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Seven steps to Increase Influenza Vaccination Rates: Outcomes of a Nationwide Cross-sectional Survey of UK General Practice

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TITLE:

Seven steps to Increase Influenza Vaccination Rates:

Outcomes of a Nationwide Survey of UK General Practice

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ABSTRACT

Objective

To identify practice strategies associated with higher flu vaccination rates in primary care.

Design

Logistic regression analysis of data from a cross-sectional online questionnaire

Setting

795 general practices across England

Participants

569 practice managers, 335 nursing staff and 107 GPs

Primary outcome measures

Flu vaccination rates achieved by each practice in different groups of at-risk patients.

Secondary outcome measures

Practice-level deprivation and ethnicity data; QOF summary scores

Results

Seven independent factors associated with higher vaccine uptake were identified. Having a lead staff member for planning the flu campaign and producing a written report of practice performance predicted an 8% higher vaccination rate for at-risk patients aged <65 years (OR 1.37; 95% CI 1.10 to 1.71). These strategies, plus sending a personal invitation to all eligible patients and only stopping vaccination when QOF targets are reached, predicted a 7% higher vaccination rate (OR 1.45; 95% CI 1.10 to 1.92) in patients ≥65 years. Using a lead member of staff for identifying eligible patients, with

either a modified manufacturer's or in-house search program for interrogating the practice IT system, independently predicted a 4% higher vaccination rate in patients aged ≥65 years (OR 1.22; 95% CI 1.06 to 1.41 / OR 1.20; 95% CI 1.03 to 1.40). The provision of flu vaccine by midwives was associated with a 4% higher vaccination rate in pregnant women (OR 1.19; 1.02 to 1.40).

Conclusion

Clear leadership, effective communication about performance, and methods used to identify and contact eligible patients were independently associated with significantly higher rates of flu vaccination. Financial targets appear to incentivise practices to work harder to maximise seasonal influenza vaccine uptake. The strategies identified here could help primary care providers to substantially increase their seasonal flu vaccination rates towards or even above the CMO's targets.

ARTICLE SUMMARY

Article focus

- Uptake of seasonal influenza vaccination in the UK's at-risk population is below the national and international target of 75%.
- Evidence-based guidance, to advise practices how to optimise all aspects of their flu vaccination campaigns and maximise their likelihood of protecting at-risk patients against flu and its serious sequelae, is greatly needed.
- This study sought to identify which strategies and procedures were associated with higher rates of flu vaccine uptake.

Key messages

- This study has identified seven key strategies that were significantly associated with the success of practices' seasonal flu vaccination campaigns.
- If widely implemented by GP practices, average vaccination rates would be predicted to rise by 7-8% (thereby exceeding the WHO target in patients >65 years).

Strengths and limitations of this study

- The study sample was large and representative, despite a participation rate of only 27.5%.
- Outcome measures (vaccination rates) were objective and corrected for practice size.
- Strategies used to provide and encourage vaccination were self-reported.

INTRODUCTION

Influenza

Influenza (flu) is a common, potentially severe, but preventable infection that places a high burden on patients and healthcare providers [1-3]. A safe and effective inactivated (killed) vaccine is produced ahead of each flu season, based on strain recommendations provided by the World Health Organisation (WHO), and is offered to at-risk groups in the UK free of charge [4-7]. These groups have been chosen based on evidence showing increased risk of severe flu infection or sequelae: epidemiological data from 2010-2011 indicated that patients in a risk group due to chronic disease had a 10-fold greater risk of mortality due to influenza, compared to those who were not in an at-risk group [1]. During the 2010-2011 flu season 602 deaths in the UK were due directly to influenza [1]. Of those who died, approximately two-thirds were in a clinical risk group that is targeted for vaccination, while only 25% had received vaccination for that season.

WHO guidance indicates that developed countries should achieve 75% influenza vaccine coverage in the elderly, while the European Union Council (EC) advises that members should aim to vaccinate 75% of all those at high risk from influenza infection [8 9]. England's Chief Medical Officer (CMO) has instructed that, in 2011-12, each practice should aim to reach or exceed 75% uptake for people aged 65 years or over, and 60% uptake for at-risk people under age 65 (increasing to 75% by 2013/14) [7]. Published data suggests that approximately 27% of England's population was eligible for free flu vaccination in 2010 [10 11]. Providing seasonal influenza vaccination is a large and complex task which is performed well in the UK, in comparison to many other European countries [12]. Over 10 million patients were vaccinated in England in the 2010-11 season: each general practice vaccinating an average of approximately 1000 patients, mostly within a period of 4-6 weeks. The proportion of people aged over 65 years in England who received the 2010/11 influenza vaccine was, at 72.8%, just below the target of 75% [10]. However, both past and current rates of vaccination in the under-65 at-risk groups fall far short of the EC or CMO targets: during 2010/11 the rate achieved was 50.4%; in

pregnant women who were not otherwise at risk it was only 36.6%, despite increasing evidence showing the beneficial effects of protection against flu for both mothers and babies [10 13-15].

A few previous studies have investigated the utility of specific interventions (such as telephone calls or letters) to generate an increase in uptake, but an optimal overall strategy for primary care providers remains undefined [16 17]. In this study, we aimed to investigate the entire process of flu vaccine provision in a wide range of UK general practices, in order to determine the correlates of higher vaccine uptake and to inform comprehensive, evidence-based recommendations for best practice.

METHODS

Survey development

Individual or small-group interviews with GPs, nurses and practice managers from six practices already achieving high rates of flu vaccination in urban (city), semi-rural (market town) and rural (village) areas were carried out, during which staff were asked to identify the factors considered by practices in designing and carrying out their flu vaccination campaigns. The information gained was used to construct three online questionnaires (one each for the participating groups of GPs, practice managers and practice nurses), using the Survey Monkey web-based software [18]. The format of the questions and the layout of the questionnaires were designed to optimise the statistical utility of the data to be collected. The questionnaires were piloted in the same six practices to further ascertain relevance and usability before final distribution.

Questionnaire distribution and survey participants

We aimed to distribute the questionnaires to all registered GPs, practice nursing staff and practice managers within four Strategic Health Authorities (SHAs) (East Midlands, London, West Midlands and Yorkshire and Humber), which together provide care for approximately 40% of the UK population. Details about the survey were sent via the Public Health teams in the participating SHAs and Primary Care Trusts (PCTs), who were requested to cascade the information to all GPs, nurses and practice managers in their area via normal electronic information circulation mechanisms. The same method was used for all other communications with practice staff during the study. A preliminary e-mail, containing a letter informing primary care teams about the forthcoming study, was distributed two weeks before the first survey invitation. Two emails, inviting participation in the survey and containing web links to the online questionnaires, were then distributed in two consecutive weeks during August 2011.

Vaccine uptake data and other comparators

The Immform web service, which is a UK Department of Health website for collecting vaccination data from general practices, was used to obtain practice-level flu vaccination uptake data for the period 1st September 2010 – 28th February 2011 [19]. Actual numbers vaccinated and actual numbers eligible were recorded for 65+ year olds and at-risk groups of <65 year olds, in addition to data showing the total practice population size. Other practice-level data, including summary Quality and Outcomes Framework (QOF) scores (most recent data available, for April 2009-March 2010) and a variety of demographic measures, were obtained in order to identify and/or adjust for other factors which may differentially affect vaccine uptake rates (such as overall practice quality performance, practice size, population ethnicity or population deprivation) [20 21]. The above information was linked to the questionnaire responses by NHS practice code (a unique six-figure identifier); codes were then removed from the dataset prior to analysis.

Statistical analyses

In analysing the responses to the questionnaires, we sought to identify: differences in routine strategies and procedures in flu vaccination campaigns within the different areas surveyed; whether and how these were associated with vaccine uptake rates; and other co-factors associated with vaccine uptake rates. In addition to a full descriptive analysis of the variables recorded in the questionnaires, logistic regression analyses were performed using STATA to compare the proportions of patients vaccinated across different categorical responses in the survey questionnaire. The logistic regression was based upon absolute numbers of patients vaccinated out of the total at-risk, to account for differences in at-risk practice population size. As there was not always complete agreement between responses from different participants in the same practice, robust standard errors were computed using a cluster correction model, thereby generating data corrected to the practice level. Multivariate regression analysis was performed on any 2 or more results from the same group(s) of participants which showed significance at the 95% level on univariable analysis. We then

used the outcomes of these statistical analyses to identify and evaluate the best strategies for carrying out successful and effective flu vaccination campaigns and how (or indeed whether) these may be broadly or specifically adopted.

RESULTS

Fifty PCTs distributed the survey invitation to a total of 2896 practices. Responses were submitted by 569 practice managers, 335 nursing staff and 107 GPs, representing 795 practices (27.5% of those invited to contribute). These practices serve a total of approximately 5.8 million patients, among whom over 1.5 million are eligible for influenza vaccination. The distributions of flu vaccination rates in the surveyed practices were well matched to national patterns (Figure 1). For the majority of eligible patients (i.e. those aged 65 years and above), our findings indicated that the variation between practices' flu vaccination rates was not influenced by differences in the ethnicity or affluence of their patient populations, whereas Quality and Outcomes Framework summary scores showed highly and significant positive correlations with vaccine uptake achieved in both age groups (supplementary table 1). The univariable logistic regression results referred to throughout this section are shown in supplementary table 2.

Staffing

Having a lead member of staff for arranging the practice flu vaccination campaign was associated with increased flu vaccine uptake rates in both 65+ and <65 age groups ($p = 0.001$ and 0.004 respectively). Nominating a staff member with responsibility for identifying eligible patients was associated with increased uptake of vaccine in older age groups ($p = 0.038$), but this trend, although present, did not reach significance in under 65s ($p = 0.218$).

Ordering vaccine

A plot of the number of vaccine doses ordered for 2011-12 versus vaccines used in 2010-11 shows a tight correlation (figure 2a). On average, practices were found to have ordered vaccines based on the number of doses given in the previous season, with an average uplift of 8.8% (95% confidence interval 4.3 – 13.3%; n = 568). As vaccines are ordered as a total, these data could not be differentiated into

doses intended for vaccination of patients aged over or under 65 years old. However, the data showed that only 78.3% of responding practices would have been able to vaccinate at least 75% of their at-risk patients (in accordance with the CMO recommendations) (figure 2b).

Contacting patients

Using personal invitations, either alone or in combination with general publicity, was significantly associated with higher rates of vaccination. The use of personal invitations for all patients (not just those who did not respond to an initial general publicity campaign) was associated with the highest vaccination rates in the larger, 65+ age group ($p = 0.003$), although a similar association did not reach statistical significance in the under 65s. Using both letters and telephone calls was not associated with significantly different vaccination rates than using either letters or phone calls alone ($p = 0.721$ for patients aged 65+; $p = 0.852$ for patients aged <65).

Identifying eligible patients

Programmes for identifying eligible patients from the practices' IT system are usually issued by the software providers. Modifying the IT supplier's standard search or creating a separate in-house search was associated with significantly higher uptake rates for patients aged 65+ than using an unmodified IT supplier's search ($p <0.001$ and 0.027, respectively). A similar trend for under 65s did not reach statistical significance, perhaps due to insufficient power. As older patients are identified simply on the basis of their age at a certain date, which should not require a complicated search strategy, these findings suggest that creating or modifying a system search reflects that the staff in these practices are more motivated and/or experienced to use their IT system to try to achieve their flu vaccination targets.

Offering clinics and appointments

More than 95% of practices held the main vaccination sessions at their usual surgery premises and 75% held the main sessions during normal surgery hours. Most practices reported using a variety of appointment types and timings to provide flu vaccination. Surprisingly, in our data, offering vaccinations at weekends, or before 8am or after 6pm, was not associated with a significant difference in the vaccination uptake rates achieved. Increasing numbers of reminders or repeat invitations were associated with significantly increased vaccine uptake in the under 65 year olds ($p = 0.038$), though not in those aged 65+. Significantly higher rates of vaccination (for under 65s) occurred in practices that identified appointments for flu vaccination using a specific Read code ($p = 0.038$).

Vaccinating pregnant women

The proportion of practices that reported that their community midwives recommended flu vaccination to pregnant women was disappointingly low (57.5%). Furthermore, there was a clear discrepancy between this figure and the proportion that reported that their community midwives actually administered vaccine (17.8%; see figure 3a). Our analysis demonstrated that practices where community midwives were active in administering flu vaccinations to pregnant patients achieved significantly higher rates of uptake in this particular at-risk group ($p = 0.023$).

Ending and reviewing the campaign

A total of 578 practices provided information on what influenced their decision to stop offering flu vaccination. Of major concern was the evidence that almost 50% of practices stopped offering flu vaccines partly, or solely, because they had exhausted their stock. Almost one third (28.9%) cited a financial factor in making their decision and the data showed that ending flu vaccination only once QOF targets had been reached was associated with increased uptake rates for those aged 65+ ($p =$

0.048); in those aged under 65 this was only weakly significant (p = 0.100), perhaps influenced by the smaller numbers of patients in this group. These results suggest that practices that focused on financial targets were motivated and/or organised to continue their efforts to vaccinate patients beyond the point at which other practices may stop. In support of this hypothesis, we found that patients whose vaccination would contribute to a QOF-related payment received an average of 42% (95% CI 33 to 51%) more reminders more than those who did not have a QOF-registered indication for vaccination (p < 0.001).

Practices which produced a written report reviewing their flu vaccination rates achieved very significantly higher vaccination rates in both younger and older age groups, compared to those practices which did not produce a written report (p = 0.006 for patients aged 65+; p = 0.002 for patients aged <65 years). Similarly, reviewing the practice's flu vaccination strategy in a written format was also significantly associated with achieving higher rates of vaccination (p = 0.067 for patients aged 65+; p = 0.028 for patients aged <65 years). This finding suggests that that practices which produced written reports may have been able to organise more rigorous campaigns, and/or have had more well-informed and motivated staff, resulting in more effective performance.

Personal motivations and attitudes of staff

Figure 3b shows a summary of GPs', nurses' and practice managers' views of the flu vaccination campaign. There was a significant association between encouraging vaccination among colleagues and other staff and achieving higher rates of vaccine uptake in patients aged 65 or above (p = 0.004), but not in those aged under 65 years (p = 0.208). There was a trend for a similar association between positive attitudes of staff towards being vaccinated themselves and higher rates of patient vaccination in a practice, but this did not reach statistical significance in either the older or younger age group (p = 0.440 and 0.185 respectively).

Predicted impact of strategies to increase rates of influenza vaccination

Seven factors were found to have significant, independent positive associations with flu vaccine uptake levels following multivariable regression analysis (Tables 1a and 1b). For patients aged <65 years, having a lead member of staff for planning the flu campaign and producing a written report of the practice's performance were associated with a combined odds ratio of 1.37, which predicts an 8% higher flu vaccination rate for practices that employ these strategies compared to those that do not (54% vs. 46%).

In patients aged 65 or over, a further two factors were also found to remain independently correlated with increased rates of flu vaccination. These were sending a personal invitation to all eligible patients and only stopping vaccination when QOF targets are reached. The overall odds ratio associated with the implementation of all four strategies in this age group was 1.45, which predicts a 7% higher vaccination rate in this age group when these strategies are used (78% vs. 71%).

The strategies of using a lead member of staff for identifying eligible patients and either a modified manufacturer's search program or an in-house search program for interrogating the practice IT system were also independently correlated with increased rates of flu vaccination in patients aged 65 years or more. However, the effect seen was weaker as this data is derived from a subset of responses from practice managers only, suggesting a rise to 78% from a baseline of 74%.

The active involvement of midwives in providing flu vaccination was significantly associated with higher levels of vaccine uptake in pregnant women but, as the only significant variable within this group, the finding could not be included in a multivariable analysis. However, applying the odds ratio of 1.20 predicted by the univariable analysis, our data indicates that the provision of vaccination by midwives rather than GPs is associated with an increase in uptake rate to 45% in pregnant women (from an observed average baseline vaccination rate of 41% in our cohort).

DISCUSSION

This study has identified seven factors which GPs might use to improve and maximise uptake of seasonal flu vaccine in at-risk patients. Many of these strategies are common sense and align with the empirical guidance given by the English and Scottish CMOs [22 23], but our study provides the first statistical evidence to support the validity of such approaches. The study sample was large and appeared to be representative of the overall cohort, despite a participation rate of only 27.5%. Although we found no evidence for selection bias of participating practice staff, when the vaccination rates of participating practices were compared with national data, it remains possible that the responses of staff who completed the questionnaire did not reliably represent the views of all practice staff within those participating practices. However, most of our questions sought factual data rather than opinions and so this bias, if present, is likely to be limited.

Numerous patient-related factors affect flu vaccine uptake. Public perception of influenza as a significant threat to health and of vaccination as an effective preventative strategy is associated with higher uptake [24]. People who receive information about these factors from official health sources (particularly GPs or nurses in the primary care setting) and who think that others want them to be vaccinated are more likely to get vaccinated [12 24 25]. In line with this, flu vaccination uptake is greater among older people and others who make routine use of hospital and community care services [26]. Unsurprisingly, fear of side-effects of vaccination is a strong negative influence, while lack of general motivation and ignorance about the recommendations are other commonly reported barriers to both seasonal and pandemic vaccination [27 28]. However, when intensive recall stimuli and information are provided to at-risk patients, as few as 3.5% will refuse vaccination, suggesting that patient attitudes are malleable and should not present a barrier to achieving the CMO's aims [29]. Our results strongly support the provision of personal invitations for all patients (in alternative languages and/or formats, if required), as advised by the CMO [22]. However, we found little evidence of benefit from offering very early (before 8am), late (after 6pm) or weekend appointments. This contradicts some current

guidance [22] and is likely to be of financially relevance for practices. Our findings with respect to the flu vaccination of pregnant women are also important. Although administering flu vaccine is not part of the current role of many midwives, it is logical that the ability both to discuss and to provide vaccination to pregnant women would increase uptake in this risk group by removing the need for referral and attendance at a separate clinic: our analyses now support this logic. However, if midwives were to provide influenza vaccination outside of the practice setting, it would be essential for reliable records of this to be transferred to the GP

The need for good communication with patients, to encourage the uptake of flu vaccination, is axiomatic. However, several statistically significant outcomes of our analyses have not previously been described and are directly or indirectly associated with the quality or extent of communication *within* practices. The production of a written review of practice performance might be associated with higher flu vaccination rates for a number of reasons. Production of such a report indicates that at least one member of staff must be able to access and manipulate the relevant data using their practice's computer systems, and is motivated to do so. Subsequent dissemination of the report allows staff to become aware of their practice's performance and identify areas for improvement. Only 20% of practices in our study produced a written report of vaccine uptake rates and this strategy is not currently recommended in the CMO guidance for England. Our results also indicate that each practice should nominate lead members of staff not only for organising the practice's influenza vaccination campaign (as advised by the English and Scottish CMOs [22 23], but also for identifying at-risk patients from the practice database. This is supported by a recently published study from the US, which suggested that effective use of electronic databases by a skilled data manager could increase the rate of flu vaccination by over 10% [30]. Our study's findings also suggest that the effectiveness of a practice's flu vaccination campaign is increased when staff promote vaccination among themselves, an effect which may arise from increased motivation for the campaign as a whole or through communication of their positive attitude to at-risk patients. This supports the findings of previous studies and should thus contribute to an increased impetus to encourage vaccination of staff [31 32].

There is currently a significant financial risk for practices attempting to improve their vaccination rates. As practices are only reimbursed on the basis of the number of vaccines administered, they face a financial penalty if they buy more doses than are used and sale-or-return schemes are usually limited to a few percent of the vaccine doses in the overall order. Perhaps as a result, we have found that almost 50% of practices currently halt their vaccination campaigns due to exhaustion of vaccine stocks. A central procurement strategy for flu vaccines, which has recently undergone consultation by the Department of Health, should remove this financial stricture and allow practices to aim for much higher vaccination rates without risking financial penalty [33]. However, this will also result in the loss of a significant proportion of practices' funding for flu vaccination (i.e. that which is currently derived from any discrepancy between tariff price and purchased price for the vaccine itself). Considerable effort and resources are required to deliver a successful flu vaccination campaign, and our findings indicate that practices' efforts can be influenced by financial motivations. The pursuit of QOF targets for flu vaccination requires practice staff to be able to perform complex interrogations of their patient database and to be aware of rates of vaccine uptake while the flu vaccination campaign is progressing. Our data suggests that pursuing the QOF targets may motivate practices to maintain vaccine stocks and encourage extra patients to receive vaccine. We would not advise that practices should automatically stop vaccinating patients once their QOF targets have been attained. However, our findings suggest that a scale of financially-supported targets applicable across all patient groups, or the inclusion of flu vaccination of all at-risk patients in the QOF scheme, might be a powerful tool to increase flu vaccine uptake.

Current vaccines achieve around 50-80% protection against influenza and associated sequelae in at-risk groups [4 34-36]. However, these efficacy rates do not translate into public health protection if the vaccine is not delivered effectively to the communities that need it. With flu vaccination rates varying from 15 to 100% (Figure 1) between the worst and best practices in our nationwide cohort, there is the potential for enormous gains to be made. This study has identified seven simple steps that can improve our performance and increase the protection of at-risk patients.

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Data sharing: the availability of additional data is subject to consent for its dissemination from the Department of Health Central Commissioning Facility. Neither the study sponsor nor the funder played any role in study design; in the collection, analysis, and interpretation of data; in the writing of the report; or in the decision to submit the article for publication. All authors had access to the study data (including statistical reports and tables) and can take responsibility for the integrity of the data and the accuracy of the data analysis.

Contributors: LJD designed, carried out and coordinated analysis and reporting of the study, and also drafted and revised this manuscript. MDT contributed to statistical aspects of design, carried out the

formal data analysis and contributed to the manuscript. MD and ANS contributed to primary care and policy aspects of study design and interpretation and also revised the manuscript. RCR contributed to study design and interpretation and revised the manuscript. He is guarantor.

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36. Osterholm MT, Kelley NS, Sommer A, et al. Efficacy and effectiveness of influenza vaccines: a systematic review and meta-analysis. *Lancet Infect Dis* 2011.

Figure 1

Box and whisker plots showing the range and distribution of influenza vaccination uptake rates for patients aged 65 years + (blue boxes and bars) and at-risk patients aged under 65 years (red boxes and bars). The distribution of uptake rates for non-participating practices (N = 2101) and participating practices (N = 795) are not significantly different.

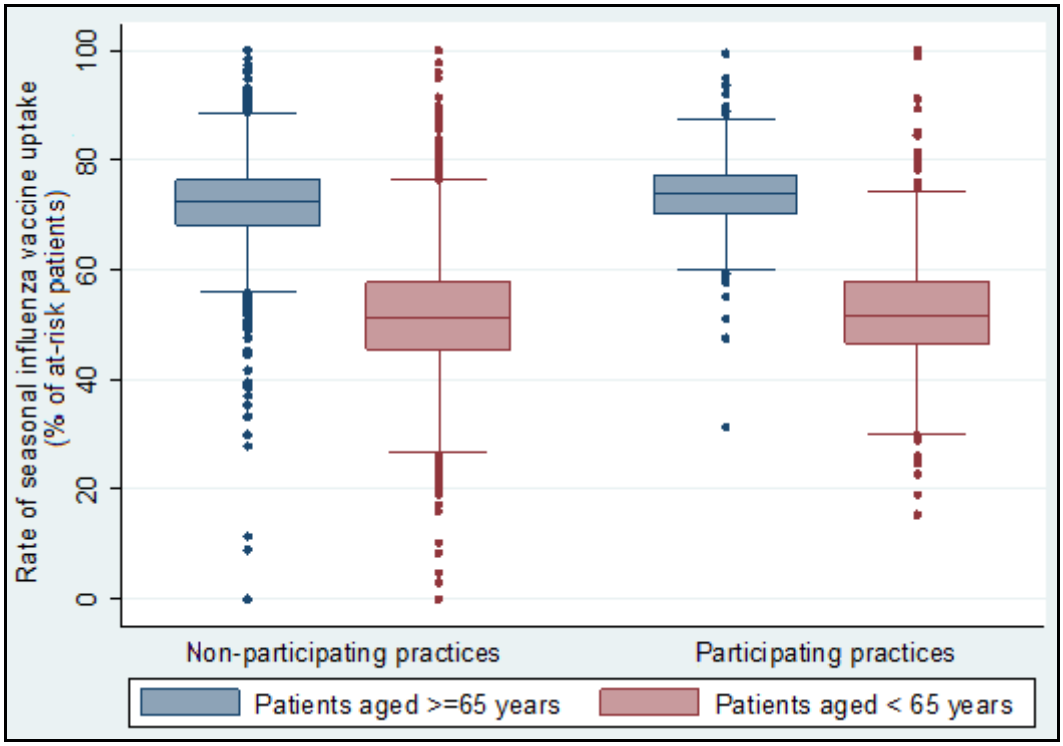
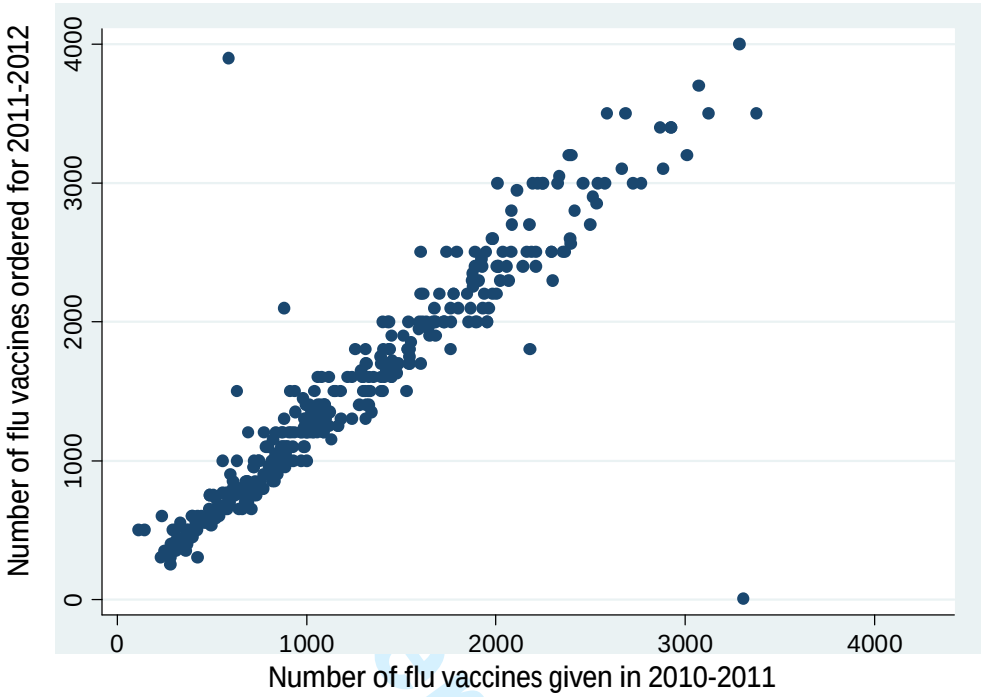


Figure 2

(a) Relationship between reported total number of vaccine doses ordered for the 2011-2012 season and actual number of doses administered in 2010-2011 (n = 568), and (b) Plot showing the maximum average achievable vaccination rates for the 2011-2012 season, based on the total number of vaccine doses ordered and the total number of eligible patients. Red line indicates the CMO's target of 75%.

(a)



(b)

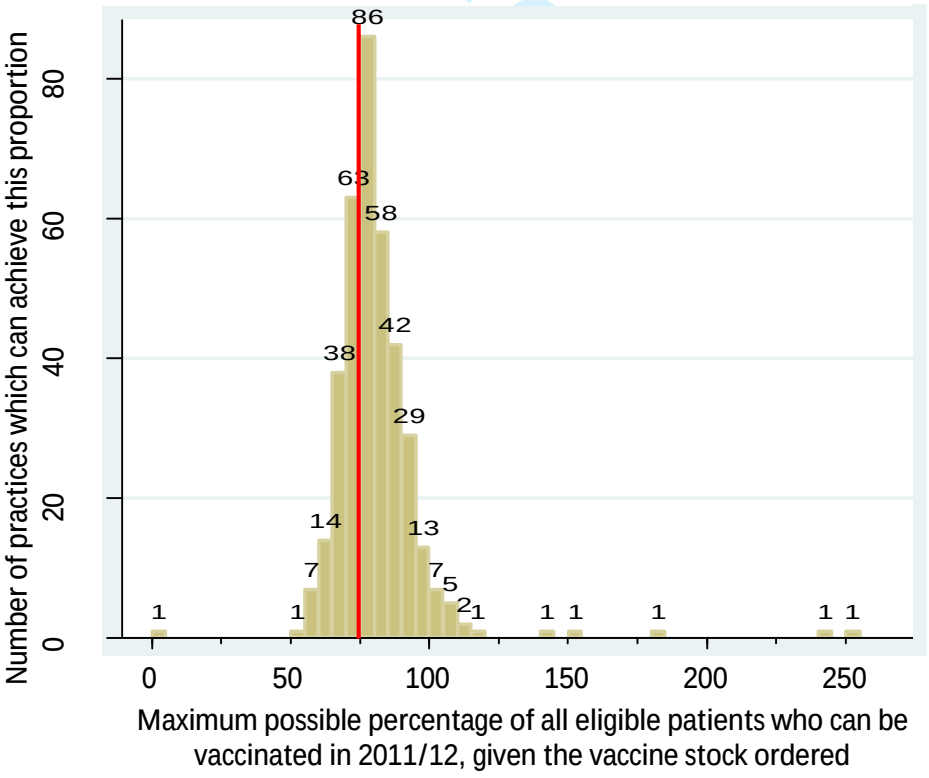


Figure 3

Showing (a) the reported activity of community midwifery teams in recommending and providing seasonal influenza vaccination to pregnant women, and (b) the attitudes of participating healthcare workers to vaccination of colleagues and themselves

Table 1a

Statistically significant results found on multivariate regression analysis of responses from all three types of staff (GPs, nursing staff and practice managers)

Factor	Patient age group	Regression co-efficient	95% CI	p-value	Number of clusters
Producing a written report to review flu vaccine uptake rates	≥ 65 years	0.065	0.023 – 0.107	0.010	659
	< 65 years	0.113	0.042 – 0.184	0.002	783
Having a lead member of staff for planning the practice's flu vaccination campaign	≥ 65 years	0.144	0.035 – 0.253	0.010	659
	< 65 years	0.203	0.054 – 0.352	0.008	783
Sending a personal invitation to all eligible patients	≥ 65 years	0.081	0.035 – 0.127	0.001	659
	< 65 years	*Not tested as not significant on univariate analysis*			
Only stopping vaccination when QOF targets are reached	≥ 65 years	0.085	0.004 – 0.166	0.039	659
	< 65 years	*Not tested as not significant on univariate analysis*			

Table 1b

Statistically significant results found on multivariate regression analysis of responses from practice managers only

Factor	Patient age group	Regression co-efficient	95% CI	p-value	Number of clusters
Identifying eligible patients using a modified manufacturer's search program	≥ 65 years	0.115	0.056 – 0.175	0.000	395
Identifying eligible patients using an in-house search program	≥ 65 years	0.096	0.028 – 0.163	0.006	395
Having a lead member of staff for identifying eligible patients in the practice	≥ 65 years	0.086	0.001 – 0.170	0.046	395

Supplementary table 1

Showing results of linear regression analyses of relationship between seasonal flu vaccination uptake rates, for patients aged 65+ (clear cells) and patients aged under 65 (shaded cells), by ethnicity; deprivation; and Quality and Outcomes Framework summary scores [n = 795].

Factor	Regression coefficient	95% confidence interval	p-value
Increasing proportion of white ethnicity	0.015	-0.014 to 0.043	0.305
	-0.140	-0.167 to -0.114	<0.001
Increasing index of multiple deprivation (IMD) score	-0.0009	-0.0015 to -0.0007	<0.001
	0.0001	-0.0017 to 0.0004	0.380
Increasing Quality and Outcomes Framework (QOF) score	1.430	1.299 to 1.561	<0.001
	0.918	0.781 to 1.054	<0.001

Supplementary table 2

Showing factor analysed, number of respondents, and results of logistic regression analyses of responses with respect to flu vaccination uptake rates in patients aged 65 years and over (clear boxes), uptake rates in patients aged under 65 years (shaded boxes) and uptake rates in otherwise healthy pregnant women (hatched boxes). Calculations were performed using Stata and incorporate robust cluster adjustment to reflect the number of responding practices (where appropriate).

Factor	Respondents			Baseline	Comparator	Regression co-efficient	95% confidence interval	p-value	Number of clusters
	PM	PN	GP						
Lead member of staff for planning seasonal flu vaccination	568	336	105	Yes	No	0.185	0.075 – 0.295	0.001	783
						0.220	0.069 – 0.371	0.004	
Dedicated member of staff for identifying eligible patients	414	N/A	N/A	No	Yes	0.087	0.005 – 0.169	0.038	397
						0.080	-0.048 – 0.208	0.218	
Use of a dedicated IT code to record appointment bookings for vaccination	414	N/A	N/A	No	Yes	0.006	-0.054 – 0.066	0.844	380
						0.092	0.005 – 0.179	0.038	
Methods used to encourage patients to attend for vaccination	415	304	107	General publicity only	General publicity & personal invitation for all	0.105	0.032 – 0.177	0.005	662
						0.010	-0.019 – 0.226	0.097	
				General publicity & personal invitation for non-responders	General publicity & personal invitation for all	0.074	0.025 – 0.124	0.003	595
						0.042	-0.243 – 0.109	0.215	
Personal invitation methods used to invite patients to attend for vaccination	362	N/A	N/A	Letter *or* telephone calls	Letter *and* telephone calls	0.011	-0.051 – 0.073	0.721	338
						-0.009	-0.107 – 0.882	0.852	
Number of reminders provided if the patient does not respond	320	N/A	N/A	Increasing numbers of reminders		-0.018	-0.047 – 0 .011	0.225	309
						0.041	0.002 – 0.079	0.038	
Vaccination is offered before 8am	395	295	N/A	No	Yes	0.014	-0.041 – 0.069	0.625	596
						-0.032	-0.111 – 0.048	0.434	
Vaccination is offered after 6pm	395	295	N/A	No	Yes	0.015	-0.030 – 0.061	0.506	595
						0.011	-0.054 – 0.077	0.733	
Vaccination is offered at weekends	395	295	N/A	No	Yes	-0.005	-0.054 - 0.044	0.834	594
						0.003	-0.996 – 0.105	0.961	
Local midwives recommend vaccine to pregnant women	369	N/A	N/A	Do not agree	Agree	0.050	-0.087 – 0.187	0.474	356
Local midwives provide vaccine to pregnant women	376	NA	NA	Do not agree	Agree	0.178	0.024 –0.333	0.023	356
Vaccination campaign is stopped when QOF targets are reached	565	334	106	No	Yes	0.078	0.001 – 0.155	0.048	791
						0.070	-0.014 – 0.153	0.100	
How flu vaccination uptake rates are reviewed	565	334	106	No written report	Written report	0.057	0.016 – 0.098	0.006	791
						0.119	0.044 – 0.195	0.002	
How the practice flu vaccination strategy is reviewed	543	N/A	87	No written report	Written report	0.076	-0.005 – 0.158	0.067	559
						0.175	0.019 – 0.330	0.028	
Staff encourage colleagues to receive vaccination	350	253	106	Do not agree	Agree	0.079	0.026 – 0.132	0.004	575
						0.055	-0.030 – 0.139	0.208	
Staff themselves happy to have the flu vaccine	347	253	106	Do not agree	Agree	0.019	-0.029 – 0.067	0.440	574
						0.060	-0.029 – 0.149	0.185	

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	3
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	6
Objectives	3	State specific objectives, including any prespecified hypotheses	7
Methods			
Study design	4	Present key elements of study design early in the paper	8
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	8
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	8
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	8,9,35,36
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	9
Bias	9	Describe any efforts to address potential sources of bias	9
Study size	10	Explain how the study size was arrived at	NA
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	9
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	9
		(*b*) Describe any methods used to examine subgroups and interactions	8,9,32,33
		(*c*) Explain how missing data were addressed	8,9,35.36
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	NA
		(*e*) Describe any sensitivity analyses	NA
Results			

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	8,11,36
		(b) Give reasons for non-participation at each stage	NA
		(c) Consider use of a flow diagram	NA
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	11,32.33
		(b) Indicate number of participants with missing data for each variable of interest	NA
Outcome data	15*	Report numbers of outcome events or summary measures	11-15,35,36
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	11-15,35,36
		(*b*) Report category boundaries when continuous variables were categorized	35,36
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	NA
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	11-15,35,36
Discussion			
Key results	18	Summarise key results with reference to study objectives	16,18
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	16
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	16-18
Generalisability	21	Discuss the generalisability (external validity) of the study results	16-18
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	19

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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Seven steps to Increase Influenza Vaccination Rates: Outcomes of a Nationwide Cross-sectional Survey of Strategies used in UK General Practice

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Seven steps to Increase Influenza Vaccination Rates:

Outcomes of a Nationwide Survey of Strategies used in UK General Practice

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ABSTRACT

Objective

To identify practice strategies associated with higher flu vaccination rates in primary care.

Design

Logistic regression analysis of data from a cross-sectional online questionnaire

Setting

795 general practices across England

Participants

569 practice managers, 335 nursing staff and 107 GPs

Primary outcome measures

Flu vaccination rates achieved by each practice in different groups of at-risk patients.

~~*Secondary outcome measures*~~

~~Practice-level deprivation and ethnicity data; QOF summary scores~~

Results

Seven independent factors associated with higher vaccine uptake were identified. Having a lead staff member for planning the flu campaign and producing a written report of practice performance predicted an 8% higher vaccination rate for at-risk patients aged <65 years (OR 1.37; 95% CI 1.10 to 1.71). These strategies, plus sending a personal invitation to all eligible patients and only stopping vaccination when QOF targets are reached, predicted a 7% higher vaccination rate (OR 1.45; 95% CI 1.10 to 1.92) in patients ≥65 years. Using a lead member of staff for identifying eligible patients, with

either a modified manufacturer's or in-house search program for interrogating the practice IT system, independently predicted a 4% higher vaccination rate in patients aged ≥65 years (OR 1.22; 95% CI 1.06 to 1.41 / OR 1.20; 95% CI 1.03 to 1.40). The provision of flu vaccine by midwives was associated with a 4% higher vaccination rate in pregnant women (OR 1.19; 1.02 to 1.40).

Conclusion

Clear leadership, effective communication about performance, and methods used to identify and contact eligible patients were independently associated with significantly higher rates of flu vaccination. Financial targets appear to incentivise practices to work harder to maximise seasonal influenza vaccine uptake. The strategies identified here could help primary care providers to substantially increase their seasonal flu vaccination rates towards or even above the CMO's targets.

ARTICLE SUMMARY

Article focus

- Uptake of seasonal influenza vaccination in the UK's at-risk population is below the national and international target of 75%.
- Evidence-based guidance, to advise practices how to optimise all aspects of their flu vaccination campaigns and maximise their likelihood of protecting at-risk patients against flu and its serious sequelae, is greatly needed.
- This study sought to identify which strategies and procedures were associated with higher rates of flu vaccine uptake.

Key messages

- This study has identified seven key strategies that were significantly associated with the success of practices' seasonal flu vaccination campaigns.
- If widely implemented by GP practices, average vaccination rates would be predicted to rise by 7-8% (thereby exceeding the WHO target in patients >65 years).

Strengths and limitations of this study

- The study sample was large and representative, despite a participation rate of only 27.5%.
- Outcome measures (vaccination rates) were objective and corrected for practice size.
- Strategies used to provide and encourage vaccination were self-reported.

INTRODUCTION

Influenza

Influenza (flu) is a common, potentially severe, but preventable infection that places a high burden on patients and healthcare providers [1-3]. A safe and effective inactivated (killed) vaccine is produced ahead of each flu season, based on strain recommendations provided by the World Health Organisation (WHO), and is offered to at-risk groups in the UK free of charge [4-7]. These groups have been chosen based on evidence showing increased risk of severe flu infection or sequelae: epidemiological data from 2010-2011 indicated that patients in a risk group due to chronic disease had a 10-fold greater risk of mortality due to influenza, compared to those who were not in an at-risk group [1]. During the 2010-2011 flu season 602 deaths in the UK were due directly to influenza [1]. Of those who died, approximately two-thirds were in a clinical risk group that is targeted for vaccination, while only 25% had received vaccination for that season.

WHO guidance indicates that developed countries should achieve 75% influenza vaccine coverage in the elderly, while the European Union Council (EC) advises that members should aim to vaccinate 75% of all those at high risk from influenza infection [8 9]. England's Chief Medical Officer (CMO) has instructed that, in 2011-12, each practice should aim to reach or exceed 75% uptake for people aged 65 years or over, and 60% uptake for at-risk people under age 65 (increasing to 75% by 2013/14) [7]. Published data suggests that approximately 27% of England's population was eligible for free flu vaccination in 2010 [10 11]. Providing seasonal influenza vaccination is a large and complex task which is performed well in the UK, in comparison to many other European countries [12]. Over 10 million patients were vaccinated in England in the 2010-11 season: each general practice vaccinating an average of approximately 1000 patients, mostly within a period of 4-6 weeks. The proportion of people aged over 65 years in England who received the 2010/11 influenza vaccine was, at 72.8%, just below the target of 75% [10]. However, both past and current rates of vaccination in the under-65 at-risk groups fall far short of the EC or CMO targets: during 2010/11 the rate achieved was 50.4%; in

pregnant women who were not otherwise at risk it was only 36.6%, despite increasing evidence showing the beneficial effects of protection against flu for both mothers and babies [10 13-15].

A few previous studies have investigated the utility of specific interventions (such as telephone calls or letters) to generate an increase in uptake, but an optimal overall strategy for primary care providers remains undefined [16 17]. In this study, we aimed to investigate the entire process of flu vaccine provision in a wide range of UK general practices, in order to determine the correlates of higher vaccine uptake and to inform comprehensive, evidence-based recommendations for best practice.

METHODS

Survey development

Individual or small-group interviews with GPs, nurses and practice managers from six practices already achieving high rates of flu vaccination in urban (city), semi-rural (market town) and rural (village) areas were carried out, during which staff were asked to identify the factors considered by practices in designing and carrying out their flu vaccination campaigns. The information gained was used to construct three online questionnaires (one each for the participating groups of GPs, practice managers and practice nurses), using the Survey Monkey web-based software [18]. The format of the questions and the layout of the questionnaires were designed to optimise the statistical utility of the data to be collected. The questionnaires were piloted in the same six practices to further ascertain relevance and usability before final distribution.

Questionnaire distribution and survey participants

We aimed to distribute the questionnaires to all registered GPs, practice nursing staff and practice managers within four Strategic Health Authorities (SHAs) (East Midlands, London, West Midlands and Yorkshire and Humber), which together provide care for approximately 40% of the UK population. Details about the survey were sent via the Public Health teams in the participating SHAs ~~and Primary Care Trusts (PCTs)~~, who were requested to cascade the information to ~~all~~ members of individual primary care teams (GPs, nurses and practice managers) in their area via normal electronic information circulation mechanisms. The same method was used for all other communications with ~~practice staff~~participants during the study. A preliminary e-mail, containing a letter informing primary care teams about the forthcoming study, was distributed two weeks before the first survey invitation. Two emails, inviting participation in the survey and containing web links to the online questionnaires, were then distributed in two consecutive weeks during August 2011.

Vaccine uptake data and other comparators

The Immform web service, which is a UK Department of Health website for collecting vaccination data from general practices, was used to obtain practice-level flu vaccination uptake data for the period 1st September 2010 – 28th February 2011 [19]. Actual numbers vaccinated and actual numbers eligible were recorded for 65+ year olds and at-risk ~~groups of~~ <65 year olds (including pregnant women). These are standard groups used for targeting and measuring influenza vaccine uptake by the WHO), ~~in addition to data showing the~~ . Total practice population size was also recorded. Other practice-level data, including summary Quality and Outcomes Framework (QOF) scores (most recent data available, for April 2009-March 2010) and a variety of demographic measures, were obtained in order to identify and/or adjust for other factors which may differentially affect vaccine uptake rates (such as overall practice quality performance, practice size, population ethnicity or population deprivation) [20 21]. QOF is a programme of annual financial rewards for GP surgeries, which forms part of the GP contract in England and Wales[22]. The above information was linked to the questionnaire responses by NHS practice code (a unique six-figure identifier); codes were then removed from the dataset prior to analysis.

Statistical analyses

~~In analysing the responses to the questionnaires, we sought to identify: differences in routine strategies and procedures in flu vaccination campaigns within the different areas surveyed; whether and how these were associated with vaccine uptake rates; and other co-factors associated with vaccine uptake rates.~~ In addition to a full descriptive analysis of the variables recorded in the questionnaires, logistic regression analyses were performed using STATA to compare the proportions of patients vaccinated across different categorical responses in the survey questionnaire. The logistic regression was based upon absolute numbers of patients vaccinated out of the total at-risk, to account for differences in at-risk practice population size. Potentially confounding variables, such as total practice size, Index of Multiple deprivation and proportion white ethnicity, were analysed for

correlation with vaccination uptake and adjusted for in the univariable analyses where appropriate.

As there was not always complete agreement between responses from different participants in the same practice, robust standard errors were computed using a cluster correction model, thereby generating data corrected to the practice level. Multivariate regression analysis was then performed on any 2 or more results from the same ~~group~~subset(s) of participants (i.e. practice managers, nurses and/or GPs) which showed significance at the 95% level on univariable analysis. ~~We then used the outcomes of these statistical analyses to identify and evaluate the best strategies for carrying out successful and effective flu vaccination campaigns and how (or indeed whether) these may be broadly or specifically adopted.~~

RESULTS

Fifty PCTs distributed the survey invitation to a total of 2896 practices. Responses were submitted by 569 practice managers, 335 nursing staff and 107 GPs, representing 795 practices (27.5% of those invited to contribute). These practices serve a total of approximately 5.8 million patients, among whom over 1.5 million are eligible for influenza vaccination. The distributions of flu vaccination rates in the surveyed practices were well matched to national patterns (Figure 1). For the majority of eligible patients (i.e. those aged 65 years and above), our findings indicated that the variation between practices' flu vaccination rates was not influenced by differences in the ethnicity or affluence of their patient populations, whereas Quality and Outcomes Framework summary scores showed highly and significant positive correlations with vaccine uptake achieved in both age groups (supplementary table 1). The univariable logistic regression results referred to throughout this section are shown in supplementary table 2.

Staffing

Having a lead member of staff for arranging the practice flu vaccination campaign was associated with increased flu vaccine uptake rates in both 65+ and <65 age groups ($p = 0.001$ and 0.004 respectively). Nominating a staff member with responsibility for identifying eligible patients was associated with increased uptake of vaccine in older age groups ($p = 0.038$), but this trend, although present, did not reach significance in under 65s ($p = 0.218$).

Ordering vaccine

A plot of the number of vaccine doses ordered for 2011-12 versus vaccines used in 2010-11 shows a tight correlation (figure 2a). On average, practices were found to have ordered vaccines based on the number of doses given in the previous season, with an average uplift of 8.8% (95% confidence interval 4.3 – 13.3%; n = 568). As vaccines are ordered as a total, these data could not be differentiated into

doses intended for vaccination of patients aged over or under 65 years old. However, the data showed that only 78.3% of responding practices would have been able to vaccinate at least 75% of their at-risk patients (in accordance with the CMO recommendations) (figure 2b).

Contacting patients

Using personal invitations, either alone or in combination with general publicity, was significantly associated with higher rates of vaccination. The use of personal invitations for all patients (not just those who did not respond to an initial general publicity campaign) was associated with the highest vaccination rates in the larger, 65+ age group ($p = 0.003$), although a similar association did not reach statistical significance in the under 65s. Using both letters and telephone calls was not associated with significantly different vaccination rates than using either letters or phone calls alone ($p = 0.721$ for patients aged 65+; $p = 0.852$ for patients aged <65).

Identifying eligible patients

Programmes for identifying eligible patients from the practices' IT system are usually issued by the software providers. Modifying the IT supplier's standard search or creating a separate in-house search was associated with significantly higher uptake rates for patients aged 65+ than using an unmodified IT supplier's search ($p <0.001$ and 0.027, respectively). A similar trend for under 65s did not reach statistical significance, perhaps due to insufficient power. As older patients are identified simply on the basis of their age at a certain date, which should not require a complicated search strategy, these findings suggest that creating or modifying a system search reflects that the staff in these practices are more motivated and/or experienced to use their IT system to try to achieve their flu vaccination targets.

Offering clinics and appointments

More than 95% of practices held the main vaccination sessions at their usual surgery premises and 75% held the main sessions during normal surgery hours. Most practices reported using a variety of appointment types and timings to provide flu vaccination. Surprisingly, in our data, offering vaccinations at weekends, or before 8am or after 6pm, was not associated with a significant difference in the vaccination uptake rates achieved. Increasing numbers of reminders or repeat invitations were associated with significantly increased vaccine uptake in the under 65 year olds ($p = 0.038$), though not in those aged 65+. Significantly higher rates of vaccination (for under 65s) occurred in practices that identified appointments for flu vaccination using a specific Read (computer identification) code ($p = 0.038$).

Vaccinating pregnant women

The proportion of practices that reported that their community midwives recommended flu vaccination to pregnant women was disappointingly low (57.5%). Furthermore, there was a clear discrepancy between this figure and the proportion that reported that their community midwives actually administered vaccine (17.8%; see figure 3a). Our analysis demonstrated that practices where community midwives were active in administering flu vaccinations to pregnant patients achieved significantly higher rates of uptake in this particular at-risk group ($p = 0.023$).

Ending and reviewing the campaign

A total of 578 practices provided information on what influenced their decision to stop offering flu vaccination. Of major concern was the evidence that almost 50% of practices stopped offering flu vaccines partly, or solely, because they had exhausted their stock. Almost one third (28.9%) cited a financial factor in making their decision and the data showed that ending flu vaccination only once QOF targets had been reached was associated with increased uptake rates for those aged 65+ ($p =$

0.048); in those aged under 65 this was only weakly significant (p = 0.100), perhaps influenced by the smaller numbers of patients in this group. These results suggest that practices that focused on financial targets were motivated and/or organised to continue their efforts to vaccinate patients beyond the point at which other practices may stop. In support of this hypothesis, we found that patients whose vaccination would contribute to a QOF-related payment received an average of 42% (95% CI 33 to 51%) more reminders more than those who did not have a QOF-registered indication for vaccination (p < 0.001).

Practices which produced a written report reviewing their flu vaccination rates achieved very significantly higher vaccination rates in both younger and older age groups, compared to those practices which did not produce a written report (p = 0.006 for patients aged 65+; p = 0.002 for patients aged <65 years). Similarly, reviewing the practice's flu vaccination strategy in a written format was also significantly associated with achieving higher rates of vaccination (p = 0.067 for patients aged 65+; p = 0.028 for patients aged <65 years). This finding suggests that that practices which produced written reports may have been able to organise more rigorous campaigns, and/or have had more well-informed and motivated staff, resulting in more effective performance.

Personal motivations and attitudes of staff

Figure 3b shows a summary of GPs', nurses' and practice managers' views of the flu vaccination campaign. There was a significant association between encouraging vaccination among colleagues and other staff and achieving higher rates of vaccine uptake in patients aged 65 or above (p = 0.004), but not in those aged under 65 years (p = 0.208). There was a trend for a similar association between positive attitudes of staff towards being vaccinated themselves and higher rates of patient vaccination in a practice, but this did not reach statistical significance in either the older or younger age group (p = 0.440 and 0.185 respectively).

Predicted impact of strategies to increase rates of influenza vaccination

Seven factors were found to have significant, independent positive associations with flu vaccine uptake levels following multivariable regression analysis (Tables 1a and 1b). For patients aged <65 years, having a lead member of staff for planning the flu campaign and producing a written report of the practice's performance were associated with a combined odds ratio of 1.37, which predicts an 8% higher flu vaccination rate for practices that employ these strategies compared to those that do not (54% vs. 46%).

In patients aged 65 or over, a further two factors were also found to remain independently correlated with increased rates of flu vaccination. These were sending a personal invitation to all eligible patients and only stopping vaccination when QOF targets are reached. The overall odds ratio associated with the implementation of all four strategies in this age group was 1.45, which predicts a 7% higher vaccination rate in this age group when these strategies are used (78% vs. 71%).

The strategies of using a lead member of staff for identifying eligible patients and either a modified manufacturer's search program or an in-house search program for interrogating the practice IT system were also independently correlated with increased rates of flu vaccination in patients aged 65 years or more. However, the effect seen was weaker as this data is derived from a subset of responses from practice managers only, suggesting a rise to 78% from a baseline of 74%.

The active involvement of midwives in providing flu vaccination was significantly associated with higher levels of vaccine uptake in pregnant women but, as the only significant variable within this group, the finding could not be included in a multivariable analysis. However, applying the odds ratio of 1.20 predicted by the univariable analysis, our data indicates that the provision of vaccination by midwives rather than GPs is associated with an increase in uptake rate to 45% in pregnant women (from an observed average baseline vaccination rate of 41% in our cohort).

DISCUSSION

This study has identified seven factors which GPs might use to improve and maximise uptake of seasonal flu vaccine in at-risk patients. Many of these strategies are common sense and align with the empirical guidance given by the English and Scottish CMOs [23 24], but our study provides the first statistical evidence to support the validity of such approaches. The study sample was large and appeared to be representative of the overall cohort, despite a participation rate of only 27.5%. Although we found no evidence for selection bias of participating practice staff, when the vaccination rates of participating practices were compared with national data, it remains possible that the responses of staff who completed the questionnaire did not reliably represent the views of all practice staff within those participating practices. However, most of our questions sought factual data rather than opinions and so this bias, if present, is likely to be limited.

This study focused on identifying strategies and approaches that GPs might use or influence to improve vaccine uptake. However, numerous patient-related factors also affect flu vaccine uptake. Highly mobile or ethnically diverse populations may prove very difficult to contact and target for flu vaccination. It is also likely that a minority of patients will always refuse or miss vaccination, no matter how much GPs strive to provide it. Public perception of influenza as a significant threat to health and of vaccination as an effective preventative strategy is associated with higher uptake [25]. People who receive information about these factors from official health sources (particularly GPs or nurses in the primary care setting) and who think that others want them to be vaccinated are more likely to get vaccinated [12 25 26]. In line with this, flu vaccination uptake is greater among older people and others who make routine use of hospital and community care services [27]. Unsurprisingly, fear of side-effects of vaccination is a strong negative influence, while lack of general motivation and ignorance about the recommendations are other commonly reported barriers to both seasonal and pandemic vaccination [28 29]. However, when intensive recall stimuli and information are provided to at-risk patients, as few as 3.5% will refuse vaccination, suggesting that patient attitudes are malleable

and should not present a barrier to achieving the CMO's aims [30]. Our results strongly support the provision of personal invitations for all patients (in alternative languages and/or formats, if required), as advised by the CMO [23]. However, we found little evidence of benefit from offering very early (before 8am), late (after 6pm) or weekend appointments. This contradicts some current guidance [23] and is likely to be of financially relevance for practices. Our findings with respect to the flu vaccination of pregnant women are also important. Although administering flu vaccine is not part of the current role of many midwives, it is logical that the ability both to discuss and to provide vaccination to pregnant women would increase uptake in this risk group by removing the need for referral and attendance at a separate clinic: our analyses now support this logic. However, if midwives were to provide influenza vaccination outside of the practice setting, it would be essential for reliable records of this to be transferred to the GP

The need for good communication with patients, to encourage the uptake of flu vaccination, is axiomatic. However, several statistically significant outcomes of our analyses have not previously been described and are directly or indirectly associated with the quality or extent of communication *within* practices. The production of a written review of practice performance might be associated with higher flu vaccination rates for a number of reasons. Production of such a report indicates that at least one member of staff must be able to access and manipulate the relevant data using their practice's computer systems, and is motivated to do so. Subsequent dissemination of the report allows staff to become aware of their practice's performance and identify areas for improvement. Only 20% of practices in our study produced a written report of vaccine uptake rates and this strategy is not currently recommended in the CMO guidance for England. Our results also indicate that each practice should nominate lead members of staff not only for organising the practice's influenza vaccination campaign (as advised by the English and Scottish CMOs [23 24], but also for identifying at-risk patients from the practice database. This is supported by a recently published study from the US, which suggested that effective use of electronic databases by a skilled data manager could increase the rate of flu vaccination by over 10% [31]. Our study's findings also suggest that the effectiveness of a

practice's flu vaccination campaign is increased when staff promote vaccination among themselves, an effect which may arise from increased motivation for the campaign as a whole or through communication of their positive attitude to at-risk patients. This supports the findings of previous studies and should thus contribute to an increased impetus to encourage vaccination of staff [32 33].

There is currently a significant financial risk for practices attempting to improve their vaccination rates. As practices are only reimbursed on the basis of the number of vaccines administered, they face a financial penalty if they buy more doses than are used and sale-or-return schemes are usually limited to a few percent of the vaccine doses in the overall order. Perhaps as a result, we have found that almost 50% of practices currently halt their vaccination campaigns due to exhaustion of vaccine stocks. A central procurement strategy for flu vaccines, which has recently undergone consultation by the Department of Health, should remove this financial stricture and allow practices to aim for much higher vaccination rates without risking financial penalty [34]. However, this will also result in the loss of a significant proportion of practices' funding for flu vaccination (i.e. that which is currently derived from any discrepancy between tariff price and purchased price for the vaccine itself). Considerable effort and resources are required to deliver a successful flu vaccination campaign, and our findings indicate that practices' efforts can be influenced by financial motivations. The pursuit of QOF targets for flu vaccination requires practice staff to be able to perform complex interrogations of their patient database and to be aware of rates of vaccine uptake while the flu vaccination campaign is progressing. Our data suggests that pursuing the QOF targets may motivate practices to maintain vaccine stocks and encourage extra patients to receive vaccine. We would not advise that practices should automatically stop vaccinating patients once their QOF targets have been attained. However, our findings suggest that a scale of financially-supported targets applicable across all patient groups, or the inclusion of flu vaccination of all at-risk patients in the QOF scheme, might be a powerful tool to increase flu vaccine uptake.

Current vaccines achieve around 50-80% protection against influenza and associated sequelae in at-risk groups [4 35-37]. However, these efficacy rates do not translate into public health protection if the

vaccine is not delivered effectively to the communities that need it. With flu vaccination rates varying from 15 to 100% (Figure 1) between the worst and best practices in our nationwide cohort, there is the potential for enormous gains to be made. This study has identified seven simple steps that can improve our performance and increase the protection of at-risk patients.

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Data sharing: the availability of additional data is subject to consent for its dissemination from the Department of Health Central Commissioning Facility. Neither the study sponsor nor the funder played any role in study design; in the collection, analysis, and interpretation of data; in the writing of the report; or in the decision to submit the article for publication. All authors had access to the study data (including statistical reports and tables) and can take responsibility for the integrity of the data and the accuracy of the data analysis.

Contributors: LJD designed, carried out and coordinated analysis and reporting of the study, and also drafted and revised this manuscript. MDT contributed to statistical aspects of design, carried out the

formal data analysis and contributed to the manuscript. MD and ANS contributed to primary care and policy aspects of study design and interpretation and also revised the manuscript. RCR contributed to study design and interpretation and revised the manuscript. He is guarantor.

All authors have completed the Unified Competing Interest form at www.icmje.org/coi_disclosure.pdf (available on request from the corresponding author) and declare that (1) LJD, MDT, MD, ANS and RCR have no support from companies for the submitted work; (2) LJD, MDT, MD, ANS and RCR have no relationships with companies that might have an interest in the submitted work in the previous 3 years; (3) their spouses, partners, or children have no financial relationships that may be relevant to the submitted work; and (4) LJD, MDT, MD, ANS and RCR have no non-financial interests that may be relevant to the submitted work.

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Figure 1

Box and whisker plots showing the range and distribution of influenza vaccination uptake rates for patients aged 65 years + (blue boxes and bars) and at-risk patients aged under 65 years (red boxes and bars). The distribution of uptake rates for non-participating practices (N = 2101) and participating practices (N = 795) are not significantly different.

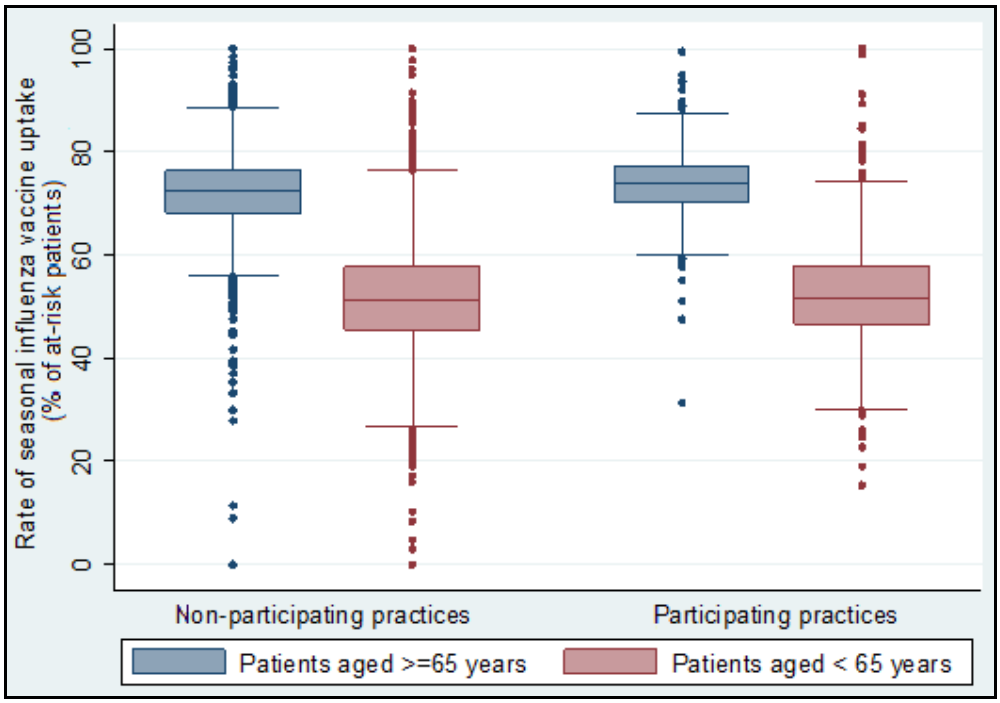
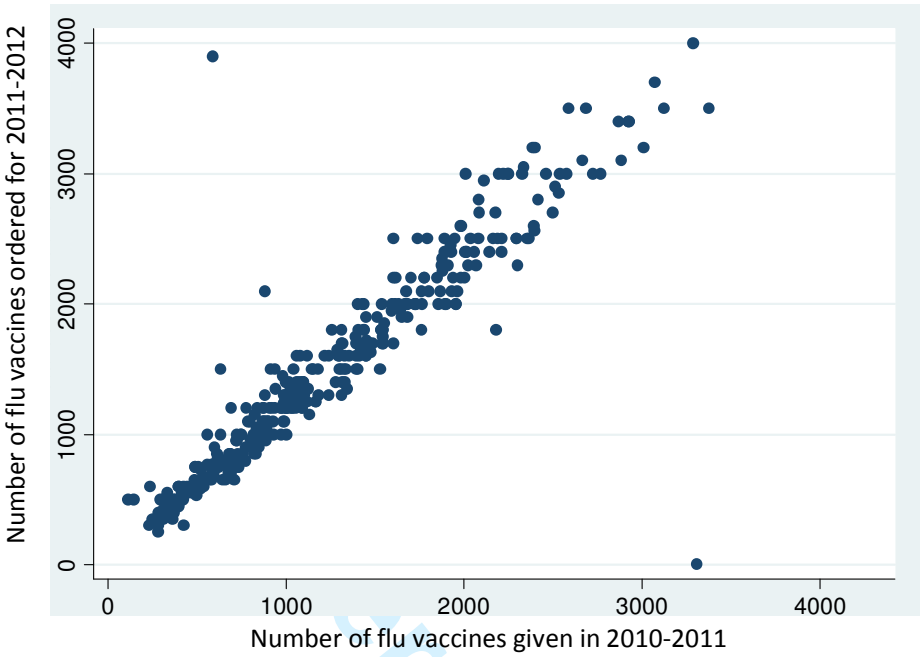


Figure 2

(a) Relationship between reported total number of vaccine doses ordered for the 2011-2012 season and actual number of doses administered in 2010-2011 (n = 568), and (b) Plot showing the maximum average achievable vaccination rates for the 2011-2012 season, based on the total number of vaccine doses ordered and the total number of eligible patients. Red line indicates the CMO's target of 75%.

(a)



(b)

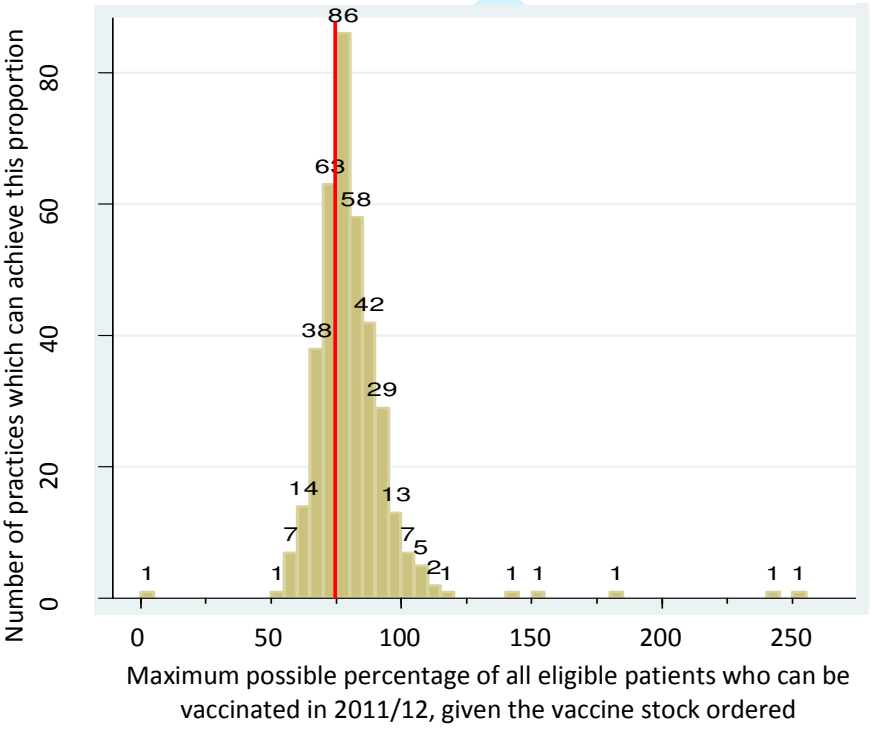


Figure 3

Showing (a) the reported activity of community midwifery teams in recommending and providing seasonal influenza vaccination to pregnant women, and (b) the attitudes of participating healthcare workers to vaccination of colleagues and themselves

Table 1a

Statistically significant ~~results~~ factors found on multivariate regression analysis of responses ~~from~~ common to all three types of staff (GPs, nursing staff and practice managers)

Description of significant factor	Regression co-efficient	95% CI	p-value	Number of clusters
For patients aged ≥65 years				
Producing a written report to review flu vaccine uptake rates	0.065	0.023 – 0.107	0.010	659
Having a lead member of staff for planning the practice's flu vaccination campaign	0.144	0.035 – 0.253	0.010	659
Sending a personal invitation to all eligible patients	0.081	0.035 – 0.127	0.001	659
Only stopping vaccination when QOF targets are reached	0.085	0.004 – 0.166	0.039	659
For at-risk patients aged <65 years				
Producing a written report to review flu vaccine uptake rates	0.113	0.042 – 0.184	0.002	783
Having a lead member of staff for planning the practice's flu vaccination campaign	0.203	0.054 – 0.352	0.008	783

Table 1b

Statistically significant ~~results~~ factors found on multivariate regression analysis of responses from practice managers only

Description of significant factor	Regression co-efficient	95% CI	p-value	Number of clusters
For patients aged ≥65 years				
Identifying eligible patients using a modified manufacturer's search program	0.115	0.056 – 0.175	0.000	395
Identifying eligible patients using an in-house search program	0.096	0.028 – 0.163	0.006	395
Having a lead member of staff for identifying eligible patients in the practice	0.086	0.001 – 0.170	0.046	395
For at-risk patients aged <65 years: no significant factors were identified by multiple regression				

Supplementary table 1

Showing results of linear regression analyses of relationship between seasonal flu vaccination uptake rates, for patients aged 65+ (clear cells) and patients aged under 65 (shaded cells), by ethnicity; deprivation; and Quality and Outcomes Framework summary scores [n = 795].

Factor	Regression coefficient	95% confidence interval	p-value
Increasing proportion of white ethnicity	0.015	-0.014 to 0.043	0.305
	-0.140	-0.167 to -0.114	<0.001
Increasing index of multiple deprivation (IMD) score	-0.0009	-0.0015 to -0.0007	<0.001
	0.0001	-0.0017 to 0.0004	0.380
Increasing Quality and Outcomes Framework (QOF) score	1.430	1.299 to 1.561	<0.001
	0.918	0.781 to 1.054	<0.001

Supplementary table 2

Showing factor analysed, number of respondents, and results of logistic regression analyses of responses with respect to flu vaccination uptake rates in patients aged 65 years and over (clear boxes), uptake rates in patients aged under 65 years (shaded boxes) and uptake rates in otherwise healthy pregnant women (hatched boxes). Calculations were performed using Stata and incorporate robust cluster adjustment to reflect the number of responding practices (where appropriate).

Factor	Respondents			Baseline	Comparator	Regression co-efficient	95% confidence interval	p-value	Number of clusters
	PM	PN	GP						
Lead member of staff for planning seasonal flu vaccination	568	336	105	Yes	No	0.185	0.075 – 0.295	0.001	783
						0.220	0.069 – 0.371	0.004	
Dedicated member of staff for identifying eligible patients	414	N/A	N/A	No	Yes	0.087	0.005 – 0.169	0.038	397
						0.080	-0.048 – 0.208	0.218	
Use of a dedicated IT code to record appointment bookings for vaccination	414	N/A	N/A	No	Yes	0.006	-0.054 – 0.066	0.844	380
						0.092	0.005 – 0.179	0.038	
Methods used to encourage patients to attend for vaccination	415	304	107	General publicity only	General publicity & personal invitation for all	0.105	0.032 – 0.177	0.005	662
						0.010	-0.019 – 0.226	0.097	
				General publicity & personal invitation for non-responders	General publicity & personal invitation for all	0.074	0.025 – 0.124	0.003	595
						0.042	-0.243 – 0.109	0.215	
Personal invitation methods used to invite patients to attend for vaccination	362	N/A	N/A	Letter *or* telephone calls	Letter *and* telephone calls	0.011	-0.051 – 0.073	0.721	338
						-0.009	-0.107 – 0.882	0.852	
Number of reminders provided if the patient does not respond	320	N/A	N/A	Increasing numbers of reminders		-0.018	-0.047 – 0 .011	0.225	309
						0.041	0.002 – 0.079	0.038	
Vaccination is offered before 8am	395	295	N/A	No	Yes	0.014	-0.041 – 0.069	0.625	596
						-0.032	-0.111 – 0.048	0.434	
Vaccination is offered after 6pm	395	295	N/A	No	Yes	0.015	-0.030 – 0.061	0.506	595
						0.011	-0.054 – 0.077	0.733	
Vaccination is offered at weekends	395	295	N/A	No	Yes	-0.005	-0.054 - 0.044	0.834	594
						0.003	-0.996 – 0.105	0.961	
Local midwives recommend vaccine to pregnant women	369	N/A	N/A	Do not agree	Agree	0.050	-0.087 – 0.187	0.474	356
Local midwives provide vaccine to pregnant women	376	NA	NA	Do not agree	Agree	0.178	0.024 –0.333	0.023	356
Vaccination campaign is stopped when QOF targets are reached	565	334	106	No	Yes	0.078	0.001 – 0.155	0.048	791
						0.070	-0.014 – 0.153	0.100	
How flu vaccination uptake rates are reviewed	565	334	106	No written report	Written report	0.057	0.016 – 0.098	0.006	791
						0.119	0.044 – 0.195	0.002	
How the practice flu vaccination strategy is reviewed	543	N/A	87	No written report	Written report	0.076	-0.005 – 0.158	0.067	559
						0.175	0.019 – 0.330	0.028	
Staff encourage colleagues to receive vaccination	350	253	106	Do not agree	Agree	0.079	0.026 – 0.132	0.004	575
						0.055	-0.030 – 0.139	0.208	
Staff themselves happy to have the flu vaccine	347	253	106	Do not agree	Agree	0.019	-0.029 – 0.067	0.440	574
						0.060	-0.029 – 0.149	0.185	

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	3
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	6
Objectives	3	State specific objectives, including any prespecified hypotheses	7
Methods			
Study design	4	Present key elements of study design early in the paper	8
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	8
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	8
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	8,9,35,36
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	9
Bias	9	Describe any efforts to address potential sources of bias	9
Study size	10	Explain how the study size was arrived at	NA
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	9
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	9
		(*b*) Describe any methods used to examine subgroups and interactions	8,9,32,33
		(*c*) Explain how missing data were addressed	8,9,35.36
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	NA
		(*e*) Describe any sensitivity analyses	NA
Results			

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	8,11,36
		(b) Give reasons for non-participation at each stage	NA
		(c) Consider use of a flow diagram	NA
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	11,32.33
		(b) Indicate number of participants with missing data for each variable of interest	NA
Outcome data	15*	Report numbers of outcome events or summary measures	11-15,35,36
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	11-15,35,36
		(*b*) Report category boundaries when continuous variables were categorized	35,36
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	NA
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	11-15,35,36
Discussion			
Key results	18	Summarise key results with reference to study objectives	16,18
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	16
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	16-18
Generalisability	21	Discuss the generalisability (external validity) of the study results	16-18
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	19

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

Strategies to Increase Influenza Vaccination Rates: Outcomes of a Nationwide Cross-sectional Survey of UK General Practice

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ABSTRACT

Objective

To identify practice strategies associated with higher flu vaccination rates in primary care.

Design

Logistic regression analysis of data from a cross-sectional online questionnaire

Setting

795 general practices across England

Participants

569 practice managers, 335 nursing staff and 107 GPs

Primary outcome measures

Flu vaccination rates achieved by each practice in different groups of at-risk patients.

Results

Seven independent factors associated with higher vaccine uptake were identified. Having a lead staff member for planning the flu campaign and producing a written report of practice performance predicted an 8% higher vaccination rate for at-risk patients aged <65 years (OR 1.37; 95% CI 1.10 to 1.71). These strategies, plus sending a personal invitation to all eligible patients and only stopping vaccination when QOF targets are reached, predicted a 7% higher vaccination rate (OR 1.45; 95% CI 1.10 to 1.92) in patients ≥65 years. Using a lead member of staff for identifying eligible patients, with either a modified manufacturer's or in-house search program for interrogating the practice IT system, independently predicted a 4% higher vaccination rate in patients aged ≥65 years (OR 1.22; 95% CI

1.06 to 1.41 / OR 1.20; 95% CI 1.03 to 1.40). The provision of flu vaccine by midwives was associated with a 4% higher vaccination rate in pregnant women (OR 1.19; 1.02 to 1.40).

Conclusion

Clear leadership, effective communication about performance, and methods used to identify and contact eligible patients were independently associated with significantly higher rates of flu vaccination. Financial targets appear to incentivise practices to work harder to maximise seasonal influenza vaccine uptake. The strategies identified here could help primary care providers to substantially increase their seasonal flu vaccination rates towards or even above the CMO's targets.

ARTICLE SUMMARY

Article focus

- Uptake of seasonal influenza vaccination in the UK's at-risk population is below the national and international target of 75%.
- Evidence-based guidance, to advise practices how to optimise all aspects of their flu vaccination campaigns and maximise their likelihood of protecting at-risk patients against flu and its serious sequelae, is greatly needed.
- This study sought to identify which strategies and procedures were associated with higher rates of flu vaccine uptake.

Key messages

- This study has identified seven key strategies that were significantly associated with the success of practices' seasonal flu vaccination campaigns.
- If widely implemented by GP practices, average vaccination rates would be predicted to rise by 7-8% (thereby exceeding the WHO target in patients >65 years).

Strengths and limitations of this study

- The study sample was large and representative, despite a participation rate of only 27.5%.
- Outcome measures (vaccination rates) were objective and corrected for practice size.
- Strategies used to provide and encourage vaccination were self-reported.

INTRODUCTION

Influenza

Influenza (flu) is a common, potentially severe, but preventable infection that places a high burden on patients and healthcare providers [1 2]. A safe and effective inactivated (killed) vaccine is produced ahead of each flu season, based on strain recommendations provided by the World Health Organisation (WHO), and is offered to at-risk groups in the UK free of charge [3-6]. These groups have been chosen based on evidence showing increased risk of severe flu infection or sequelae: epidemiological data from 2010-2011 indicated that patients in a risk group due to chronic disease had a 10-fold greater risk of mortality due to influenza, compared to those who were not in an at-risk group [1]. During the 2010-2011 flu season 602 deaths in the UK were due directly to influenza [1]. Of those who died, approximately two-thirds were in a clinical risk group that is targeted for vaccination, while only 25% had received vaccination for that season.

WHO guidance indicates that developed countries should achieve 75% influenza vaccine coverage in the elderly, while the European Union Council (EC) advises that members should aim to vaccinate 75% of all those at high risk from influenza infection [7 8]. England's Chief Medical Officer (CMO) has instructed that, in 2011-12, each practice should aim to reach or exceed 75% uptake for people aged 65 years or over, and 60% uptake for at-risk people under age 65 (increasing to 75% by 2013/14) [6]. Published data suggests that approximately 27% of England's population was eligible for free flu vaccination in 2010 [9 10]. Providing seasonal influenza vaccination is a large and complex task which is performed well in the UK, in comparison to many other European countries [11]. Over 10 million patients were vaccinated in England in the 2010-11 season: each general practice vaccinating an average of approximately 1000 patients, mostly within a period of 4-6 weeks. The proportion of people aged over 65 years in England who received the 2010/11 influenza vaccine was, at 72.8%, just below the target of 75% [9]. However, both past and current rates of vaccination in the under-65 at-risk groups fall far short of the EC or CMO targets: during 2010/11 the rate achieved was 50.4%; in

pregnant women who were not otherwise at risk it was only 36.6%, despite increasing evidence showing the beneficial effects of protection against flu for both mothers and babies [9 12-14].

A few previous studies have investigated the utility of specific interventions (such as telephone calls or letters) to generate an increase in uptake, but an optimal overall strategy for primary care providers remains undefined [15 16]. In this study, we aimed to investigate the entire process of flu vaccine provision in a wide range of UK general practices, in order to determine the correlates of higher vaccine uptake and to inform comprehensive, evidence-based recommendations for best practice.

METHODS

Survey development

Individual or small-group interviews with GPs, nurses and practice managers from six practices already achieving high rates of flu vaccination in urban (city), semi-rural (market town) and rural (village) areas were carried out, during which staff were asked to identify the factors considered by practices in designing and carrying out their flu vaccination campaigns. The information gained was used to construct three online questionnaires (one each for the participating groups of GPs, practice managers and practice nurses), using the Survey Monkey web-based software [17]. The format of the questions and the layout of the questionnaires were designed to optimise the statistical utility of the data to be collected. The questionnaires were piloted in the same six practices to further ascertain relevance and usability before final distribution.

Questionnaire distribution and survey participants

We aimed to distribute the questionnaires to all registered GPs, practice nursing staff and practice managers within four Strategic Health Authorities (SHAs) (East Midlands, London, West Midlands and Yorkshire and Humber), which together provide care for approximately 40% of the UK population. Details about the survey were sent via the Public Health teams in the participating SHAs, who were requested to cascade the information to members of individual primary care teams (GPs, nurses and practice managers) in their area via normal electronic information circulation mechanisms. The same method was used for all other communications with participants during the study. A preliminary e-mail, containing a letter informing primary care teams about the forthcoming study, was distributed two weeks before the first survey invitation. Two emails, inviting participation in the survey and containing web links to the online questionnaires, were then distributed in two consecutive weeks during August 2011.

Vaccine uptake data and other comparators

The Immform web service, which is a UK Department of Health website for collecting vaccination data from general practices, was used to obtain practice-level flu vaccination uptake data for the period 1st September 2010 – 28th February 2011 [18]. Actual numbers vaccinated and actual numbers eligible were recorded for 65+ year olds and at-risk <65 year olds (including pregnant women). These are standard groups used for targeting and measuring influenza vaccine uptake by the WHO), . Total practice population size was also recorded. Other practice-level data, including summary Quality and Outcomes Framework (QOF) scores (most recent data available, for April 2009-March 2010) and a variety of demographic measures, were obtained in order to identify and/or adjust for other factors which may differentially affect vaccine uptake rates (such as overall practice quality performance, practice size, population ethnicity or population deprivation) [19 20]. QOF is a programme of annual financial rewards for GP surgeries, which forms part of the GP contract in England and Wales[21]. The above information was linked to the questionnaire responses by NHS practice code (a unique six-figure identifier); codes were then removed from the dataset prior to analysis.

Statistical analyses

In addition to a full descriptive analysis of the variables recorded in the questionnaires, logistic regression analyses were performed using STATA to compare the proportions of patients vaccinated across different categorical responses in the survey questionnaire. The logistic regression was based upon absolute numbers of patients vaccinated out of the total at-risk, to account for differences in at-risk practice population size. Potentially confounding variables, such as total practice size, Index of Multiple deprivation and proportion white ethnicity, were analysed for correlation with vaccination uptake and adjusted for in the univariable analyses where appropriate. As there was not always complete agreement between responses from different participants in the same practice, robust standard errors were computed using a cluster correction model, thereby generating data corrected to the practice level. Multivariate regression analysis was then performed on any 2 or more results

from the same subset(s) of participants (i.e. practice managers, nurses and/or GPs) which showed significance at the 95% level on univariable analysis.

RESULTS

Fifty PCTs distributed the survey invitation to a total of 2896 practices. Responses were submitted by 569 practice managers, 335 nursing staff and 107 GPs, representing 795 practices (27.5% of those invited to contribute). These practices serve a total of approximately 5.8 million patients, among whom over 1.5 million are eligible for influenza vaccination. The distributions of flu vaccination rates in the surveyed practices were well matched to national patterns (Figure 1). For the majority of eligible patients (i.e. those aged 65 years and above), our findings indicated that the variation between practices' flu vaccination rates was not influenced by differences in the ethnicity or affluence of their patient populations, whereas Quality and Outcomes Framework summary scores showed highly and significant positive correlations with vaccine uptake achieved in both age groups (supplementary table 1). The univariable logistic regression results referred to throughout this section are shown in supplementary table 2.

Staffing

Having a lead member of staff for arranging the practice flu vaccination campaign was associated with increased flu vaccine uptake rates in both 65+ and <65 age groups ($p = 0.001$ and 0.004 respectively). Nominating a staff member with responsibility for identifying eligible patients was associated with increased uptake of vaccine in older age groups ($p = 0.038$), but this trend, although present, did not reach significance in under 65s ($p = 0.218$).

Ordering vaccine

A plot of the number of vaccine doses ordered for 2011-12 versus vaccines used in 2010-11 shows a tight correlation (figure 2a). On average, practices were found to have ordered vaccines based on the number of doses given in the previous season, with an average uplift of 8.8% (95% confidence interval 4.3 – 13.3%; n = 568). As vaccines are ordered as a total, these data could not be differentiated into

doses intended for vaccination of patients aged over or under 65 years old. However, the data showed that only 78.3% of responding practices would have been able to vaccinate at least 75% of their at-risk patients (in accordance with the CMO recommendations) (figure 2b).

Contacting patients

Using personal invitations, either alone or in combination with general publicity, was significantly associated with higher rates of vaccination. The use of personal invitations for all patients (not just those who did not respond to an initial general publicity campaign) was associated with the highest vaccination rates in the larger, 65+ age group ($p = 0.003$), although a similar association did not reach statistical significance in the under 65s. Using both letters and telephone calls was not associated with significantly different vaccination rates than using either letters or phone calls alone ($p = 0.721$ for patients aged 65+; $p = 0.852$ for patients aged <65).

Identifying eligible patients

Programmes for identifying eligible patients from the practices' IT system are usually issued by the software providers. Modifying the IT supplier's standard search or creating a separate in-house search was associated with significantly higher uptake rates for patients aged 65+ than using an unmodified IT supplier's search ($p <0.001$ and 0.027, respectively). A similar trend for under 65s did not reach statistical significance, perhaps due to insufficient power. As older patients are identified simply on the basis of their age at a certain date, which should not require a complicated search strategy, these findings suggest that creating or modifying a system search reflects that the staff in these practices are more motivated and/or experienced to use their IT system to try to achieve their flu vaccination targets.

Offering clinics and appointments

More than 95% of practices held the main vaccination sessions at their usual surgery premises and 75% held the main sessions during normal surgery hours. Most practices reported using a variety of appointment types and timings to provide flu vaccination. Surprisingly, in our data, offering vaccinations at weekends, or before 8am or after 6pm, was not associated with a significant difference in the vaccination uptake rates achieved. Increasing numbers of reminders or repeat invitations were associated with significantly increased vaccine uptake in the under 65 year olds ($p = 0.038$), though not in those aged 65+. Significantly higher rates of vaccination (for under 65s) occurred in practices that identified appointments for flu vaccination using a specific Read (computer identification) code ($p = 0.038$).

Vaccinating pregnant women

The proportion of practices that reported that their community midwives recommended flu vaccination to pregnant women was disappointingly low (57.5%). Furthermore, there was a clear discrepancy between this figure and the proportion that reported that their community midwives actually administered vaccine (17.8%; see figure 3a). Our analysis demonstrated that practices where community midwives were active in administering flu vaccinations to pregnant patients achieved significantly higher rates of uptake in this particular at-risk group ($p = 0.023$).

Ending and reviewing the campaign

A total of 578 practices provided information on what influenced their decision to stop offering flu vaccination. Of major concern was the evidence that almost 50% of practices stopped offering flu vaccines partly, or solely, because they had exhausted their stock. Almost one third (28.9%) cited a financial factor in making their decision and the data showed that ending flu vaccination only once QOF targets had been reached was associated with increased uptake rates for those aged 65+ ($p =$

0.048); in those aged under 65 this was only weakly significant (p = 0.100), perhaps influenced by the smaller numbers of patients in this group. These results suggest that practices that focused on financial targets were motivated and/or organised to continue their efforts to vaccinate patients beyond the point at which other practices may stop. In support of this hypothesis, we found that patients whose vaccination would contribute to a QOF-related payment received an average of 42% (95% CI 33 to 51%) more reminders more than those who did not have a QOF-registered indication for vaccination (p < 0.001).

Practices which produced a written report reviewing their flu vaccination rates achieved very significantly higher vaccination rates in both younger and older age groups, compared to those practices which did not produce a written report (p = 0.006 for patients aged 65+; p = 0.002 for patients aged <65 years). Similarly, reviewing the practice's flu vaccination strategy in a written format was also significantly associated with achieving higher rates of vaccination (p = 0.067 for patients aged 65+; p = 0.028 for patients aged <65 years). This finding suggests that that practices which produced written reports may have been able to organise more rigorous campaigns, and/or have had more well-informed and motivated staff, resulting in more effective performance.

Personal motivations and attitudes of staff

Figure 3b shows a summary of GPs', nurses' and practice managers' views of the flu vaccination campaign. There was a significant association between encouraging vaccination among colleagues and other staff and achieving higher rates of vaccine uptake in patients aged 65 or above (p = 0.004), but not in those aged under 65 years (p = 0.208). There was a trend for a similar association between positive attitudes of staff towards being vaccinated themselves and higher rates of patient vaccination in a practice, but this did not reach statistical significance in either the older or younger age group (p = 0.440 and 0.185 respectively).

Predicted impact of strategies to increase rates of influenza vaccination

Seven factors were found to have significant, independent positive associations with flu vaccine uptake levels following multivariable regression analysis (Tables 1a and 1b). For patients aged <65 years, having a lead member of staff for planning the flu campaign and producing a written report of the practice's performance were associated with a combined odds ratio of 1.37, which predicts an 8% higher flu vaccination rate for practices that employ these strategies compared to those that do not (54% vs. 46%).

In patients aged 65 or over, a further two factors were also found to remain independently correlated with increased rates of flu vaccination. These were sending a personal invitation to all eligible patients and only stopping vaccination when QOF targets are reached. The overall odds ratio associated with the implementation of all four strategies in this age group was 1.45, which predicts a 7% higher vaccination rate in this age group when these strategies are used (78% vs. 71%).

The strategies of using a lead member of staff for identifying eligible patients and either a modified manufacturer's search program or an in-house search program for interrogating the practice IT system were also independently correlated with increased rates of flu vaccination in patients aged 65 years or more. However, the effect seen was weaker as this data is derived from a subset of responses from practice managers only, suggesting a rise to 78% from a baseline of 74%.

The active involvement of midwives in providing flu vaccination was significantly associated with higher levels of vaccine uptake in pregnant women but, as the only significant variable within this group, the finding could not be included in a multivariable analysis. However, applying the odds ratio of 1.20 predicted by the univariable analysis, our data indicates that the provision of vaccination by midwives rather than GPs is associated with an increase in uptake rate to 45% in pregnant women (from an observed average baseline vaccination rate of 41% in our cohort).

DISCUSSION

This study has identified seven factors which GPs might use to improve and maximise uptake of seasonal flu vaccine in at-risk patients. Many of these strategies are common sense and align with the empirical guidance given by the English and Scottish CMOs [22 23], but our study provides the first statistical evidence to support the validity of such approaches. The study sample was large and appeared to be representative of the overall cohort, despite a participation rate of only 27.5%. Although we found no evidence for selection bias of participating practice staff, when the vaccination rates of participating practices were compared with national data, it remains possible that the responses of staff who completed the questionnaire did not reliably represent the views of all practice staff within those participating practices. However, most of our questions sought factual data rather than opinions and so this bias, if present, is likely to be limited.

This study focused on identifying strategies and approaches that GPs might use or influence to improve vaccine uptake. However, numerous patient-related factors also affect flu vaccine uptake. Highly mobile or ethnically diverse populations may prove very difficult to contact and target for flu vaccination. It is also likely that a minority of patients will always refuse or miss vaccination, no matter how much GPs strive to provide it. Public perception of influenza as a significant threat to health and of vaccination as an effective preventative strategy is associated with higher uptake [24]. People who receive information about these factors from official health sources (particularly GPs or nurses in the primary care setting) and who think that others want them to be vaccinated are more likely to get vaccinated [11 24 25]. In line with this, flu vaccination uptake is greater among older people and others who make routine use of hospital and community care services [26]. Unsurprisingly, fear of side-effects of vaccination is a strong negative influence, while lack of general motivation and ignorance about the recommendations are other commonly reported barriers to both seasonal and pandemic vaccination [27 28]. However, when intensive recall stimuli and information are provided to at-risk patients, as few as 3.5% will refuse vaccination, suggesting that patient attitudes are malleable

and should not present a barrier to achieving the CMO's aims [29]. Our results strongly support the provision of personal invitations for all patients (in alternative languages and/or formats, if required), as advised by the CMO [22]. However, we found little evidence of benefit from offering very early (before 8am), late (after 6pm) or weekend appointments. This contradicts some current guidance [22] and is likely to be of financially relevance for practices. Our findings with respect to the flu vaccination of pregnant women are also important. Although administering flu vaccine is not part of the current role of many midwives, it is logical that the ability both to discuss and to provide vaccination to pregnant women would increase uptake in this risk group by removing the need for referral and attendance at a separate clinic: our analyses now support this logic. However, if midwives were to provide influenza vaccination outside of the practice setting, it would be essential for reliable records of this to be transferred to the GP

The need for good communication with patients, to encourage the uptake of flu vaccination, is axiomatic. However, several statistically significant outcomes of our analyses have not previously been described and are directly or indirectly associated with the quality or extent of communication *within* practices. The production of a written review of practice performance might be associated with higher flu vaccination rates for a number of reasons. Production of such a report indicates that at least one member of staff must be able to access and manipulate the relevant data using their practice's computer systems, and is motivated to do so. Subsequent dissemination of the report allows staff to become aware of their practice's performance and identify areas for improvement. Only 20% of practices in our study produced a written report of vaccine uptake rates and this strategy is not currently recommended in the CMO guidance for England. Our results also indicate that each practice should nominate lead members of staff not only for organising the practice's influenza vaccination campaign (as advised by the English and Scottish CMOs [22 23], but also for identifying at-risk patients from the practice database. This is supported by a recently published study from the US, which suggested that effective use of electronic databases by a skilled data manager could increase the rate of flu vaccination by over 10% [30]. The ability to perform a modified or in-house search of the

practice's patient database is unlikely to improve the simple process of identification of those aged over 65 years. However, a member of staff who is thoroughly familiar with the IT system may be more able to contribute to improved rates of vaccination by, for example: monitoring levels of appointment bookings and vaccine uptake in real-time throughout the campaign; generating automatic invitation and reminder letters, text messages or emails; creating alert flags on the patient record to promote opportunist vaccination. Our study's findings also suggest that the effectiveness of a practice's flu vaccination campaign is increased when staff promote vaccination among themselves, an effect which may arise from increased motivation for the campaign as a whole or through communication of their positive attitude to at-risk patients. This supports the findings of previous studies and should thus contribute to an increased impetus to encourage vaccination of staff [31 32].

The relationship between staff motivation and practice performance is neither simple nor exclusive. Individuals may have different motivations and their interaction within a larger team may produce variable outcomes. We do not argue that introducing written reports and/or tailoring the practice search strategies would necessarily increase motivation. However, in practices where these actions are not already undertaken, their introduction would ensure that staff become more aware of the practice's performance and the underlying mechanisms that influence it. Having found a highly significant correlation of these strategies with increased vaccine uptake, we propose that increased awareness and knowledge may help to increase staff motivation. However, our study was not designed to measure motivation per se or its effects in isolation and this would be an interesting (though challenging) area for further study.

There is currently a significant financial risk for practices attempting to improve their vaccination rates. As practices are only reimbursed on the basis of the number of vaccines administered, they face a financial penalty if they buy more doses than are used and sale-or-return schemes are usually limited to a few percent of the vaccine doses in the overall order. Perhaps as a result, we have found that almost 50% of practices currently halt their vaccination campaigns due to exhaustion of vaccine stocks. A central procurement strategy for flu vaccines, which has recently undergone consultation by

the Department of Health, should remove this financial stricture and allow practices to aim for much higher vaccination rates without risking financial penalty [33]. However, this will also result in the loss of a significant proportion of practices' funding for flu vaccination (i.e. that which is currently derived from any discrepancy between tariff price and purchased price for the vaccine itself). Considerable effort and resources are required to deliver a successful flu vaccination campaign, and our findings indicate that practices' efforts can be influenced by financial motivations. The pursuit of QOF targets for flu vaccination requires practice staff to be able to perform complex interrogations of their patient database and to be aware of rates of vaccine uptake while the flu vaccination campaign is progressing. Our data suggests that pursuing the QOF targets may motivate practices to maintain vaccine stocks and encourage extra patients to receive vaccine. We would not advise that practices should automatically stop vaccinating patients once their QOF targets have been attained. However, our findings suggest that a scale of financially-supported targets applicable across all patient groups, or the inclusion of flu vaccination of all at-risk patients in the QOF scheme, might be a powerful tool to increase flu vaccine uptake.

Current vaccines achieve around 50-80% protection against influenza and associated sequelae in at-risk groups [3 34-36]. However, these efficacy rates do not translate into public health protection if the vaccine is not delivered effectively to the communities that need it. With flu vaccination rates varying from 15 to 100% (Figure 1) between the worst and best practices in our nationwide cohort, there is the potential for enormous gains to be made. This study has identified seven simple steps that can improve our performance and increase the protection of at-risk patients.

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Data sharing: the availability of additional data is subject to consent for its dissemination from the Department of Health Central Commissioning Facility. Neither the study sponsor nor the funder played any role in study design; in the collection, analysis, and interpretation of data; in the writing of the report; or in the decision to submit the article for publication. All authors had access to the study data (including statistical reports and tables) and can take responsibility for the integrity of the data and the accuracy of the data analysis.

Contributors: LJD designed, carried out and coordinated analysis and reporting of the study, and also drafted and revised this manuscript. MDT contributed to statistical aspects of design, carried out the

formal data analysis and contributed to the manuscript. MD and ANS contributed to primary care and policy aspects of study design and interpretation and also revised the manuscript. RCR contributed to study design and interpretation and revised the manuscript. He is guarantor.

All authors have completed the Unified Competing Interest form at www.icmje.org/coi_disclosure.pdf (available on request from the corresponding author) and declare that (1) LJD, MDT, MD, ANS and RCR have no support from companies for the submitted work; (2) LJD, MDT, MD, ANS and RCR have no relationships with companies that might have an interest in the submitted work in the previous 3 years; (3) their spouses, partners, or children have no financial relationships that may be relevant to the submitted work; and (4) LJD, MDT, MD, ANS and RCR have no non-financial interests that may be relevant to the submitted work.

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Figure 1

Box and whisker plots showing the range and distribution of influenza vaccination uptake rates for patients aged 65 years + (blue boxes and bars) and at-risk patients aged under 65 years (red boxes and bars). The distribution of uptake rates for non-participating practices (N = 2101) and participating practices (N = 795) are not significantly different.

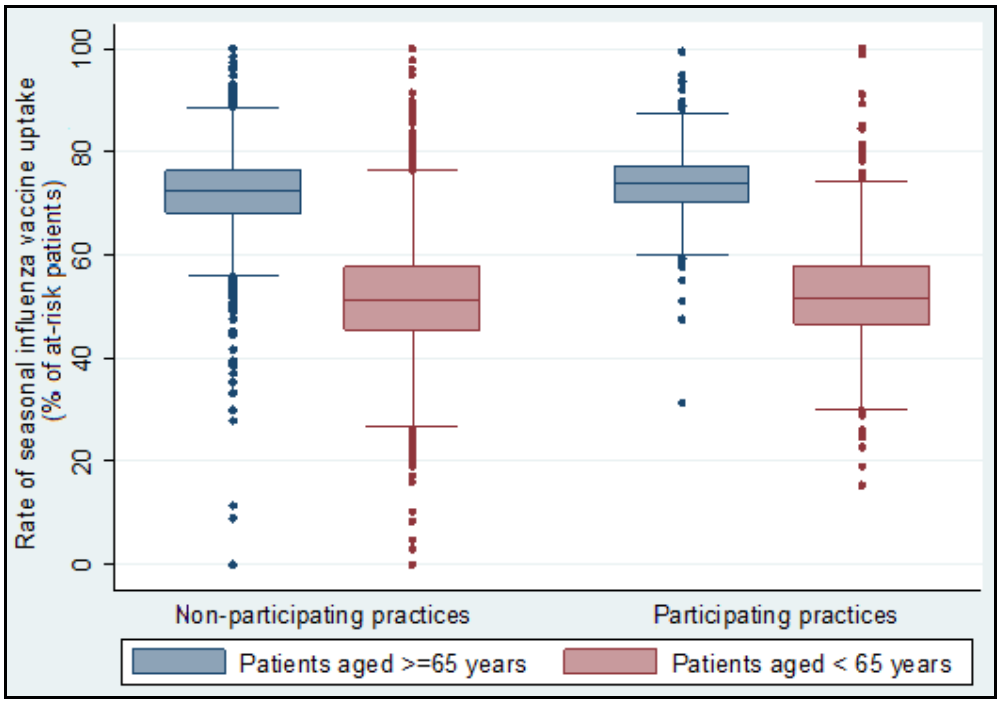
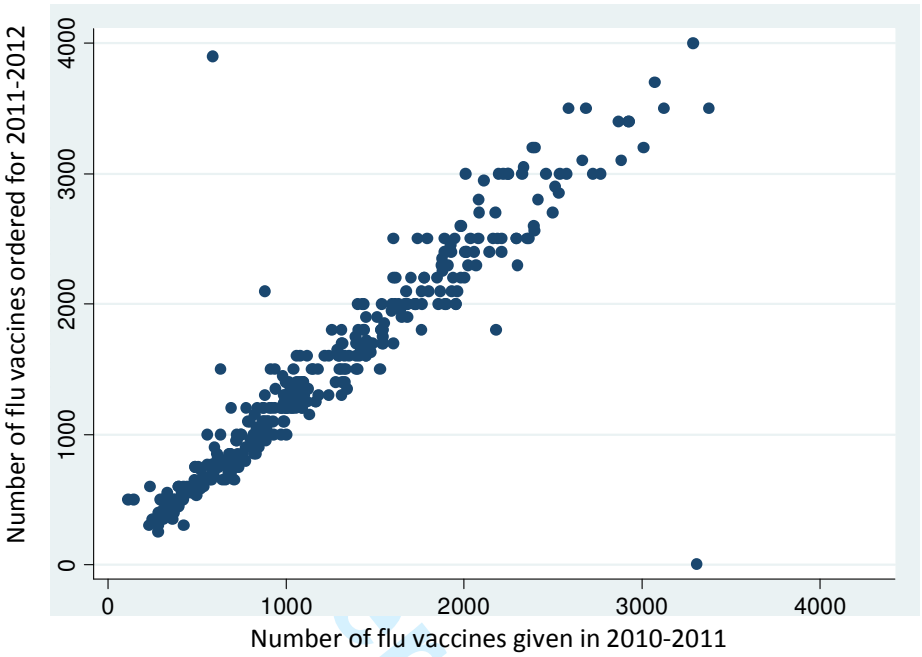


Figure 2

(a) Relationship between reported total number of vaccine doses ordered for the 2011-2012 season and actual number of doses administered in 2010-2011 (n = 568), and (b) Plot showing the maximum average achievable vaccination rates for the 2011-2012 season, based on the total number of vaccine doses ordered and the total number of eligible patients. Red line indicates the CMO's target of 75%.

(a)



(b)

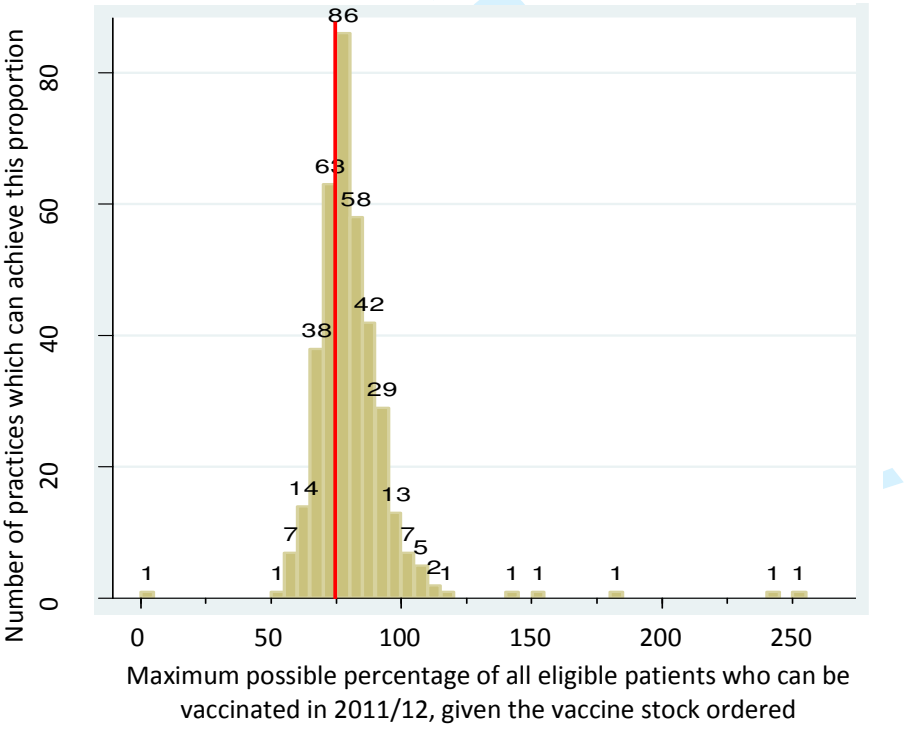


Figure 3

Showing (a) the reported activity of community midwifery teams in recommending and providing seasonal influenza vaccination to pregnant women, and (b) the attitudes of participating healthcare workers to vaccination of colleagues and themselves

Table 1a

Statistically significant factors found on multivariate regression analysis of responses common to all three types of staff (GPs, nursing staff and practice managers)

Description of significant factor	Regression co-efficient	95% CI	p-value	Number of clusters
For patients aged ≥65 years				
Producing a written report to review flu vaccine uptake rates	0.065	0.023 – 0.107	0.010	659
Having a lead member of staff for planning the practice's flu vaccination campaign	0.144	0.035 – 0.253	0.010	659
Sending a personal invitation to all eligible patients	0.081	0.035 – 0.127	0.001	659
Only stopping vaccination when QOF targets are reached	0.085	0.004 – 0.166	0.039	659
For at-risk patients aged <65 years				
Producing a written report to review flu vaccine uptake rates	0.113	0.042 – 0.184	0.002	783
Having a lead member of staff for planning the practice's flu vaccination campaign	0.203	0.054 – 0.352	0.008	783

Table 1b

Statistically significant factors found on multivariate regression analysis of responses from practice managers only

Description of significant factor	Regression co-efficient	95% CI	p-value	Number of clusters
For patients aged ≥65 years				
Identifying eligible patients using a modified manufacturer's search program	0.115	0.056 – 0.175	0.000	395
Identifying eligible patients using an in-house search program	0.096	0.028 – 0.163	0.006	395
Having a lead member of staff for identifying eligible patients in the practice	0.086	0.001 – 0.170	0.046	395
For at-risk patients aged <65 years: no significant factors were identified by multiple regression				

Supplementary table 1

Showing results of linear regression analyses of relationship between seasonal flu vaccination uptake rates, for patients aged 65+ (clear cells) and patients aged under 65 (shaded cells), by ethnicity; deprivation; and Quality and Outcomes Framework summary scores [n = 795].

Factor	Regression coefficient	95% confidence interval	p-value
Increasing proportion of white ethnicity	0.015	-0.014 to 0.043	0.305
	-0.140	-0.167 to -0.114	<0.001
Increasing index of multiple deprivation (IMD) score	-0.0009	-0.0015 to -0.0007	<0.001
	0.0001	-0.0017 to 0.0004	0.380
Increasing Quality and Outcomes Framework (QOF) score	1.430	1.299 to 1.561	<0.001
	0.918	0.781 to 1.054	<0.001

Supplementary table 2

Showing factor analysed, number of respondents, and results of logistic regression analyses of responses with respect to flu vaccination uptake rates in patients aged 65 years and over (clear boxes), uptake rates in patients aged under 65 years (shaded boxes) and uptake rates in otherwise healthy pregnant women (hatched boxes). Calculations were performed using Stata and incorporate robust cluster adjustment to reflect the number of responding practices (where appropriate).

Factor	Respondents			Baseline	Comparator	Regression co-efficient	95% confidence interval	p-value	Number of clusters
	PM	PN	GP						
Lead member of staff for planning seasonal flu vaccination	568	336	105	No	Yes	0.185	0.075 – 0.295	0.001	783
						0.220	0.069 – 0.371	0.004	
Dedicated member of staff for identifying eligible patients	414	N/A	N/A	No	Yes	0.087	0.005 – 0.169	0.038	397
						0.080	-0.048 – 0.208	0.218	
Use of a dedicated IT code to record appointment bookings for vaccination	414	N/A	N/A	No	Yes	0.006	-0.054 – 0.066	0.844	380
						0.092	0.005 – 0.179	0.038	
Methods used to encourage patients to attend for vaccination	415	304	107	General publicity only	General publicity & personal invitation for all	0.105	0.032 – 0.177	0.005	662
						0.010	-0.019 – 0.226	0.097	
				General publicity & personal invitation for non-responders	General publicity & personal invitation for all	0.074	0.025 – 0.124	0.003	595
						0.042	-0.243 – 0.109	0.215	
Personal invitation methods used to invite patients to attend for vaccination	362	N/A	N/A	Letter *or* telephone calls	Letter *and* telephone calls	0.011	-0.051 – 0.073	0.721	338
						-0.009	-0.107 – 0.882	0.852	
Number of reminders provided if the patient does not respond	320	N/A	N/A	Increasing numbers of reminders		-0.018	-0.047 – 0 .011	0.225	309
						0.041	0.002 – 0.079	0.038	
Vaccination is offered before 8am	395	295	N/A	No	Yes	0.014	-0.041 – 0.069	0.625	596
						-0.032	-0.111 – 0.048	0.434	
Vaccination is offered after 6pm	395	295	N/A	No	Yes	0.015	-0.030 – 0.061	0.506	595
						0.011	-0.054 – 0.077	0.733	
Vaccination is offered at weekends	395	295	N/A	No	Yes	-0.005	-0.054 - 0.044	0.834	594
						0.003	-0.996 – 0.105	0.961	
Local midwives recommend vaccine to pregnant women	369	N/A	N/A	Do not agree	Agree	0.050	-0.087 – 0.187	0.474	356
Local midwives provide vaccine to pregnant women	376	NA	NA	Do not agree	Agree	0.178	0.024 –0.333	0.023	356
Vaccination campaign is stopped when QOF targets are reached	565	334	106	No	Yes	0.078	0.001 – 0.155	0.048	791
						0.070	-0.014 – 0.153	0.100	
How flu vaccination uptake rates are reviewed	565	334	106	No written report	Written report	0.057	0.016 – 0.098	0.006	791
						0.119	0.044 – 0.195	0.002	
How the practice flu vaccination strategy is reviewed	543	N/A	87	No written report	Written report	0.076	-0.005 – 0.158	0.067	559
						0.175	0.019 – 0.330	0.028	
Staff encourage colleagues to receive vaccination	350	253	106	Do not agree	Agree	0.079	0.026 – 0.132	0.004	575
						0.055	-0.030 – 0.139	0.208	
Staff themselves happy to have the flu vaccine	347	253	106	Do not agree	Agree	0.019	-0.029 – 0.067	0.440	574
						0.060	-0.029 – 0.149	0.185	

TITLE:

Strategies to Increase Influenza Vaccination Rates: Outcomes of a Nationwide Cross-sectional Survey of UK General Practice

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ABSTRACT

Objective

To identify practice strategies associated with higher flu vaccination rates in primary care.

Design

Logistic regression analysis of data from a cross-sectional online questionnaire

Setting

795 general practices across England

Participants

569 practice managers, 335 nursing staff and 107 GPs

Primary outcome measures

Flu vaccination rates achieved by each practice in different groups of at-risk patients.

~~*Secondary outcome measures*~~

~~Practice-level deprivation and ethnicity data; QOF summary scores~~

Results

Seven independent factors associated with higher vaccine uptake were identified. Having a lead staff member for planning the flu campaign and producing a written report of practice performance predicted an 8% higher vaccination rate for at-risk patients aged <65 years (OR 1.37; 95% CI 1.10 to 1.71). These strategies, plus sending a personal invitation to all eligible patients and only stopping vaccination when QOF targets are reached, predicted a 7% higher vaccination rate (OR 1.45; 95% CI 1.10 to 1.92) in patients ≥65 years. Using a lead member of staff for identifying eligible patients, with

either a modified manufacturer's or in-house search program for interrogating the practice IT system, independently predicted a 4% higher vaccination rate in patients aged ≥65 years (OR 1.22; 95% CI 1.06 to 1.41 / OR 1.20; 95% CI 1.03 to 1.40). The provision of flu vaccine by midwives was associated with a 4% higher vaccination rate in pregnant women (OR 1.19; 1.02 to 1.40).

Conclusion

Clear leadership, effective communication about performance, and methods used to identify and contact eligible patients were independently associated with significantly higher rates of flu vaccination. Financial targets appear to incentivise practices to work harder to maximise seasonal influenza vaccine uptake. The strategies identified here could help primary care providers to substantially increase their seasonal flu vaccination rates towards or even above the CMO's targets.

ARTICLE SUMMARY

Article focus

- Uptake of seasonal influenza vaccination in the UK's at-risk population is below the national and international target of 75%.
- Evidence-based guidance, to advise practices how to optimise all aspects of their flu vaccination campaigns and maximise their likelihood of protecting at-risk patients against flu and its serious sequelae, is greatly needed.
- This study sought to identify which strategies and procedures were associated with higher rates of flu vaccine uptake.

Key messages

- This study has identified seven key strategies that were significantly associated with the success of practices' seasonal flu vaccination campaigns.
- If widely implemented by GP practices, average vaccination rates would be predicted to rise by 7-8% (thereby exceeding the WHO target in patients >65 years).

Strengths and limitations of this study

- The study sample was large and representative, despite a participation rate of only 27.5%.
- Outcome measures (vaccination rates) were objective and corrected for practice size.
- Strategies used to provide and encourage vaccination were self-reported.

INTRODUCTION

Influenza

Influenza (flu) is a common, potentially severe, but preventable infection that places a high burden on patients and healthcare providers [1 2]. A safe and effective inactivated (killed) vaccine is produced ahead of each flu season, based on strain recommendations provided by the World Health Organisation (WHO), and is offered to at-risk groups in the UK free of charge [3-6]. These groups have been chosen based on evidence showing increased risk of severe flu infection or sequelae: epidemiological data from 2010-2011 indicated that patients in a risk group due to chronic disease had a 10-fold greater risk of mortality due to influenza, compared to those who were not in an at-risk group [1]. During the 2010-2011 flu season 602 deaths in the UK were due directly to influenza [1]. Of those who died, approximately two-thirds were in a clinical risk group that is targeted for vaccination, while only 25% had received vaccination for that season.

WHO guidance indicates that developed countries should achieve 75% influenza vaccine coverage in the elderly, while the European Union Council (EC) advises that members should aim to vaccinate 75% of all those at high risk from influenza infection [7 8]. England's Chief Medical Officer (CMO) has instructed that, in 2011-12, each practice should aim to reach or exceed 75% uptake for people aged 65 years or over, and 60% uptake for at-risk people under age 65 (increasing to 75% by 2013/14) [6]. Published data suggests that approximately 27% of England's population was eligible for free flu vaccination in 2010 [9 10]. Providing seasonal influenza vaccination is a large and complex task which is performed well in the UK, in comparison to many other European countries [11]. Over 10 million patients were vaccinated in England in the 2010-11 season: each general practice vaccinating an average of approximately 1000 patients, mostly within a period of 4-6 weeks. The proportion of people aged over 65 years in England who received the 2010/11 influenza vaccine was, at 72.8%, just below the target of 75% [9]. However, both past and current rates of vaccination in the under-65 at-risk groups fall far short of the EC or CMO targets: during 2010/11 the rate achieved was 50.4%; in

pregnant women who were not otherwise at risk it was only 36.6%, despite increasing evidence showing the beneficial effects of protection against flu for both mothers and babies [9 12-14].

A few previous studies have investigated the utility of specific interventions (such as telephone calls or letters) to generate an increase in uptake, but an optimal overall strategy for primary care providers remains undefined [15 16]. In this study, we aimed to investigate the entire process of flu vaccine provision in a wide range of UK general practices, in order to determine the correlates of higher vaccine uptake and to inform comprehensive, evidence-based recommendations for best practice.

METHODS

Survey development

Individual or small-group interviews with GPs, nurses and practice managers from six practices already achieving high rates of flu vaccination in urban (city), semi-rural (market town) and rural (village) areas were carried out, during which staff were asked to identify the factors considered by practices in designing and carrying out their flu vaccination campaigns. The information gained was used to construct three online questionnaires (one each for the participating groups of GPs, practice managers and practice nurses), using the Survey Monkey web-based software [17]. The format of the questions and the layout of the questionnaires were designed to optimise the statistical utility of the data to be collected. The questionnaires were piloted in the same six practices to further ascertain relevance and usability before final distribution.

Questionnaire distribution and survey participants

We aimed to distribute the questionnaires to all registered GPs, practice nursing staff and practice managers within four Strategic Health Authorities (SHAs) (East Midlands, London, West Midlands and Yorkshire and Humber), which together provide care for approximately 40% of the UK population. Details about the survey were sent via the Public Health teams in the participating SHAs ~~and Primary Care Trusts (PCTs)~~, who were requested to cascade the information to ~~all~~ members of individual primary care teams (GPs, nurses and practice managers) in their area via normal electronic information circulation mechanisms. The same method was used for all other communications with ~~practice staff~~participants during the study. A preliminary e-mail, containing a letter informing primary care teams about the forthcoming study, was distributed two weeks before the first survey invitation. Two emails, inviting participation in the survey and containing web links to the online questionnaires, were then distributed in two consecutive weeks during August 2011.

Vaccine uptake data and other comparators

The Immform web service, which is a UK Department of Health website for collecting vaccination data from general practices, was used to obtain practice-level flu vaccination uptake data for the period 1st September 2010 – 28th February 2011 [18]. Actual numbers vaccinated and actual numbers eligible were recorded for 65+ year olds and at-risk ~~groups of~~ <65 year olds (including pregnant women). These are standard groups used for targeting and measuring influenza vaccine uptake by the WHO), ~~in addition to data showing the~~ . Total practice population size was also recorded. Other practice-level data, including summary Quality and Outcomes Framework (QOF) scores (most recent data available, for April 2009-March 2010) and a variety of demographic measures, were obtained in order to identify and/or adjust for other factors which may differentially affect vaccine uptake rates (such as overall practice quality performance, practice size, population ethnicity or population deprivation) [19 20]. QOF is a programme of annual financial rewards for GP surgeries, which forms part of the GP contract in England and Wales[21]. The above information was linked to the questionnaire responses by NHS practice code (a unique six-figure identifier); codes were then removed from the dataset prior to analysis.

Statistical analyses

~~In analysing the responses to the questionnaires, we sought to identify: differences in routine strategies and procedures in flu vaccination campaigns within the different areas surveyed; whether and how these were associated with vaccine uptake rates; and other co-factors associated with vaccine uptake rates.~~ In addition to a full descriptive analysis of the variables recorded in the questionnaires, logistic regression analyses were performed using STATA to compare the proportions of patients vaccinated across different categorical responses in the survey questionnaire. The logistic regression was based upon absolute numbers of patients vaccinated out of the total at-risk, to account for differences in at-risk practice population size. Potentially confounding variables, such as total practice size, Index of Multiple deprivation and proportion white ethnicity, were analysed for

correlation with vaccination uptake and adjusted for in the univariable analyses where appropriate.

As there was not always complete agreement between responses from different participants in the same practice, robust standard errors were computed using a cluster correction model, thereby generating data corrected to the practice level. Multivariate regression analysis was then performed on any 2 or more results from the same ~~group~~subset(s) of participants (i.e. practice managers, nurses and/or GPs) which showed significance at the 95% level on univariable analysis. ~~We then used the outcomes of these statistical analyses to identify and evaluate the best strategies for carrying out successful and effective flu vaccination campaigns and how (or indeed whether) these may be broadly or specifically adopted.~~

RESULTS

Fifty PCTs distributed the survey invitation to a total of 2896 practices. Responses were submitted by 569 practice managers, 335 nursing staff and 107 GPs, representing 795 practices (27.5% of those invited to contribute). These practices serve a total of approximately 5.8 million patients, among whom over 1.5 million are eligible for influenza vaccination. The distributions of flu vaccination rates in the surveyed practices were well matched to national patterns (Figure 1). For the majority of eligible patients (i.e. those aged 65 years and above), our findings indicated that the variation between practices' flu vaccination rates was not influenced by differences in the ethnicity or affluence of their patient populations, whereas Quality and Outcomes Framework summary scores showed highly and significant positive correlations with vaccine uptake achieved in both age groups (supplementary table 1). The univariable logistic regression results referred to throughout this section are shown in supplementary table 2.

Staffing

Having a lead member of staff for arranging the practice flu vaccination campaign was associated with increased flu vaccine uptake rates in both 65+ and <65 age groups ($p = 0.001$ and 0.004 respectively). Nominating a staff member with responsibility for identifying eligible patients was associated with increased uptake of vaccine in older age groups ($p = 0.038$), but this trend, although present, did not reach significance in under 65s ($p = 0.218$).

Ordering vaccine

A plot of the number of vaccine doses ordered for 2011-12 versus vaccines used in 2010-11 shows a tight correlation (figure 2a). On average, practices were found to have ordered vaccines based on the number of doses given in the previous season, with an average uplift of 8.8% (95% confidence interval 4.3 – 13.3%; n = 568). As vaccines are ordered as a total, these data could not be differentiated into

doses intended for vaccination of patients aged over or under 65 years old. However, the data showed that only 78.3% of responding practices would have been able to vaccinate at least 75% of their at-risk patients (in accordance with the CMO recommendations) (figure 2b).

Contacting patients

Using personal invitations, either alone or in combination with general publicity, was significantly associated with higher rates of vaccination. The use of personal invitations for all patients (not just those who did not respond to an initial general publicity campaign) was associated with the highest vaccination rates in the larger, 65+ age group ($p = 0.003$), although a similar association did not reach statistical significance in the under 65s. Using both letters and telephone calls was not associated with significantly different vaccination rates than using either letters or phone calls alone ($p = 0.721$ for patients aged 65+; $p = 0.852$ for patients aged <65).

Identifying eligible patients

Programmes for identifying eligible patients from the practices' IT system are usually issued by the software providers. Modifying the IT supplier's standard search or creating a separate in-house search was associated with significantly higher uptake rates for patients aged 65+ than using an unmodified IT supplier's search ($p <0.001$ and 0.027, respectively). A similar trend for under 65s did not reach statistical significance, perhaps due to insufficient power. As older patients are identified simply on the basis of their age at a certain date, which should not require a complicated search strategy, these findings suggest that creating or modifying a system search reflects that the staff in these practices are more motivated and/or experienced to use their IT system to try to achieve their flu vaccination targets.

Offering clinics and appointments

More than 95% of practices held the main vaccination sessions at their usual surgery premises and 75% held the main sessions during normal surgery hours. Most practices reported using a variety of appointment types and timings to provide flu vaccination. Surprisingly, in our data, offering vaccinations at weekends, or before 8am or after 6pm, was not associated with a significant difference in the vaccination uptake rates achieved. Increasing numbers of reminders or repeat invitations were associated with significantly increased vaccine uptake in the under 65 year olds ($p = 0.038$), though not in those aged 65+. Significantly higher rates of vaccination (for under 65s) occurred in practices that identified appointments for flu vaccination using a specific Read (computer identification) code ($p = 0.038$).

Vaccinating pregnant women

The proportion of practices that reported that their community midwives recommended flu vaccination to pregnant women was disappointingly low (57.5%). Furthermore, there was a clear discrepancy between this figure and the proportion that reported that their community midwives actually administered vaccine (17.8%; see figure 3a). Our analysis demonstrated that practices where community midwives were active in administering flu vaccinations to pregnant patients achieved significantly higher rates of uptake in this particular at-risk group ($p = 0.023$).

Ending and reviewing the campaign

A total of 578 practices provided information on what influenced their decision to stop offering flu vaccination. Of major concern was the evidence that almost 50% of practices stopped offering flu vaccines partly, or solely, because they had exhausted their stock. Almost one third (28.9%) cited a financial factor in making their decision and the data showed that ending flu vaccination only once QOF targets had been reached was associated with increased uptake rates for those aged 65+ ($p =$

0.048); in those aged under 65 this was only weakly significant (p = 0.100), perhaps influenced by the smaller numbers of patients in this group. These results suggest that practices that focused on financial targets were motivated and/or organised to continue their efforts to vaccinate patients beyond the point at which other practices may stop. In support of this hypothesis, we found that patients whose vaccination would contribute to a QOF-related payment received an average of 42% (95% CI 33 to 51%) more reminders more than those who did not have a QOF-registered indication for vaccination (p < 0.001).

Practices which produced a written report reviewing their flu vaccination rates achieved very significantly higher vaccination rates in both younger and older age groups, compared to those practices which did not produce a written report (p = 0.006 for patients aged 65+; p = 0.002 for patients aged <65 years). Similarly, reviewing the practice's flu vaccination strategy in a written format was also significantly associated with achieving higher rates of vaccination (p = 0.067 for patients aged 65+; p = 0.028 for patients aged <65 years). This finding suggests that that practices which produced written reports may have been able to organise more rigorous campaigns, and/or have had more well-informed and motivated staff, resulting in more effective performance.

Personal motivations and attitudes of staff

Figure 3b shows a summary of GPs', nurses' and practice managers' views of the flu vaccination campaign. There was a significant association between encouraging vaccination among colleagues and other staff and achieving higher rates of vaccine uptake in patients aged 65 or above (p = 0.004), but not in those aged under 65 years (p = 0.208). There was a trend for a similar association between positive attitudes of staff towards being vaccinated themselves and higher rates of patient vaccination in a practice, but this did not reach statistical significance in either the older or younger age group (p = 0.440 and 0.185 respectively).

Predicted impact of strategies to increase rates of influenza vaccination

Seven factors were found to have significant, independent positive associations with flu vaccine uptake levels following multivariable regression analysis (Tables 1a and 1b). For patients aged <65 years, having a lead member of staff for planning the flu campaign and producing a written report of the practice's performance were associated with a combined odds ratio of 1.37, which predicts an 8% higher flu vaccination rate for practices that employ these strategies compared to those that do not (54% vs. 46%).

In patients aged 65 or over, a further two factors were also found to remain independently correlated with increased rates of flu vaccination. These were sending a personal invitation to all eligible patients and only stopping vaccination when QOF targets are reached. The overall odds ratio associated with the implementation of all four strategies in this age group was 1.45, which predicts a 7% higher vaccination rate in this age group when these strategies are used (78% vs. 71%).

The strategies of using a lead member of staff for identifying eligible patients and either a modified manufacturer's search program or an in-house search program for interrogating the practice IT system were also independently correlated with increased rates of flu vaccination in patients aged 65 years or more. However, the effect seen was weaker as this data is derived from a subset of responses from practice managers only, suggesting a rise to 78% from a baseline of 74%.

The active involvement of midwives in providing flu vaccination was significantly associated with higher levels of vaccine uptake in pregnant women but, as the only significant variable within this group, the finding could not be included in a multivariable analysis. However, applying the odds ratio of 1.20 predicted by the univariable analysis, our data indicates that the provision of vaccination by midwives rather than GPs is associated with an increase in uptake rate to 45% in pregnant women (from an observed average baseline vaccination rate of 41% in our cohort).

DISCUSSION

This study has identified seven factors which GPs might use to improve and maximise uptake of seasonal flu vaccine in at-risk patients. Many of these strategies are common sense and align with the empirical guidance given by the English and Scottish CMOs [22 23], but our study provides the first statistical evidence to support the validity of such approaches. The study sample was large and appeared to be representative of the overall cohort, despite a participation rate of only 27.5%. Although we found no evidence for selection bias of participating practice staff, when the vaccination rates of participating practices were compared with national data, it remains possible that the responses of staff who completed the questionnaire did not reliably represent the views of all practice staff within those participating practices. However, most of our questions sought factual data rather than opinions and so this bias, if present, is likely to be limited.

This study focused on identifying strategies and approaches that GPs might use or influence to improve vaccine uptake. However, numerous patient-related factors also affect flu vaccine uptake. Highly mobile or ethnically diverse populations may prove very difficult to contact and target for flu vaccination. It is also likely that a minority of patients will always refuse or miss vaccination, no matter how much GPs strive to provide it. Public perception of influenza as a significant threat to health and of vaccination as an effective preventative strategy is associated with higher uptake [24]. People who receive information about these factors from official health sources (particularly GPs or nurses in the primary care setting) and who think that others want them to be vaccinated are more likely to get vaccinated [11 24 25]. In line with this, flu vaccination uptake is greater among older people and others who make routine use of hospital and community care services [26]. Unsurprisingly, fear of side-effects of vaccination is a strong negative influence, while lack of general motivation and ignorance about the recommendations are other commonly reported barriers to both seasonal and pandemic vaccination [27 28]. However, when intensive recall stimuli and information are provided to at-risk patients, as few as 3.5% will refuse vaccination, suggesting that patient attitudes are malleable

and should not present a barrier to achieving the CMO's aims [29]. Our results strongly support the provision of personal invitations for all patients (in alternative languages and/or formats, if required), as advised by the CMO [22]. However, we found little evidence of benefit from offering very early (before 8am), late (after 6pm) or weekend appointments. This contradicts some current guidance [22] and is likely to be of financially relevance for practices. Our findings with respect to the flu vaccination of pregnant women are also important. Although administering flu vaccine is not part of the current role of many midwives, it is logical that the ability both to discuss and to provide vaccination to pregnant women would increase uptake in this risk group by removing the need for referral and attendance at a separate clinic: our analyses now support this logic. However, if midwives were to provide influenza vaccination outside of the practice setting, it would be essential for reliable records of this to be transferred to the GP

The need for good communication with patients, to encourage the uptake of flu vaccination, is axiomatic. However, several statistically significant outcomes of our analyses have not previously been described and are directly or indirectly associated with the quality or extent of communication *within* practices. The production of a written review of practice performance might be associated with higher flu vaccination rates for a number of reasons. Production of such a report indicates that at least one member of staff must be able to access and manipulate the relevant data using their practice's computer systems, and is motivated to do so. Subsequent dissemination of the report allows staff to become aware of their practice's performance and identify areas for improvement. Only 20% of practices in our study produced a written report of vaccine uptake rates and this strategy is not currently recommended in the CMO guidance for England. Our results also indicate that each practice should nominate lead members of staff not only for organising the practice's influenza vaccination campaign (as advised by the English and Scottish CMOs [22 23], but also for identifying at-risk patients from the practice database. This is supported by a recently published study from the US, which suggested that effective use of electronic databases by a skilled data manager could increase the rate of flu vaccination by over 10% [30]. The ability to perform a modified or in-house search of the

practice's patient database is unlikely to improve the simple process of identification of those aged over 65 years. However, a member of staff who is thoroughly familiar with the IT system may be more able to contribute to improved rates of vaccination by, for example: monitoring levels of appointment bookings and vaccine uptake in real-time throughout the campaign; generating automatic invitation and reminder letters, text messages or emails; creating alert flags on the patient record to promote opportunist vaccination. Our study's findings also suggest that the effectiveness of a practice's flu vaccination campaign is increased when staff promote vaccination among themselves, an effect which may arise from increased motivation for the campaign as a whole or through communication of their positive attitude to at-risk patients. This supports the findings of previous studies and should thus contribute to an increased impetus to encourage vaccination of staff [31 32].

The relationship between staff motivation and practice performance is neither simple nor exclusive. Individuals may have different motivations and their interaction within a larger team may produce variable outcomes. We do not argue that introducing written reports and/or tailoring the practice search strategies would necessarily increase motivation. However, in practices where these actions are not already undertaken, their introduction would ensure that staff become more aware of the practice's performance and the underlying mechanisms that influence it. Having found a highly significant correlation of these strategies with increased vaccine uptake, we propose that increased awareness and knowledge may help to increase staff motivation. However, our study was not designed to measure motivation per se or its effects in isolation and this would be an interesting (though challenging) area for further study.

There is currently a significant financial risk for practices attempting to improve their vaccination rates. As practices are only reimbursed on the basis of the number of vaccines administered, they face a financial penalty if they buy more doses than are used and sale-or-return schemes are usually limited to a few percent of the vaccine doses in the overall order. Perhaps as a result, we have found that almost 50% of practices currently halt their vaccination campaigns due to exhaustion of vaccine stocks. A central procurement strategy for flu vaccines, which has recently undergone consultation by

the Department of Health, should remove this financial stricture and allow practices to aim for much higher vaccination rates without risking financial penalty [33]. However, this will also result in the loss of a significant proportion of practices' funding for flu vaccination (i.e. that which is currently derived from any discrepancy between tariff price and purchased price for the vaccine itself). Considerable effort and resources are required to deliver a successful flu vaccination campaign, and our findings indicate that practices' efforts can be influenced by financial motivations. The pursuit of QOF targets for flu vaccination requires practice staff to be able to perform complex interrogations of their patient database and to be aware of rates of vaccine uptake while the flu vaccination campaign is progressing. Our data suggests that pursuing the QOF targets may motivate practices to maintain vaccine stocks and encourage extra patients to receive vaccine. We would not advise that practices should automatically stop vaccinating patients once their QOF targets have been attained. However, our findings suggest that a scale of financially-supported targets applicable across all patient groups, or the inclusion of flu vaccination of all at-risk patients in the QOF scheme, might be a powerful tool to increase flu vaccine uptake.

Current vaccines achieve around 50-80% protection against influenza and associated sequelae in at-risk groups [3 34-36]. However, these efficacy rates do not translate into public health protection if the vaccine is not delivered effectively to the communities that need it. With flu vaccination rates varying from 15 to 100% (Figure 1) between the worst and best practices in our nationwide cohort, there is the potential for enormous gains to be made. This study has identified seven simple steps that can improve our performance and increase the protection of at-risk patients.

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Data sharing: the availability of additional data is subject to consent for its dissemination from the Department of Health Central Commissioning Facility. Neither the study sponsor nor the funder played any role in study design; in the collection, analysis, and interpretation of data; in the writing of the report; or in the decision to submit the article for publication. All authors had access to the study data (including statistical reports and tables) and can take responsibility for the integrity of the data and the accuracy of the data analysis.

Contributors: LJD designed, carried out and coordinated analysis and reporting of the study, and also drafted and revised this manuscript. MDT contributed to statistical aspects of design, carried out the

formal data analysis and contributed to the manuscript. MD and ANS contributed to primary care and policy aspects of study design and interpretation and also revised the manuscript. RCR contributed to study design and interpretation and revised the manuscript. He is guarantor.

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All authors have completed the Unified Competing Interest form at www.icmje.org/coi_disclosure.pdf (available on request from the corresponding author) and declare that (1) LJD, MDT, MD, ANS and RCR have no support from companies for the submitted work; (2) LJD, MDT, MD, ANS and RCR have no relationships with companies that might have an interest in the submitted work in the previous 3 years; (3) their spouses, partners, or children have no financial relationships that may be relevant to the submitted work; and (4) LJD, MDT, MD, ANS and RCR have no non-financial interests that may be relevant to the submitted work.

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Figure 1

Box and whisker plots showing the range and distribution of influenza vaccination uptake rates for patients aged 65 years + (blue boxes and bars) and at-risk patients aged under 65 years (red boxes and bars). The distribution of uptake rates for non-participating practices (N = 2101) and participating practices (N = 795) are not significantly different.

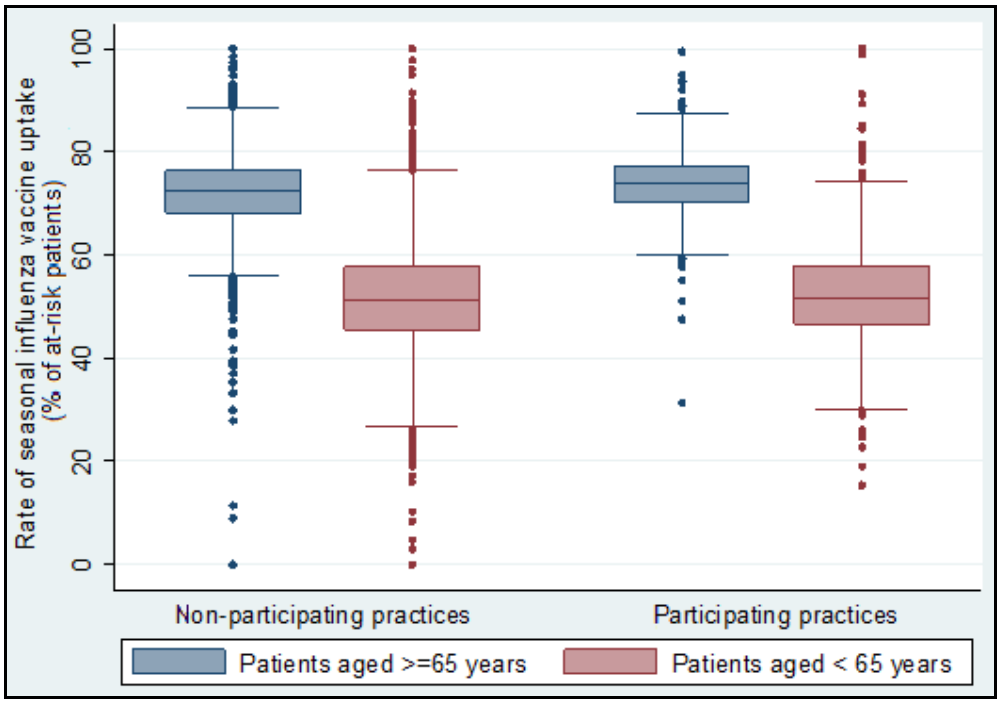
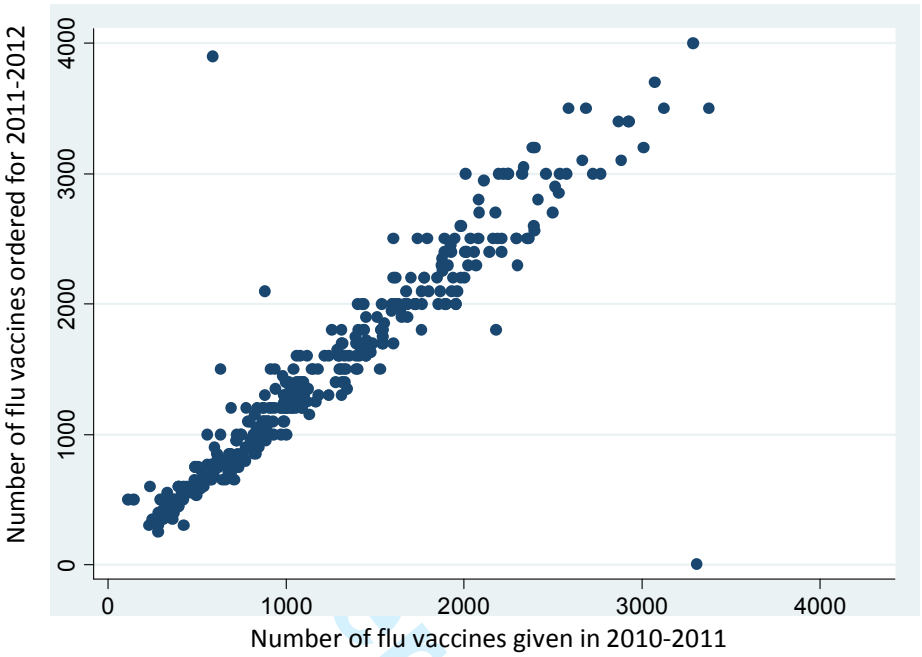


Figure 2

(a) Relationship between reported total number of vaccine doses ordered for the 2011-2012 season and actual number of doses administered in 2010-2011 (n = 568), and (b) Plot showing the maximum average achievable vaccination rates for the 2011-2012 season, based on the total number of vaccine doses ordered and the total number of eligible patients. Red line indicates the CMO's target of 75%.

(a)



(b)

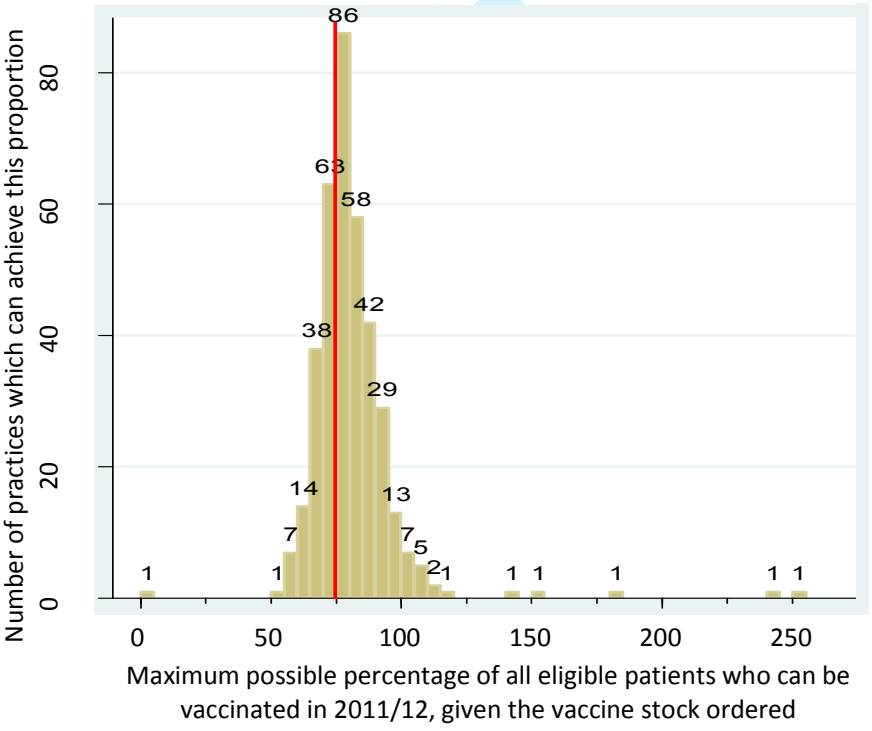


Figure 3

Showing (a) the reported activity of community midwifery teams in recommending and providing seasonal influenza vaccination to pregnant women, and (b) the attitudes of participating healthcare workers to vaccination of colleagues and themselves

Table 1a

Statistically significant ~~results~~ factors found on multivariate regression analysis of responses ~~from~~ common to all three types of staff (GPs, nursing staff and practice managers)

Description of significant factor	Regression co-efficient	95% CI	p-value	Number of clusters
For patients aged ≥65 years				
Producing a written report to review flu vaccine uptake rates	0.065	0.023 – 0.107	0.010	659
Having a lead member of staff for planning the practice's flu vaccination campaign	0.144	0.035 – 0.253	0.010	659
Sending a personal invitation to all eligible patients	0.081	0.035 – 0.127	0.001	659
Only stopping vaccination when QOF targets are reached	0.085	0.004 – 0.166	0.039	659
For at-risk patients aged <65 years				
Producing a written report to review flu vaccine uptake rates	0.113	0.042 – 0.184	0.002	783
Having a lead member of staff for planning the practice's flu vaccination campaign	0.203	0.054 – 0.352	0.008	783

Table 1b

Statistically significant ~~results~~ factors found on multivariate regression analysis of responses from practice managers only

Description of significant factor	Regression co-efficient	95% CI	p-value	Number of clusters
For patients aged ≥65 years				
Identifying eligible patients using a modified manufacturer's search program	0.115	0.056 – 0.175	0.000	395
Identifying eligible patients using an in-house search program	0.096	0.028 – 0.163	0.006	395
Having a lead member of staff for identifying eligible patients in the practice	0.086	0.001 – 0.170	0.046	395
For at-risk patients aged <65 years: no significant factors were identified by multiple regression				

Supplementary table 1

Showing results of linear regression analyses of relationship between seasonal flu vaccination uptake rates, for patients aged 65+ (clear cells) and patients aged under 65 (shaded cells), by ethnicity; deprivation; and Quality and Outcomes Framework summary scores [n = 795].

Factor	Regression coefficient	95% confidence interval	p-value
Increasing proportion of white ethnicity	0.015	-0.014 to 0.043	0.305
	-0.140	-0.167 to -0.114	<0.001
Increasing index of multiple deprivation (IMD) score	-0.0009	-0.0015 to -0.0007	<0.001
	0.0001	-0.0017 to 0.0004	0.380
Increasing Quality and Outcomes Framework (QOF) score	1.430	1.299 to 1.561	<0.001
	0.918	0.781 to 1.054	<0.001

Supplementary table 2

Showing factor analysed, number of respondents, and results of logistic regression analyses of responses with respect to flu vaccination uptake rates in patients aged 65 years and over (clear boxes), uptake rates in patients aged under 65 years (shaded boxes) and uptake rates in otherwise healthy pregnant women (hatched boxes). Calculations were performed using Stata and incorporate robust cluster adjustment to reflect the number of responding practices (where appropriate).

Factor	Respondents			Baseline	Comparator	Regression co-efficient	95% confidence interval	p-value	Number of clusters
	PM	PN	GP						
Lead member of staff for planning seasonal flu vaccination	568	336	105	~~Yes~~No	~~No~~Yes	0.185	0.075 – 0.295	0.001	783
						0.220	0.069 – 0.371	0.004	
Dedicated member of staff for identifying eligible patients	414	N/A	N/A	No	Yes	0.087	0.005 – 0.169	0.038	397
						0.080	-0.048 – 0.208	0.218	
Use of a dedicated IT code to record appointment bookings for vaccination	414	N/A	N/A	No	Yes	0.006	-0.054 – 0.066	0.844	380
						0.092	0.005 – 0.179	0.038	
Methods used to encourage patients to attend for vaccination	415	304	107	General publicity only	General publicity & personal invitation for all	0.105	0.032 – 0.177	0.005	662
						0.010	-0.019 – 0.226	0.097	
				General publicity & personal invitation for non-responders	General publicity & personal invitation for all	0.074	0.025 – 0.124	0.003	595
						0.042	-0.243 – 0.109	0.215	
Personal invitation methods used to invite patients to attend for vaccination	362	N/A	N/A	Letter *or* telephone calls	Letter *and* telephone calls	0.011	-0.051 – 0.073	0.721	338
						-0.009	-0.107 – 0.882	0.852	
Number of reminders provided if the patient does not respond	320	N/A	N/A	Increasing numbers of reminders		-0.018	-0.047 – 0 .011	0.225	309
						0.041	0.002 – 0.079	0.038	
Vaccination is offered before 8am	395	295	N/A	No	Yes	0.014	-0.041 – 0.069	0.625	596
						-0.032	-0.111 – 0.048	0.434	
Vaccination is offered after 6pm	395	295	N/A	No	Yes	0.015	-0.030 – 0.061	0.506	595
						0.011	-0.054 – 0.077	0.733	
Vaccination is offered at weekends	395	295	N/A	No	Yes	-0.005	-0.054 - 0.044	0.834	594
						0.003	-0.996 – 0.105	0.961	
Local midwives recommend vaccine to pregnant women	369	N/A	N/A	Do not agree	Agree	0.050	-0.087 – 0.187	0.474	356
Local midwives provide vaccine to pregnant women	376	NA	NA	Do not agree	Agree	0.178	0.024 –0.333	0.023	356
Vaccination campaign is stopped when QOF targets are reached	565	334	106	No	Yes	0.078	0.001 – 0.155	0.048	791
						0.070	-0.014 – 0.153	0.100	
How flu vaccination uptake rates are reviewed	565	334	106	No written report	Written report	0.057	0.016 – 0.098	0.006	791
						0.119	0.044 – 0.195	0.002	
How the practice flu vaccination strategy is reviewed	543	N/A	87	No written report	Written report	0.076	-0.005 – 0.158	0.067	559
						0.175	0.019 – 0.330	0.028	
Staff encourage colleagues to receive vaccination	350	253	106	Do not agree	Agree	0.079	0.026 – 0.132	0.004	575
						0.055	-0.030 – 0.139	0.208	
Staff themselves happy to have the flu vaccine	347	253	106	Do not agree	Agree	0.019	-0.029 – 0.067	0.440	574
						0.060	-0.029 – 0.149	0.185	

Figure 1

Box and whisker plots showing the range and distribution of influenza vaccination uptake rates for patients aged 65 years + (blue boxes and bars) and at-risk patients aged under 65 years (red boxes and bars). The distribution of uptake rates for non-participating practices (N = 2101) and participating practices (N = 795) are not significantly different.

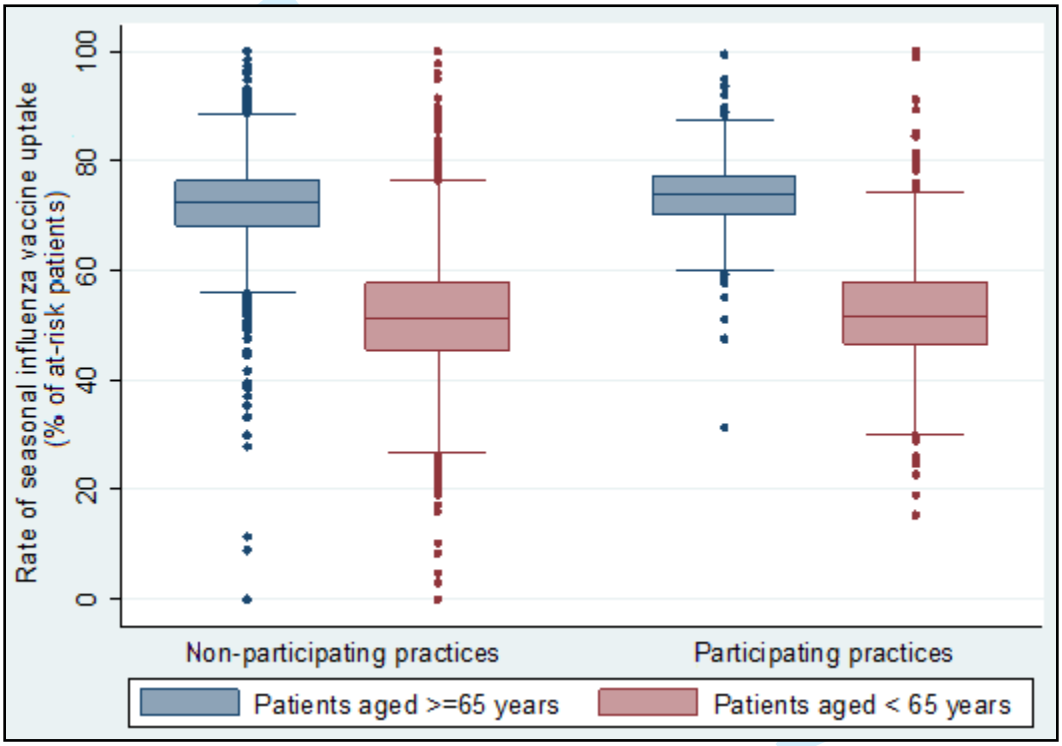
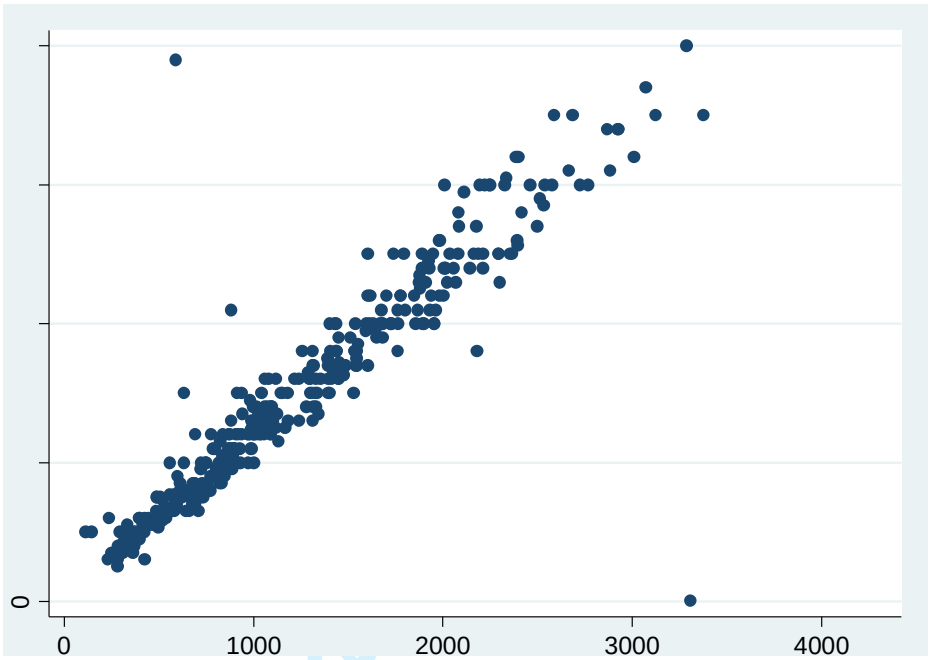


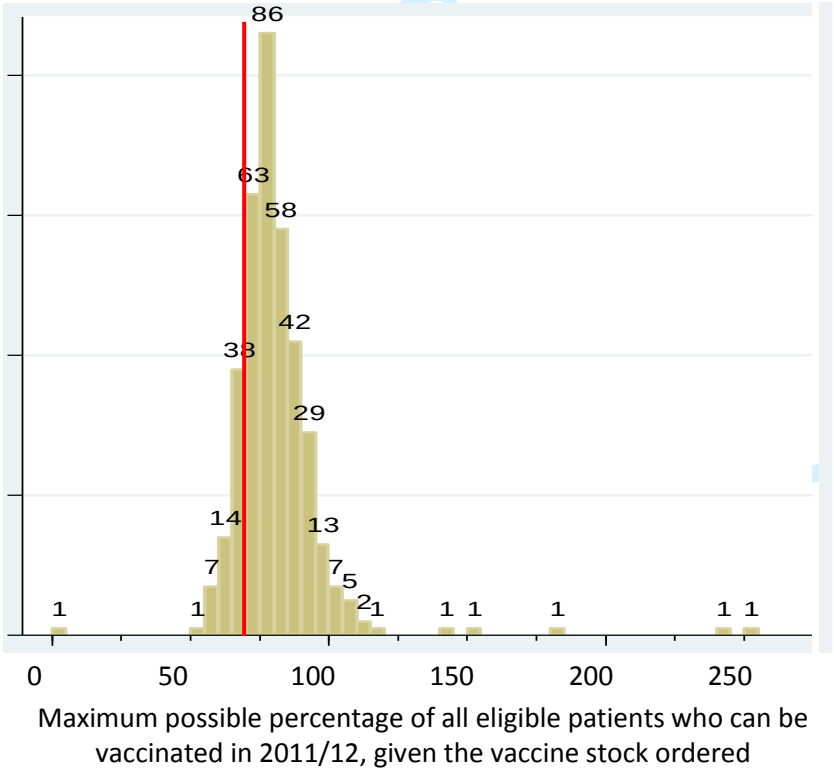
Figure 2

(a) Relationship between reported total number of vaccine doses ordered for the 2011-2012 season and actual number of doses administered in 2010-2011 (n = 568), and (b) Plot showing the maximum average achievable vaccination rates for the 2011-2012 season, based on the total number of vaccine doses ordered and the total number of eligible patients. Red line indicates the CMO's target of 75%.

(a)


0
0
1000
2000
3000
4000
Number of flu vaccines given in 2010-2011

(b)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150
200
250
Maximum possible percentage of all eligible patients who can be vaccinated in 2011/12, given the vaccine stock ordered

Figure 3

Showing (a) the reported activity of community midwifery teams in recommending and providing seasonal influenza vaccination to pregnant women, and (b) the attitudes of participating healthcare workers to vaccination of colleagues and themselves