



Real-life experience on COVID-19 and seasonal influenza vaccines co-administration in the vaccination hub of the University Hospital of Palermo, Italy

Claudio Costantino, Walter Mazzucco, Arianna Conforto, Livia Cimino, Alessia Pieri, Sara Rusignolo, Nicole Bonaccorso, Floriana Bravatà, Laura Pipitone, Martina Sciortino, Marcello Tocco, Elena Zarcone, Giorgio Graziano, Fabio Tramuto, Carmelo Massimo Maida, Alessandra Casuccio & Francesco Vitale

To cite this article: Claudio Costantino, Walter Mazzucco, Arianna Conforto, Livia Cimino, Alessia Pieri, Sara Rusignolo, Nicole Bonaccorso, Floriana Bravatà, Laura Pipitone, Martina Sciortino, Marcello Tocco, Elena Zarcone, Giorgio Graziano, Fabio Tramuto, Carmelo Massimo Maida, Alessandra Casuccio & Francesco Vitale (2024) Real-life experience on COVID-19 and seasonal influenza vaccines co-administration in the vaccination hub of the University Hospital of Palermo, Italy, *Human Vaccines & Immunotherapeutics*, 20:1, 2327229, DOI: [10.1080/21645515.2024.2327229](https://doi.org/10.1080/21645515.2024.2327229)

To link to this article: <https://doi.org/10.1080/21645515.2024.2327229>



© 2024 The Author(s). Published with license by Taylor & Francis Group, LLC.



[View supplementary material](#)



Published online: 18 Mar 2024.



[Submit your article to this journal](#)



[View related articles](#)



[View Crossmark data](#)

Real-life experience on COVID-19 and seasonal influenza vaccines co-administration in the vaccination hub of the University Hospital of Palermo, Italy

Claudio Costantino¹^{a,b}, Walter Mazzucco¹^{a,b}, Arianna Conforto¹^{a,b}, Livia Cimino¹^{a,b}, Alessia Pieri¹^b, Sara Rusignolo¹^a, Nicole Bonaccorso¹^a, Floriana Bravatà¹^a, Laura Pipitone¹^a, Martina Sciortino¹^a, Marcello Tocco¹^a, Elena Zarcone¹^a, Giorgio Graziano¹^{a,b}, Fabio Tramuto¹^a, Carmelo Massimo Maida¹^a, Alessandra Casuccio¹^a, and Francesco Vitale¹^{a,b}

^aDepartment of Health Promotion, Maternal and Infant Care, Internal Medicine and Excellence Specialist Medicine, University of Palermo, Palermo, Italy; ^bCOVID-19 Vaccination Center, Hospital Unit of Clinical Epidemiology and Cancer Registry, University Hospital of Palermo, Palermo, Italy

ABSTRACT

With the pandemic, there has been a global reduction in influenza virus circulation, with WHO reporting, during 2021/22 season, laboratory testing positivity rate for influenza of less than 3%. Influenza surveillance systems anticipated a peak of influenza cases in the Northern Hemisphere during 2022/2023 season and the Italian Ministry of Health recommended the routine co-administration of influenza with bivalent COVID-19 vaccines for the 2022/2023 season. At the Vaccination Hub of the University Hospital (UH) of Palermo, more than 700 subjects received influenza and COVID-19 booster doses in co-administration, during the 2021/2022 season. A cross-sectional study analyzing attitudes and factors associated with adherence to influenza and COVID-19 seasonal vaccines co-administration was conducted at the Vaccination Hub of the UH of Palermo, from October to December 2022. Among the 1,263 respondents, 74.7% ($n = 944$) received the co-administration of seasonal influenza and COVID-19 vaccines. The main reason reported for accepting it was confidence in the recommendations of the Health Ministry (41.3%). At the multivariable analysis, subjects aged ≤ 59 y old (AdjOR: 2.48; CI95%: 1.89–3.65), male (AdjOR: 1.51; CI95%: 1.27–1.75), Health-care professionals (HCPs) (AdjOR: 1.66; CI95%: 1.08–2.57) and those who received co-administration during 2021/2022 (AdjOR: 41.6; CI95%: 25.5–67.9) were significantly more prone to receive co-administration during 2022/23 season. From data obtained, the role of HCPs in accepting and then promoting co-administration of COVID-19 and influenza vaccines is crucial, as well as receiving co-administration in the previous season that represented the main drive for accepting it in the following seasons, supporting safety and effectiveness of this procedure.

ARTICLE HISTORY

Received 28 November 2023
Revised 27 February 2024
Accepted 4 March 2024

KEYWORDS

Influenza seasonal vaccination; COVID-19 seasonal vaccination; co-administration; vaccination acceptance; vaccination attitudes

Introduction

The emergence of Severe Acute Respiratory Syndrome by Coronavirus 2 (SARS-CoV-2) in late 2019, followed by its pandemic spread in 2020, had a major impact on the circulation of influenza viruses.¹

During the last two influenza seasons, 2020/2021 and 2021/2022, a dramatic reduction in cases of influenza-like illness (ILI) syndromes was observed globally.^{2,3}

Multiple factors may have contributed to this epidemiological change, including nonpharmacological interventions, reduced population movement (both local and long-distance), possible virus–virus interactions, sometimes referred to as “viral interference.”¹

However, in countries within the temperate zone of the Southern Hemisphere, influenza surveillance showed an increase in confirmed influenza cases in the 2022 season: between mid-April 2022 and the end of July 2022, the weekly number of notifications of laboratory-confirmed influenza cases reported in Australia exceeded the five-year average data. After 2 years without circulation of influenza virus in Australia, the 2022/2023 season was characterized by a high


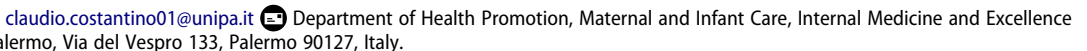
peak of cases in June and it was dominated by influenza A (mainly A/H3N2).²


In some areas of Australia, concurrent with the circulation of influenza A, there was an increase in respiratory syncytial virus (RSV).²

In the 2022/2023 influenza season in Italy, the peak of influenza syndrome cases occurred earlier (48th–49th week), compared to previous seasons. This observation confirmed the prediction made in the Ministry of Health circular dated July 6, 2022, which recommended starting the influenza vaccination campaign in early October.³

Furthermore, in December 2022, Europe witnessed the circulation of RSV alongside influenza viruses and SARS-CoV-2. This occurrence led to an increase in severe acute respiratory infections (SARIs) among vulnerable groups and placed significant pressure on health-care systems, earning the term “Triplendemic” in the ECDC Rapid Risk Assessment.⁴

Vaccination represents the main public health intervention to reduce the burden of seasonal influenza disease.⁵ Similarly, vaccination against COVID-19 is a primary intervention to tackle the ongoing pandemic.^{6,7}

CONTACT Claudio Costantino  claudio.costantino01@unipa.it 

 Supplemental data for this article can be accessed on the publisher's website at <https://doi.org/10.1080/21645515.2024.2327229>

© 2024 The Author(s). Published with license by Taylor & Francis Group, LLC.

This is an Open Access article distributed under the terms of the Creative Commons Attribution-NonCommercial License (<http://creativecommons.org/licenses/by-nc/4.0/>), which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited. The terms on which this article has been published allow the posting of the Accepted Manuscript in a repository by the author(s) or with their consent.

Regarding the Respiratory Syncytial Virus (RSV), in June and August 2023, the European Medicines Agency (EMA) recommended the approval for marketing authorization of “Arexvy” by GSK® and “Abrysvo” by Pfizer®, respectively.^{8,9}

The two new vaccines are designed to provide active immunization for adults over 60 and “Abrysvo” also for passive immunization for newborns from birth to 6 months of age following maternal vaccination during pregnancy.^{8,9}

The vaccination campaign against COVID-19 in Italy started on December 27, 2020. As of January 14, 2023, Italy has administered 143,534,102 anti-COVID-19 vaccine doses. Approximately 48,071,760 (90.2% of the over-12 population) have completed the primary vaccination cycle. Additionally, 41,944,802 people (87.93% of those eligible) have received booster/additional doses, and 7,391,036 individuals (38.66% of the booster dose-eligible population) have received a second booster dose. Furthermore, 1,535,596 anti-COVID-19 vaccine doses were administered to 5–11-year-olds, covering 42% of this age group.^{10,11}

In Italy, the recommendation for co-administration COVID-19 and influenza vaccines contextually in the same vaccination session was introduced in the 21/22 season; and also for the 2022/2023 season, the Ministry of Health confirmed the opportunity for co-administration of all influenza vaccines available with COVID-19 vaccines updated against BA.4/BA.5 Omicron variants where sustainable.^{1,12}

Indeed, it has been observed that co-administration of COVID-19 and influenza vaccines preserves the immune response to both vaccines without any safety concerns.^{13–16}

Guidelines issued by the United States Centers for Disease Control and Prevention (CDC) state that COVID-19 vaccines can be administered independently of the timing of other vaccines, including seasonal influenza vaccines (SIV). The World Health Organization (WHO) suggests that co-administration of any inactivated SIV and any approved COVID-19 vaccine is a feasible option due to its logistical simplicity and the potential for increased coverage.^{17,18}

Similar recommendations have been provided by public health authorities in other countries, including, France, Germany, Spain, Finland, the UK, and Russia.^{19–24}

The primary objective of the present study is to assess the acceptance of influenza and COVID-19 vaccines co-administration and the reasons behind non-administration or successful co-administration at one of the major vaccination Center of Sicily, at the University Hospital of Palermo. Sicily, with approximately 5 million inhabitants, is the fourth most populous Italian region, and Palermo is the most populous Sicilian Province with 1,2 million inhabitants.²⁵

The vaccination unit of the University Hospital of Palermo is one of the region’s key vaccine hubs. For the past 2 years, it has been one of the few centers in the region offering the co-administration of COVID-19 and influenza vaccines. Over the last 5 years, the center has administered approximately 3,000 to 4,000 SIV doses per season.

Since December 2020, it has administered around 80,000 of COVID-19 doses. Additionally, the Palermo UH is the sole hospital in Western Sicily with an outpatient vaccination unit, serving health-care workers, employees, inpatients, and the general high-risk population.

Currently, several COVID-19 vaccines are authorized by the European Medicines Agency (EMA) and the Italian Medicines Agency (AIFA).

During the study period, the following vaccines were used (Table 1):

- (1) mRNA-1273 (Moderna®);
- (2) BNT162b2 (Comirnaty®);
- (3) NVX-COV2373 (Nuvaxovid®).

These vaccines are licensed and recommended in active and free of charge offer, for different age and at-risk groups in accordance with available evidence on efficacy and safety.⁹

For the 2022/2023 influenza season, the Italian Ministry of Health recommended in active and free of charge offer, several

Table 1. COVID-19 and influenza virus vaccines used during the study period.

Vaccine Preventable Disease	Vaccine's type offered during 2022/23 influenza and COVID-19 vaccination campaigns in Italy and Sicily	Vaccine's characteristics and indications for different group of population
Influenza	LAIV (Live attenuated quadrivalent influenza vaccine)	Vaccine indicated for subjects aged from 2 to 17 y old by the Ministry of Health
	QIV-cc (Cell Culture based inactivated quadrivalent influenza vaccine)	Vaccine indicated to subjects aged 2 y and older by the Ministry of Health
	QIV-sd (Inactivated quadrivalent influenza vaccine standard dose)	Vaccine indicated to subjects aged 6 months and older by the Ministry of Health
	QIV-hd (High dose inactivated quadrivalent influenza vaccine)	Vaccine indicated to subjects aged 60 y and older by Italian Ministry of Health
	QIV-a (Adjuvanted with MF59 Inactivated quadrivalent influenza vaccine)	Vaccine indicated to subjects aged 65 y and older by Italian Ministry of Health
SARS-CoV-2	Protein subunit COVID-19 vaccine	NVX-CoV2373: Vaccine indicated as primary vaccination to people aged 12 y and older and as booster dose to people aged 18 y and older by Italian Ministry of Health
	mRNA COVID-19 vaccines	mRna-1273 bivalent D614G/B.A.1: Vaccine indicated to people aged 12 y and older as booster dose by Italian Ministry of Health
		mRna-bnt162b2 Bivalent D314G/B.A.1: Vaccine indicated to people aged 12 y and older as booster dose by Italian Ministry of Health
		mRna-bnt162b2 Bivalent B.A.4/B.A.5: Vaccine indicated to people aged 5 y and older as booster vaccination by Italian Ministry of Health
		mRna-1273 Bivalent B.A.4/B.A.5: Vaccine indicated to people aged 12 y and older as booster vaccination by Italian Ministry of Health

influenza vaccines.¹ During the study period, the following influenza vaccines were used in Sicilian context among adult population (Table 1):

- (1) QIV quadrivalent split virion inactivated vaccine – Vaxigrip Tetra® and QIV – Fluarix Tetra® both indicated in adults and children from 6 months old;
- (2) VIQcc – Flucelvax® quadrivalent inactivated cell culture vaccine indicated in adults and children from 2 y of age;
- (3) VIQhd – Efluelda high-dose vaccine® indicated in adults 60 y of age and older.
- (4) VIQa – Flud Tetra® quadrivalent adjuvanted inactivated vaccine indicated for people aged from 65 y (Table 1).

In order to design effective targeted health promotion interventions, it is useful to quantify public acceptance of COVID-19 and SIV co-administration or combined vaccines.

Methods

A cross-sectional study was carried out from October 2022 to January 2023 to investigate the knowledge, attitudes, and acceptance rate of COVID-19 and influenza vaccines among patients attending the vaccination unit of the University Hospital of Palermo during the 2022/2023 influenza and COVID-19 vaccination season.

Sample collection

Participants in this study were selected based on specific inclusion and exclusion criteria.

Inclusion criteria

We included individuals who presented themselves to the University Hospital of Palermo vaccination center for any vaccination procedure or counseling needs.

Exclusion criteria

Individuals excluded from the study comprised minors than 18 y.o. and those who were incapable of providing informed consent.

Questionnaire structure and administration

The anonymous, self-administered questionnaire was provided to patients referred to the vaccine center for any type of vaccine administration and was completed through a Google Forms® platform, protected by password and accessible only to health-care personnel involved in the study.

Questionnaire was administered during the observation period following vaccination to those subjects who matched inclusion criteria.

The questionnaire consisted of 20 items divided into the following sections:

- Sociodemographic data: gender, age.
- Employment data: whether the individual works in healthcare and if so, their specific health-care profession

(Medical doctor; doctor in training; student trainee; other health-care worker; administrative worker in health-care institution; other).

- Health status: the presence of comorbidity and the type of comorbidity, if applicable (cardiac diseases, neoplastic diseases, nephrological diseases, pulmonary diseases, hematological diseases, rheumatological diseases, and others).
- Influenza vaccination: whether the influenza vaccine has been administered and if so, which type of influenza vaccine was given (QIV-cc, QIV-e, aQIV, QIVhd, and Fluenz tetra).
- COVID-19 vaccination: if COVID-19 vaccine has been administered and, if so, which COVID-19 vaccine has been administered (mRna-1273 bivalent D614G/BA.1, mRna-bnt162b2 Bivalent D314G/BA.1, mRna-bnt162b2 Bivalent BA.4/BA.5, proteic subunit-NVX-CoV2373, Adjuvanted Recombinant Protein-based, mRna-1273 Bivalent BA.4/BA.5), and which dose was administered (first, second, first booster, second booster, third booster).
- Knowledge about co-administration of influenza and COVID-19 vaccines: awareness of the possibility of receiving both vaccines (flu and COVID-19 vaccines) in the same vaccination session; source of information about co-administration (family doctor, pharmacist, pediatrician, social network, web, print newspapers, online newspapers, TV, scientific magazine government sites, family, colleagues, friends); any co-administration performed in the previous year (right arm and left arm); willingness or refusal to receive both vaccines simultaneously and the primary reason for accepting or refusing it.

The questionnaire, available as Appendix A, along with the informed consent and information about the study, was previously validated and approved by the Ethical Committee Palermo 1 on October 19, 2022.

Results

A total of 1,263 subjects vaccinated at Palermo University Hospital's Vaccination Hub completed the questionnaire. The main socio-demographic characteristics and data related to the acceptance of the co-administration of COVID-19 and flu vaccines are shown in Table 2. The most represented age group was the 41–59-year old (42.9%; n.543), followed by the over 60-year-old age group (34.5%; n.436), with female respondents comprising the majority (51.4%; n.649).

The majority of respondents (72.8%; n. 920) reported having no comorbidities. Among 27.2% of the subjects who reported comorbidities, the following conditions were identified: cardiac diseases (33.1%; n.113), hematological diseases (6.4%; n.22), nephrological diseases (0.88%; n.3), cancer (7.04%; n.24), lung diseases (6.16%; n.21), rheumatic diseases (11.4%; n.39), and other diseases (34.9%; n.119). Among the subjects enrolled in the study, (40.1%; n.507) were health-care workers (HCWs), with medical doctors comprising the majority (60.4%; n.306), followed by other HCWs (nurses, obstetricians . . .) (22.5%; n.114) (Table 2).

Table 2. Socio-demographic characteristics and data related to the acceptance of the co-administration of COVID-19 and seasonal influenza vaccines of the 1,263 subjects interviewed at the vaccination hub of the University Hospital of Palermo, Italy.

	n (%)
Gender	
– Male	611 (48.4)
– Female	649 (51.4)
– Unspecified	2 (0.16)
Age classes	
– 18–40	284 (22.5)
– 41–59	543 (42.9)
– ≥60	436 (34.5)
Comorbidity	
– Yes	343 (27.2)
– No	920 (72.8)
Type of comorbidities	
– Cardiac diseases	113 (33.1)
– Haematological diseases	22 (6.4)
– Nephrological diseases	3 (0.88)
– Cancer	24 (7.04)
– Lung diseases	21 (6.16)
– Rheumatic diseases	39 (11.4)
– Others	119 (34.9)
Healthcare professionals (HCPs)	
– Yes	507 (40.1)
– No	756 (59.9)
Type of HCPs	
– Administrative working in Health Authority	20 (3.94)
– Medical doctor	306 (60.4)
– Medical trainee	67 (13.2)
– Other healthcare workers (nurse, obstetrician ...)	114 (22.5)
Influenza vaccine administration	
– Yes	1020 (80.8)
– No	243 (19.2)
Type of influenza vaccine administered	
– aQIV (flud tetravalente adiuvato)	211 (20.7)
– QIV–e (vaxigrip)	40 (3.92)
– QIV–cc (flucelvax tetra)	647 (63.4)
– QIVhd (efluelda)	122 (11.9)
Sars–CoV2 vaccine administration	
– Yes	1241 (98.3)
– No	22 (1.74)
Dose received	
– 1	2 (0.16)
– 2	3 (0.24)
– First Booster	159 (12.8)
– Second Booster	1015 (81.8)
– Third Booster	62 (5.0)
Knowledge on co–administration recommendation	
– Yes	1107 (87.7)
– No	156 (12.3)
Source of information	
– Family/colleagues and/or friends	263 (23.8)
– Printed or online newspapers/TV	298 (26.9)
– GP/pharmacist/pediatrician	272 (24.6)
– Scientific journals/government sites (WHO, CDC etc.)	184 (16.6)
– Social network/web	90 (8.13)
Co–administration of flu and COVID-19 vaccines during 2021/2022 season	
– Yes	737 (61.2)
– No	467 (38.8)
Co–administration of flu and COVID-19 vaccines during 2022/2023 season	
– Yes	944 (74.7)
– No	319 (25.3)
Main reason for accepting co–administration	
– Trust in official recommendations	400 (41.5)
– Physician’s recommendation	48 (4.98)
– Concern about the enhanced protection against the two viruses	180 (18.7)
– Reduction in admissions to the vaccination center	318 (33.0)
– Others (travel, work, comorbidities)	4 (0.42)
– All previous	13 (1.34)

(Continued)

Table 2. (Continued).

	n (%)
Reasons for refusing flu vaccine (n = 82)	
– Lack of Physician's recommendation	6 (7.32)
– Flu is not a serious illness	29 (35.4)
– Low circulation of influenza virus	30 (36.6)
– I don't consider the vaccine effective	14 (17.1)
– I don't consider the vaccine safe	3 (3.66)
Reasons for refusing COVID-19 vaccine (n = 36)	
– COVID-19, having received the first booster dose, is not a serious illness	21 (58.3)
– COVID-19's Omicron variant has no serious and severe effects	7 (19.5)
– I don't consider the vaccine effective	5 (13.9)
– I don't consider the vaccine safe	3 (8.33)

Regarding the knowledge, attitudes, and practices of respondents about influenza and COVID-19 vaccinations, 80.8% (n.1020) reported receiving both vaccines and 98.3% (n.1241) received the respective vaccines. Additionally, 87.7% (n.1107) of subjects were aware of the possibility of co-administering the two vaccinations. Only 16.6% of the participants obtained information about co-administration from scientific journals or government sites (WHO, CDC, etc.) while 24.6% received information from their general practitioner (GP), pharmacist, or pediatrician (Table 3).

The primary reasons for accepting co-administration were trust in official recommendations (41.5%; n.400), reduction in visits to the vaccination center (33.0%; n.318) and concern about the severity of pathologies/enhanced protection against the two viruses (18.7%; n.180) (Table 2).

For those unwilling to receive the influenza vaccine, the main reason for refusal was the belief in low circulation of the influenza virus (36.6%; n.30), followed by the perception that the flu is not a severe illness (35.4%; n.29) (Table 2).

Those who declined the COVID-19 vaccine primarily cited the assumption that COVID-19 posed no health risk after

receiving the booster dose (58.3%; n.21), the belief that the COVID-19's Omicron variant has no serious and severe effects (19.5%; n.7) and finally, concerns about vaccine effectiveness and safety, respectively, among 13.9% and 8.33% of the respondents (Table 2).

As reported in Figure 1, an increase in subjects that received co-administration of flu and COVID-19 vaccines comparing 2021/22 and 2022/23 season was observed. Indeed, more than half (61.2%; n.737) of the subjects vaccinated received influenza and COVID-19 vaccines in the same session during the 2021/2022 season this finding increased (74.7%; n.944) during 2022/2023 season.

Table 3 presents the univariate and multivariate analyses of factors associated with the willingness to receive co-administration of COVID-19 and SIV. The multivariate analysis revealed that factors significantly associated with willingness to receive co-administration of COVID-19 and Seasonal influenza vaccines included being male (Adj-OR = 1.51 (95%CI = 1.27–1.75); p -value <.01); having an age less than or equal to 59 y old (Adj-OR = 2.48 (95%CI = 1.89–3.65); p -value = <.01); being a health-care worker (Adj-OR = 1.66

Table 3. Univariate (crude OR) and multivariate (adj OR) analysis of factors associated with willingness to receive coadministration of COVID-19 and seasonal influenza vaccines at the vaccination hub of the University Hospital of Palermo, Italy.

Flu and COVID-19 Vaccines co-administration during 2022/2023 season (Yes vs. No)				
	Crude OR (95% CI)	p -value	Adj-OR (95% CI)	p -value
Gender				
–Female	Ref.	.02	Ref	<.01
– Male	1.45 (1.21–1.87)		1.51 (1.27–1.75)	
Age classes				
≥60	Ref	<.001	Ref	<.01
–≤ 59	2.56 (1.98–3.85)		2.48 (1.89–3.65)	
Comorbidities				
– No	Ref	<.001	Ref	.11
– Yes	0.36 (0.28–0.48)		0.72 (0.49–1.07)	
HCWs				
– No	Ref	<.001	Ref	<.05
– Yes	3.12 (2.32–4.19)		1.66 (1.08–2.57)	
Type of HCW				
– Trainees, Other HCWs (nurse, obstetrician, ...)	Ref	.66		
– Medical doctor	1.12 (0.66–1.87)			
Knowledge on co-administration recommendation				
–No	Ref	.001	Ref	.86
–Yes	1.86 (1.30–2.65)		1.04 (0.63–1.71)	
Source of information				
– Family/colleagues and/or friends, Social network/web, Printed or online newspapers/TV	Ref	.26		
– GP/pharmacist/pediatrician, Scientific journals/government sites (WHO, CDC etc.)	0.90 (0.76–1.41)			
Flu and COVID-19 vaccines co-administration during 2021/2022 season				
– No	Ref	<.001	Ref	<.05
– Yes	45.6 (28.2–73.8)		41.6 (25.5–67.9)	

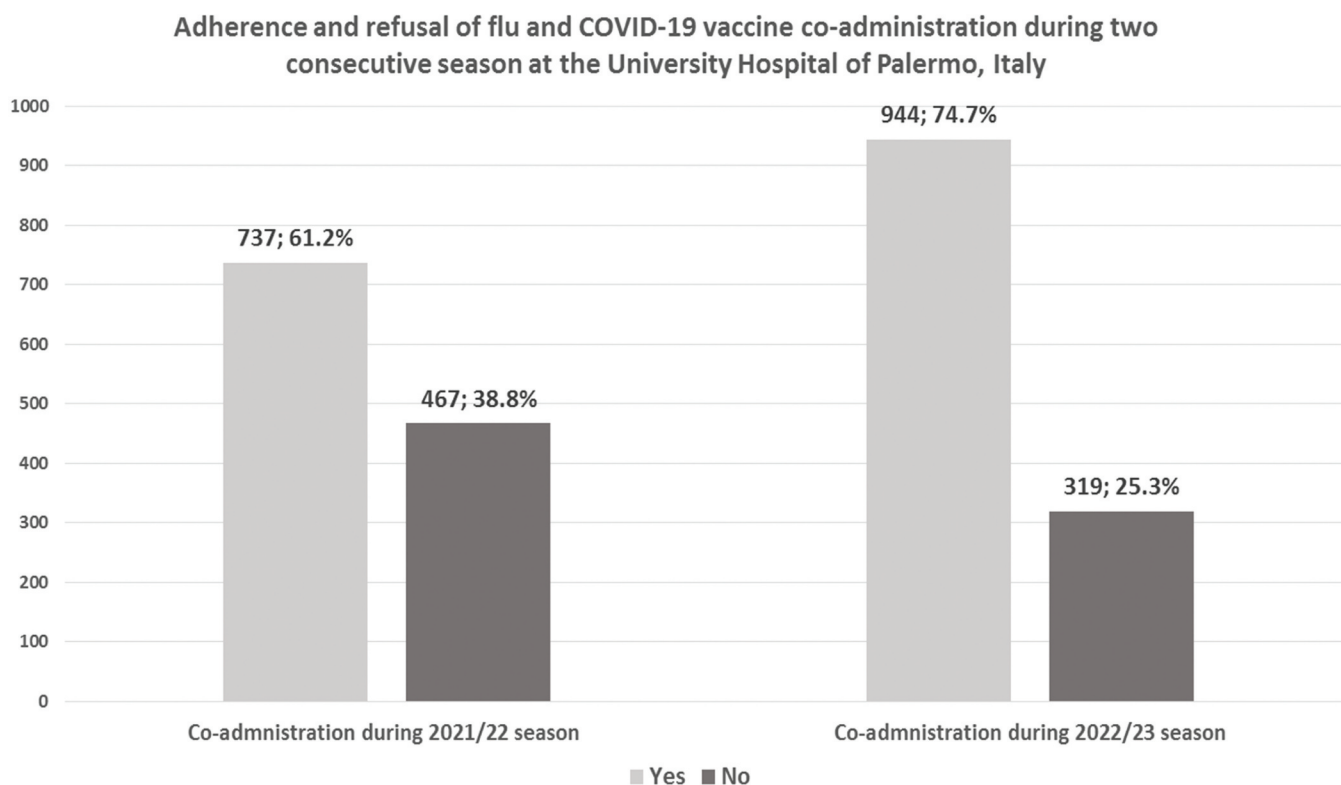


Figure 1. Acceptance and refusal of flu and COVID-19 vaccines coadministration during 2021/2022 and 2022/2023 seasons at the vaccination hub of the University Hospital of Palermo, Italy.

(95%CI = 1.08–2.57); p -value <.05) and having received both vaccinations in co-administration in the 2021/2022 season (Adj-OR = 41.6 (95%CI = 25.5–67.9); p -value <.05).

Discussion

The main objectives of the present study were to assess the acceptance of co-administering COVID-19 and influenza vaccines, evaluate the knowledge and attitudes surrounding this practice, and understand the reasons for either choosing to receive them together or refusing co-administration of the two vaccines.

In accordance with Italian recommendations and supported by literature data, influenza vaccines do not interfere with the immune response to other inactivated or live-attenuated vaccines. Specifically, co-administering all influenza vaccines with anti-SARS-CoV-2/COVID19 vaccines is feasible.¹

The Italian Ministry of Health reiterated the importance of co-administration of the influenza vaccines, including QIVe, QIVcc, QIVa, QIVhd, QIV-LAIV, with other vaccines, including COVID-19 vaccines. In the ‘Prevention and control of influenza: recommendations for the 2022–2023 season’ Annual Circular published the 6th of July 2022.¹

A key result of our study was that the majority of individuals who had already received both vaccines in the same vaccination session during the previous season (2021/2022) were willing to repeat the co-administration in the current season. This inclination, derived from patients’ firsthand experiences, appears to align with observations from recent

studies suggesting that co-administration of COVID-19 and influenza vaccines preserves the immune response without raising safety concerns, also reducing the need for additional accesses to the vaccination center.^{13–16}

Several studies have previously showed that generally higher vaccination rates were among individuals who consult official websites of Health Authorities, particularly among the younger population.^{26,27} Our study supports this trend, as most subjects willing to receive coadministration of COVID-19 and influenza vaccines were under the age of 59.^{28,29}

Health-care workers, partly due to their increased perception of disease risk and their inclination to obtain information from official sources, were more likely to undergo COVID-19 and influenza vaccination.^{30,31}

As reported in the fourteenth report on the surveillance of COVID-19 vaccines of the Italian Medicines Agency, susceptibility to COVID-19 infection is equally likely among males and females, but clinical findings reveal that males experience higher severity and mortality from COVID-19 infection.²⁹ Nevertheless, women generally develop more robust innate and acquired humoral and cell-mediated immune responses than men, and this is also reflected in their response to vaccination.²⁹ Women reported more adverse reactions after COVID-19 vaccination, possibly explaining why they were less likely to receive co-administration of COVID-19 and influenza vaccines.²⁹

Some limitations of the present study need to be highlighted. The surveys were primarily conducted during observation period following vaccination at Palermo University Hospital’s vaccination center, and participants were volunteers

interested in vaccination, which could introduce potential selection bias.

Additionally, a social desirability bias should be considered since vaccine acceptance was self-reported. This may lead to participants reporting responses influenced by social expectation rather than their true beliefs, potentially overestimating the acceptance of vaccination in general and, in this case, the coadministration of the COVID-19 and influenza vaccines.

In addition, a partial generalizability bias to the general population should be taken into account, due to a high percentage (40%) of respondents that were health-care professionals (HCPs). This could be explained because the vaccination hub belongs to the main University Hospital of Sicilian Region and HCPs represented one of the categories for which seasonal flu and covid vaccination were strongly recommended. At the same time, more than 750 subjects belonging to the general population were enrolled in the study and in the multivariable analysis the adjusted impact of being HCPs in administration acceptance was evaluated by the AAs.

Finally, recall bias may affect the accuracy of reported factors associated with vaccination-related decisions. The clinic-based nature of our sample warrants consideration. While strategically chosen for its relevance to vaccination decisions, it inherently limits the external validity of our findings. The insights garnered may be more applicable to individuals actively seeking health-care services, potentially excluding those less engaged with health-care facilities.

While our study aimed to capture the dynamics and perceptions within a specific vaccination hub's real-world setting, we recognize the absence of a comparative arm for individuals who did not undergo co-administration. This limitation restricts our ability to draw causal inferences and generalize our findings to the broader population.

Despite these limitations, we believe that our study contributes meaningfully to the existing literature by shedding light on the practical aspects of vaccine co-administration. The observed acceptance rates, attitudes, and experiences provide valuable insights for health-care practitioners and policy-makers. Future studies employing a controlled design could further explore the factors influencing vaccine choice and refusal.

Conclusions

The present study demonstrated that, among subjects that usually go to vaccination center in order to receive influenza or COVID-19 seasonal vaccines, a significant majority are willing to receive both the vaccines in the same vaccination session. This inclination was primarily observed in those subjects who had already received both vaccines in co-administration during the 2021–2022 season.

The decision to opt for co-administration during the following season could be likely influenced from the relatively few side effects experienced after administration, which are no more severe than those associated with the single vaccine (influenza or COVID-19) administration.

Furthermore, co-administration reduces the need for multiple visits to the vaccine center, proving especially important

during the pandemic period when it was crucial to minimize gatherings and interactions.

Co-administration should become a standard procedure in public healthcare. Already implemented during 2022/2023 season in Italy and in other European countries as a standard recommended procedure, it should further become increasingly common in the upcoming seasons, as COVID-19, similarly to influenza, would become seasonal in its circulation.

Disclosure statement

Supported in part by an independent research grant from Novavax Inc. The opinions expressed in this paper are those of the authors and do not necessarily represent those of Novavax Inc.

Funding

Supported in part by an independent research grant from Novavax Inc.

ORCID

Claudio Costantino  <http://orcid.org/0000-0002-3397-7331>
Walter Mazzucco  <http://orcid.org/0000-0001-5090-1366>

Data availability statement

The data that support the findings of this study are available from the corresponding author, CC, upon reasonable request.

References

1. Italian Ministry of Health. Recommendations for prevention and control of influenza for the 2022/2023 season in Italy; 2022 [accessed 2023 Oct 20]. <https://www.trovanorme.salute.gov.it/norme/renderNormsanPdf?anno=2022&codLeg=87997&parte=1%20&serie=null>.
2. World Health Organization. Review of global influenza circulation, late 2019 to 2020, and the impact of the COVID-19 pandemic on influenza circulation; 2021 [accessed 2023 Oct 20]. <https://www.who.int/publications/i/item/who-wer-9625-241-264>.
3. InFluNet. National epidemiological report of respiratory diseases; 2022 [accessed 2022 Sept 22]. https://www.salute.gov.it/portale/temi/documenti/epidemiologica/Influnet_2021_16.pdf.
4. European Centre for Disease Prevention and Control. Intensified circulation of respiratory syncytial virus (RSV) and associated hospital burden in the EU/EEA; 2022 [accessed 2023 Oct 20]. <https://www.ecdc.europa.eu/en/publications-data/intensified-circulation-respiratory-syncytial-virus-rsv-and-associated-hospital>.
5. Kissling E, Maurel M, Emborg HD. Interim 2022/23 influenza vaccine effectiveness: six European studies, October 2022 to January 2023. *Euro Surveill*. 2023 May;28(21):2300116. doi:10.2807/1560-7917.ES.2023.28.21.2300116.
6. Watson O, Barnsley G, Toor J, Hogan AB, Winskill P, Ghani AC. Global impact of the first year of COVID-19 vaccination: a mathematical modelling study. *Lancet Infect Dis*. 2022 Sept;22(9):1293–1302. doi:10.1016/S1473-3099(22)00320-6.
7. Domnich A, Cambiaggi M, Vasco A, Maraniello L, Ansaldi F, Baldo V, Bonanni P, Calabrò GE, Costantino C, de Waure C, et al. Attitudes and beliefs on influenza vaccination during the COVID-19 pandemic: results from a representative Italian survey. *Vaccines (Basel)*. 2020 Nov 30;8(4):711. doi:10.3390/vaccines8040711.
8. European Medicines Agency. Abrysvo respiratory syncytial virus vaccine (bivalent, recombinant) authorization; 2023 Sept. [accessed

- 2023 Oct 20]. <https://www.ema.europa.eu/en/medicines/human/EPAR/abrysvo#:~:text=Why%20is%20abrysvo%20authorised%20in,Abrysvo%20were%20mild%20or%20moderate>.
9. European Medicines Agency. Arexvy (recombinant respiratory syncytial virus pre-fusion F protein, adjuvanted with AS01E) authorization; 2023 June. [accessed 2023 Oct 20]. <https://www.ema.europa.eu/en/medicines/human/EPAR/arexvy>.
 10. Italian Ministry of Health. COVID-19 vaccines report administered updated to 14th January 2023; 2023 [accessed 2023 Oct 20]. <https://www.governo.it/it/cscovid19/report-vaccini/>.
 11. Italian Ministry of Health. Influenza vaccination coverage in Italy; 2022 [accessed 2023 Oct 20]. <https://www.salute.gov.it/portale/influenza/dettaglioContenutiInfluenza.jsp?lingua=italiano&id=679&area=influenza&menu=vuoto>.
 12. Italian Ministry of Health. Recommendations for prevention of influenza for the 2021/2022 season; 2022 [accessed 2023 Oct 20]. <https://www.trovanorme.salute.gov.it/norme/renderNormsanPdf?anno=2021&codLeg=79647&parte=1%20&serie=null>.
 13. Lazarus R, Baos S, Cappel-Porter H, Carson-Stevens A, Clout M, Culliford L, Emmett SR, Garstang J, Gbadamoshi L, Hallis B, et al. Safety and immunogenicity of concomitant administration of COVID-19 vaccines (ChAdox1 or BNT162b2) with seasonal influenza vaccines in adults in the UK (ComFluCOV): a multicentre, randomised, controlled, phase 4 trial. *Lancet*. 2021 Dec 18;398(10318):2277–2287. doi:10.1016/S0140-6736(21)02329-1.
 14. Toback S, Galiza E, Cosgrove C, Galloway J, Goodman AL, Swift PA, Rajaram S, Graves-Jones A, Edelman J, Burns F, et al. Safety, immunogenicity, and efficacy of a COVID-19 vaccine (NVX-CoV2373) co-administered with seasonal influenza vaccines: an exploratory substudy of a randomised, observer-blinded, placebo-controlled, phase 3 trial. *Lancet Respir Med*. 2022 Feb;10(2):167–179. doi:10.1016/S2213-2600(21)00409-4.
 15. Domnich A, Orsi A, Trombetta CS, Guarona G, Panatto D, Icardi G. COVID-19 and seasonal influenza vaccination: cross-protection, co-administration, combination vaccines, and hesitancy. *Pharmaceuticals (Basel)*. 2022 Mar 8;15(3):322. doi:10.3390/ph15030322.
 16. Izikson R, Brune D, Bolduc JS, Bourron P, Fournier M, Moore TM, Pandey A, Perez L, Sater N, Shrestha A, et al. Safety and immunogenicity of a high-dose quadrivalent influenza vaccine administered concomitantly with a third dose of the mRNA-1273 SARS-CoV-2 vaccine in adults aged ≥65 years: a phase 2, randomised, open-label study 4. *Lancet Respir Med*. 2022 Apr;10(4):392–402. doi:10.1016/S2213-2600(21)00557-9.
 17. Centre for Disease Prevention and Control. Use of COVID-19 vaccines in the United States; 2021 [accessed 2023 Oct 20]. <https://www.cdc.gov/vaccines/COVID-19/clinical-considerations/COVID-19-vaccines-us.html#Coadministration>.
 18. World Health Organization. Coadministration of seasonal inactivated influenza and COVID-19 vaccines; 2022 [accessed 2023 Oct 20]. https://www.who.int/publications/i/item/WHO-2019-nCoV-vaccines-SAGE_recommendation-coadministration-influenza-vaccines.
 19. HAS Sante France. Covid-19 et grippe : la HAS précise les conditions d'une co-administration des vaccins; 2022 [accessed 2023 Oct 20]. https://www.has-sante.fr/jcms/p_3288855/fr/COVID-19-et-grippe-la-has-pre.
 20. STIKO-Empfehlung zur Koadministration. *Epidemiologisches Bulletin* [accessed 2023 Oct 20]. <https://edoc.rki.de/bitstream/handle/176904/8809/EB-39-2021-STIKO-Empfehlung-Koadministration-Online-vorab.pdf?sequence=1&isAllowed=y>.
 21. Ministerio De Sanidad. Vacunas y Programa de Vacunación. [accessed 2023 Oct 20]. <https://www.sanidad.gob.es/profesionales/saludPublica/prevPromocion/vacunaciones/programasDeVacunacion/>.
 22. Finnish Institute for Health and welfare (THL). New recommendations for coronavirus vaccinations – pregnant women may take a coronavirus vaccine if they wish; 2022 [accessed 2023 Oct 20]. <https://thl.fi/en/web/thlfi-en/-/new-recommendations-for-coronavirus-vaccinations-pregnant-women-may-take-a-coronavirus-vaccine-if-they-wish>.
 23. UK Government. COVID-19 green book chapter 14a; 2022 [accessed 2023 Oct 20]. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1102459/Greenbook-chapter-14a-4September22.pdf.
 24. Russian Federation Ministry of Health. COVID-19 and influenza vaccine co-administration; 2022 [accessed 2023 Oct 20]. <https://minzdrav.gov.ru/news/2021/10/22/17665-minzdrav-rossii-razreshil-odnovremennuyu-vaktsinatsiyu-ot-kovida-i-grippa>.
 25. Istat. Demographical data of Italian population [accessed 2024 Jan 31]. <https://demo.istat.it/>.
 26. Capodici A, Montalti M, Soldà G, Salussolia A, La Fauci G, Di Valerio Z, Scognamiglio F, Fantini MP, Odone A, Costantino C, et al. Influenza vaccination landscape in Italy: a comprehensive study through the OBVIOUS project lens. *Hum Vaccin Immunother*. 2023 Aug;19(2):2252250. doi:10.1080/21645515.2023.2252250.
 27. Castro I, Van Tricht M, Bonaccorso N, Sciortino M, Garcia Burgos J, Costantino C, Gonzalez-Quevedo R. Stakeholders' understanding of European medicine agency's COVID-19 vaccine information materials in EU and regional contexts. *Vaccines (Basel)*. 2023 Oct 19;11(10):1616. doi:10.3390/vaccines11101616.
 28. Bendau A, Plag J, Petzold MB, Ströhle A. COVID-19 vaccine hesitancy and related fears and anxiety. *Int Immunopharmacol*. 2021 Aug;97:107724. doi:10.1016/j.intimp.2021.107724.
 29. Italian National Medices Agency. Fourteenth report on the surveillance of COVID-19 vaccines [accessed 2024 Jan 31]. <https://www.aifa.gov.it/en/-/quattordicesimo-rapporto-aifa-sulla-sorveglianza-dei-vaccini-anti-covid-19>.
 30. Di Giuseppe G, Pelullo CP, Della Polla G, Montemurro MP, Napolitano F, Pavia P, Angelillo IF. Surveying willingness toward SARS-CoV-2 vaccination of healthcare workers in Italy. *Expert Rev Vaccines*. 2021 July;20(7):881–889. doi:10.1080/14760584.2021.1922081.
 31. Di Giuseppe G, Pelullo CP, Paolantonio A, Della Polla G, Pavia M. Healthcare workers' willingness to receive influenza vaccination in the context of the COVID-19 pandemic: a survey in southern Italy. *NATO Adv Sci Inst Se*. 2021;9(7):766. doi:10.3390/vaccines9070766.