 36.6 in season 2005-6). Individuals in the chronically ill target group had an odds ratio of 15.5 in season 2006-7, which was higher than in the previous three seasons (OR ranging from 9.3 to 11.2). Being aged 65 years or older and chronically ill raised the prediction of getting vaccinated distinctively in all seasons, with a maximum of 76.4 in season 2004-5. The likelihood of vaccination of health-care professionals was in the range of 1.8 and 3.8, and was 2.0 in season 2006-7.

The probability of vaccination for the composite target group (at least one of age ≥65 years, chronic illness, health-care worker) was 14.6 (CI: 11.5; 18.7) in season 2006-7, which was equal to the average of the four seasons from 2003-4 (data not shown). The highest probability of getting vaccinated was seen in season 2005-6 (OR 15.8; CI: 12.4; 20.1), and there was no trend over the four seasons covered (p for trend = 0.658, data not shown).

Motivations and barriers to vaccination

Table 3 shows reasons for getting or not getting vaccinated and how frequently they were named. In all seasons between 2001-2 and 2006-7 the reasons most frequently stated by those who had been vaccinated were "My family doctor/nurse advised me to do it" and "Because the flu is a serious illness and I did not want to get it". The media coverage of avian influenza and influenza pandemics had influenced the decision of 6.7% of the vaccinated respondents in 2006-7. This subgroup was not statistically different from the other vaccinated in terms of age, sex and belonging to a target group.

In season 2006-7 the most common reason for having never been vaccinated was "My family doctor did not recommend it to me" (38%, Table 3). Individuals previously vaccinated, but not in the current season (2006-7), most frequently said "I didn't think about it, I forgot it" (27.8%, previous season 28.1%), followed by "I do not feel concerned" (23.8%, same as in previous season).

There was little change in the knowledge about influenza vaccination in season 2006-7 compared to the previous seasons. Three-quarters of the surveyed were aware that it is possible to catch influenza even if vaccinated, and about two-thirds knew that

Table 2

Adjusted odds ratios of vaccination coverage in target groups vs. the non-target group (adjusted for age ≥ 65 years, chronic illness, working in the medical field); influenza vaccination coverage surveys, United Kingdom, from 2003-4 to 2006-7 (n = 8,048)

Target group	2003-4 n=2,013*	2004-5 n=1,994*	2005-6 n=2,015*	2006-7 n=2,026*
Age ≥ 65 years				
OR	25.9	16.8	36.6	19.9
(95% CI)	(18.8; 35.6)	(12.3; 23.0)	(25.9; 51.7)	(14.6; 27.3)
p-value	<0.001	<0.001	<0.001	<0.001
N	266	282	248	258
Chronic illness				
OR	10.0	11.2	9.3	15.5
(95% CI)	(6.8; 14.6)	(7.8; 16.1)	(6.5; 13.4)	(10.8; 22.2)
p-value	<0.001	<0.001	<0.001	<0.001
N	144	169	179	186
Chronic illness and age ≥ 65 years				
OR	42.8	76.4	46.2	51.9
(95% CI)	(24.3; 75.3)	(40.3; 144.7)	(27.1; 78.5)	(30.1; 89.6)
p-value	<0.001	<0.001	<0.001	<0.001
N	83	103	105	119
Work in medical field				
OR	3.8	2.4	1.8	2.0
(95% CI)	(2.4; 6.0)	(1.5; 3.9)	(1.0; 3.1)	(1.1; 3.4)
p-value	<0.001	<0.001	0.055	0.017
N	134	123	117	118
Work in medical field or chronic illness or age ≥ 65 years				
OR	18.0	13.0	12.6	3.9
(95% CI)	(17.1; 45.4)	(4.4; 38.6)	(5.5; 28.8)	(1.4; 10.9)
p-value	<0.001	<0.001	<0.001	0.01
N	20	14	24	17

* n< total sample for the season due to missing covariate values
Reference category: non-target group (persons who do not belong to any target group)

the infection is then less severe. A third of the interviewed persons agreed with the statement that the influenza vaccine would protect them against avian influenza, whereas a weak majority disagreed (52.5%).

The survey also showed that most people would be encouraged to get vaccinated in the future:

- "If my family doctor/nurse recommended it to me" (rank 1, 72%),
- "If I had more information on the vaccine regarding efficacy and/ or tolerance" (rank 2, 46%),
- "If my pharmacist recommended it to me" (rank 3, 35%),
- "If I knew more about the disease" (rank 4, 37%),
- "If there were other ways of administering the vaccine (orally, injection without needle)" (rank 5, 34%).

Discussion and conclusion

Telephone interviews have been used on a number of occasions to study vaccination coverage in the UK [9]. The random drawing of telephone numbers has been shown to be a good basis for a high quality selection process [17].

Despite correct sampling non-response is the major potential reason for selection bias. Comparisons of telephone, mail and face-to–face surveys on health-related issues, however, revealed only minor differences between modes of administration and modest non-response effects with respect to prevalence estimates [16,18]. In comparison with mailed surveys, non-response was found to be less content-oriented in telephone surveys [19]. Furthermore, bias due to dissimilar sociodemographic characteristics of individuals not reachable by telephone only slightly affected reporting of illness and related use of medical services, as long as the general population was addressed, and telephone coverage exceeded 90% [19,20]. These reports support the validity of our approach, even though we had no ways to independently confirm self-reported vaccination status. An earlier publication has described the limitations of the present data collection in greater detail [15]. The use of wireless telephones is a growing problem. In the United States (US) persons with landlines were shown to have higher odds of being vaccinated than those with exclusive access to wireless telephones (OR 1.27) [21]. If the same is true in the UK where mobile phones are even more common than in the US [22-24], our reported vaccination rates may have been slightly over-estimated.

The decrease in overall vaccination coverage in the UK in season 2006-7, compared to seasons 2004-5 and 2005-6, was not statistically significant. Coverage was still higher than in the seasons before 2004-5 and there is no strong evidence for a long-term change of trend. In 2006-7, 38.4% of the respondents expressed the intention to get vaccinated in season 2007-8. Thus, in the UK there may be a potential to increase future vaccination coverage provided that those who intend to get vaccinated but in the end do not are better targeted. Additionally, the increasing trend of those who had been vaccinated in the past but not in the current season could be explained by a failure of vaccine campaigns to maintain their trust in vaccination. A decreasing trend, however, was apparent in the age group of 65 to 69 years old respondents whose coverage dropped to the lowest level since season 2001-2 (Figure 3). As vaccinations are offered free of charge by the UK National Health Service, and as it is government policy to vaccinate all people aged 65 years and older we have no explanation for the decreasing trend in this particular age group. No trend over all seasons was apparent in the age group of 70 years or older, although the vaccination coverage in this group also reached the peak level in season 2005-6 and in 2006-7 returned to similar value as in season 2004-5.

In the two years before season 2006-7, the UK media have frequently reported on avian influenza and a potential shortage of antiviral agents. This may have increased the primary care providers' awareness of the risk of influenza pandemic and, by consequence, may have positively affected vaccination coverage in one of the high risk groups, namely the elderly, in season 2005-6. However, after season 2005-6 avian influenza lost the focus of the media [25], which may be a possible cause of the coincident decline in vaccination rates in 2006-7 to levels observed before the 2005-6 season. However, only less than 7% of respondents

Table 3

Ranking of reasons for and against vaccination; influenza vaccination coverage surveys, United Kingdom, from 2001-2 to 2006-7 (n = 10,252)

Motivations to get vaccinated (among those vaccinated in the current season)	2001-2 n=458 Rank (%)	2002-3 n=451 Rank (%)	2003-4 n=497 Rank (%)	2004-5 n=507 Rank (%)	2005-6 n=524 Rank (%)	2006-7 n=509 Rank (%)
My family doctor/nurse advised me to do it	2 (70)	2 (75)	1 (49)	1 (60)	1 (51)	1 (60)
Because flu is a serious illness and I did not want to get it	1 (73)	1 (82)	2 (47)	2 (46)	2 (42)	2 (50)
Because of my age	3 (59)	4 (56)	3 (41)	3 (39)	3 (40)	3 (42)
Because I am not in a very good health	6 (34)	6 (33)	5 (25)	4 (30)	5 (25)	4 (32)
So I do not pass the flu bug to my family and friends	4 (56)	3 (57)	4 (28)	5 (28)	4 (27)	5 (32)
Because the social security system pays for it	5 (40)	5 (36)	6 (25)	6 (26)	6 (24)	6 (29)
Reasons for not getting vaccinated (among those never vaccinated)	**2001-2 n=1,281 Rank (%)**	**2002-3 n=1,274 Rank (%)**	**2003-4 n=1,228 Rank (%)**	**2004-5 n=1,185 Rank (%)**	**2005-6 n=1,155 Rank (%)**	**2006-7 n=1,183 Rank (%)**
My family doctor did not recommend it to me	1 (56)	1 (54)	2 (33)	1 (37)	2 (37)	1 (38)
I have never considered it before	2 (56)	2 (51)	3 (33)	2 (34)	1 (37)	2 (35)
I do not think I am very likely to catch the flu	4 (32)	3 (41)	1 (34)	3 (33)	3 (30)	3 (33)
I am too young to be vaccinated	3 (34)	4 (37)	4 (29)	4 (31)	4 (29)	4 (32)
My pharmacist did not recommend it to me	-	5 (34)	5 (17)	5 (18)	5 (19)	5 (21)

listed the media as one of the factors influencing the decision to get vaccinated. Also, it neither explains the transitory decline in vaccination coverage in the chronically ill group in season 2005-6, nor the more long-term decrease in the healthcare professionals' vaccination rates. Working as health professional in the UK did not distinctly encourage vaccination as the adjusted odds were several magnitudes lower than those of the other defined target groups. Furthermore, the rate of vaccinated healthcare workers seemed to be decreasing (although statistically non-significant). Previous publications on influenza vaccination coverage [26-31] found low coverage rates in healthcare workers in Germany, ranging from 8% to 26% [27]. In comparison, in the UK surveys from 2001-2 to 2006-7 we obtained vaccination coverage in healthcare workers ranging between 14.3% and 25.2%, whereas the rates in non-target group never exceeded 9.4%.

Our observations on immunisation uptake in the UK population are largely consistent with findings from studies performed in the UK using a representative general practice database [32]. One notable difference regarding coverage trends is that in contrast with our findings the study by Coupland et al. found invariably increasing vaccination rates from every season to the next in all risk groups. The reason for these divergent results may primarily lie in the different approaches to collecting data; while Coupland's data were sampled from a subset of the population that visited a general practitioner (QRESEARCH database [33,34]), our data were sampled from the entire population accessible by telephone, irrespective of whether the respondents visited a physician or not.

Vaccination rates of children and young people under 16 years of age were not covered by our article. However, high vaccination coverage in children will be difficult to achieve at least in some countries, as paediatric recommendations for influenza vaccination in healthy children in most countries are nonexistent. This is why reaching high vaccination levels in the risk populations is even more important.

The overall vaccination rate in eleven European countries was 20.2% in season 2006-7 [our survey series, unpublished data]. Thus, in season 2006-7 the vaccination rate in the UK (25.0%) was higher than the European average. In previous seasons, the UK rates were above or slightly below the average of five European countries [13,19,35].

Regarding individual motivations for vaccination, our data confirm that the recommendation from the family doctor or nurse is the most important encouraging factor. Other publications support this finding [15,26,31,36-38]. A better understanding of the disease and administration of the vaccine without needle would generally encourage a third of the surveyed, and more information on the vaccine would encourage two-fifths of the respondents to get vaccinated in the future.

In order to achieve higher vaccination coverage, dealing with barriers to vaccination and enhancing positive motivations remain an important undertaking in the UK. This challenge should be accepted not only by the patients' key motivators, the primary care professionals, but also by government agencies, health professional organisations and independent media, which could all contribute to bridging the knowledge gap.

According to the WHO, the influenza pandemic risk remains on a high level [1]. Efforts should be made at national and international levels to raise coverage as set out in the WHO objectives (i.e. 50% vaccination coverage in the elderly to be reached in 2006 and 75% in 2010 [39]). As in the years before, the UK exceeded the 2006 goal with the 2006-7 vaccination rate reaching 65.3% in those aged 65 years and older. To arrive at the WHO objectives for 2010, though, additional efforts are required, and this remains a challenge for health organisations, primary healthcare providers, government, and the media.

Competing interests

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