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## Can we know the immunization status of healthcare workers? Results of a feasibility study in hospital trusts, England, 2008

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### SUMMARY

In England, there is no surveillance system for vaccines offered to healthcare workers apart from that in place annually for the seasonal influenza vaccine. To inform the feasibility of a general vaccine uptake surveillance system and to understand which policies are currently in place, we conducted a survey in the 162 National Health Service Foundation and Acute Hospital trusts in England, by submitting a questionnaire to their occupational health departments on immunization policies and methods of storing vaccine uptake data. In total, 104 hospital trusts (64·2%) responded. All responders offer hepatitis B, tuberculosis, measles-mumps-rubella, and influenza vaccines to healthcare workers; 0·9% reported not offering varicella and 13·5% not offering tetanus-diphtheria-polio; 66·4% record staff eligible for immunizations and 68·2% record staff they have immunized. Our study suggests that setting up a surveillance system to monitor vaccine uptake in healthcare workers is possible but would be challenging, given the variation in current systems.

**Key words:** Epidemiology, hospital-acquired (nosocomial) infections, occupation-related infections, surveillance system, vaccine-preventable diseases.

### INTRODUCTION

Healthcare workers (HCWs), by virtue of their exposure to patients and to blood and other bodily substances, are at increased risk of acquiring and spreading infectious diseases [1–4]. Immunization is thus very important in this population, both for self-protection and to protect patients' health [5].

In England, the Department of Health (DH) recommends routine immunization of HCWs against

diseases normally included in the routine childhood immunization schedule, e.g. measles-mumps-rubella (MMR) or diphtheria-tetanus-inactivated polio vaccine (DTaP/IPV), and, in addition, against seasonal influenza, tuberculosis, hepatitis B, and varicella [6].

In the English National Health Service (NHS), hospital services are provided by Acute and Foundation trusts. Acute trusts are managed directly by the central NHS whereas Foundation trusts have a decentralized management system and extra freedoms for organizing their services, hence also immunization of staff [7]. Foundation trusts have to meet national targets and standards like the rest of the NHS, but they are free to decide how to achieve this [8]. In

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England, there is a national surveillance system to measure influenza vaccine uptake in HCWs in Acute and Foundation trusts, but no system has been developed to measure the uptake of the other vaccines offered to HCWs.

Recent incidents involving the transmission of vaccine-preventable diseases in hospital settings in staff and their patients in England [9, 10] and the fact that national influenza vaccine uptake in HCWs is reportedly very low [11], suggest that general vaccine uptake in the healthcare setting may be unsatisfactory. Therefore, establishing a surveillance system to measure uptake for these vaccines in the HCW population would be very useful in England. However, uncertainties about the individual occupational health (OH) systems used to manage immunizations and the fact that different vaccines are recommended to various subsets of the HCW population, make the design of a such a system a very complex task [6, 12].

In order to understand how HCWs immunizations are managed and to determine the feasibility of establishing a national surveillance system for vaccine uptake in HCWs, we conducted a survey of all English Acute and Foundation NHS hospital trusts.

## MATERIAL AND METHODS

### Study design and study population

We conducted a cross-sectional survey, including all the OH departments of the 162 English NHS Acute and Foundation hospital trusts (hereafter trusts) in the study.

### Data collection

Between January and April 2008 we sent a standardized questionnaire to the OH immunization managers in each trust using the email contact list available for the annual influenza uptake survey undertaken jointly by the DH and the Health Protection Agency (HPA). Data on influenza vaccine coverage was previously available from this survey [12].

The questionnaire collected the following data at trust level:

- (1) Descriptive information (size, population served, etc.).
- (2) Policies in place to immunize HCWs (which vaccines are offered, screening procedures, etc.).
- (3) Modalities of storing data on HCW vaccinations (use of software, databases, etc.).

- (4) Description of HCW population (number of employees, staff categories, etc.).

We presented the questionnaire in two formats: as a word-processing document sent by email attachment that could be filled in electronically or in print, and as an online form [13].

### Data analysis

We used descriptive statistics to report responses to the questionnaire. Survey data were also analysed to determine which independent variables (i.e. following specific procedures and policies to immunize HCWs or store immunization data, and being a Foundation trust or an Acute trust) were associated with several outcomes (i.e. having responded to the seasonal influenza survey 2007/2008, levels of influenza coverage reported, or using software to manage the OH department). We calculated the prevalence ratio (PR) to measure univariate statistical associations. We used the Mann–Whitney test to compare means. *P* values of 0.05 were set as the threshold for statistical significance. Analyses were performed using Stata 10 and Excel [14, 15].

## RESULTS

### Trust population

The response rate to the survey was 64.1% (104/162); 63.5% (66/104) of trusts used the online form, 19.2% (20/104) the email and 17.3% (18/104) post. All ten strategic health authorities (SHA) of England were equally represented in responding to the survey and we could not show any statistical difference in terms of immunization policy or recording of information when we considered the SHA catchment area in the analysis. Each trust was responsible for between one and eight hospitals (median = 2). OH services were managed internally in 88.5% (92/104) of trusts and by external consultants (private companies or primary-care NHS trusts) in 7.7% (8/104), while 3.9% (4/104) did not respond to this question.

### Screening and vaccination

With regard to immunization policy, 81.7% (85/104) of trusts reported having policies in place for HCW immunizations, 1.9% (2/104) reported that no policies were in place, while 16.4% (17/104) did not answer this question. The OH vaccines offered to

Table 1. *Vaccines offered to healthcare workers in the trusts, England, 2008*

Vaccine	Yes (%)	No (%)	Not responded (%)
Hepatitis B	94 (90.4)	0 (0)	10 (9.6)
Varicella	92 (88.5)	1 (0.9)	11 (10.6)
BCG	94 (90.4)	0 (0)	10 (9.6)
Influenza	94 (90.4)	0 (0)	10 (9.6)
MMR	94 (90.4)	0 (0)	10 (9.6)
DTaP/IPV	71 (68.3)	14 (13.5)	19 (18.3)
Other	48 (46.2)	9 (8.7)	47 (45.2)

BCG, Bacillus Calmette-Guérin; DTaP/IPV, diphtheria-tetanus-inactivated polio vaccine; MMR, measles-mumps-rubella.

HCWs in the trusts are shown in Table 1. In addition 33 trusts reported offering to HCWs hepatitis A vaccine, 19 typhoid vaccine, nine meningitis vaccines, five anthrax vaccine, and one Yellow fever vaccine. Different vaccines were offered to various staff categories (Fig. 1).

When asked which HCWs were considered for hepatitis B vaccination, 87.5% (91/104) of trusts reported considering all HCWs in direct contact with patients' blood and not only staff performing exposure-prone procedures (EPPs), while 12.5% (13/104) did not respond to this question. Fifty-three per cent (55/104) of trusts reported verbally screening all HCW for varicella immunity; 6.7% (7/104) reported screening only HCWs directly involved in patient care; 33.7% (35/104) did not respond to this question. Serological screening was done only in HCWs with a negative history of varicella in 68.3% of trusts (71/104), whereas in 13.5% (14/104) it was always undertaken; 27.9% (29/104) did not respond to this question. No trusts reported offering BCG (Bacillus Calmette-Guérin) vaccine without screening, although 54.8% (57/104) did not respond to this question. Sixty-one per cent (63/104) reported screening for tuberculosis and considering BCG vaccine for new HCWs, whatever their age, if they had been in contact with patients and/or clinical specimens; were test-negative for Mantoux tuberculin skin test (TST) or interferon-gamma release assay (IGRA), and had not been previously vaccinated. For influenza immunization, 78.9% (82/104) reported offering the vaccine annually to all staff, while 10.6% (11/104) reported offering it annually only to staff directly involved in patient care; 18.3% (19/104) did not respond to this question. MMR vaccine was offered to all susceptible

(either on documentary or serological evidence) HCWs in 87.5% (91/104) of trusts, while 12.5% (13/104) did not respond to this question.

### Management of immunization records

With regard to storing data on HCWs immunizations in a central database, 68.2% (71/104) of trusts reported recording all immunizations and 66.4% (69/104) also recording information on staff eligible for vaccination. The numbers were lower for specific vaccines (Table 2). The use of OH software was reported by 76.0% (79/104) of responders; 9.6% (10/104) reported not using any software and 14.4% (15/104) did not respond to this question. Trusts reported using nine different software packages: 45.6% (36/79) used Cohort, 27.9% (22/79) used Opas, 13.9% Excel, 7.6% (6/79) Access, and 17.7% (14/79) other software [14, 16–18].

### Knowledge of the HCW population

Eighty-five per cent (88/104) of trusts reported knowing the exact number of staff employed and 1.9% (2/104) did not have this knowledge. Seventy-two per cent (75/104) reported knowing the exact number of staff per occupational category (e.g. medical doctors, nurses, physiotherapists, etc.), while 14.4% (15/104) did not record this information, and 13.5% (14/104) did not respond to this question.

Hepatitis B vaccine is offered especially to HCWs performing EPPs or performing tasks that put them in direct contact with patients' blood [6], 35.7% of trusts reported recording the number of staff performing EPPs, whereas only 14.4% (15/104) recorded the number of staff in direct contact with patients' blood; 14.4% (15/104) did not respond to this question (Table 3).

The Occupational Health Smart Card (OHSC) [19] for managing OH of doctors and medical students was in use in 81.7% (85/105) of trusts; 5.8% (6/104) did not use it, while 12.5% (13/105) did not respond to this question. Of trusts using OHSC, 45% (38/85) claimed to hold HCW immunization information in a centralized database via this system (Table 3).

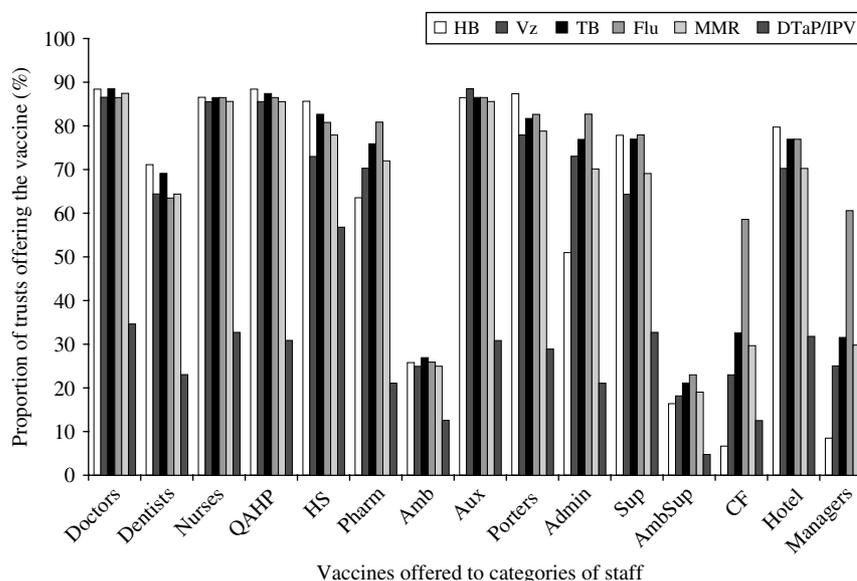
### Reporting vaccine uptake data

Forty-two percent (44/104) of trusts would agree to report coverage data to a national public health body (i.e. HPA or DH), 39% (41/104) would not agree, and

Table 2. Proportion of trusts knowing specific information about immunization of healthcare workers, England, 2008 ( $n=104$ )

Information recorded	Yes (%)	No (%)	Not responded (%)
All vaccinations in a central database	71 (68.2)	6 (5.8)	27 (26.0)
All staff eligible for immunizations in a central database	69 (66.4)	7 (6.7)	28 (27.0)
Hepatitis B vaccinations	51 (49.0)	38 (36.5)	15 (14.4)
Staff eligible for hepatitis B vaccine	17 (16.4)	72 (69.2)	15 (14.4)
Varicella vaccinations	50 (48.1)	39 (37.5)	15 (14.4)
Staff eligible for varicella vaccine	17 (16.4)	72 (69.2)	15 (14.4)
MMR vaccinations	48 (46.2)	38 (36.5)	18 (17.3)
Staff eligible for MMR vaccine	16 (15.4)	73 (70.2)	15 (14.4)
BCG vaccinations	39 (37.5)	16 (15.4)	49 (47.1)
Staff eligible for BCG vaccine	17 (16.4)	72 (69.2)	15 (14.4)

BCG, Bacillus Calmette-Guérin; MMR, measles-mumps-rubella.



**Fig. 1.** Proportion of hospital trusts ( $n=104$ ) offering vaccines to different staff categories, England, 2008. HB, Hepatitis B; Vz, varicella zoster; TB, tuberculosis; Flu, influenza; MMR, measles-mumps-rubella; DTaP/IPV, diphtheria-tetanus-inactivated polio; QAHP, qualified allied health professionals; HS, healthcare scientists; Pharm, pharmacists; Amb, ambulance staff; Aux, auxiliary staff; Admin, administrative staff; Sup, support workers; AmbSup, ambulance support staff; CF, central functions.

18% (19/104) did not respond to this question. Of those who would agree, 11.4% (5/44) preferred to export individual-level data directly from their database, 22.7% (10/44) to export it in bulk extract, 34.1% (15/44) by inserting it in a web-based format, and 47.7% (21/44) by using paper-based reporting. Seventy-two percent (75/104) of trusts had reported influenza vaccine uptake data for the 2007/2008 season.

### Analytical epidemiology

Trusts responding to the influenza vaccine uptake survey of 2007/2008 were more likely to have responded to our survey (PR 1.72, 95% CI 1.25–2.38,  $P<0.001$ ). Trusts responding to our survey had higher influenza vaccine uptake (mean 15.2, 95% CI 12.9–17.5) compared to non-responders (mean 11.6, 95% CI 8.7–14.4,  $P=0.04$ ). We did not identify any

Table 3. *Data available at trust level, England, 2008 (n = 104)*

Data	Yes (%)	No (%)	Not responded (%)
Number of staff employed	88 (84.6)	2 (1.9)	14 (13.5)
Number of employees per occupational category	75 (72.1)	15 (14.4)	14 (13.5)
Number of staff performing exposure-prone procedures	35 (33.6)	54 (51.9)	15 (14.4)
Number of staff in direct contact with patients' blood	15 (14.4)	69 (66.4)	20 (19.2)
Trusts issuing the Smart Card	85 (81.7)	6 (5.8)	13 (12.5)
Smart card users that store immunization data in a central database via this system	38 (44.7)	—	—

statistical difference in terms of response to our survey when we compared Foundation with Acute trusts. Reporting the use of OH software was also associated with knowing the number of staff employed in the trust (PR 4.6, 95% CI 1.7–12.8,  $P < 0.001$ ) and the number of staff employed per occupational category (PR 1.8, 95% CI 1.2–2.6,  $P < 0.001$ ). Reporting influenza vaccine uptake data was associated with knowing the exact number of staff per category (PR 1.4, 95% CI 1.0–2.0,  $P = 0.017$ ).

## DISCUSSION

The response rate was satisfactory and all regions of England were represented. The majority of trusts relied on their internal OH department to manage staff immunizations. Our study indicated that policies for immunizing HCWs were widely followed in the trusts, with only two claiming that they did not have OH immunization policies in place. Vaccines offered to HCWs were the ones recommended by the DH, plus, in some cases, vaccines recommended also for the general population. Screening procedures and algorithms to facilitate decisions on staff vaccinations also seemed to be in place in the majority of trusts in line with national recommendations [20].

Our study indicates that there are many different approaches employed to store HCW immunization data in the trusts. Most trusts reported storing immunization data in databases, especially information regarding vaccinations, but also, although in a lower percentage, staff members eligible for vaccination, using various software programs. Over 75% of responding trusts reported on using various software packages to manage OH services.

Most of the trusts reported knowing the number of staff employed, but the proportion knowing the number of staff per occupational category was lower. The trusts knowing the number of staff performing

EPPs or working in direct contact with patients' blood was low. A great proportion of trusts (>80%) used the OHSC and about half of these claimed that information about HCWs immunizations was available in a database via this system.

Less than half of responders would agree to transmit coverage information to a central national public health body. Concerned was expressed about the impossibility of increasing the already intense workload of OH staff with additional duties if these were optional. The majority of trusts would prefer an electronic way of reporting the data, either using the web or an automated system integrated in the OH software in use, although many selected paper-based return as one of the preferred options to report data.

We were able to combine influenza vaccine uptake data and responses regarding vaccination policies in place at trust level. Hospitals that responded to the influenza vaccine uptake survey were more likely to respond to the current study. Reporting influenza coverage data was more frequent in trusts that had knowledge of the number of staff employed per occupational category.

Surveillance of vaccine uptake in HCWs in Acute and Foundation trusts in England for influenza vaccination is undertaken through a web-based system [the annual HCW Influenza Vaccine Uptake Survey, collected via the Health Protection Informatics (HPI) website – now known as the ImmForm website] [11]. This system has the advantage that it is very quick [12]. Influenza vaccine uptake coverage for all HCWs in England was reported to be low (13.4% in 2007/2008), consistent with similar European and international settings [12, 21, 22]. Some studies have shown that vaccination policies seem to influence vaccination uptake in different target populations [23, 24]. Many of the vaccine coverage surveys described in the literature relied on sampling HCWs randomly

and interviewing them about their vaccination history or conducting serosurveys to measure their immune status [25–32]. These studies were generally conducted locally (i.e. individual hospitals), rather than nationally, where the selection of a representative sample of the whole hospital population could be problematic.

Previous studies on vaccine uptake relied on systems to manage immunizations already in place in the hospital [33–35]. Information on the number of individuals immune or immunized is an important element of any surveillance system for vaccine coverage, because it constitutes the numerator of the coverage figure in a given population; denominator data (target population eligible to receive the vaccine) is the other important element [36, 37].

Although our findings reassure us about the policies in place in the trusts, a comprehensive evaluation of the vaccination process would not be complete without measuring the actual vaccine uptake in the HCW population, especially to have a clear indication that policies that are reportedly in place are actually implemented. For this purpose a surveillance system for vaccine uptake in HCWs is needed. This knowledge is confirmed by the fact that policies are reported to be in place to vaccinate HCWs against seasonal influenza, but the yearly reported coverage is consistently very low.

We believe that the HCW vaccine coverage surveillance system should be based on electronic systems, such as the current ImmForm website, rather than paper-based reporting, as it is quick, efficient and provides validation on point of entry. In addition, we believe that such a surveillance system should extract the required data from systems already in place in the hospitals, where possible, to avoid additional labour in the OH departments. Specifying a common electronic data exchange mechanism, will allow data to be transferred electronically, as long as hospital systems can output data in a specified format. An XML schema (extensible markup language, the governmental standard for electronic data interchange) could be used for the required datasets. Although the majority of trusts have centralized systems and use software to store vaccination coverage data, the programs vary across hospitals, and some reported not using any software at all.

Designing such a system would rely on accurately estimating the number of staff immune (numerator) and the number of staff eligible for vaccines (denominator), consistently across the trusts. OH vaccines are

not offered equally across the HCW population, so the knowledge of the exact number of staff employed per occupational category would be necessary to estimate coverage accurately. This information would also be beneficial to the NHS employer to have accurate data on denominator and numerator (previous years) to know how much vaccine to buy. One potential way to estimate the denominator for the coverage data is to use the registers of the number of staff employed, although we have shown that there was considerable variability in the modalities of holding these registries in each trust. In addition, the OHSC database or the registries of staff performing EPPs or in direct contact with patients' blood could be used to estimate the denominator. However, these do not cover all the HCW population and are not kept by every trust.

Our study suggests that knowing how many staff are employed and in which category may be a predisposing factor to report effectively vaccine coverage data. In addition, the use of software in the trusts may be a predisposing factor to increase knowledge about numerators and denominators and therefore increase the reporting of valuable coverage data.

Although the response rate was satisfactory for a voluntary survey, many responders did not answer all the questions leaving many blank answers. Trusts that responded to our survey may be the ones with policies in place and we cannot be sure how policies are followed in non-responders, possibly leading us to overestimate good practice. The fact that responding trusts were more likely to have responded also to the influenza vaccine survey may indicate that there is a consistent group of trusts that are not keen to respond. It is worth noting from the graph that shows the vaccines offered to different staff categories (Fig. 1) that trusts that do not offer certain vaccines to certain staff categories may not be employing them rather than deliberately not offering the vaccine.

These results provide understanding of the management of HCWs immunizations in the hospital setting and useful directions on how to design a general HCW vaccine uptake surveillance system. To design such a system is certainly possible but technically challenging, given the variability in the trusts. Further research is needed in this field in order to explore the best and most efficient options, for example designing pilot surveys encompassing only those trusts that use the same systems (e.g. same OH software) and later aggregate the data.

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## DECLARATION OF INTEREST

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