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Declining Influenza Vaccination Uptake, Attitudes, and Knowledge Among Healthcare Workers in Chengdu, China, in the Post-COVID-19 Era

Lin Xu[1,*], Shaohua Chen[1,*], Chunmei Li[1], Xiaogang Zhou[1], Li Tang[2]

[1]Department of Science and Education, The First People's Hospital of Shuangliu District, Chengdu, People's Republic of China; [2]Department of Healthcare, Chengdu Women's and Children's Central Hospital, School of Medicine, University of Electronic Science and Technology of China, Chengdu, People's Republic of China

*These authors contributed equally to this work

Correspondence: Li Tang, Chengdu Women's and Children's Central Hospital, School of Medicine, University of Electronic Science and Technology of China, No. 1617, Riyue Avenue, Chengdu, 610091, People's Republic of China, Email tangli207@hotmail.com

Purpose: Despite the benefits of influenza vaccination, particularly for healthcare workers (HCWs) at higher risk, vaccination coverage among HCWs in China remains low. This study aims to provide updated insights into the knowledge, attitudes, practices, and barriers related to influenza vaccination among HCWs in China post-COVID-19 era, to inform strategies for improving vaccination rates and healthcare safety.

Methods: A cross-sectional survey was conducted between December 2023 and January 2024 at two tertiary hospitals in Chengdu, China. Logistic regression analyses were used to identify factors associated with HCWs' influenza vaccination uptake for the 2023–2024 season.

Results: Of the 602 HCWs who completed the questionnaire (response rate: 86.0%), influenza vaccination uptake for the 2023–2024 season was low at 14.1%, down from 31.2% in 2021–2022 and 18.4% in 2022–2023. Main reasons for vaccine hesitancy included mistrust of vaccines (56.0%), inconvenient access (52.0%), and concerns over time, cost, and information (57.6%). Although most HCWs acknowledged the protective benefits of vaccination, only one-third supported mandatory vaccination, with concerns about personal autonomy among opponents. Multivariable logistic regression analysis showed that HCWs were more likely to be vaccinated if they believed it was essential for their job [adjusted odds ratio (aOR): 2.21; 95% confidence interval (CI): 1.13, 4.30), recognized their higher risk (aOR: 2.37; 95% CI: 1.09, 5.15), and were aware of high-risk groups for influenza vaccination (aOR: 2.49; 95% CI: 1.41, 4.40) as well as the age group with a higher infection rate (aOR: 1.89; 95% CI: 1.01, 3.51). However, those favoring increased campaign visibility had lower vaccination rates (aOR: 0.38; 95% CI: 0.17, 0.82).

Conclusion: The persistently low influenza vaccination rates among HCWs in China post-COVID-19 highlight significant gaps in healthcare risk management. Targeted interventions, including enhanced education and better vaccine access, are needed, along with further discussion on mandatory vaccination as a potential solution.

Keywords: vaccine hesitancy, public health interventions, perception, healthcare safety

Introduction

Influenza, an acute respiratory infection caused by influenza viruses, remains a significant public health challenge, contributing to substantial morbidity and mortality worldwide. Each year, there are 3–5 million cases of severe influenza illness and between 290,000 to 650,000 influenza-related deaths globally.[1] In China, the disease burden is also substantial, with an estimated average of 88,000 (95% confidence interval [CI]: 84,000, 92,000) influenza-associated excess respiratory deaths annually.[2] During the COVID-19 pandemic, mainland China implemented a strict dynamic zero-COVID-19 strategy, which largely suppressed influenza circulation due to shared transmission routes among respiratory viruses.[3] However, with the conclusion of the pandemic, there has been a notable resurgence in respiratory

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illnesses, including influenza, across the country last winter season. This upsurge has placed a substantial burden on healthcare workers (HCWs).[4] According to the latest data from the Chinese Center for Disease Control and Prevention (CDC), as of the week ending 10 December 2023, the proportion of laboratory-confirmed influenza cases among influenza-like illness cases in sentinel hospitals reached 54.1% in southern China and 43.9% in northern China.[5] In contrast, the corresponding figures for the same period in the previous year were significantly lower, at 10.3% and 3.6%, respectively.[6]

HCWs face a higher risk of exposure to the influenza virus and subsequent infection in their daily work compared to the general population. A meta-analysis of 29 studies showed that the incidence rate of laboratory-confirmed influenza per season among unvaccinated HCWs was 18.7%,[7] which is higher than the estimated rate of 10.7% in unvaccinated adults.[8] Annual influenza vaccination is widely recognized as the most effective method for preventing influenza and its associated complications.[9] Both the World Health Organization (WHO) and the Chinese CDC recommend that HCWs be prioritized for influenza vaccination.[10,11] Vaccinating HCWs against influenza serves multiple crucial purposes in healthcare settings, including reducing virus transmission, lowering staff illness and absenteeism rates, and minimizing the risk of transmitting influenza to high-risk patients who may experience severe complications from the virus.[12]

Despite these recommendations and potential benefits, influenza vaccination coverage among HCWs in China remains generally low.[13] An internet-based survey of 4,078 HCWs conducted in China reported a vaccination uptake of only 11.6% during the 2018–2019 season.[14] Similarly, three separate cross-sectional studies conducted in Shanghai, Chongqing, and Guizhou Province found that seasonal influenza vaccination coverage among HCWs ranged from 6.63% to 16.78% for the same season.[15–17] Several factors positively associated with higher vaccination coverage rates among HCWs in China have been identified, including access to free vaccinations, compulsory vaccination policies implemented by employers, a high level of knowledge regarding influenza, and a positive attitude towards vaccination.[14–17]

During the COVID-19 pandemic, COVID-19 vaccination was mandatory for all HCWs, unless medically contraindicated. Various strategies, including education on vaccine safety and effectiveness, were implemented to enhance acceptance. These efforts have been suggested to indirectly influenced HCW's willingness to receive influenza vaccination, as evidenced by increased uptake in some regions. For instance, a survey conducted in Guizhou Province revealed an increase in influenza vaccination uptake among HCWs from 6.63% in the 2018–2019 season to 22.60% in the 2020–2021 season, one year after the onset of the COVID-19 outbreak.[15] However, an internet-based cross-sectional survey found a decline in influenza vaccination coverage among Chinese HCWs during the COVID-19 pandemic, dropping from 43.7% in the 2020–2021 season to 35.4% in the 2021–2022 season.[18] Irrespective of these trends, influenza vaccination coverage among HCWs in China continues to fall below desired levels.[11] The suboptimal influenza vaccination coverage among HCWs in China highlights a critical area for improvement within healthcare policy and risk management frameworks. Effective risk management in healthcare involves minimizing the transmission of infectious diseases, protecting both patients and healthcare providers. Influenza vaccination of HCWs is a key strategy in this regard, as it directly impacts patient safety, operational efficiency, and the overall resilience of healthcare systems.

After the COVID-19 pandemic, limited research has been conducted on influenza vaccination within healthcare settings in China. The present study aims to provide updated insights into the knowledge, attitudes, practices and barriers related to influenza vaccination among HCWs in China. Understanding these factors is crucial for developing targeted strategies to enhance compliance with influenza vaccination, thereby strengthening infection control measures and ensuring a safer healthcare environment.

Materials and Methods

Study Design and Setting

This cross-sectional survey was conducted between December 2023 and January 2024 to assess the knowledge, attitudes and practices of HCWs regarding influenza vaccination. The study was carried out at two tertiary hospitals in Chengdu, Sichuan Province, China: the First People's Hospital of Shuangliu District and Maternity and Child Health Care Hospital of Shuangliu District. These are the only two tertiary hospitals in the district, excluding the traditional Chinese medicine hospital. Our choice was driven by the need to assess vaccination attitudes, behaviors and knowledge in a high-risk,

resource-intensive environment, such as tertiary hospitals. These health facilities handle complex cases and higher patient volumes, increasing HCWs' exposure to infectious diseases like influenza, making their vaccination behaviors particularly important. Also, these hospitals offer diverse specializations, providing a broader representation of healthcare roles. Since they typically serve as training centers for future healthcare professionals, HCWs in these institutions are more exposed to updated medical knowledge and practices, making their attitudes toward vaccination reflective of current healthcare education standards. These two hospitals collectively employ approximately 1,600 HCWs (as of 1 December 2023) and primarily serve the residents of Shuangliu District and its surrounding areas. The survey targeted diverse categories of HCWs including physicians, nurses, pediatricians, obstetricians, gynecologists, surgeons, laboratory technicians and other healthcare providers.

The Questionnaire

An online self-administered, anonymous questionnaire (Additional file 1) was created using the online survey platform WJX.CN (https://www.wjx.cn/). A quick response (QR) code was generated and distributed personally by the first author to each department, inviting HCWs to scan the QR code and participate in the survey. The questionnaire was adapted from a validated questionnaire used in a previous study,[19] with some items modified to suit its applicability among Chinese HCWs. To ensure linguistic accuracy, the questionnaire was translated from English to Chinese and back-translated to English by the authors. The questionnaire comprised 31 questions across four sections: participant demographics, attitudes toward influenza vaccination, vaccination behaviors, and knowledge on influenza vaccination. All questions were mandatory, and respondents were unable to alter their answers once submitted.

Before the questionnaire was officially distributed, a preliminary pilot survey was conducted in the departments of the first and corresponding authors. The questionnaire was refined based on the feedback received to ensure that all questions were clear and comprehensible. Key revisions included the addition of "lack of convenient access to vaccination" as a determinant of vaccination refusal or uncertainty, addressing colleagues' concerns about the limited availability of vaccination clinics during weekends and holidays. Moreover, modifications were made to the response options for the questions regarding the flu vaccines currently in use in China and the recommended risk categories for flu vaccination, in accordance with the latest guidelines from the China CDC. In addition, the question on primary flu prevention measures was revised to include the option "use of medical masks by healthcare professionals", reflecting a prevalent belief among HCWs in China that self-wearing masks can help prevent influenza.

Sample Size Determination

It was assumed that 16.8% of HCWs received an influenza vaccination in the 2023–2024 season.[16] With a desired margin of error of 3% and a significance level of 5%, a minimum sample size of 597 participants was required to ensure adequate statistical power. To account for an anticipated non-response rate of 15%, we aimed to recruit approximately 700 HCWs for the study. The OpenEpi sample size calculator was used to determine the required sample size.

Statistical Analysis

The collected dataset was analyzed using Stata version 16 (StataCorp LLC, College Station, USA). Descriptive statistics were carried out to summarize the characteristics of the study sample, with categorical variables presented as frequencies and percentages. χ^2 tests were performed to compare the demographic characteristics between HCWs who received influenza vaccination during the 2023–2024 season and those who did not. All questions regarding attitudes and knowledge were included in the univariable logistic regression analyses to examine their association with HCWs' adherence to influenza vaccination for the same period. Questions pertaining to knowledge were categorized based on whether the responses were correct (coded as 1) or incorrect (coded as 0). In the multivariable model, only variables demonstrating a significant association with the outcome variable in either the χ^2 tests or univariable logistic regression analysis ($p<0.05$) were retained. Correlation analyses were conducted to evaluate multicollinearity; if the correlation coefficient between any two independent variables exceeded 0.7 or was less than −0.7, one of those variables was excluded from the multivariable logistic regression model. Results are presented with adjusted odds ratios (aORs) and 95% confidence intervals (CIs). Statistical significance was set at a two-tailed p-values < 0.05.

Ethical Statement

The study was carried out in accordance with the Declaration of Helsinki, with approval from the ethics committee of the First People's Hospital of Shuangliu District (approval number: 2023-KS-A-01). Potential participants were fully informed about the study's objectives, procedures, voluntary participation, and personal data safety regulations. All participants provided electronic informed consent before completing the online survey.

Results

Of 700 HCWs approached (representing approximately 45.0% of all HCWs in the two tertiary hospitals), 602 questionnaires were completed and submitted, resulting in a response rate of 86.0%. The characteristics of the respondents are detailed in Table 1. The majority of respondents (71.6%) were females. Approximately half of the respondents were doctors holding a bachelor's degree, had less than nine years of experience in health services, and spent more than three-quarters of their working time in direct patients contact. There were no statistically significant differences in characteristics between HCWs who received influenza vaccination during the 2023–2024 season and those who did not ($p>0.05$).

Table 1 Characteristics of the Respondents[a]

Characteristic	Total (n=602)	Vaccination Status in 2023/2024		χ^2	P-value[b]
		Not Vaccinated (n=517)	Vaccinated (n=85)		
1. Gender				0.666	0.414
Female	431 (71.6)	367 (85.2)	64 (14.8)		
Male	171 (28.4)	150 (87.7)	21 (12.3)		
2. Age, years				3.107	0.375
< 25	147 (24.4)	124 (84.4)	23 (15.6)		
25–34	194 (32.2)	171 (88.1)	23 (11.9)		
35–44	199 (33.1)	166 (83.4)	33 (16.6)		
≥ 45	62 (10.3)	56 (90.3)	6 (9.7)		
3. Job title				0.017	0.992
Doctor	265 (44.0)	228 (86.0)	37 (14.0)		
Nurse	237 (39.4)	203 (85.7)	34 (14.3)		
Other	100 (16.6)	86 (86.0)	14 (14.0)		
4. Department				10.490	0.105
Internal Medicine	111 (18.4)	91 (82.0)	20 (18.0)		
Surgical	123 (20.4)	104 (84.6)	19 (15.4)		
Obstetrics and Gynecology	74 (12.3)	58 (78.4)	16 (21.6)		
Pediatrics	49 (8.1)	42 (85.7)	7 (14.3)		
ENT, Ophthalmology, Stomatology	60 (10.0)	56 (93.3)	4 (6.7)		
Other clinical departments	111 (18.4)	98 (88.3)	13 (11.7)		
Medical laboratory	74 (12.3)	68 (91.9)	6 (8.1)		

(*Continued*)

Table 1 (Continued).

Characteristic	Total (n=602)	Vaccination Status in 2023/2024		χ^2	P-value[b]
		Not Vaccinated (n=517)	Vaccinated (n=85)		
5. Professional title				0.502	0.919
None	112 (18.6)	96 (85.7)	16 (14.3)		
Junior	182 (30.2)	159 (87.4)	23 (12.6)		
Intermediate	208 (34.6)	177 (85.1)	31 (14.9)		
Senior	100 (16.6)	85 (85.0)	15 (15.0)		
6. Education level				1.473	0.479
Junior college or below	134 (22.3)	116 (86.6)	18 (13.4)		
Bachelor degree	342 (56.8)	297 (86.8)	45 (13.2)		
Master or PhD degree	126 (20.9)	104 (82.5)	22 (17.5)		
7. Years of work in health services				0.418	0.811
0–9	297 (49.3)	257 (86.5)	40 (13.5)		
10–19	229 (38.0)	194 (84.7)	35 (15.3)		
≥20	76 (12.6)	66 (86.8)	10 (13.2)		
8. Percentage of working time spent in patient contacts				0.460	0.928
0–25	112 (18.6)	97 (86.6)	15 (13.4)		
26–50	115 (19.1)	99 (86.1)	16 (13.9)		
51–75	132 (21.9)	111 (84.1)	21 (15.9)		
76–100	243 (40.4)	210 (86.4)	33 (13.6)		

Notes: [a]Data are represented as n (%). [b]The p-values refer to the differences between two groups as derived from χ^2 tests.

Attitudes

All 23 survey questions are presented in Table 2. Regarding attitudes towards vaccination, the majority of respondents believed that influenza vaccination for HCWs was a professional obligation (73.9%), a right and responsibility for health protection (83.4%), and a necessary requirement for employment in health institutions (67.1%). Although approximately 70% of our respondents recognized the crucial role of vaccines in eliminating severe infectious diseases, one-fourth expressed concerns about potential serious side effects and risks associated with vaccines. When asked about the factors contributing to vaccination refusal or uncertainty among HCWs, the main reasons identified included mistrust of vaccines and vaccination practice (56.0%), inconvenient access to vaccination (52.0%), and other factors such as time, cost and lack of information (57.6%). Most respondents agreed that influenza vaccination could protect themselves (84.6%), their family members (85.0%) and their patients (81.6%). Concerns about vaccine side effects were notable among respondents, particularly regarding fever (64.5%) and allergic reactions (54.3%). Regarding mandatory influenza vaccination for HCWs, about one-third supported it, while among those opposed, over half cited the impact on individual freedom of choice as a concern. Furthermore, respondents identified specific strategies to promote influenza vaccination among HCWs with offering specific training on influenza being considered the most effective by 35.2%.

Table 2 Survey Responses on Influenza Vaccination Attitudes, Behaviors, and Knowledge and Logistic Regression Analysis Evaluating the Associations Between Variables and Vaccination Uptake in the 2023–2024 Season

Survey Statement	Yes, n (%)			Univariable Analysis	Multivariable Analysis	
	Total	Vaccination Status in 2023–2024 Season				
	(n=602)	Not vaccinated (n=517)	Vaccinated (n=85)	OR (95% CI)	OR (95% CI)	P-value
Attitudes						
9. Do you believe that vaccinations for healthcare professionals constitute an obligation from a professional responsibility viewpoint?	445 (73.9)	373 (72.1)	72 (84.7)	2.14 (1.15, 3.98)	1.72 (0.77, 3.82)	0.184
10. Do you believe that vaccinations for healthcare professionals constitute a right and a responsibility in the defence and protection of health?	502 (83.4)	422 (81.6)	80 (94.1)	3.60 (1.42, 9.13)	Omitted due to multicollinearity	
11. Do you believe that vaccinations for healthcare professionals constitute an indispensable requirement for working in a health institution?	404 (67.1)	48 (56.5)	356 (68.9)	1.70 (1.07, 2.72)	2.21 (1.13, 4.30)	0.020
[a]12. What are your beliefs about the role of vaccinations in individual and collective human health?						
Vaccines are often linked to serious side effects	171 (28.4)	151 (29.2)	20 (23.5)	0.75 (0.44, 1.27)	–	–
The effects of vaccination are unknown	248 (41.2)	228 (44.1)	20 (23.5)	0.39 (0.23, 0.66)	0.71 (0.38, 1.32)	0.275
The potential risks outweigh the potential benefits	155 (25.7)	138 (26.7)	17 (20.0)	0.69 (0.39, 1.21)	–	–
Vaccines represent a legacy of achievement in the prevention of infectious diseases	433 (71.9)	360 (69.6)	73 (85.9)	2.65 (1.40, 5.03)	0.89 (0.38, 2.11)	0.790
Vaccines are important for reducing or eliminating serious infectious diseases	425 (70.6)	350 (67.7)	75 (88.2)	3.58 (1.80, 7.10)	1.98 (0.80, 4.93)	0.141
It is better to "go through" the disease rather than to vaccinate against it	115 (19.1)	100 (19.3)	15 (17.6)	0.89 (0.49, 1.63)	–	–
[a]13. Which of the following factors do you consider to be determinants of vaccination refusal/ uncertainty for healthcare professionals?						
Mistrust of vaccines and vaccination practice	337 (56.0)	293 (56.7)	44 (51.8)	0.82 (0.52, 1.30)	–	–
Scepticism, negative perception of the importance of vaccines	252 (41.9)	223 (43.1)	29 (34.1)	0.68 (0.42, 1.10)	–	–
Lack of convenient access to vaccination	313 (52.0)	252 (48.7)	61 (71.8)	2.67 (1.62, 4.42)	1.70 (0.94, 3.08)	0.079
Contextual influences of a social, cultural, and economic nature	223 (37.0)	195 (37.7)	28 (32.9)	0.81 (0.50, 1.32)	–	–

Other types of influences (time, cost, and lack of information)	347 (57.6)	300 (58.0)	47 (55.3)	0.90 (0.56, 1.42)	–	–
14. Do you believe flu vaccination for healthcare professionals is protection for yourself?	509 (84.6)	426 (82.4)	83 (97.6)	8.87 (2.14, 36.70)	Omitted due to multicollinearity	
15. Do you believe flu vaccination for healthcare professionals is protection for your family members?	512 (85.0)	429 (83.0)	83 (97.6)	8.51 (2.06, 35.26)	Omitted due to multicollinearity	
16. Do you believe flu vaccination for healthcare professionals is protection for patients?	491 (81.6)	412 (79.7)	79 (92.9)	3.36 (1.42, 7.91)	1.89 (0.69, 5.18)	0.217
[a]17. Which of the following (common, rare, or only theoretical) side effects to some extent related to flu Vaccination worry you?						
Pain at the injection site	297 (49.3)	250 (48.4)	47 (55.3)	1.32 (0.83, 2.10)	–	–
Fever	388 (64.5)	327 (63.2)	61 (71.8)	1.48 (0.89, 2.45)	–	–
Feeling of tiredness and/or fatigue	268 (44.5)	234 (45.3)	34 (40.0)	0.81 (0.51, 1.29)	–	–
Diseases of the peripheral nervous system or Guillain–Barré syndrome	272 (45.2)	243 (47.0)	29 (34.1)	0.58 (0.36, 0.94)	0.86 (0.49, 1.51)	0.589
Allergic manifestations	327 (54.3)	287 (55.5)	40 (47.1)	0.71 (0.45, 1.13)	–	–
No concern, the reactions are transient, minor, and very rare	157 (26.1)	133 (25.7)	24 (28.2)	1.14 (0.68, 1.90)	–	–
18. Would you be in favour of mandatory flu vaccination for health workers as a fundamental requirement for working within the national health system?	201 (33.4)	173 (33.5)	28 (32.9)	0.98 (0.60, 1.59)	–	–
[a,b]18.a Why would you be against it?						
Obligation affects individual freedom of choice	233 (58.1)	197 (57.3)	36 (63.2)	–	–	–
Some people are not suitable for vaccination due to health reasons	114 (28.4)	99 (28.8)	15 (26.3)	–	–	–
Obligation would expose me to a risk I had not chosen to take	54 (13.5)	48 (14.0)	6 (10.5)	–	–	–
19. In a hospital setting, what do you think could be the best strategy to propose flu vaccination to health professionals?						
Make vaccination mandatory	57 (9.5)	52 (10.1)	5 (5.9)	0.56 (0.22, 1.44)	–	–
Give greater visibility to the vaccination campaign	161 (26.7)	151 (29.2)	10 (11.8)	0.32 (0.16, 0.64)	0.38 (0.17, 0.82)	0.014
Award a bonus to employees who decide to get vaccinated	172 (28.6)	141 (27.3)	31 (36.5)	1.53 (0.95, 2.48)	–	–
Give specific training on the topic of influenza	212 (35.2)	173 (33.5)	39 (45.9)	1.69 (1.06, 2.68)	1.12 (0.64, 1.95)	0.703

(*Continued*)

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Table 2 (Continued).

Survey Statement	Yes, n (%)			Univariable Analysis	Multivariable Analysis	
	Total	Vaccination Status in 2023–2024 Season				
	(n=602)	Not vaccinated (n=517)	Vaccinated (n=85)	OR (95% CI)	OR (95% CI)	P-value
Behaviors						
[a]20. Did you get flu vaccination during these periods?						
2021–2022	188 (31.2)	163 (31.5)	25 (29.4)	0.91 (0.55, 1.50)	–	–
2022–2023	111 (18.4)	89 (17.2)	22 (25.9)	1.68 (0.98, 2.87)	–	–
2023–2024	85 (14.1)	0 (0)	85 (100.0)	–	–	–
[c]20.a Are you planning to be vaccinated against flu in 2023–2024?	–	188 (36.4)	–	–	–	–
21. Have you had the flu in the past 2 years?	192 (31.9)	168 (32.5)	24 (28.2)	0.82 (0.49, 1.36)	–	–
[d]21.a If you have had the flu in the past 2 years, what action did you take?						
Taking flu antiviral medications	148 (77.1)	129 (76.8)	19 (79.2)	–	–	–
Taking symptomatic medications	146 (76.0)	126 (75.0)	20 (83.3)	–	–	–
Absence from work until complete recovery	36 (18.8)	32 (19.0)	4 (16.7)	–	–	–
Keep working despite of being sick	90 (46.9)	82 (48.8)	8 (33.3)	–	–	–
Return to work before complete recovery	57 (29.7)	49 (29.2)	8 (33.3)	–	–	–
Knowledge						
[a]22. Which of the following answers is a reason for not adhering to flu vaccination?						
The flu vaccine is not entirely safe for health	329 (54.7)	284 (54.9)	45 (52.9)	0.92 (0.58, 1.46)	–	–
The flu vaccine is not effective in preventing seasonal flu	328 (54.5)	286 (55.3)	42 (49.4)	0.79 (0.50, 1.25)	–	–
The flu vaccine can cause serious side effects	236 (39.2)	200 (38.7)	36 (42.4)	1.16 (0.73, 1.85)	–	–
Difficulty accessing flu vaccination	298 (49.5)	244 (47.2)	54 (63.5)	1.95 (1.21, 3.13)	0.82 (0.46, 1.47)	0.515
Cost of the vaccine	214 (35.5)	177 (34.2)	37 (43.5)	1.48 (0.93, 2.36)	–	–

23. Do you believe that given your professional activity, the risk of contracting the flu compared to the general public is:						
Greater than the general public	457 (75.9)	381 (73.7)	76 (89.4)	3.01 (1.47, 6.18)	2.37 (1.09, 5.15)	0.030
Less than or equal to the general public	145 (24.1)	136 (26.3)	9 (10.6)	–	–	–
[a]24. The sources of influenza infection are:						
Healthy carriers	360 (59.8)	318 (61.5)	42 (49.4)	–	–	–
Asymptomatic carriers	424 (70.4)	366 (70.8)	58 (68.2)	–	–	–
People with flu symptoms	540 (89.7)	459 (88.8)	81 (95.3)	–	–	–
All selected	269 (44.7)	237 (45.8)	32 (37.6)	0.71 (0.45, 1.14)	–	–
[a]25. Which flu vaccines are currently in use in China?					–	–
Attenuated	490 (81.4)	420 (81.2)	70 (82.4)	–	–	–
Inactivated	514 (85.4)	440 (85.1)	74 (87.1)	–	–	–
Split	166 (27.6)	141 (27.3)	25 (29.4)	–	–	–
Subunit	158 (26.2)	130 (25.1)	28 (32.9)	–	–	–
All selected	114 (18.9)	99 (19.1)	15 (17.6)	0.91 (0.50, 1.65)	–	–
[a]26. In China, flu vaccination is recommended in the following risk categories:						
Under 5 years old	446 (74.1)	373 (72.1)	73 (85.9)	–	–	–
6–14 years old	487 (80.9)	412 (79.7)	75 (88.2)	–	–	–
Over 65 years old	432 (71.8)	358 (69.2)	74 (87.1)	–	–	–
Pregnant women	156 (25.9)	109 (21.1)	47 (55.3)	–	–	–
Patients with chronic diseases	285 (47.3)	231 (44.7)	54 (63.5)	–	–	–
Health worker	357 (59.3)	293 (56.7)	64 (75.3)	–	–	–
All selected	127 (21.1)	88 (17.0)	39 (45.9)	4.13 (2.55, 6.71)	2.49 (1.41, 4.40)	0.002
[a]27. Which of these measures are recommended in primary flu prevention?						
Standard immunoglobulins	258 (42.9)	226 (43.7)	32 (37.6)	0.78 (0.49, 1.25)	–	–

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Table 2 (Continued).

Survey Statement	Yes, n (%)			Univariable Analysis	Multivariable Analysis	
	Total	Vaccination Status in 2023–2024 Season				
	(n=602)	Not vaccinated (n=517)	Vaccinated (n=85)	OR (95% CI)	OR (95% CI)	P-value
Specific immunoglobulins	231 (38.4)	201 (38.9)	30 (35.3)	0.86 (0.53, 1.38)	–	–
Prophylactic vaccination	451 (74.9)	376 (72.7)	75 (88.2)	2.81 (1.41, 5.59)	1.17 (0.53, 2.58)	0.699
Hand washing	507 (84.2)	432 (83.6)	75 (88.2)	1.48 (0.73, 2.97)	–	–
Use of medical masks by oneself	514 (85.4)	443 (85.7)	71 (83.5)	0.85 (0.45, 1.58)	–	–
Use of medical masks by flu patients	459 (76.2)	392 (75.8)	67 (78.8)	1.19 (0.68, 2.07)	–	–
28. The incubation period of influenza is:						
6–12 h	93 (15.4)	85 (16.4)	8 (9.4)	–	–	–
1–2 days	236 (39.2)	203 (39.3)	33 (38.8)	–	–	–
1 week	245 (40.7)	205 (39.7)	40 (47.1)	1.35 (0.85, 2.15)		
2 weeks	28 (4.7)	24 (4.6)	4 (4.7)	–	–	–
29. Influenza has a higher incidence in those aged:						
<15 years old	374 (62.1)	306 (59.2)	68 (80.0)	2.76 (1.58, 4.83)	1.89 (1.01, 3.51)	0.045
15–64 years old	127 (21.1)	117 (22.6)	10 (11.8)	–	–	–
≥65 years old	101 (16.8)	94 (18.2)	7 (8.2)	–	–	–
30. What is the most frequent complication of flu?						
Pneumonia	491 (81.6)	420 (81.2)	71 (83.5)	1.17 (0.63, 2.17)	–	–
Myocarditis/pericarditis	30 (5.0)	28 (5.4)	2 (2.4)	–	–	–
Myositis	8 (1.3)	6 (1.2)	2 (2.4)	–	–	–
Reye syndrome	6 (1.0)	5 (1.0)	1 (1.2)	–	–	–
Encephalitis	3 (0.5)	2 (0.4)	1 (1.2)	–	–	–

Death	6 (1.0)	3 (0.6)	0 (0)	–	–	–
I do not know	61 (10.1)	53 (10.3)	8 (9.4)	–	–	–
31. The influenza vaccines in use protect against viruses of type:						
Only A	35 (5.8)	28 (5.4)	7 (8.2)	–	–	–
Only B	15 (2.5)	14 (2.7)	1 (1.2)	–	–	–
A and B	416 (69.1)	349 (67.5)	67 (78.8)	1.79 (1.03, 3.11)	1.11 (0.59, 2.09)	0.745
A, B, and C	136 (22.6)	126 (24.4)	10 (11.8)	–	–	–

Notes: [a]Multiple answers allowed. [b]Q18.a was made accessible only to those who gave a negative answer to question no.18. [c]Q20.a was made accessible only to those who did not get flu vaccination in 2023–2024 based on question no.20. [d]Q21.a was made accessible only to those who gave an affirmative answer to question no.21.

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Behaviors

In our study, the influenza vaccination uptake among HCWs for the 2023–2024 season was observed to be low at 14.1%, marking a decline compared to the previous seasons: 31.2% in 2021–2022 and 18.4% in 2022–2023. Moreover, 36.4% of HCWs who remained unvaccinated in the 2023–2024 season expressed a willingness to receive the vaccination. Over the past two years, 31.9% of respondents reported contracting influenza; among them, less than 20% reported being absent from work until they had fully recovered.

Knowledge

Concerns about safety, doubts about the effectiveness in preventing seasonal influenza, and difficulty accessing vaccinations were the most commonly cited reasons for not receiving influenza vaccination among our respondents. A significant majority (75.9%) believed their risk of contracting influenza was higher compared to the general public. However, awareness about specific high-risk groups, such as pregnant women who are recommended to receive the vaccination, was limited, with only 21.1% respondents aware of this recommendation. With regard to primary influenza prevention measures, our participants recommended the use of medical masks by oneself (85.4%), hand washing (84.2%), and the use of medical masks by the influenza patents (76.2%), followed by prophylactic vaccination (74.9%). In addition, 40.7% of respondents were knowledgeable about the actual incubation period of influenza, and more than half (62.1%) understood that the disease incidence is higher among individuals under 15 years old. Moreover, the majority recognized pneumonia as the most frequent complication (81.6%) and understood that current vaccines protect against type A and type B influenza viruses (69.1%).

Logistic Regression Analysis

The results of logistic regression analysis assessing the relationships between variables and HCWs' influenza vaccination uptake during the 2023–2024 season are detailed in Table 2. Variables that showed statistical significance in the univariable analysis regarding vaccination uptake for the 2023–2024 season were included in a multivariate logistic

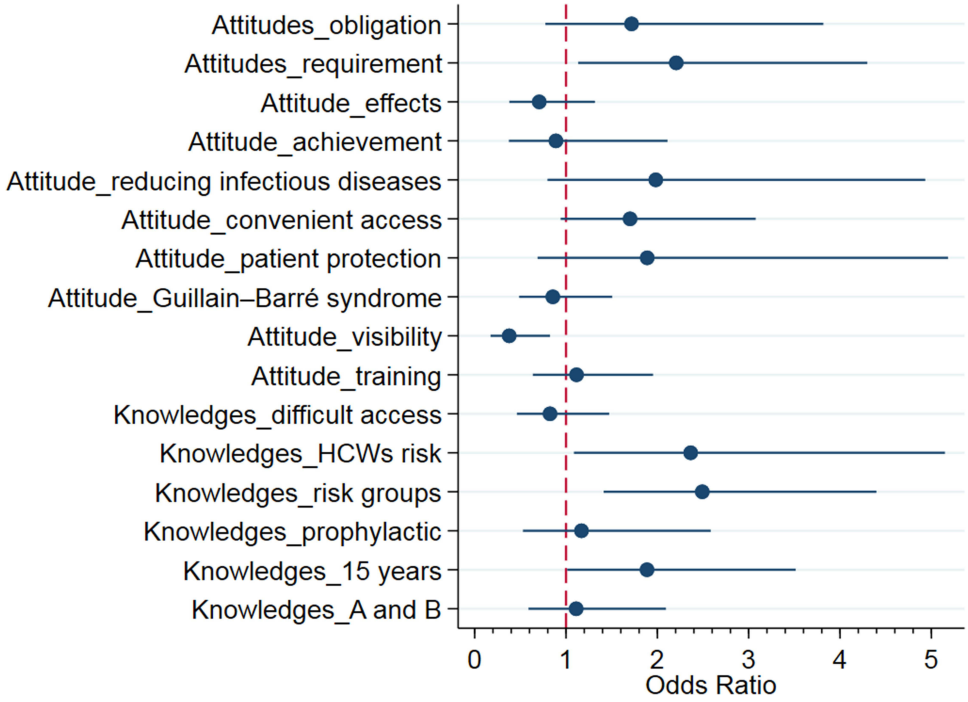

Figure 1 Forest plot reporting the multivariable logistic analysis results; odds ratios and 95% confidence intervals (question_answer) regarding the vaccination uptake in the 2023–2024 season.

regression model (Figure 1). However, certain variables (ie questions number 10, 14 and 15) were excluded due to multicollinearity as determined by correlation analysis.

Based on the multivariable analysis, four variables were found to be associated with HCWs' vaccination uptake for the 2023–2024 season. Specifically, HCWs were more likely to receive the influenza vaccination if they believe that vaccinations for healthcare professionals are essential for working in a health institution (aOR: 2.21; 95% CI: 1.13, 4.30), if they were aware of their higher risk of developing the disease compared to the general population (aOR: 2.37; 95% CI: 1.09, 5.15), if they knew the high-risk groups recommended for flu vaccination according to Chinese guidelines (aOR: 2.49; 95% CI: 1.41, 4.40), and if they correctly identified the age group with a higher infection rate (aOR: 1.89; 95% CI: 1.01, 3.51). However, HCWs who considered enhancing the visibility of the vaccination campaign as the best strategy to propose influenza vaccination among their peers had a lower uptake rate for the 2023–2024 season (aOR: 0.38; 95% CI: 0.17, 0.82).

Discussion

The results of our cross-sectional survey highlights the persistently low and declining rates of influenza vaccination among HCWs in Chengdu, China over the past three years. Our findings corroborated those of a previous online survey conducted in China, demonstrating a decrease in influenza vaccination coverage among HCWs from 43.7% in 2020–2021 to 35.4% in 2021–2022.[18] The low vaccination rates observed in our study were also consistent with findings from a multicenter survey in the country during the 2020–2021 season, where only 24.1% (243 out of 1,010) HCWs self-reported having received at least one influenza vaccine within the past five years.[20] However, our rate was lower than that of many developed countries, such as the United States,[21] Singapore,[22] and Finland.[23] This discrepancy could potentially be attributed to national policies, as influenza vaccination has not been integrated into China's immunization program. Also, influenza vaccination is not mandatory for HCWs in China, including those working in high-risk departments.

A prominent theme in our study was the mistrust of vaccines and vaccination practices, which emerged as a considerable barrier to higher uptake. More than half of the respondents expressed a lack of trust, coupled with concerns regarding vaccine side effects. This aligns with global trends where vaccine hesitancy, driven by safety concerns and misinformation, continues to impede vaccination initiatives, particularly in regions lacking robust vaccine advocacy or public health campaigns.[24,25] Addressing this mistrust is crucial; targeted interventions, such as educational campaigns that directly confront these issues and engage respected peers as advocates, may prove effective. Our findings suggest that providing clearer information on the safety and benefits of vaccination, specifically tailored to HCWs, could alleviate some of these concerns.

Consistent with previous research studies,[19] our study also emphasized the importance of disseminating flu-related knowledge among HCWs. Participants were more inclined to receive flu vaccination when they recognized their increased susceptibility of contracting influenza compared to the general population and demonstrated awareness of the recommended high-risk groups for vaccination. This suggests that improving flu-related knowledge may serve as a pivotal mechanism for increasing vaccine coverage. The fact that many HCWs continue to work while ill, despite understanding the transmission risk, further underscores the necessity for stronger workplace policies that support both vaccination and illness-related leave. Research has shown that a 10% increase in vaccination rate correlates with a 10% deduction in sickness absence rates.[26] Moreover, healthcare facilities where the flu vaccination rate among employees exceeded 60% exhibit lower incidences of flu-related illness and mortality among patients compared to those where the vaccination rate fell below 60%.[27] Therefore, promoting vaccine education and endorsing workplace health policies that encourage vaccination uptake could reduce influenza transmission within hospitals and protect both staff and patients.

Interestingly, our results challenge the assumption that visibility campaigns or financial incentives alone will significantly boost vaccination rates. While a portion of our respondents expressed support for these strategies, our regression analysis indicated that such measures were not associated with increased vaccination uptake. Existing literature suggests that traditional interventions such as education (through informational handouts, posters, etc.) and free vaccination have demonstrated limited success in achieving vaccination rates beyond 60%.[28] In contrast, mandatory influenza vaccination has consistently proven to be the most successful approach in boosting vaccination coverage among HCWs. For instance, in Finland, the implementation of mandatory influenza vaccination led to a significant rise in

vaccination coverage, climbing from 59.5% to nearly 100%.[23] Although mandatory vaccination raises ethical concerns regarding personal autonomy, it is essential to carefully consider the broader public health benefits, particularly for HCWs who are in frequent contact with high-risk patients.

Our study has several limitations. Firstly, the data collection of our study was completed prior to the conclusion of the influenza season, potentially resulting in a slight underestimation of the vaccine coverage. Secondly, although we achieved a high response rate of 86.0%, there remains a possibility of selection bias as individuals with greater attention towards vaccination are typically more inclined to participate in interviews on this topic. In addition, the use of significance tests assumes random recruitment of participants; however, our study used non-random (convenience) sampling. Although we achieved a high response rate of 86% and ensured representation from a diverse sample of HCWs across various departments within the two hospitals, potential biases associated with non-random sampling persist. As a result, our findings may not fully represent the target population of HCWs in China.

Conclusion

The persistently low and declining coverage of influenza vaccination among HCWs in China during the post-COVID-19 era highlights a critical gap in healthcare risk management, with significant implications for patient safety and healthcare system efficiency. Our data underscore the need for targeted interventions, with focus on education, clear dissemination of information, and ensuring convenient access to vaccination services. Mandatory vaccination as an efficient measure is also worth contemplating and discussion. To overcome the significant barrier of vaccine mistrust among HCWs, it is imperative to provide evidence-based education and facilitate open dialogue that directly addresses their concerns. Engaging respected peers as advocates may also enhance their confidence in vaccination initiatives. However, given the methodological constraints of our study, we advise readers to interpret the results with caution.

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Disclosure

The authors report no conflicts of interest in this work.

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