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Can we achieve high uptakes of influenza vaccination of healthcare workers in hospitals? A cross-sectional survey of acute NHS trusts in England

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SUMMARY

It is unknown which intervention strategies are used or effective to increase influenza vaccine uptake by healthcare workers (HCWs) in acute hospitals in England. We undertook a survey in acute hospitals, described strategies employed from 2008 to 2012 and used multivariable binomial regression to identify those effective. Eighty out of 166 trusts responded and reported 25 strategies. Every intervention showed increased use: peer vaccination from 3·8% to 38·8% (+921%); educational DVDs from 3·8% to 22·5% (+492%); Twitter from 2·5% to 12·5% (+400%) and Facebook from 1·3% to 6·3% (+384%). Peer vaccination increased uptake by 7·3% [95% confidence interval (CI) 1·1–13·6, $P=0·02$] overall; educational DVDs by 9·7% overall (95% CI 1·8–17·6, $P=0·02$), 11·9% in non-doctor, non-nurse HCWs (95% CI 0·9–22·8, $P=0·03$). For doctors, using a champion doctor increased uptake by 17·8% (95% CI 7·6–28·0, $P<0·01$). No intervention increased uptake by nurses. Increasing uptake requires multi-intervention strategies targeted at different HCW groups.

Key words: Influenza, public health, vaccines.

INTRODUCTION

Influenza epidemics occur annually in England and across the world, causing substantial mortality, morbidity and socioeconomic burden [1]. Outbreaks of healthcare-acquired influenza are well documented [2]. Vaccination of frontline healthcare workers (HCWs) indirectly protects patients against infection and directly limits the impact of influenza on workforce capacity [3] by reducing infections and absenteeism [2]. Annual influenza vaccination rates for HCWs are almost universally low despite recommendations from the World Health Organization (WHO) and public health authorities in many countries [4]. Factors such as concern about vaccine effectiveness, fear of vaccine adverse effects, lack of concern about influenza and lack of perception of risk following infection have all contributed to keeping uptake rates down in HCWs [2], while increased knowledge about the vaccine has been shown to increase uptake [5]. Organizational barriers to vaccination have also contributed to low vaccine uptake [2].

In England, the Department of Health identified HCWs as an influenza vaccine priority group [6] in accordance with WHO recommendations [4]. The 2012/2013 Department of Health seasonal flu plan highlights increasing the uptake of influenza vaccine by HCWs as a specific objective [6]. Vaccine uptake by HCWs in English acute trusts was only 16·5% in 2008/2009 [7]. Following the 2009 influenza pandemic, overall uptake increased to 34·7% in 2010/2011 [8] and

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44·1% in 2011/2012 [9]. In England, groups of acute hospitals belonging to the National Health Service (NHS) under the same management team are called trusts. There was a very wide range of influenza vaccine uptake across individual acute NHS trusts in 2011/2012 ranging from 11·6% to 100% [9]. The reasons for these observed differences are unclear.

A number of strategies have been proposed to increase influenza vaccine uptake by HCWs. Some have been shown to be effective in a range of healthcare settings, such as educational campaigns [10], promotion by a vaccine champion [11], the use of vaccine ward trolleys [12], peer vaccination [12], or incentives [12]. A systematic review published in September 2012 identified more than 45 interventions improving influenza vaccine uptake by HCWs [4], although none were evaluated in an acute setting in England. Little has been published to describe which interventions or strategies acute hospital trusts in England have implemented to increase influenza vaccine uptake by their healthcare staff, and whether these interventions were effective in this context. The aim of this study was to ascertain what strategies acute NHS trusts in England have used to increase influenza vaccine uptake in their HCWs between 2008/2009 and 2011/2012 and to identify which specific interventions were associated with an increased vaccine uptake overall and by staff group, in order to inform future HCW vaccination strategies.

METHODS

A cross-sectional survey was designed using SelectSurvey [13], an online questionnaire building tool. The survey intended to elicit which interventions acute NHS trusts implemented between 2008/2009 and 2011/2012 to increase influenza vaccination uptake by frontline HCWs. The survey targeted all acute NHS trusts in England. With assistance from the Health Protection Agency (HPA) influenza vaccine tracking officer for HCWs, an email invitation was sent in July 2012 to the occupational health team in each acute NHS trust in England. The survey was open for 20 days with several reminders sent to the trusts during this period. The survey included questions about the use of interventions, identified from a review of the published literature [11, 12, 14] between 2008/2009 and 2011/2012 as well as information about trust characteristics (trust size, a large trust being defined as >500 beds, foundation status, occupational health provider) and organizational aspects of vaccination campaigns (Staff involved in the vaccination campaign, method of identification of eligible staff, method of recording vaccination status of staff, presence of a call recall system, setting of a vaccination target). The survey allowed participants to mention other unlisted interventions they might have implemented in their trusts. This voluntary survey was undertaken by the HPA as part of their surveillance of the national influenza vaccine programme and no ethical approval was sought. The uptake of influenza vaccine for each trust and by professional group (doctors, nurses, other HCWs) was obtained from the HPA/Department of Health 2011/2012 Immform seasonal influenza vaccine uptake survey of frontline HCWs in England [8]. Eligible staff were frontline clinical staff (clinical staff with patient contact) belonging to either of these categories. The 'other HCWs' category included chiropodists/podiatrists, dietitians, occupational therapists, orthoptists, physiotherapists, radiographers, art therapists, speech and language therapists, healthcare scientists and pharmacists [9].

The results of the survey were collected in a Microsoft Excel database and statistical analysis was performed using Stata version 12 (StataCorp., USA). The proportion of trusts implementing each intervention was reported to establish trends in strategies employed to increase influenza vaccine uptake by HCWs. Trusts that did not answer a specific question pertaining to trust characteristics or organizational aspects of the campaign were excluded from the analysis for that question only. As the online survey required participants to answer questions about each intervention in order to complete the survey, there is no missing data with regard to interventions. Using a series of binomial regressions, crude risk differences (additional uptake or decrease in absolute terms) were calculated along 95% confidence intervals (CIs), identifying factors individually associated with a significant increase or decrease in vaccine uptake (cut-off value at the $\alpha = 0{\cdot}05$ level). Additional uptake or decrease was reported at trust level overall and for each HCW category. Interventions implemented by only one trust or less were omitted from the analysis; conversely interventions were omitted from analysis if one trust or less did not implement them. Trusts that answered 'don't know' to specific questions with regards to implementation of interventions were excluded from analysis for those particular questions. For each HCW category as well as overall, factors associated with a significant crude increased or

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decreased vaccine uptake at the $\alpha = 0{\cdot}05$ level were fitted in a multiple binomial regression model.

RESULTS

Eighty out of 166 acute NHS trusts in England responded to the survey (48·2%) representing a total of 345 619 HCWs. The mean vaccine uptake in the trusts that answered the survey was 48·3%. The uptake in trusts that answered was not significantly different from those that did not (48·3% *vs.* 47·8%, *t* test for difference in means $P = 0{\cdot}85$). In trusts that responded, mean vaccine uptake was 50·5% by doctors, 43·4% by nurses and 53·9% for other HCWs. Trusts that answered the survey were significantly more likely to be large than those that did not (76·2% *vs.* 56·3%, $P = 0{\cdot}01$). Of responding trusts, 68/80 (85%) managed occupational health internally, whereas external private providers managed occupational health in only 6/80 (7·5%) of responding trusts, and 5/80 (6·2%) trusts were contracting their occupational health to another NHS trust. One trust had another arrangement.

Seventy-eight out of 80 trusts answered the question pertaining to the identification of staff eligible for vaccination. While 16/78 (20·5%) of trusts did not attempt to identify members of staff eligible for vaccination and only vaccinated members of staff who requested it, 52/78 (66·7%) of trusts identified eligible staff through a centralized database. Other trusts identified eligible staff through ward-based registers (4/78, 5·1%) or through personal files (1/78, 1·3%). Of the 80 trusts that responded to the survey, 79 answered the question pertaining to record keeping. All trusts that answered documented the vaccinations taking place: 67/79 (84·8%) of trusts recorded it in a central database whereas 9/79 (11·4%) recorded it in the individual's personal file. Three out of 79 (3·8%) trusts had an alternative recording method. Out of the 79 trusts that answered the question about call/recall, eight (10·1%) had a call/recall system in place to remind staff who had not received the vaccine to do so. Fifty-six of 79 (70·9%) trusts had defined a vaccination uptake target: the actual target was not always stated but varied between 50% and 70% when specified.

Since 2008/2009, the mean number of listed interventions implemented in each acute NHS trust has significantly increased, from a mean of 8·4 interventions in 2008/2009 to 12·6 in 2011/2012 (*t* test for difference in means, $P < 0{\cdot}001$). Interventions such as trolley service, posters and leaflets had become practically universal by 2011/2012 (96·3%, 95% and 95%, respectively). Within the organizational characteristics of vaccine campaigns, peer vaccination increased from 3·8% to 38·8% (+921%) between 2008/2009 and 2011/2012, whereas vaccination by nurses decreased by 2·6%. The individual interventions which increased most were educational DVDs and videos (3·8% to 22·5%, +492%), and Twitter and Facebook vaccine promotion (2·5% to 12·5%, +400% and 1·3% to 6·3%, +384%, respectively, over this period). Table 1 details the implementation trends for each intervention.

Table 2 details the individual associations between each factor and increased uptake, overall and by HCW category. Overall, when analysing the effect of individual factors on the mean vaccine uptake, none of the trust characteristics were associated with a significantly increased vaccine uptake although using an internal occupational health department was associated with a significant 12·4% decrease in vaccine uptake.

At trust level overall, the organizational characteristics associated with a significant crude increase in vaccine uptake were peer vaccination resulting in an additional 8·5% uptake, and identifying eligible staff through a centralized database, with an additional 7·8% uptake. The interventions associated with a significant crude increase in vaccine uptake were use of educational DVDs and using a senior doctor as a flu vaccine champion, with a respective additional 13·1% and 7·8% increase in vaccine uptake. Vaccination by drop-in in the occupational health department was associated with a significant 16·4% decreased uptake. When these factors were adjusted for each other using a multiple binomial regression model (Table 3), only peer-vaccination (additional 7·3% uptake) and educational DVDs (additional 9·7% uptake) remained independently associated with an increased uptake.

For doctors, identifying eligible staff through a centralized database was the only organizational characteristic significantly associated with a crude increased vaccine uptake (additional 15·1%). Using a senior doctor as a champion was the only intervention associated with a significant crude increased uptake in this group, with an additional 12·2% uptake. Use of Facebook and Twitter were associated with a significantly reduced crude uptake of vaccine of 22% and 23·6%, respectively. After adjusting for other significant factors (Table 3), only the use of a senior

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Table 1. *Use of interventions aimed at increasing influenza vaccine uptake in acute NHS trusts, 2008–2011*

Intervention	Number of trusts implementing (%)				Change 2008–2011
	2008 ($n=80$)	2009 ($n=80$)	2010 ($n=80$)	2011 ($n=80$)	
Vaccination in the occupational health department, by appointment	54 (67·5%)	55 (68·8%)	54 (67·5%)	54 (67·5%)	0%
Vaccination in the occupational health department, drop in	71 (88·8%)	74 (92·5%)	75 (93·8%)	75 (93·8%)	+5·6%
Vaccine offered directly on wards and departments	53 (66·3%)	70 (87·5%)	76 (95·0%)	77 (96·3%)	+45·2%
Vaccination in staff areas (canteen, staff room)	37 (46·3%)	53 (66·3%)	60 (75·0%)	61 (76·3%)	+64·8%
Peer vaccination	3 (3·8%)	17 (21·3%)	26 (32·5%)	31 (38·8%)	+921%
Vaccination by nurses	77 (96·3%)	76 (95·0%)	77 (96·3%)	75 (93·8%)	−2·6%
Vaccination by doctors	3 (3·8%)	4 (5·0%)	6 (7·5%)	5 (6·3%)	+39·7%
Educational/awareness posters (including NHS flu fighter material)	59 (73·8%)	72 (90·0%)	77 (96·3%)	76 (95·0%)	+28·7%
Education/awareness leaflets (including NHS flu fighter material)	52 (65·0%)	67 (83·8%)	75 (93·8%)	76 (95·0%)	+46·2%
Talks/lectures (including NHS flu fighter materials)	13 (16·3%)	25 (31·3%)	37 (46·3%)	42 (52·5%)	+222·1%
Video/DVD presentation (including NHS flu fighter materials)	3 (3·8%)	7 (8·8%)	13 (16·3%)	18 (22·5%)	+492·1%
Other educational/awareness campaign*	9 (11·3%)	9 (11·3%)	15 (18·8%)	18 (22·5%)	+99·1%
Emails to staff	45 (56·3%)	54 (67·5%)	62 (77·5%)	66 (82·5%)	+46·5%
Intranet page	47 (58·8%)	61 (76·3%)	74 (92·5%)	74 (92·5%)	+57·3%
Facebook page	1 (1·3%)	1 (1·3%)	4 (5·0%)	5 (6·3%)	+384·6%
Twitter	2 (2·5%)	4 (5·0%)	6 (7·5%)	10 (12·5%)	+400·0%
Electronic other†	7 (8·8%)	11 (13·8%)	14 (17·5%)	18 (22·5%)	+155·7%
Using the chief executive as a flu vaccine champion	36 (45·0%)	47 (58·8%)	51 (63·8%)	53 (66·3%)	+47·3%
Using a senior doctor as a flu vaccine champion	32 (40·0%)	43 (53·8%)	49 (61·3%)	51 (63·8%)	+59·5%
Using a senior nurse as a flu vaccine champion	38 (47·5%)	50 (62·5%)	56 (70·0%)	60 (75·0%)	+57·9%
Using other champions‡	10 (12·5%)	8 (10·0%)	13 (16·3%)	16 (20·0%)	+60·0%
Vouchers given to vaccinated healthcare workers	0 (0·0%)	2 (2·5%)	4 (5·0%)	8 (10·0%)	n.a.
Free meal/drinks given to vaccinated healthcare workers	1 (1·3%)	2 (2·5%)	3 (3·8%)	1 (1·3%)	0·0%
Other incentive§	11 (13·8%)	11 (13·8%)	12 (15·0%)	26 (32·5%)	+135·5%

n.a., Not available.

* Other educational/awareness campaigns included briefings from the chief executive, bulletins and letters to staff.

† Other electronic interventions included screensavers, weekly updates, SMS.

‡ Other champions include: peers, director of infection prevention and control, HR director, matrons, previous flu sufferers.

§ Other incentives include sweets, stickers, pens, prize draws.

doctor as champion remained associated with an increased uptake by doctors (additional 17·8% uptake). Using Twitter remained associated with a decreased uptake (−20·7% uptake).

With regard to nurses, for trust characteristics the use of an internal occupational health provider was significantly associated with a crude decreased uptake (−20·8%). For organizational characteristics, peer vaccination resulted in a significant crude increase in uptake of 6·9% and identifying eligible staff through a centralized database resulted in a crude additional 7·8% uptake. Using occupational health nurses was associated with a significantly crude decreased uptake (−13%). The following interventions were significantly associated with additional crude uptake by nurses: talks and lectures (additional 8·1% uptake),

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Table 2. *Crude change in vaccine uptake associated with each study factor, 2011/2012 influenza season, by professional group*

	Overall			Doctors			Nurses			Other healthcare workers		
	Uptake difference (%)	95% CI	*P* value	Uptake difference (%)	95% CI	*P* value	Uptake difference (%)	95% CI	*P* value	Uptake difference (%)	95% CI	*P* value
Trust characteristics												
Trust size	0·1	−10·6 to 10·7	0·99	4·5	−12·2 to 21·3	0·59	0·7	−10·5 to 12·0	0·90	2·6	−12·6 to 18·0	0·73
Trust status	2·6	−3·9 to 9·2	0·43	9·6	−1·6 to 20·9	0·09	2·2	−4·8 to 9·3	0·53	0·0	−9·2 to 9·2	0·99
Occupational health provider												
Internal	−12·4	−23·1 to −1·8	0·02*	0·3	−17·2 to 17·7	0·98	−20·8	−31·6 to −10·0	<0·01*	−15·4	−28·3 to −2·5	0·02*
External private provider	4·0	−13·0 to 20·9	0·65	10·0	−19·0 to 39·0	0·50	11·1	−7·1 to 29·3	0·23	−5·3	−29·3 to 18·8	0·67
Provided by another trust	6·2	−10·4 to 22·8	0·47	−16·4	−36·6 to 3·8	0·11	14·0	−3·5 to 31·4	0·12	13·5	−9·8 to 36·9	0·26
Organizational characteristics of the vaccination campaign												
Staff involved in the vaccination campaign												
Occupational health nurses	−10·7	−22·7 to 1·2	0·08	11·2	−5·6 to 27·9	0·19	−13·0	−25·5 to −0·5	0·04*	−8·4	−22·6 to 5·8	0·25
Occupational health doctors	2·9	−7·4 to 13·2	0·58	−8·2	−25·0 to 8·5	0·34	3·5	−7·8 to 14·8	0·55	3·8	−10·5 to 18·1	0·60
Peer vaccination	8·5	2·1 to 14·8	0·01*	9·4	−2·0 to 20·8	0·11	6·9	0·0 to 13·9	0·05*	3·0	−6·2 to 12·2	0·52
Method of identification of eligible staff												
Central database	7·8	1·0 to 14·5	0·02	15·1	4·3 to 25·9	0·01*	7·8	0·7 to 15·0	0·03*	5·0	−4·8 to 14·7	0·32
By ward/ department	−12·2	−31·7 to 7·3	0·22	−15·4	−46·7 to 15·9	0·33	−12·5	−32·4 to 7·4	0·22	−12·2	−41·0 to 16·5	0·40
Not recorded	−5·6	−13·3 to 2·0	0·15	−4·1	−17·2 to 8·9	0·54	−5·1	−13·2 to 3·0	0·22	2·9	−7·8 to 13·7	0·59
Method of recording vaccination status of staff												
In one centralized database	0·9	−8·3 to 10·2	0·84	1·5	−14·3 to 17·3	0·85	0·6	−9·1 to 10·2	0·91	−0·6	−13·8 to 12·6	0·93
In individual files	−1·8	−12·4 to 8·8	0·74	16·4	−3·2 to 36·0	0·10	1·1	−9·8 to 12·1	0·84	−5·3	−20·4 to 9·8	0·49
Call/recall system	1·9	−8·9 to 12·6	0·74	−1·1	−18·8 to 16·6	0·90	2·3	−9·0 to 13·5	0·69	5·2	−7·8 to 18·1	0·43
Vaccination target	2·3	−4·9 to 9·5	0·53	−7·1	−19·9 to 5·7	0·28	3·8	−3·7 to 11·3	0·32	4·2	−6·1 to 14·5	0·43
Interventions												
Vaccination in occupational health department												
By appointment	1·2	−5·7 to 8·1	0·74	3·1	−8·7 to 14·8	0·61	−1·1	−8·5 to 6·3	0·78	−2·6	−12·2 to 6·9	0·59
Drop in	−16·4	−30·6 to −2·2	0·02*	11·8	−8·4 to 31·9	0·25	−18·0	−32·2 to −3·8	0·01*	−20·1	−39·1 to −1·2	0·04*
Vaccination in staff areas	2·6	−6·0 to 11·1	0·56	1·5	−14·0 to 16·9	0·85	5·7	−3·2 to 14·6	0·21	6·1	−6·4 to 18·5	0·34
Talks/lectures	6·5	−0·1 to 13·1	0·05	−4·9	−16·4 to 6·5	0·40	8·1	1·1 to 15·1	0·02*	6·4	−2·8 to 15·7	0·17
Video/DVD	13·1	5·6 to 20·5	<0·01*	5·8	−8·4 to 19·9	0·43	12·4	3·9 to 20·8	<0·01*	14·9	4·7 to 25·0	<0·01*
Emails	1·5	−6·8 to 9·8	0·73	−8·0	−22·9 to 6·9	0·29	5·5	−2·9 to 13·8	0·20	−4·0	−15·4 to 7·4	0·49
Intranet	−2·3	−17·0 to 12·5	0·76	−19·2	−48·0 to 9·6	0·19	−1·6	−18·2 to 15·0	0·85	0·6	−20·8 to 22·0	0·96
Facebook	2·8	−12·0 to 17·5	0·71	−22·0	−39·5 to −4·5	0·01*	4·8	−11·1 to 20·8	0·55	−3·1	−24·2 to 18·0	0·77

Table 2 (*cont.*)

	Overall			Doctors			Nurses			Other healthcare workers		
	Uptake difference (%)	95% CI	*P* value	Uptake difference (%)	95% CI	*P* value	Uptake difference (%)	95% CI	*P* value	Uptake difference (%)	95% CI	*P* value
Twitter	−1·0	−11·1 to 9·1	0·85	−23·6	−35·9 to −11·3	<0·01*	2·9	−8·1 to 13·9	0·61	−4·2	−18·9 to 10·5	0·58
Chief executive as a champion	1·7	−5·2 to 8·7	0·62	−3·1	−15·4 to 9·1	0·61	4·8	−2·5 to 12·0	0·20	5·9	−3·7 to 15·5	0·23
Senior doctor as a champion	7·8	1·0 to 14·5	0·02*	12·2	1·0 to 23·4	0·03*	10·0	3·0 to 17·0	0·01*	8·5	−1·4 to 18·4	0·09
Senior nurse as a champion	5·4	−2·4 to 13·2	0·17	3·3	−10·3 to 16·8	0·64	8·4	0·3 to 16·5	0·04*	6·3	−4·6 to 17·2	0·26
Vouchers	4·3	−5·7 to 14·2	0·40	9·6	−9·3 to 28·6	0·32	2·5	−8·3 to 13·3	0·65	3·1	−10·3 to 16·6	0·65
Other incentives	5·7	−1·4 to 12·9	0·12	9·9	−3·3 to 23·0	0·14	4·1	−3·7 to 11·9	0·31	−3·1	−13·5 to 7·3	0·56

CI, Confidence interval.
* $P<0·05$.

educational DVDs (additional 12·4% uptake), the use of a senior doctor as champion (additional 10·0% uptake) and the use of a senior nurse as a champion (additional 8·4% uptake). Vaccination by drop-in in the occupational health department was associated with a significant decrease in crude vaccine uptake (−18%). However, after adjusting for other significant factors in a multiple binomial regression, no factors remained independently associated with an increased uptake, although the use of an internal occupational health provider (−14·6%) and use of occupational health nurses (−22·6%) remained associated with a decreased uptake (Table 3).

Regarding other HCWs, for trust characteristics, again use of internal occupational health provider was associated with a significantly decreased crude vaccine uptake (−15·4%). Use of educational DVDs was the only intervention associated with a significant crude additional vaccine uptake of 14·9%. Use of drop-in in the occupational health department was associated with a significant crude decrease in vaccine uptake (−20·1%). By multivariable analysis only use of educational DVDs remained associated with an additional uptake of 11·9% after adjusting for other (negatively) associated factors (Table 3).

DISCUSSION

This study highlights the changes that have occurred in strategies used to increase influenza vaccine uptake by HCWs in acute NHS trusts in England and Wales over the last 4 years, a period when vaccine uptake has increased in HCWs. The majority of trusts rely on an internal occupational health department to deliver staff vaccination. In 2008/2009, influenza vaccine was almost exclusively administered by occupational health nurses. In 2011/2012, peer-to-peer vaccination has seen a surge in popularity, offered in 38% of trusts, *vs.* 3·8% in 2008/2009. The implementation of interventions to increase the uptake of influenza vaccine has also greatly increased in the last 4 years. Every intervention assessed was implemented by more trusts in 2011/2012 than in 2008/2009 to the extent that some interventions like trolley service, posters and leaflets have become practically universal. Regular emails to staff, intranet pages, posters and leaflets have become the norm, giving influenza vaccination a much higher profile for HCWs. Although remaining uncommon, the use of multimedia and social media interventions has increased four- or fivefold over this 4-year period. This increase in the

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Table 3. *Adjusted change in vaccine uptake associated with each study factor, 2011/2012 influenza season, by professional group†*

	Overall				Doctors				Nurses				Other HCWs			
	Uptake difference (%)				Uptake difference (%)				Uptake difference (%)				Uptake difference (%)			
	Crude	Adjusted	95% CI	*P* value	Crude	Adjusted	95% CI	*P* value	Crude	Adjusted	95% CI	*P* value	Crude	Adjusted	95% CI	*P* value
Occupational health provider																
Internal	−12·4	−10·1	−23·1 to 1·0	0·08	–	–	–	–	−20·8	−14·6	−26·5 to −2·7	0·02†	−15·4	−8·4	−22·9 to −6·0	0·25
Staff involved in the vaccination campaign																
Occupational health nurses	–	–	–	–					−13·0	−22·6	−35·2 to −10·1	<0·01†	–	–	–	–
Peer vaccination	8·5	7·3	1·1 to 13·6	0·02†	–	–	–	–	6·9	6·1	0·0 to 12·9	0·07	–	–	–	–
Method of identification of eligible staff																
Central database	7·8	1·4	−5·3 to 8·1	0·69	15·1	4·2	−6·3 to 14·8	0·43	7·8	−1·0	−8·2 to 6·1	0·78	–	–	–	–
Vaccination in occupational health department, drop in	−16·4	−1·6	−16·0 to 12·7	0·82	–	–	–	–	−18·0	0	−0·2 to 6·8	0·97	−20·1	−12·5	−31·4 to 6·4	0·20
Talks/lectures	–	–	–	–	–	–	–	–	8·1	5·5	−2·2 to 13·3	0·16	–	–	–	–
Video/DVD	13·1	9·7	1·8 to 17·6	0·02†	–	–	–	–	12·4	3·5	−5·3 to 12·3	0·44	14·9	11·9	0·9 to 22·8	0·03†
Facebook	–	–	–	–	−22·0	−12·5	−29·6 to −4·6	0·15	–	–	–	–	–	–	–	–
Twitter	–	–	–	–	−23·6	−20·7	−34·0 to −7·3	<0·01*	–	–	–	–	–	–	–	–
Senior doctor as a champion	7·8	3·9	−2·4 to 10·4	0·23	12·2	17·8	7·6 to 28·0	0·03*	10·0	6·5	−1·0 to 14·0	0·09	–	–	–	–
Senior nurse as a champion	–	–	–	–	–	–	–	–	8·4	1·0	−7·1 to 9·1	0·8	–	–	–	–

† Only uptakes for interventions found to be significant in the univariate analysis are included.
* $P < 0{\cdot}05$.

number of strategies has been accompanied by an increase in the reported uptake of influenza vaccine in English acute trusts over this period, from a mean uptake of 16·5% in 2008/2009 to 44·1% in 2011/2012.

Factors significantly associated with increased uptake at trust level in 2011/2012 were peer vaccination and use of video and educational DVD presentations. The effect of educational presentations was consistent with the literature: the use of educational presentations was also associated with increased influenza vaccine uptake in nationwide surveys of HCWs in Greece and Germany [15, 16]. The use of trolley service, leaflets and posters has become so universal in acute NHS trusts in England that it was not possible to evaluate their impact on uptake. Doctors were particularly responsive to a senior doctor acting as a vaccination champion in the trust. We could not identify any factors independently associated with increased vaccine uptake by nurses, who had the lowest mean vaccine uptake, a finding consistent with the literature [5]. HCWs other than doctors and nurses were most responsive to educational DVDs. The study also highlights the fact that different groups of HCWs respond differently to interventions. Overall, the study found that although individual interventions can increase influenza vaccine uptake, individual interventions are unlikely to result in a very high uptake: when the mean uptakes of trusts implementing the identified interventions were examined, they were always below 60% (a target cut-off used by several Strategic Health Authorities in the North of England). However, for other HCWs the mean uptake in trusts using educational DVDs was 65·7%.

The low number of trusts implementing certain interventions may have led to the study being underpowered, failing to detect significant associations. Another limitation of the study lies in the direct use of numerator and denominator data in a binomial regression model. While this approach generates more precise estimates, it can also lead to the results being biased towards the larger trusts. The analysis was therefore re-run excluding the five largest trusts in order to explore the possibility of bias, and the identified factors associated with an increased uptake were the same. Moreover, the study may not have captured all the strategies employed by acute trusts. The mean uptake of vaccine in the trusts included in the sample was not statistically different from the mean uptake in the trusts that did not participate, making sampling bias unlikely, although trusts that answered the survey were more likely to be large (more than 500 beds) than those that did not. As trust size was not associated with a higher uptake, this is unlikely to introduce any confounding. Missing data is unlikely to introduce bias in this study. The highest number of missing answers for any question was 2/80. There was no missing data in the description of interventions implemented. Trusts mentioned many different interventions in the 'other' categories, such as SMS messaging, vaccination reminders in payslips, prize draws, using previous flu sufferers as champions, showcasing the creativity and initiative taken by trusts to increase vaccine uptake. These interventions could not be included in the analysis, and due to the wide range of interventions existing in trusts, it is likely that there are other interventions associated with an increase in vaccine uptake not included in the study. It is uncertain whether the strategies found to be effective in this study of acute trusts apply to other types of trusts such as primary care, ambulance and mental health trusts. These types of trusts represent different organizational arrangements and a different workforce. Some interventions assessed in this study, such as trolley service on wards for example, may not apply. Social media interventions such as vaccine promotion through Facebook and Twitter did not show a significant benefit in this study although their use as a promotion tool is rapidly increasing. After adjusting for other factors, using Twitter was actually associated with a lower vaccine uptake by doctors. Further evidence is required before widespread implementation of such tools. We also found that using occupational health nurses and an internal occupational health department was associated with a decreased uptake by nurses, even after adjusting for other factors. These settings represent the most traditional setup for vaccination campaigns for HCWs and the results may indicate that trusts not adopting more innovative interventions will find it increasingly difficult to obtain high vaccine coverage, particularly in nursing staff.

HCWs in acute trusts constitute a large, heterogeneous workforce comprised of a variety of professional groups. It can be inferred from the results of this study that they do not all respond to the same interventions and that obtaining a high uptake of influenza vaccine may necessitate a range of interventions aimed at the different healthcare professional groups. This finding is consistent with the literature, which suggests that not all categories of HCWs

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respond to vaccination campaigns in the same way: doctors are for example more likely to see immunization as a professional responsibility [17] whereas nurses see influenza immunization as a personal health choice, not a nursing intervention [18]. Trusts that are looking to increase their uptake of influenza vaccine by HCWs should introduce peer vaccination and educational DVDs if they have not already done so. Additionally, a senior doctor as an influenza vaccine champion will contribute to improve the uptake of influenza vaccine, at least by doctors. Isolated interventions are probably not sufficient to reach high levels of vaccine uptake, and evidence suggests that increasing the influenza vaccine uptake by HCWs requires not a focus on interventions but a paradigm shift in the way influenza vaccine is perceived [17], with the vaccine seen as part of a comprehensive infection control programme designed to protect patients and staff [17]. This study suggests that a multi-intervention strategy differentially targeting the different categories of HCWs, will be more successful. However, the interventions described in this study are unlikely to enable very high levels of uptake on their own. A long-term, well structured approach combining organizational and managerial components is most likely to achieve a sustained increase in vaccination uptake by HCWs.

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DECLARATION OF INTEREST

None.

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