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Client satisfaction, safety, and insights from a three-season survey on influenza vaccinations delivered at community pharmacies in Germany

Quirin Werthner [a], Laura Faehrmann [b], Katharina Och [a], Nicola Luigi Bragazzi [a], Martin Johannes Hug [c], Jona Stahmeyer [d], Birte Burger [d], Cosima Bauer [e], Dominik Selzer [a], Oliver Schwalbe [b], Uwe May [e,f,1], Thorsten Lehr [a,*,1]

[a] Department of Clinical Pharmacy, Saarland University, Saarbrücken, Germany
[b] Institute for Health Services Research in Community Pharmacies, Chamber of Pharmacists Westphalia-Lippe, Münster, Germany
[c] Pharmacy of the University Hospital Freiburg, Freiburg, Germany
[d] Health Services Research Unit, AOK-Niedersachsen, Hannover, Germany
[e] May und Bauer GmbH & Co. KG, Bad Honnef, Germany
[f] Faculty of Economics and Management, Fresenius University of Applied Sciences, Wiesbaden, Germany

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ABSTRACT

To address the challenges posed by influenza, its associated complications, and economic burden, the World Health Organization recommends a vaccination rate exceeding 75 % for populations at elevated risk of severe diseases. Presently, vaccination rates in Germany severely lag behind. To augment these rates, pilot projects have been initiated, allowing community pharmacists to administer vaccines. This study aimed to investigate the the acceptability of pharmacy-led influenza vaccinations among clients and pharmacists, clients' motivations to get vaccinated in community pharmacies, and the rate of adverse events during this process. Data were obtained through anonymous questionnaires from influenza vaccination pilot projects in various German regions between 2020 and 2023. The questionnaire consisted of two sections: one for the vaccinating pharmacist to record and document the vaccination process and one for the recipient, focusing on their experiences and views. In total 11,571 responses were evaluated. Notably, 44 % of participants mentioned they would not have sought vaccination outside a pharmacy setting. This percentage was higher (65 %) in those receiving their first influenza vaccination. Vaccinees reported high levels of satisfaction with the supplied information (88.5 %) and vaccination procedure (93.8 %). Furthermore, clients declared a high willingness to repeat the vaccination (93.9 %) and the possibility of receiving other vaccinations in pharmacies (79.7 %). Among all surveyees, only nine reported adverse reactions post pharmacy-administered vaccination, with none necessitating emergency intervention. Pharmacy-led influenza vaccinations were identified as safe, well-received by vaccinees and effective in increasing vaccination acceptability with the potential to enhance vaccination rates across diverse demographics in Germany.

1. Introduction

Seasonal influenza poses a significant global burden, due to its widespread impact on health and the economy [1]. In Europe, influenza infections resulted in approximately 27,600 deaths annually, with Germany accounting for 156,000 hospital admissions between 2010 and 2019 [1,2]. Populations, such as the elderly, pregnant individuals, and those with underlying co-morbidities, are at an elevated risk of severe influenza-induced complications [3]. The World Health Organization (WHO) and the European Union (EU), thus, recommend vaccinations for these populations as well as for individuals with an increased risk of exposure, such as healthcare workers [4]. For these groups, a coverage rate of at least 75 % is recommended. However, Germany's coverage rates still linger between 35 % and 40 % [5], trailing countries with comparable healthcare systems such as Portugal, the Netherlands, and the United Kingdom [6].

* Corresponding author.
E-mail address: thorsten.lehr@mx.uni-saarland.de (T. Lehr).
[1] Contributed equally.

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To improve vaccine accessibility, increase vaccination rates, and ultimately enhance overall coverage, pharmacy-based vaccination services are now authorized in 56 countries worldwide [7]. Community pharmacists play diverse roles, including serving as immunizers, facilitators of immunization, and educators. This approach has proven effective in expanding vaccine coverage while also demonstrating cost-effectiveness [8–12]. Other countries, including Germany, have, instead, relied primarily on general practitioners for influenza vaccinations. In Germany, beyond traditional healthcare facilities, vaccinations are available in a variety of settings including local public health departments (*Gesundheitsämter*) for both routine and specialized vaccines, work-based programs where employers collaborate with occupational health services, and mobile units that provide vaccines to rural and underserved communities, all of which enhance accessibility and coverage across the population. While many countries have recognized the role of pharmacists in the field of immunization, the approach was met with skepticism in Germany, particularly from medical associations concerned about client safety [13]. Motivated by the objective to enhance immunization coverage, pharmacists were authorized to administer vaccines in pilot projects in selected German regions starting in 2020. The onset of the COVID-19 pandemic further underscored the critical need for accessible vaccination services. These pilots supported the introduction of a new regulatory framework in 2022, allowing German pharmacists to administer influenza vaccinations. The objectives of this study were to compile, homogenize, and analyze survey data collected during the three pilot influenza seasons (2020−2023) across eight German federal states. The present study aimed to investigate pharmacists' and clients' acceptance of pharmacy-led immunizations and to assess the safety and satisfaction levels of vaccinees using these services.

2. Materials and methods

2.1. Study design

The study was designed as a cross-sectional survey. More in detail, our analysis compiled anonymous survey data from local model projects conducted between September 2020 and March 2023 in the following German federal states: Baden-Wuerttemberg, Bavaria, Lower Saxony, North Rhine-Westphalia, Rhineland-Palatinate, Saarland, Saxony, and Schleswig-Holstein. North Rhine-Westphalia executed two separate projects in its regions Westphalia-Lippe and North Rhine, each of which is represented by its own pharmacy association. Berlin also initiated a model project, but data was not shared and, therefore, not included in our analysis. The inception and organization of these projects in different states rested with either the overseeing pharmacist associations or collaborative efforts between groups of pharmacists and participating health insurers.

2.2. Ethical approval

Enabled by an amendment in §132j of the Fifth Book of Social Code (SGB V) effective from March 2020, vaccinations in pharmacies within the framework of model projects were permitted. The evaluation of the vaccination model project in pharmacies was mandated by the state and legally enshrined. Since all data were anonymized from the moment of collection and anonymity was preserved and maintained throughout the entire analysis, obtaining ethical approval for this study was deemed not mandatory, as affirmed by the Ethics Commission of Westfalia-Lippe. All participating clients across the model regions provided written, informed consent prior to vaccination.

2.3. Participants eligibility criteria

Pharmacy owners were approached for the project by pharmacist associations. Prior to administering vaccines, pharmacists had to undergo physician-supervised training providing competencies necessary for the safe provision of immunization. It covered a wide range of areas, from obtaining client consent and recognizing contraindications to managing potential acute vaccination reactions.

Participants had to be at least 18 years old and have coverage from a participating statutory health insurance program. Exclusion criteria were contraindications such as severe acute illnesses, feverish infections (>38.5 °C), or hypersensitivity to vaccine components. Those who had experienced severe reactions to vaccines in the past, were due for surgeries in the following three days, were on anticoagulant therapy, were pregnant, or were potentially infected with SARS-CoV-2, were referred to seek vaccinations from a physician and were not eligible to participate in the pilot. These exclusion criteria and subsequent referrals were mandated in the legislation that authorized the pilot programs.

2.4. Data collection

The data collection was based on an anonymous, two-section survey developed by the Federal Association of German Pharmacists Associations (ABDA) in collaboration with the Federal Institute for Vaccines and Biomedicines (Paul-Ehrlich-Institute) and the Robert Koch Institute (RKI) for Public Health. Pharmacies engaged with customers on an individual basis, while participating organizations, such as health insurance companies, promoted the pilot projects to the public through various media channels. The ABDA provided community pharmacies with materials, including leaflets and posters. However, no dedicated public health campaign specifically targeting influenza vaccinations in community pharmacies was conducted.

All model projects were mandated to employ this survey.

The majority of survey data (88.8 %) was collected electronically through online systems (GEDISA, GEDISA GmbH, Potsdam, Germany; SurveyMonkey, SurveyMonkey Inc., San Mateo, California, USA) and directly exported in CSV-like tabular formats. The remaining 11.2 % of surveys were conducted using paper forms, which were mailed to the respective insurance providers. For these, manual transcription was carried out by insurance company employees (Lower Saxonian data, all seasons) and an independent working group from Saarland University (Bavarian data, first season only) following data entry by one person with sample-based checking by another. The transcribed data was then stored in Microsoft Excel, ensuring any pharmacy-level identifiers were pseudonymized using SHA-256 hashing (Bavarian data) or purged entirely (Lower Saxonian data). Survey anonymity was ascertained for online submissions, as these systems recorded no identifying information. For paper forms, pharmacy-level anonymity was maintained through pseudonymization, ensuring no direct identifiers were accessible to the researchers. The datasets, including anonymized patient-level data and pseudonymized pharmacy-level data, were securely transferred to the research team via encrypted email or password-protected data-hosting platforms.

2.5. Survey

The questionnaire consisted of two parts. One section focused on the vaccination procedure, while the other addressed the client's perspective on pharmacist-led vaccination. The first section consisted of standardized items commonly used in vaccine pharmacovigilance in Germany. To enhance participant anonymity, the initial categorization of age groups into 5-year intervals was expanded to 10-year intervals. Due to the increased workload during the COVID-19 pandemic, the second section of the questionnaire was not formally pretested (personal communication with ABDA). The section for pharmacists covered topics such as client demographics, duration of the vaccination encounter, and the German Standing Committee on Vaccination (STIKO) indications for the vaccination, if applicable. These STIKO indications refer to a published set of criteria identifying individuals at increased risk from influenza. These criteria include being over the age of 65, having specific

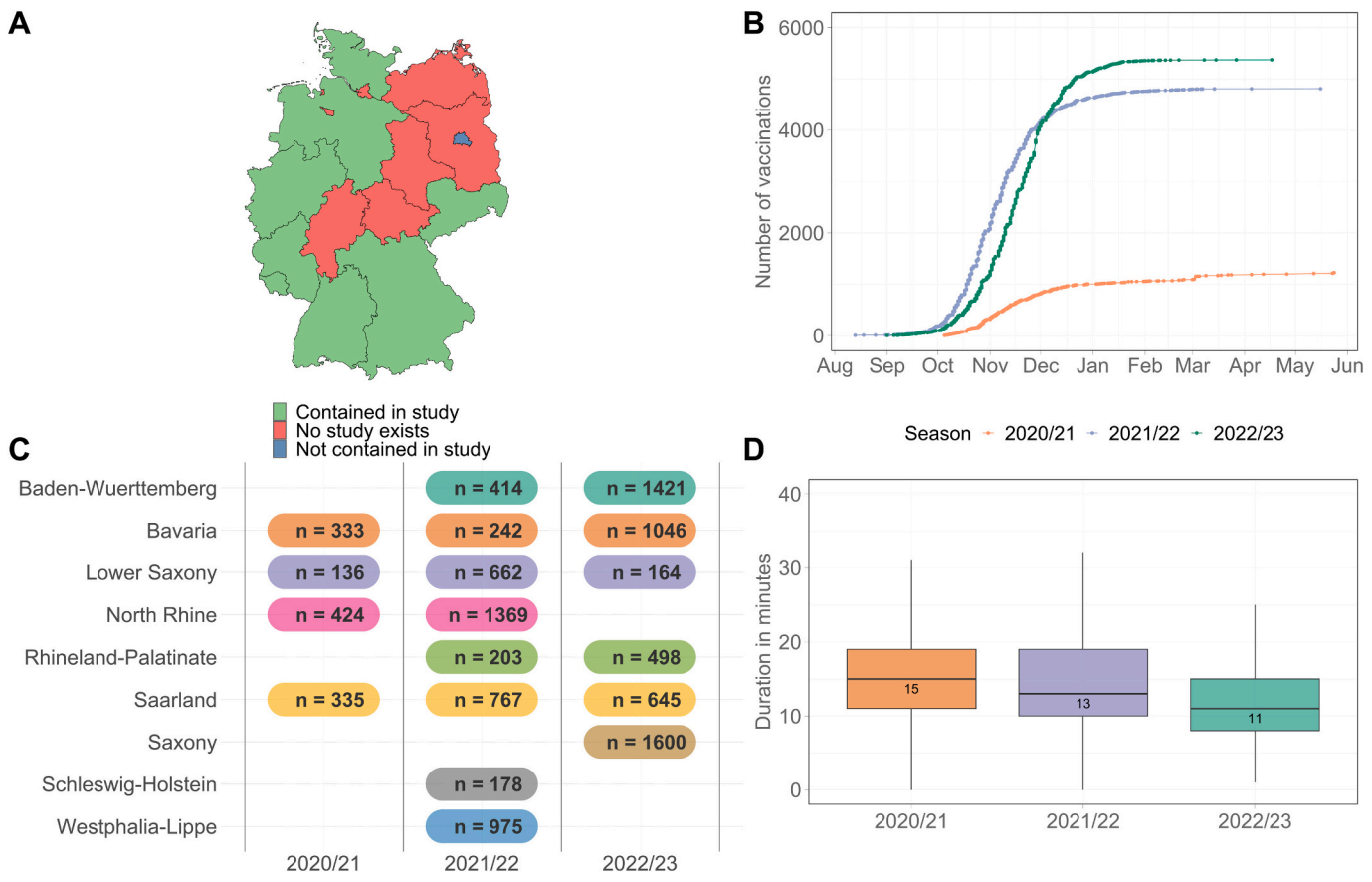

Fig. 1. Vaccination trends and patterns across the study. Subfigure A presents a geographical map highlighting the German federal states with participating model projects (light green) as well as states where the pilot did not participate (light blue) and states without influenza vaccination pilots (light red). Subfigure B displays the cumulative number of vaccinations administered during the three seasons over time. Season 2020/21 is depicted in orange, 2021/22 in purple, and 2022/23 in dark green. Subfigure C shows the number of vaccinations per model region by influenza season. The tags provide the number of participants per model region for that respective season. Subfigure D illustrates the box-plots of the vaccination encounter duration in minutes at the vaccination site including pre-vaccination informative talk for participating pharmacies. Season 2020/21 is shown in orange, 2021/22 in purple, and 2022/23 in dark green. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

health conditions, or being in occupational or caregiving roles with heightened exposure to sick individuals or populations at elevated risk of severe disease, such as healthcare professionals like doctors and nurses [14]. The label "No STIKO-Indication was used for clients who got vaccinated in the context of this vaccination pilot but did not fall under one of the published STIKO-Indications. Furthermore, it included questions about contraindications, client safety, and acute vaccination reaction effects during or following the vaccination procedure. For clients, the questions addressed prior influenza vaccinations, how they learned about the program, and their rationale for choosing a pharmacy-based vaccination. For certain questions, such as prior vaccination locations, reasons for getting vaccinated, and awareness of vaccination opportunities, participants could provide multiple answers. Furthermore, the survey assessed the client's satisfaction with the vaccination process, the information received at the vaccination site, and their inclination to consider community pharmacies for future vaccinations against influenza or other diseases. These questions were on a five-point Likert-like scale, ranging from 1 ("Strongly disagree") to 5 ("Strongly agree"). Lastly, clients were asked if they would have chosen to receive an influenza vaccination if it had not been offered at the pharmacy.

The survey was conducted in appropriate rooms in the pharmacy, either during the vaccination process or post-vaccination. Pharmacists and clients completed the questionnaire sections in sequence (first the pharmacist, then the client), but independently. Sample questionnaires in both the original language (German) and English are provided in the supplementary materials (Table S1–S2).

2.6. Data processing and statistical analysis

Questionnaires from different regions were homogenized to create a consistent analysis set. While the core set of questions remained the same (Table S1–S2)., some regions omitted specific questions due to local policies or data security concerns, such as region-identifying information. Similarly, pharmacist responses regarding vaccine stability (e.g., clarity, absence of particles, vaccine type, manufacturer, batch number) were recorded in some regions but documented separately and not shared in others. Participant ages were categorized into eight groups: "18–20", "20–29", "30–39", "40–49", "50–59", "60–69", "70–79" and "+80". Data was analyzed using descriptive statistics as well as logistic regression and Chi-squared-test for group differences regarding dichotomous variables and ordinal logistic regressions to evaluate group differences in the responses to the Likert-like items. For regressions, missing data was listwise deleted. In the analysis of the Likert scales, responses were quantified in terms of counts and proportions, with the exclusion of "not answerable" responses and questionnaires lacking demographic data. For each regression, *p*-values and odd-ratios (OR) with their 95 % confidence intervals (CI) were reported; p-values below 0.05 were considered significant. Changes in frequencies were analyzed using the Cochran-Armitage test, computing the p-value of the trend (p_{trend}) or Chi-squared test. To adjust for outliers in reported duration of the vaccination encounter, data points exceeding 151 min (the top 1 %) were truncated. Missing entries for STIKO-indications were assumed to be "no indication". Participants with contraindications that

Table 1
Distribution of clients by age, gender, and state for seasons 2020/21 to 2022/23. Clients counts are detailed by season and characteristic (age, gender, state), with percentages in parentheses. For some questionaires, both the entry for the season as well as for the demographics were missing.

Characteristic	Total	2020/21	2021/22	2022/23
Age group				
18–19	138 (1·2)	19 (1·5)	56 (1·2)	63 (1·2)
20–29	794 (6·9)	93 (7·6)	350 (7·3)	350 (6·5)
30–39	1360 (11·8)	131 (10·7)	601 (12·5)	622 (11·6)
40–49	1588 (13·7)	140 (11·4)	725 (15·1)	720 (13·4)
50–59	2628 (22·7)	267 (21·7)	1230 (25·6)	1120 (20·8)
60–69	2674 (23·1)	303 (24·7)	1066 (22·2)	1290 (24·0)
70–79	1454 (12·6)	192 (15·6)	515 (10·7)	737 (13·7)
>80	807 (7·0)	83 (6·8)	266 (5·5)	451 (8·4)
Total	**11,443 (98·9)**	**1228 (100)**	**4809 (100)**	**5353 (99·6)**
Missing	**128 (1·1)**	**0 (0·0)**	**1 (0·0)**	**21 (0·4)**
Gender				
Female	6190 (53·5)	661 (53·8)	2735 (56·9)	2770 (58·5)
Male	4558 (39·4)	558 (45·4)	2031 (42·2)	1946 (41·3)
Other	17 (0·2)	1 (0·1)	7 (0·1)	9 (0·2)
Total	**10,765 (93·0)**	**1220 (99·3)**	**4773 (99·2)**	**4725 (87·9)**
Missing	**806 (7·0)**	**8 (0·7)**	**37 (0·8)**	**649 (12·1)**
States				
Baden-Wuerttemberg	1835 (15·9)	0 (0)	414 (8·6)	1421 (26·4)
Bavaria	1622 (14·0)	333 (27·1)	242 (5·0)	1046 (19·5)
Lower Saxony	1120 (9·7)	136 (11·1)	662 (13·8)	164 (3·1)
North Rhine-Westphalia	2768 (23·9)	424 (34·5)	2344 (48·7)	0 (0)
Rhineland-Palatinate	701 (6·1)	0 (0)	203 (4·2)	498 (9·3)
Saarland	1747 (15·1)	335 (27·3)	767 (15·9)	645 (12·0)
Saxony	1600 (13·8)	0 (0)	0 (0)	1600 (29·8)
Schleswig-Holstein	178 (1·5)	0 (0)	178 (3·7)	0 (0)
Total	**11,571 (100·0)**	**1128 (100·0)**	**4810 (100·0)**	**5374 (100·0)**
Missing	**0 (0·0)**	**0 (0·0)**	**0 (0·0)**	**0 (0·0)**

could not be vaccinated were removed from the dataset. Furthermore, if participants listed both work- and health-related indications, a combined level was designated. Those participants older than 59 and who did not specify an indication, were assigned an "age-related indication". Free-text comments were categorized and aligned with existing options. A vaccination season was assumed to begin in August. All statistical analyses were conducted with the statistical programming language R version 4.2.0 [13]. The analysis relied on the packages *readxl* [15] for data import, *dplyr* [16] and *tidyr* [17] for data manipulation, *ggplot2* [18] for visualization, and *MASS* [19] for statistical modeling.

3. Results

Over the span of three vaccination seasons (2020/21, 2021/22, and 2022/23), a total of 11,571 questionnaires were collected from nine model regions in eight German states (Fig. 1A). The number of participants increased from 1228 in the 2020/21 season to 4810 in 2021/22 and peaked at 5374 in 2022/23. Despite the absence of pharmacy identifiers from Westphalia-Lippe and Schleswig-Holstein due to regional data privacy restrictions, data from the remaining seven regions showed that 104 pharmacies participated in the first season (vaccinating 1228 clients, client-to-pharmacy ratio: 11.81), 293 pharmacies in the second season (vaccinating 3657 clients, client-to-pharmacy ratio: 12.48), and 477 pharmacies in the third season (vaccinating 5374 clients, client-to-pharmacy ratio: 11.27). The client-to-pharmacy ratio remained relatively stable across the seasons. The majority of vaccinations were administered between the months of October (28 %) and November (46.6 %) each year, as illustrated in Fig. 1B. For 159 vaccinees (1.4 %), no season was provided in the survey. The pooled data showed heterogeneity regarding some factors such as variations in model regional involvement, project duration, and vaccine administration volume across states. Some states had staggered start dates or expanded the model projects throughout the three seasons as can be seen in Fig. 1C. When considering the duration of the entire vaccination procedure, including both information on the client and vaccine administration, the median time was 12 min (IQR: 10–16 min). The vaccination times remained consistent across different age groups and states (Fig. S1). However, it declined over the successive seasons from a median of 15.0 min in 2020/21 to 14.0 min in 2021/22 and 11.0 min in 2022/23 (Fig. 1D). The gender distribution among respondents was skewed, with 57.5 % female, 42.3 % male, and 0.2 % diverse participants. Age-wise, the bracket of 60–69 years dominated with 23.1 %, closely followed by the age groups of 50–59 (22.7 %), 40–49 (13.7 %), and 7079 (12.6 %), cumulatively representing nearly half of all respondents. A more detailed breakdown of client and study characteristics is presented in Table 1.

Overall, the leading indication for vaccination against influenza was an increased health risk due to pre-existing health conditions, which represented 26.9 % of all vaccinations. This was followed by an increased risk for infection attributable to occupation ("work-related risk") at 20.3 % and an elevated risk due to older age, accounting for 18.7 % of vaccinations. Notably, 25.1 % of individuals were vaccinated without any underlying STIKO indication. Fig. 2A depicts the distribution of participants by age group alongside their respective STIKO indication. However, since the absolute client counts are highly influenced by the overall age distribution in the general population, a more proportionate representation of indications by age group, adjusted for the number of participants in each bracket, is displayed in Fig. 2B. Work-related-indication emerged as the predominant reason among those younger than 40 (41.1 %) and between the ages of 40 and 59 (38.3 %). However, for participants older than 59, this work-related factor was stated in only 12.8 %. In contrast, the prevalence of health-related indications increased with age, where 16.3 % of clients below the age of 40, 26.7 % between the ages of 40 and 59 and 49.9 % of participants older than 59 years cited health-related reasons for the vaccination. In the 2020/21 season, health-related indications were most dominant with 41.8 % but dropped to 28.3 % in 2021/22 and rebounded slightly to 38.5 % in 2022/23. Over the evaluated seasons the frequency of age-related indications increased from 15.1 % in 2020/21, to 18.6 % in 2021/22 and 19.9 % in 2022/23 ($p_{trend} < 0.001$).

The majority of clients (86.4 %) stated that they have been previously vaccinated against influenza, primarily by their family physician (66.9 %) or through a work-based vaccination program (4.9 %). Vaccinations at healthcare departments (0.5 %) or medical specialists (2.0 %) were less common. A significant upward trend over the project period of people opting for vaccinations at alternative sites could be noted, with those citing unspecified locations increasing from 1.8 % in the 2020/21 season to 5.0 % in 2021/22 and 21.1 % in 2022/23 ($p_{trend} < 0.001$) (Fig. 3A). It is worth noting that "pharmacy" was not provided as an option for previous vaccination sites in the questionnaire.

Overall, 13.6 % stated to have received their first influenza vaccination (implicitly at a pharmacy). 17.5 % of clients with work-related indication were not previously vaccinated against influenza infections, compared to 9.0 % with health-related indications, and 8.5 % with indication due to older age. Over the seasons, the percentage of first-time vaccinations decreased, dropping from 25.7 % in the 2020/21 season to 7.1 % in 2022/23. Here, client age group as linear predictor (OR 1.27 per increase in age group, 95 % CI [1.23, 1.32], $p < 0.001$) and health-related indications (OR 2.40, 95 % CI [1.62, 3.58], $p < 0.001$) were significant predictors for prior influenza vaccinations. When treating age groups as ordered categories, participants aged 40–49 (OR

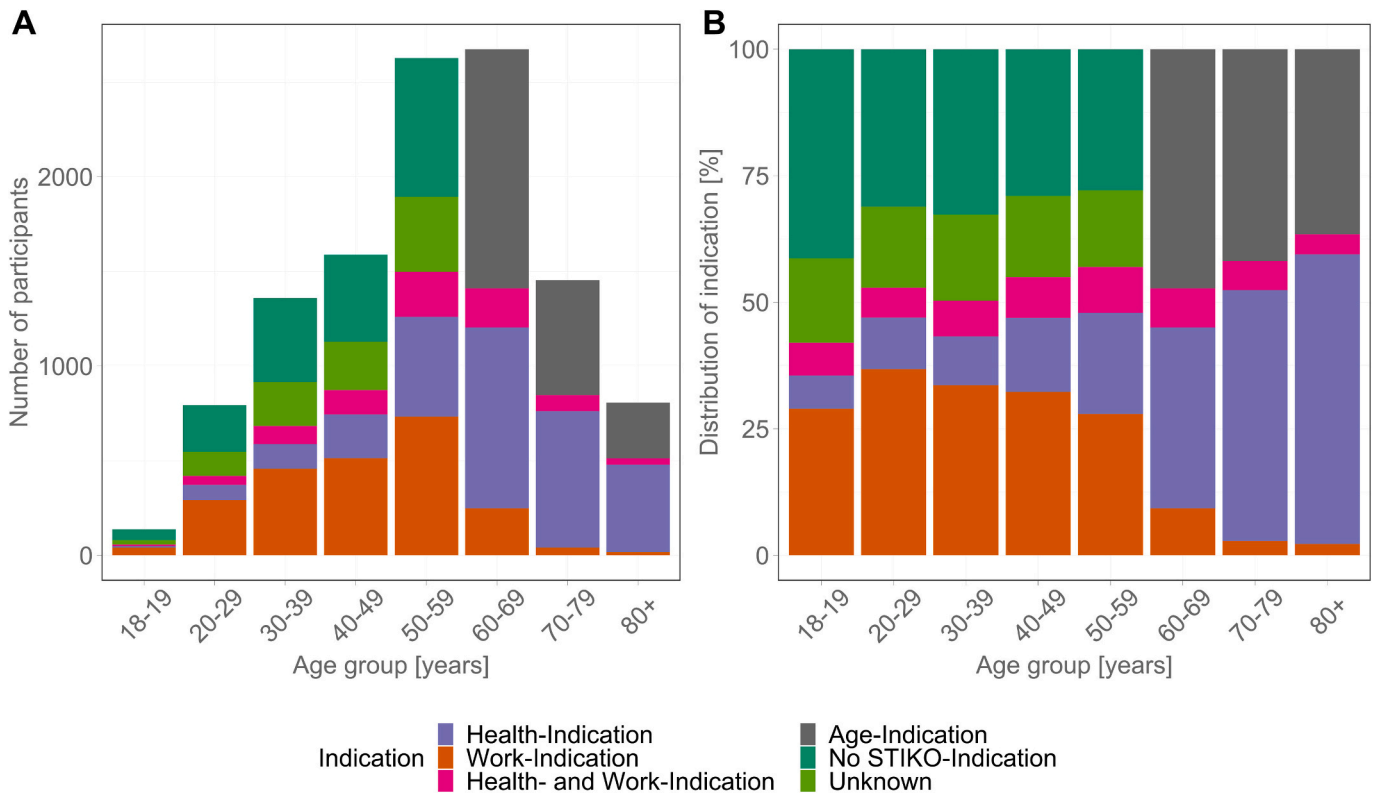

Fig. 2. Distribution of participants with STIKO-indications by age group shown as absolute numbers (A) and as percentages normalized for the number of participants in each age group (B). The combined health- and work-indication (pink) includes individuals eligible for the influenza vaccine both due to underlying health conditions (purple) and those concurrently at increased risk due to work-related circumstances (orange). Participants over the age of 60 with no other indications are denoted in grey. Those without any specified STIKO-indication are depicted in dark green, while individuals with unknown indications are represented in light green. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

1.65, 95 % CI [1.10–2.43], $p = 0.014$) and older showed significantly higher odds of prior influenza vaccination, with the highest odds observed in participants aged 80+ (OR 4.38, 95 % CI [2.73–7.00], $p < 0.001$), while health-related indications remained a strong predictor (OR 1.65, 95 % CI [1.46–1.86], $p < 0.001$; Table S4). The likelihood of a first influenza vaccination decreased with age: 22.0 % for those under 40, 14.5 % for ages 40–59, and 8.7 % for individuals over 59. Conversely, vaccinations by family physicians became more prevalent with age. Specifically, 57.3 % of those under 40, 64.2 % between ages 40 and 59, and 74.0 % of those over 59 acknowledged being vaccinated by their family physician previously (Fig. 3B).

Clients receiving their first influenza vaccination at the pharmacy displayed differences from those previously vaccinated against influenza in certain aspects. Younger demographics dominated among first-time vaccine recipients, whereas participants over 60 typically had prior vaccination experience (Fig. 4A). Work-related indications (26.4 % vs. 20.5 %) and the absence of a specified indication (27.2 % vs. 17.0 %) were more common among first time vaccinees, while older age groups (18.9 % vs. 11.9 %) and those with health concerns (27.2 % vs. 18.0 %) had fewer first vaccinees among them (Fig. 4B).

However, both groups were similar in gender distribution, information sources, and motivations for selecting pharmacy-based vaccination. When inquired if they would opt for other sites, such as doctor's offices or healthcare departments, if pharmacies did not offer vaccinations, 56.9 % replied affirmatively, 11.5 % were uncertain, and 17.0 % would not have been vaccinated outside the pharmacy program. Among the first-time vaccinees, only 35.0 % would have pursued vaccination irrespective of the pharmacy initiative, while 34.5 % remained undecided, and 27.6 % would not have explored other options (Fig. 4C).

The study revealed that a variety of sources informed participants about the option of receiving influenza vaccinations in pharmacies. Notably, 35.0 % credited pharmacy staff, followed by 26.4 % who relied on printed information in the pharmacy itself. Personal recommendations or word of mouth were cited by 15.8 %. Meanwhile, broader media channels like the news, which included press, TV, radio, and advertisements, were the source for 10.9 % of participants, whereas 10.4 % turned to the internet. In contrast, insurances (4.5 %), doctor's offices (2.8 %), and other miscellaneous sources (4.1 %) played a more diminished role in disseminating this information (Fig. 5A). Tracing the trends over the three monitored seasons, a noticeable shift in information channels could be observed. While referrals from insurances showed a marked decline from 8.9 % in the 2020/21 season to just 2.1 % in 2022/23, news sources also observed a downtrend, more prominently cited in 2020/21 (18.9 %) and 2021/22 (17.8 %) than in the final season (7.8 %). In contrast, the relevance of both pharmacy staff (2020/21: 28.9 %; 2021/22: 28.6 %, 2022/23: 42.1 %, $p_{trend} < 0.001$) and printed pharmacy materials (2020/21: 15.2 %; 2021/22: 28.1 %; 2022/23 27.6 %, $p_{trend} < 0.001$) increased over the course of the three seasons. When considering age as a variable, younger participants (under 40 years of age) demonstrated a more pronounced inclination towards the internet (14.7 %) compared to the 40–59 age group (11.1 %, $p < 0.001$) and those older than 60 (7.8 %, $p < 0.001$). In comparison, participants older than 59 were more frequently informed through direct interactions, either with pharmacy staff (<40: 32.3 %; 40–59: 33.2 %; >59: 37.7 %, $p_{trend} < 0.001$) or at their regular doctor's office (<40: 2.0 %; 40–59: 2.1 %; >59: 3.9 %, $p_{trend} < 0.001$). The distribution of motivations for getting vaccinated in a pharmacy stated by the queried participants is visualized in Fig. 5B. Here, the primary drivers were logistical and trust-based: easy access (66.7 %), the lack of a waiting time (52.5 %), trust in the pharmacist's expertise (42.6 %), convenient operating hours (35.7 %), and being a regular visitor to the pharmacy (26.1 %). However, a few participants were influenced by external advisories: 12.8 % were

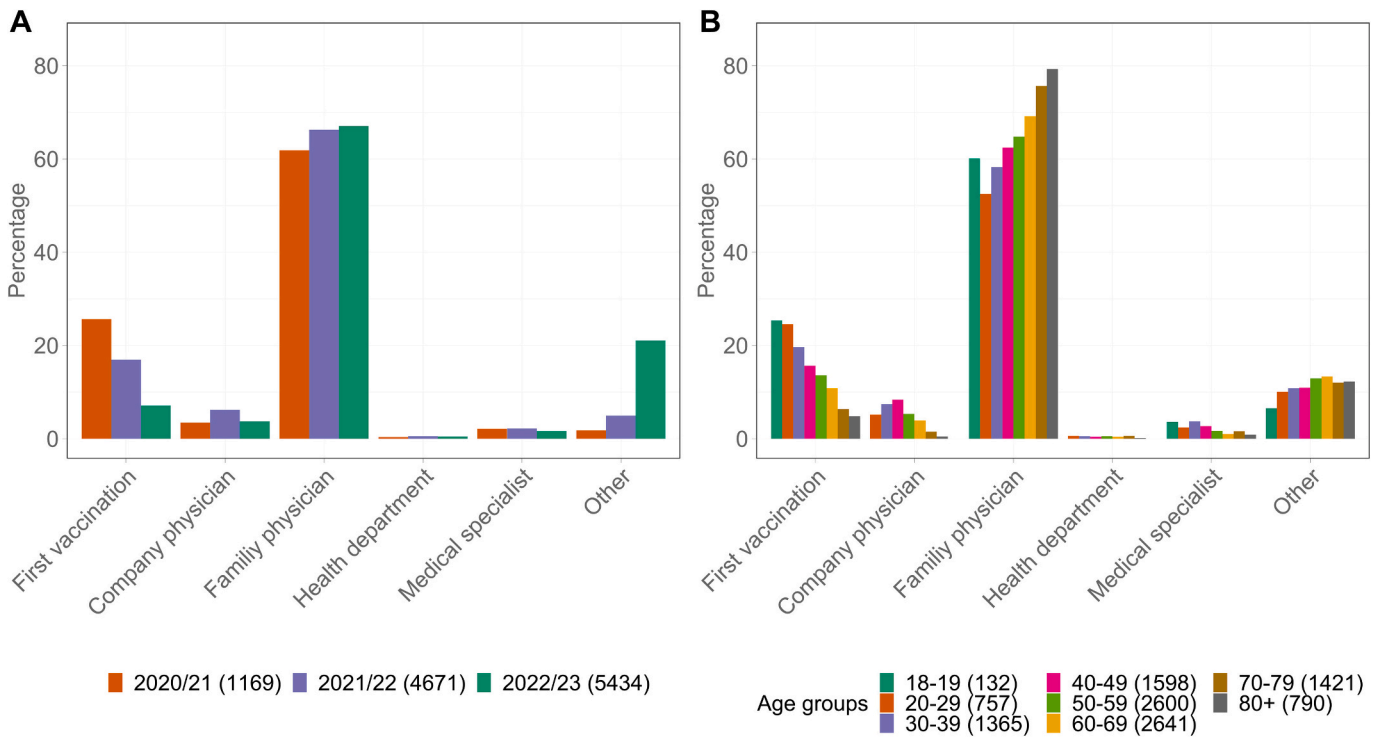

Fig. 3. Previous influenza vaccination sites. Subfigure A shows previous vaccination sites over the study seasons. 2020/21 is depicted in orange, 2021/22 in purple, and 2022/23 in green. Subfigure B provides an overview of previous vaccination sites by age group where age-group 18–19 is depicted in dark-green, 20–29 in orange, 20–39 in purple, 40–49 in pink, 50–59 in light-green, 60–69 in yellow, 70–79 in brown and older than 80 in grey. Numbers in parentheses indicate clients who answered the question in each group. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

directly informed by pharmacists, and 9.2 % by their social environment. A small subset, about 5.8 %, opted for pharmacies out of fear of contracting infections at a doctor's office. Another 4.7 % said the vaccine was not offered by their physician. A small fraction (0.2 %) preferred pharmacies due to an insurance provision program covering costs there, unlike at the doctor's office. A notable change in motivations over the three seasons could be observed. For instance, the concern of potential infections at a doctor's office was more pronounced in 2020/21 at 13.1 % but diminished to around 5.0 % in subsequent years (2020/21: 13.1 %; 2021/22: 4.8 %; 2022/23 5.0 %, $p_{trend} < 0.001$). Similarly, the option "Not offered by physician" saw a decline from 10.4 % in 2020/21 to 4.8 % in 2021/22 and 3.3 % in 2022/23 ($p_{trend} < 0.001$). Although logistical reasons like convenience were universal across age groups, they were cited less by older participants. On the other hand, with 16.6 % for people younger than 40, 24.5 % for people between 40 and 60 years of age and 31.5 % for participants older than 60, older age groups were more likely to define themselves as "regular pharmacy users" as reason for getting vaccinated in a community pharmacy.

Fig. 6 presents responses from the Likert-like survey assessing client satisfaction with different facets of the vaccination process and their inclination towards future vaccinations at a community pharmacy. Overall, participants reported high levels of satisfaction with the received vaccination. 88.5 % rated the information about the vaccination procedure as "Very good" while 1.0 % had neutral or negative perceptions (Fig. 6A). Satisfaction regarding the vaccination procedure mirrored this trend, with 93.8 % indicating they were "Very satisfied" (Fig. 6B). Moreover, 93.9 % voiced their willingness to consider another pharmacy-based influenza vaccination in the future (Fig. 6C). When asked about their willingness to receive other types of vaccinations besides influenza in a pharmacy, 79.7 % answered with "Yes" and 16.3 % with "Probably" (Fig. 6D). Notably, the patterns of responses about information provision, overall satisfaction, and propensity for future vaccination remained consistent across the three seasons. However, there was a notable shift in attitudes concerning the acceptance of other vaccines in a pharmacy setting. While 69.5 % were amenable in the 2020/21 season, this number surged to 81.0 % in 2021/22 and marginally increased to 81.1 % in the 2022/23 season. Ordinal logistic regression showed significant differences between the seasons with OR 1.92 (95 % CI [1.65, 2.22], $p < 0.001$) for 2021/22 and OR 1.90 (95 % CI [1.63, 2.20], $p < 0.001$) for 2022/23 compared to the starting season 2020/21. Here, age and gender were not significant predictors ($p \geq 0.1$). Table S3 presents a further breakdown of questionnaire items.

Among all 11,571 vaccinations administered, nine adverse reactions post vaccination were reported (0.08 %). Three questionnaires noted anaphylactic reactions, three reported respiratory emergencies and in one case cardiovascular emergencies. Furthermore, one questionnaire documented an emergency due to bleeding and one reported a case of circulatory problems with dizziness. No emergency measures were required for any of the nine recorded events.

4. Discussion

In the evolving landscape of healthcare, pharmacist-led immunization interventions have emerged as a pivotal strategy to enhance public health outcomes [8–12]. This study evaluated data from eight out of nine German states that initiated community pharmacy vaccination pilots covering 98 % of the data collected, resulting in a total of 11,571 questionnaires. It is the first study to comprehensively evaluate their implementation with respect to client satisfaction, safety, and the potential to broaden access to influenza vaccinations.

There are many potential barriers to immunization which can be tackled by pharmacy-based influenza vaccination, including lack of knowledge about the vaccination and related recommendations, past experiences with influenza vaccinations, and limited access due to lack of infrastructure, inconvenience, or little interaction with the healthcare system among others [20]. Consequently, the primary reason participants cited for choosing a community pharmacy as a vaccination site was convenience, including easy access, no waiting time, convenient

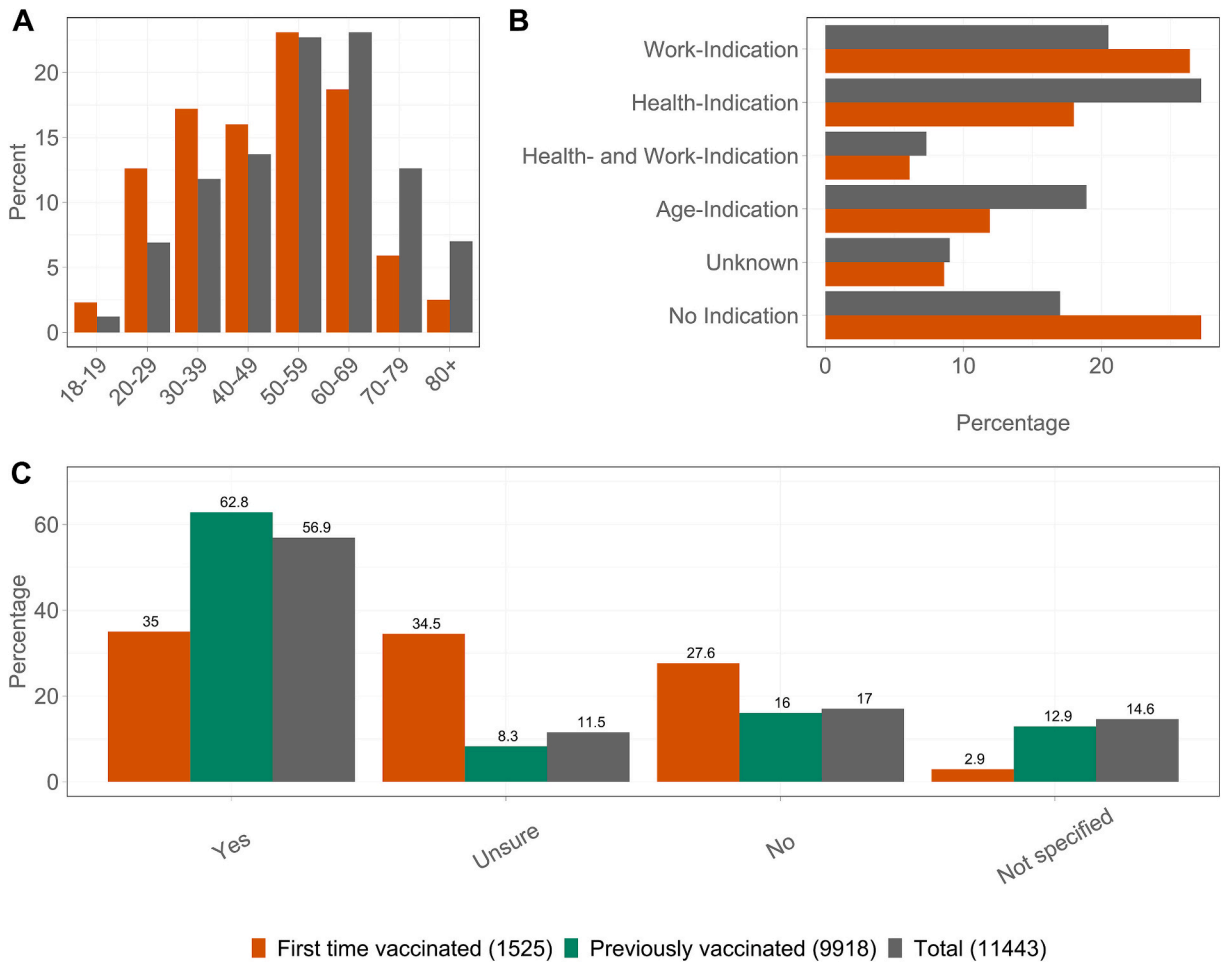

Fig. 4. Comparison between clients receiving their first vaccination (orange), clients who had been vaccinated against influenza in the past (green) and the overall population (grey). Numbers in parentheses indicate clients who answered the question in each group. (A) illustrates the percentage of participants vaccinated across age groups. (B) presents the distribution of STIKO-indications for both groups. (C) reveals the response distribution to the query, "Would you have sought influenza vaccination if not available in the pharmacy?". This subfigure contrasts the responses from all participants, first-time vaccinees, and previously vaccinated individuals. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

opening hours, and being a pharmacy regular user, which is in line with previous studies [21–24]. The importance assigned to convenience by the clients found in our study was also documented by others [25]. During the 2020/21 season, reasons such as the fear of infection at a doctor's office and the unavailability of vaccination at physicians saw a spike, likely reflecting the influence of the SARS-CoV-2 pandemic on public sentiment. Historically, Germany has relied on family physicians, who typically operate on appointment systems, and administer most influenza vaccinations. Consequently, this system has not been able to leverage the convenience benefits provided by community pharmacies [23,26].

A pivotal outcome of our research is the demonstrable capability of pharmacy-based vaccination services to substantially increase influenza vaccine uptake. Our findings reveal, that among all participants, 17 % would not have pursued vaccination, and an additional 11 % were undecided about receiving the vaccine had it not been accessible through pharmacies. This effect is even more pronounced among first-time vaccine recipients, with 28 % indicating they would not have been vaccinated and 35 % expressing initial uncertainty. Work by Warner and coworkers also showed a broadening of access for participants normally not reached via conventional vaccination providers [27]. In addition, our study suggests that pharmacies may not only be relevant for first-time vaccines but also remain a pertinent vaccination source for those who have previously been vaccinated in community pharmacies throughout this project. Similarly, other studies also show clients tendency to frequent previously utilized services [28]. These findings highlight the significant role of pharmacies in enhancing vaccine accessibility and acceptance, making the process more approachable for the general public.

Additionally, it has been shown that clients with previous exposure to influenza vaccinations are more likely to get vaccinated again [29], which increases the importance of the high rate of first-time vaccinations shown in this study. Moreover, low-risk perception, knowledge about the vaccination or regular cues to action are also barriers for which pharmacies can be helpful, due to the better accessibility, more frequent contact with the healthcare system and vaccinating parties that pharmacies can provide. This is especially the case for hard-to-reach and at-risk groups such as healthcare workers, individuals with chronic illnesses, and the elderly, for whom the pharmacy is a more frequent destination. Consequently, targeting these groups with reminders and educational initiatives becomes more promising [27,29–32]. The findings of this study also underpin this notion, considering that for all mentioned groups, information about vaccination opportunities was primarily provided within the pharmacy, either via printed material or directly through the pharmacist, underscoring the valuable role of the pharmacist in educating and empowering the population.

More than 95 % of participants expressed satisfaction with the vaccine administration process in pharmacies, mirroring the positive outcomes observed in other countries and in recent German pilot projects for COVID-19 vaccinations in community pharmacies [33,34]. This high

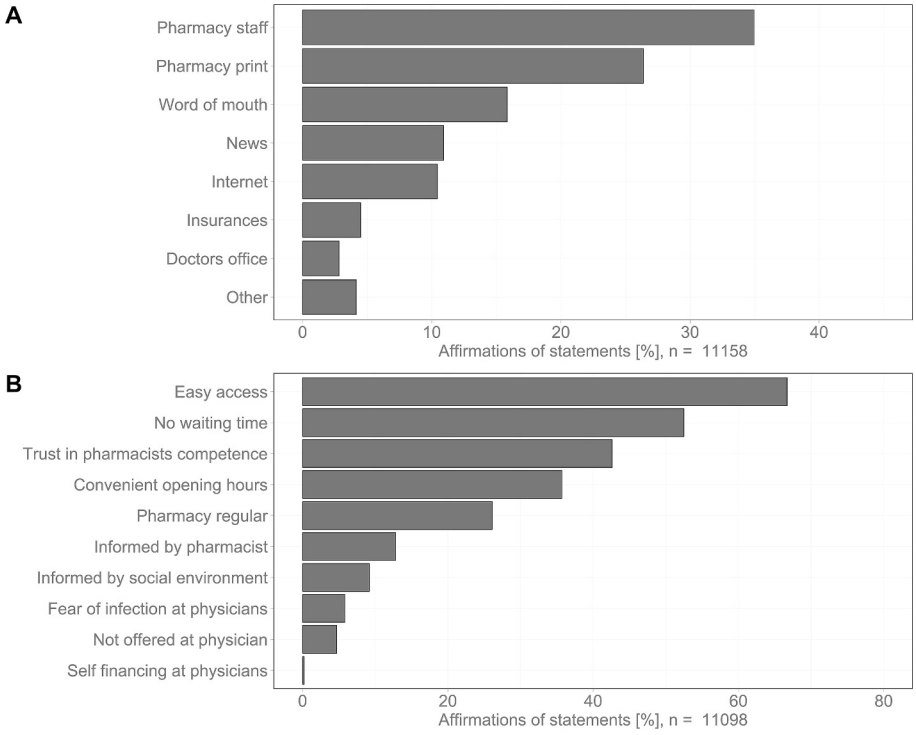

Fig. 5. Source of information and motivations for choosing community pharmacy-based vaccinations. (A) Distribution of participants by the sources from which they learned about the pharmacy vaccination option. (B) Breakdown of participants by their stated motivations for opting for vaccination in a pharmacy. Corresponding data is listed in Table S3. The number of clients who answered the respective question is indicated by n.

level of satisfaction was coupled with a strong willingness for future vaccinations in the same setting, exceeding 95 % among participants. This trend was not only consistent for repeated influenza vaccinations but also showed an increasing acceptance of receiving other types of vaccinations in pharmacies. The study found minimal negative sentiments regarding both satisfaction and willingness to repeat vaccinations, with these attitudes remaining consistent across various demographics and participating German states. These findings are also in accordance with several studies in other countries that reported on the positive opinions of vaccinees regarding pharmacist led vaccination efforts [28,35,36]. Significantly, high satisfaction levels and the willingness to repeat vaccinations are key indicators of positive past vaccination experiences and trust in the healthcare provider. Given that lack of trust can severely hinder vaccination programs, the findings of our study suggest that pharmacy-led initiatives could play a crucial role in strengthening public confidence in vaccination programs in Germany.

The average duration for vaccine administration, including informed consent, was 12 min. This duration aligns with existing literature, which reports vaccination times ranging from 5 to 30 min depending on the vaccination site [37]. Notably, there was a marked decrease in the required time for vaccination over the course of the three seasons, from 15 min initially to 11 min by the end. This reduction suggests that as pharmacy-led vaccination programs become more established, they are likely to achieve greater efficiency and predictability. The increasing speed of vaccine administration without compromising quality or client education is a promising indicator for the scalability and effectiveness of these programs in wider healthcare settings.

While some German medical associations have expressed reservations about pharmacy-led vaccinations, primarily due to concerns about safety and pharmacists' competency in administering vaccinations, the findings of our study showed that pharmacy-led immunization interventions are safe. Furthermore, there is some concern regarding increased occurrence of shoulder injury related to vaccine administration (SIRVA) in a pharmacy setting [38]. SIRVA is a much discussed preventable adverse vaccination reaction with heterogenous clinical representation [39]. Pharmacists taking part in this study had to undergo special training before vaccination to ensure vaccination safety, as similarly required in other countries [40].

Dedicated studies investigating the occurance of SIRVAs in pharmacy settings are rare. Work of Hibbs and colleagues hinted at a potentially increased risk of SIRVAs when not administered by a trained physician (e.g. pharmacies and retail stores in the United States) [41]. In our study no cases of SIRVA were documented. Among the 11,571 vaccinations administered during our project, there were 9 instances (0.08 %) reported as acute serious vaccination reactions. This rate appears higher when compared to the findings of Vellozzi et al. [42], who reported serious adverse reactions to influenza vaccines at a rate of up to 0.0004 % in the US between 1990 and 2005. However, it is important to note that none of these nine incidents in our study necessitated additional emergency measures such as in-house medical interventions or emergency services, which was a survey questions checked for all 9 of these cases. Additionally, no further comments were made about the adverse reaction, other necessary medical intervention or resulting problems. This suggests that these cases might be more accurately classified as an incorrectly ticked answer or a non-severe adverse reaction, potentially influenced by heightened sensitivity towards vaccination reactions. This interpretation, along with the absence of serious medical interventions, underscores the overall safety of pharmacy-administered influenza vaccinations in our study. This is also in line with other studies in various countries that also showed a positive safety profile of pharmacy administered influenza vaccines [43,44].

4.1. Limitations

This study's primary limitation is the heterogeneity in data collection methods. Due to the state-based management of the study by healthcare providers and pharmacist associations, there was variability in questionnaire design and implementation. Some states included additional queries, while others limited data collection to one or two of the three seasons. Moreover, not all states implemented vaccination projects

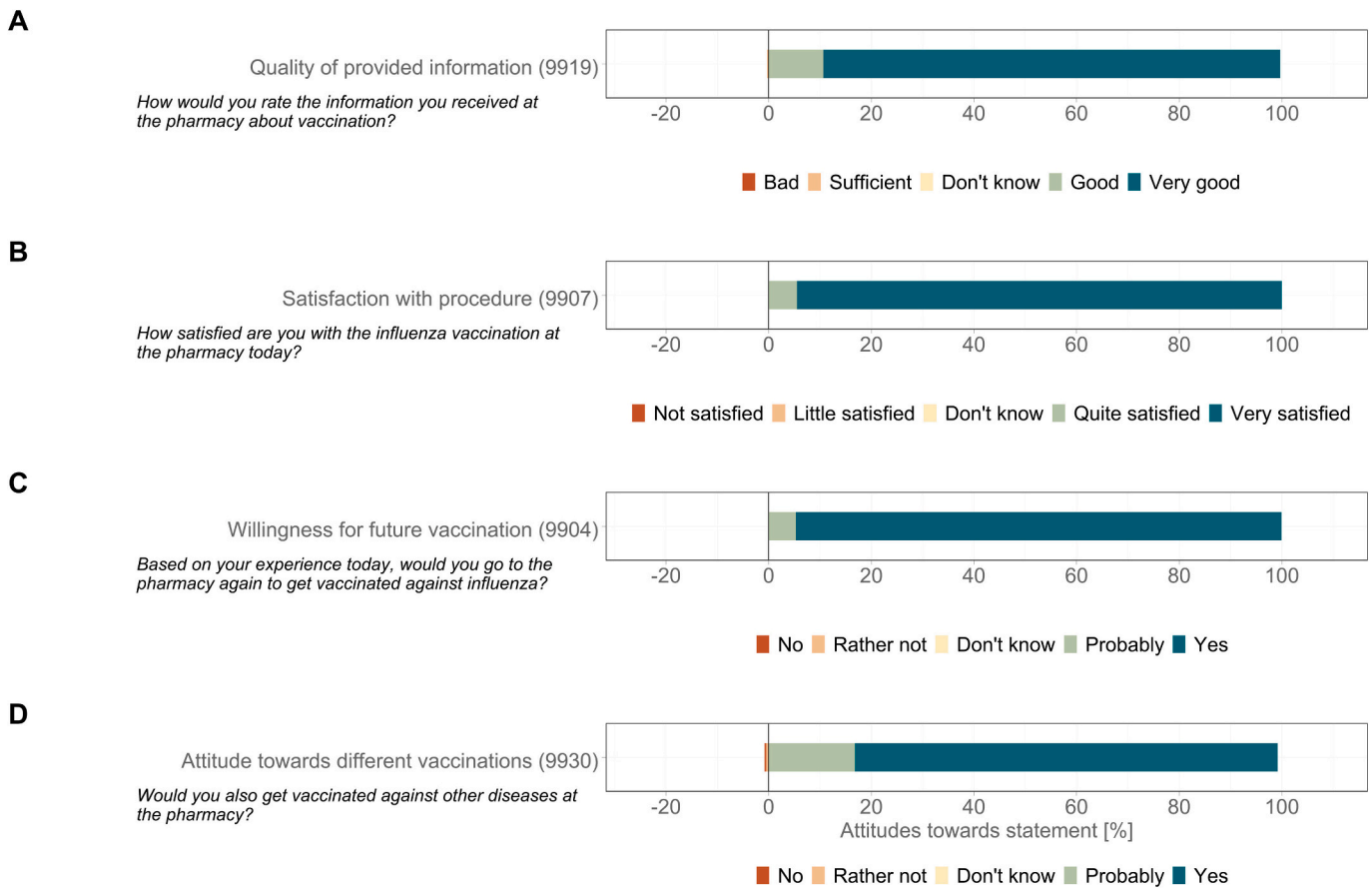

Fig. 6. Attitudes towards the received vaccination and the pharmacy as a unique vaccination site. Responses were measured on a Likert-like scale. Response options to each likert element are shown in the plot legends. The colour-coded bars display the percentage of participants selecting specific responses, centered on the Likert scale's midpoint. The illustrated questions assess participants' satisfaction with the provided information (A), the overall procedure (B), their willingness to repeat influenza vaccination in a pharmacy (C), and their openness to vaccinations against other diseases in a pharmacy context (D). The full text of the respective question is displayed in italics as part of the respective y-axis description. The number of client who answered each element is given in parentheses. Corresponding data is listed in Table S3.

uniformly across their regions, potentially affecting representativeness. Another significant limitation is the inherent selection bias, as both clients and pharmacists volunteered to participate. This could mean that the study sample may not accurately represent the broader population but rather a subgroup with a pre-existing inclination towards pharmacy-led vaccinations. Response bias is also a concern, as the questionnaires were completed post-vaccination in the presence of the vaccinating pharmacists. Moreover, our study acknowledges a limitation related to the percentage of missing responses for some questions, which exhibit a non-response rate exceeding 5 %. Notably, these include questions regarding indications for vaccination (10 %), potential future vaccination sites (14.6 %), evaluation of the information provided (14.2 %), satisfaction with the vaccination procedure (14.4 %), interest in future vaccinations within a pharmacy context (14.4 %), and interest in other vaccination programs offered by the pharmacy (14.2 %). Given that these missing responses range from 10 % to 14.6 %, there is a potential for introducing a non-response bias. This should be considered when interpreting our findings. This might have led to more favourable responses due to perceived social pressure or a desire to provide positive feedback. Finally, given the rarity of severe adverse reactions post-vaccination, our study was not statistically powered to definitively assess the frequency of such events. As a result, the study may not have captured sufficient data to conclusively evaluate the occurrence of serious adverse reactions, which are statistically unlikely given the number of vaccinations administered.

5. Conclusion

This study represents the most comprehensive evaluation of vaccinations in community pharmacies within Germany to date. Individuals vaccinated by a pharmacist demonstrated a high willingness to utilize these services again in the future, primarily attributing their choice to the convenient access provided by community pharmacies. Furthermore, our data highlights substantial satisfaction with the vaccination process and an increase in the number of first-time influenza vaccinations, emphasizing the role of pharmacy-based services in enhancing vaccine uptake and accessibility. While severe adverse events are rare and our study was not powered to detect them, our findings contribute insights into the overall safety of vaccinations in this setting. This aligns with the growing evidence supporting the safe administration of vaccinations in community pharmacies. In summary, influenza vaccinations in community pharmacies have been well-received and could serve as a valuable tool to enhance both the acceptance and accessibility of influenza vaccinations for the wider public and specific at-risk demographics. While the legal framework for pharmacy-based influenza and COVID-19 vaccinations has recently been established, considering the expansion of vaccination services offered by pharmacies is warranted, given their proven low-barrier and safe service provision.

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CRediT authorship contribution statement

Quirin Werthner: Writing – review & editing, Writing – original draft, Visualization, Validation, Software, Methodology, Investigation, Formal analysis, Data curation. **Laura Faehrmann:** Writing – review & editing, Funding acquisition. **Katharina Och:** Writing – review & editing, Validation, Software, Conceptualization. **Nicola Luigi Bragazzi:** Writing – review & editing, Methodology. **Martin Johannes Hug:** Writing – review & editing. **Jona Stahmeyer:** Writing – review & editing, Conceptualization. **Birte Burger:** Writing – review & editing. **Cosima Bauer:** Writing – review & editing. **Dominik Selzer:** Writing – review & editing, Writing – original draft, Visualization, Validation, Methodology, Data curation. **Oliver Schwalbe:** Writing – review & editing. **Uwe May:** Writing – review & editing, Funding acquisition, Conceptualization. **Thorsten Lehr:** Writing – review & editing, Writing – original draft, Supervision, Resources, Project administration, Funding acquisition, Conceptualization.

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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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.vaccine.2024.126650.

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