



JRC TECHNICAL REPORT

Applying lessons from behavioural sciences to vaccination acceptance and demand

Final Report

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Abstract

This Joint Research Centre (JRC) technical report gives an overview of a large project on vaccination acceptance and demand and illustrates its outcomes and lessons learnt. The project started at the end of 2019 and was completed in 2022. The overarching objective of the project was to facilitate and execute research on vaccine confidence, identifying behavioural determinants of vaccine hesitancy across different subgroups of the population, like parents and healthcare workers, for specific categories of vaccines in several Member States of the European Union.

The project highlighted the complexity of vaccine acceptance and demand, bringing to attention several challenges and opportunities. In particular, it has brought out the importance of civic trust in increasing vaccination acceptance and demand and the crucial role played by healthcare providers. While it proposes a taxonomy of parents (classifying them into four distinct categories: acceptors, hesitant acceptors, delayers, and skippers) that allows for more effective, targeted policy interventions, it also points out that some groups are resistant to nearly all attempts at increasing vaccination uptake.

Furthermore, the project seized the opportunity to take stock of the progress made in understanding the behavioural determinants of vaccination during the COVID-19 pandemic. This invaluable knowledge is fundamental to improved health emergency preparedness, response plans and infrastructures.

The project consisted of four key and four supplementary activities. The activities were designed by JRC's Competence Centre on Behavioural Insights (CCBI) and executed with the support of external contractors.

1 Introduction

Vaccination is one of the most powerful and cost-effective public health measures. It remains the main tool for primary prevention of communicable diseases. Thanks to widespread vaccination, smallpox was eradicated globally in 1979, Europe has been polio-free since 2002, and many other diseases have been almost eliminated. Despite its brilliant track record, several European Union and neighbouring countries have been facing serious public health challenges, manifesting with unprecedented outbreaks of vaccine-preventable diseases due to insufficient vaccination coverage rates. At the core of these pressing challenges are concerns over the waning of public confidence in vaccination, geographical differences in accessibility, as well as the rise of mis- and disinformation on vaccination.

A further ongoing challenge is represented by the effects of the COVID-19 pandemic on childhood and life-course vaccination programs and policies. Recent data published by the World Health Organization (WHO) has rung an alarm bell on a global historic backsliding in rates of immunization, with global coverage rates dropping from 86% in 2019 to 81% in 2021¹. Particularly worrisome for the health of women and girls was the recorded loss of over a quarter of the global coverage of Human Papilloma Virus (HPV) vaccines recorded in 2019². Furthermore, experts are now pondering on the effects of the COVID-19 pandemic on future outbreaks, and how vaccine confidence can be restored and improved for better emergency preparedness, given the dynamic and changing nature of vaccine hesitancy.

Although vaccination policies are a competence of national authorities, the European Commission supports EU countries in coordinating their vaccination policies and programmes. In December 2018, the EU Health Ministers adopted a Council Recommendation on strengthened cooperation against vaccine-preventable diseases. Actions called for by this policy initiative included tackling vaccine hesitancy, with the overall objective of increasing the uptake of vaccination in the EU in a life-course perspective.

The WHO's Strategic Advisory Group of Experts on Immunization (SAGE) defines vaccine hesitancy as: "[a] delay in acceptance or refusal of vaccines despite availability of vaccine services. Vaccine hesitancy is complex and context specific, varying across time, place and vaccines. It is influenced by factors such as complacency, convenience, and confidence [the "3Cs"]" (WHO, Report of the SAGE Working Group on Vaccine Hesitancy, 2014). This definition encapsulates the possible drivers of vaccine acceptance or refusal. While complacency and convenience relate respectively to the perceived risk of disease and the ease with which vaccine services can be reached, vaccine confidence is defined as the trust in the effectiveness and safety of vaccines and trust in the healthcare system that delivers them. A more recent definition of vaccine hesitancy by Larson et al. (2022) gives a nuanced description of the phenomenon "as a state of indecision and uncertainty that precedes a decision to become (or not become) vaccinated. Vaccine hesitancy is an attitude or sentiment, whereas vaccination is an action, which is measured to determine vaccine coverage. The period of hesitancy and indecision is a time of vulnerability, as well as opportunity. Sentiments concerning whether to undergo vaccination can change and change again". Throughout this document, the term "confidence" will refer to the state of uncertainty and indecision over vaccination decisions.

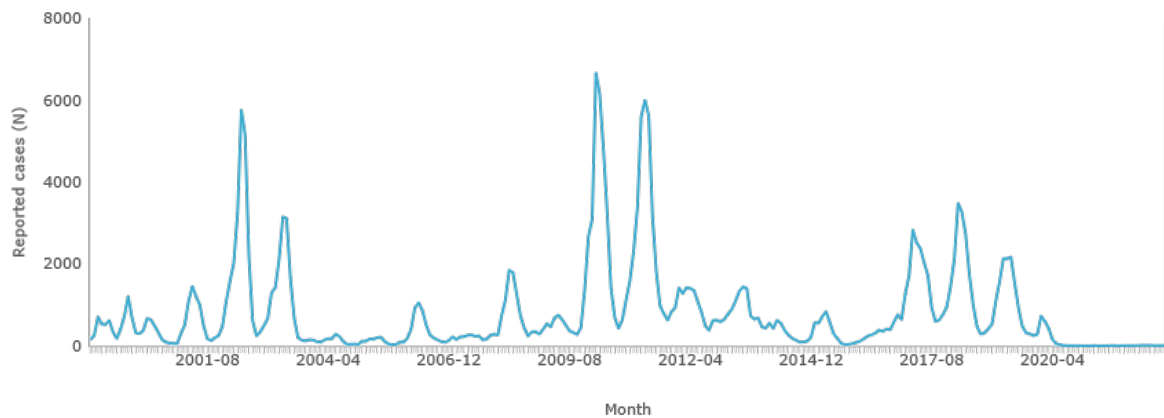
A high confidence in vaccination programmes is crucial for maintaining high coverage rates, especially at levels that exceed those required for herd immunity. Across the EU, however, vaccine delays and refusals are contributing to declining immunisation rates in several countries, leading to increases in disease outbreaks. Even if over the past two years the number of reported measles cases in Europe has been very low, pre-pandemic measles outbreaks – the highest in the EU for seven years (see Figure 1) – illustrate the immediate impact of declining coverage on disease outbreaks. It is important to stress that the lower number of cases of measles across the EU since the onset of the COVID-19 pandemic is probably due to non-pharmaceutical interventions put in place as COVID-19 control measures, rather than high vaccination coverage³. Therefore, identifying behavioural determinants of measles vaccine acceptance is even more paramount now that non-pharmaceutical interventions have been lifted across the EU.

¹ Immunization key facts, by WHO available at <https://www.who.int/news-room/fact-sheets/detail/immunization-coverage>

² Ibidem.

³ Europe at risk of measles resurgence as COVID-19 restrictions are eased, by Linda Geddes available at <https://www.gavi.org/vaccineswork/europe-risk-measles-resurgence-COVID-19-restrictions-are-eased>

Figure 1 – Reported cases of measles in the EU (1999-2022). Source: ECDC Surveillance atlas of infectious diseases



(Available at <https://atlas.ecdc.europa.eu/public/index.aspx>)

In the case of routine childhood immunization, it is *parental* acceptance that plays the key role. Increasingly, many parents doubt the benefits and safety of vaccines as they question the need for immunization. Opposition to vaccination is as old as vaccination itself and has never faded away, despite the public's growing scientific sophistication. A variety of factors contribute to modern vaccine hesitancy, including the layperson's heuristic thinking when it comes to balancing risks and benefits as well as several other features of vaccination, including the risk of being a victim of its own success: successful vaccination of the population creates an impression that the disease does not pose a threat.

Vaccine-Hesitant Parents (VHPs) are a heterogeneous group of individuals who tend to have beliefs that are in between the continuum of immunization acceptance and rejection (Opel et al., 2011). They might reject one or two vaccines, agree on others, delay some, ask for separate shots rather than a combination vaccine, or be unsure about the right thing to do when it comes to have their children vaccinated. VHPs often follow the expert advice with their first child but develop a sense of advocacy with subsequent children. These parents often rely on their own (often biased or incomplete) research on immunization to come up with a would-be informed decision, rather than be deferential: for them being a good parent means questioning the expert (or generalized) advice. This type of "fence-sitters" are parents who are uncertain about whether the benefits of vaccines outweigh the risks and are easily amenable to behaviour change: they might become immunization resistant. The policy concern around VHPs is that hesitancy becomes refusal, as suggested by previous instances and studies (Salathé and Bonhoeffer, 2008): when there is refusal, unvaccinated clusters emerge, and disease outbreaks occur. Hesitancy is therefore a steppingstone towards rejection.

Conventional approaches to increase vaccine acceptance assume that educating parents about the scientifically confirmed benefits of vaccination will change their minds. Unfortunately, this is a simplistic model of how human beings make decisions and a poor framework to overcome rejection or hesitance. Including insights from behavioural sciences helps shedding light on the mechanisms at work when people make decisions about childhood vaccination. Some of the factors are the immediacy effect, loss aversion, overestimating and over-weighting of small probabilities, and social preferences and trust.

The COVID-19 pandemic has also accelerated reflections on vaccination hesitancy related to adult and life-course vaccination, highlighting the need for further work incorporating the general population, and not only parents and occupational groups. This topic was already part of the policy debate, due to a combination of aspects like demographic changes, mobility of people, climate change and waning immunity, which all contribute to the epidemiological shift in the burden of vaccine-preventable diseases that require vaccination programmes beyond childhood years. The life-course approach to vaccination aims to ensure adequate lifelong protection and contributes to healthy living, healthy ageing, and the sustainability of healthcare systems.

In this context, health-care professionals are key actors in working towards the goal of improved vaccination coverage rates, both for childhood and adulthood vaccines. Their role is twofold: firstly, healthcare workers are exposed to vaccine-preventable diseases and can be the carriers of transmission. Cases where vaccination rates of healthcare workers are considered insufficient with respect to national recommendations should be understood and investigated, also from a behavioural stance, to protect both workers and their patients.

Secondly, healthcare workers are the point of contact for individuals seeking information or questioning vaccination. Healthcare providers are the most trusted source of health information, as we confirm in our studies, and thus key players that would need constant training, information, and monitoring.

Within this complex framework, at the end of 2019 the Competence Centre on Behavioural Insights (CCBI) embarked on a two-year project aimed at identifying the most promising areas of intervention to increase vaccine acceptance and demand in the EU 27. The overarching mission of the CCBI is to support EU policymaking with evidence about human behaviour. The objectives of the CCBI are to use behavioural insights to help design better policies, bridge the gap between policymakers and behavioural researchers and increase the use of behavioural insights for policy, when they are relevant. The overall purpose of the project was to facilitate and execute research on vaccine confidence, identifying behavioural determinants of vaccine hesitancy across different subgroups of the population and healthcare workers, for specific categories of vaccines in several Member States of the European Union. The project initially targeted two specific vaccines (Measles Mumps and Rubella – MMR and Human Papilloma Virus – HPV) and two categories of individuals (parents and primary health care providers).

The project started merely weeks before March 11, 2020, when the WHO declared the novel coronavirus (COVID-19) outbreak a global pandemic. Since then, the European Commission has given five COVID-19 vaccines a conditional marketing authorization (with the European Medicines Agency – EMA – recently converting into standard marketing authorisations three of them and granting direct marketing authorization to another two). It secured up to 4.2 billion doses of COVID-19 vaccines and delivered 1.7 billion doses, reaching a vaccination coverage rate of 83.4% of the adult population⁴. This project needed to be adapted to the circumstances, expanding its initial scope and purpose. While holding fixed the primary objectives mentioned above, the CCBI at first only included the possibility of a COVID-19 vaccine being developed and then investigated how European Citizens reacted to the COVID-19 vaccination campaigns.

Furthermore, the research team anticipated sizeable effects of the COVID-19 pandemic on vaccine demand and acceptance: these effects were immediately relevant for the COVID-19 vaccination campaigns but were also a key stock of evidence to assess spill-over effects onto the demand and acceptance of other vaccines. By adjusting the part of this project related to the research activities, the CCBI was able not only to monitor changes in vaccine demand and acceptance, but also to record the willingness to get vaccinated, the perceptions and beliefs on the EUDCC (EU digital COVID-19 Certificate), the vaccination status of Ukrainian refugees and the status of the pandemic, among other items.

For what concerns healthcare providers (HCP), the research team acknowledged that during the past two years national health systems were overburdened with pressing issues related to the COVID-19 pandemic and related vaccination programmes and are currently still under pressure to recover from the aftermath of the pandemic. This aspect was particularly relevant when trying to reach HCP for data collection, and it was thus necessary to accommodate such challenges and further adapt the research methodology.

While the original intent of this project was to investigate the behavioural determinants of vaccination demand and acceptance with a specific focus on paediatric vaccinations, the framework created by the original project design could also efficiently serve the purpose of collecting insights for COVID-19 vaccination programmes. For example, with more COVID-19 vaccines becoming available in time, the emergence of trends of differentiated acceptance across vaccines was documented. In addition, being able to monitor parents' acceptance of a potential vaccine against COVID-19 and then compare it with the acceptance for approved vaccines could be beneficial for future paediatric vaccination campaigns, especially in the case of a health emergency. Further, developments on the proposal for a digital green pass, the Ukrainian migrant crisis and the evolving stages of the pandemic were addressed in the study. The data collected on all these issues was not only needed to understand what has happened amid the pandemic and to inform policymakers at the time. It may also be used in future comparative studies (especially those needing data collected in different phases of the pandemic) and to provide information for health emergency preparedness and response plans and infrastructures.

More generally, the insights of this project are directed to supporting the identification of the most promising areas of implementation of behavioural insights to improve vaccine confidence. These will potentially have an impact in the field of vaccination and will allow effective prioritisation of resources at the EU and national

⁴ Figures at the time of writing. For updates please visit: https://ec.europa.eu/info/live-work-travel-eu/coronavirus-response/safe-covid-19-vaccines-europeans_en

levels. They will also enhance the capacity of Member States to implement effective policies and best practices, with the final aim of increasing vaccination coverage and contributing to the overall aim of the 2018 Council Recommendation on strengthened collaboration on vaccine-preventable diseases, i.e., to increase public health security and to decrease health inequalities.

In this final report we account for all the activities undertaken, briefly describing each of them, and summarizing for policymakers the key insights and lessons learnt. The individual outputs and relative components for each activity are available upon request from the corresponding author and will be, or have been, individually published as JRC technical reports, JRC science for policy briefs, or peer-reviewed papers.

This document is structured as follows: this section (Section 1) has introduced the policy background of the project; Section 2 reviews key activities, while Section 3 appraises additional activities carried out under the broad umbrella of the project scope. Section 4 concludes. Figure 2 summarizes the different activities carried out during the lifespan of the project.

Figure 2 - Summary of project activities

KEY ACTIVITIES	ADDITIONAL ACTIVITIES
✓Literature review on vaccine acceptance and demand ✓Cross-sectional survey monitoring vaccine acceptance and demand ✓Behavioural data linking study on knowledge, attitudes and practices towards vaccination among paediatricians: the case study of Italy ✓Symposium on vaccination and the pandemic	✓Exploratory survey study on vaccine acceptance and demand ✓Literature review on vaccination and the pandemic ✓Behavioural study on knowledge, attitudes and practices towards vaccination among paediatricians: extending the study to France, Spain and Poland ✓Parents questions on the COVID-19 vaccine for children and adolescents

2 Key activities

This section covers the key activities of the project consisting of (i) a literature review on vaccine acceptance and demand, (ii) a cross-sectional survey designed to monitor vaccine acceptance and demand, (iii) a behavioural data-linking study on knowledge, attitudes, and practices towards vaccination among paediatricians and (iv) the proceedings of a symposium on vaccination and the pandemic. For each activity we describe the context, objectives, methodology and structure, lessons learnt and policy recommendations.

2.1 Literature review on vaccine acceptance and demand

This literature review was commissioned in early 2020 and went through two rounds of revisions and updates, respectively in 2021 and early 2022. The contributors of the document are Hoffmann, M. (Harvard University), Baggio M. and Krawczyk, M. (team members of the CCBI).

The specific purpose of this activity was to perform a preliminary literature review of articles on vaccination demand and acceptance, with a particular focus on childhood immunization (focusing on but not limiting the scope to MMR and HPV) and healthcare workers. The two key objectives were:

Objective #1 – Understanding the behavioural determinants of parents' childhood vaccination demand and acceptance: undertake a general review of the key behavioural elements related to childhood vaccine demand and acceptance, devoting particular attention to the role of altruism, free riding, band-wagoning, social norms, and social networks. In addition, to investigate the influence of political ideology and trust towards health/pharmaceutical institutions, healthcare providers' competences and integrity, as well as official vaccine information, was investigated.

Objective #2 – Focus on healthcare workers: scope the literature to map studies on behavioural interventions aimed at increasing vaccination demand and acceptance delivered through healthcare workers, as well as behavioural interventions aimed at changing the behaviour of health care workers when delivering vaccination services, or their own personal views on vaccination. To map interventions using social norms feedback (expert feedback, relative performance compared to others, etcetera), as well as healthcare workers social networks.

This work on the review started in March 2020, just days prior to the WHO declaring COVID-19 outbreak a pandemic. Although in this literature review a separate chapter was dedicated to COVID-19, the quickly growing literature focused on the attitudes towards COVID-19 vaccine per se was reviewed in a separate exercise (see section 3.2 of this report). However, it was of great importance to include reflections on the scope of the applicability of the findings from earlier literature on vaccine hesitancy in the context of the current pandemic. Last but not least, the literature review also took into account the current unprecedented crisis involving millions of Ukrainians fleeing the Russian invasion, as it was worth noting the several factors making refugees likely to be vaccine hesitant.

This literature review will be published in due course as a JRC technical report.

2.1.1 Structure and methodology of the literature review

While much progress has been made by looking through the lens of neoclassical economic models of rational choice, we have long known that rational choice does not fully capture the reality we humans live in. Rational choice models are approximations of reality, describing humans as machines that make choices by maximizing utility given constraints with an infinite capacity and speed to absorb information under stable preferences. Behavioural economics has the purpose to overcome biases that we do not fully understand and, hence, categorize as non-rational, or biases that are completely at odds with the model of a rational human being that maximizes utility to make the choice to vaccinate or not. Behavioural factors such as choice overload, perception biases, uncertainty, unstable preferences over time and the impacts of peers have been recognized over time and they are important determinants of health choices, including decisions concerning vaccines. In general, across all behavioural factors, there is a large potential for future research, which, especially amid the current COVID-19 pandemic, deserves further attention to overcome research gaps that have not yet been fully understood and closed.

In this literature we paid special attention to the following items, each of these represented a separate section of the document:

- **Involvement:** being involved in a vaccination decision is a highly important factor since it suggests a state of mindfulness, rational and educated decision making and a motivation to act upon one's

intentions. Individuals are often involved in decision-making for others. Notably, parents represent a numerous group of individuals making proxy decisions for their children. They need to be aware of the correct information available. Proxy decisions for the elderly are another important case to be investigated. They can be crucial i.e. for influenza vaccinations.

- **Vaccination decisions under uncertainty:** a vaccination decision requires the need to evaluate perceived risks of vaccination and non-vaccination. Those perceptions might be different, based on whether someone makes decisions for oneself or for others. As hinted upon, vaccination is a decision made under uncertainty. One either faces the uncertain prospects of getting sick due to non-vaccination or the uncertain prospects to get side-effects from the vaccine (even if serious consequences are very rare). Incorrect evaluations of those prospects or ambiguity, i.e. the state of not knowing the probabilities with which events occur, may harm overall coverage rates. Individuals may also make decisions based on knowing the efficacy versus effectiveness of a vaccine. While efficacy is the reduction in disease incidence in a vaccinated compared to an unvaccinated group under controlled conditions, effectiveness measures this reduction in the field, as the vaccination is administered at scale. Efficacy is usually higher than effectiveness of any vaccine. If individuals base their beliefs on efficacy studies, their perceptions of the benefits in empirical reality might be distorted and are too high in comparison to reality. This may cause individuals to engage in risky behaviour, since they might feel more protected than they are.
- **Vaccination decision-making over time:** some vaccines, like influenza, are recommended to be taken every year due to mutations of the virus strains. Other vaccines only need to be administered during childhood. In either event, the individual might face a trade-off between immediate costs of vaccination and delayed benefits of reduced propensity to become sick. In such decisions, present-biased individuals may incorrectly overweight their current utility relative to future utility. As a result, they may want to postpone or skip vaccination. Reducing procrastination can therefore assist in increasing coverage for any vaccine.
- **Peer effects:** another important behavioural factor that may influence vaccination coverage are peers, such as other parents, friends, colleagues, or other close individuals within a network. We know from economic theory that externalities can be generated through peers and that the individual behaviour of others can influence the individual propensity to get vaccinated, e.g. by receiving additional information, or through social norms. Being a role-model for others might have an impact on overall vaccination coverage.
- **Healthcare professionals:** among them are physicians, nurses, aides, helpers, laboratory technicians and other health-related professionals. They are often interacting with patients and provide vaccinations or are recommending them. Healthcare professionals are at the frontlines of the pandemic, such as the one we are facing against COVID-19 currently. Therefore, trust in those professionals is essential. However, those professionals can be prone to behavioural biases which researchers can try to address through interventions. Leveraging the trusted source of healthcare professionals has a large potential, ripe for behavioural interventions.

The literature of each section was split into suggestive evidence and causal evidence. The literature review was integrated with additional sections on the ways in which findings from earlier literature can apply to the COVID-19 pandemic and the Ukrainian refugee crisis.

To find the relevant literature, we mainly relied on Google Scholar. Using a time horizon from the year 2000 until 2020, we employed the following keywords (initial paper count between parenthesis) for our search strategy:

- childhood vaccination behavioural economics experiment (21,500 results)
- vaccination hyperbolic discounting (1,950 results)
- vaccine hesitancy Europe (16,300 results)
- vaccination 'peer effects' (1,050 results)
- vaccination 'social norms' Europe (15,800 results)

We identified 209 papers that were considered relevant. We aimed for a comprehensive coverage of quantitative empirical papers, including literature reviews. We also included theoretical papers in behavioural

economics, shedding light on vaccination demand, as well as selected qualitative papers characterized by their high quality and the use of relatively large samples.

We downloaded each paper, and we populated a database with several variables for the identification and selection of papers to be included and discussed. Our review was mainly focused on Europe, but we identified some other regions as well. Literature reviews and opinion pieces were mainly classified to have world-wide relevance since they were usually not based on regional restrictions. The database included the following countries: Austria, Belgium, Bulgaria, Canada, China, Croatia, Czech Republic, Denmark, Ecuador, Finland, France, Germany, Ghana, Greece, Hong Kong, Hungary, India, Italy, Japan, Kenya, Kosovo, Malawi, Mexico, the Netherlands, Nicaragua, Nigeria, Pakistan, Paraguay, Poland, Romania, Senegal, Serbia, Sierra Leone, Singapore, Slovenia, South Africa, South Korea, Spain, Sweden, Switzerland, Tanzania, Turkey, the UK, the USA.

For the employed search terms, we identified a visual structural break in the number of references: we found more papers for the period 2013-2020 than for 2000-2013. This is not surprising, since behavioural economics is a rather new field and the intersection with vaccination even more novel. The outbreak of the pandemic marked a tectonic shift in the literature on vaccine acceptance. In most countries, the acceptance of Covid-19 vaccines turned out to be much lower than for other recommended vaccines, triggering many projects investigating the reasons for this discrepancy. As already mentioned, this literature was reviewed in a separate additional activity, however a section focusing on the ways in which the body of knowledge on vaccine acceptance accumulated hitherto is applicable to the context of COVID-19 was added.

2.1.2 Lessons learnt and policy recommendations

Vaccination choice is a complex topic and while the supply-side has received attention from an economic perspective, a systematic investigation of the demand-side factors from a behavioural economics viewpoint is still underdeveloped. In this review, we investigated the current state of the literature by focusing on a non-exhaustive list of four factors: vaccination involvement, vaccination decisions under uncertainty, vaccination decisions over time, and the impact of peers on the propensity to get vaccinated. We mainly focused on behavioural aspects in contrast to health outcomes. Throughout the literature review, three groups received more attention: children, parents, and healthcare professionals. For healthcare professionals, we dedicated one separate chapter to highlighting research where behavioural factors may matter on the supply side.

Summarizing, the fundamental behavioural insights drawn from this literature review on vaccination demand and acceptance, and related policy recommendations are as follows:

- **Key attributes of vaccines are safety** (risk of side effects) and **accessibility**. Vaccine **safety** is **correlated with positive parental response** to childhood vaccination. Also, individuals accept higher probabilities of potential side effects as the effectiveness of the vaccine increases. Clear and transparent communication, highlighting the efficacy of vaccines and not only the risks of side effects is key to support parental decision making.
- **Being exposed**, even for a limited amount of time, **to vaccine-critical information increases vaccine risk perceptions**. Being the first voice heard in the vaccination debate, and counteracting false claims and misinformation, are vital actions to combat vaccination hesitancy. Public health authorities and policymakers should make a concrete effort to be the first voice heard in the debate, notwithstanding the paramount imperatives of a good communication that is reliable, transparent, consistent, understandable, and accessible.
- **The greater the trust in government, healthcare systems and professionals, the greater the vaccine acceptance**. Healthcare professionals' quality is correlated with vaccination uptake. Making sure that healthcare professionals can build good relationships with the patients and know how to deliver complex messages around vaccination is essential to combat hesitancy. Therefore, continuous training and support to HCP, empowering them in their role as patients' and patients' parents educators should be a key priority for public health authorities.
- **Memory issues and present biasedness may be important drivers of low vaccination coverage rates**. Opt-out vaccination appointments and multiple reminders are an easy, yet effective, tool to overcome vaccination barriers. Public health authorities and policymakers should widely implement such techniques and make them the standard approach in the management of vaccination campaigns.

- Prospect theory can explain a portion of vaccination hesitancy: **people overweigh small probabilities (vaccination side effects) and underweight relatively large ones (contracting a vaccine-preventable disease)**. Also, **individuals prefer known risks over unknown risks**: the future risk of contracting a known disease might be preferred to an immediate risk of experiencing the unlikely adverse effects of new vaccine. This finding is particularly relevant for new vaccines, such as COVID-19, but also HPV. In these cases, clear communication to explain the process of vaccination approval in the EU and how the standard safety procedures implemented within the accelerated timeline of vaccine development is necessary to ease fears of speed being favoured over safety.
- Vaccinated individuals may **engage in risk related trade-offs**. For example, they could disregard other preventive measures, once they receive the vaccine. Reinforcing the importance of a holistic approach to health should accompany vaccination campaigns, reinforcing the individual agency for one own health.
- **Homophily** (selecting similar individuals, in particular individuals sharing our beliefs, as interaction partners) and **contagion** (spreading of behaviour across social networks) are central in understanding vaccination behaviour. In particular, healthcare professionals can have a large impact on vaccination coverage: they are key to positive attitudes and should be empowered in this role.

This exploratory literature review provided a comprehensive state-of-the-art on the behavioural determinants of vaccination. However, across behavioural factors, we found large gaps in the literature. A substantial amount of work would still need to be done to improve our understanding of vaccination behaviour and to recommend policies that allow improving overall societal welfare in a world where extended coverage is important in itself and generates positive externalities.

2.2 Cross-sectional survey monitoring vaccine acceptance and demand

This cross-sectional survey was commissioned in 2021 and the contributors of this activity are Baggio M., Nohlen, H. (team members of the CCBI), Pantazi, M. (Université Libre de Bruxelles) and Proestakis, A. (Hellenic Mediterranean University), who designed the study and analysed the data collected. The study was carried out by LE Europe and Ipsos on behalf of the JRC.

The goal of the activity was to collect information on vaccine confidence and hesitancy in the EU, with a specific focus on the attitudes of parents of children aged 18 months to 18 years, as well as the general population, to assess the behavioural determinants of vaccine hesitancy across different sub-groups of the population and for specific vaccines in selected Member States. The outcome of this activity is meant to be used to facilitate the identification of the most promising areas of implementation of behavioural insights to improve vaccine confidence.

More in detail, the activity aimed at:

Objective #1 – Collecting information on parents’ understanding of their country’s vaccination framework, as well as what determines or hinders their willingness to have their children vaccinated and how to overcome potential barriers to vaccination. The information collected would be then used to create a reliable taxonomy of parents’ profiles.

Objective #2 – Understanding behavioural attitudes of the general population (18+) towards vaccines in general, and towards specific vaccines, and how to overcome potential barriers to vaccination.

Objective #3 – Understanding whether, and if so how, parents’ and other adults’ attitudes towards vaccines change over time.

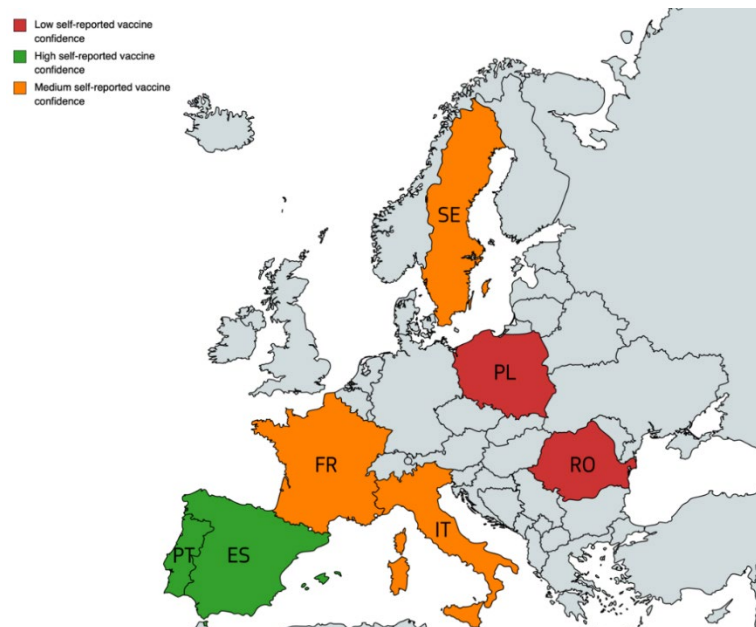
Key findings of this cross-sectional survey will be available to the public in due course in the form of JRC science for policy briefs and/or peer reviewed scientific articles. A policy brief “Perceptions of the COVID-19 pandemic phases and future waves” has already been published and can be found [here](#).

2.2.1 Survey design and methodology

The activity consisted of three repetitions of a cross-sectional survey. In terms of geographical scope, the research had to be applicable across all EU 27 Member States plus Norway, Iceland and Liechtenstein. The choice of countries to be covered followed both a principle of good geographical spread and good representation of different levels of country average self-reported vaccine confidence (based on the [Special Eurobarometer 488](#)

- [Europeans' attitudes towards vaccination](#)). The online repeated cross-sectional survey was carried out in seven EU Member States (Italy, Spain, Portugal, Romania, Poland, France, and Sweden), in the respective official languages. In Figure 3 the selected countries are represented: in red are the member states with low, in orange with medium and in green with high self-reported vaccine confidence.

Figure 3 - Selected member states, self-reported levels of vaccine confidence



Map created with mapchart.net.

2.2.1.1 Geographical scope

For each Member state, we collected key figures on how national vaccination programmes are carried out, which vaccines are recommended or compulsory, and how much they cost if they are not free of charge. We also recorded major changes in the vaccination programmes and how the COVID-19 vaccination was integrated. Our goal was to collect timely and accurate information on vaccination schedules at the time of the study. However, since vaccination schedules, especially with reference to COVID-19 vaccinations, are subject to changes in time, we accept no responsibility or liability whatsoever regarding the information on vaccination schedules in this section. If errors are brought to our attention, we will try to correct them, but we strongly recommend that readers access the latest information on the European Centre for Disease Prevention and Control (ECDC) vaccine scheduler⁵ or the relevant national competent authorities' resources. The following information was the most accurate at pre-data collection time (December 2021 – January 2022)⁶, and is presented in the next paragraphs in a shortened format.

Vaccinations in **Spain** are **recommended**. However, since 2012 Castilla y Leon and Extremadura require vaccination records to be up to date for children to be admitted in nursery. Sometimes schools and summer clubs require a vaccination card to admit children. This often results in an “informal mandate” for vaccinations. All the recommended vaccinations are **free of charge**. However, there is an interesting case regarding chickenpox (varicella): around 2012-13 in the regions where varicella was scheduled later in childhood (after 12 years old) many parents purchased the vaccine to anticipate the vaccination, compared to the proposed schedule (at a cost of around 70€). In 2015-16 the schedule was changed to accommodate this phenomenon. The recommended vaccines are generally **administered in primary care centres** in the public clinics network. The Human Papilloma Virus (HPV) vaccine is recommended for females only (two doses), and

⁵ The ECDC vaccine scheduler is accessible at <https://vaccine-schedule.ecdc.europa.eu>.

⁶ For example the readers might notice that a number of COVID-19 vaccines are not listed (Valneva, Nuvavaxoid, VidPrevty Beta), since those were approved for use at the time of the study. Updates on the list of vaccines approved by the European Medicines Agency (EMA) are available at <https://www.ema.europa.eu/en/human-regulatory/overview/public-health-threats/coronavirus-disease-covid-19/treatments-vaccines/vaccines-covid-19/covid-19-vaccines-authorised#originally-authorised-covid-19-vaccines-section>

the first opportunity to take this vaccine is offered at the age of 12, but then the catch-up can be done until 18 years old. For what concerns COVID-19, the approved vaccines for use were SpikeVax (Moderna), Comirnaty (Pfizer/BioNTech), Janssen (Johnson & Johnson) and Vaxzevria (Oxford/AstraZeneca). Pfizer and Moderna were available for children above the age of 12. Pfizer was also available for children aged 5 -11 since 15 December 2021. The EUDCC was in use for travel, and some regions (Galicia, Canaries) started requiring it as an alternative of a proof of vaccination / recovery.

In **Poland** vaccination is **mandatory** for 11 vaccines, namely tuberculosis, hepatitis B, diphtheria, tetanus, pertussis, poliomyelitis, Haemophilus influenzae type b, pneumococcal, measles, mumps and rubella (MMR). Vaccination schemes date back to 1919 (smallpox) and its modern form – to 1960s. Mandatory vaccinations are **free of charge** for everybody up to the age of 19. The recommended, elective vaccines (Rotavirus, Meningococcal C, HPV, influenza) are not free and need to be paid by either patients individually, by employers or from individual private insurance funds. The cost of the HPV vaccination, per dose, is currently around 60 euros. Each child at birth receives an immunization card which is stored at the **general practitioner's** office and is used to monitor progress through the immunization schedule. Based on this card, the general practitioner calls parents for well-baby visits and administers scheduled vaccines as part of developmental monitoring. Vaccinations can also be undertaken by nurses and midwives in individual **medical practices**, individual specialist practices or group practices of nurses and midwives. For what concerns COVID-19 the approved vaccines for use were SpikeVax (Moderna), Comirnaty (Pfizer/BioNTech), Janssen (Johnson & Johnson), Vaxzevria (Oxford/AstraZeneca). Pfizer and Moderna were available for children above the age of 12, while Pfizer for children aged 5-11 was available from 14 December 2021. The EUDCC was in use for travel in the EU.

In **France** for children born after the first of January 2018 there are 11 **mandatory vaccines** (tetanus, diphtheria, poliomyelitis, Haemophilus influenzae type b, pertussis, Streptococcus pneumoniae (pneumococcal vaccine), group C Neisseria meningitidis (meningococcal C vaccine), hepatitis B, rubella, measles and mumps). Some vaccines are currently only recommended (HPV and others for at risk categories). In France vaccines used in both mandatory and recommended immunizations are **covered by the statutory health insurance**, hence **free of charge**. Most childhood vaccinations are administered by self-employed general practitioners. However, they can also be administered by hospital doctors, nurses (if prescribed by a doctor), in public vaccination centres, in mother and child health services, and by midwives for pregnant women, cohabitating relatives, and relatives of new-borns under the age of eight weeks. Pharmacists sell vaccines, and they can administer the flu vaccination. 85% of infant immunizations are done by **private practitioners** (equal share between GP and paediatricians), while the remaining part is done at MCH clinics (**maternal and child health** – for children up to 6 years of age). The HPV vaccine is only recommended for girls. For what concerns COVID-19, the approved vaccines for use were SpikeVax (Moderna), Comirnaty (Pfizer/BioNTech), Janssen (Johnson & Johnson), Vaxzevria (Oxford/AstraZeneca). Pfizer and Moderna were available for children above the age of 12. Pfizer was available for children 5 -11 but only if they were at risk or lived with a person at risk of developing a serious form of COVID-19. The EUDCC (Pass Sanitaire) was in use for travel, but also for the following activities: restaurants, museums, conferences, services, etc.

Currently in **Italy** there are 10 **mandatory vaccinations** for children aged 0-16 (polio, diphtheria, hepatitis B, Hib, pertussis, measles, mumps, rubella, and varicella). Some vaccinations are recommended (rotavirus, pneumococcal, meningococcal, HPV). Until June 2017 only four vaccinations were mandatory. Chicken pox (varicella) vaccination is compulsory for children born from 2017 onwards. All the vaccines included in the vaccination plan are provided **free of charge**. All vaccinations, except against influenza, are mainly administered by nurses (or, less often, by doctors) **in the local health units**. Paediatricians do not have an active role in the vaccination procedure, but some regions are currently investigating their involvement (piloting). For what concerns COVID-19, the approved vaccines for use were SpikeVax (Moderna), Comirnaty (Pfizer/BioNTech), Janssen (Johnson & Johnson), Vaxzevria (Oxford/AstraZeneca). Vaccination was open from 12 years of age (Pfizer and Moderna). Pfizer was also available for children aged 5-11 from 1 December 2021. The EUDCC (Certificazione Verde) was in use for travel, transport, work, school and university, health sector, access to service.

Vaccinations in **Portugal** are **recommended**. The national immunization programme was established in Portugal in 1965. Several vaccines have been included under the national immunization programme since its inception. Currently, the Portuguese national immunization programme includes vaccines against hepatitis B, diphtheria, tetanus, pertussis, H. influenzae type b, poliomyelitis, pneumococcal disease, meningococcal disease, measles, mumps, rubella, and human papilloma virus. Vaccines that are included in the national programme are **free of charge** for all. Vaccines included in the national immunization programme (such as

the MMR vaccine) are mainly provided at **National Health Service primary health care units**. Alternatively, private health care units can also offer national immunization programme vaccines, according to specific agreements with the Regional Health Administrations, which are responsible for providing the vaccines for those private units. Nurses are the health care workers involved in the implementation of the national immunization programme by administering vaccines and maintaining vaccination records. For what concerns COVID-19, the approved vaccines for use were SpikeVax (Moderna), Comirnaty (Pfizer/BioNTech), Janssen (Johnson & Johnson), Vaxzevria (Oxford/AstraZeneca). Pfizer and Moderna were available for children above the age of 12. Vaccination with Pfizer for children 5-11 was available since 18 f December 2021, by age groups. The EUDCC was in use for travel in the EU. Furthermore, it was needed to enter major cultural events, bars and restaurants, health facilities.

Vaccinations in **Romania** are **recommended** (TB, diphtheria, tetanus, pertussis, poliomyelitis, Hib, hepatitis B, pneumococcal disease, MMR, HPV). A draft Vaccination Law to make vaccination mandatory (by checking the vaccination history of children when they start school) was issued in 2017 and generated intense public debate. At the time of data collection, the Law was withdrawn. All vaccinations are **free of charge, except for the HPV**. The cost of the HPV three-dose course was around 300 euros. Vaccination is performed by **family doctors** (except for those vaccines administered at birth in **neonatal departments**, in tuberculosis outpatient clinics, in health units hosting abandoned children, and in **vaccination centres** where vaccinations are performed on request or in case of epidemics). For what concerns COVID-19, the approved vaccines for use were SpikeVax (Moderna), Comirnaty (Pfizer/BioNTech), Janssen (Johnson & Johnson), Vaxzevria (Oxford/AstraZeneca). Pfizer and Moderna were available for children above the age of 12. The EUDCC was in use for travel in the EU, for access to public location and to access to non-essential services (restaurants, stores, swimming pools, gyms).

In **Sweden** vaccinations are **recommended** and **free of charge**. The vaccination schedule was updated in 2014 and 2019. There were 11 vaccinations recommended in Sweden: rotavirus infection, diphtheria, tetanus, whooping cough, polio, infections caused by Haemophilus influenzae type b, measles, mumps, rubella, serious diseases caused by pneumococcus and human papillomavirus (HPV). Since 2016, all regions additionally have offered all infant vaccinations against hepatitis B. The HPV vaccination is recommended to both genders from the age of 10. Before starting school, children are offered vaccinations within the framework of the **child health services**, usually at **well-baby clinics**. Vaccinations offered during school-age are the responsibility of the school health services. For what concerns COVID-19 the approved vaccines for use were SpikeVax (Moderna), Comirnaty (Pfizer/BioNTech), Janssen (Johnson & Johnson) and Vaxzevria (Oxford/AstraZeneca). In Sweden, vaccination against COVID-19 was voluntary and free of charge. Anyone over the age of 12 could be vaccinated, however the country decided against recommending COVID-19 vaccines for kids aged 5-11. For children the only vaccine available was Pfizer. In Sweden the EUDCC was only in use for travel.

2.2.1.2 Sample size and fieldwork

The online repeated cross-sectional survey was conducted among two main target groups of EU residents: the **general population sample** and the **parental sample**.

The survey for the general population of residents in each of the 7 EU Member States in scope was addressed to citizens aged 18 years and over. The universe description (population distributions) was based on demographic data as published by Eurostat. In addition to the general population, the survey also included a sample of parents of children between the ages of 18 months and 18 years old (i.e. the parental sample). For this segment, no official statistics in Europe are available. For the sample of parents, however, targets for child age ranges were determined per country by the CCBI. In all countries, non-probability/volunteer online access panels were used as a sampling frame. Respondents were randomly drawn from the online panels; for the parental sample, parents were pre-targeted within the panels.

After having piloted the survey between 29 November and 15 December 2021, the cross-sectional survey was repeated three times. The main stage fieldwork for time point 1 was launched on 24 February and ended on 7 March 2022, for time point 2 it was launched on 4 April and ended on 18 April, and for time point 3 it was launched on 9 May and ended 23 May 2022.

A total sample of 36,087 respondents was achieved as described in detail in Table 1 below. A fresh sample was available for each repeated survey, for both the general population and the parental sample. The data analysis was carried out with the STATA16 software. The ethical approval was obtained from the JRC Research Ethics Board.

Table 1 - Country coverage and sample achieved, across all three waves

		General population sample	Parental sample	Total
Country	Italy	2580	2577	5157
	Spain	2571	2589	5160
	Portugal	2591	2588	5179
	Romania	2578	2587	5165
	Poland	2568	2573	5141
	France	2569	2560	5129
	Sweden	2581	2575	5156
Total		18038	18049	36087

The CCBI had previously conducted an exploratory experimental survey covering six Member States (same selection covered in this study, except for Sweden), with approximately 9,000 respondents (see section 3.1). The questionnaire in use for the exploratory experimental survey served as the basis for designing the repeated cross-sectional survey. The main topics covered in the survey were: trust in institutions related to vaccination in general and the management of the pandemic; vaccination decisions, centered mainly on three vaccines (HPV, MMR and COVID-19); role, and perception of, health care providers; risk perceptions and use of sources of information; social norms and social networks; health literacy and numeracy.

The questionnaire in use for this study was structured in the following blocs:

- Screening questions to determine whether respondents were eligible for either the general population or the parents' survey.
- For both samples, questions about trust in the management of vaccination programmes and the management of the COVID-19 pandemic.
- For parents, questions about up to two children's exact vaccination dates (of HPV, MMR vaccines) per respondent (with separate sections for different categories of parents, namely acceptors / hesitant acceptors / skippers / delayers), reasons for being late/skipping/hesitant regarding children's vaccination, influence of paediatricians and HCP on health choices for the child.
- For parents, questions about social norms and the influence of the respondent's social network and groups in the health decisions taken.
- For parents, questions about psychological antecedents of vaccination (e.g., experience of the respondents with vaccinations in the past, with a particular focus on the role of primary health care providers).
- For both samples, questions to assess the respondent's health numeracy.
- For both samples, questions about the respondent's vaccination record and approach to life-course vaccination.
- For both samples, questions replicating the 5C model (an extension of the 3C model, including also Calculation and Collective responsibility), in order to corroborate the results of the survey to those of a validated scale.
- For both samples, questions about COVID-19 vaccination, including reasons for (not) being vaccinated and the perceptions of different types of vaccines.
- For parents, questions about COVID-19 vaccination for children, including reasons for (not) having vaccinated e their child(ren).
- For both samples, questions about the respondents' views on the EU digital COVID-19 certificate (EUDCC).
- For both samples, socio-demographic questions on the respondent and the respondent's partner.
- For parents, question to upload a picture/scan of the child's vaccination card, for the purposes of assessing data accuracy.

The questionnaire was optimised and finalised for piloting. Compared to the original questionnaire in the first exploratory experimental survey conducted by the CCBI, the questionnaire piloted was subject to a variety of amendments. Before the revised version of the questionnaire was piloted, the questionnaire's routing and

scripting instructions were thoroughly reviewed by both Ipsos and the CCBI. The pilot aimed to test the functionality of the online questionnaire and to assess whether respondents may have had any difficulties understanding the questions and tasks they needed to complete. Based on the pilot, some minor adjustments were implemented to the survey.

Last, in order to account for changes regarding COVID-19 vaccination, the questionnaire was integrated in both the second time point, when questions about the vaccination status of refugees fleeing Ukraine were added, and the third time point, when questions on the perceptions on the status of the pandemic and the likelihood of a next wave were investigated.

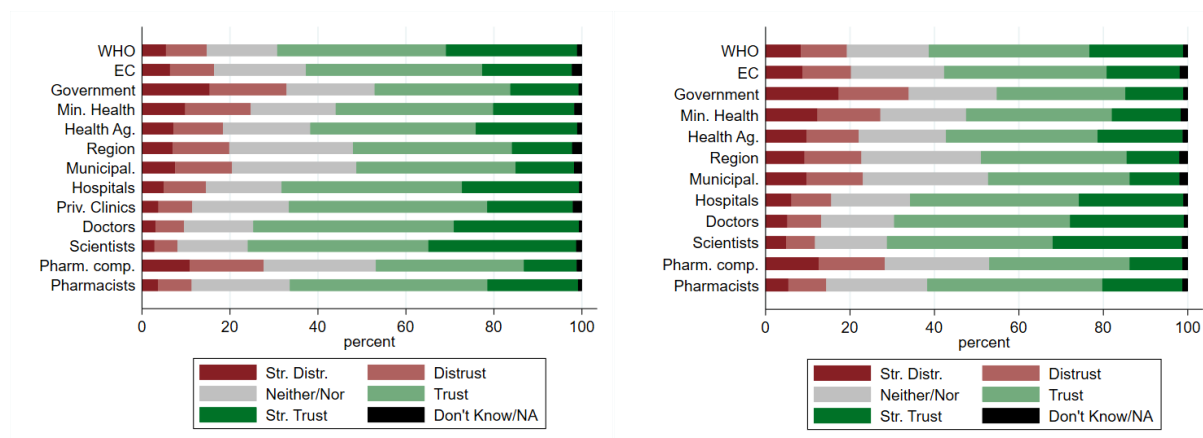
2.2.2 Lessons learnt and policy recommendations

The study has highlighted the complexity of vaccine acceptance and demand, bringing to attention several challenges and opportunities. This report has highlighted several behavioural determinants of vaccine acceptance and demand, pointing policymakers in the direction of behavioural interventions that could be introduced at national and local level. We ran an in-depth analysis of the first repetition of the survey and since we haven't detected significant differences between the three waves, we consolidated the dataset into one.

First, we looked at **civic trust**, which is an individual's confidence in institutions or actors to act with a specific purpose (*"A trusts B to do X"*, Kumagai and Ilorio, 2020). The **most trusted** in their role in vaccination programmes were **scientists**, followed closely by **doctors**. On the other hand, the **least trusted** were **pharmaceutical companies**. The European Commission scored a similar level of trust compared to national health authorities and pharmacists. The European Commission was trusted more than national governments, ministries of health, regional authorities, municipalities and pharmaceutical companies but less than WHO, hospitals, private clinics, doctors and scientists (Wilcoxon signed-rank test, $P < .01$).

When asked about the management of the **COVID-19 crisis**, respondents showed a lower level of trust across all institutions and stakeholders. As seen for vaccination programmes, the **most trusted** in handling the COVID-19 pandemic were **scientists**, followed closely by **doctors**. On the other hand, the **least trusted** were **National Governments**. The European Commission scored a similar level of trust compared to national health authorities. The European Commission was trusted more than national governments, ministries of health, regional authorities, municipalities, and pharmaceutical companies, but less than the WHO, hospitals, doctors, scientists and pharmacists. Understandably, the picture by country was somewhat different from the overall view: for example, Italy, although not faring particularly well in trust across institutions, has seen the least trust erosion across institutions. Portugal as well did not show major differences between the two levels of overall trust. On the other hand, Romania has the lowest levels of both trust items, as well as the biggest negative difference between the two.

Figure 4 - Trust in Institutions and other stakeholders involved in vaccination programmes (left) and handling the Covid-19 pandemic (right)



Although trust is a complex, multidimensional, cultural concept, and too often it has been viewed by policymakers and other actors as too sensitive and hazy of an issue to be addressed, it has become evident that trust measures are fundamental to social and economic outcomes. Recent research has shown that trust levels have been tarnished by the effects of the pandemic ([Standard Eurobarometer 96 - Winter 2021-2022](#))

and [Edelman Trust Barometer](#) 2022). However, trust in institutions is key to improve vaccination demand and acceptance: the greater the civic trust, the higher the vaccination rates. This study showed that trust in institutions was lower when related to the management of the pandemic (which includes vaccination), compared to the overall trust in managing vaccination programmes in general. **Recovering the loss of trust in institutions caused by the pandemic should be of paramount importance.** We therefore urge policymakers and stakeholders from different groups to look at these results, broken down by country, and pinpoint critical areas and design interventions to increase trust.

This study also looked at **vaccination cards**: these are an important tool and proxy for vaccine acceptance and demand and are essential in the management of the health care of children and adults (Wagner, 2019). Our study showed that mothers report more often having a vaccination card compared to fathers, and this parental difference is true in all seven MS studied. Just short of **70%** of respondents declare of either having their **own vaccination card**, or their parents having it. Also in this case, compared to men, women are more likely to report having a vaccination card. Having a vaccination card or record is a key instrument to make sure that one's vaccination status is up to date and appropriate for their age and lifestyle. Not having it ready, or not having it at all could be problematic, also considering new outbreaks and lack of centralized immunization information system. We urge policymakers to reflect on both the need to promote home-based health records for all citizens, as well as to consider gender differences when targeting behavioural interventions.

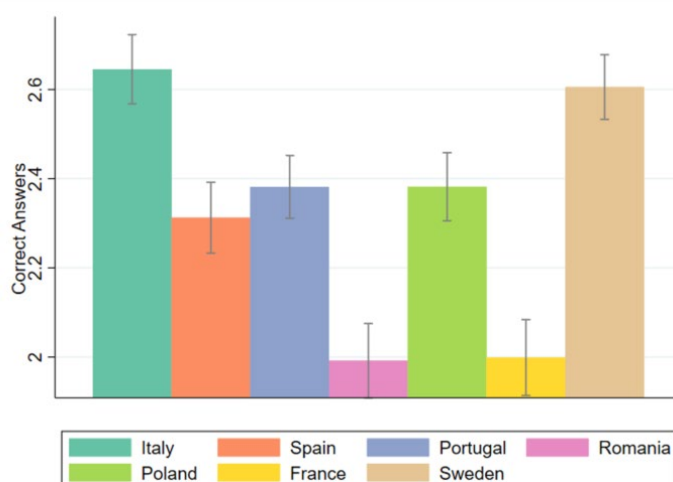
Combining several questions in the survey, this study also introduced a **parental taxonomy**, with predictable behaviours and beliefs for different categories of parents. The proposed taxonomy of parents classifies them in four distinct categories:

1. **Acceptors**, whose children have followed the national vaccination schedule.
2. **Hesitant acceptors**, whose children have followed the national vaccination schedule, but actively considered delaying or skipping one or more vaccinations.
3. **Delayers**, whose children have been vaccinated following the national vaccination schedule but were late (over one month) compared to what the national vaccination schedule suggested.
4. **Skippers**, whose children did not get one or more vaccines included in the national vaccination schedule.

According to our study, **acceptors and delayers**, have similar behavioural profiles, and tend to be **more reliant on expert advice**, while **hesitant acceptors and skippers** are more reliant on their **own research**, basing their decisions on peer-to-peer exchange of information. This finding is key and raises awareness on the efficacy of vaccination education and promotion campaigns. Oftentimes policymakers believe that informing the public is sufficient to change behaviour, however results from this study show that the source of information matters. While acceptors and delayers trust information coming directly from experts, hesitant acceptors and skippers prefer to find information on their own terms. This must be reflected in education and promotion campaigns, potentially providing a more active role to those parents who prefer a higher degree of involvement. At the same time further, research on the reasons behind this preference should be carried out, so that this phenomenon is better understood, and not simply identified. When parents rely on their own research, they could easily fall prey to **mis- or disinformation**. Empowering highly involved parents with tools to protect themselves from mis- and disinformation could be one of the many potential interventions' policymakers should consider. Parental education level, income level, health literacy and age have also been found to play an important role in vaccination decisions. **Promoting health literacy and numeracy** is another pillar to work on to improve vaccine acceptance and demand. **Health literacy** is a person's ability to understand and use information to make decisions about their **health**. **Health numeracy** describes a person's ability to understand clinical and public **health** data. Health literacy and numeracy are associated with several undesirable health outcomes related to poor health status. Hence, the improvement of health literacy and numeracy is crucial to develop a new type of relationship between individuals and the healthcare system (Lorini et al., 2018). The information about vaccines tends to be complex and understanding this information requires a certain degree of literacy and numeracy skills. Therefore, communicating vaccine related information to patients is sometimes a challenge, particularly if patients have a low health literacy or numeracy (Rowlands, 2014). In such a scenario, health literacy, and specifically vaccine literacy, can influence vaccine uptake. Hence, vaccine literacy and numeracy should be considered as two of the potential determinants of vaccine acceptance and demand (Biasio, 2017).

In this study, we used four questions to elicit participants' health literacy and numeracy level. The questions were taken by Schwartz et al. (2005) and adjusted to the European context. In Figure 5, we show the average number of correct answers by country ranging from a minimum of 0 (no correct answers) to 4 (all answers were correct). Italian and Swedish respondents were the more successful, while all other countries gave significantly lower number of correct answers. The lowest scores were those of Romanian and French respondents (with 2 correct answers). Checking for gender differences, we found that males gave more correct answers than females in Romania and Italy, while there was no significant difference in other countries. The average probability of a parent with 3 or 4 correct answers to report that his child has skipped the MMR vaccine is below 6% while the respective probability of a parent with 0 correct answers is about 10.4%. This means that parents with higher health literacy scores have a lower probability of skipping the MMR vaccine."

Figure 5 -Health literacy - average correct answers by MS



Another objective of this study was to understand how parents perceived the risk for children to contract a vaccine-preventable disease: we found that parents of unvaccinated children felt as safe as parents of fully vaccinated children.

Furthermore, three vaccines were studied: **measles, mumps and rubella (MMR)**, **human papilloma virus (HPV)** and **SARS-CoV-2 (COVID-19)**. In our sample, around 5% of parents declared having skipped the MMR vaccine, and convenience reasons were the most frequently cited, followed by confidence reasons, and only then complacency reasons. The same applied for delaying the MMR vaccination. We found parents relying more on experts' opinions to be less likely to skip the MMR vaccination than parents relying more on own research activities. Regarding HPV, in our sample the percentage of parents declaring having skipped the HPV vaccine was around 34% (a result in line with the available UNICEF HPV immunization coverage estimates⁷). Confidence reasons were the most frequently cited, followed by convenience reasons, and only then complacency. For what concerns delaying the HPV vaccination, convenience reasons were the most frequently cited, followed by confidence and complacency.

On **social networks influence**, we found that parents' second-order beliefs (i.e., parents' beliefs about what others believe) about vaccine safety and necessity had a positive effect on both parents' routine immunisation and COVID-19 vaccination decisions. We estimated that parents who believe that their friends consider vaccination to be unnecessary had a 2-3 times higher probability (depending on the vaccine) to skip the vaccine, compared to parents believing that their friends considered vaccination to be necessary. The estimated effect was found even stronger for parents' beliefs over the compliance level of other parents. In some cases (e.g., of the MMR vaccine) we found that parents believing that their friends had skipped all vaccines, had themselves a probability to skip the MMR vaccine which was four times higher than the corresponding probability of parents believing that their friends are compliant. As suggested by Konstantinou

⁷ Available at <https://data.unicef.org/resources/dataset/immunization/>.

et al. 2021, public health authorities should **design interventions that include the involvement of family and friends** to result in greater vaccination uptake.

COVID-19 vaccination decisions in children were found to be highly correlated with and to be affected by similar factors to routine immunization decisions, such as experts' advice, education, income, age and health literacy. This is a key finding for policymakers as access to vaccination registries would allow to track past behaviour and lead to targeted policy interventions, mainly towards hesitant parents, but also adults. This could be especially important when new vaccines are made available to citizens, or when other vaccination campaigns are required for public health purposes. In other words, since **past vaccination behaviour is a good predictor of future vaccination choices**, administrative data on vaccination should be tapped into for better behaviour predictions and targeted behavioural interventions.

For the COVID-19 vaccination we also investigated **conflicting thoughts**, defined as psychological conflict between opposing evaluations, often experienced as being torn between alternatives. We found that parents of vaccinated children had significantly lower conflicting thoughts, compared to parents whose children were eligible but not vaccinated. This could either mean that parents with vaccinated children did a reconciliation of their doubts after the vaccination, or that conflicting thoughts about the vaccination are one of the reasons why vaccination was stalled. As for the reasons why parents vaccinated, or were willing to have their children vaccinated, the most frequent reason mentioned was to protect the children themselves. On the other hand, for the parents who did not vaccinate, or were not willing to have their children vaccinated, the most compelling reason was linked to doubts about the safety of the vaccine.

The self-reported **COVID-19 vaccination** coverage (VC) for the **general population** was overall 84.47%, with the highest in Spain and Portugal (95%) and the lowest in Romania (67%). The data collected was coherent with the available information from the ECDC, except for Romania. In this case the self-reported vaccination status was higher than official statistics, signalling either a sample selection bias in the study or that answers were affected by social desirability. As we have seen for children, also for the general population the most frequent reason to obtain the vaccine was to protect oneself. Of the unvaccinated portion of our sample, 66% declared that they were not willing to get vaccinated at all and only 10% that they would possibly do so in the future. The reasons most frequently given for the unwillingness of the unvaccinated were the low perceived safety and efficacy of the vaccine. The study also confirmed that the age, education health literacy and income were predictors of vaccination uptake.

In the second and third time points of the study we included questions on the current **Ukrainian refugee** crisis in the context of the COVID-19 pandemic and of the national vaccination programmes. A large majority of respondents agreed that people who fled the war in Ukraine and are now in one of the studied MS **should be vaccinated according to the national vaccination plan, including COVID-19**. However, respondents were undecided about the need to subject entry into the EU for Ukrainian refugees to the condition of a proof of the COVID-19 vaccination or to the requirement of vaccination at the border.

In time point 3 of the study, we included a set of questions on the **perceptions on the status of the pandemic**, both at country and global level, as well as on the **likelihood of a new wave of COVID-19 before the end of 2022⁸**. Since **stepping up vaccination and boosting** would require campaigns with tailored messaging, if the campaign is targeting the unvaccinated, then policymakers should be aware of the fact that the **unvaccinated** thought that the **COVID-19 pandemic was almost finished and that a next wave was not very likely** before the end of 2022. We urged policymakers to acknowledge this difference and match epidemiological intelligence with tailored information campaigns aimed at remedying wrong beliefs. At the same time, the **unvaccinated did not expect to take up the vaccine in the future**, and therefore could be hard to reach with universal messages that promote vaccination, if at all. On the other hand, since there was a strong association between the increased perceived risk of a new wave and the willingness to get a booster, the **vaccinated** population could be **more responsive to information about the potential next wave of the pandemic**. However, it is important to stress that our evidence also showed that **also the vaccinated who think that a next wave was unlikely to happen tend to be less prone to get a booster**. Tailored messages for this specific category should be carefully designed to be effective, possibly by clearly communicating the likelihood of a new COVID-19 wave in the future. Also, the

⁸ A Science for policy report focused on these results is available at <https://publications.jrc.ec.europa.eu/repository/handle/JRC129853>

evidence collected is relevant in the fight against mis- and disinformation on COVID-19 vaccines. The understanding of the pandemic phases and likelihood of next waves is critical: for example, misinformation that Omicron is “the last COVID-19 variant” gained traction in spring of 2022 and it is likely that similar arguments would resurface in the future. This could be especially critical if such messages are linked to vaccination being “unnecessary” given the status of the pandemic and the likelihood of next waves. Making sure to link information campaigns with this evidence and epidemiological intelligence is key if the objective is to anticipate mis- and disinformation messages.

Finally, we investigated the perceptions of respondents regarding the **EU digital COVID certificate**: countries with higher vaccination rates tended to have more positive views on the EUDCC compared to countries with lower vaccination rates. The EUDCC was also viewed as a means to make the COVID-19 vaccination mandatory, but also as something that made travelling and the reopening of the society easier during the most complicated phases of the pandemic.

2.3 Behavioural data-linking study on knowledge, attitudes and practices towards vaccination among paediatricians: the case study of Italy

This study was commissioned in 2021 and the contributors of this activity are Casigliani V. (University of Pisa), Collini F. (Regional health agency of Tuscany), Di Maggio E. (University of Foggia), Forni S. (Regional health agency of Tuscany), Fortunato F. (University of Foggia), Galletti G. (Regional health agency of Tuscany), Gemmi F. (Regional health agency of Tuscany), Martinelli D. (University of Foggia), Menicagli D. (IMT Lucca), Szasz C. (Regional health agency of Tuscany), Tavoschi L. (University of Pisa), Baggio M., Nohlen, H., (team members of the CCBI), Proestakis, A. (Hellenic Mediterranean University), who were all involved in the design, administration of the study and analysis of the data collected.

As we have already mentioned, in Italy, vaccinations included in the National Immunization Schedule are actively offered free of charge to the general population as a benefit package of health services and have to be guaranteed to all citizens. The life-course approach to vaccination was first introduced in Italy with the 2012-2014 Plan, as a milestone in the national health policy agenda. Nevertheless, vaccine coverage (VC) was observed to decrease over the years until 2017 when the Italian government extended mandatory vaccinations from 4 to 10 for all children from 0 up to sixteen years of age. Together with vaccination against diphtheria, hepatitis B, polio, and tetanus, which were already compulsory, now also the vaccination cycles for *Haemophilus influenzae* type b and pertussis vaccinations and Measles, Mumps, Rubella, and Varicella (MMRV) are a requirement to attend educational services (Law n. 119/2017). The introduction of mandatory vaccination had an immediate impact on VC for all vaccines. Recently available data from the Italian Ministry of Health showed that in 2019 the threshold of 95% was reached for hexavalent vaccination (DTaP-Hib-IPV-HepB: diphtheria, tetanus, acellular pertussis, *Haemophilus influenza* type B, poliovirus and hepatitis B) while coverage for one dose of MMR among children of 24 month of age was 94.5%. During the first three years following the introduction of the law 119/2017, a significant increase in VC level was also recorded for the recommended vaccinations against meningococcus B and C, pneumococcus, and rotavirus (Sabatucci et al, 2021). In this scenario, the global pandemic of COVID-19 had a detrimental impact on all preventive service delivery, including those providing routine immunizations. As a direct consequence, VC for mandatory vaccinations declined in 2020 compared to 2019 (decrease range: -1% to -2.7%) and for most of the other recommended vaccinations (range -1.4% to -2.7%).

Declines in vaccine coverage as those experienced in Italy in the last decade can be explained by a mix of different factors that can include the capacity of the health system to safely meet citizens' essential needs and the heterogeneity in the vaccination policies, as well as the low perceived risk of infectious diseases, and the confidence in the availability of antimicrobial therapies, to name but a few. Among this complex pattern of factors that can affect the parents' decision whether to have their children vaccinated, the role of family paediatricians appears crucial in influencing parents' decision-making process within the context of their trust-based relationship. In this sense, some studies reported that the paediatricians' individual attitude towards vaccinations influence their propensity to recommend this preventive intervention. In Italy, a Knowledge, Attitudes, and Practices (KAP) study conducted among a large number of paediatricians from February to March 2016 pointed out some gaps between physicians' overall positive attitudes towards vaccination and their knowledge, beliefs, and practices (Filia et al., 2016). Moreover, a significant proportion, particularly, of younger paediatricians did not feel sufficiently knowledgeable about vaccine safety and how to address parents' questions. Finally, one third of respondents did not routinely verify their little patients' vaccination status.

In consideration of their critical role in the successful implementation of childhood vaccination strategies, it is important to investigate how family paediatricians' (in Italian, *pediatri di famiglia*, are doctors who have an agreement with the Italian National Health Service, specializing in the care of children and adolescents) attitude may influence parents' decision to vaccinate their children, and ultimately vaccine coverage. At the same time, in the post-acute phase of the health emergency, it appears crucial to better understand how the COVID pandemic impacted on paediatricians' perceptions and practices on vaccinations.

This study aimed at investigating the attitude of Italian family paediatricians (FP) towards childhood universal vaccinations by assessing knowledge, attitudes, and practices in relation to coverage for polio, measles and HPV vaccinations, during the specific contextual conditions determined by the COVID-19 pandemic.

The specific goals set for this study were to:

Objective #1: Analyse vaccination coverage for a specific selection of vaccinations (indicator vaccinations) on a regional basis and among the children assisted by individual FP (Apulia and Tuscany regions).

Objective #2: Describe the attitudes, knowledge, and practices in vaccination among Italian FP in the pandemic era, with a focus on professionals operating in Apulia and Tuscany regions.

Objective #3: Identify factors that influenced FP in recommending/administering the vaccinations foreseen by the national immunisation schedule.

Objective #4: Measure the impact of the pandemic on childhood vaccination activity and coverage for selected indicator vaccinations.

Key findings of this behavioural data linking survey will be published in due course in the form of JRC science for policy briefs and/or peer reviewed scientific articles.

2.3.1 Study design and methodology

The study was structured in two complementary approaches: the evaluation of vaccination coverage data in Apulia and Tuscany regions; and the administration of a survey to family paediatricians operating in Italy, with a specific focus on Apulia and Tuscany regions.

Figure 6 - Map of selected Italian regions



Map created with mapchart.net.

In the two regions, vaccination data are routinely recorded by the regional Immunisation Information System (IIS). For the purposes of the study, they were anonymised and provided by the Regional Health Agencies of Tuscany (Agenzia Regionale Sanità, ARS) and the Apulian regional authorities. Immunisations included in the analysis were anti-polio (IPV), usual proxy for the hexavalent vaccination; anti-measles (MMR/MMRV) as a proxy of anti-measle, mumps and rubella; anti-papillomavirus (HPV). The analysis of VC aimed at identifying significant differences in the selected birth cohorts. In addition, to verify the impact of the COVID-19 pandemic, vaccination coverage for the selected immunisations were analysed over time (2018-2020). The data analysis was carried out with STATA15 software. For each vaccination included in the study, the

regional-level immunisation coverage rates were reported. The number of eligible children, both in total and the median by paediatrician, were also reported.

The survey aimed at investigating:

- Trust in public health institutions, national and international.
- Clinical practice routine (e.g., opening hours of the individual practice, volume of parents attending the clinic).
- Attitudes, knowledge, and experience in relation to vaccinations (e.g., knowledge of vaccination schedules).
- Knowledge of the vaccination attitude of the parents whose children are assisted by the FP (e.g., reasons to skip vaccinations).
- Social norms and peer influence (e.g., regional vaccination coverage, vaccination coverage among children assisted by other FPs in the area).
- Attitudes linked to COVID-19 vaccination (e.g., vaccination status of the family paediatrician, attitude towards anti-COVID-19 vaccination for children).
- Socio-demographic information of the FP, including regional practice code.

The beta version of the questionnaire was piloted in self-administration mode, in online form, among a sample of ten FP to verify its clarity, acceptability and duration. Following the pilot phase, the questionnaire was refined and finalised for dissemination. The final questionnaire was programmed using online software (Qualtrics survey platform). The dissemination of the questionnaire was performed between September 2021 and March 2022 primarily online, but also via ad hoc webinars. The completed questionnaires were collected and transferred via a password-protected cloud system to the referents of the centres, where they were connected, for the Apulia and Tuscany regions, to the coverage data in the population of the individual paediatrician using the doctor's regional code in numeric format. Fifty-three Italian paediatricians responded to the survey, 43 from Apulia and 10 from Tuscany. Most of them were female, with a mean age of 56 ± 14 years and a mean professional experience of 31 ± 12 years. A study protocol was developed in the Italian language, and ethical approvals were obtained from both the JRC Research Ethics Board and from the University of Pisa Bioethics Committee

2.3.2 Lessons learnt and policy recommendations

Vaccination is one of the most efficient strategies adopted to prevent the spread of infectious diseases, but its success also depends on the support of medical authorities and the general population. **Children's vaccination relies on parents' and paediatricians' trust** in these procedures to achieve an adequate level of coverage. While efforts have been made in recent years to increase paediatric vaccination coverage rates in Italy, the global pandemic may have affected compliance with this preventive measure.

The analysis of regional **vaccination coverages** (as extracted from administrative data records) showed a **decrease from 2018 to 2020** for two of the three indicator vaccines considered: **Polio, MMR** first and second dose (only in Apulia). By contrast, **HPV vaccination coverage showed an increase in both genders**, albeit with some differences between the two regions. For the polio vaccination, it was possible to compare vaccination coverage by birth cohort from 2017 until 2020. A decrease in coverage was observed: an increasing proportion of paediatricians with overall vaccination coverage below 85% among the children under their care. The same pattern was observed for MMR in both regions. **HPV vaccination coverage showed an increase** in the birth cohorts from 2006 to 2008 in the two regions, **in particular among males**. The regional coverage, however, disguised **different levels of coverage between paediatricians**, that showed a different behaviour during the period analysed with a general increase of the paediatricians with a low coverage (<85%).

For the second branch of this project, a self-administered questionnaire targeting paediatricians, we found that almost a quarter of our sample claimed to sporadically support vaccination skipping for MMR and HPV, with a slightly higher number supporting HPV immunisation skipping. Interestingly, **paediatricians were able to report accurately vaccination coverage** in the population of the children registered for care in their individual practice, by vaccination type and gender (for HPV). Moreover, among paediatricians who reported to accept parental decision to skip a vaccine, the most endorsed justification was the presence of a medical

condition incompatible with children vaccination (allergy, illness, other diseases). Another relevant justification was related to **the possible “overload” of the immune system due to an excessive number of vaccinations, a consideration compatible with the lower support for the MMR vaccine.**

A second part of the survey required a classification of parents by the paediatricians according to their attitude towards vaccination, using the taxonomy developed in the repeated cross-sectional survey described in 2.2. While most **parents** were classified as acceptors, about **36%** of them could be described at various levels of **scepticism or avoidance towards vaccination**, with a mean of **6%** that were considered true **skippers**. This classification was matched with the paediatricians' consideration related to the main source of information based on parents' decision on vaccination. Paediatricians were also able to predict correctly what source of information each type of parent would use mostly to make vaccination decisions: the paediatricians-reported rate of **trust in experts was lower for acceptors compared to skippers, correctly reflecting our results from the cross-sectional survey.**

The last question to paediatricians was related to the COVID-19 pandemic and their global trust in various health agencies. The sample of professionals self-reported low trust in the WHO and local authorities, including local health providers. These opinions are probably motivated by the recent pandemic crisis and by the response of these specific agencies. Regarding paediatric COVID-19 vaccination, **paediatricians reported strongly endorsing vaccination for children between 12-15 years, but not for children between 6 and 12 years.**

The role of paediatricians is crucial to promote vaccination. Being able to identify paediatricians with low vaccination coverage and trends in time is paramount to focus and target behavioural interventions. The results of the survey provided insights on attitudes of the paediatricians towards vaccination. The link of the survey's results with the administrative data should help designing tailored strategies to increase paediatricians' attitudes to promote vaccination and their vaccination coverage rate. Despite the various and composite information provided by this study, the limitations of this analysis and the possible future research steps must be acknowledged. First, the conclusions on the vaccination coverage were limited to the first year of the pandemic: it could be interesting to extend the period of analysis to assess more accurately the potential impact of different stages of the pandemic. Then, the results from the self-reported survey were preliminary due to the restricted sample size. Plans for the near future are to extend the number of respondents in Italy, provisionally in 2023. This study however served as a pilot and learning exercise for the launch of the same initiative in France, Spain, and Poland. Furthermore, thanks to a larger dataset, a behavioural data-linking exercise between the survey's results and the vaccination coverage of each participant will be undertaken.

2.4 Symposium on vaccination and the pandemic

The CCBI organized a symposium to serve as a space for sharing research results, stocktaking, exploring, and discussing priorities and lessons learnt from behavioural sciences on vaccination and the pandemic. The pandemic has amplified some of the challenges already associated with vaccine acceptance and demand, but it has also stimulated related behavioural sciences research and innovation. Since the start of the COVID-19 pandemic in early 2020, many behavioural sciences researchers and practitioners have contributed to the understanding of the determinants of vaccine acceptance and demand. They have produced a wealth of knowledge that could prove useful for policymakers at the national and international level. There are lessons learnt not only on COVID-19 vaccination, but also on how the pandemic has changed routine childhood vaccination, life-course vaccination and future pandemic preparedness. The purpose of this symposium was to pull these sources of insight from behavioural science research and public policy together to paint a cohesive picture of the most effective, innovative, and impactful ways to increase vaccine acceptance and demand.

The event tried to answer the following questions:

- What behavioural insights could be leveraged during boosting campaigns?
- What type of reminders work best, and for whom?
- Are adults more conscious of life-course vaccination now compared to before the pandemic?
- What are the pressing concerns that parents have regarding COVID-19 vaccines?

The symposium took place on the 26th of April 2022, from 09:00 to 17:30. The event was hybrid, with participants online and in person in Brussels. Over 200 people registered and around 100 individuals were

actively participating on the day of the event. The symposium's audience included behavioural sciences researchers, practitioners and policymakers who work on public health from 37 countries across the world. The symposium was also a platform for facilitating novel academic research ideas and served as a means of inspiring those in policymaking to think about new innovative perspectives that embrace behavioural insights.

The symposium developed over three interlocking vantage points: the European Commission, International Organizations and Member States. In Table 2 we report the organizations represented, the names of participating speakers, presentation titles, brief summaries provided by the presenters, and links to supporting materials (if available).

The symposium has been recorded and is available online (<https://webcast.ec.europa.eu/vaccination-after-the-pandemic-lessons-from-behavioural-sciences> Access Password: VaC210416SC - please note that the recording will be available until 25/04/2024).

Table 2 – Symposium presentation and contents

Organization	Speaker	Title	Summary	Links
London School of Hygiene & Tropical Medicine	Emilie Karafillakis (European research lead - Vaccine Confidence Project)	<i>The Vaccine Confidence Report 2022: preliminary data, trends and the impact of COVID-19</i>	In 2016, Europe was identified as one of the regions in the world with the lowest level of public confidence in vaccination. Continuous monitoring of vaccine confidence is essential to detect possible changes in confidence levels and ensure rapid and targeted responses. Since 2018, the European Commission has been monitoring public and healthcare professionals' confidence in vaccination on a regular basis, looking at changes across time and between countries, as well as differences in confidence levels by vaccine. This presentation shared preliminary results from the 2022 State of Vaccine Confidence in the EU report, focusing on the impact of the COVID-19 pandemic on European populations' confidence in vaccines in general, as well as in the MMR, HPV and seasonal influenza vaccines.	https://www.vaccineconfidence.org
European Centre for Disease Prevention and Control	John Kinsman (Expert Social and Behaviour Change)	<i>Facilitating vaccine acceptance and uptake in the EU/EEA - lessons learnt from the COVID-19 pandemic</i>	This presentation provided an overview of the work that has been conducted by the ECDC aimed at promoting COVID-19 vaccine acceptance and uptake, including the extra support provided for countries with below-average coverage rates. The discussion included a focus on terminology and the various theoretical frameworks in use, and how these may either facilitate or inhibit acceptance and uptake. There were also reflections on the importance of maintaining policymakers' interest in COVID-19 vaccination when their focus might be diverted to other issues. This would be particularly crucial in anticipation of a possible upsurge in cases of COVID-19 caused either by a new variant of concern or during the autumn, due to seasonality.	https://www.ecdc.europa.eu/en/publications-data/facilitating-COVID-19-vaccination-acceptance-and-uptake
Joint Research Centre	Marianna Baggio (Policy Analyst – Joint Research Centre,) and	<i>Understanding and monitoring vaccine acceptance and demand: a multi</i>	A series of surveys focusing on the behavioural determinants of vaccination demand and acceptance in both parents and the general population was carried out in Italy, Spain, Portugal, Romania, Poland, France and Sweden. The study focused on	

	Antonios Proestakis (Hellenic Mediterranean University)	<i>country cross sectional survey</i>	MMR, HPV and COVID-19 vaccination, investigating key items such as trust in institutions, barriers to vaccination and the role of experts. The outcome of the study supported the identification of the most promising areas of implementation of behavioural insights to improve vaccine confidence. These will have an impact in the field of vaccination and will allow effective prioritization of resources at EU and national level, as well as enhanced capacity in Member States to implement effective policies and best practices.	
University of Pisa and IMT School for Advanced Studies Lucca	Virginia Casigliani (Public Health resident) and Dario Menicagli (Research collaborator)	<i>VaxPro: investigating family paediatricians' attitude towards vaccine promotion</i>	The purpose of this study was to investigate perceptions and attitudes towards vaccinations among family paediatricians in Italy (with the intention to extend it to family doctors and general practitioners in other Member States) as well as the self-reported counselling activity. This study matched the insights brought forward by the a repeated cross-sectional survey undertaken by the JRC and complemented it.	
University of Montpellier	Rustam Romaniuc (Associate Professor)	<i>Vaccination and the pandemic: a literature review</i>	This literature review, carried out with the support of the University of Montpellier, had 3 key objectives: understanding the behavioural determinants of adults and parents' COVID-19 vaccination demand and acceptance; compile a list of behavioural interventions aimed at maintaining and/or increasing COVID-19 vaccination coverage; and compile a list of lessons learnt for vaccination programmes in a post-pandemic world.	
Joint Research Centre	Hendrik Bruns (Policy Analyst)	<i>Countering COVID-19 misinformation using targeted behavioural interventions</i>	This project aimed at assessing the effectiveness of different strategies to fight COVID-19 misinformation: how can these interventions best reduce the impact and spread of misinformation? The project explores how to target different strategies to specific groups of individuals. If applied responsibly, targeting could strengthen the fight against misinformation.	https://knowledge4policy.ec.europa.eu/projects-activities/countering-COVID-19-misinformation-through-targeted-behavioural-interventions_en and https://publications.jrc.ec.europa.eu/repository/handle/JRC130111
Joint Research	Bertrand De Longueville	<i>COVID-19 vaccines</i>	The report summarized reporting trends in online media coverage of COVID-19 vaccines for children and adolescents	

Centre	(Team Leader)	<i>in the headlines</i>	between 15 November 2020 and 2 December 2021 in Europe, with a focus on Germany, Italy, Spain, France and Greece. The report highlighted that compared to other vaccines, Pfizer/BioNTech was the most frequently reported vaccine and that most news items with a headline referring both to the specific vaccines and to the younger generations were most often related to the evolution of the vaccination review and the authorization processes. The study also gave special attention to the European Medicines Agency's approval of the Pfizer vaccine for children between the ages of 5 and 11.	
WHO-Europe	Siff Malue Nielsen (Behavioural and cultural insights for health)	<i>Rapid qualitative research to inform interventions for increasing COVID-19 vaccine uptake</i>	This presentation focused on lessons learned related to conducting rapid qualitative research to understand drivers and barriers for COVID-19 vaccination uptake. It introduced a rapid qualitative tool that was developed to support countries with gathering insights and developing tailored interventions within a very short time frame to enable implementation of tailored activities immediately. In addition. The presentation outlined a range of country examples, best practices and discussed how this same approach could be useful for routine immunization moving forward.	https://apps.who.int/iris/handle/10665/351117
WHO	Lisa Menning (Team Lead Demand and Behavioural Sciences - Department of Immunization, Vaccines and Biologicals)	<i>Understanding behavioural and social drivers of vaccine uptake: a global perspective.</i>	This presentation shared insights on trends and learning related to COVID-19 vaccination uptake. It introduced a framework that was developed through a global working group to understand the behavioural and social drivers of vaccination and offered an outline of the main reasons for low uptake based on the application of this framework in specific settings. Lastly it outlined a range of promising interventions shown to increase vaccination.	https://www.who.int/teams/immunization-vaccines-and-biologicals/essential-programme-on-immunization/demand
UNICEF Office of Research Innocenti	Benjamin Hickler (Behavioural Science Research Manager)	<i>Ethical Considerations When Applying Behavioural Science in Projects Focused on</i>	This talk introduced a set of ethical principles and practical tools developed for BI practitioners. It is based on a systematic exploration of relevant literature along with consultations with youth to develop a discussion paper and framework to help practitioners navigate ethical considerations specific to applying methods and evidence from the behavioural sciences	https://www.unicef-irc.org/publications/1251-ethical-considerations-when-applying-behavioural-science-in-projects-focused-on-children.html

		<i>Children</i>	to interventions that implicate children and young people.	
Save the children	Veerle Snijders (Behavioural Scientist)	<i>Using behavioural insights at scale</i>	This presentation covered key insights from the Save the Children adaptable online COVID-19 vaccinations campaign which reached 235million people in 8 countries in Asia, in 2021 and 2022. The campaign drew on the Little Jab Book series, used behavioural insights in design and delivery and was supported by offline activities.	https://resourcecentre.savethechildren.net/document/little-jab-book18-behavioral-science-strategies-increasing-vaccination-uptake/
ITALY - ARS Toscana	Giacomo Galletti (Health and social care researcher)	<i>Promoting Influenza Vaccination among Staff of Nursing Homes According to Behavioral Insights.</i>	A behaviourally informed intervention was conducted during November – December 2019 in the broader context of a cross-sectional study aiming at understanding the choice architecture of influenza vaccine acceptance or refusal among health workers in Tuscan Nursing Homes. The intervention's effectiveness was evaluated by comparing results of Influenza vaccination uptake and intention to get the vaccine between the nudged and the comparison groups, along the 2019–2020 vaccination season and the 2020–2021 one. Results show that both vaccination uptake and intention to get the vaccine appeared significantly higher in the nudged group. Consequently, simple, fast and low-cost nudge interventions could be effective in promoting vaccine acceptance.	https://www.mdpi.com/2076-393X/8/4/600
SWEDEN –Public Health Agency of Sweden	Sarah Earnshaw Blomquist (Analyst in the Vaccination Programme) and Emma Appelqvist (Analyst in the Vaccination Programme)	<i>Acceptance for vaccination against COVID-19 in Sweden over time</i>	Using an adapted version of the WHO tool for behavioural insights on COVID-19, the presenters followed vaccine acceptance as a complement to coverage data over time. The study aimed to provide insights into reasons for accepting or delaying vaccination as well as practical aspects and information needs. The target groups for the surveys were adults, youths and parents to children aged 5-15 years in Sweden. The results were implemented into policies and actions including in the development of guidance for youth vaccination and informing the targeting of unvaccinated individuals.	https://www.folkhalsomyndigheten.se/smittskydd-beredskap/utbrott/aktuella-utbrott/COVID-19/statistik-och-analyser/acceptans-for-vaccination-mot-COVID-19/
THE NETHERLANDS– Corona	Marijn de Bruin (Behavioural)	<i>Vaccination willingness, drivers and interventions</i>	In this presentation the Corona Behavioural Unit shared its research into vaccination willingness, drivers and interventions. The research included large population surveys and qualitative	https://www.rivm.nl/en/coronavirus-COVID-19/research/behaviour

Behavioural Unit of the RIVM	Scientist)	during the COVID-19 pandemic in the Netherlands	interviews amongst citizens; surveys and interviews amongst regional health services regarding their efforts to support hard-to-reach groups; experts input and literature reviews. This has been used to formulate recommendations for interventions to support citizens in making their vaccination choice.	
GERMANY German Federal Chancellery	Malte Petersen (Policy Advisor)	COVID-19 Response in Germany; Pinpointing a moving target with snapshot monitoring	Since the sudden emergence of COVID-19 there has been a high degree of uncertainty and various changes in public perception. The COVID-19 Snapshot Monitor (COSMO) has been quickly set up and is a successful cooperation between science and administration. Survey data made it possible to monitor attitudes and behaviour related to COVID-19. Evidence about effective counter measures has been scarce and often short living given a mutating virus. Even though ex-ante evidence was often missing, monitoring helped with ex-post evaluation. The international community was a further important source for quickly exchanging ideas and experiences	
BELGIUM University of Ghent	Maarten Vansteenkiste (Professor)	The role of motivational dynamics in understanding citizen's sustained behavioral adherence and vaccination.	Based on a large scale and population-wide study in the context of the motivation barometer project, the critical role of motivational dynamics and risk perception in predicting sustained adherence to COVID-19 restrictions and vaccination was discussed.	www.motivationbarometer.com

2.4.1 Lessons learnt and policy recommendations

The symposium represented an excellent opportunity to collect insights on the work carried out during the COVID-19 pandemic by a range of academics and practitioners. It was also the perfect environment to exchange ideas and visions for the future.

The five key meta-lessons that emerged from the symposium were:

- *Lesson 1* – **Networking, exchanging and finding synergies is key** to foster the role and influence of behavioural sciences policymaking in the field of vaccine acceptance and demand. This would limit unnecessary duplication of studies, enhance mutual learning and support, and create common frameworks and language.
- *Lesson 2* – **Vaccination programmes across the EU should be guided by a strong empirical understanding of behavioural determinants**, including population knowledge, concerns and expectations about the vaccine in question. Making sure that the necessary evidence is soundly collected, analysed, documented and demonstrated is paramount.
- *Lesson 3* – **Behavioural sciences capacities and expertise** are not homogenous across the EU: such **disparities should be addressed**, and where behavioural sciences capacity is available, it should be established as a common and accepted part of the system, to avoid loss of expertise and infrastructure.
- *Lesson 4* – **Interdisciplinary collaboration between the different specialties of behavioural sciences**, and the related methodologies, is not only welcomed, but also necessary to understand a complex phenomenon such as vaccine acceptance and demand. Sociology, social and cultural anthropology, psychology, and behavioural aspects of biology, economics, geography, law, psychiatry, and political science should be all considered and invited into the discussions and research programmes dedicated to vaccine acceptance and demand.
- *Lesson 5* – **Ethical considerations when applying behavioural sciences** to vaccine acceptance and demand are paramount. This is even more critical when behavioural interventions target children, adolescents, minorities and underserved communities' ethical considerations and reflections are fundamental for the success of behavioural interventions.

3 Additional activities

This section covers the additional activities carried out under the broader umbrella of the project, either as a preparatory, exploratory, or expansive initiative that were not explicitly listed, but by nature were required to achieve the objectives set. These additional activities include (i) an exploratory survey study on vaccine acceptance and demand, (ii) a literature review focused on vaccination and the pandemic, (iii) an extension of the behavioural study on knowledge, attitudes, and practices towards vaccination among paediatricians, and (iv) a rapid study on parents' questions on the COVID-19 vaccine for their children and adolescents. For each activity we describe the context, objectives, methodology and structure, lessons learnt and policy recommendations.

3.1 Exploratory survey study on vaccine acceptance and demand

The exploratory study was commissioned in 2020 and the contributors of this activity are Baggio M., Ciriolo, E. (team members of the CCBI) and Proestakis, A. (Hellenic Mediterranean University), who designed the study and analysed the data collected. The study was carried out with the support of an external consortium (London School of Economics, with Open Evidence and BDI Research) during 2020.

The overall purpose of the study was to facilitate and execute preliminary research on vaccine confidence, identifying behavioural determinants of vaccine hesitancy across different subgroups of the population and healthcare workers, for specific categories of vaccines in several Member States of the European Union. The outcome of the preliminary study supported the identification of the most promising areas of implementation of behavioural insights to improve vaccine confidence and informed the design and setup of the project work plan.

The above overall purpose was operationalized in the following two objectives:

Objective #1 - To investigate parents' knowledge about vaccinations and the behavioural biases that might affect their attitudes towards them. We also wanted to know if and why parents find decisions about vaccines daunting and how they can be supported when making them.

Objective #2 - To study the attitudes towards vaccination of health care providers, to understand their perception of the forms of prevention in place to ensure their protection from vaccine-preventable diseases, and understand their communication skills and practices, from a behavioural stance, and how these feed into the determinants of parents.

In the pursuit of these objectives, different quantitative and qualitative research methods were combined, gathering primary data through field work. The combined use of these different techniques ensured that both the generic and the more specific research questions were addressed. The study included focus groups and an online experimental survey. Two different focus groups (adults between age of 18 and 40 and paediatricians) were conducted in February 2020 in three countries (Spain, Poland, and Romania), for a total of six groups. The experimental online survey, divided in three steps (i.e., screening questions, experimental survey, and final questionnaire) was conducted in six countries (Spain, France, Italy, Poland, Portugal and Romania), with a sample of 1500 participants per country, for a total of 9000 respondents. The mixed methods approach ensured that the objectives and research questions were covered by triangulation and resulted in obtaining robust evidence for all the research questions.

Key findings of this exploratory survey will be published in due course in the form of JRC science for policy briefs and/or peer reviewed scientific articles.

3.1.1 Focus groups: design and methodology

In each country (Spain, Poland, and Romania), two separate focus groups were conducted: one with doctors and one with parents. Each session lasted 120 minutes. Each group had eight members, except that only seven doctors participated in Romania. The focus group discussions were divided into two phases. In the first phase, both parents and paediatricians were together in a group and were interviewed. Following the discussion guide, participants gave their individual responses, with deeper probing taking place wherever the moderator felt this was necessary or likely to provide more informative insights. Free debate among the respondents was encouraged. In the second phase of the discussion, in the group of the parents, participants were divided into "enthusiasts" and "hesitants". Each of these groups worked in a separate room, drafting a detailed written argument supporting their views. This argument was subsequently presented to the entire group of parents. This was followed by a reply from the "opposing" group of parents and a counter-reply from

the presenting group, with the aim of probing the issues in the maximum possible depth. In the case of the doctors, who were all pro-vaccine, they were asked to randomly split in two groups, i.e., “enthusiasts” and “hesitants”, and to act out the role accordingly. Like parents, they drafted a written argument supporting their position and subsequently presenting it in front of the other group. In this exercise, the first group of doctors tried to act as if they were hesitant parents, exploring in depth their attitudes and the motivations. In addition, they also presented the potential arguments of hesitant doctors, who were less rigorous with their patients in terms of vaccines. As in the case of the parents, this presentation was followed by a reply from the “opposing” group and a counter-reply by the presenting group.

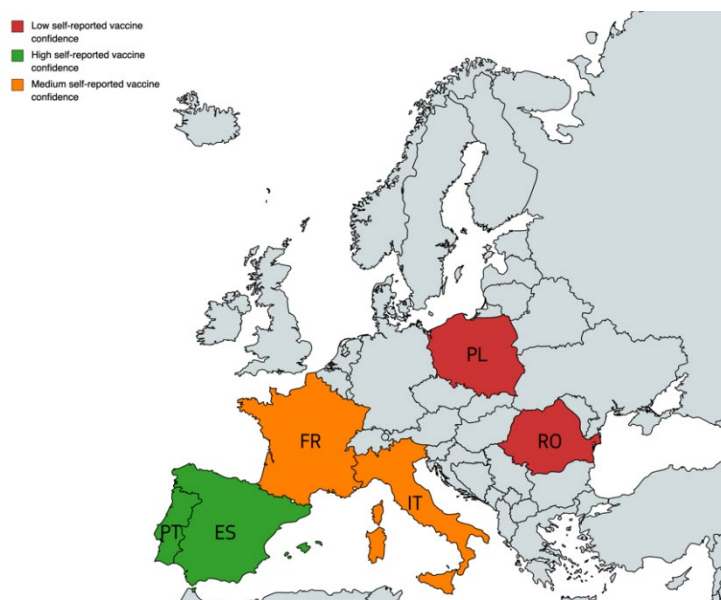
3.1.2 Experimental survey study: design and methodology

The online experimental survey was administered to a sample of parents with children between the ages of 18 months and 18 years old. For the parents, no official statistics in Europe are available, therefore it was not possible to have a representative sample. However, targets for child age ranges were determined per country by the CCBI. In all countries, non-probability/volunteer online access panels were used as a sampling frame. Respondents were randomly drawn from the online panels. After piloting the survey, field work started in all six member states and took place between August and September 2020, a time when the COVID-19 had slowed down, but vaccines were not yet available. The survey, initially designed to be covering only HPV and MMR vaccinations, was adapted to consider the potentially upcoming COVID-19 vaccines. The sample size was 8982 parents, with approximately 1500 participants per selected MS.

In terms of geographical scope, the research had to be applicable across all EU27 Member States plus Norway, Iceland, and Liechtenstein. The choice of countries to be covered followed both a principle of good geographical spread, as well as of good representation of different levels of country average self-reported vaccine confidence (based on the Special Eurobarometer 488 - Europeans’ attitudes towards vaccination). The online experimental survey was carried out in six EU Member States (Italy, Spain, Portugal, Romania, Poland, and France) all in the respective official languages. In).

Figure 7, the selected countries are represented: in red are the member states with low, in orange with medium and in green with high self-reported vaccine confidence. For a more detailed description of the Member States’ key figures on how national vaccination programmes are carried out, which vaccines are recommended or compulsory, and whether they are free or how much they cost, please refer to section 2.2.1.1).

Figure 7 - Selected member states, self-reported levels of vaccine confidence



Map created with mapchart.net.

The questionnaire in use for the exploratory experimental survey – of 92 questions overall – was structured in the following blocks:

- Screening questions to determine whether respondents were parents of children aged between 18 months and 18 years old: if eligible, they were asked questions about their children's vaccinations and, if not eligible, they were screened out.
- Questions about up to two children's exact vaccination dates per respondent, as well as the perceptions and understanding of vaccination policies for each vaccine (i.e., compulsory, recommended and free of charge, etc.) in place at the time of the child's vaccination, reasons for being late/skipping/hesitant for vaccinating children, influence of paediatrician on health choices for the child.
- Questions about social norms and the influence of the respondent's social network and groups in the health decisions taken.
- Questions about psychological antecedents of vaccination (e.g., experience of the respondents with vaccinations in the past).
- Questions about the role of, and perceptions on, healthcare providers.
- A vignette study, where the experimental portion of the survey was tested.
- Questions about the respondent's vaccination record.
- Questions about a potential COVID-19 vaccination, including reasons for (not) wanting to get vaccinated.
- Questions about a potential COVID-19 vaccination for children, including reasons for (not) wanting to have their child(ren) vaccinated.
- Socio-demographic questions on the respondent and the respondent's partner.
- Option to upload a picture/scan of the child's vaccination card.

The experimental survey supported the creation of a unique dataset, where over 41% of respondents provided precise vaccination dates from a vaccination record (card or booklet). A reliable taxonomy of parents was first created thanks to this experimental survey. It classified them into four distinct categories: acceptors, hesitant acceptors, delayers, and skippers. The taxonomy has proved to be a good predictor for other behavioural elements such as sources of information used in vaccination decision-making, relationships with healthcare providers, social norms and understanding of herd immunity. Furthermore, the taxonomy correctly predicted the willingness to get vaccinated, or to vaccinate their children, against COVID-19. This taxonomy was then used in the main study part of this project (see section 2.2.2 for more details).

In the vignette study, participants were introduced to a hypothetical scenario where doctors were voluntarily participating in a programme which allowed them to disclose the percentage of children vaccinated in their practice. Parents were informed whether a particular doctor had joined the programme and (if yes) what was the actual vaccination coverage (VC) in this doctor's office. They finally asked if they would choose this doctor for the care of their young child. We introduced five positive vignette scenarios: doctor joined the programme and a) VC=72%, b) VC=80% c) VC=88%, d) VC=96%, e) did not join the programme with an average VC 72%-96%; and five negative vignette scenarios, where the same information was negatively framed (i.e., indicating the rate of non-coverage). We randomly assigned each parent to only one of the vignette scenarios.

3.1.3 Lessons learnt and policy recommendations

The focus groups highlighted how none of the parents interviewed could be classified as clearly or dogmatically anti-vaccine in their views. On the contrary, they were all broadly in favour of vaccination in principle. They did, however, fall into two categories in terms of their level of confidence in, and questioning of, the benefits and safety of vaccination. The parents were divided into enthusiasts and questioners. This early classification of parents sparked the idea of designing a survey that would allow the CCBI to create a taxonomy of parents, by means of a combination of self-reported beliefs and inferred vaccination decisions. **Parents in the focus groups had a basic understanding of vaccines as a method of preventing disease by stimulating the recipient's immune system.** Some of the **more informed parents** were **aware of the term "herd immunity"**. Those who had not heard this technical term before, rapidly captured its significance when its meaning was explained to them. They understood its relevance and importance in terms of offering protection to society at large. **Parents estimated that over 90% of the population would have to be vaccinated to achieve herd immunity.** However, they admitted to being unsure of this

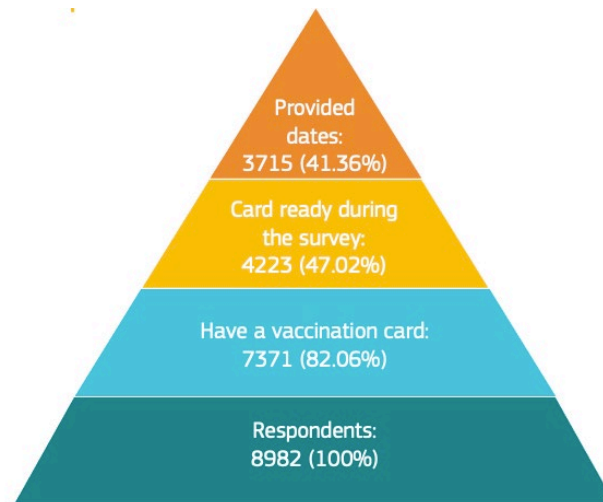
figure and that they had not been given any precise information by their healthcare professionals in this regard nor had they sought such information from any other source. It is important for the reader to remember that the focus groups took place in February 2020, and that the concept of herd immunity might have become more common. Parents were aware of the potential implications of vaccination at the wider societal level and regarded this as one of the reasons in favour of vaccinating their children. Apart from the obvious altruistic considerations involved in terms of encouraging as many parents as possible to have their children vaccinated to protect society at large, they were also aware that **herd immunity offers their own children protection** against the risk of contracting infectious diseases by reducing the prevalence of these diseases in the population. They were concerned, to a varying extent, about the potential risk involved in their children meeting non-vaccinated children. It was reported that some kindergartens and schools attempted to relieve any fears parents might have had by refusing to accept unvaccinated children. However, parents were aware that it is almost impossible to avoid such contact with non-vaccinated children as it is very likely that their own children will encounter them in their daily lives, without necessarily being aware of it. They tended to adopt a pragmatic, realistic approach in this regard. In terms of possible future trends, they would be **concerned if the anti-vaccine movement gained momentum and resulted in more parents deciding not to vaccinate their children, with a subsequent decline in herd immunity**. They agreed that this should be avoided by countering the anti-vaccination arguments. Parents' estimated percentage of unvaccinated children attending paediatrician's offices was very low (less than 10%). In case a poster in each office would show such percentage, only a minority of parents would be concerned about taking their children to such a paediatrician's office for the risk of their children being infected by unvaccinated ones. For this minority of parents, they would consider a range between 10-20% of unvaccinated children in the office as a potential threat. However, most of the parents felt they would not be influenced by such a poster in their paediatrician's office indicating the percentage of non-vaccinated children. Such information would not dissuade them from taking their children to this paediatrician's office. This information was used to test in the experimental survey whether this self-reported attitude could be influenced by framing or varying degrees of vaccination coverage. In general, **parents did not feel they have been unduly pressured by health care professionals to have their children vaccinated**. The doctors limited their role to advising and recommending and did not attempt to impose their will on the parents. In terms of the compulsory vaccines in the vaccination calendar, all parents indicated that they attempted to comply fully with these requirements. The experimental survey attempted to check whether this was true, and if so, to what extent in terms of precision in the recall of vaccinations (which ones and when). Although the parents ensured that their children received all the compulsory vaccines, they admitted that the administration of a vaccine or a booster dose may be **delayed occasionally due to forgetfulness rather than any conscious decision on their part**. **They felt that there was no effective system currently in place to remind them of when the vaccines were due**. They also indicated that their **compliance tends to be stricter with their first child**. In the case of subsequent children, they tend to be a little more "relaxed", which sometimes leads to delays. Some **hesitant parents** also pointed out that, after their first born, they became more familiar with vaccinations and were **more likely to have questions** regarding the vaccination of any brothers or sisters. All the parents interviewed agree that the debate around optional vaccines, which tend to be expensive and are not financed by the social security system, is more nuanced and controversial.

The group of doctors interviewed in the focus groups were all strong advocates of vaccination. They believed very few of their colleagues to be overtly anti-vaccine. The vast majority acknowledging the importance of complying with the compulsory vaccination schedule. However, they recognized that a small minority of their colleagues might be less enthusiastic advocates of some of the optional vaccines. The doctors interviewed were completely convinced by the scientific evidence supporting the efficacy and safety of the compulsory vaccines included in the vaccination calendar and of the optional vaccines. They reported attempting to transmit this confidence in the scientifically proven benefits and low risk of vaccination to parents. They unreservedly promoted and encouraged the uptake of vaccines. They also reported having concerns on possible long-term adverse effects of certain components of vaccines. Despite some nuances or reservations regarding the efficacy and safety of vaccines, doctors are convinced that the balance is clearly positive, and that vaccination is an important public health measure which should be encouraged by healthcare professionals. They regarded the anti-vaccine movement as one which, if not opposed, could significantly compromise herd immunity, and put public health in jeopardy. The doctors interviewed would have no objection to putting a poster in their offices indicating the percentage of unvaccinated children in their practice, although none of them did so at the time of the focus groups. They recognised the difficulty in explaining to parents why, if optional vaccines are truly important, they are not compulsory or funded by the state. It is difficult to explain to parents that the inclusion or not of a given vaccine in the compulsory

schedule depends on multiple factors, including the incidence and severity of the disease and the cost-effective implications of vaccinating widely against it.

Regarding the online experimental survey, the first key element that deserves attention is the unique dataset that it generated. As shown in Figure 5 below, of the nearly 9000 respondents 82% reported having a vaccination card for their children; 47% declared that they could consult it during the survey, and 41% provided exact dates for the vaccinations. Those who did not have a vaccination record for their children were not sure where they stored it or declared that the other parent had it.

Figure 8 - Dataset layers, based on the availability of vaccination records



Secondly, we have already pointed out that one of the main findings was the creation of a **reliable taxonomy of parents**, which grouped respondents into five categories, then streamlined them into four categories, to be used again in the main study. Furthermore, the experimental part of the study focused on a potential policy intervention: presenting the vaccination rates of the doctor as a further piece of information that could help parents deciding whether to choose a specific health care professional for their child(ren). We hypothetically tested a policy intervention where doctors participated in a scheme where they were allowed to voluntarily disclose the vaccination coverage rate of their practice. The VC rates were either framed positively or negatively, and the scenario of the doctor not participating in the voluntary initiative was included, for a total of 10 treatments (see below).

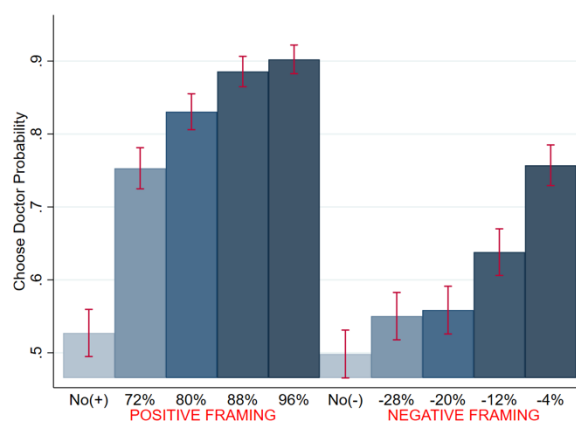
Figure 9 - Vignette framing treatments

POSITIVE FRAMING % children vaccinated	NEGATIVE FRAMING % children NOT vaccinated
72%	28%
80%	20%
88%	12%
96%	4%
The doctor did not volunteer in the program to disclose the number of vaccinated children.	The doctor did not volunteer in the program to disclose the number of NOT vaccinated children

While the voluntary nature of our intervention eliminated any privacy concerns from the doctor's side (as the data was aggregated for the practice), at the same time **doctors' unwillingness to participate in such a scheme was perceived by parents as a negative signal**. Indeed, **parents would prefer to choose a doctor with the lowest coverage rate (72%) rather than a doctor who is not participating in the scheme**. We also found that the **vaccination rates are positively associated with the parents' decision to select a doctor**. The higher the vaccination rate in the doctors' practice, the higher the

propensity of parents to choose this doctor. **Negatively framed vaccination rates make parents more reluctant when selecting a doctor.** The results are reported in Figure 7 where are represented the percentages of parents who decided to choose the doctor in each vignette scenario, with positive (left panel) and negative framing (right panel). Red bars show the corresponding 95% confidence intervals in each vignette scenario. Less than 55% of parents choose the doctor if the latter has not joined the voluntary scheme, indicating that parents perceive this action as a negative signal. The difference is highly significant as compared to all other vignette scenarios. Vaccination coverage (VC) in the doctors' practices has a significant and positive effect, which is stronger in the negative frame scenarios. The difference between the choice rate of the doctor in the highest (96%) and the lowest (72%) VC is about 14.93% (90.24%- 75.31%) in the positively framed scenarios and 20.69% (75.72%-55.03%) in the negatively framed scenarios. We performed multivariate regression analysis (not shown here) controlling for different country, socio-demographic and variables related to vaccination habits of the parents and found that an 1% decrease in the vaccination rate will reduce the choice of the doctors by 0.6% and 0.9% in the positive and in the negative frame respectively⁹. The overall effect of the negative frame on the choice of the doctor is about 21.6% on average. This means that, irrespectively of the vaccination rate in the doctor's practice, the possibility of a parent to choose a doctor when seeing a negatively framed message is about 1/5 lower than the possibility of choosing the same doctor when seeing a positively framed message. The highest difference (27.2%) is observed between parents who received the information that 80% are vaccinated (positive frame) and parents who received the information that 20% are NOT vaccinated (negative frame). Although the information is literally identical, parents in the positive frame perceive the vaccination rate to be higher than patients in the negative frame.

Figure 10 - Probability of Choosing a Doctor by Vaccination Coverage level and Framing



However, the **most resistant parents**, such as those who rely more on own research than on experts' opinion when making vaccination decision for their child, **were less affected by vaccination rate disclosure and negative framing**, compared to acceptant parents. Again, this is a crucial finding: being able to categorize parents and to identify whether they rely on their own information or if they prefer experts' information, is key for the effectiveness of policy interventions. In fact, **even strong mechanisms found in the literature, such as that of framing, might not work for the most resistant groups that policymakers are targeting.** However, the advantage of the positive over the negative framing intervention proved robust in that it was large and significant in all the countries under scrutiny, regardless of their actual vaccination coverage and other idiosyncrasies. This suggests that it could be applied at different levels of governance, and for different purposes.

Moreover, the negative frame effect was found very strong in all countries independently of the real coverage level or other country specific characteristics.

⁹ Controls: country, age, gender, number of children, fully vaccinated children, estimation of vaccination rate in child's school, vaccination decision on experts opinion rather than on own research, holding a vaccination card when answering the questionnaire.

3.2 Literature review – Vaccination and the pandemic

This literature review was commissioned in early 2022. The contributors of the document are Rustam Romaniuc (Montpellier Business School), Danlin Li (University Paris 1 Panthéon-Sorbonne), Alexandra Alvergne (ISEM, University of Montpellier), Dimitri Dubois (CEE-M, University of Montpellier), Baggio M. and Krawczyk, M. (team members of the CCBI).

The purpose of this task was to review articles on COVID-19 vaccination demand and acceptance with a particular emphasis on behavioural interventions to improve Covid19 vaccination coverage and how the Covid-19 pandemic might affect childhood immunisation programmes and life-course approach to vaccination. The relevant literature published since 2020 was summarized and reported, with the following research objectives:

Objective #1 – Understanding the behavioural determinants of adults' and parents' COVID-19 vaccination demand and acceptance, devoting particular attention to the role of altruism, free riding, bandwagoning, social norms, and social networks, in addition to the influence of political ideology and trust towards health institutions, pharmaceutical institutions, healthcare providers' competences and integrity, as well as towards official vaccine information.

Objective #2 – Compiling a list of behavioural interventions aimed at maintaining and/or increasing COVID-19 vaccination coverage: scanning the literature to map studies on behavioural interventions aimed at maintaining and increasing vaccination demand and acceptance, delivered through healthcare institutions at the national, regional and local levels, as well as behavioural interventions aimed at changing the behaviour of health-care workers when delivering vaccination services, or their own personal views on vaccination. Of particular importance was the collection of information on incentives-based interventions (refreshments, small tokens, reimbursement of travel costs, time off-work, lotteries etc.), as well as low self-efficacy to get vaccinated (e.g., the ability to overcome barriers such as lack of time, distance to the vaccination centre).

Objective #3 – Planning for vaccination programmes in a post-pandemic world: scanning the literature to map lessons learned from the experience with COVID-19, how the pandemic could or has already shaped confidence in other vaccines (new vaccines, or already existing), and how it could re-define the concept of life-course vaccination.

This literature review will be published in due course in the form of JRC technical report.

3.2.1 Structure of the literature review and methodology

The COVID-19 pandemic has offered additional evidence that although vaccination is one of public health's greatest achievements, it faces major behavioural challenges. While medical researchers delivered a vaccine within less than 12 months after the beginning of the COVID-19 pandemic, surveys that were conducted in different countries after the announcement that a vaccine may be soon available showed that nearly 30% of the population were vaccine hesitant (Lazarus et al., 2021). During the past two years, a large quantity of research has been conducted in different countries with various populations to investigate the behavioural and structural determinants of vaccine hesitancy. Furthermore, many policy interventions have been tested and implemented to increase vaccination uptake rates, targeting various determinants of vaccination-related decisions. Facing the challenges ahead, including booster campaigns or other emerging infectious disease threats, this literature review took stock of the body of research produced since the onset of the COVID-19 pandemic. The insights on vaccination decisions gathered during the COVID-19 pandemic can serve to inform policies that seek to increase vaccination coverage against other types of infectious diseases in the future.

Based on the analysis of 196 articles, this literature review shed light on the behavioural determinants of vaccination-related decisions of parents, healthcare workers, and other adults and provided insights into the design and practice of vaccination programmes to increase vaccine coverage during and after the pandemic. The searching process was conducted between February 1st and April 13th, 2022 in four databases (PubMed, JSTOR, Econlit, RePEc/IDEAS and Scopus) as well as by a call for relevant literature on the Economic Science Association's methods discussion forum. The search was restricted to publication dates from 2020 to 2022. The report consisted of three main sections. The first part summarised the behavioural determinants of COVID-19 vaccine acceptance and demand. From 124 studies covering 173 countries, seven key behavioural factors have been identified, including trust in the vaccine, trust in the healthcare system and the government, perceived personal risk, perceived collective responsibility, media and social influence, structural barriers, and vaccine mandates. The second part focused on interventions aiming at promoting vaccine acceptance and uptake, including standard information communication, financial incentives, and interventions relying on

insights from behavioural sciences (e.g., framing effects, social norm-based messages, reminders, and defaults). Based on the findings of the first two sections, the third part of the literature review discussed the scalability of policies that were found to change vaccination decisions in the context of COVID-19, thus addressing lessons and insights for vaccination policies in a post-pandemic world. It also emphasised the major gaps and policy-relevant questions which remain, at the time of writing, unanswered.

3.2.2 Lessons learnt and policy recommendations

The large body of research discussed in the report provided new empirical evidence on strategies that may be implemented by policymakers to increase vaccination against COVID-19 as well as against other infectious diseases, thereby complementing the existing policy-oriented reviews on how to change health-related behaviours, in general, and vaccination, in particular.

Regarding the behavioural determinants of acceptance and uptake of the COVID-19 vaccine, the report identified seven key factors presented in Table 3 below. While higher trust in the vaccine, higher trust in the healthcare system and the government, more uptake of trustworthy information and higher perceived collective responsibility are associated with higher vaccination intention or uptake, on the other hand, lower complacency, more conspiracy beliefs, and structural barriers, along with conditional vaccine mandates are negatively related to vaccination intention or uptake.

Table 3 - Key Determinants of COVID-19 Vaccination Acceptance and Demand Based on Available Evidence

Determinant	Details of the Determinant	Population ¹	Countries ²	Number of Articles
Trust in the vaccine	Higher confidence in the safety and efficacy of the vaccine and fewer concerns about the speed of the vaccine development and sufficient testing are associated with higher vaccination intentions and uptake.	1,2,3	HI, LMI	58
Trust in the healthcare system and the government	Higher trust in provider of the vaccine and in the authorities associated with vaccination programmes is associated with higher vaccination intentions.	1,2,3	HI, LMI	30
Media influences	The use of social media as the main source of information is negatively associated with COVID-19 vaccination intentions and taking traditional media as main source predicts higher vaccination intentions.	1,2	HI, LMI	35
Perceived personal risk	Low perceived susceptibility of contraction of the virus or/and low perceived severity of the consequences of the contraction are associated with low vaccination intentions and uptake.	1,2,3	HI, LMI	28
Perceived collective responsibility and social influences	The more individuals feel responsible to protect others by getting themselves vaccinated, the more likely they are willing to take up the vaccine. Recommendations from acquaintances and trusted healthcare workers in the community are associated with higher vaccination intentions.	1,2, 3	HI, LMI	41
Availability of the vaccine	Higher perceived availability of the vaccine is associated with higher vaccination intentions.	1	LMI	10
Vaccine mandates	Vaccine mandates are positively associated with vaccination intentions for people holding favourable attitudes towards the vaccine and negatively associated with vaccination intentions for those who value freedom in vaccination decisions.	1,3	HI	5

(1) 1 = general adult population; 2 = healthcare workers; 3 = parents deciding for their children

(2) HI = high-income countries, LMI = low- and middle- income countries

As summarized above, trust in the safety and the efficacy of the vaccine consistently predicts vaccination intentions regardless of the population. This is a finding consistent with the previous literature on vaccine acceptance and demand: in this sense COVID-19 vaccines are not much different than any other vaccines. However, the main concerns about vaccine safety and efficacy in this context come from the **rapid speed of vaccine development and perceived insufficient testing**. The second determinant, trust in the healthcare system and the government, is significant in both low- and middle-income countries and high-income countries, especially among the socially vulnerable and hard-to-reach populations. The third factor, individual perceived risk, is an important element in the cost-benefit analysis of vaccine uptake for the adult population, healthcare workers, and parents deciding for their children. It has been consistently found that people with lower perceived risk of the disease tend to be hesitant towards vaccine uptake.

The determinants identified in this literature review relate to some of the policy interventions to make people take one of the approved and available COVID-19 vaccines. For example, researchers sought to improve vaccine coverage by **increasing people's trust in the vaccine and in the vaccine providers**. One of the policy lessons highlighted in this literature review is that information **campaigns clearly accounting for the potential side-effects of the vaccine can increase people's trust in the vaccine provider but are unlikely to improve vaccination coverage**. An alternative strategy that has been shown to achieve both higher trust in the vaccine provider and higher vaccination intentions is the **use of chatbots to provide people with information about the safety and efficacy of the vaccine** (thus, emphasizing not only the vaccine's negative side-effects but also its benefits). Importantly, there is good evidence that the same safety and efficacy information presented in a more standard and static manner compared to the dialogue-style of chatbot communication is less effective in changing people's vaccination intentions. In addition, studies that sought to emphasize the collective benefits from vaccination against COVID-19 or that implemented strategies to address complacency barriers found modest increases in self-reported vaccination intentions. There is less evidence regarding the causal effects of structural barriers and vaccination mandates, although one survey experiment suggests that **mandates may crowd-out the intrinsic motivation to get vaccinated in contexts with high baseline intentions rates**.

The policy interventions that proved to have the largest impact on vaccination behaviour and for which there is good causal evidence are therefore the following:

- I. Chatbots that provide people with safety and efficacy information and debunking messages about COVID-19 vaccines.
- II. Guaranteed cash payments in exchange for vaccination.
- III. Information about high acceptance rates of COVID-19 vaccines among doctors.
- IV. Automatic appointments to get vaccinated with the option to cancel or reschedule the date and time of the appointment.
- V. Text messages reminding people that they can receive the vaccine, in particular when the message uses an ownership effect ("Your vaccine" or "Claim your dose").

Furthermore, in an effort to analyse policies that can be implemented at scale (in other contexts and for different groups than the individuals for whom the policy worked originally), we combined evidence from the pre-COVID-19 literature with findings based on research dealing with the current pandemic to see whether there is evidence that what works to improve vaccination coverage against COVID-19 proves to be effective in improving vaccine coverage against some other types of infectious diseases. This allowed us to conclude that there is good evidence that three policy instruments can effectively encourage vaccination across contexts and across demographic groups are those illustrated in points II (cash payments), IV (automatic appointments) and V (text messages). The literature review emphasised the specific conditions under which each of these policy instruments works well to change people's vaccination intentions and behaviours. However, it is fundamental to underline how these behavioural interventions, as other health-related measures, need to be scrutinized with **ethical considerations** in mind, so that the risks of problematic and unethical intervention design processes are minimized.

In addition to showing which policy instruments can be used to improve vaccination coverage across demographic groups and contexts, this literature review highlighted avenues for future research. First, there is mixed evidence from behavioural literature using messages emphasising the benefits from vaccination (collective or personal) or using social norms to increase vaccination rates. The high heterogeneity in methods employed did not allow us to infer clear policy lessons from this literature. Furthermore, the existing evidence relies on self-reported measures of people's willingness to take the vaccine. The lack of evidence from actual

vaccination behaviour is also problematic in the case of studies that analysed the effect of a promising policy tool: chatbots that provide safety and efficacy information and debunking messages. Second, the design of vaccination programmes would benefit from a better understanding of the scalability of some policy instruments, such as the communication of information about the acceptance of a vaccine by doctors. It is not clear what works best to increase vaccination coverage: information about doctors' attitudes towards the vaccine or about their uptake.

Finally, a word of caution: extending the lessons learnt from the COVID-19 literature to vaccination decisions in the context of other infectious diseases may be problematic for several reasons. For example, the political polarization around COVID-19 has been found to play a role in the way people respond to specific policy instruments. Thus, while interventions based on political endorsement of vaccines against COVID-19 were generally found to have null or even sometimes negative effects on people's willingness to take the vaccine, such campaigns may prove more effective in the context of other infectious diseases, characterized by a lower level of political polarization. Among the other reasons why the generalization of findings from the COVID-19 literature to a post-COVID-19 world may be perilous, one can note the limited evidence gathered during COVID-19 in the case of some studies, leading to false positives (when we interpret some piece of evidence as proof that something is true when in fact it is not so), the non-representativeness of the subset of people for whom the behaviour change intervention worked originally, and the idiosyncratic nature of the situation.

3.3 Behavioural study on knowledge, attitudes and practices towards vaccination among paediatricians: extending the study to France, Spain and Poland

This study was commissioned in 2022 and the contributors of this activity are Baggio M., Krawczyk, M., Nohlen, H. (team members of the CCBI) and Proestakis, A. (Hellenic Mediterranean University), who designed the study and analysed the data collected. The study was carried by Kantar on behalf of the JRC.

The objective of this activity was to expand the data collection that initially focused on Italy to other member states, namely Spain, France, and Poland.

The main objectives were:

Objective #1 - To understand relevant perceptions and attitudes towards vaccinations among paediatricians and general practitioners. In particular, to answer the following questions: What are the most relevant factors influencing paediatricians and general practitioners' attitudes towards vaccination (e.g., confidence, complacency or convenience factors)? Are any individual socio-cultural, economic, or political elements predictive of perceptions and attitudes towards vaccinations? Do paediatricians and general practitioners have a clear idea of their patients' vaccination coverage for certain types of vaccines or vaccine schedules? Are paediatricians and general practitioners' enablers of vaccination acceptance and demand, or do they foster hesitancy? What is the role of social networks, including paediatricians and general practitioners, on parents' vaccine attitudes?

Objective #2 - To understand the **dynamics of attitudes towards traditional vaccines and the recently developed vaccines against COVID-19**. To answer the following questions: Do paediatricians and general practitioners showcase consistent acceptance/hesitancy attitudes for the COVID-19 vaccine? Do paediatricians and general practitioners' attitudes towards vaccines co-vary with other attitudes, behavioural and contextual factors? Has the pandemic fundamentally changed their way of liaising with patients?

Key findings of this survey will be published in due course in the form of JRC science for policy briefs and/or peer reviewed scientific articles.

3.3.1 Study design and methodology

In terms of geographical scope, the research had to be applicable across all EU27 Member States plus Norway, Iceland and Liechtenstein. The online survey was carried out in three carefully selected Member States: Spain, Poland and France. First, the choice of the Member States was driven by the need to link the results of this activity to the results of the previous cross-sectional survey on parents. This cross-sectional study on the determinants of parental vaccination acceptance and demand covered seven MS: Spain, France, Italy, Poland, Portugal, Romania, and Sweden. Among these MS, the CCBI chose the final three countries to cover different childhood primary health care systems. For example, in Spain children are under the care paediatricians until the age of 15. Parents entitled to public healthcare register their children with a

paediatrician of their choice. In France, children are under the care of general practitioners and/or paediatricians. In Poland children are either followed by general practitioners or paediatricians. With a reform in 1999, the role of paediatricians in Poland became secondary and since then general practitioners are the main health care providers for children. Still, a lot of families have a first-contact paediatrician.

The scope of the survey the following subject category were carefully defined:

- **Paediatricians:** defined as medical practitioners specializing in children and their diseases. Paediatricians working in an office-setting providing private consultation services were eligible for the study. Paediatricians who exclusively work in the hospital services as specialists were excluded from the study.
- **General practitioners:** defined as medical practitioners that at the time of the survey have at least 10 children between 1 month and 18 years old under their care. General practitioners working in an office setting providing private consultation services are eligible for the study. General practitioners who exclusively work in the hospital services as specialists are excluded from the study.

The subject category to be covered in each Member State was decided to be as follows:

- Spain: paediatricians
- Poland: paediatricians
- France: general practitioners and/or paediatricians

In each of the countries, about 220 of them filled in an ad hoc questionnaire initially developed for the activity in Italy, adjusted to account for institutional differences and translated in the respective national languages. The questionnaire aimed at investigating:

- Trust in public health institutions: national and international
- Clinical practice routine (e.g., opening hours of the individual practice, volume of parents attending the clinic)
- Attitudes, knowledge and experience in relation to vaccinations (e.g., knowledge of vaccination schedules)
- Knowledge of the vaccination attitude among parents of the children assisted in the individual practice (e.g., reasons to skip vaccinations);
- Social norms and peer influence (e.g., regional vaccination coverage, vaccination coverage among children assisted by other health care providers in the area);
- Attitudes linked to COVID-19 vaccination (e.g., vaccination status of the health care provider, attitude towards anti-COVID-19 vaccination for children);
- Socio-demographic information of the health care provider, including regional practice code.

From the lessons learnt of the cross-sectional survey on parents and the general population, additional items were added to the questionnaire to cover:

- The current Ukrainian refugees' crisis in the context of the COVID-19 pandemic and the national vaccination programmes.
- The perceptions on the status of the pandemic at the country and global level.
- The perceptions on the likelihood of a new wave of COVID-19 before the end of 2022.

3.3.2 Lessons learnt and policy recommendations

A large majority of **respondents trusted that international organizations**, such as the European Commission and the World Health Organization, **handle matters related to children's vaccinations well**. They were also **trustful towards doctors and scientists in this respect**. By contrast, their **trust towards national authorities was low**, particularly so in Poland, where nearly half the respondents mistrusted or strongly mistrusted the Ministry of Health and the national government. In the case of COVID-19 vaccinations, the patterns were similar, except that respondents were generally more negative. This raises some concerns that the relatively **widespread mistrust towards (national) policymaking concerning COVID-19**

vaccines may spill over to other types of vaccinations. This is troubling especially given that respondents already identified anti-vaccination attitudes among the parents of their patients.

Concerning the **MMR vaccination, it was universally endorsed** by respondents but there was some variation in preferred **timing**. While about two-thirds of the sample said they recommended their patients' parents to follow the national scheme in terms of administering the first dose around the age of 12 months, nearly 12% recommended that it may be administered earlier and some 20% - later.

In the case of HPV vaccines, respondents were more split. In all the countries these vaccines were nearly universally recommended for girls. However, **only about 80% of respondents in Spain and France and as few as 54.7% in Poland recommended them also for boys.** As in the case of MMR, in each country a sizable minority recommended administering them at a different age than 11-12 years featured in national vaccination schemes – typically earlier than that in Spain and later than that in Poland.

Even in the case of MMR, **respondents did not believe that compliance was universal.** We asked them to estimate how many of their patients who should have received both doses at least 24 months ago have indeed received both vs. just one vs. none. **At just about 55%, the perceived percentage of fully compliant parents was much lower in Poland than in the other two countries (above 80%).**

The numbers for HPV were much lower, especially when respondents were asked about male patients. Again, Polish physicians saw less compliance among their patients than their colleagues in the other two countries did. Accordingly, when asked to estimate the fraction of **“Acceptors”, “Hesitant Acceptors”, “Delayers” and “Skippers”** among their patients, **Polish respondents believed the first group to be less numerous (52%) than was the case in Spain or France (70-75%).** In follow-up questions, respondents in France and Poland said that Acceptors relied primarily on experts' opinions whereas Skippers – primarily on their own research. **Spain was a striking exception there, because Acceptor parents were also often believed to rely on their own research.**

Zooming in on Skippers and Delayers, the respondents were asked to report **how they would react to their hesitancy.** In the case of parents wanting to **delay**, reactions differed significantly between countries. **As many as 95.3% of French respondents said they would at least “usually” try to change parents' opinions, compared to 89.8% in Spain and 86.3% in Poland.** Respondents were even more willing to persuade parents not to *skip* a dose altogether, with smaller differences between the countries. In the case of HPV, they were more likely to say they would “usually” or “always” accept the parents' choice and less likely to say they would “always or almost always” try to change their mind.

Such anticipated reactions depended on the hypothetical reasons for which parents would want to delay or skip a dose. For example, in all the countries, a much higher fraction of respondents indicated they would be “very unlikely” to support parents believing the vaccine to be more dangerous than those avoiding the vaccines' high costs. Still, the anticipated reactions to different reasons correlated highly, see Figure 11. For several possible reasons of skipping/delaying, there were between-country differences, in particular religious reasons were less appreciated in France than Poland or Spain; the belief that the disease is not dangerous was more appreciated in Spain than the other countries; worries concerning vaccines' safety were most appreciated in Spain, followed by France and Poland. Finally, in the case of the HPV vaccine, respondents in Spain were more supportive towards parents opposing the vaccine on the grounds that the child is not sexually active. Overall, however, other variables were only weakly unrelated to the variables capturing willingness to support parents' decision to skip or delay.

Figure 11 - Spearman correlations between willingness to support parents' decision to skip or delay a vaccination depending on the reason to do it and demographic variables

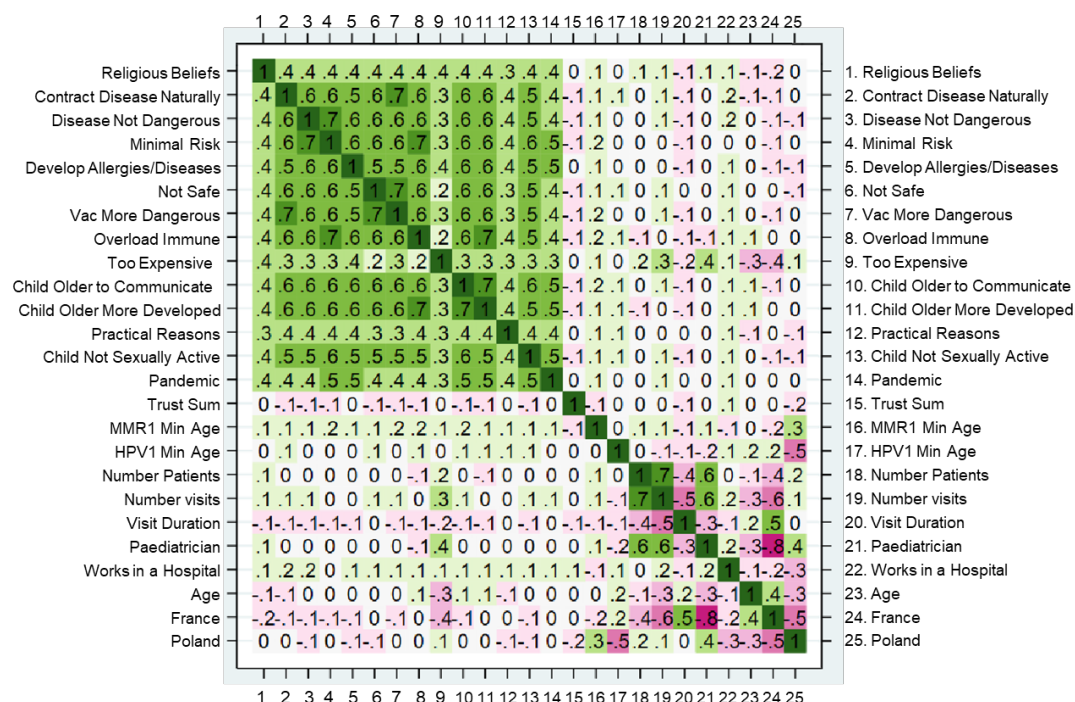


Fig. Note: Trust Sum is the sum of all variables capturing trust towards different institutions' concerning their handling of children's vaccination, except the one concerning regional authorities which was not used in Poland. The colour of each cell corresponds to the value of given Spearman correlation coefficient.

In all the countries, the majority said they would be “likely” or “very likely” to join the previously discussed programme of voluntary disclosure of vaccination rates. Again, the differences between countries were significant, with Spanish respondents providing a particularly high fraction of affirmative responses. They also tended to answer more positively to more specific follow-up questions about such a programme. Overall, however, in all the countries **respondents tended to agree that such a programme could bring greater trust in vaccination in general and greater trust in their own practice. They also tended to disagree that it would represent a violation of privacy. These opinions were highly inter-correlated**, see Figure 12, except for the claim that parents should not decide basing on other parents' opinions. There were also some weak correlations with other variables, with **respondents having more patients and more visits tending to have more positive opinions about the programme.**

Figure 12 - Spearman correlations of reactions to the voluntary disclosure program and demographic variables

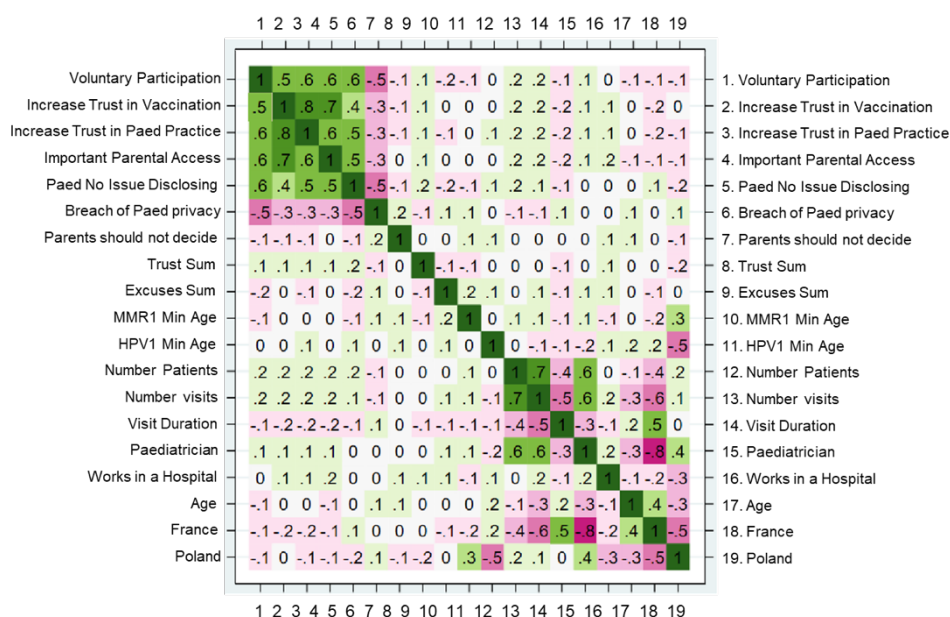


Fig. Note: Trust Sum is the sum of all variables capturing trust towards different institutions' concerning their handling of children's vaccination, except the one concerning regional authorities which was not used in Poland. Excuses Sum is the sum of all variables capturing reactions to skippers and delayers, depending on their motivation. The colour of each cell corresponds to the value of given Spearman correlation coefficient.

Based on **cluster analysis** using the three groups of questions about opinions analysed before, namely those about 1) trust 2) reactions to the voluntary disclosure programme and 3) reactions to parents' attempts to skip or delay vaccination, we were able to identify three groups of respondents. Those in the first group, which could be labelled **The Enthusiasts** and **represented about 30% of the sample**, showed high trust, embraced the programme and were unwilling to support skippers and delayers. The second group, **The Pragmatic (about 50% of the sample)**, were less trustful, also supported the program but were more lenient, i.e., more willing to support skippers and delayers at least in some circumstances. Finally, **The Disillusioned (about 20%)** were less trustful, less enthusiastic, and unwilling to support skippers. While all groups were represented in each of the countries, The Enthusiasts were less prevalent in Poland, The Pragmatic less prevalent in France and The Disillusioned less prevalent in Spain.

3.4 Questions from on the COVID-19 vaccine for children and adolescents

This pulse survey was commissioned in 2022 and the contributors of this activity are Baggio M., Nohlen, H. (team members of the CCBI) and Proestakis, A. (Hellenic Mediterranean University), who designed the study and analysed the data collected. The study was carried out with the support of an external contractor, Prolific Academic Ltd.

This additional activity was created to respond to an immediate need expressed by the Directorate-General for Health and Food Safety: collecting a set of real questions and doubts on childhood COVID-19 vaccination expressed by parents. These questions were used to draft the Q&A document to support Member States in their communication to citizens around childhood vaccination against COVID-19, with a focus on children aged 5-11. The CCBI designed a specific survey to collect such questions and doubts, together with other key variables to help interpret the results obtained.

Key findings of this activity will be published in due course in the form of JRC science for policy briefs and/or peer reviewed scientific articles.

3.4.1 Study design and methodology

The data was collected on the 14 February 2022 on the research platform Prolific (<https://www.prolific.co/>). A total of 250 subjects participated in the study, of which 237 unique subjects completed the study. The average completion time of the survey was around eight minutes. The sample was balanced in terms of

gender, and respondents were pre-selected based on their country of residence (EU 27). The survey was programmed on EU Survey, and it is available at the following link: <https://ec.europa.eu/eusurvey/runner/c19vaccination>. Socio-demographic data was obtained from Prolific and merged with the EU Survey dataset. The survey was administered in English. The survey asked a series of questions aimed at collecting the vaccination status of respondents and their child(ren), worries and beliefs about COVID-19 vaccination, beliefs about COVID-19 vaccination coverage, which source of information is most trusted and trust in institutions, experts and pharmaceutical companies.

Furthermore, the survey had an open question, to which parents could answer in English or in their mother tongue to avoid language barriers. The question was formulated as follows: "You have the chance to address any kind of question to a group of experts on COVID-19 vaccination FOR CHILDREN. Your questions will be grouped with other respondents' questions and transferred anonymously to the experts. At a later stage, the answers of the experts to your questions will be used to inform other parents. What would you like to ask?"

The questions collected were divided in three categories depending on who asked the question:

- **Cat. A:** Parents of children who were **not eligible** for vaccination (0 to 4 years old) [74 parents].
- **Cat. B:** Parents who had **at least one vaccinated child** between the ages of 5 and 16 years [94 parents].
- **Cat. C:** Parents who have **not yet vaccinated** any of their eligible children (between the ages of 5 and 16 years) [79 parents].

It is also important to note that some parents submitted more than one question, while others did not submit any questions.

For each category we then sorted the questions into eight broad topics:

1. *Safety*: this set of questions included vaccine safety concerns related to the process of approving the vaccine, and whether the vaccines were sufficiently tested before being approved. It also included questions about balancing risks and benefits of the vaccination.
2. *Complacency*: this set of questions revolved around the concerns over the true need for children to get vaccinated against COVID-19, as well as the perceived risks associated with children contracting COVID-19. Parents made claims related to their questions on the lower incidence of severe cases of COVID-19 for children, the Omicron variant, the fact that vaccines appear to fail in preventing infections, the possibility of the virus to become endemic and the fact that most adults have been vaccinated or have recovered from COVID-19.
3. *Efficacy, effectiveness, and protection*: this set of question revolved around doubts that stemmed from vaccines providing somewhat limited protection from infection and transmission, and the limited need for children to gain protection against serious illness and death (since they are perceived to be a category not at risk). Questions also focused on immunity and its lasting effects.
4. *Adverse reaction and side effects (short and long term)*: this category encompassed questions about adverse reactions and side effects. They focused on both short-term and long-term side effects to children's healthy development, in particular their immune system, cognitive abilities, and future fertility.
5. *Vaccination Campaigns*: this set of questions gathered all doubts on how vaccination campaigns have been organized, managed, and coordinated at the national and EU level. It included, among others, questions related to vaccination mandates, recommendations, and policy processes.
6. *Timing*: this set of questions regarded the best timing for COVID-19 vaccination. Specific issues pertained to its combination with other vaccines included in the national immunization schedules, as well as the optimal waiting time after recovery from COVID-19.
7. *Boosters*: this set of questions focused on how the vaccination plan for COVID-19 will look like in the future: whether boosters will be required, whether the vaccine will become routine, whether the vaccine will be adapted to current or future variants etc.
8. *Other*: this set of questions collected all the remaining questions that could not be included in any of the previous seven categories. These included questions corroborating conspiracy theories and general questions about the pandemic.

In total we collected 335 questions, distributed as shown in Table 4.

Table 4 - Distribution of types of questions by category of parents

	Category A (Not eligible)	Category B (Vaccinated)	Category C (Not vaccinated)
<i>Safety</i>	30 (25.64%)	24 (18.60%)	22 (20.18%)
<i>Complacency</i>	26 (22.22%)	11 (8.53%)	29 (26.61%)
<i>Efficacy, effectiveness, and protection</i>	10 (8.55%)	12 (9.30%)	10 (9.17%)
<i>Adverse reactions and side effects</i>	29 (24.79%)	43 (33.33%)	27 (24.77%)
<i>Vaccination Campaigns</i>	7 (5.98%)	3 (2.33%)	6 (5.50%)
<i>Timing</i>	6 (5.13%)	4 (3.10%)	8 (7.34%)
<i>Boosters</i>	6 (5.13%)	27 (20.93%)	1 (0.92%)
<i>Other</i>	3 (2.56%)	5 (3.88%)	6 (5.50%)
Total number of questions	117	129	109

It is interesting to note that Category B parents asked mostly about adverse reactions and side effects, even though they have vaccinated one or more of their eligible children. This percentage is lower for parents who have not vaccinated their eligible children (Category C: 24.77%) and for parents whose children were not eligible (Category A: 24.79%). In the latter two categories, complacency questions were also very prominent (A: 22.22%, C: 26.61%). It is also worth noting that Category B parents were the ones most interested in knowing about boosters for children (20.93% of questions, compared to A: 5.13% and C: 0.92%). Timely communication on boosters for parents who have already vaccinated their children is therefore important.

3.4.2 Lessons learnt and policy recommendations

The questions collected with this exercise gave a good representation of the main parental concerns, by categories of parents, in line with the findings of the other key activities carried out under the project on vaccine acceptance and demand. However, collecting doubts and concerns via this survey, and giving the respondents the opportunity to express themselves freely and in their mother tongue, revealed some interesting insights:

- The **safety of the vaccination** is one of the main concerns: parents seem to want **reassurance on the testing and approval processes** of the vaccines.
- **Complacency** plays a pivotal role for those parents who have not yet had their children vaccinated. Parents are **uncertain about the real necessity of getting children vaccinated**, and a clarification on this matter is necessary.
- Parents are worried about **adverse reactions and side effects**, especially in the **medium and long term**. Parents are worried that vaccination would interfere with the healthy development of their children, their immune system, and their fertility. Parents are also worried about who will be responsible for long-term side effects of the vaccination.
- Parents who have already had their children vaccinated are eager to learn more about **boosters** for children and **how vaccination campaigns against COVID-19 will evolve over time**.
- Some respondents welcomed the opportunity to express their doubts and worries and appreciated the survey as an outlet to voice their concerns. **More opportunities should be created for citizens to voice their concerns and to get their questions answered by experts in immunization.**

4 Conclusions and way forward

This final report gave an overview of the work carried out over a span of two and half years on the behavioural determinants of vaccination acceptance and demand. The objective of the project was to collect information on vaccine confidence and hesitancy in the EU, with a specific focus on the attitudes of parents of children aged 18 months to 18 years, the general population, and health care providers. Three specific vaccines were targeted (MMR, HPV and COVID-19) in a selection of EU Member States (Spain, France, Italy, Poland, Portugal, Romania, and Sweden). The project highlighted the complexity of vaccination acceptance and demand, bringing to attention several challenges and opportunities. This report also pointed out to policymakers several behavioural interventions that could be introduced at the national and local level to increase, directly or indirectly, vaccination uptake.

The project confirmed the importance of **vaccination cards** as a fundamental tool in the management of children and adults' health care. Having a vaccination card (or another comparable form of vaccination record) is a key instrument to make sure that one's vaccination status is up to date and appropriate to one's age and lifestyle. Not having it readily available for consultation, or not having it at all, could become an issue, especially considering new outbreaks and the lack of centralized immunization information systems. The repeated cross-sectional survey showed that mothers reported more often having a vaccination card for their children compared to fathers, and this parental difference was true in all chosen Member States. Just short of **70%** of respondents declared having their **own vaccination card** (in some cases this meant that they were aware of their parents having it). Women reported having a vaccination card more often compared to men. We urge policymakers to reflect on both the need to **promote home-based health records for all citizens**, and to consider gender differences when targeting behavioural interventions in this area. A **digital solution for vaccination cards and records** would be preferable, in particular if it could host both a **default, with opt-out, vaccination appointment feature** and **reminders linked to life-course vaccination schedules**. This requirement is driven by **memory issues and present biasedness being important drivers of low vaccination coverage rates**. Another digital solution for increasing vaccination acceptance and demand is the use of **chat bots** to provide people with **information** about the **safety and efficacy of vaccines**. Their interactive nature, according to the most recent literature developed during the COVID-19 pandemic, is more effective in delivering public health messages compared to more static classic media.

A key insight drawn from both the literature reviews and the data collection activities, is that **past vaccination behaviour is a good predictor of future vaccination choices**. For policymakers, having access to vaccination registries could allow to track past behaviour and lead to targeted policy interventions, mainly towards hesitant adults and parents. This could be especially important when new vaccines are made available or when other vaccination campaigns are required for public health purposes. Similarly, we investigated any **relationship between parent and child vaccination status**, and, for COVID19, we found evidence that parents' decisions to get vaccinated or have their children vaccinated are driven by similar mechanisms and affected by similar factors. The most frequent reasons mentioned why parents had their children vaccinated or were willing to do so was to protect them. On the other hand, for the parents who were not vaccinated or were not willing to have their children vaccinated, the most compelling reason to stall vaccination was linked to **doubts about the safety of the vaccine**. For the COVID-19 vaccination, we also investigated **conflicting thoughts**. The evidence suggested that parents of vaccinated children had significantly lower conflicting thoughts, compared to parents whose children were eligible but not vaccinated. This could mean either that parents with vaccinated children reconciled their doubts after the vaccination, or that conflicting thoughts about the vaccination are one of the drivers for stalling this vaccination.

Concern about the safety and the efficacy of vaccines is a stable feature of the determinants of vaccination acceptance and demand, for all vaccines, but particularly for new ones. Past literature has shown that **individuals accept higher probabilities of potential side effects, as the effectiveness of the vaccine increases**. **Clear and transparent communication, highlighting the efficacy of vaccines and not only the risks of side effects is key** to support vaccination decisions. In the case of **new vaccines**, such as those for COVID-19, the concerns about safety and efficacy are specifically related to the **rapid development of the vaccine and the perceived insufficient testing**. In this case, communication should also include clear and comprehensive information on the development, evaluation, and approval of vaccines. For these messages to be effective, the institutions delivering them should be trusted by the community. To maintain a community healthy, citizens should hold a belief that the institutions in charge of public health

would provide trustworthy information, make appropriate decisions, and would work effectively to safeguard their health and wellbeing.

As shown across several project activities, trust in institutions is a significant factor in both routine immunization and COVID-19 vaccination decisions. The most trusted in their role in vaccination programmes (both routine and COVID-19) were scientists, followed closely by doctors. By contrast, pharmaceutical companies were least trusted. The European Commission scored a similarly to National Health Authorities and pharmacists.

Although trust is a complex, multidimensional, cultural concept, and too often it has been viewed by policymakers and other actors as too sensitive and hazy of an issue to be addressed, it has become evident that **measures that protect and improve trust are fundamental to social and economic outcomes**. Therefore, **trust in institutions is key to improve vaccination demand and acceptance: the greater the trust, the higher the vaccination rates**. This project showed that trust in institutions was lower when it came the management of the pandemic, including the COVID-19 vaccination campaigns, compared to the trust in managing routine vaccination programmes. **Recovering the loss of trust in institutions caused by the pandemic should be a priority for good governance and community resilience**. We urge therefore policymakers and stakeholders from different groups to acknowledge this challenge and to identify critical areas for improvement, with the collaboration and inputs of all relevant community stakeholders. With the involvement of non-profit organizations, faith-based groups, private sector organization, individuals, families and communities, policymakers should aim at designing interventions aimed at restoring and increasing trust.

The repeated cross-sectional survey has also shown that the willingness to receive a COVID-19 vaccine was affected by participants' **beliefs about the phase of the current pandemic and the likelihood of a new wave**. In this light, we proposed two policy actions: first, **stepping up vaccination and boosting** would require **campaigns with tailored messaging**. Second, **intensifying collaboration against mis- and disinformation on COVID-19 vaccines should also consider the understanding of the pandemic phases and beliefs on the likelihood of next waves**. For example, arguments that Omicron is "the last COVID-19 variant" gained traction in spring of 2022 and it is likely that similar arguments will resurface in the future. If these are linked to vaccination being "unnecessary" given the status of the pandemic and the likelihood of next waves is downplayed, vaccination acceptance and demand could be hampered. Making sure to link information campaigns with the evidence presented in this report and epidemiological intelligence is key, if the objective is to anticipate mis- and disinformation messages. This policy implication is all-important considering that being exposed, even for a limited amount of time, to vaccine-critical information increases vaccine risk perceptions. On this basis, public health authorities and policy makers should make a concrete effort to **be the first voice heard in the debate, notwithstanding the paramount imperatives of a good communication that is reliable, transparent, consistent, understandable, and accessible**.

Another important contribution of our stream of research was the creation of a reliable taxonomy of parents that classified them into four distinct categories: acceptors, hesitant acceptors, delayers, and skippers. Combining the taxonomy of parents with sources of information for vaccination decision-making, our study highlighted that acceptors tend to be **more reliant on expert advice**, while **skippers** are more reliant on their **own research**, basing their decisions on peer-to-peer exchange of information. This finding raises awareness on the efficacy of vaccination education and promotion campaigns: **oftentimes policymakers believe that informing the public is sufficient to change behaviour**, however results from this research show once again that **for the source of information to be effective the recipient should be well-understood first**. While acceptors and delayers trust information coming directly from experts, the hesitant and the skippers prefer to research and elaborate information on their own terms. This must be reflected in education and promotion campaigns, potentially **providing a more active role to those parents who prefer a higher degree of involvement**. Future research should certainly be devoted to understanding the reasons behind this preference. In addition, when parents rely on their own research, they could easily fall prey to **mis- or disinformation**. Empowering highly involved parents with tools to protect themselves from mis- and disinformation could be one of the many potential interventions that policymakers should consider. In the same line, parental **education level, income level, health literacy and age** have also been found to play an important role in vaccination decisions. Again, **promoting health literacy and numeracy is another pillar to work on to improve vaccination acceptance and demand**.

Regarding the influence of **social networks and homophily**, we found that parents' **second-order beliefs** (i.e. parents' beliefs about what others believe) about **vaccine safety and necessity had an effect on**

both parents' routine immunisation and COVID-19 vaccination decisions, suggesting that social networks, and particularly parents' personal networks, play an important role in parents' decision-making on vaccination. This report provides further support to the idea that more focused research on the **interaction between social network and mis- or disinformation** will provide public health authorities with more robust evidence for tailoring interventions which involve family and friends to pursue greater vaccination uptake.

Moving to broader considerations on the role of behavioural sciences in improving vaccination acceptance and demand, **this project highlighted the importance of continuing behavioural research, notwithstanding the need to improve how behavioural sciences are included in the policy-making cycle**. First, **networking, exchanging and finding synergies** is key to fostering the role and influence of behavioural sciences in the field of vaccine acceptance and demand policy-making. This would limit unnecessary duplication of studies, mutual learning and support, as well as the creation of common frameworks and language. Secondly, since behavioural sciences capacities and expertise are not homogenous across the EU, **disparities should be addressed, and where behavioural sciences capacity is available it should be institutionalized in order to avoid loss of expertise and infrastructure**. Furthermore, the pandemic has shown the importance of interdisciplinary collaboration between the different specialties of behavioural sciences. Sociology, social and cultural anthropology, psychology, and behavioural aspects of biology, economics, geography, law, psychiatry, and political science should be all considered and invited into the discussions and research programmes dedicated to vaccine acceptance and demand, as well as health emergency preparedness and response plans and infrastructures. Last but not least, **ethical considerations when applying behavioural sciences to vaccine acceptance and demand are paramount**, so that the risks of designing problematic and unethical intervention processes are minimised, in particular when behavioural interventions target children, adolescents, minorities and underserved communities.

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List of abbreviations and definitions

CCBI	Competence Centre on Behavioural Insights
DTP/DtaP	Diphtheria, Tetanus, and Pertussis
EC	European Commission
ECDC	European Centre for Disease Prevention and Control
ES	Spain
EU	European Union
EUDCC	EU Digital COVID-19 Certificate
FP	Family paediatrician
FR	France
HCP	Health Care Providers
HPV	Human Papilloma Virus
IPV	Inactivated sequential Polio Vaccine
IT	Italy
JRC	Joint Research Centre
KAP	Knowledge Attitudes and Practices
MHC	Maternal and Child Health
MMR	Measles Mumps and Rubella
NPIs	Non pharmaceutical interventions
NUTS	Nomenclature of territorial units for statistics
OPV	live Oral Polio Vaccine
PL	Poland
PT	Portugal
RO	Romania
SE	Sweden
VC	Vaccine Coverage
VH	Vaccine Hesitancy
VHPs	Vaccine Hesitant Parents
WHO	World Health Organization

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