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Influenza vaccine coverage among healthcare workers: A cluster analysis from a cross-sectional survey

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Conflict of interest

The authors have no conflict of interest related to this work.

Abstract:

Objectives. Influenza vaccination is recommended for healthcare workers (HCWs). However, in a 1500-bed tertiary care university hospital in France, influenza vaccine coverage among HCWs was 23% in 2017.

Patients and methods. We performed a cross-sectional study between 05/09/2018 and 25/09/2018 among HCWs, randomly selected independent of their vaccination status, to estimate influenza vaccination coverage rate during the 2017-2018 season, and explore factors influencing vaccination, using a questionnaire. Multivariable regression analysis to assess factors associated with vaccine uptake and hierarchical clustering on principal components to identify HCW profiles regarding factors influencing vaccine uptake, were performed after multiple imputation.

Results. 977 HCWs were included (68% participation rate), primarily females (84%), nurses (38%) of 18-39 years old. Influenza vaccination coverage rate reached 33[30-36]%. Frequent vaccination (aOR 39.27[21.52 - 74.51]) and personal/family medical history of influenza (aOR 3.33[1.16-10.02]) were independently associated with vaccination. In HCWs' patterns of influenza vaccination status, three clusters were identified: 1 (n=438) mostly vaccinated (70%); 2 (n=507) most unvaccinated (97%); and 3 (n=32) unvaccinated HCWs lacking knowledge on influenza and influenza vaccine.

Among the 148 (15%) HCWs reluctant to receive the vaccine the following year, 23 (16%) received it for the 2017-2018 season, while 125 (84%) did not, mostly stating they had doubt about the vaccine (82%).

Conclusion. This work identifies determinants of vaccine uptake and highlights HCW profiles associated with factors influencing vaccination and a subgroup of HCWs flexible about having the vaccine during the upcoming seasonal campaign. This result opens up perspectives toward improved vaccination coverage among HCWs.

Keywords: Influenza; vaccine; hesitancy; Healthcare workers

Introduction

The flu caused by influenza virus is an acute viral disease that mostly occurs during the winter period in an epidemic mode [1]. According to the WHO, the annual influenza epidemic is responsible for 3 to 5 million cases of severe illness and 250,000 to 500,000 deaths worldwide each year [2].

During the 2017-2018 influenza epidemic, Public Health France reported 2.4 million consultations for influenza-like illness, 9738 hospitalizations, 2915 admissions with 490 deaths in intensive care units [3]. The disease, usually mild, can be the cause of high morbi-mortality [4], especially in certain populations: pregnant women, very young children, the elderly and immunocompromised individuals and those with certain chronic diseases [5–9]. Healthcare workers (HCWs) are at occupational risk of not only contracting but also transmitting the influenza virus to sensitive populations [10]. The most effective way to prevent seasonal

influenza remains annual vaccination for high prevalence of individual protection and substantial reduction of viral circulation with the WHO objective being vaccination coverage reaching 75%. The French Ministry of Solidarity and Health recommends annual vaccination for HCWs and any other professional in regular and prolonged contact with people at risk of severe influenza. Despite these guidelines, HCW vaccine hesitancy remains high [11].

In 2017 in Rennes university hospital, a 1500-bed tertiary care center in Western France, influenza vaccine coverage among HCWs was 23% in (unpublished data, 2017, Influenza vaccine coverage in Rennes University Hospital). Upstream factors of influenza vaccine uptake had never been investigated in this setting.

The aims of this study were to assess the prevalence of vaccine uptake during the 2017-2018 season and to identify determinants of influenza vaccine uptake in HCWs in view of developing a strategic plan to tackle this public health issue.

Methods

Population and study design

We conducted a questionnaire-based cross-sectional study among HCWs, in the network of hospitals affiliated with the university hospital of Rennes (South Hospital, Hôtel-Dieu, La Tauvrais and Pontchaillou Hospital) between September 5 and September 25, 2018.

A qualitative survey was initially conducted to explore the motivating and demotivating factors for influenza vaccination within different categories of HCWs. Briefly, a semi-directive interview with open-ended questions was carried out with volunteers from different specialties, departments and professional categories. Forty-three HCWs representing different professional categories (2-5 per category) and departments were included. Among the participants, 9 were physicians, 22 paramedics (nurses and nursing assistants) and 12 were not directly involved in patient care (hospital service assistants, secretaries and technicians). Others respondents were specialized in infectious diseases (n=6), bacteriology (n=3), radiology (n=5), traumatology (n=3), thoracic surgery (n=7), pneumology (n=4), internal medicine (n=5), and miscellaneous (n=10). Results of the qualitative survey and data from the literature enabled the development of a questionnaire (**Appendix 1**) to assess positive and negative factors of influenza vaccine uptake on a larger scale and to identify specific factors influencing vaccine uptake, based and on which targeted strategies could one day be implemented to increase influenza vaccination coverage among HCWs.

Thirty among 130 medical units were randomly selected units, and 1448 HCWs, including medical, paramedical and administrative staff working in these units on the day the survey was conducted, were eligible. Randomly selected independent of their vaccination status, HCWs were proposed two anonymized standardized questionnaires: a complete questionnaire for those who consented to participate, and a brief questionnaire, collecting only their influenza vaccination status for the current season, for those who refused to fill out the full questionnaire. Questionnaires were collected within 48 hours after distribution. All HCWs who had agreed to participate were included.

This study was carried out in accordance with the Declaration of Helsinki. All HCWs were given complete information on the study protocol and purposes. Written consent was obtained before filling out the questionnaire. Data were managed in accordance with General Data Protection Regulation (CNIL).

Questionnaire

The complete questionnaire included demographic data (gender, age, household characteristics), profession and workplace, history of influenza, vaccinations (tuberculosis, B hepatitis, diphtheria tetanus poliomyelitis), previous influenza vaccinations (location, frequency), factors influencing influenza vaccine uptake, whether positive (motivating factors for vaccine uptake) or negative (demotivating factors for vaccine uptake), and the measures that would facilitate vaccination for the next influenza season (**Appendix 1**). Positive and negative factors are indicated in **Supplementary Table 1**.

Answers to the different questions of the survey on factors that could influence vaccine uptake are given as “Yes”, “No” or “I don’t know” for respectively “Yes, I agree”, “No, I don’t agree” and “I don’t know”, which connotes ignorance.

Statistical analysis

Expecting a response rate of 75%, the sample size was set at 10-15% of the total number of Rennes university hospital HCWs (n=9158), i.e., 800-1200 participants, excluding students, as their vaccination programme is under the responsibility of their faculties in France, not hospitals.

Data collected from the questionnaires were filled out on Epi Info 7 software. A random quality-check was performed by one investigator on 10% of the questionnaires. Data are given in absolute value and percentage for qualitative variables and median with interquartile interval for quantitative variables. Influenza vaccination coverage rate is given in percentage with 95% confidence interval.

Multiple imputation was performed using principal component method [12,13] for the multivariable analyses (multivariable regression and hierarchical clustering on principal components).

Multivariable analysis to assess factors associated with influenza vaccination for the 2017-2018 season was performed by logistic regression. Variables were selected according to the univariate analysis, to their relevance, and then by a backward stepwise selection process. A P value < 0.05 was considered as significant and results of the logistic regression were presented as adjusted odds ratio (aOR) with their 95% confidence intervals.

Hierarchical clustering on principal components was performed to identify different profiles of HCWs regarding factors influencing vaccine uptake on the imputed dataset. Included variables were gender, profession, department, work schedules, previous diagnosis of influenza, hepatitis B vaccination, concern about influenza, support for mandatory HCW vaccination, vaccination status for the 2017-2018 season, willingness to receive the influenza vaccine the following year, positive factors (vaccination for personal protection, patient protection, family protection, and/or general population protection, personal or medical history of influenza, influenza severity, influenza contagiousness, vaccine efficiency, reduction of absenteeism, habit, recommendations for HCWs, easy access, improved knowledge), and negative factors (doubt, side effects, never had influenza, no time for vaccination, youth, reluctance to have non-compulsory vaccination, never performed the influenza vaccine, fear of virus inoculation, lack of knowledge about influenza, no contact with patient, no contact with children, respect of barrier measures, bad experience with previous vaccination, media controversies).

Using the output of the multiple correspondence analysis, HCWs were represented by subgroups according to their vaccination status for the 2017-2018 season and their willingness to receive the influenza vaccine the following year.

Statistical analyses were performed using R studio® 2021.09.0.

Results

One thousand four hundred forty-eight questionnaires were distributed, and 985 were collected, resulting in a participation rate of 68%. Among them, 44 filled out the brief questionnaire, and 941 filled out the complete questionnaire. Eight participants were excluded because of missing data on their vaccination status for the current season. A total of 977 HCWs were included, mostly females (824, 84%), primarily in the 18-to-39-year-old age class (**Table 1**). Participants were predominantly nurses (38%) followed by nursing assistants (29%). Physicians accounted for only 13% of total HCW participants. More than half of HCWs (56%) had a previous history of flu (**Table 1**) and 98% had had all mandatory vaccines for HCWs in France (tuberculosis, B hepatitis, diphtheria, tetanus, and poliomyelitis; data not shown).

Influenza vaccination coverage rate reached 33[30-36]% for the 2017-2018 season. In the univariate analysis, striking differences in vaccine uptake were observed according to professional category ($P<0.001$): 86% (107/124) of physicians reported they were vaccinated, as compared to 19% (53/284) of nursing assistants ($P=0.001$). Previous diagnosis of influenza was more common in vaccinated HCWs, reaching 64% versus 52% in non-vaccinated HCWs ($P=0.001$). Vaccinated HCWs were also more likely to declare easy access to vaccination (88% versus 38%; $P<0.001$) (**Table 1**).

The main factors motivating vaccine uptake are listed in **Table 2**. Not surprisingly, vaccinated HCWs were more likely to feel concerned by annual influenza vaccination (96% versus 40%; $P<0.001$), to show willingness to protect patients (98% versus 71%; $P<0.001$), and family (92% versus 66%; $P<0.001$), to be aware of virus transmissibility (78% versus 36%; $P<0.001$) and disease severity (81% versus 42%; $P<0.001$). Concerning the negative determinants of vaccine

uptake, non-vaccinated HCWs more frequently reported doubts about vaccine efficacy (84% versus 49%; $P<0.001$) and concerns about side effects (73% versus 34%; $P<0.001$) (**Table 3**).

Among measures to facilitate influenza vaccine uptake, a need for more information on the vaccine was reported by 49% of unvaccinated HCWs, whereas all the others measures were reported by less than 40% of HCWs (**Supplementary Table 2**).

After multivariable regression analysis, frequent vaccination (aOR 39.27 [21.52 - 74.51]; $P<0.001$) and personal or family medical history of influenza (aOR 3.33 [1.16-10.02]; $P=0.006$) were determinants independently associated with vaccination vaccine uptake. Being a nursing assistant (aOR 0.29 [0.11-0.71]; $P=0.008$), a nurse (aOR 0.31 [0.13-0.70]; $P=0.006$) and against compulsory vaccination (aOR 0.46 [0.26-0.82]; $P=0.008$) were determinants negatively associated with influenza vaccine uptake (**Figure 1**).

In order to detect patterns of HCWs with regard to factors for influenza vaccine uptake, a three-cluster model best fitted our population ($n=977$; **Figure 2 and Supplementary Figure 1**). **Supplementary Table 3** summarizes HCW characteristics within clusters. Cluster 1 (red; $n=438$) included mostly vaccinated individuals (70%), with a past history of influenza (65%), feeling concerned by the disease (95%), willing to protect patients (98%) and having the intention to receive the influenza vaccine the following year (81%). This cluster consisted mostly in physicians (120/124, 97%). Cluster 2 (green; $n=507$) was predominantly composed of unvaccinated HCWs ($n=493$, 97%), primarily nurses (40%) and nursing assistants (39%), not willing to receive the influenza vaccine the following year (84%), having doubts about vaccine efficacy (92%), and apprehending its side effects (82%). More than half of HCWs did not feel concerned by influenza (59%) and 61% were lacking in knowledge on the subject. Cluster 3 (blue, $n=32$) was predominantly composed of nursing assistants ($n=10$, 31%) and other hospital professions ($n=11$, 34%) who mostly had not received the influenza vaccine during the 2017-2018 season ($n=30$, 94%) and were not willing to receive the vaccine the following year ($n=23$, 72%). Concerning determinants against vaccine uptake, cluster 3 mainly included 29 (91%) HCWs reporting not knowing whether their lack of knowledge concerning influenza triggered their not wishing to get the influenza vaccine. Most HCWs in this group ignored whether vaccine efficiency, easy access to vaccination and reduction of absenteeism were positive determinants for vaccine uptake and whether reluctance to have non-compulsory vaccines, absence of contact with patients or children, negative experience with previous vaccines and controversies in the media corresponded to negative determinants of vaccine uptake (**Supplementary Table 3**).

Using the output of the multiple correspondence analysis, HCWs were represented by subgroups according to whether they had received influenza vaccine for the current season (**Figure 3A**) and according to whether they intended to receive it the following year (**Figure 3B**). Among the 148 (15%) HCWs reluctant to receive the vaccine the following year, 124 (85%) were women, predominantly nurses (45%). This group included only 6 (4%) doctors. HCWs mostly worked in low-risk units ($n=102$, 69%) and on day-time schedules (122, 82%). Among them, 23 (16%) HCWs had received influenza vaccination for 2017-2018 season, whereas 125

(84%) had not. Close to three quarters 70% (n=104) of these HCWs felt concerned by influenza; 102 (69%) were aware of influenza severity and would primarily consider vaccination to protect patients (89%). However, 117 (79%) did not get the vaccine every year, 122 (82%) had doubts about the vaccine, only 58 (39%) considered it efficient and 100 (68%) apprehended side effects.

Discussion

The primary finding of this study is the low influenza vaccine coverage among HCWs (33% for the 2017-2018 season), at the university hospital of Rennes, a referral centre for Western France. This sobering fact underscores the need for enhanced efforts to identify the barriers to vaccination coverage, and to decide on interventions to improve the situation. Vaccine hesitancy remains a major public health issue. HCWs could be viewed as optimal candidates for vaccine compliance, as they are routinely faced with patients at risk of (or suffering from) influenza, and they theoretically are trained to understand the positive risk/benefit ratio of influenza vaccination. However, vaccination coverage in this population remains insufficient.

Facilitators for and barriers to influenza vaccination in HCWs have been largely described in the literature [14]. Of note, nurses and other nursing assistants are often much more hesitant, or even against influenza vaccination, than doctors [15–19]. The primary drivers for improved vaccine coverage have been labelled the 5C (confidence, complacency, constraints, calculation, and collective responsibility) [20]). The main barriers to vaccination include doubt about vaccine effectiveness, fear of side effects, and the belief that HCWs are not at high risk of influenza [21,22,19]. In the general population, the lack of knowledge about influenza, and influenza vaccine are major barriers [23]. We found that most non-vaccinated HCWs had doubts about vaccine efficiency (91%) but did not consider themselves as lacking in knowledge about the disease. On the other hand, educational sessions for HCWs about influenza and vaccines have been followed by increased vaccination coverage, from 21% to 38% in the literature [24]. Lack of time has been identified as another potential barrier (24), but not in our study.

Among measures to increase influenza vaccine coverage among HCWs, mandatory vaccination may be an option [25]. In the United-States, mandatory influenza vaccination policies has resulted in vaccination coverage exceeding 95% [26,27]. In our study, probably due to a cultural effect, mandatory influenza vaccination was not identified as a powerful determinant,. However, HCWs supporting compulsory influenza vaccination more frequently received the influenza vaccine. Interestingly, several studies have reported a dramatic increase in influenza vaccine coverage since the start of the COVID-19 pandemic [28], even in low and middle-income countries [29] and in populations previously hesitant or reluctant, such as nurses [30,31]. In our setting, the same tendency was observed in 2021, with a significant increase in influenza vaccination coverage (to 46%). However, in 2022 the proportion went down to 36%, a decline underscoring the need for persistent efforts to promote vaccination in this population (unpublished data, 2021 and 2022, Influenza vaccine coverage in Rennes University Hospital). Efforts to increase and facilitate access to influenza vaccine, with flexible and extended opportunities to receive the vaccine during work hours, represent another reported intervention aimed at increasing coverage among HCWs [32,33].

Potential interventions to change HCW attitudes toward this vaccine could be improved by targeting specific groups of HCWs. Our cluster analysis highlighted two main HCW profiles in terms of their positions regarding influenza vaccination, with one group in favour of vaccination (primarily physicians, with good knowledge about the disease, its transmissibility, and the vaccine), and another against. However, the determinants identified in the multivariable regression were not univocally distributed among clusters. As for Bardenheier and colleagues [34], they identified not three but four clusters of HCWs according to their attitudes and beliefs towards influenza vaccine: immunization champions, unworried vaccinators, fence sitters and sceptics. These groups cannot be extrapolated to our population of HCWs; in their setting, influenza vaccination coverage reached 78.4%, and their clustering was based on different factors. In our results, we observed distinct patterns of HCWs, some of which share similarities with those of Bardenheier and colleagues [34]. Our cluster 1 include not only a majority of vaccination advocates, but some also fence sitters, while cluster 2 is predominantly composed of reluctant or hesitant HCWs. Concerning cluster 3, some HCWs in this group evince disinterest. Our clustering to some extent coincides with the three categories found by Caristea and colleagues regarding SARS-CoV-2 vaccination. They identified three profiles: "non-fanatical" pro-vaccination, anti-vaccination, and those without a clear opinion (uninterested and/or undecided) [35]. Notwithstanding identification of different clusters based on motivating and demotivating factors, the labelling of HCWs so as to predict their attitude toward vaccine uptake remains controversial. This is in line with a cluster analysis assessing patterns of beliefs and intentions regarding SARS-CoV-2 vaccine uptake and reporting that vaccine willingness varied significantly among the three identified cluster groups: voluntary, hesitant and suspicious [36]. Of particular interest in this work was identification of a subgroup of HCWs (n=148), composed of HCWs from different clusters, who were hesitant about influenza vaccine uptake for the coming season. This subgroup harbored doubts about vaccine efficiency, and were concerned about possible side effects. However, these HCWs were well-aware of the severity and contagiousness of influenza. Their hesitancy seemed related to a lack of information about the vaccine and its efficiency rather than lack of knowledge about the disease itself. By contrast with those adamantly opposed to vaccine uptake, these HCWs could draw benefit from educational interventions concerning the vaccine. In addition to this subpopulation, 69 (11%) unvaccinated HCWs were willing to receive the vaccine during the coming season, a finding suggesting that implementation of global approaches could be more beneficial than targeted or stigmatizing campaigns as a means of improving vaccination coverage.

Our study has limitations. First, although our participation rate was elevated (68%), selection bias could not be ruled out. However, our population was representative in terms of gender and profession of the HCWs in our institution. For instance, physicians represented 13% of our sample and 14% of the hospital staff. Second, our results might not be generalizable to other institutions or other countries, and work atmosphere/work conditions within a given healthcare setting may be strongly influenced by national healthcare systems, legislation, and cultural aspects.

Our study also has strengths, including the random selection of hospital units to participate, and an adequate response rate [37]. The design including a primary qualitative study on a subset of HCWs followed by a large-scale quantitative investigation on a representative sample. Lastly and perhaps most importantly, we drew attention to a subgroup of HCWs that might be receptive to educational sessions on influenza vaccination.

In conclusion, our work highlights some of the determinants associated with HCWs' influenza vaccine uptake, and we were able to draw three different HCW profiles on the topic, with a subgroup of non-vaccinated HCWs remaining flexible about performing the vaccine (or being vaccinated) during the upcoming campaign. These results open up new perspectives and justify the implementation of comprehensive approaches and/or targeted interventions designed to improve vaccination coverage.

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Figure legends

Figure 1. Multivariable regression analysis for factors independently associated with vaccination coverage for the 2017-2018 season. Forest plot based on the results of the multivariable logistic regression. Variables were selected according to the univariate analysis, to their relevance, and then by a stepdown selection process. P value <0.05 was considered as significant and results of the logistic regression were presented as odds ratio (OR) with their 95% confidence intervals.

Figure 2. Three-cluster model representation patterns of healthcare workers with regard to factors influencing influenza vaccine uptake. Hierarchical clustering on principal components was performed to identify different profiles of HCWs regarding factors motivating and demotivating influenza vaccine uptake on the imputed dataset.

Figure 3. Healthcare workers factor map according to influenza vaccine status and the intention to receive it the following year. Multiple Correspondence Analysis data visualization was performed to map individuals according to **A.** whether they had received influenza vaccine for the current season and **B.** whether they intended to receive it the following year.

Supplementary figure

Supplementary figure 1. Visualisation of factors influencing influenza vaccine uptake contribution in each dimension and factors influencing relationships after multiple correspondence analysis.

Highlights

- Influenza vaccination hesitancy remains significant among healthcare workers (HCWs).
- Among the 977 HCWs included, influenza vaccination coverage rate reached 33%.
- Frequent vaccination and medical history of influenza are associated with vaccination.
- A subgroup of “reluctant” HCWs reported having doubts about the vaccine.

Author contributions

FR, JP, RG, PT and CP constructed the questionnaire. AS analysed the data. AS, RG, PT and CP interpreted the results. AS wrote the manuscript. RG, PT and CP reviewed the manuscript.

Table 1. Comparison of healthcare workers vaccinated, or not vaccinated, against influenza.

	Overall	Not vaccinated	Vaccinated	<i>P</i>
	n=977	n= 654	n=323	
Female, n (%)	824 (84)	567 (87)	257 (80)	0.005
Age (year class)				0.060
>60	19 (2)	8 (1)	11 (3)	
18-39	505 (52)	344 (53)	161 (50)	
40-59	453 (46)	302 (46)	151 (47)	
Children in the household	330 (36)	227 (37)	103 (33)	0.236
Profession				<0.001
Physician	124 (13)	17 (3)	107 (33)	
Nursing assistant	284 (29)	231 (35)	53 (16)	
Nurse	372 (38)	258 (39)	114 (35)	
Secretary	66 (7)	54 (8)	12 (4)	
Other	131 (14)	94 (14)	37 (12)	
Risk of influenza in the workplace				<0.001
High-risk units	174 (18)	103 (16)	71 (22)	
Intermediate-risk units	162 (17)	130 (21)	32 (10)	

	Low-risk units	617 (65)	402 (63)	215 (68)	
Work Schedules					0.022
	Day	752 (80)	516 (82)	236 (75)	
	Night	181 (19)	105 (17)	76 (24)	
Influenza infection					
Previous diagnosis of influenza		518 (56)	320 (52)	198 (64)	0.001
Concerned by influenza					<0.001
	Don't know	86 (10)	79 (14)	7 (2)	
	No	278 (31)	272 (47)	6 (2)	
	Yes	529 (59)	233 (40)	296 (96)	
Influenza vaccination					
Place of vaccination					0.025
	At the general practitioner's office	29 (9)	0 (0)	29 (9)	
	In the unit by a colleague	38 (12)	0 (0)	38 (12)	
	In the unit by an occupational health nurse	83 (26)	1 (25)	82 (26)	
	At the occupational health department	144 (45)	1 (25)	143 (46)	
	Other	24 (8)	2 (50)	22 (7)	
Usually getting the influenza vaccination					<0.001
	No	539 (58)	511 (83)	28 (9)	

Occasional	123 (13)	75 (12)	48 (15)
Yes	263 (28)	27 (4)	236 (76)

Willingness to receive influenza vaccination the following year <math><0.001</math>

Don't know	146 (16)	124 (20)	22 (7)
No	431 (46)	426 (69)	5 (2)
Yes	354 (38)	69 (11)	285 (91)

Support mandatory vaccination for healthcare workers <math><0.001</math>

Don't know	157 (17)	94 (15)	63 (21)
No	549 (60)	477 (78)	72 (24)
Yes	215 (23)	44 (7)	171 (56)

Table 2. Positive factors for influenza vaccine uptake among healthcare workers.

	Overall n=977	Not vaccinated n=654	Vaccinated n=323	<i>P</i>
For personal protection against influenza				<0.001
Don't know	53 (6)	49 (8)	4 (1)	
No	285 (32)	258 (44)	27 (9)	
Yes	550 (62)	275 (47)	275 (90)	
For patient protection against influenza				<0.001
Don't know	55 (6)	52 (9)	3 (1)	
No	123 (14)	121 (20)	2 (1)	
Yes	722 (80)	419 (71)	303 (98)	
For family protection against influenza				<0.001
Don't know	40 (5)	37 (6)	3 (1)	
No	187 (21)	164 (28)	23 (8)	
Yes	666 (75)	386 (66)	280 (92)	
For protection of the general population against influenza				<0.001
Don't know	91 (10)	77 (13)	14 (5)	
No	267 (31)	240 (42)	27 (9)	
Yes	517 (59)	262 (45)	255 (86)	
Vulnerable health				0.006

Don't know	93 (11)	75 (13)	18 (6)
No	393 (46)	261 (46)	132 (46)
Yes	370 (43)	234 (41)	136 (48)
Personal or familial medical history of influenza			
			<0.001
Don't know	78 (9)	68 (12)	10 (3)
No	580 (67)	398 (69)	182 (62)
Yes	209 (24)	109 (19)	100 (34)
Habit of receiving the vaccine annually			
			<0.001
Don't know	61 (7)	48 (8)	13 (5)
No	606 (71)	475 (84)	131 (45)
Yes	193 (22)	46 (8)	147 (51)
Recommendation for healthcare workers			
			<0.001
Don't know	76 (9)	65 (11)	11 (4)
No	427 (49)	364 (64)	63 (22)
Yes	363 (42)	144 (25)	219 (75)
Knowledge about influenza			
			0.022
Don't know	83 (10)	61 (11)	22 (8)
No	459 (53)	318 (55)	141 (49)
Yes	324 (37)	198 (34)	126 (44)

Awareness of the contagiousness of influenza <0.001

Don't know	90 (10)	73 (13)	17 (6)
No	342 (39)	293 (51)	49 (16)
Yes	439 (50)	207 (36)	232 (78)

Awareness of the severity of influenza <0.001

Don't know	92 (11)	78 (14)	14 (5)
No	294 (34)	253 (44)	41 (14)
Yes	481 (56)	241 (42)	240 (81)

Efficiency of the vaccine <0.001

Don't know	131 (15)	93 (16)	38 (13)
No	440 (51)	341 (59)	99 (34)
Yes	294 (34)	141 (25)	153 (53)

Easy access to vaccination <0.001

Don't know	72 (8)	61 (11)	11 (4)
No	365 (42)	329 (57)	36 (12)
Yes	438 (50)	184 (32)	254 (84)

Reduction of absenteeism <0.001

Don't know	94 (11)	71 (12)	23 (8)
No	457 (53)	356 (62)	101 (35)

	Yes	316 (36)	149 (26)	167 (57)	
Being at an age at risk					0.078
	Don't know	220 (25)	137 (24)	83 (29)	
	No	407 (47)	287 (49)	120 (42)	
	Yes	243 (28)	157 (27)	86 (30)	

Table 3. Negative factors for influenza vaccination among healthcare workers.

	Overall n=977	Not vaccinated n=654	Vaccinated n=323	<i>P</i>
Doubt about vaccine efficiency				<0.001
Don't know	36 (4)	28 (5)	8 (3)	
No	209 (24)	68 (11)	141 (48)	
Yes	643 (72)	499 (84)	144 (49)	
Fear of side effects				<0.001
Don't know	31 (4)	25 (4)	6 (2)	
No	319 (36)	132 (23)	187 (64)	
Yes	528 (60)	430 (73)	98 (34)	
Never had influenza				<0.001
Don't know	32 (4)	30 (5)	2 (1)	
No	524 (62)	295 (52)	229 (81)	
Yes	292 (34)	240 (43)	52 (18)	
No time for vaccination				<0.001
Don't know	31 (4)	28 (5)	3 (1)	
No	683 (81)	465 (84)	218 (77)	
Yes	125 (15)	63 (11)	62 (22)	
Never had the influenza vaccine				<0.001

Don't know	28 (3)	26 (5)	2 (1)
No	534 (63)	271 (48)	263 (95)
Yes	282 (33)	270 (48)	12 (4)
Reluctance to have non-compulsory vaccines			
			<0.001
Don't know	52 (6)	44 (8)	8 (3)
No	479 (56)	235 (41)	244 (87)
Yes	319 (38)	290 (51)	29 (10)
Fear of injections			
			0.024
Don't know	26 (3)	20 (4)	6 (2)
No	749 (90)	485 (88)	264 (94)
Yes	61 (7)	49 (9)	12 (4)
No risk factor for severe influenza			
			<0.001
Don't know	52 (6)	46 (8)	6 (2)
No	452 (54)	227 (41)	225 (80)
Yes	336 (40)	284 (51)	52 (18)
Fear of virus inoculation by the vaccine			
			<0.001
Don't know	69 (8)	61 (11)	8 (3)
No	467 (55)	228 (40)	239 (86)
Yes	310 (37)	280 (49)	30 (11)

Low risk of viral transmission by healthcare workers <math><0.001</math>

Don't know	140 (17)	129 (23)	11 (4)
No	568 (68)	312 (56)	256 (91)
Yes	133 (16)	118 (21)	15 (5)

Belief that influenza is a harmless disease <math><0.001</math>

Don't know	104 (13)	95 (17)	9 (3)
No	613 (74)	360 (65)	253 (90)
Yes	116 (14)	98 (18)	18 (6)

Lack of knowledge about influenza <math><0.001</math>

Don't know	60 (7)	49 (9)	11 (4)
No	597 (72)	360 (65)	237 (85)
Yes	177 (21)	145 (26)	32 (11)

No contact with patients <math><0.001</math>

Don't know	34 (4)	30 (5)	4 (1)
No	691 (83)	439 (80)	252 (90)
Yes	106 (13)	82 (15)	24 (9)

No contact with children <math><0.001</math>

Don't know	28 (3)	24 (4)	4 (1)
No	640 (78)	390 (71)	250 (89)

	Yes	158 (19)	132 (24)	26 (9)	
Negative experience with previous vaccinations					0.002
	Don't know	31 (4)	27 (5)	4 (1)	
	No	666 (78)	426 (75)	240 (85)	
	Yes	152 (18)	113 (20)	39 (14)	
Media controversies					<0.001
	Don't know	83 (10)	70 (13)	13 (5)	
	No	557 (66)	324 (58)	233 (82)	
	Yes	200 (24)	161 (29)	39 (14)	

Variable		N	Odds ratio	p
sexe	Man	153	Reference	
	Woman	824	2.14 (1.06, 4.45)	0.038
Profession	Doctor	124	Reference	
	Healthcare assistant	284	0.29 (0.11, 0.71)	0.008
	Nurse	372	0.31 (0.13, 0.70)	0.006
	Other	131	0.24 (0.09, 0.61)	0.004
	Secretary	66	0.31 (0.08, 1.06)	0.070
Frequency_influenza_vaccination	No	577	Reference	
	occasionally	123	5.75 (3.19, 10.56)	<0.001
	Yes	277	39.27 (21.52, 74.51)	<0.001
Support_compulsory_influenza_vaccination	Don't know	157	Reference	
	No	591	0.46 (0.26, 0.82)	0.008
	Yes	229	1.95 (0.99, 3.84)	0.053
Influenza_concern	Don't know	86	Reference	
	No	323	0.57 (0.16, 2.05)	0.382
	Yes	568	2.18 (0.87, 6.12)	0.112
Patient_protection	Don't know	55	Reference	
	No	123	0.14 (0.01, 1.62)	0.109
	Yes	799	1.67 (0.41, 10.83)	0.525
Personal_family_influenza_history	Don't know	79	Reference	
	No	679	2.51 (0.93, 7.14)	0.077
	Yes	219	3.33 (1.16, 10.02)	0.028



