

ORIGINAL ARTICLE

The impact of COVID-19 on hospital-based workers influenza vaccination uptake: A two-year retrospective cohort study

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Abstract

Objectives: This study aimed at exploring 2020/2021 and 2019/2020 seasonal influenza vaccine uptake among healthcare and non-healthcare workers, hereafter hospital-based workers (HBWs); examining attitudes and motivations for uptake in the 2020/2021 season; and exploring the amount, types, and sources of information used by HBWs.

Methods: A retrospective cohort study. Socio-demographics, working profile, working area, and vaccination status data were collected. Motivations for vaccination uptake in the 2020/2021 season were also explored. Descriptive and inferential statistics were used.

Results: Overall, uptake increased from 14.8% in 2019/2020 to 31.7% in 2020/2021. Male workers show greater vaccination uptake than their female counterparts (20.4% vs. 12.6% in 2019/2020, and 36.5% vs. 29.8% in 2020/2021). Uptake increased for healthcare assistants (+8.9%), administrative/managerial staff (+17%), nurses/midwives (+17.1%), non-medical graduate staff (+22.8%), and physicians (+33.2%), while it decreased slightly for resident physicians despite still being one of the most vaccinated categories (−4.6%). Main reasons for vaccination were the desire to protect patients (33.0%) and relatives (51.1%). Lastly, 60.8% of HBWs relied on institutional sources of information; the remainder relied on non-institutional sources including social media and chatting with colleagues.

Conclusions: Vaccination uptake increased in the 2020/21 season. Tailored educational interventions are required on the impact of influenza in care settings, vaccine efficacy, and vaccination safety. Investments in improving HBWs' reliance on institutional sources, and their ability to find them, are also needed.

KEYWORDS

health personnel, influenza, retrospective studies, vaccination

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1 | INTRODUCTION

Seasonal influenza is a respiratory vaccine-preventable disease that causes about 3–5 million cases of severe illnesses and 290 000 to 650 000 deaths annually worldwide.¹ The impact of influenza on healthcare services is a well-known phenomenon, with consequences on mortality and morbidity, especially for immunocompromised and intensive care patients.² The 2009 H₁N₁ influenza pandemic highlighted the crucial role of hospital-based workers (HBWs) in the nosocomial transmission of the virus and limit the spread of influenza.²

HBWs are recognized by the Centers for Disease Control and Prevention (CDC)³ and the World Health Organization (WHO)⁴ as persons working in healthcare settings who have the potential for exposure to patients and/or to infectious materials, including body substances, or contaminated environmental supplies, surfaces, or air. These persons are not limited only to direct healthcare providers (e.g., physicians, nurses, and more); but also to people potentially exposed to infectious agents, such as cleaners, drivers, administrative staff, and other occupational groups in health-related activities (indirect HBWs).^{3,4}

If not vaccinated, these workers could represent a source of infection that contributes to the spread of influenza.² Indeed, all HBWs are at high risk of contracting influenza and transmitting infections to patients and colleagues, thus increasing the overall disease burden, especially in high-risk hospital departments.² In winter, influenza is one of the main causes of absenteeism among all workers including non-healthcare workers.^{5,6} The reduced number of HBWs at work could contribute to increasing the workload and reduce the quality of the care provided.⁵

Despite the availability of antiviral drugs that can be administered both for therapeutic and preventive purposes, vaccines remain the most effective tool for the prevention of influenza.³ Multiple organizations and agencies such as the CDC,⁷ the Advisory Committee on Immunization Practices, and the Society for Healthcare Epidemiology of America (SHEA),⁸ recommend all HBWs to be vaccinated each year. Vaccination limits the spread of influenza, increases the number of days worked by HBWs, and reduces the number of infected patients, mortality rates, and related costs of healthcare services.^{5–7}

Vaccination coverage against influenza in the global adult population and categories at risk of infection is still scarce, and far from the optimal rate (minimum 75%, ideal 95%) to obtain herd immunity.⁸ Nowadays, only 65% of the population at risk is vaccinated in the USA; while in EU, this rate is even lower (35.4%).^{8,9} In the absence of mandatory influenza vaccination, it is necessary to find ways of increasing HBWs' vaccination uptake.

The WHO recognizes vaccine uptake as compliance with a vaccination schedule.¹⁰ Vaccine uptake implies the correct behaviors of individuals toward vaccines.^{8,10} Generally, HBWs' non-uptake of influenza vaccination is due to underestimating the disease and its consequences.^{11,12} In particular, factors decreasing vaccination uptake in HBWs are related to fear of side effects,¹² misinformation on vaccines provided by unofficial networks and information channels,¹³ poor knowledge of the benefits of vaccination, and limited access to free vaccinations (i.e., the limitation of vaccines available).¹⁴ Conversely, some factors positively affect HBWs' influenza vaccine uptake, such as an older age range, being a man, working as a physician, and being employed in emergency units.^{12–14}

Despite literature recognizing that the COVID-19 pandemic has modified several factors influencing vaccination uptake among HBWs,^{15,16} a detailed description of the extent to which influenza vaccination uptake increased, and which factors contributed to this increase, is still lacking. Furthermore, most studies focused only on healthcare workers and did not consider those workers who are not directly involved in patients' care, but who do work within the healthcare services. Lastly, the current literature on influenza vaccination has mainly used a cross-sectional design for studies.¹⁶ Few studies have applied a longitudinal retrospective design, and no data are included of HBWs' influenza vaccination during the COVID-19 pandemic.^{17–19}

1.1 | Aim

This study has three main objectives: (i) to explore 2020/2021 and 2019/2020 seasonal influenza vaccine uptake among HBWs; (ii) to examine motivations for adherence to the 2020/2021 vaccination campaign, and (iii) to explore the amount, type, and source of information received by HBWs.

2 | METHODS

2.1 | Study design, setting, and participants

A retrospective cohort study on HBWs at an Italian university hospital (Città della Salute e della Scienza di Torino) was planned. This hospital provides care across four sites with a total of 2339 beds, divided into a general hospital (1176 beds), a trauma center (405 beds), a maternity wing, and a children's hospital (489 and 278 beds, respectively). Each year, this hospital offers free seasonal influenza vaccination to all its employees

between October and January. The vaccination campaign is promoted by adopting several strategies, including advertising on the intranet and posters displayed in the most-frequented places (e.g., clocking in, corridors) and wards.

2.2 | Data source and procedure

Data were obtained from two databases: one local database which provided HBWs' socio-demographics, working profile, and working area information; and one regional database which provided information about influenza vaccination status. Data from these two databases were merged into one dataset.

To examine HBWs' attitudes to vaccination and motivations for uptake, a paper-and-pencil questionnaire was administered to those HBWs who underwent vaccination in 2020/2021.

A team of three occupational physicians, two nurses, and one health assistant created a 2-min ad hoc questionnaire which explored: (a) adherence to previous seasonal influenza campaigns (never, once, sometimes, every year); (b) reasons for having the influenza vaccination in 2020/2021 (multiple choice question); (c) perceived level of information on influenza vaccination (on a Numeric Rating Scale (NRS), 1—minimum information; 10—maximum information); and (d) sources of information (institutional vs. non-institutional). HBWs were asked to return the completed questionnaire to the occupational medicine ward at the end of the vaccination session.

2.3 | Variables collected

Data including gender, age, working profile (i.e., nurse/midwife, physician, technical and administrative staff, healthcare assistant, physician undergoing specialized medical training, and non-medical graduate staff), working area (i.e., medical, surgical, management, outpatients' services, pediatric, acute care), and seasonal influenza vaccination status in 2019/2020 and in 2020/2021, were collected.

2.4 | Exposure

Receipt of influenza vaccination was defined as an electronic recording of vaccination in the regional database between October 22, 2019 and January 8, 2020 (i.e., vaccination status in the 2019/2020 season), and between

October 26, 2020 and December 30, 2020 (i.e., vaccination status in the 2020/2021 season).

2.5 | Statistical analysis

Baseline socio-demographics of the study cohort were summarized. Categorical variables are shown as absolute frequencies and percentages, continuous variables as means and standard deviation (SD), or median and interquartile range (IQR), as appropriate.

The χ^2 test was employed to test associations between categorical variables. The Student's *t*-test, the Wilcoxon test, the analysis of variance, or the Kruskal–Wallis test, were performed to assess differences for continuous variables according to the distribution of the variables and the number of the study groups.

The Shapiro–Wilk normality test was performed to check the normality of continuous variables. For all tests the significance level was set at .05. All analyses were performed with Stata V.16.0 (StataCorp).

2.6 | Missing data

Data were removed from analyses when it was not possible to merge the local and the regional database due to missing or unmatched unique identifiers.

2.7 | Ethical considerations

Both the local and the regional database, as well as the 2-min questionnaires, were anonymous. Findings are reported as per Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines for observational studies of routinely collected data.²⁰

3 | RESULTS

3.1 | Characteristics of the study cohort and uptake of influenza vaccination in 2019/2020 and 2020/2021

The total sample increased in the 2 years from 10 885 to 11 446. Women were about 70% of the overall sample in both seasons. Physicians and nurses were the larger professional groups, accounting for about 15% and 35% of the overall sample in both seasons. Most of HBWs come from the medical area (approximately 30%) and the surgical area (approximately 20%) (Table 1).

TABLE 1 Characteristics of the study cohort

Variables	Season 2019/2020		P-value	Season 2020/2021		P-value
	N = 10 855			N = 11 446		
	Vaccinated (n = 1604)	Not vaccinated (n = 9251)		Vaccinated (n = 3623)	Not vaccinated (n = 7823)	
Gender, n (%)						<.001
Male	619 (38.6)	2421 (26.2)	<.001	1173 (32.4)	2043 (26.1)	
Female	985 (61.4)	6830 (73.8)		2450 (67.6)	5780 (73.9)	
Median age, years (IQR)	46 (31.5; 57)	50 (40; 56)	<.001	49 (37; 57)	49 (37; 56)	<.001
Working profile, n (%) ^a						
Physicians	425 (26.5)	1214 (13.1)		1040 (28.7)	721 (9.2)	
Nurses	288 (18.0)	3437 (37.2)		948 (26.2)	2870 (36.7)	
Healthcare assistants	104 (6.5)	1345 (14.5)		248 (6.8)	1288 (16.5)	
Resident physicians	452 (28.2)	625 (6.8)	<.001	468 (12.9)	782 (10.0)	<.001
Non-medical graduate staff	173 (10.8)	854 (9.2)		434 (12.0)	662 (8.5)	
Managerial/ Administrative staff	161 (10.0)	1575 (17.0)		461 (12.7)	1295 (16.6)	
Working area, n (%) ^a						
Medical	568 (35.4)	2566 (27.7)		1179 (32.5)	2207 (28.2)	<.001
Surgical	287 (17.9)	1937 (20.9)	<.001	681 (18.8)	1610 (20.6)	
Critical	175 (10.9)	669 (7.2)		335 (9.2)	566 (7.2)	
Pediatric	150 (9.4)	883 (9.5)		334 (9.2)	764 (9.8)	
Outpatients' services	207 (12.9)	1540 (16.6)		66 (1.8)	1164 (14.9)	
Management/ Administrative	174 (10.8)	1640 (17.7)		384 (10.6)	1467 (18.8)	

Abbreviation: IQR, interquartile range.

^aPresence of missing data.

Overall, influenza vaccination uptake increased from 14.8% (1604/10855) in 2019/2020 to 31.7% (3623/11446) in 2020/2021 ($P < .001$). The median age of vaccinated HBWs increased from 46 years (2019/2020) to 49 years (2020/2021). Males were more likely received vaccination in both seasons compared to their female counterparts (20.4% vs. 12.6%, $P < .001$, in 2019/2020, and 36.5% vs. 29.8%, $P < .001$, in 2020/2021).

Working profile and working area were significantly associated with vaccination uptake in both seasons ($P < .001$). Physicians (25.9% in 2019/2020 and 59.1% in 2020/2021) and resident physicians (42.0% in 2019/2020 and 37.4% in 2020/2021) reported the highest vaccination uptake; while healthcare assistants had the lowest vaccination uptake rate (7.2% in 2019/2020 and 16.1% in 2020/2021) in both seasons.

Except for resident physicians (−4.6%), vaccination uptake increased for all working profiles; physicians (+33.2%) had the highest increase in vaccination uptake, followed by non-medical graduate staff (+22.8%). The acute care area reported the highest vaccination rate in

both seasons (20.7% in 2019/2020 and 37.2% in 2020/2021, respectively) (Table 1).

Out of 10 483 HBWs who were active in both seasons, 6835 (65.2%) HBWs were never vaccinated in any season, 1095 (10.4%) adhered to both vaccination campaigns, and 2049 (19.5%) were vaccinated only in 2020/2021. Nurses were vaccinated only in 2020/2021 more often than other workers ($n = 687/2049$, 33.5%). HBWs in the management area (from 6.4% to 22.6%), followed by those working in the medical area (from 5.7%), were vaccinated only in 2020/2021 more often compared to those working in the acute care area (from 3.3%). Details of vaccination uptake in 2019/2020 and 2020/2021 are shown in Table 2.

3.2 | Profile of HBWs receiving influenza vaccination in 2020/2021

In all, 538/3623 (14.8%) questionnaires were returned to the occupational medicine ward at the end of the 2020/2021 vaccination campaign; 94 (17.5%), 89 (16.5%),

TABLE 2 Uptake of influenza vaccination in 2019/2020 and 2020/2021

Variables	Vaccination status <i>N</i> = 10 483				<i>P</i> -value
	Never <i>n</i> = 6830	Both <i>n</i> = 1095	Only in 2019/2020 <i>n</i> = 509	Only in 2020/2021 <i>n</i> = 2049	
Gender, <i>n</i> (%)					<.001
Male (<i>n</i> = 2940)	1724 (25.2)	414 (37.8)	205 (40.2)	597 (29.1)	
Female (<i>n</i> = 7543)	5106 (74.8)	681 (62.1)	304 (59.7)	1452 (70.8)	
Median age, years (IQR)	50 (40; 56)	48 (34; 58)	35 (31; 54)	52 (44; 58)	<.001
Working profile (missing data <i>n</i> = 202) <i>n</i> (%)					
Physicians (<i>n</i> = 1580)	580 (8.4)	332 (30.3)	93 (18.2)	575 (28.0)	
Nurses (<i>n</i> = 3596)	2621 (38.3)	219 (20.0)	69 (13.5)	687 (33.5)	
Healthcare assistants (<i>n</i> = 1385)	1115 (16.3)	66 (6.0)	38 (7.4)	166 (8.1)	<.001
Resident physicians (<i>n</i> = 1057)	531 (7.7)	227 (20.7)	225 (44.2)	74 (3.6)	
Non-medical graduate staff (<i>n</i> = 995)	589 (8.6)	133 (12.1)	40 (7.8)	233 (11.3)	
Managerial/Administrative staff (<i>n</i> = 1668)	1196 (17.5)	118 (10.7)	43 (8.4)	311 (15.1)	
Working area (missing data <i>n</i> = 56) <i>n</i> (%)					
Medical (<i>n</i> = 3029)	1879 (27.5)	394 (35.9)	174 (34.1)	582 (28.4)	
Surgical (<i>n</i> = 2148)	1448 (21.2)	199 (18.1)	88 (17.2)	413 (20.1)	
Critical (<i>n</i> = 1760)	1335 (19.5)	116 (10.5)	58 (11.3)	251 (12.2)	<.001
Pediatric (<i>n</i> = 1678)	1068 (15.6)	152 (13.8)	55 (10.8)	403 (19.6)	
Outpatients services (<i>n</i> = 1004)	650 (9.5)	99 (9.0)	51 (10.0)	204 (9.9)	
Management/Administrative (<i>n</i> = 808)	450 (6.5)	23 (2.1)	52 (10.2)	183 (8.9)	

Abbreviation: IQR, interquartile range.

and 127 (23.6%) HBWs reported having been previously vaccinated once, sometimes, and every year, respectively. Two-hundred and twenty-eight (42.4%) workers reported no vaccination before the 2020/2021 season. HBWs at their first vaccination in 2020/2021 were older than those who had had at least one vaccination before 2020/2021 (median age 51, (IQR) 40.5–57 vs. 47, (IQR) 34–57, $P = .014$), most often had a nursing profile ($n = 92/228$, 40.4%), and worked in medicine ($n = 51/111$, 22.4%) or outpatients services ($n = 50/111$, 22.0%) (Table 3).

3.3 | Motivations and perceived information levels for receiving influenza vaccination in 2020/2021

In the 538 questionnaires, most frequent reasons for vaccination uptake were the desire to protect fragile relatives living together ($n = 276$, 51.3%), belonging to a high-risk category (e.g., having an autoimmune or chronic illness) ($n = 221$, 41.0%), the desire to protect patients ($n = 178$, 33.0%), and awareness-raising due to the COVID-19 pandemic ($n = 203$, 37.7%). More than 40% of responders provided more than one reason. Less frequently reported reasons were the perceived need to protect themselves,

perceived importance of vaccination, and an easier differential diagnosis with COVID-19 infection.

Workers reported a median level of perceived information about vaccination of 8 (7–9) out of 10, with significant differences among working profiles ($P = .011$). Physicians, nurses/midwives, and physicians in training reported higher levels of perceived information compared to technical and administrative staff (median 8, [IQR] 7–9 vs. median 7, [IQR] 6–8). Age did not affect the amount of perceived information ($P = .321$) when workers who reported a score higher than the median (i.e., 8) were compared to those who reported a score lower than the median. No significant differences in the median amount of perceived information emerged by gender ($P = .112$) or working area ($P = .222$).

HBWs mainly relied on institutional sources such clinical guidelines and recommendations of the Ministry of Health ($n = 327$, 60.8%). Two hundred and eleven (39.2%) HBWs reported using non-institutional sources including social media and chatting with colleagues at the workplace. Working profile ($P = .209$), working area ($P = .074$), and age ($P = .527$) did not influence the source of information (institutional vs. non-institutional). Conversely, males were less likely to use institutional sources of information compared to females (49.3% vs. 65.1% vs. $P = .001$).

TABLE 3 Profile of workers with at least one vaccination before 2020/2021 compared to those with no vaccination before 2020/2021, based on self-completed questionnaires

Variables	At least one vaccination before 2020/2021 (N = 310, 57.6%)	No vaccination before 2020/2021 (N = 228, 42.4%)	P-value
Gender, n (%)			.189
Male	92 (29.6)	56 (24.5)	
Female	218 (70.3)	172 (75.4)	
Median age, years (IQR)	47 (34;57)	51 (40.5;57)	.014
Working profile (missing data n = 3) n (%)			<.001
Physicians (n = 151)	96 (30.9)	55 (24.1)	
Nurses (n = 167)	75 (24.1)	92 (40.3)	
Healthcare assistants (n = 40)	27 (8.7)	13 (5.7)	
Resident physicians (n = 66)	56 (18.0)	10 (4.3)	
Non-medical graduate staff (n = 61)	33 (10.6)	28 (12.2)	
Managerial/Administrative staff (n = 50)	23 (7.4)	27 (11.8)	
Working area (missing data n = 23) n (%)			.380
Medical (n = 111)	60 (19.3)	51 (2.2)	
Surgical (n = 84)	49 (15.8)	35 (15.3)	
Critical (n = 57)	31 (10.0)	26 (11.4)	
Pediatric (n = 117)	74 (23.8)	43 (18.8)	
Outpatients' services (n = 106)	56 (18.0)	50 (2.1)	
Management/Administrative (n = 40)	18 (5.8)	22 (9.6)	

Abbreviation: IQR, interquartile range.

4 | DISCUSSION

This study primarily aimed at exploring seasonal influenza vaccine uptake over two seasonal influenza vaccination campaigns from 2019 to 2021 and investigating attitudes and motivations for adherence to vaccination campaigns, and the amount, type, and source of information received by HBWs. In our sample vaccination uptake doubled over the two seasonal influenza vaccination campaigns (from 14.8% to 31.7%) for all direct and indirect HBWs.

Similar results emerged from the meta-analysis by Kong et al.²¹ reporting that after the COVID-19 pandemic, the general intention of the HBWs to receive influenza vaccination was greater. Vaccination uptake of HBWs highly increased in the 2020/2021 season compared with 2019/2020, suggesting the impact of the COVID-19 pandemic on influenza vaccination uptake from HBWs. In particular, the COVID-19 pandemic has been recognized as a major reason for choosing to be vaccinated. In this sense, our direct HBWs reported that the main reason for vaccination was the desire to protect family members and patients. Furthermore, feelings of unsafety could be another reason to get the vaccination. During the first wave of the COVID-19 pandemic, direct HBWs were constantly exposed to patients with limited personal protective equipment (PPE) and involved in isolation rooms.^{22,23}

While for indirect HBWs, the COVID-19 pandemic may have strengthened their sense of moral and civic responsibility in limiting the spread of infection, increasing their intention to vaccinate.^{20,21}

Media focus on preventing the spreading of COVID-19 may have also had a pivotal role in promoting vaccination uptake. Indeed, as in the 2009 influenza epidemic, social media promoted vaccination uptake, which is a fundamental measure in controlling and limiting pandemics. In particular, the effect of an early rollout of social media and public messaging on the importance of vaccination coverage seems to increase general vaccination uptake in the population.²⁴

Consistently with previous literature^{12,25} our male HBWs were more likely to adhere to the vaccination program. Women's vaccine hesitancy emerged before COVID-19, as shown by previous authors.²⁵ Women's hesitancy is generally related to fear of vaccines' side effects or adverse reactions concerning their fertility and potential future pregnancy.²⁵ However, women's sense of protecting loved ones develops a positive attitude toward getting vaccinated; women are generally more responsible about family protection, which could increase their vaccine uptake.²⁶ Moreover, when women are involved in vaccination promotion campaigns, they increased awareness about the benefits of vaccination.²⁶ Thus, it is likely that

the increased attention to the COVID-19 pandemic, to the detriment of influenza vaccination campaigns, has further reduced women's uptake of influenza vaccination.²⁵

Young HBWs showed greater uptake of influenza vaccination in both seasons (2019/2020 and 2020/2021). Younger workers are usually better informed about vaccines, and the amount of knowledge increases trust and promotes vaccination uptake.^{21,26} A higher or college educational level is a crucial factor in getting vaccinated.²⁷ As demonstrated by our results in professional groups with a generally lower educational level (i.e., healthcare assistants), vaccination compliance increased slightly (+8.9%) from the first year surveyed to the second. On the other hand, as the training level increases, the uptake level also increases (i.e., physicians: +33.2%). Moreover, it seems that COVID-19 affected organization and staffing levels, filling the previous labor shortages, and hiring younger HBWs.^{27,28} Most of these young HBWs worked with positive COVID-19 patients. Kwok et al.²⁹ affirmed that this working condition has certainly affected young HBWs' vaccination behaviors. In our sample, uptake of influenza vaccination also increased among older HBWs in the 2020/2021 season, probably due to their fear of severe COVID-19-related complications.

Our results showed that vaccination coverage was higher in areas at greatest risk of infection, such as intensive/acute care and emergency units and medical units. During the pandemic, these units had to care for patients severely compromised by COVID-19-related respiratory distress. Consistently with the literature^{20,29} we found a relevant increase particularly in the medical area.

Also, the staff of administrative/managerial area registered an increase in vaccination uptake (+6.4%). It is likely that the managers wanted to promote good practices and set an example for their colleagues.³⁰ The literature suggests that during pandemics, managers' vaccination behaviors motivate workers^{30,31}; in fact, the role of managers in promoting the adoption of annual vaccination among HBWs is well known for their contribution to plan vaccination campaigns. Through their vaccination, managers advocate for best practices; then their vaccination uptake is crucial to promote the adherence of employees.^{30,31}

The uptake of vaccination was also increased among administrative staff. As stated previously, the desire to protect themselves and others had reinforced the intention of getting influenza vaccination.^{18,32} Knowing someone who had suffered from a complicated COVID-19 infection, which sometimes exited in death, possibly influenced HBWs vaccination behavior. Furthermore, the need to return to normality was also a reason for greater adherence to vaccination.³³

Our findings suggested that vaccination uptake varied among direct HBWs. Physicians registered the highest

vaccination uptake, thus confirming previous literature. Genovese and colleagues³¹ pointed out that physicians have positive attitudes toward vaccines and are more likely to receive the shot. Professional responsibility and physicians' role in vaccinations are strong predictors of immunization behavior.^{32–35} Nurses and healthcare assistants were the professionals with the lowest vaccination uptake in both seasons even though they are on the front line in caring for patients.³⁴ This hesitancy may be due to poor knowledge about vaccines and vaccination.³⁵ Doubts about the effectiveness of vaccines and misinformation were suggested as being the main knowledge barriers.³⁵ Therefore, the role of education is essential. Nevertheless, several educational barriers to influenza vaccination still exist among HBWs.³⁵ Education of nurses and healthcare assistants may benefit from the introduction of specific curricula on vaccines and vaccination, which are also currently lacking in several developed countries.^{33,35,36} When HBWs are aware of the benefits of vaccines and set a good example, patients are also more likely to receive vaccination.^{33,36} According to the WHO vaccine advisory group³⁵ HBWs have a central role in building public confidence on vaccines. HBWs can spread the message about vaccination benefits and address patients' worries or concerns about a newly developed vaccine.

HBWs declared that they used mostly institutional resources and guidelines. COVID-19 may prompt HBWs to seek information from reliable scientific sources. In particular, institutional resources were consulted to obtain information on influenza vaccine efficacy, its interactions with COVID-19, and correct procedures to prevent and reduce influenza and COVID-19 transmission.^{36–38} However, our data suggested that information is still based on non-institutional sources with about 40% of HBWs looking for information in social media or chatting with colleagues. The possible reason for using non-institutional sources could depend on HBWs' personal beliefs about vaccines. Clarke and McComas³⁶ stated that the issue of vaccines is personally relevant and depends on the individual's level of knowledge and awareness of this knowledge. Health officials have recommended influenza vaccination to HBWs for more than 25 years and have attempted multiple interventions to convince them that vaccinations are safe, effective, and necessary.^{36,39} Paradoxically, although HBWs may consider their vaccine knowledge adequate, research suggests that this knowledge is still scanty, and guides their information-gathering wrongly.³⁶ Thus, HBWs feel confident and are not motivated to seek further information, even though what they know is potentially inaccurate.³⁶

Our data on vaccination uptake in the 2020/2021 season quadrupled compared to the previous. In addition to the hypothesized impact of the pandemic, the growth in vaccination adherence may depend on possible

strategies implemented in hospitals to promote vaccination. Vaccination campaigns are carried out yearly; the pandemic has reinforced these interventions. Perrone et al.³⁷ highlighted how their promotional and educational campaign increased the uptake of vaccine among employees. In particular, the massive communication campaign on the critical importance of undergoing influenza vaccination to avoid overburdening of the healthcare system and prevent co-infection with COVID-19 undoubtedly increased vaccine uptake among workers.

5 | LIMITATIONS

This study has some limitations. The retrospective design could have limited the association between variables. It is necessary to consider the possible differences in the definition of *hospital-based workers* in the scientific literature, mainly attributable to different contexts. This last consideration can also be applied to the subdivision of the areas of competence. A further limitation of the study could be the low response rate of the questionnaires completed and returned by vaccinated subjects. The main reason for this low response rate was that the distribution of the questionnaires began 2 weeks after the start of the vaccination campaign, with a loss of possible respondents.

6 | CONCLUSION

This study showed that HBWs' vaccination uptake increased significantly in the 2020/21 season. The COVID-19 pandemic seems to have positively affected uptake by increasing HBWs' sense of civic and moral responsibility. However, influenza vaccine uptake rates among HBWs are still far from optimal. Healthcare organizations should continue to promote influenza vaccination campaigns to reduce hospital infections. It is worth knowing the characteristics of the vaccine hesitant HBW population, such as female gender, and nurses or healthcare assistants' profiles, in order to structure targeted vaccination campaigns.

Knowledge and education on influenza vaccination as well as vaccine efficacy and safety, and availability of sources of accurate information, are essential to improve uptake. Investments in improving HBWs' ability to access institutional information sources are needed. Therefore, beyond educational interventions aimed at promoting awareness about the potential benefits of vaccination, HBWs should be given the opportunity to attend courses on self-retrieving evidence-based information.

Vaccination behaviors are complex and require multifaceted and multi-level interventions, including those at the individual, organizational, and institutional levels.

Hospitals should not be left alone in promoting vaccination uptake but should be sustained by policymakers. Policymakers should recognize different views on influenza vaccination, investigate the motivations underlying vaccine hesitancy, and offer campaigns structured around these issues. Furthermore, this study could help future research to plan targeted interventions to increase vaccination uptake against seasonal influenza and COVID-19, considering the coexistence of these two conditions in the next years.

AUTHOR CONTRIBUTIONS

Conceptualization: Beatrice Albanesi, Marco Clari, Daniela Chiarini; Data Collection: Marco Clari, Daniela Chiarini, Carla Aimasso; Methodology: Beatrice Albanesi, Marco Clari, Silvia Gonella, Lorena Charrier; Formal Analysis: Marco Clari, Silvia Gonella, Lorena Charrier; Writing—Original Draft Preparation: Beatrice Albanesi, Silvia Gonella; Writing—Review & Editing: Marco Clari, Ihab Mansour, Lorena Charrier, Maurizio Coggiola, Valerio Dimonte.

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DATA AVAILABILITY STATEMENT

Data were not deposited in publicly available repositories owing to ethical restrictions and participant confidentiality concerns. However, on reasonable request, derived data supporting the findings of this study are available with approval from the principal investigator (Dr. Marco Clari).

DISCLOSURE

Ethical approval: The Ethical Committee of the University of Torino approved the study (approval number 183424, 18/03/2021). *Informed consent:* All the participants consented to the collection of their medical records for inclusion in the databases. *Registry and the Registration No. of the study/Trial:* N/A. *Animal Studies:* N/A. *Conflict of interest:* The authors declare no potential conflicts of interest.

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