

Diverse roles of Primary Health Care in COVID-19 vaccination across 28 European countries – Insights from the Eurodata study

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Diverse roles of Primary Health Care in COVID-19 vaccination across 28 European countries – Insights from the Eurodata study

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KEY MESSAGES

1. Primary Health Care (PHC) professionals, especially nurses and General Practitioners, played a pivotal role in the effective distribution and administration of COVID-19 vaccines in Europe.
2. PHC participated in communication strategies in some countries.
3. Disparities in vaccine availability and prioritisation groups were found across Europe.

ABSTRACT

Background: The COVID-19 vaccination campaign in several European countries involved collaboration between public health and Primary Health Care (PHC).

Objective: To highlight the role of PHC professionals in the COVID-19 vaccination rollout, specifically in terms of vaccine administration, communication and contributing to vaccination population coverage.

Methods: A descriptive retrospective study of the COVID-19 vaccination campaign across 28 European countries was conducted, covering data from December 2020 to November 2021. Data were collected by key informants recruited from each country, who were health professionals involved in their national vaccination campaigns. Utilising an ad-hoc semi-structured questionnaire, information was gathered on organisation, communication strategies, priority groups, vaccine types, and vaccination pathways in PHC.

Results: PHC participated in communication strategies in 10 out of 28 countries, and vaccination was voluntary in most of them. The priority groups for vaccination varied across Europe, and the availability of vaccines in PHC differed between countries within the European Union (EU) and non-EU countries. The BioNTech Pfizer vaccine was the most widely available vaccine in most countries, followed by Moderna and AstraZeneca. PHC administered COVID-19 vaccines to the population, being the nurses the most involved, followed by general practitioners. Vaccination appointments were available online in 18/28 or by phone in 15/28, direct appointments at health centres were available in 8/28. In several countries, healthcare professionals who administered vaccines were given extra compensation for their role.

Conclusion: PHC professionals played a crucial role in the successful distribution and administration of COVID-19 vaccines in European countries.

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COVID-19 vaccines; primary health care; vaccination program; vaccine hesitancy; vaccination coverage

Introduction

The development and distribution of COVID-19 vaccines significantly altered the pandemic's trajectory, proving effective and safe in reducing spread, mortality, and long-term effects [1]. According to WHO Europe, the first year of the vaccination campaign saved nearly half a million lives among those over 60 [2]. However, vaccinating the entire adult population posed challenges for European health systems [3], despite administering 975 million doses by May 5, 2023 [4]. The EU centralised vaccine procurement, but individual countries developed varied strategies [5], influenced by vaccine availability, cultural, geographic, economic factors [6], and hesitancy [7]. To ensure program success, WHO recommended urgent vaccination of high-priority groups, expanding to achieve herd immunity [6]. Emphasising equitable vaccine distribution, WHO urged increased investment in research for new, durable vaccines.

Primary Health Care (PHC) plays a crucial role in Europe by promoting health and preventing diseases, including through vaccination efforts. When individuals visit a primary care physician, they are more likely to receive evidence-based preventive care interventions that enhance health outcomes and reduce healthcare expenses [8].

Moreover, PHC facilities are easily accessible to the entire population, including vulnerable groups, making them key players in vaccination programs [9]. Research has shown that individuals who trust their General Practitioners (GPs) are more likely to be vaccinated [10], and interventions carried out by GPs have already increased vaccination rates in certain communities [9,11].

Although there is limited knowledge about the specific involvement and the role of PHC in the COVID-19 vaccination efforts in Europe, at least one European study has explored the effectiveness of vaccination in PHC [12]. The WHO has also recommended improving access to COVID-19 vaccines by implementing flexible delivery models in GP practices [6]. Therefore, the aim of this study is to describe the role of PHC in the implementation of the COVID-19 vaccination program during the first two years of the pandemic with a focus on comparing vaccination the patient pathways across 28 European countries, identifying both similarities and differences.

Methods**Study design**

This study employed a descriptive approach using retrospective data during spanning from December 2020 to

November 2021 across 28 European countries. Data collection took place in 2022. This study is part of the Eurodata study, which aims to investigate the role of PHC during the COVID-19 pandemic in Europe [13,14]. The research team in this study consisted of six specialists with expertise in family medicine, preventive medicine, and public health.

Participants

The study included 28 countries from Europe continent and associated with the European General Practice Research Network (EGPRN) and the World Organisation of Family Doctors (WONCA) Europe countries affiliated: Austria, Belarus, Belgium, Bosnia and Herzegovina, Bulgaria, Croatia, France, Germany, Greece, Hungary, Ireland, Israel, Italy, Latvia, Lithuania, Luxembourg, North Macedonia, Poland, Portugal, Romania, Serbia, Slovenia, Spain, Sweden, Switzerland, Turkey, Ukraine and United Kingdom (UK). A project presentation was conducted at the EGPRN meeting in October 2021, and all the attendees were invited to participate. The main inclusion criteria were either being a GP or having a background in PHC or public health and having collaborated with PHC at some point in their career. All participants had to be involved or associated with COVID-19 vaccination efforts in their respective countries during the campaign.

Questionnaire

A semi-structured questionnaire was built based on the WHO guidelines [6,15], and guidelines including the EU ones [16–18]. The questionnaire consisted in 6 sections: national organisation of the COVID-19 vaccination, the general campaign, the PHC participation in the vaccination side effects (advice and providing care) and information system, COVID-passport as detailed in Supplement 1. While one section specifically focused on the role of PHC, the overall aim of the questionnaire was to capture the diversity in COVID-19 control strategies across different countries.

The questionnaire underwent two rounds, with comments and feedback from all researchers. In October 2022, a consensus was reached after incorporating all into a new version. During the second round, agreement was achieved.

Data collection by key informants

To ensure the collection of reliable and relevant information, we provided recommendations to each key-informant on how to gather data from official sources. Additionally, an open question was included

in each section of the questionnaire, allowing key-informants to provide clarifications or indicate if certain information was unavailable.

For the collection of national data, we requested at least two key-informants from each country to provide information about their vaccination campaigns conducted between December 2020 and November 2021. The key-informants were health professionals, proficient in English and served as lead researchers in their respective countries during the campaign. Most participants worked in general practice, except for those from Lithuania and Belgium, who also worked in the field of public health during the study period. The EGPRN is an organisation comprising professionals from various disciplines, including PHC, who engage in medical research. WONCA Europe is a European organisation that represents the national associations of family doctors. The key-informants were asked to specify the sources of information they consulted, which were categorised as follows: official websites of the Ministry of Health of the different European countries, other governmental websites, insurance companies' websites, family physician associations' websites, or another sources (with an option to explain in free text). Please refer to Supplement 2 for the list of sources that were consulted.

Data validation and analysis

To ensure data quality, two national key-informants reviewed the information received from each country. If the information collected was unclear, key-informants were contacted to provide further details to complete the initial data. Any disagreements were thoroughly discussed among the core team and key-informants to reach a consensus.

For data analysis, the responses were coded as follows: Quantitative data, such as yes/no responses, were coded directly into binary categories. For qualitative data, which included open-ended responses, thematic analysis was conducted. These responses were synthesised and simplified to capture the essence and unique characteristics of each country's approach. The qualitative data were then presented as free text in the tables to ensure that the specific details and variations between countries were preserved.

Results

Participation of PHC for promoting COVID-19 vaccination campaign

The involvement of PHC in the communication campaign aimed at promoting COVID-19 vaccination was observed in several countries, namely Austria, Belarus,

Bosnia and Herzegovina, Bulgaria, Croatia, France, Greece, Ireland, Italy, Latvia, North Macedonia, Slovenia, Spain, Switzerland and Ukraine (Table 1). In most of these countries, various methods were employed to encourage vaccination, including public campaigns, SMS messages, postal mail, and distributions of leaflets. In Croatia and Switzerland, family doctors personally contacted priority groups via phone to extend the vaccination invitation. Slovenia adopted a similar approach, using SMS messages and web pages. In Israel, Pop-Ups were incorporated into the electronic medical record as reminders for family doctors or nurses to invite the patient for vaccination. In some countries, as Portugal and Ukraine employed family doctor consultations as a means to promote vaccination among elderly people. For information regarding the specific national authorities responsible for vaccination, please refer to Supplement 3.

Despite the benefits of vaccination, there were drivers of low vaccination in all countries (Table 1). To target these vaccine-hesitant population groups, new communication campaigns were launched. In this second pro-vaccination communication campaign, PHC participated in Austria, Belarus, Bulgaria, Croatia, Greece, Israel and Italy. In Austria, Belarus, Belgium, Greece, Ireland, Latvia, Lithuania, North Macedonia, Poland, Romania, Slovenia, Sweden and Turkey PHC took part in activities that facilitated spontaneous vaccination. Lithuania introduced a GP's bonus scheme, offering one-off payments of €100 per vaccination to elderly people as an incentive for them to receive a booster dose of the vaccine. Vaccination was particularly promoted during primary care consultation in Austria, Belarus, Croatia, France, Greece, Hungary, Italy, Latvia, Lithuania, Poland, Romania, Spain and Turkey. COVID-19 vaccination coverage with 2 doses during the period time has been represented in Figure 1. High coverage, considered has $\geq 80\%$ population vaccine, was achieved in Belgium, France, Germany, Ireland, Italy, Spain, Sweden, Switzerland, Turkey and UK (Figure 1 and Table 2).

Strategies and measures for increasing vaccine uptake after the initial roll-up

Vaccination was mostly voluntary, with a few exceptions. In Austria, it was mandatory for a month for the whole population, and in Poland, it was mandatory for some critical workers but in both countries was not really executed. In Latvia, it was required for certain populations working in direct contact with people (healthcare workers, teachers, shop assistants, public transportation drivers, catering service employees, and

beauty service providers) for nearly the first year of the campaign. In Germany, Greece and Hungary, Italy and Ukraine, it was mandatory for certain groups (Table 3). In Greece people over 60 years old had a 100 euros fee monthly if they were not vaccinated [19]. The priority groups for vaccination are described in Table 3. The categories of prioritisation were similar across Europe, but the specific groups prioritised varied among countries.

The availability of vaccines in PHC differs between countries within the EU and those outside of it (Table 4).

Vaccination pathway in PHC

PHC participated in organising the administration of the vaccine to the population in all countries, with the exception of Luxembourg and North Macedonia where the participation of family doctors was voluntary (Table 5). Vaccination appointments could be obtained online in 21 countries, by phone in 17 countries, or directly at the health centre in 9 countries. All countries, except for Ukraine, had established a special vaccination protocol. In Europe, nurses (26 countries) and GPs (23 countries) were the most common professionals responsible for administering vaccinations. However, other professionals such as pharmacists, students, administrative staff, midwives, and physiotherapists also participated. PHC facilities not only organised and administered vaccines but also managed the critical logistics required to maintain vaccine integrity. This included ensuring the cold chain was maintained throughout the process, adhering to specific temperature requirements for vaccines such as -70°C for Pfizer-BioNTech and -20°C for Moderna. The organisation of the cold chain was meticulously handled, with no reported limitations in administering the vaccine across different PHC settings. This attention to detail ensured that vaccines were delivered safely and effectively to the population.

The safety protocol before and after vaccination, as well as the waiting times for possible side effects, varied across different countries. In the event of any adverse effects following vaccination, patients were attended by nurses, GPs, or Accident and Emergency (A&E) doctors. Notably, in France, every person administering the vaccine must have an adrenaline injection available in case of anaphylaxis.

Healthcare professionals who administered vaccines received extra compensation for performing this task in Austria, Belarus, Bulgaria, France, Greece (private doctors), Ireland, Italy, Lithuania, Luxembourg, Ukraine (only those

Table 1. Strategies to promote vaccination, drivers of low vaccination, involvement of primary health care and how patients were invited to participate in the campaign in 28 European countries.

Country	Communication strategy to promote vaccination from authorities to general population	How patients were invited to participate	Drivers of low vaccination	Strategies and measures for increasing vaccine uptake after the initial roll-up	PHC involvement in strategies to increase vaccine uptake
Austria	Mass media/ official websites/ PHC	First target group: a letter from the social health insurance. Next groups: public campaign, healthcare workers via employer	Mistrust in the vaccine, conspiracy theories, anti-vaccine groups	National campaign, vaccine promotion by GPs, improving the access to vaccination, COVID-19 passport for indoor activities.	Participation in vaccination buses and vaccination centres or spontaneously in PHC, GP practices
Belarus	Mass media/Experts/PHC	Information in practices and mass media	Low risk perception in young people	National campaign, vaccine promotion by GPs, improving the access to vaccination.	GP practices, supermarkets vaccination centres
Belgium	Mass media/ Websites from Healthcare authorities ⁶	Letter, e-mail and SMS if you registered yourself in an online platform	Disadvantaged socioeconomic groups (with lower levels of income and education, unemployed), one-person households, young individuals, migrants, male individuals, Δ conspiracy theories	Social media/ mass media Contact points to increase vaccination (streets, malls, etc.), vaccine promotion through community-based associations	Campaigns in mass media to reach young people. Easy locations to get vaccinated, mobile teams in vulnerable population, vaccine centres without appointment, vaccination during home visits for immobile people
Bosnia and Herzegovina	Websites/Vaccination points/PHC	Public campaign	Anti-vaccine groups, low risk perception in young people	Social media: TV national campaign	No PHC involvement
Bulgaria	Mass Media/PHC	Public campaigns and at local level	Mistrust in both the virus and vaccines, low perception of risk, fear of the Astra-Zeneca vaccine after the report side effects. Conspiracy theories via social media.	Non-stop campaign, social media and GP, COVID-19 passport for social activities	Vaccination in the community
Croatia	Mass media/Experts/PHC	Public campaigns, phone calls by GP	Inconsistencies in the implementation of the agreed activity plan, Anti-vaccine groups	National PR campaign ⁵ , vaccine promotion by GPs	National PR campaign, focused activities by GPs
France	Mass media/PHC	Public campaigns, letters from National Health Fund	Anti-vaccine groups among yellow jacket movement, upper sociodemographic status, mistrust in the vaccine and theories of conspiracy	Social media: TV national campaign	Promotion of vaccination in the GP offices and at patient's homes together with nurses and GP trainees, positive role model
Germany	Mass media/Experts	High risk group via letter by the insurance. Public campaign	Far right political party promoted a negative opinion on Eastern migrants, conspiracy theories	Raise awareness, multilanguage information, vaccination teams in areas of low coverage, COVID-19 passport for social activities	Social media campaign, vaccinations in the community, and offering some kind of bonus (e.g. Food)
Greece	Mass media/Daily press conference/Pharmacies/ Experts/ PHC/Punitive laws for HCW and people older than 60-year-old	SMS	Mistrust in the vaccine ⁸ , low risk perception in young people, conspiracy theories	National campaign, COVID-19 passport for social activities, freedom pass, financial incentives to GPs and pharmacists to promote vaccination, vaccine mandate for adults 60 years and older	GP practices, home vaccinations for immobile patients, offering bonus for young people
Hungary	Mass media/ Daily press conference/ Experts	Registered patients in PHC: Phone/Mail	Low risk perception in young people, Low sociodemographic status	Patients registered in PHC were invited to participate, mass vaccination in schools. COVID-19 passport for social activities. No appointment needed in November 2021, Direct call to priority groups	PHC phoned the target population to offer the vaccination
Ireland	Mass media/ PHC/Pharmacies/ Citizens Advice Bureau from the government office	Registered patients in PHC: SMS/ Mail, public campaign, the immunocompromised were invited at the hospitals through their specialist clinics	Anti-vaccine groups, COVID-19 passport for social activities, a big demonstration against the vaccination in November 2021	Social media campaign which involved PHC	Participation in the vaccination centres
Israel	Mass media/ Healthcare professionals/ Call centre from Ministry of Health	Public campaigns, SMS from the HMO ⁶ Pop Ups in the PHC electronic medical record	Religious reasons in some groups (Muslims, Bedouins, Ultra-Orthodox Jewish people)		Participation in social media

(Continued)

Table 1. Continued.

Country	Communication strategy to promote vaccination from authorities to general population	How patients were invited to participate	Drivers of low vaccination	Strategies and measures for increasing vaccine uptake after the initial roll-up	PHC involvement in strategies to increase vaccine uptake
Italy	Mass media/PHC	Invitation letter, SMS, e-mail, public campaigns	Anti-vaccine groups	Virologists on TV explaining the benefits, GP invited elderly and frail population to be vaccinated in PHC	Participation in social media, bonus to patients who vaccinated, important role in offering boosters.
Latvia	Mass media/PHC	SMS	Mistrust in the vaccine, misinformation on social media, anti-vaccine groups	Mandatory requirement in all professions with direct contact with people. Not available medical services if the patient was not vaccinated. COVID-19 Passport needed to access general services	GP practices as the main vaccination point for patients. PHC workers as direct informers to solve patient's doubts
Lithuania	Website Corona stop	SMS, public campaigns	Mistrust in the vaccine, fear of side effects	National campaign, improving access to vaccination, COVID-19 passport for indoor activities, bonus of one-off payments of €100 per vaccination to elderly for complete full vaccination or for uptake of a booster dose of vaccine ⁶	Participation in vaccination centres, GP practices, mobile teams, transport support or vaccination at home for immobile patients
Luxembourg	Mass media	Invitation letter by mail, Staff in hospital and nursing homes were offered vaccination during campaigns at home, healthcare workers: e-mails from the hospital	Misinformation on social media, mistrust in the vaccine (including some healthcare professionals), anti-vaccine groups.	COVID-19 passport for social activities (unvaccinated persons had to get tested before), vaccination points in supermarkets/shopping centres. Infectiologists in the news to promote vaccination, restrictions to travel, move inside the country, even to work for unvaccinated	Mobile vaccination teams, social media campaigns, several Q&A Facebook live sessions with patients.
North Macedonia	Mass media/SMS/PHC	SMS for eligible, public campaigns	Misinformation on social media, conspiracy theories, fear of side effects, hesitation from healthcare professionals regarding the vaccine, low health education for understanding the benefit of vaccination.	UNICEF campaigns (video spots on TV and social media), social media campaigns, SMS by the Ministry of Health	Mobile vaccination to elderly homes, mobile caravan in regions with low vaccination rate, social media supported by USAID, UNICEF, mobile remainder through MyTerm (health electronic information system) to high-risk groups for boosters
Poland	Mass media/PHC, Websites, Information from Healthcare authorities	SMS, public campaigns	Anti-vaccine groups, mistrust in the vaccine (also very low rate for some other recommended vaccinations, e.g. flu or HPV vaccinations), populist messages against the vaccination from some politicians, misinformation on social media, social prejudice against vaccinations	Media campaigns with celebrities, financial incentives for successful vaccination rates in villages/rural areas, financial support for organising social events with the vaccination points**, mobile vaccination centres for remote areas, government lottery for vaccinated	Vaccinations centres in the PHC offices, also many PHC doctors leading the mobile vaccinations points, social campaigns, leaflets, and information at PHC offices, PHC and Family Medicine organisations involved in spreading information and encouragement in mass media
Portugal	Healthcare professionals, Media campaigns, Communication by health authorities	SMS from the NHS to schedule vaccination, book their vaccination in a website, no need to get an appointment from June/July 2021	Low levels of vaccine hesitancy.	National campaigns (social media), debates, leaflets, news coverage, individual counselling from healthcare professionals, no need to get an appointment for vaccination	Individual counselling from PHC professionals
Romania	Mass media	Public campaigns and through the online platform #ROVACCINARE	Anti-vaccine groups, low risk perception in young people, conspiracy theories	Social media campaigns, mobile caravans in villages/rural areas, vaccination marathons during the weekends	Vaccination marathons promoted by GPs who volunteered to vaccinate the population
Serbia	Mass media/Official websites/ Press conferences and Interviews with members of Ministry of health, epidemiologists, spec. of infectious diseases	Public campaigns, SMS	Anti-vaccine groups, misinformation on social media, low risk perception in young people, mistrust of the vaccination	Social media campaigns, TV campaigns and government incentives on media and newspapers, COVID-19 passport for social activities	No PHC involvement

(Continued)

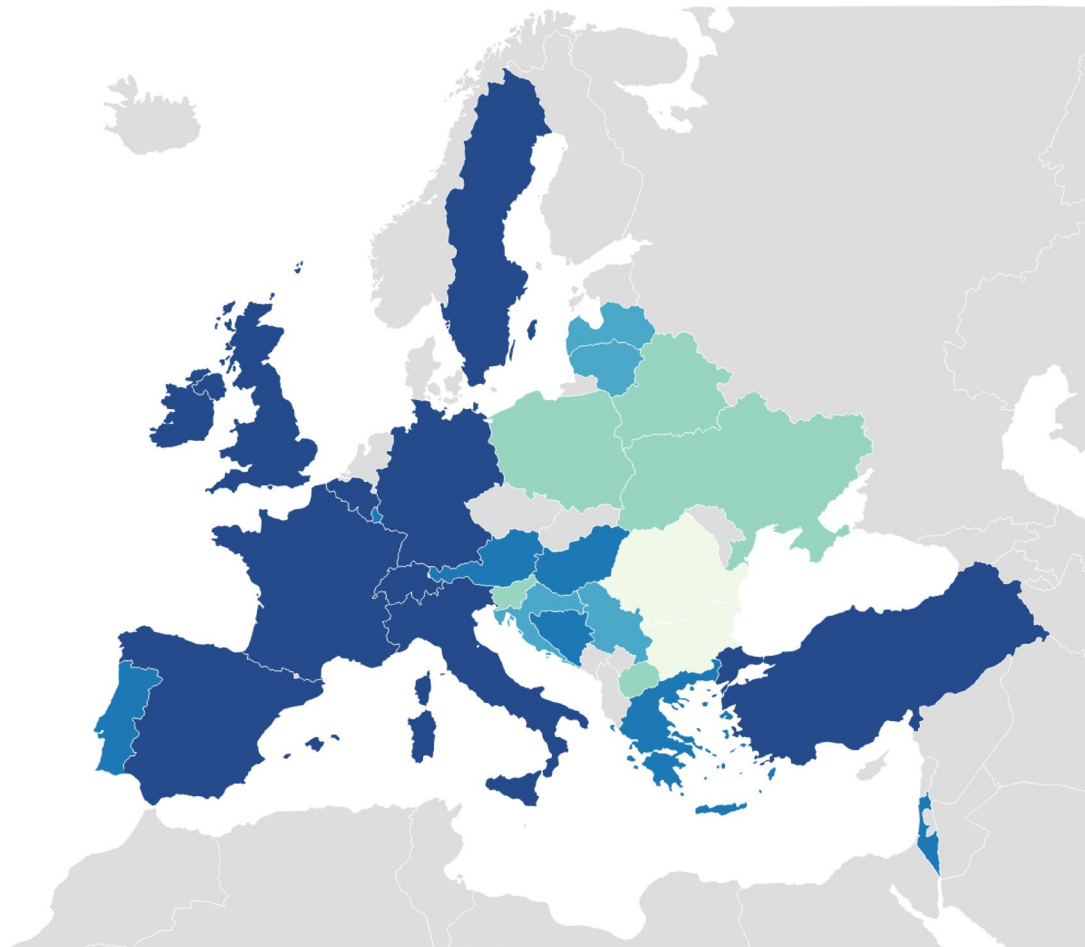
Table 1. Continued.

Country	Communication strategy to promote vaccination from authorities to general population	How patients were invited to participate	Drivers of low vaccination	Strategies and measures for increasing vaccine uptake after the initial roll-up	PHC involvement in strategies to increase vaccine uptake
Slovenia	Mass media/ Press conferences and Interviews with members of Ministry of health, epidemiologists, spec. of infectious diseases, GPs/ PHC	Elderly and people with chronic disease were invited by their GPs (phone, SMS, information on web page), public campaigns	Anti-vaccine groups, low risk perception in young people, misinformation on social media, not being able to choose the type of vaccine.	Public vaccination of politicians, doctors shared pictures of themselves getting vaccination in their websites, Efforts to educate people about the vaccine, COVID-19 passport for social activities	Mobile teams – going to the communities, 'vaccine days' (24h vaccination). Most of the vaccination involved PHC.
Spain	Mass media/Official websites/ PHC	Public campaigns, SMS	Mistrust, misinformation and low perception of risk in young people.	Vaccinations teams (sports centres, football stadiums), social media campaigns. Increasing availability of vaccination appointments in health centres.	Individual counselling from PHC professionals
Sweden	Recommendations from Public Health Agency	There were both invitation letters (digitally and by mail) and public campaigns.	There was a difference in vaccination rate noted in different populations. to dissolve fake news etc.	Targeted information campaigns were carried out in these population areas. Mobile vaccination efforts with buses aiming to encourage and motivate vaccination in some areas.	Both mobile buses and pop-up vaccination teams involved the PHC.
Switzerland	Campaign Swissmedic/ Information for PHC professionals -Cantons: for PHC professionals and patients	Different approaches per county (cantons): mail letter, registration in a web platform to be invited. GPs directly contacted their at-risk patients	Misinformation, fear of side effects.	Social events to promote vaccination including concerts, a special 'vaccination week', vaccination counselling with translation services and mobile vaccination centres	PHC were asked to produce videos for social media etc giving testimony that the vaccination is available and the best choice
Turkey	Mass media/Press conferences	Public campaigns and SMS	Misinformation on social media, mistrust in the vaccine (including some healthcare professionals), anti-vaccine groups.	Social media, SMS from the Ministry of Health, leaflets at hospitals, bus stations etc.	GP practices, easy locations to get vaccinated in Turkey, mobile teams in crowded places especially centre of cities. Home vaccinations for immobile patients, warnings from mobile app
Ukraine	Mass media/PHC/ONGs	People asked for appointment by themselves or were sent from work. Older people were persuaded at GPs' appointments	Misinformation on social media, mistrust of the vaccine.	Speeches of public figures, trainings for doctors, media stories	
United Kingdom	Mass media/Healthcare workers/ Leaflets in vaccination points	Public campaigns	Fear of side effects, mistrust in the vaccine.	Social media, stickers to say you are vaccinated in your items, COVID-19 passport for social activities	GPs settings were used to do vaccination sessions

PHC: Primary Health Care. **Experts:** A recognised key opinion leader with background in medical sciences who can be linked to a national organisation or not. **Mass media:** Mass media includes newspaper, radio, television, web sites, social media platforms. **SMS:** Short message service in a mobile phone. **Social activities:** Events with groups of people, visiting indoors spaces where social interaction happens (restaurant, café, bar, etc.).
 Δ Cavillot L, Van Loenhout J, Catteau L, Van den Borre L, De Pauw R, Blot K, et al. COVID-19 vaccination uptake in Belgium: socioeconomic and sociodemographic disparities. Eur J Public Health. 2022 Oct 21;32(Supplement_3).
 α: Healthcare authorities were Scienciano (Belgium Institute for Health), Healthcare providers including PHC and members of the government.
 β: PR is a national representative from the Croatian Public Health Institute to promote vaccination.
 X: Official religion leaders were in favour of vaccination but some local priest shared mistrust on the vaccines.
 δ: HMO: Healthcare Maintenance Organisation, organisation formed by the main insurance companies to provide healthcare in the country. All citizens are required by law to be affiliated with an HMO.
 ε: Seniors aged 75 and over who have received the full vaccination schedule between 1 September and 30 November, 2021, or a booster dose before 30 November.
 *Ministry of Health and Social Welfare (Republic of Srpska), Ministry of Health (Federation of Bosnia and Herzegovina) and Government of Brcko District of BiH Department of Health.
 ^Task Force on COVID-19 Vaccination is made up with senior representatives from the Department of Health, the Health Service Executive, the Health Products Regulatory Authority, the Office of the Government Chief Information Officer, the Office of Government Procurement, IDA Ireland, the Dublin Airport Authority, the Department of Enterprise, Trade and Employment and the Department of the Taoiseach.
 ***Mainly for the clubs of rural housewives and the fire departments in rural areas.

COVID-19 vaccination coverage, full regimen (2 doses)

< 38% 38%–52% 52%–66% 66%–80% ≥ 80%



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Figure 1. COVID-19 vaccination coverage of participant countries during the study period, full regime considered was 2 doses. *Legend:* The percentages varied among <38% as the minimum coverage of full vaccinated population to >80% as the maximum coverage of full vaccinated population. Data available in Table 2.

participated in the campaign, such as GPs, nurses and infectious disease specialists), and the UK (Local NHS commissioners, Primary Care networks, acting on behalf of a group of GPs and community pharmacies). Croatia, Israel, Portugal and Romania paid overtime hours.

Discussion

PHC actively participated in the initial COVID-19 vaccination communication campaign across 15 countries, with GPs taking a proactive stance in promoting vaccination in 13 of these countries. Subsequently, to sustain vaccination efforts beyond the initial rollout, PHC collaborated on communication campaigns and facilitated vaccination in 15 countries, with 7 countries involving PHC in the second campaign. The prioritisation of vaccination groups displayed heterogeneity

across all 28 countries, with the BioNTech Pfizer vaccine being the most widely available in PHC in Europe. The cold chain, essential for maintaining vaccine safety, did not pose a limitation to delivering COVID-19 vaccinations in PHC settings. The administration of the COVID-19 vaccine took place in 26 countries, primarily overseen by nurses and GPs. Most vaccination appointments were accessible either via phone or online booking.

Promotion of vaccination campaign

PHC, characterised by accessibility, first contact, continuity, and a wide range of services, plays an active role in executing the COVID-19 vaccination plan in Europe [15]. While the vaccination campaign relies on electronic dissemination of information, PHC has been instrumental in

Table 2. Population, number of COVID-19 doses administered and percentage of population with the vaccination.

Country	Adults over 19 years old	Number of administered first dose	Coverage of population with one dosage	Number of administered second dose	Coverage of population with second dosage
Austria Ψ	7,211,927	6,127,966	84.96%	5,380,025	74.5%
Belarus Ψ	9,302,285	6,331,049	68.0%	3,582,000	38.5%
Belgium Ψ	8,978,799	8,391,300	93.4%	7,769,778	86.5%
Bosnia and Herzegovina φ	1,128,309	882,641	78.2%	NA	NA
Bulgaria Ψ	5,603,296	1,884,438	33.6%	1,357,449	24.2%
Croatia Ψ	3,265,628	2,202,688	67.4%	1,804,815	55.2%
France φ	55,465,671	48,600,000	87.6%	47,200,000	85.0%
Germany Ψ	67,820,457	58,200,000	85.8%	54,900,000	80.9%
Greece Ψ	8,619,596	6,933,651	80.4%	5,976,966	69.3%
Hungary Ψ	7,825,789	5,785,043	73.9%	5,323,848	68.0%
Ireland φ	4,963,363	NA	NA	4,650,671	93.7%
Israel φ	9,374,700 τ	6,356,827	67.8%	NA	NA
Italy $\varphi\epsilon$	48,742,655	47,700,000	97.8%	42,300,000	86.7%
Latvia Ψ	1,499,680	1,211,512	80.7%	874,802	58.3%
Lithuania φ	2,246,034	1,807,243	80.46%	1,469,198	65.41%
Luxembourg Ψ	500,264	407,808	81.5%	354,653	70.8%
North Macedonia $\varphi\epsilon$	1,620,357	845,282	40.9%	806,135	39.0%
Poland Ψ	37,840,001	17,665,721	46.6%	NA	NA
Portugal θ	8,379,183	9,788,002	94.7%	7,054,573	68.1%
Romania Ψ	15,147,774	75,893,40	50.1%	5,489,849	36.2%
Serbia φ	5,533,739	NA	58.2%	NA	NA
(Official press release)					
Slovenia Ψ	1,697,299	1,161,268	55.06%	961,332	45.5%
Spain Ψ	38,201,070	35,900,000	93.9%	31,000,000	81.1%
Sweden $\lambda\epsilon$	7,964,921	14,702,588	89.68%	14,405,584	88.24%
Switzerland φ	6,995,893	NA	NA	5,827,848	83.3%
Turkey θ	59,248,191	56,360,977	90.80%	50,632,985	81.57%
Ukraine $\varphi\epsilon$	33,237,520	16,350,375	49.1%	15,201,112	45.7%
United Kingdom ϵ,η	67,025,542	40,202,543	90.4%	38,180,280	85.9%

NA: Not available.

Ψ : Data was obtained from Eurostat (2021) and ECDC (2021).

φ : Data obtained from national sources quoted at Supplement 2. Data from 2011 census published in the 2021 Municipalities and regions of the Republic of Serbia.

ϵ : Data from the whole population was obtained from Eurostat.

θ : Data was obtained by WHO website updated 11 June 2023 from all age groups.

τ : Data was obtained from the World bank website quoted at Supplement 2.

λ : Data was obtained by official Swedish source which include accumulative vaccination till 20 January 2023.

η : Data was obtained by official English source including the percentages of vaccination.

promoting vaccination within communities [18]. The literature review indicates varying vaccine acceptance rates globally, with the lowest rates (<60%) in some European countries like Italy (53.7%), Russia (54.9%), Poland (56.3%), and France (58.9%) [20]. In contrast, our results reflect Italy and France has high coverage of COVID-19 vaccination with 2 doses, 85.0% and 86.7% respectively (Figure 1 and Table 2). Differences might be related with conceptualising rate acceptance and real vaccination action. Despite challenges, PHC's active participation in multiple activities post-initial campaign launch underscores the need for coordinated campaigns across all healthcare levels [8]. Involving PHC in the planning stages helps anticipate potential roadblocks, ensuring a more effective and streamlined vaccination process.

Increasing vaccine uptake

Among the measures to increase the vaccinated population, mandatory vaccination stands out, which was implemented in 8 countries. The case of Austria is noteworthy, where the mandatory vaccination for the

entire population failed to be implemented [21], and the regulation did not lead the country to achieve a coverage similar to other countries in its surroundings such as Germany, Switzerland, or Italy (Figure 1). Although, most of these countries implemented only in essential workers or high-risk populations. This approach is already controversial in the general population [22,23] but also among healthcare professionals who support mandatory vaccination in their own group in 64% (95% CI: 55%, 72%) and in 50% (95% CI: 38%, 61%) for the general population [24]. Furthermore, in childhood vaccination, there is no data supporting that coercive measures increase vaccine coverage [25]. This leads us to suggest that the role of family doctors [26], exercising the values of person-centered care, equity of care, continuity of care, and community-oriented approach, can be useful in reaching these populations. Instead of enforcing mandatory vaccination, offering evidence-based answers, building trust and fostering empathy can assist those hesitant about vaccination [25,27], as well as, helping individuals to deal with anxiety and lack of control [28].

Table 3. Priority groups for vaccination and the order number of prioritisation in 28 European countries.

Country	Age > 80 yo	Age >75 yo	Age >60 yo	Adults 18-65 years	Health Care workers	Residents in LTCF	Chronic conditions	Another prioritisation
Austria	1	1	2	3	1 (depending on setting)	Depending on age and chronic conditions	1	2: All other HCW, chronic conditions also depending on age and severity, teachers. 3: Critical workers
Belarus	2	2	2	4	1	1	4	3: Critical workers
Belgium	2	2	2	3	1	1	3	1: Interventional police crew 3: People working and living in correctional facilities; para-Olympic athletes; Critical workers
Bosnia and Herzegovina	1	1	1 (>65 yo and comorbidity)	3	1	1	2	3: Teachers in school 3: Adults with disabilities
Bulgaria	2	2	2	3	1	2	3	3: Critical workers
Croatia	1 (>85 yo)	1	1 (>65 yo and comorbidity)	3	1	1	2	1: Very high-risk patients and caregivers 2: Politicians and other governmental employees with critical workers
France	2	2	2	3	1	3	3	5; First responders: police and military – on site 6: Workers of critical infrastructure and public transport
Germany	3	3	3	4	2	1	3	7: Nursery, kindergarten and school workers, VC 8: Prison inmates
Greece	3	3	4	4	3	2	4	4: Pregnant women, adults with comorbidities, etc. and frail people e.g. oncologic patients
Hungary	3	3	3	4	1	2	4	2: Very high-risk person (e.g. end-stage diseases, organ or stem cell transplantation) 4: Teachers at schools
Ireland	2	2	4	4	2	1	2	
Israel	1	1	4	4	2	3	4	
Italy	2	2	4	4	1	2	3	
Latvia	1	3	3	3	1	3	2	
Lithuania	5	5	5	4	1	3	2	
Luxembourg	3	3	3	6	1	2	6	
North Macedonia	1	3	3	3	1	3	2	
Poland	3	3	4	4	1	2	2	
Portugal	1	1	2	3	1	1	2	1: People living in hospices, people 50-79 yo and with selected morbidities; people with Down syndrome >16 yo. Selected state officials. Selected people (firemen, police, armed forces) directly involved in services vital to the pandemic management. 3: People > 12 yo with selected comorbidities. Pregnant women > 16 yo. People between 12 and 79 yo, starting with the oldest cohorts. 2: People with disabilities or immunodepression, companions or personal assistants who live at the same residence
Romania	2	2	2	3	1 and social workers	2	2	
Serbia	1	1	2	3	1	1	2	4: Vulnerable people with chronic disease and immune deficit
Slovenia	3	3	2	3	2	1	4	5: Specific professional groups (teachers, police, shop assistants, public drivers...)
Spain	2	2	3	3	1	1	2	

(Continued)

Table 3. Continued.

Country	Age > 80 yo	Age >75 yo	Age >60 yo	Adults 18-65 years	Health Care workers	Residents in LTCF	Chronic conditions	Another prioritisation
Sweden	1	2	2	3	2	1	1	3: Relatives in close contact to high-risk patients (if in group 1+2 not vaccinated) 2: Soldiers, police, gendarmerie, judicial personnel, inmates and employees. 1: Military personnel
Switzerland	1	1	1	2		1	1	
Turkey	3	3	3	5	1	1	4	
Ukraine	1	1	1	3	1		2	
United Kingdom	2	3	5	6	1	1	4	
	No existing information							
1	Priority group 1							
2	Priority group 2							
3	Priority group 3							
4	Priority group 4							
5	Priority group 5							
6	Priority group 6							
7	Priority group 7							
8	Priority group 8							

Legend: LTCF (Long Term Care Facility), yo (years old).

Vaccination pathway in PHC

The prioritisation of vaccination phases, as per WHO and ECDC guidelines, aimed at equitable distribution [16]. Early phases targeted health workers, the elderly (>65 years), and individuals with comorbidities. Regional variations and uncertainties in predicting naturally acquired immunity influenced prioritisation [5]. Reviewing literature on prioritisation regulations revealed a consistent trend of prioritising criteria related to infection fatality rate (IFR), such as age and health conditions, rather than risk of being infected [29]. Prioritisation of elderly people and vulnerable groups was associated with a 53% reduction in deaths and a 28% reduction in hospitalisations compared to random vaccination [5]. Our results are in line with prioritising vaccination for elderly people, vulnerable populations, and healthcare personnel. However, differences in age range and vaccination order among countries were influenced, probably, by cultural values [30].

Maintaining the cold chain for COVID-19 vaccines, particularly in remote and PHC settings, posed logistical challenges. Different vaccines had varying temperature requirements, Moderna requiring -20°C and Pfizer requiring -70°C for instance, yet the cold chain did not impede the vaccination rollout [31]. The WHO Immunisation Devices Programme-Performance, Quality, and Safety (PQS) played a crucial role in advancing cold chain equipment technologies [32]. Vaccination efforts varied by location, with EU countries prioritising approved vaccines, like BioNTech Pfizer, Moderna, AstraZeneca, and Jansen. Meanwhile, other countries have used different vaccines like Sputnik or Sinopharm, which could be linked to geopolitical relations and gross domestic product [33]. Global disparities in vaccine access highlighted the need for coordinated efforts between public health and PHC.

Inequities in accessing COVID-19 vaccination due to appointment systems were reported [34], prompting successful strategies involving other healthcare professionals [30]. However, challenges of shortages and retention issues of healthcare personnel in Europe are present challenges that should be properly addressed. The pandemic impacted healthcare professionals' payment structures, necessitating modifications in countries with fee-for-service rates to compensate the loss of usual activity that was replaced by COVID-19 [35]. The proactive role of PHC professionals in managing side effects, from pre-vaccination advice to post-vaccination monitoring, underscores the essential contribution of PHC to the overall safety and success of the vaccination campaign.

Table 4. Vaccines available in Europe from 1 December 2020 until 4 December of 2021 in 28 European countries.

Country	BioNTech	Pfizer	Moderna	AstraZeneca	Janssen	Sinovac	Sinopharm	Sputnik	Novavax	Valneva	Cold chain organisation to store vaccines in PHC
Austria	Ω		Ω	Ω			Ω				PH delivered vaccines in PHC regularly (first B/P was available, then, A/Z, then all three: M, B/P, A/Z)
Belarus	Ω		Ω	Ω	Ω		Ω				PH delivered vaccines in PHC regularly
Belgium	Ω		Ω	Ω	Ω		Ω				PH delivered vaccines at the vaccination mobile PHC needed to retrieve vaccines at the vaccination centres according to predetermined procedures. Vaccination centres or federal providers organise delivery at nursing homes, institutional care and residential care homes, as well as outreach actions for more than 20 people.
Bosnia and Herzegovina	Ω		Ω	Ω	Ω		Ω				PH delivered vaccines in PHC
Bulgaria	Ω		Ω	Ω	Ω		Ω				Pharmacists delivered the weekly doses to the GP offices
Croatia	Ω		Ω	Ω	Ω		Ω				Vaccination centre sent vaccines to PHC regularly
France	Ω		Ω	Ω	Ω		Ω				PHC received vaccines from Ministry of Health twice a week
Germany	Ω		Ω	Ω	Ω		Ω				PHC had freezers to keep the vaccines for one week
Greece	Ω		Ω	Ω	Ω		Ω				PH delivered vaccines in PHC regularly
Hungary	Ω		Ω	Ω	Ω		Ω				PH delivered vaccines in PHC regularly
Ireland	Ω		Ω	Ω	Ω		Ω				Vaccination centre sent vaccines to PHC regularly
Israel	Ω		Ω	Ω	Ω		Ω				PH delivered vaccines in PHC twice a week.
Italy	Ω		Ω	Ω	Ω		Ω				PHC had freezers to keep the vaccines.
Latvia	Ω		Ω	Ω	Ω		Ω				COVID-19 'ice' vaccines were administered at hospitals.
Lithuania	Ω		Ω	Ω	Ω		Ω				No vaccination in PHC
Luxembourg	Ω		Ω	Ω	Ω		Ω				No vaccination in PHC
North Macedonia	Ω		Ω	Ω	Ω		Ω				The Polish Material Reserves Agency delivered vaccines once or twice a week
Poland	Ω		Ω	Ω	Ω		Ω				Vaccines were sent to the vaccination centre
Portugal	Ω		Ω	Ω	Ω		Ω				No cold chain needed
Romania	Ω		Ω	Ω	Ω		Ω				PH delivered vaccines in a central point regularly in remote areas, Sinopharm vaccine was administrated
Serbia	Ω		Ω	Ω	Ω		Ω				PH delivered vaccines in PHC regularly
Slovenia	Ω		Ω	Ω	Ω		Ω				PH delivered vaccines in PHC regularly
Spain	Ω		Ω	Ω	Ω		Ω				Central depot which delivered vaccines regularly to PHC
Sweden	Ω		Ω	Ω	Ω		Ω				The military provided central storage and they distributed to the cantonal health ministries who sent it to PHC
Switzerland	Ω		Ω	Ω	Ω		Ω				PH delivered vaccines in PHC daily
Turkey	Ω		Ω	Ω	Ω		Ω				Regional vaccine storage centre to deliver vaccines regularly in PHC
Ukraine	Ω		Ω	Ω	Ω		Ω				PHC had freezers to keep the vaccines
United Kingdom	Ω		Ω	Ω	Ω		Ω				

Green: Vaccine available in the country Yellow: Vaccine unavailable in the country. PH: Public Health. PHC: Primary Health Care. Ω: Vaccine available in primary health care.

Table 5. Vaccination pathway in primary health care during December 2020 and December 2021 in 28 European countries.

Country	Locations providing vaccination	Did PHC participate in administering vaccines to the population?	How to get an appointment in PHC to be vaccinated	Safety protocol in PHC before vaccination	PHC professional involved in administering vaccines	Advice regarding possible side effects before administration	Waiting time after vaccination	In case of side effect, healthcare professional who provided care
Austria	Vaccination centres, GP practices	Yes	First online, later both: by phone and online	Yes, PHC triaged people with prior anaphylactic reactions to be vaccinated in hospital before	GPs	Yes	15–20 min if allergies 30–40 min	GP, A&E doctor
Belarus	GP practices, supermarkets, public spaces	Yes	By phone, in person	Yes, GP examined patient before	GPs, nurses	Yes, written informed consent	15–30 min	Doctor
Belgium	Vaccination centres, GP practices, LTCF, hospital, shelters (homeless and irregular migrants)	Yes, PHC was involved in vaccination centres, LTCF, mobile teams from the vaccination centres (Home visits)	In person, by phone, online, proactive invitation Φ	PHC triaged people with prior anaphylactic reactions	Nurses, GPs, Midwives	Yes, oral informed consent Σ	15 min	Doctor
Bosnia and Herzegovina	Vaccination centres, Healthcare settings (GP practices, Hospital, PH)	Yes, including immobile patients and LTCF	Online, by phone	Yes	GPs, nurses	Yes	15–30 min	GP, A&E doctor
Bulgaria	Vaccination centre, Healthcare settings (GP practices, Hospital, PH)	Yes	By phone, in person	Yes	GPs, nurses ^a	Yes	15–30 min	GP, A&E doctor
Croatia	Vaccination centre ^b , Healthcare settings (GP practices, home visits, Hospital, PH)	Yes, first in vulnerable groups (elderly, immunocompromised, patients with chronic diseases) and later in general population	via national online portal, PHC teams	PHC triaged people with prior anaphylactic reactions to be vaccinated in hospital	All members of PHC teams	Yes	15 minutes If allergies: 30 min	GP, A&E doctor GP, A&E doctor
France	Vaccination centres, pharmacy	Yes	In person, by phone, online	Yes	Nurses, GPs, midwives, pharmacists	Yes	15 min If allergies: 30 min	The person who vaccinates had always to carry an adrenaline injection Doctor (GP)
Germany	Vaccination centres run by GP, GP practices	Yes	Online, by phone	Yes	Nurses, midwives, medical students	Yes	15 min If allergies: 30 min	Doctor (GP)
Greece	Vaccination centres, GP practices, private GP practices, GP home visits, paediatric clinics, Hospitals, mobile teams	Yes, except in children	Online, in person	Yes	Nurses, GPs	Yes	15 min If allergies: 30 min	Doctor (GP)
Hungary	Vaccination centres in Hospitals, GPs practice, LTCF, schools	Yes	Online (e-mail), by phone	Yes: BP and a questionnaire High risk patients: hospital	Nurses, GPs	Yes	30 min	GP
Ireland	Vaccination centres in social places (including three GP-run centres), GP practices, pharmacies	Yes	Online	PHC triaged people with prior anaphylactic reactions	Nurses, GPs, physiotherapies, midwives	Yes, written consent for the initial vaccination, and oral consent for the booster shot	15 min	GP, A&E doctor

(Continued)

Table 5. Continued.

Country	Locations providing vaccination	Did PHC participate in administering vaccines to the population?	How to get an appointment in PHC to be vaccinated	Safety protocol in PHC before vaccination	PHC professional involved in administering vaccines	Advice regarding possible side effects before administration	Waiting time after vaccination	In case of side effect, healthcare professional who provided care
Israel	Central logistics centre, GP practices	Yes	Online	PHC triaged people with prior anaphylactic reactions, it was mandatory to consult Allergology	Nurses	Yes	10–15 min	GP
Italy	Vaccination centres, Schools, GP practices	Yes, it was voluntary	By phone	Patients without acute conditions (i.e. fever, bronchitis, etc.)	Nurse, GPs	Yes	15 min If allergies: 30 min	GP
Latvia	GP practices, hospitals, vaccination points (e.g. supermarkets), vaccination centres, mobile vaccination centre for LTCF	Yes	Online, by phone	Yes	Nurses, GPs, resident in family medicine	Yes	15 min	GP, A&E doctor
Lithuania	Healthcare facilities, other locations (e.g. workplaces, social services, patients' homes or vaccination centres)	Yes, in patients who were registered with a GP	In person, by phone, patient pre-registration in an online portal	Yes: patients without fever	GPs, nurses, midwives	Yes	15 min	GP
Luxembourg	Vaccination centres, mobile teams (LTCE, secondary schools), Pop-up vaccination centres in shopping centres and supermarkets, GPs & paediatrician practices	No, PHC participated voluntarily						
North Macedonia	Vaccination centres in sport facilities.	No, some GPs volunteered in the vaccination centres						
Poland	Vaccination centres, GP practices, mobile teams, hospitals, pharmacies	Only GP practices which opened official vaccination centres were able to participate	Online, by phone, in person	Yes, kids had to be vaccinated by doctors	Doctors, nurses, paramedics, final-year medical students	Yes	20 min	The one who administered the vaccine
Portugal	Hospitals, GP practices (home visits), vaccination centres	Yes, all non-hospitalized citizens	At the GPs practices or vaccination centres	Yes, potential contraindications should be checked. GP triaged people with prior anaphylactic reactions to be vaccinated in hospital.	Nurses, GPs	Yes	30 min	Nurses and GPs
Romania	Vaccination centres, Vaccination marathons in social settings, GP practices (home visit)	Yes, in the vaccination centres or marathons. From September 2021: At GP practices	By phone, by mail, WhatsApp	PHC triaged people with prior anaphylactic reactions to be vaccinated in hospital	GPs, Nurses, Midwives, Medical students	Yes	30 min	GP, A&E doctor
Serbia	Vaccination centres, GPs practices (home visits)	Yes, PHC were the main providers of vaccination in the vaccination centres, GPs practices (home visits) and in LTCE	Online	Yes, potential contraindications should be checked, PHC triaged people with prior anaphylactic reactions to be vaccinated in hospital	GPs, paediatricians, dentists, nurses, midwives	Yes	15–30 min	A&E doctor

(Continued)

Table 5. Continued.

Country	Locations providing vaccination	Did PHC participate in administering vaccines to the population?	How to get an appointment in PHC to be vaccinated	Safety protocol in PHC before vaccination	PHC professional involved in administering vaccines	Advice regarding possible side effects before administration	Waiting time after vaccination	In case of side effect, healthcare professional who provided care
Slovenia	Vaccination centres located in GPs practices, hospitals. Individual GPs did not perform vaccination but they participated in the vaccination centres	Yes, HCW from PHC were the main providers of vaccination, but in the vaccination centres or mobile units, not in their own practices	By App, drop-in	Yes	Nurses, GPs, students, young doctors	Yes, plus the informed consent form is signed by the patient	15 min	Mild side effect: Nurse Other side effects: Doctor
Spain	Hospital, GP practices (home visits), vaccination centres	Yes	In person, by phone, online, App	Yes, potential contraindications should be checked.	Nurses	Yes	15–30 min	Mild side effect: Nurse Other side effects: Doctor
Sweden	Hospital, GP practices, vaccination centres	Yes	Online, by phone. Drop-in vaccination was offered at some GP practices	Yes	Nurses	Yes, nurses had a written information letter with an explanation	15 min If allergies: 30 min	Nurses and physicians
Switzerland	Vaccination centres, GP practices, Pharmacists, Drive-in/Walk-in approaches, vaccination trucks, mobile vaccination teams (LTCF), Community projects	Yes	In person, by phone, online	Yes, checklist was completed before administration	GPs, pharmacists, assistants, students, nurses	Yes	15 min If allergies: 30 min	GPs, Pharmacists, Hospital doctors: dependent on the side effect
Turkey	GP practices (it is not needed to be registered), vaccination clinic within a hospital.	Yes, in adults	Online portal (Physician Appointment System), by phone In person	Yes, written consent	Nurses, GPs	Yes	15 min If allergies: 30 min	Nurse and GP
Ukraine	Vaccination points in shopping centres or public places, public and private clinics	Yes	In person	No	Nurses, GPs	Yes	30 min	GP, or any doctor who see this
United Kingdom	GP practices, vaccination centres (stadiums, community faith centres, exhibition halls, meeting halls)	Yes	Online portal by personal messages from the registered GP practices	Yes, checklist was completed before administration	GPs, paediatricians, nurses, midwives	Yes	15 min	A&E doctor

Grey: Countries where vaccination was not available in PHC. **EHR:** Electronic Health Record **HCW:** Healthcare workers **LTCF:** Long Term Care Facilities (e.g. nursing homes, care homes for disabled persons) **PH:** Public Health **PHC:** Primary Health Care **Vaccination centres:** Any kind of social settings which was used to vaccinate (sport centre, stadium, concert centre, education centre, shopping centres, etc.) **Community projects:** local authorities together with local health care providers organise an event to vaccinate **GP practices (Home visits):** Vaccination in GP practices including patients were vaccinated at their home because of mobility problems **%:** normal protocol for normal vaccination. **Φ:** Earlier vaccination if GPs identified persons with an underlying health condition, that would give the person a higher risk of developing severe COVID-19 (in combination with a selection by health insurance agency IMA-AIM). People were invited first to the vaccination centre but in case they preferred to go to PHC, they could get an appointment at GPs or PC medical health centres from July 2021 **α:** Initially, there was an official instruction stating that COVID-19 vaccines should only be administered by doctors. However, during the campaign, nurses were also allowed to administer the vaccine under medical supervision. The vaccine's registration required an electronic signature from a doctor **β:** Some vaccination centre depended on GP practices and other ones depended on PH **Σ:** Tacit consent for children and people incapable to give consent (e.g. severe mental handicap), parents or legal representatives give oral consent if they accompany them otherwise a written consent if needed (Wallonia requested written consent for 12–15 years old). Upon patient or physician request, a written consent could be added to the medical record (Law of 22 August 2002 on Patients' Right).

The standardised observation period, coupled with the readiness of PHC teams to respond to adverse reactions, demonstrates the effectiveness of PHC systems in safeguarding public health during mass vaccination efforts. Adequate compensation for new services introduced into PHC portfolios is crucial for sustainability and the retention of healthcare personnel [30].

Strengths and limitations

This study provides a distinctive perspective on the COVID-19 vaccination campaign, with significant PHC involvement in 26/28 European nations. However, the extent of involvement varied. The credibility of the data, sourced from reliable online resources by local researchers, is a strength. The Eurodata project commenced in 2022 with an initial collaboration of researchers spanning 30 countries. As the project unfolded, additional research inquiries emerged among the team, resulting in the development of more articles beyond the initial scope. To accommodate this expansion and to respect the varied commitments and preferences of our researchers, we chose to divide the project into sub-projects that runs independently. This approach granted researchers the freedom to participate based on their preferences and schedules.

While the core team consisted of researchers from all 30 countries, there were four countries—Cyprus, Czech Republic, Finland, and the Netherlands—that participated only in some specific sub-projects. Additionally, new countries, including Latvia and Switzerland, joined the project afterwards. This flexible framework allowed us to maintain momentum and achieved feasible goals, ultimately ensuring the successful completion of each sub-project.

Limitations include unaccounted regional changes and caution against country-to-country comparisons due to potential PHC organisational variations. Key informants identified disinformation and political discord as primary sources of distrust, with data limitations in the UK and challenges in international and national data cut-offs. Despite these limitations, our study aligns with Rodriguez-Blanco et al. [36], emphasising the findings' relevance for guiding campaigns, particularly in areas with restricted access, highlighting the pivotal role of PHC and advocating for tailored communication strategies to address distrust and misinformation.

Implications for the future

Future pandemics should consider the role of PHC in communication and organisation of vaccination campaigns due to its proximity to the community and

established trust as first line of care. Comparative studies on vaccination rates between areas where PHC alone was involved and those using different methods are essential. Comprehensive awareness campaigns, addressing vaccine hesitancy, misinformation, and emphasising ongoing public health measures, should be launched by public health agencies and governments. Robust surveillance systems should be in place to monitor the effectiveness of vaccination campaigns, including tracking vaccine coverage, monitoring adverse events, and assessing the long-term effectiveness of the vaccines. To optimise the immunisation efforts, regular follow-up and adjustment of strategies could be helpful. Additionally, it is necessary to study the role of the family doctor, their longitudinal relationship with patients and engagement with the community. Understanding the potential value of this relationship, built in trust, could help alleviate vaccine hesitancy and increase acceptance of vaccination by addressing their concerns, answering any questions, ensuring access to accurate evidence and presenting personalised arguments that could help patients alleviate vaccine hesitancy and make informed decisions. While vaccination plays a crucial role, it should be complemented with ongoing public health measures such as practicing good hand hygiene, maintaining physical distance, and adhering to local guidelines. This comprehensive awareness campaigns to educate the public about the importance and safety of vaccines should be launched by public health agencies and governments. These campaigns should address vaccine hesitancy, misinformation, and provide accurate information about the benefits and potential side effects of vaccines.

Conclusion

PHC played an active role in the initial COVID-19 vaccination communication campaign across half of the countries, with GPs actively promoting vaccination. There was a variability in both, the strategy for prioritising groups to facilitate vaccination and in efforts to increase vaccine uptake across countries. The coordination between public health and PHC has been crucial in ensuring effective logistical requirements for the vaccination campaign. The integrity of the vaccine cold chain posed no obstacle to administering COVID-19 vaccinations in PHC settings. PHC has been instrumental in the distribution and administration of COVID-19 vaccines across European countries.

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