



Missed opportunities and co-administration patterns for influenza vaccination in older adults in Italy: a retrospective cohort study

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ABSTRACT

Background: Missed opportunities for vaccination (MOV) reduce seasonal influenza vaccine (SIV) coverage among high-risk older adults who frequently access healthcare services but remain unvaccinated.

Methods: We conducted a retrospective cohort study using the Siracusa Local Health Authority immunization registry in Italy. Individuals aged ≥ 65 years who received pneumococcal, herpes zoster, COVID-19, or respiratory syncytial virus vaccines during the 2023/24 and 2024/25 influenza seasons were assessed for SIV status. Outcomes included missed opportunities for SIV and co-administration patterns.

Results: Among 4485 COVID-19, 3428 pneumococcal, 1617 herpes zoster, and 198 respiratory syncytial virus vaccine recipients, the proportion of individuals who did not receive SIV during the same influenza season (i.e., missed SIV opportunities) was 10.2%, 8.0%, 18.4%, and 7.6%, respectively. Co-administration was highest in the pneumococcal (47.6%) and respiratory syncytial virus (42.4%) cohorts, and lower in the COVID-19 (8.9%) and herpes zoster (11.0%). Older age was positively associated with SIV uptake in the COVID-19 and pneumococcal groups, while sex was not a consistent determinant, except for higher uptake among males in the RSV cohort.

Conclusions: MOV were frequent among older adults who received other recommended vaccines, underscoring persistent gaps in adult immunization delivery. These findings support the need for systematic assessment of influenza vaccination status at every healthcare encounter, broader co-administration practices, and strengthened training and organizational support for healthcare professionals to optimize influenza vaccination and strengthen prevention in this vulnerable population.

1. Introduction

Due to its high global incidence and significant mortality burden, influenza is consistently regarded as one of the most consequential infectious diseases [1]. According to the World Health Organization (WHO), influenza infects up to roughly 10% of the global population annually, causing between 290,000 and 650,000 respiratory deaths worldwide [2]. Furthermore, influenza accounts for the greatest health

burden among infectious diseases, with a median of 81.8 disability-adjusted life years (DALYs) lost annually per 100,000 population [1].

Although seasonal influenza can affect individuals across all age groups, adults over the age of 65 years and individuals with chronic medical conditions (such as chronic cardiac, pulmonary, renal, metabolic, neurodevelopmental, liver or hematologic diseases, immunosuppressive conditions/treatments) are disproportionately affected [3,4], accounting for up to 50% of all influenza-related hospitalizations and

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90% of all influenza-associated deaths [5].

Vaccination is the cornerstone of influenza prevention and represents the most effective strategy for reducing influenza-related morbidity and mortality, particularly among vulnerable populations. In this context, seasonal influenza vaccination (SIV) constitutes a major public health intervention capable of substantially reducing the overall burden of diseases [6]. Formal economic evaluations have shown that SIV is a cost-effective intervention, even at very low levels of vaccine efficacy/effectiveness [7], and contributes to reducing both direct and indirect healthcare expenditures, including those related to hospitalizations, medical consultations, and productivity losses [8,9].

Vaccines against influenza, pneumococcal (PCV), herpes zoster (HZ), COVID-19, and respiratory syncytial virus (RSV) are considered the primary immunizations recommended for older adults to support healthy ageing and reduce the burden of preventable diseases in this population [10,11]. Many industrialized countries have implemented routine immunization policies for older adults [12,13]. In Italy, vaccines against influenza, PCV, HZ and COVID-19 are offered free of charge to all adults ≥ 65 years old [14,15]. In Sicily, the regional immunization plan includes the possibility of offering RSV vaccination to individuals aged 60 years and older with chronic health conditions, as well as to all individuals belonging to the 75-year-old age cohort, irrespective of comorbidities [16].

Despite strong supporting evidence and policy recommendations, SIV uptake remains suboptimal in the majority of high-income countries [17,18].

Missed opportunities for vaccination (MOV), often resulting from inadequate engagement or actions by healthcare professionals, represent an important contributor to this gap. According to the WHO, a MOV refers to “any contact with health services by an individual (child or person of any age) who is eligible for vaccination (e.g. unvaccinated or partially vaccinated and free of contraindications to vaccination), which does not result in the person receiving one or more of the vaccine doses for which he or she is eligible” [19]. In line with this framework, a missed opportunity for seasonal influenza vaccination (MOSIV) can be defined as any contact with healthcare services by a subject who is eligible for SIV that does not result in that subject actually receiving SIV [20].

Previous MOV assessments have found that they commonly arise in two main contexts: first, during appointments for immunization and other preventive care activities (such as growth monitoring, nutritional evaluations); second, during visits aimed at curative care [21]. Addressing these missed opportunities can significantly improve overall vaccination coverage. In settings where healthcare availability and usage are limited, it becomes even more crucial to vaccinate at every possible healthcare encounter, given the elevated risk of vaccine-preventable diseases in these areas [19,21]. Generally, reasons for MOV generally fall into three broad categories: factors relating to health workers knowledge, attitude, and practices; factors due to health system issues or constraints, including national policies; and demand-related issues (caregiver/community behaviours) [22].

According to the Italian National Immunization Plan, promoting and facilitating vaccination among older adults and individuals with chronic conditions is a strategic priority [23]. Vaccination strategies targeting these groups should be integrated into routine clinical care pathways, including hospital care, outpatient services, home care, and community-based settings, with the involvement of multiple healthcare professionals such as general practitioners (GPs) and specialists. In Italy, GPs play a central role in the delivery of seasonal influenza and other vaccinations among older adults and individuals with chronic conditions [24]. [15,25] Within this organizational framework, SIV is recommended for all older adults in Italy and is provided free of charge [14]. In accordance with current national regulations, SIV can be administered by GPs, public vaccination clinics, and community pharmacies.

Despite this structured and widely accessible delivery system, influenza vaccination coverage among adults aged ≥ 65 years remains

below recommended targets. - In the most recent influenza seasons with consolidated data [26], coverage was 52.5% at the national level (2024/2025), 48.2% in Sicily (2023/2024), and 46.1% in the Siracusa Local Health Authority (LHA) (2024/2025), all well below the recommended target of 75% [27].

The relationship between SIV uptake and receipt of the other vaccinations in older adults remains inadequately explored, as does the prevalence of MOV in this population. In this registry-based retrospective cohort study, we assessed MOSIV by reviewing the SIV status of all subjects aged ≥ 65 years residing in the Siracusa LHA, Italy, who received at least one dose of PCV, HZ, COVID-19, and/or RSV vaccines during the 2023/24 and/or 2024/25 influenza seasons.

2. Methods

2.1. Study design

This retrospective cohort included individuals aged 65 years and older residing in the jurisdiction of the Siracusa LHA, located in Sicily, southern Italy. In 2024, this age group comprised 90,757 people, representing 23.7% of the overall population [28].

Eligible participants were individuals aged ≥ 65 years who had received at least one dose of a target vaccine, namely PCV, HZ, RSV, or COVID-19, during the 2023/2024 and/or 2024/2025 winter seasons, independently of whether they received seasonal influenza vaccination. Exposure was defined as receipt of at least one dose of a target vaccine during the influenza season. This vaccination encounter was considered the healthcare contact in which seasonal influenza vaccination could potentially have been co-administered. No additional exclusion criteria were applied.

Vaccination data were obtained from the electronic immunization registry of the Siracusa LHA and covered the periods from October 1, 2023, to February 28, 2024, and from October 1, 2024, to February 28, 2025. These timeframes are consistent with national recommendations for the annual influenza vaccination campaign in Italy, which typically begins in October and continues throughout the season. The electronic immunization registry mandatorily captures all influenza vaccinations administered by general practitioners, public vaccination clinics, and community pharmacies. SIV status was determined based on corresponding entries in the same registry.

Since data on RSV vaccination were available only for the 2024/2025 season, RSV-related analyses were limited to that campaign.

2.2. Study variables

The study considered two main outcomes. The first was the occurrence of MOSIV, defined as the absence of SIV during the same influenza season among individuals who received at least one dose of a target vaccine, with each vaccination encounter representing a potential opportunity for co-administration. The second outcome was the co-administration of SIV and target vaccines, calculated as the proportion of individuals who received both vaccines on the same day, relative to the total number of individuals who received both vaccines at any time during the same season.

The independent variables included sex (female vs. male) and age (as a continuous variable in years). To account for potential differences in vaccine availability and timing, the regression models were adjusted for the month of vaccination, district of residence, and influenza season (2023/2024 or 2024/2025). All variables used in the study were mandatory fields in the electronic immunization registry, and no missing data were reported.

2.3. Statistical analysis

Categorical variables were presented as proportions accompanied by exact 95% confidence intervals (CIs) calculated using the Clopper-

Pearson method, while continuous variables were summarized using means and standard deviations. The crude associations were assessed using simple logistic regression, with results expressed as odds ratios (ORs). To evaluate adjusted associations between SIV status in the 2023/2024 and 2024/2025 seasons and the selected independent variables, multivariable logistic regression models were employed, producing adjusted odds ratios (aORs). All models included tests for potential interaction effects. Given the differing characteristics of the three vaccination campaigns—such as rollout strategy, vaccine availability, and public perception—separate models were developed for each target vaccine. All statistical analyses were performed using Stata version 18.0 (StataCorp LP, College Station, TX, USA).

3. Results

A total of 4485 individuals aged 65 years and older residing in Siracusa LHA received at least one dose of the COVID-19, 3428 received the PCV vaccine, 1617 received the HZ vaccine and 198 individuals received the RSV vaccine during the two influenza seasons (2023/24 and 2024/2025) in Siracusa (with the latter vaccine only in the 2024/2025 season).

As shown in Table 1, overall, the mean age of the subjects ranged

Table 1
Characteristics of the study participants.

Variable	Levels	Cohorts			
		COVID-19 (n = 4485)	HZ (n = 1615)	PCV (n = 1446)	RSV (n = 198)
Sex	Female, n (%)	2018 (45.0)	811 (50.2)	1697 (49.5)	98 (49.5)
	Male, n (%)	2467 (55.0)	806 (49.8)	1731 (50.5)	100 (50.5)
Age (years), mean (SD)	Total	76.5 (±7.2)	73.8 (±6.5)	75.3 (±7.1)	79.3 (8.6)
	Female	76.8 (±7.6)	73.9 (±6.7)	75.8 (±7.4)	81.9 (8.9)
	Male	76.2 (±6.9)	73.7 (±6.3)	74.8 (±6.8)	76.7 (7.4)
	Month of target vaccination n (%)	October	39 (0.9)	207 (12.8)	187 (5.2)
Month of SIV n (%)	November	900 (20.1)	513 (31.8)	1773 (51.7)	128 (64.7)
	December	2294 (51.1)	340 (21.1)	901 (26.3)	41 (20.7)
	January	1128 (25.1)	325 (20.1)	364 (10.6)	8 (4.0)
	February	124 (2.8)	230 (14.2)	212 (6.2)	16 (8.1)
	October	1231 (26.2)	297 (26.3)	740 (21.9)	53 (26.8)
Influenza season	November	2718 (63.0)	995 (65.0)	2267 (67.2)	132 (66.7)
	December	175 (4.1)	41 (2.7)	135 (4.0)	2 (1.0)
	January	239 (5.5)	67 (4.4)	181 (5.4)	7 (3.5)
	February	49 (1.1)	5 (0.3)	48 (1.4)	4 (2.0)
	2023–2024	4041 (90.1)	833 (51.6)	1982 (57.8)	/
SIV	2024–2025	444 (9.9)	782 (48.4)	1446 (42.2)	198 (100.0)
	Yes, % (n)	4029 (89.8)	1318 (81.6)	3152 (92.0)	183 (92.4)
Co-administration of SIV	No, n (%)	456 (10.2)	297 (18.4)	275 (8.0)	15 (7.6)
	Yes, % (n)	399 (8.9)	177 (11.0)	1633 (47.6)	84 (42.4)
Co-administration of SIV	No, n (%)	4086 (91.1)	1438 (89.0)	1795 (52.4)	114 (57.6)

Note: SD, standard deviation.

from 73.8 years (±6.5) in the HZ cohort to 79.3 years (±8.6) in the RSV cohort. Males slightly prevailed (52.5%). Women were slightly less represented in the COVID-19 cohort (45.0%) compared to the others (HZ: 50.2%; PCV: 49.5%; RSV: 49.5%). Most of the target vaccinations were administered between November and December for each season, with marked differences among cohorts: in the PCV cohort, 51.7% were vaccinated in November, whereas in the COVID-19 cohort, the peak occurred in December (51.1%). The administration of the SIV followed a similar pattern, with a clear concentration in November across all cohorts (COVID-19: 63.0%; HZ: 65.0%; PCV: 67.2%; RSV: 66.7%). Seasonal influenza vaccine coverage was highest in the PCV (92.0%) and RSV (92.4%) cohorts, followed by the COVID-19 (89.8%) and HZ (81.6%) cohorts. Accordingly, the proportion of MOSIV was higher in the HZ cohort (18.4%) compared to the COVID-19 (10.2%), PCV (8.0%), and RSV (7.6%) cohorts. Co-administration of SIV was more frequent in the PCV (47.6%) and RSV (42.4%) cohorts, while it was less common in the COVID-19 (8.9%) and HZ (11.0%) cohorts. Lastly, the seasonal distribution indicated that most vaccinations in the COVID-19, PCV, and HZ cohorts were concentrated during the 2023–2024 influenza season.

In the univariate analysis (Table 2), age was significantly associated with the likelihood of receiving the seasonal influenza vaccine (SIV) in three out of four cohorts: COVID-19 (OR: 1.03; 95% CI: 1.01–1.04; $p = 0.000$), PCV (OR: 1.03; 95% CI: 1.01–1.05; $p = 0.005$), and marginally in the HZ cohort ($p = 0.141$).

These results were confirmed in the multivariable logistic regression models adjusted for age, sex, month of target vaccination, health district, and influenza season (Table 2). The association with age remained significant for the COVID-19 (aOR: 1.03; 95% CI: 1.01–1.05; $p = 0.001$) and PCV (aOR: 1.03; 95% CI: 1.03–1.05; $p = 0.007$) cohorts, but not for HZ (aOR: 1.02; 95% CI: 0.99–1.04; $p = 0.124$) or RSV (aOR: 1.04; 95% CI: 0.96–1.12; $p = 0.357$). Regarding sex, no statistically significant associations were observed in the COVID-19, HZ, or PCV cohorts. However, in the RSV cohort, male subjects were significantly more likely to receive SIV compared to females (aOR: 4.20; 95% CI: 1.26–14.14; $p = 0.020$), indicating a significant sex-related difference only in this group. In the other cohorts, aORs for males versus females remained close to unity and non-significant (COVID-19: aOR 0.86; $p = 0.152$; HZ: aOR 1.02; $p = 0.859$; PCV: aOR 0.97; $p = 0.805$).

4. Discussion

Our research found that MOSIV occurred frequently among older adults in Siracusa LHA who received other recommended vaccines during the 2023/24 and/or 2024/25 flu seasons. Indeed, during the study period, a total of 1043 vaccination encounters were identified as MOSIV, accounting for 11.2% of the total vaccinated older adult population.

MOSIV varied by vaccine type, ranging from 7.6% in the RSV cohort to 18.4% in the HZ cohort. Age was consistently associated with SIV uptake, while co-administration of SIV with other vaccines remained limited, ranging from 8.9% in the COVID-19 cohort to 47.6% in the PCV cohort.

A comparison between the two seasons revealed a substantial decline (~90%) in the COVID-19 vaccinations from the 2023/24 to the 2024/25 season, whereas influenza vaccination coverage remained stable. Interestingly, the proportion of co-administration increased across cohorts, particularly for COVID-19 vaccines, likely reflecting the reduction in standalone COVID-19 vaccination visits. RSV vaccination was introduced only in the 2024/25 season; therefore, no comparison with the previous season was possible.

Older age is a well-established predictor of seasonal influenza vaccination uptake [29–32], likely reflecting both increased risk awareness and more frequent healthcare contacts among older adults. [33]. Our findings indicate that age was a significant determinant of SIV uptake in both the COVID-19 and PCV cohorts, with older participants being more likely to receive the vaccine. A similar trend was observed in

Table 2
Correlates of seasonal influenza vaccination, by cohort.

Variable	Levels	SIV		OR	(95% CI)	p-value	aOR ^a	(95% CI)	p-value	
		Yes, n (%)	No, n (%)							
COVID-19 vaccination										
Age (years)	Mean (SD)	76.6 (±7.2)	75.3 (±7.2)	1.03	(1.01–1.04)	0.000	1.03	(1.01–1.05)	0.001	
Sex	Female	1829 (90.6)	189 (9.4)	<i>Ref</i>						
	Male	2200 (89.2)	267 (10.8)	0.85	(0.70–1.04)	0.121	0.86	(0.69–1.06)	0.152	
HZ vaccination										
Age (years)	Mean (SD)	73.9 (±6.5)	73.2 (±6.8)	1.02	(0.99–1.04)	0.141	1.02	(0.99–1.04)	0.124	
Sex	Female	659 (81.3)	152 (18.7)	<i>Ref</i>						
	Male	659 (82.0)	145 (18.0)	1.05	(0.81–1.35)	0.716	1.02	(0.79–1.33)	0.859	
PCV vaccination										
Age (years)	Mean (SD)	75.4 (±7.1)	74.1 (±6.8)	1.03	(1.01–1.05)	0.005	1.03	(1.01–1.05)	0.007	
Sex	Female	1562 (92.0)	135 (8.0)	<i>Ref</i>						
	Male	1591 (92.0)	140 (8.0)	0.98	(0.77–1.26)	0.888	0.97	(0.75–1.26)	0.805	
RSV vaccination^b										
Age (years)	Mean (SD)	79.6 (±8.6)	76.3 (±8.3)	1.05	(0.98–1.13)	0.170	1.04	(0.96–1.12)	0.357	
Sex	Female	87 (88.8)	11 (11.2)	<i>Ref</i>						
	Male	96 (96.0)	4 (4.0)	3.03	(0.93–9.91)	0.066	4.2	(1.26–14.14)	0.020	

the HZ and RSV cohorts, although the associations did not reach statistical significance, possibly due, in the case of RSV, to the limited number of vaccinated individuals.

As highlighted in a systematic review, the relationship between sex and seasonal influenza vaccine uptake remains inconclusive [34]. Although some studies report higher adherence among women [35]. Several factors have been hypothesized to explain this difference, including greater health consciousness, more frequent interactions with healthcare services, caregiving roles, and higher levels of trust in health authorities [36]. However, this association is not consistently statistically significant and may vary depending on sociocultural and healthcare contexts. Although sex appeared to influence vaccination patterns across cohorts—with female sex associated with higher uptake in the COVID-19 and PCV cohorts, and male sex in the HZ and RSV cohorts—these associations did not reach statistical significance in our study across any of the target vaccine cohorts.

Co-administration of vaccines is widely recognized as an effective strategy to increase vaccine uptake, reduce healthcare visits and costs, and improve adherence to immunization schedules [37]. In adults, the co-administration of vaccines such as influenza, COVID-19, PCV, HZ, and RSV has been shown to be safe, generally well tolerated, and not detrimental to vaccine effectiveness [38]. Despite these benefits, our findings indicate a suboptimal implementation of co-administration practices, likely contributing to the observed prevalence of MOSIV. Lower co-administration with COVID-19 vaccines may reflect their more recent introduction, whereas higher rates with PCV likely reflect longer-standing familiarity in clinical practice. Limited co-administration with HZ vaccines may be influenced by recommendations regarding adjuvanted vaccines [39], while higher RSV co-administration rates may be partly due to the small number of doses administered. While the present study focused on missed opportunities for seasonal influenza vaccination, the relatively modest levels of co-administration observed also suggest that some seasonal influenza vaccination encounters may represent missed opportunities to administer other recommended adult vaccines. This bidirectional perspective highlights the importance of integrated adult immunization strategies and systematic vaccination status checks at every healthcare contact.

Despite variations in study design and methodological approaches, our findings are consistent with previous evidence indicating that MOSIV is a frequent occurrence [40–43]. This reinforces the notion that structural and procedural gaps within healthcare delivery, rather than individual vaccine hesitancy alone, may play a significant role, even

among individuals who are already in contact with the healthcare system [22,44]. It should be noted that the proportions of SIV uptake observed in our cohort do not represent population-level influenza vaccination coverage rates. Rather, they reflect conditional uptake among individuals aged ≥ 65 years who had who received at least another recommended adult vaccine during the same influenza season. These estimates are further influenced by the inclusion of two influenza seasons and should therefore not be directly compared with cross-sectional or population-based vaccination coverage figures reported in the literature.

In addition to structural and organizational gaps within healthcare delivery, healthcare professionals' practices and time constraints may also contribute to missed opportunities. Qualitative evidence indicates that limited consultation time is a major barrier to vaccination delivery [45]. In particular, physicians often reported that time spent on vaccination may reduce the time available for other practices judged as a higher priority. In Italy, the average duration of individual vaccination counseling has been estimated at approximately 15 min [46], and influenza vaccination is often offered opportunistically rather than systematically in primary care [47]. Low vaccination uptake among healthcare workers has also been linked to limited awareness campaigns, insufficient health literacy, perceived low risk, and organizational barriers [48–51]. These multifactorial determinants of hesitancy are further reflected in temporal trends in vaccine uptake. In Italy, HCW vaccine acceptance increased during the pandemic but declined again afterward, suggesting fluctuating preventive awareness [52].

The WHO recommends a range of strategies to effectively reduce missed opportunities for vaccination [22]. These include the regular systematic vaccination status checks at every healthcare encounter, promotion of co-administration when feasible, and ongoing training of healthcare professionals to reduce missed opportunities [22,53].

This study has several limitations. First, as with all analyses based on electronic health records, data accuracy depends on the completeness and reliability of registry entries, and underreporting of influenza vaccinations cannot be entirely excluded. Second, the registry lacks key demographic and clinical variables—such as socioeconomic status, education, and comorbidities—limiting the ability to assess determinants of MOSIV. In addition, the electronic immunization registry does not include structured fields to record reasons for non-vaccination, such as refusal or medical contraindications. Therefore, we were unable to distinguish between different underlying causes of missed opportunities for seasonal influenza vaccination or to assess whether MOSIV were

mainly driven by patient-related factors, healthcare professionals' practices, or organizational constraints. Third, our operational definition of MOSIV captured only a subset of all potential missed opportunities, as it was restricted to vaccination encounters in which another recommended adult vaccine was administered. Additional missed opportunities may therefore have occurred at other healthcare contacts during the influenza season, including visits preceding eventual SIV uptake. This group likely excludes those entirely opposed to vaccination and may be more amenable to targeted interventions [54]. Lastly, the study was conducted within a single local health unit, which may limit the generalizability of findings.

This study presents several notable strengths. It quantifies and analyzes missed opportunities for influenza and other adult vaccinations in older adults—a high-risk group—offering insights to improve coverage. By exploring co-administration practices, it supports more integrated vaccination strategies. The use of electronic health records, rather than self-reported data, minimizes recall and social desirability bias and reflects real-world clinical practice. The transparent, publicly available methodology enhances reproducibility and comparability. Focusing on a particularly vulnerable population, the study provides valuable evidence to inform targeted prevention policies. To the best of our knowledge, few studies in Italy have specifically investigated missed opportunities for vaccination during healthcare visits for other adult immunizations, making this one of the first contributions in this area.

Overall, this study found that a notable share of older adults who received PCV, herpes zoster, COVID-19, and RSV vaccines did not receive the seasonal influenza vaccine during the 2023/24 and 2024/25 seasons, despite it being officially recommended for all older adults. These individuals likely represent the most accessible target group for interventions aimed at reducing missed opportunities for influenza vaccination. This highlights a missed opportunity to capitalize on existing healthcare contacts, underscoring the need for more robust efforts to promote influenza vaccination, especially in high-risk groups.

5. Conclusion

MOSIV remain a relevant and actionable problem among older adults already in contact with the healthcare system in Siracusa and similar settings in Sicily and Italy. Our findings highlight persistent gaps in both influenza vaccine uptake and co-administration practices, indicating that current adult immunization services do not fully capitalize on existing healthcare encounters.

Based on these results, several concrete recommendations can be formulated for decision-makers and public health authorities. Influenza vaccination status should be systematically assessed at every healthcare encounter involving older adults, and co-administration of the influenza vaccine with other recommended adult vaccines should be actively promoted whenever clinically appropriate. In addition, targeted training and organizational support for general practitioners and vaccinators should be strengthened to improve proactive vaccine recommendation and address practical barriers such as time constraints. The active use of electronic immunization registries to identify and recall individuals who experience missed vaccination opportunities may further improve coverage at the local and regional level.

Future studies should adopt more comprehensive MOV outcome measures and better characterize the determinants of missed vaccination opportunities and limited co-administration practices, in order to further inform targeted and effective adult immunization strategies.

Together, these measures could help strengthen integrated adult immunization strategies and increase seasonal influenza vaccination uptake in Siracusa, Sicily, and Italy.

Clinical trial registration

Not applicable.

CRedit authorship contribution statement

Fabio Contarino: Writing – original draft, Data curation, Conceptualization. **Claudio Fiorilla:** Writing – original draft, Methodology, Formal analysis, Data curation, Conceptualization. **Francesca Bella:** Writing – original draft, Methodology. **Francesco Leonforte:** Writing – review & editing. **Vito Nicosia:** Writing – review & editing. **Andrea Orsi:** Writing – review & editing, Supervision. **Giovanna Elisa Calabrò:** Writing – review & editing. **Antonio Mistretta:** Writing – review & editing, Supervision. **Giancarlo Icardi:** Writing – review & editing, Supervision.

Patient consent statement

Not applicable.

Ethics approval statement

As this study constituted public health surveillance, ethical approval from the institutional review board was not required. All data were provided and analyzed anonymously.

Permission to reproduce material from other sources

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Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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