Strategies for introducing and implementing vaccines for adults into National Immunization Programmes in Europe: Exemplary Approaches and Key Insights

Meeting Report

AIB Technical Meeting, April 18 -19, Prague, Czech Republic

University of Antwerp and University of Florence

The Adult Immunization Board (AIB) (www.adultimmunizationboard.org) is an independent multidisciplinary advisory board created in November 2022. The purpose of the AIB is to contribute to the reduction of mortality and morbidity from vaccine-preventable infections and diseases in European adults by providing evidence-based guidance on fundamental technical and strategic issues while monitoring the progress of adult immunization programmes at regional, national, and European levels.

The AIB comprises a group of prominent experts from various fields of adult immunization and representing different European regions. Board members come from a broad array of adult immunization stakeholders (academia, public health, and international organisations) but act in their personal capacity for the board. The AIB is supported by an unrestricted grant from Vaccines Europe (www.vaccineseurope.eu) and applies the ethical rules of its hosting universities, the University of Antwerp and the University of Florence, to guarantee strict operational and scientific independence throughout its activities. The AIB and its board members pledge to work independently, transparently, and collaboratively.

The AIB leverages the long-standing experience of the Viral Hepatitis Prevention Board (VHPB, created in 1992; www.vhpb.org) and the HPV Prevention and Control Board (HPV Board, created in 2015; www.hpvboard.org). In line with the *modus operandi* of the VHPB and HPV Board, the AIB organises two live meetings per year: a technical meeting to discuss specific technical aspects on adult immunization with subject-matter experts, and a country meeting to discuss country and region-specific issues on adult immunization together with local experts. All meeting slides and reports are available on the AIB website (www.adultimmunizationboard.org).

Table of Contents

Authors and reviewers

Name	Affiliation	Role	Contribution
Chloé Wyndham-Thomas	P95	Rapporteur	Medical writing
Sara Boccalini	University of Florence	Scientific secretariat	Revision
Jade Pattyn	University of Antwerp	Project Manager	Revision
Paolo Bonanni	University of Florence	Expert	Revision
Pierre Van Damme	University of Antwerp	Expert	Revision
Marco Del Riccio	University of Florence	Scientific secretariat	Revision
Angela Bechini	University of Florence	Scientific secretariat	Revision
Greet Hendrickx	University of Antwerp	Scientific secretariat	Revision
Birgit Weinberger	University of Innsbruck	Advisor	Revision
Jacek Wysocki	Poznan University	Advisor	Revision
Domenico Martinelli	University of Foggia	Speaker	Revision
Rebecca Forman	Maastricht University	Speaker	Revision
Ole Wichmann	Robert Koch Institute	Speaker	Revision
Tiina Likki	WHO Regional Office for Europe	Speaker	Revision

Abbreviations list

ACCESS	vACcine Covid-19 monitoring readinESS
AESI	Adverse event of special interest
AIB	Adult Immunization Board
ADVAC	Advanced course in Vaccinology
ARI	Acute respiratory infection
ARVAC	Alumni refresher Vaccinology course
BCI	Behavioural and cultural insights
CEA	Cost-effectiveness analysis
CDC	Centre for Disease Control
ECDC	European Centre for Disease Control
EEA	European economic area
EMA	European Medicines Agency
EU	European union
EU-JAV	European Joint Action on Vaccination
GPs	General practitioners
HCWs	Health care workers
HIV	Human immunodeficiency virus
HMA	Heads of Medicines Agencies
HPV	Human papilloma virus
HTA	Health Technology Assessment
HZ	Herpes zoster
ICAVT	International collaboration on advanced Vaccinology training
ICU	Intensive care unit
I-MOVE	Influenza - Monitoring Vaccine Effectiveness in Europe
IPD	Invasive pneumococcal disease
JCVI	Joint Committee on Vaccination and Immunisation
KCE	Healthcare Knowledge Centre
LMIC	Low- and middle-income countries
LTCF	Long-term care facility
NITAG	National immunization technical advisory group
NIP	National Immunization Programme
PASS	Post-authorisation safety study
PCV20	20-valent Pneumococcal conjugate vaccine
PPV23	23-valent pneumococcal polysaccharide vaccine
RMP	Risk management plan
RSV	Respiratory syncytial virus
SARI	Severe acute respiratory infection
SHC	Superior Health Council
SLR	Systematic literature review
SOPs	Standard operating procedures
SPEAC	Safety Platform for Emergency vACcines
STIKO	Standing Committee on Vaccination (Germany)
TTS	Thrombosis with thrombocytopenia syndrome
UK	United Kingdom
US	United States
Tdap	Tetanus diphtheria acellular pertussis
VE	Vaccine effectiveness
VEBIS	Vaccine Effectiveness, Burden and Impact Studies
VPD	Vaccine-preventable disease
WHO	World Health Organization

Meeting definitions

Adult immunization	Adult immunization refers to the administration of vaccines (active immunization) or antibodies (passive immunization) to individuals who are 18 years of age or older in order to protect them against various infectious diseases, before or after exposure. *Source: AIB secretariat*
Introduction	The act of introducing something: such as the act of bringing something into practice or use for the first time. *Source: Cambridge dictionary* Introducing a vaccine refers to a (sub)national recommendation and inclusion of a vaccine in immunization programs. *Source: AIB secretariat*
Implementation	The process of moving an idea from concept to reality. It refers to a building process rather than a design process. *Source: Cambridge dictionary* Implementing a vaccine involves the detailed process of defining targets, distribution, ensuring access, managing logistics, monitoring coverages, to achieve widespread vaccination. *Source: AIB Secretariat*
Implementation science	Implementation science is the scientific study of the methods to promote the uptake of research findings into routine healthcare in clinical, organisational, or policy contexts. *Source: Wensing M(1)* The scientific study of methods to promote the systematic uptake of research findings and other evidence-based practices into routine practice, and, hence, to improve the quality and effectiveness of health services. It includes the study of influences on healthcare professional and organizational behaviour.' *Source : Eccles M & Mittman BS(2)*

Meeting report

1. Introduction

In light of the increasing adoption of lifelong vaccination policies in Europe, the Adult Immunization Board (AIB) convened a technical meeting in April 2024 to explore the latest strategies and gather valuable insights regarding the implementation of vaccines for adults into National Immunization Programs (NIPs).

The aim of the meeting was to provide updated information on the introduction and implementation of vaccines for adults in European countries now and in the coming years. Through this meeting, the AIB sought to gather diverse perspectives, from various contexts, disciplines and for several vaccines.

The specific meeting objectives were the following:

- Decision-making objectives:
  - Explore and understand the evolving criteria influencing national decision-making processes for the introduction of vaccines for adults.
  - Identify pivotal factors facilitating effective decision-making in different European countries.
- Implementation objectives - planning and managing:
  - Investigate the current status and evolution of vaccination programs for adults in the European Union (EU).
  - Analyse the implementation procedures of vaccines for adults, including setting goals and targets, defining the scope of application, identifying target populations, selecting introduction strategies, and managing the planning, scheduling, coordination, and associated costs.
- Monitoring and Evaluation objectives:
  - Gain valuable insights from monitoring, evaluation, and impact assessment examples across European adult vaccination programs.
  - Utilise lessons learnt from real-world scenarios to enhance the efficiency and impact of adult vaccination introductions.

This report summarises the presentations, discussions, and lessons learnt during the two-day meeting. Meeting slides are available on the AIB website (www.adultimmunizationboard.org).

2. Decision-making

Through various studies and surveys, the key criteria used for deciding on the introduction of vaccines in adults used globally and in Europe have been mapped and weighted. Country-specific examples give further insight into the national/regional decision-making process.

Investigating the criteria and enabling factors for inclusion of vaccines for adults into NIP

The increasing number of new and improved vaccines available in a context of competing health priorities warrant transparent and evidence-based decision-making processes when deciding on the introduction of a vaccine in a NIP.

To document the evolving criteria that affect vaccine policy decision, Donadel et al. performed a global systematic literature review (SLR), spanning from 2010 to 2020 (3). This SLR included articles presenting a framework of decision-making for vaccine adoption, studies collecting or analysing empirical data on decision-making for vaccine adoption, and theoretical and empirical articles that provided insights into the process of vaccine policymaking. Of 116 references included and extracted for the study, fifteen were from European countries (Belgium, Denmark, France, Finland, Germany, Italy, Luxembourg, Poland, Spain, Sweden, Netherlands and the United Kingdom (UK)). Results showed that the most frequently used criteria in the vaccine decision-making process were burden of disease, vaccine efficacy and effectiveness, vaccine safety, economic evaluations, vaccine impact on health outcomes, and the quality of the evidence. Criteria infrequently used (included in less than 50% of the processes) were accessibility, equity and ethics, feasibility issues, vaccine acceptability, delivery issues, and others (political priority, affordability, financial sustainability, funding sources). Comparing results to those of a previous SLR by Burchett et al. of 2012 (4) revealed that decision-making criteria have evolved over time, with an increase in the considerations on the quality of the evidence and in the use of economic evaluations.

The main themes or factors enabling successful vaccine policymaking were also explored in the SLR by Donadel et al. and results are shown in Table 1. Although key enabling factors included national governance, political will, and policy dialogue, the highest-ranking enabling factor was the availability of evidence-informed recommendations.

Table 1. Enabling factors for policymaking globally. Adapted from Donadel et al.(3)

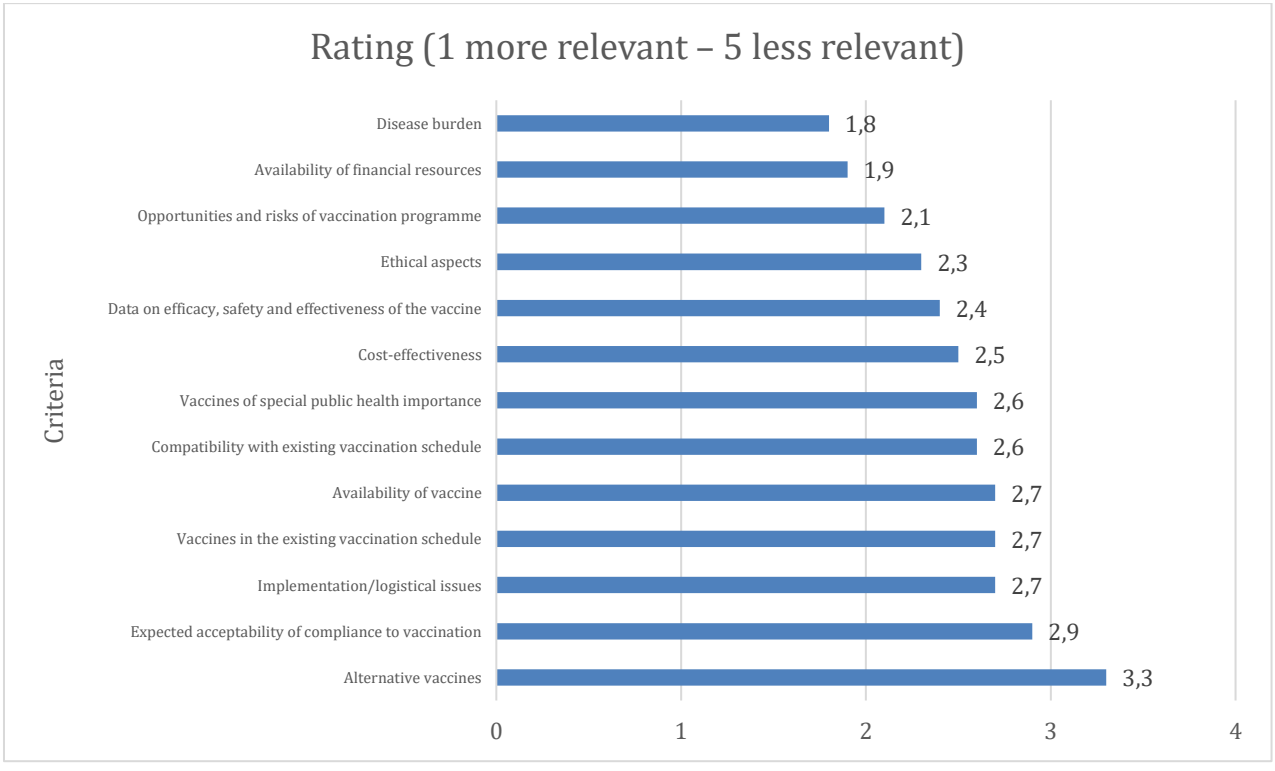
Enabling factor	**% of references***
National, regional, or global evidence-informed recommendation	82
National governance, political will	70
Policy dialogue, networks, champions	57
Public private partnerships	57
Institutionalised process for vaccine introduction	56
Robust health system	52
Lessons learnt from other countries or regions	43

** Percentage of references where the factor is mentioned, out of 61 identified theoretical and empirical articles.*

A key role in the recommendation processes is played by the National Immunization Technical Advisory Groups (NITAGs). NITAGs are independent multidisciplinary bodies of national experts that provide evidence-based recommendations to policymakers and immunization programme managers. In 2021, an online survey was organised in the context of the European Joint Action on Vaccination (EU-JAV; www.eu-jav.com) and led by the Italian National Institute of Health (5). The aim of the survey was to collect the main criteria used for vaccine recommendation development in European countries and identify the planned recommendations for the upcoming two years. The survey targeted NITAG representatives or persons in charge of the national or subnational immunization programmes as identified

through the EU-JAV project. Overall, thirteen of the 28 invited countries responded to the survey. The survey was completed either by a NITAG representative (Ireland, Latvia, Portugal), the NITAG secretariat (Belgium, Norway, Spain), a representative of National Public Health Institutes (Bosnia-Herzegovina, Croatia, Denmark, Hungary, Romania, Sweden), or a representative of the Ministry of Health (Italy). All participants ranked the five key criteria used for vaccine recommendation development in their countries. As in the SLR by Donadel et al. (3), disease burden and availability of financial resources were the highest rated criterions, whilst the presence of alternative vaccines, implementation, logistic issues, and expected acceptability were rated amongst the lowest (Figure 1). Conversely, ethical aspects (right to be protected, informed consent and protection of confidentiality) rated higher than in the global SLR by Donadel et al. (3), above data on efficacy/effectiveness/safety and cost effectiveness. Of note, the survey did not explore the role of NITAGs in the introduction of vaccines during health emergencies. Upcoming NITAG plans revealed the multiplicity of new vaccines arriving on the market and a shift towards life-course immunization with multiple future recommendations concerning vaccines for adults. Across participating countries, NITAGs have an advisory role, with the Ministry of Health or other authorities deciding on the recommendations. The only exception among the surveyed countries is Romania, where NITAG recommendations are binding for the government or the health authority.

Figure 1. Criteria for development of vaccine recommendations in 13 European Union/European Economic Area countries. Source: Martinelli et al.(5)



Although economic evaluations, predominantly cost-effectiveness analysis (CEA), are increasingly used as a criterion for vaccine recommendation and/or implementation, this is not without challenge. CEAs require important resources and time to perform. Therefore, not all countries have the necessary local resources to execute country-specific CEA, and the use of cost-effectiveness results from other settings may not be appropriate in terms of selected model and cut-offs applied. Additionally, the input data for CEA can be rapidly outdated and may not capture all vaccine-related costs (e.g., communication, training). In a SLR by Levin et al., including 171 studies on new vaccine cost projections, half of the economic evaluations only included partial vaccine delivery costs, leading to underestimations of the total cost (6). Good cost projections of new vaccine introductions are however essential to generate the evidence for CEA or cost-benefit analysis that will in turn inform policy decision. These costs should be mapped, and the uncertainty around the cost projections appropriately characterised for improved assessments in the future.

Adult vaccine decision-making processes: country- and vaccine-specific examples

Even with comparable demographics and disease burden, country processes may result in different vaccine decisions (e.g., rotavirus vaccine introduction in Nordic countries (7)). To further explore vaccine decision processes, three recent case examples were shared:

RSV vaccination of older adults, United Kingdom

In the UK, the Joint Committee on Vaccination and Immunisation (JCVI) is the expert scientific advisory committee which advises UK Government on vaccination and immunization matters. JCVI recommendations on RSV vaccinations of older adults were published on 7 June 2023 (8). An age-based rather than risk-based strategy was recommended, with JCVI advising an RSV vaccination programme for adults aged 75 years old and above. Furthermore, JCVI favoured a one-off campaign as the implementation strategy for this programme with initially covering several age cohorts followed by a routine programme for those turning 75 years old. These recommendations were driven by burden of the disease data and CEA.

Burden of disease data from Europe and the United States (US) were used. These have shown high RSV illness rates, hospitalisation rates and mortality in older adults (9-11). Even among the older adult population, an age-related gradient has been found, with increasing age associated with higher burden (e.g., highest hospitalisation rates are found in those above 75 or 85 years of age) (12-14). In a US population-based surveillance investigating the characteristics and outcomes of RSV-hospitalisations among adults aged 60 years and older, increasing age, congestive heart failure and chronic obstructive pulmonary disease were all disproportionately associated with severe outcomes: intensive care unit (ICU) admission, mechanical ventilation, and death(15).

Regarding the CEA, the findings of Moghadas et al. for the US were utilised to support the current recommendations, showing high cost-effectiveness, especially when the RSV vaccines are used across two seasons (16). UK-specific CEA and further studies on burden of disease in

those with chronic underlying conditions are ongoing and may shape JCVI recommendations in the future.

Pneumococcal vaccination of adults, Germany

The Standing Committee on Vaccination (STIKO) – 12-19 members - is Germany's NITAG. This multidisciplinary board develops national recommendations for the use of licensed vaccines after the recommendation and scientific background paper are reviewed and endorsed by the Federal Joint Committee. All vaccines that are recommended will be free of charge for Germany's citizens. In September 2023, STIKO updated its recommendations on pneumococcal vaccination, advising the 20-valent pneumococcal conjugate vaccine (PCV20) in place of the 23-valent pneumococcal polysaccharide vaccine (PPSV23) in both adults ≥18 years with chronic diseases and adults ≥ 60 years.

The development of a STIKO recommendation follows a defined process of eight core-steps: (1) perform a prioritisation procedure to select which vaccine will be discussed (2) set the goal of the vaccination, (3) set PICO[1] questions that will allow the systematic assessment of vaccine efficacy, effectiveness and safety, (4) perform a SLR where needed, (5) rate bodies of evidence using GRADE[2], (6) explore additional questions such as disease burden, expected impact based on mathematical models, feasibility and equity, (7) develop an Evidence-to-Decision table, (8) define the recommendation. This process and all associated results are detailed in the background paper of each recommendation. CEA is not required but can be used by STIKO as one criterion to compare the efficiency of different vaccination strategies. The Standard Operating Procedures (SOPs) of STIKO and modelling method guidance for analysis are also available on the STIKO website (17, 18).

The Evidence-to-Decision table of STIKO is an important tool that offers transparency and details how STIKO reached its recommendation. The table summarises the judgement and research evidence for each criterion used in the decision-making process. The Evidence-to-Decision table for the updated pneumococcal vaccination recommendation is available as an attachment to the background document (19) and here. The criteria used to answer the question whether PCV20 should replace PPSV23 for people aged ≥ 60 years, with the goal of reducing the burden of invasive pneumococcal disease (IPD) and its consequences such as hospitalisation, disability and death in people aged ≥ 60 years were: burden of disease, benefits and harms of the different options (vaccine efficacy, effectiveness and safety), financial resources (CEA), equity, acceptability, feasibility, and mathematical modelling suggesting that vaccination with PCV20 prevents more IPD cases and deaths than vaccination with PPSV23 in the elderly while having a similar safety profile

Herpes Zoster vaccine for adults, Belgium

Belgium's NITAG resides within the country's Superior Health Council (SHC). The NITAG is composed of over 70 members and is coordinated by a dedicated secretariat. For the generation or update of a recommendation, a working group composed of experts in the related field is

[1] PICO(s): Population, Intervention, Control, Outcome, (study design)
[2] GRADE for bodies of evidence: assessing the certainty of a body of evidence using Grading of Recommendations Assessment, Development and Evaluation.

formed. Their proposal is presented in a plenary meeting to achieve a consensus document. In September 2022, the SHC recommended vaccination against HZ using the recombinant, non-live adjuvanted subunit vaccine against HZ for immunocompetent adults aged ≥60 years and immunocompromised patients, including those under immunosuppressive therapy aged ≥ 16 years and in addition patients under treatment with anti-JAK therapy (20). The SHC also stated that it is aware of the high cost of the vaccine and suggests taking into account the results of ongoing country-specific CEA for vaccine introduction. Indeed, CEA are not included in Belgium's NITAG assessments but performed separately by the federal Healthcare Knowledge Centre (KCE). Notably, the CEA performed for HZ vaccination in Belgium concluded that the vaccine is not cost-effective at the current price, a result which contradicts equivalent studies from other settings (21, 22).

While country recommendations and CEA are performed at the federal level, vaccine decision-making on introduction and implementation is organised at the regional level. Vaccines included in the regional immunization programmes are free of charge (or partly reimbursed in the case of rotavirus vaccine). Currently, in Belgium, no regional immunization programme for adults or older adults exists, but federal reimbursement can be requested for a specific vaccine. In the case of HZ, federal reimbursement was granted in November 2023 for selected groups of immunocompromised adults ≥18 years old (haematological malignancy or other malignant tumours with active treatment within the last five years; persons living with human immunodeficiency virus (HIV); persons having undergone or eligible for a hematopoietic stem cell transplantation or organ transplantation). Reimbursement of HZ was not granted for older adults nor some of the other key target groups identified by the NITAG. Nevertheless, this is considered an important first step in improving HZ vaccination. HZ vaccination coverage in at-risk groups is increasing but remains very low.

3. Implementation

To set the stage for vaccine implementation planning and management discussions, implementation science was introduced, followed by a snapshot of current vaccination programmes in Europe and their evolution was given.

Implementation science

Implementation research involves the scientific study of methods to promote the systematic uptake of research findings and other evidence-based practices into routine healthcare, and, hence, to improve the quality and effectiveness of health services. It includes the study of factors that influence the behaviour of healthcare professional and organisations (1, 2).

Implementation science covers three domains: the recommended practice, the context, and the implementation strategy. Recommended practices (e.g., a specific vaccine recommendation) differ in terms of their complexity, compatibility, visibility, evidence-base data, and costs. The context includes the organisation leadership culture and the capacity for organisational change, social and political factors, the presence or not of previous experiences, individual factors (e.g., health professional and patient factors) and available resources and incentives. The implementation strategies researched include planning, education, support, finance incentives, restructure, and legislation.

Implementation science can identify a broader range of strategies and factors for improvement and reduction of evidence-to-practise gaps than practical experience or common sense might provide. Implementation science can also help to develop concepts and frameworks for design and evaluation of (vaccine) programmes. Its research applies rigorous analytical research methods, common to other scientific domains, and defines realistic aspirations for implementation goals, based on a body of research.

The current status and evolution of vaccination programmes for adults in Europe

In the last two decades, young adults have been disproportionately affected during vaccine-preventable disease (VPD) epidemics. This is the result of gaps in immunity (e.g., less exposure due to lower circulation of VPD pathogens), gaps in vaccination programmes, vaccine hesitancy, and barriers to attend vaccination services. In parallel, Europe is facing an increased life expectancy and an ageing population. Older age is associated with multi-morbidity and immunosenescence (age-related decline of the immune system), leading to lesser immune responses and higher VPD morbidity and mortality. In total, adults are to be targeted for catch-up vaccinations and booster doses, but also for primary vaccinations related to specific VPDs (travel-related, comorbidity-related, age-related). Consequently, lifelong vaccination strategies are increasingly accepted and adopted, replacing the historical child-based vaccine programmes.

In 2019, Cassimos et al. studied the vaccination policies for adults in 42 European countries. Vaccine programmes for adults were in place in all included countries, but with significant differences in terms of number of vaccines included, vaccine schedules, target population and implementation-frame (e.g., mandatory versus non-mandatory) (23). These differences are reflected in the European Centre for Disease Prevention and Control (ECDC) Vaccine Scheduler https://vaccine-schedule.ecdc.europa.eu/, a web-based platform sharing vaccine schedules across the European Union (EU) and European Economic Area (EEA).

Each EU/EEA country is responsible for its own national public health policy, including NIP and vaccination schedule. Vaccine schedules are tailored to local circumstances and health systems. Vaccination programmes will need to evolve depending on new vaccine development, growing evidence, and changes in VPD epidemiology. An illustrative example of how vaccination programmes may evolve in time is that of pertussis. Pertussis (whooping cough) is an endemic VPD, associated with severe disease in infants with a 2% fatality rate and permanent complications, and increased morbidity and complications in older adults. Since the replacement of the traditional whole-cell vaccine by the acellular pertussis vaccine in many European immunization programmes due to its improved safety profile, there has been an increase in pertussis epidemic waves. This rise is attributed to the higher waning rates of immune response for the acellular vaccine. In response, changing vaccine strategies have been used to complement childhood vaccinations: cocoon vaccination (immunization of the parents and close relatives to protect infants too young to be vaccinated), now largely replaced by maternal vaccinations and booster vaccinations in adults. In 2021, pertussis vaccination during pregnancy was included in the vaccination programmes of 28 out of 42 European countries (24).

Setting goals/targets for an adult vaccination programme

To discuss the setting of goals and targets for an adult vaccination programme, two examples were presented: the targets set for the elimination of cervical cancer and the targets set for vaccination coverage of older adults against influenza.

Cervical cancer elimination strategies

World Health Organization (WHO) response strategies to public health emergencies aim either to control, eliminate or eradicate a disease (25):

- Control: the reduction of disease incidence, prevalence, morbidity, and/or mortality to a locally acceptable level (e.g., aim for COVID-19).
- Elimination: can be either the elimination of transmission or as a public health problem
    - Elimination of transmission: reduction to zero of the incidence of infection caused by a specific pathogen in a defined geographical area, with minimal risk of reintroduction (e.g., mpox).
    - Elimination as a public health problem: achievement of clear, measurable and commonly agreed global targets set by WHO in relation to a specific disease (e.g., cervical cancer, viral hepatitis).
- Eradication: the permanent reduction of a pathogen's prevalence to zero (e.g., as achieved for smallpox, and aimed for polio).

In 2020, WHO defined a global triple intervention strategy to achieve the *elimination of cervical cancer as a public health problem*, using an incidence threshold of 4 per 100 000 women-years for elimination. The goals of the triple strategy were: (1) 90% of girls fully vaccinated with the human papillomavirus (HPV) vaccine by the age of 15 years, (2) 70% of women screened using a high-performance test by the age of 35 years, and again by the age of 45 years; and (3) 90% of women identified with cervical disease receive treatment (90% of women with pre-cancer treated and 90% of women with invasive cancer managed) (26). These targets are to be met by 2030 for countries to be on the path towards cervical cancer elimination. However, the 90% vaccination coverage target remains far out of reach, including in high-income countries. In 2022, the mean HPV programme performance coverage[3] in the WHO European Region was 65% for the first dose and 60% for the second dose (WHO/UNICEF data (27)), and only a third of European countries had reached a programme coverage above 70% (28). Important differences are found between and within countries, with coverages below 50% mostly found in central and eastern Europe. Remarkably, the performance of an HPV vaccination programme during its first two years appears to be a strong predictor of the level of vaccine coverage in subsequent years (27, 28).

To achieve HPV elimination, introductions worldwide need to be sped up and, in parallel, HPV vaccination programme performance needs to be improved. To accelerate the road to cervical cancer elimination, various strategies that leverage both the direct and indirect effects of the vaccine (herd immunity) are being investigated. In a study by Lehtinen et al., authors state that the following requirements should now guide the implementation of HPV vaccination: gender-

[3] Programme performance coverage: vaccination coverage according to the national schedule and the programmes'seligibility criteria for each calendar year.

neutral approach, equitable delivery, a comprehensive strategy for immigrants and migrants, and reaching the country-specific critical immunization thresholds[4] (29). Another strategy to accelerate the road to elimination is the use of an off-label single dose regimen (instead of the standard two-dose schedule) in immunocompetent populations. Current evidence suggests that a single dose has comparable efficacy and duration of protection as a 2-dose schedule, and offers vaccine programme advantages (e.g., efficiency, availability, affordability and overall coverage) (30). In Europe, single-dose regimens are currently in use in Albania, Estonia, Ireland, Montenegro and the UK. Long-term follow-up of these programmes can inform on the impact of a potential increased rate in waning of effectiveness with the single-dose approach. Further strategies to accelerate the road to cervical cancer elimination include extended catch-up vaccinations (extending the upper age limit for catch-up vaccinations), HPV-FASTER strategies that pair HPV vaccination to HPV screening in older women (31, 32), and the outreach to vulnerable groups.

Influenza vaccination strategy

The WHO influenza immunization target for older adults has been set at 75% (2003 World Health Assembly), a threshold that has since been used by the EU Council and the ECDC. Although the decision-process or rationale for this specific 75% target is unpublished, the need for a high vaccine coverage in older adults is undeniable in view of the heavy disease burden and evidence of lower vaccine effectiveness in this risk group. Older adults are at high risk of severe influenza, including complications, hospitalisations and mortality, with a 4-5-fold higher hospitalisation rate than in young adults. In persons ≥65 years vaccine effectiveness is generally low. Particularly, vaccine effectiveness against influenza A(H3N2) is consistently lower than vaccine effectiveness against influenza A(H1N1) and type B. High-dose inactivated and adjuvated vaccines have shown higher efficacy than standard dose in this age group (33).

During the COVID-19 pandemic, governments strengthened influenza vaccination programmes to avoid adding morbidity and mortality from influenza to that of COVID-19, particularly in its first autumn-winter season (pre-COVID-19 vaccine roll-out). Dose distribution was increased in countries with pre-existing programmes and high coverage rates were obtained. This progress was achieved through tailored communication and vaccine promotion for specific populations, improved vaccine reimbursement, and safe, convenient and increased access points for vaccination (34).

European governments could sustain and further leverage the efforts made during the COVID-19 pandemic, but, according to the latest ECDC report on influenza recommendations and coverage rates in the EU/EEA Member states, only Denmark reached the 75% influenza vaccine coverage target for season 2021-2022 (35). In this report, ECDC recommends that targeted and context specific strategies be put in place to increase demand, that investment should be made in evaluation efforts to inform future strategies and maximise the use of public health resources, and to improve access to vaccines and convenience for those being vaccinated.

[4] The critical vaccination threshold is the coverage at which a specific HPV type may be eliminated through the direct and indirect effects (herd immunity) of the vaccine. The threshold depends on the HPV vaccine efficacy/effectiveness and the R0 (basic reproductive numbers), that are HPV type and population specific. The R0 and resulting critical vaccination coverage is higher for HPV16, the most oncogenic HPV type, than for other high-risk types.

Additionally, the report concludes that health care workers (HCWs) continue to play a critical role in increasing uptake of vaccines and should be encouraged to lead by example, while improvements to existing seasonal influenza vaccines are critical and efforts to develop a new generation of more effective influenza vaccines must be increased.

Key factors to improve influenza vaccination coverage and reach the set immunization targets have also been identified in the scope of four benchmark countries - Australia, Canada, UK and USA. These factors can be clustered into five pillars: (1) Health Authority accountability and strengths of the influenza programme, (2) facilitated access to vaccination, (3) healthcare professional accountability and engagement, (4) awareness of the burden and severity of disease and (5) belief in influenza vaccination benefit. The fundamental elements applicable across all pillars are data collection and communication, multi-stakeholder accountability, and multi-faceted recipes tailored to each countries' health system (36).

Identification of the target population

For all vaccine introductions, target populations are to be clearly defined. Once a target population is defined, obtaining good target estimates is essential for vaccine programme planning and its evaluation. As shown with COVID-19, vaccine strategies and target populations may evolve over time.

Target population estimates: assessing and improving the accuracy of target populations estimates

For child-based vaccine programmes, immunization target populations estimates are typically based on live births (for birth doses) and surviving infants (for infant vaccinations in countries with high infant mortality rates). Target estimates may be aggregated by time period or by birth cohort. Target population estimates for older children and adults, and for specific risk-groups (e.g., HCWs, pregnant women) are generally more challenging to capture.

Multiple data sources should be used, including civil registrations and vital statistics (births and deaths registration), census and projections, population (health) registries, electronic immunization registries, modelling or even satellite images, with each source having advantages and limitations. Projections, for example, are more accurate for the national rather than the subnational levels, with accuracy decreasing over time. Accuracy of population health registries will depend on overall access to healthcare and the quality of the reporting system. Such limitations are to be well understood for correct interpretation of the data.

To assess the accuracy of a given source, several steps can be taken. For a defined period of 5-10 years, epidemiological targets and indicators obtained using the data source can be compared with other independent sources of data (e.g., World Population Prospects, National Stats Office data). Similarly, implied mortality rates obtained from the data source can be compared to referent sources (e.g., World Population Prospects, World Development Indicators, data from surveys). Additionally, national target population estimates can be compared to the sum of the subnational estimates, annual growth rates can be calculated and assessed (>10% annual fluctuation likely indicating errors), and time series can be plotted and analysed for coherence (plausibility between time-trends in target population, vaccine numbers, and vaccine coverage).

Method of calculation of immunization coverage is also to be considered when assessing the accuracy of target population estimates. For HPV, for example, both programme coverage (coverage according to schedule and eligibility criteria) and vaccine coverage by age 15 are used. With programme coverage, the main estimation challenge lies with the denominator, with definitions varying across countries and over time. With coverage by age, challenges lie with the numerator, as accumulated data from several years back is required.

In general, as vaccine coverage rises, coverage estimates become increasingly sensitive to errors in target population estimates. A systematic approach to assess and improve the accuracy of target population estimates is made available in a WHO technical report (37).

Target population of COVID-19 adult vaccination: evolution and current status

The initial goal and targets of the Global COVID-19 Vaccination Strategy as defined by the WHO, was "*to minimise deaths, severe disease and overall disease burden; curtail the health system impact; fully resume socio-economic activity; and reduce the risk of new variants"*(38).

In the early stages of the vaccine campaign, prioritisation was required due to the limited availability of the COVID-19 vaccines. Prioritisation in Europe was based on SARS-CoV-2 risk categorisation (e.g., higher risk in older adults or those with certain predisposing health conditions), ethical considerations (e.g., high exposure risk of HCWs and other workforces), and logistical reasons. Countries referred either to local data or the literature to establish these risk categories. For booster doses, the trade-off of the primary vaccination of low-risk individuals to allow for early booster campaigns in older adults were modelled and then implemented in certain countries, such as the UK.

As COVID-19 vaccine availability issues resolved, vaccine coverage increased throughout the European region and peaked late 2021. Thereafter, adult vaccination rates drastically declined, with highly variable coverages reported across the EU/EEA. For season 2023-2024, COVID-19 vaccine uptake in 60-69 year olds ranged from 0.01% in Romania to 43.5% in Denmark (39).

Each EU/EEA country is responsible for its own national public health policy including NIP and vaccination schedule, resulting in differences in (COVID-19) vaccine recommendations. Currently, while the general approach in the EU/EEA is to vaccinate older adults, pregnant women, and high-risk groups against seasonal COVID-19, there are significant differences across countries regarding, age threshold for vaccination, the recommended dose interval, the defined risk groups, whether a SARS-CoV-2 infection counts as a dose, co-administration with influenza vaccine, and the use of a spring boost and for whom (40). Further changes in COVID-19 vaccine strategies in Europe are expected this fall (e.g., further tailoring of COVID-19 vaccine to emerging variants) and after the European Joint purchase agreement ceases in December 2025, after which countries may or may not include the vaccine in their NIPs.

Selection of introduction strategies and implementation activities

To further discuss vaccine introduction strategies and implementation activities, a selection of vaccine-specific introductions (COVID-19 roll-out; RSV vaccine introduction in the US; introduction of maternal vaccination against pertussis in Denmark) and implementation activities (involvement of pharmacists, training, and communication) were presented.

Leveraging lessons learnt from COVID-19 roll-out

COVID-19 vaccine roll-out was characterised by multiple successes, from research and development to vaccine distribution, with at least 1.4 million lives saved in the European Region (41). Nonetheless, many challenges have been identified. These fall within three dimensions: vaccine development, vaccine dissemination and vaccine deployment. Focussing on the latter two, challenges have included equity, with markedly low vaccine accessibility and uptake in low- and middle-income countries (LMICs), sufficient manufacturing, assuring secure transport of vaccine, determining fair vaccine allocation, encouraging uptake, fighting misinformation, adapting clinical and health research systems, and the ethical implications of vaccine passports and vaccine requirements (42).

These challenges represent an opportunity to learn lessons from experience and identify best practises and target areas for change. An extensive list of future considerations can be compiled, and examples include (1) multisectoral engagement, with the identification of both enablers and barriers to health policy-making to establish a foundation for change (43), (2) the harmonisation of vaccine policies across the European region when possible, with effective communication around necessary divergences (44, 45), and (3) adaptive and well trained personnel to deliver and communicate about vaccines. The above considerations all require political will and financing, but also cooperation, collaboration, coordination to improve efficiency, sustainability and robustness. Cooperation, collaboration, coordination can be promoted through intersectoral task forces, public private partnerships, legal frameworks, resource pooling, shared data platforms, and functional communication lines.

RSV vaccines in the US

At the moment of the meeting, two RSV vaccines are currently licensed in the US, RSVpreF (Abrysvo, Pfizer), a one-dose bivalent subunit vaccine licensed in pregnant women and in adults aged ≥60 years, and RSVPreF3 (Arexvy, GSK), a one-dose monovalent adjuvanted vaccine licensed only in adults aged ≥ 60 years. In 2023, the Centre for Disease Control (CDC) recommended that adults ages 60 years and older may receive a single dose of RSV vaccine using shared clinical decision making (46). As part of this discussion, providers and patients are to consider the patient's risk for severe RSV-associated disease (e.g., presence of chronic underlying medical conditions associated with severe RSV disease, residence in nursing home or other long-term care facility (LTCF), frailty and advanced age). RSV vaccine can be administered year-round, with most benefit just before the start of the RSV season and may be co-administered with other vaccines for adults depending on vaccine status, likelihood of returning for additional vaccine doses, risk of acquiring a VPD, vaccine reactogenicity profiles and patient preferences. The same year, CDC recommended a single dose of maternal RSV vaccination during 32–36 weeks gestation, with seasonal administration (47).

Vaccination rates achieved for the first RSV season following the CDC recommendations have remained relatively low, reaching 20% of adults ≥60 years. Potential factors contributing to low vaccination uptake include (1) the time required to integrate into systems, gain wide access, increase awareness among healthcare providers, and normalise among the population, (2) "shared clinical decision-making" as a recommendation is difficult to communicate and implement, (3) the complex coadministration messaging may have resulted in missed

opportunities for vaccination, and (4) the high price of the vaccines and insurance plans not yet mandated to cover RSV immunization. The CDC recommendations for season 2024-2025 will be adapted according to the gained knowledge. In pregnant women, the high price of the vaccine ($295/dose, compared to ~$50 for tetanus, diphtheria, and acellular pertussis - Tdap - vaccine) and its inadequate reimbursement is also a likely obstacle to vaccination, as reimbursement and cost recovery challenges have previously been identified as specific barriers to maternal immunization (48). Another implementation challenge is that vaccination decisions fall upon obstetricians, rather than healthcare professionals sharing longer standing relationships with the patient (e.g., GPs). Finally, the recent multiplication of vaccines recommended during pregnancy now reaching a total of four (RSV, influenza, COVID-19 and pertussis) is a new barrier. In a recent survey of pregnant people carried out by the CDC and the University of Iowa (unpublished), out of 523 respondents, 12% said they would accept no vaccines during pregnancy, 10% were unsure, 49% would accept one or two vaccines, while only 9% and 20% would accept three or four vaccines, respectively.

Multiple actions are now being taken by the CDC to increase RSV vaccine uptake in these two target populations, through tailored communications using social media and other consumer resources, frequent speaking engagements and additional resources to provide education on the recommendations to both the public and HCW. Additionally, surveys, focus groups, and in-depth interviews will be performed to identify barriers and enablers, and regular collaborations with key stakeholders (e.g., Medicaid services, LTCFs)

Pertussis in Denmark

In Denmark, universal healthcare coverage financed by taxes allows for free and equal access to vaccines. Pertussis vaccination has been offered to infants since 1961, with whole cell vaccines then acellular vaccines from 1997 onwards. The vaccine programme has significantly reduced the incidence and mortality of pertussis, and the current schedule (3,5 and 12 months, and booster dose at 5 years) successfully meets its 95% coverage target. Nonetheless, pertussis remains endemic, with epidemics occurring approximately every 3-5 years. High incidence and hospitalisation rates occur in children younger than 3 months of age, but with very low mortality (one child in 2020, one in 2023). In 2019, faced with a surge in cases, Denmark introduced a temporary programme for pertussis vaccination for pregnant women. The programme was extended several times and made permanent in 2024 after another record high epidemic (49) and thorough assessment according to the Health Technology Assessment (HTA).

Pertussis vaccination is now part of the national recommendations and offered in week 25 or 32 of gestation at an already established visit with the General practitioners (GPs). This approach offers several advantages. Compliance to the visit is high (likely >90%) and vaccine advice comes directly from the woman's GP, typically with whom she shares a long-standing relationship and associated high level trust. Moreover, health authorities in Denmark have the direct communication channels with GPs. Finally, the permanent offer in place of an epidemic-driven temporary programme prevents confusion. Conversely, one of the main disadvantages of this strategy is that COVID-19 and influenza vaccines, also indicated in pregnancy, are offered at vaccination centres and not by the GP.

To date, the program has been highly successful, with an 85% coverage rate recorded in 2023. High media attention around infant pertussis disease has played a role in this success. The first signs of impact of the programme may be showing, with the proportion of infants among confirmed pertussis cases being lower than in previous years.

Continuous monitoring of the programme is needed, ideally with improved surveillance of vaccine coverage and vaccine effectiveness to evaluate programme performance. The impact of a recent change in law allowing midwives to administer vaccines to pregnant women, as well as arrival of new RSV maternal vaccines on the market (increasing the number of vaccines indicated during pregnancy to four) on the programme will also need to be assessed.

Involvement of pharmacists: what impact can be expected?

Multiple studies show that pharmacist intervention, whether facilitating, educating or administering vaccines, is an added value for vaccine implementation and uptake among adults (50-52). This added value is related to the high convenience and better accessibility offered by pharmacists, compared to other HCWs such as GPs. In the EU, there are over 180 000 pharmacies serving 3,245 citizens on average, with 60% of residents having access to nearest pharmacy within a 5-minute walk and with no need of an appointment: pharmacies are the first point of contact between patients and the healthcare system.

In light of these advantages, pharmacists are increasingly involved within vaccine programmes, and the COVID-19 vaccination programme was an enabler or starting point in many countries. Currently, influenza and/or COVID-19 vaccination are offered at pharmacies in 15 European countries (Belgium, Denmark, France, Germany, Greece, Ireland, Italy, Latvia, Luxembourg, Poland, Portugal, Norway, Romania, Switzerland, and UK) and 9 countries offer also other vaccines (Denmark, France, Greece, Ireland, Italy, Norway, Portugal, Switzerland, and the United Kingdom) (53). However, major differences are found across the EU with regards to the role and responsibilities given to the pharmacist. Legal framework, prescription possibilities and reporting obligations, involvement and contribution to uptake, and level of training all differ. As the involvement of pharmacists in vaccine programmes is relatively new, data on the overall impact of their contributions is still scarce. In Ireland, involvement of pharmacists resulted in an increase in vaccine coverage, not only because of the involvement of pharmacists, but also by an increase in vaccinations by GPs (54), indicating a synergic effect either through collaboration or competition.

Overall, pharmacists can play a key and complementary role in immunization, through the education and/or administration of vaccines to populations that remain unreached by GPs and nurses, thus increasing uptake and supporting the overburdened primary healthcare system.

The role of training for implementing vaccines for adults: equipping healthcare professionals and students

HCWs are confronted daily with questions about vaccines, yet do not have strong training on immunization in their initial curriculum. Adapted and continuous training should be offered to the whole spectrum of healthcare professions (doctors, nurses, pharmacists, mid-wives etc) and at various levels of experience - students and young professionals, mid-career professionals, and experts.

Although training on vaccines is an acknowledged need, multiple challenges exist. These include the limited time of HCWs, funding needs, and the constant evolution of knowledge. To address some of the barriers, the International Collaboration on Advanced Vaccinology Training (ICAVT; www.icavt.org) was created in March 2022. The purpose of the ICAVT is to facilitate vaccinology education by providing an up-to-date list of globally available courses, foster collaborations between courses, create opportunities for pooling resources and increasing effectiveness through sharing experiences, lessons learnt, and documentation. Currently, the collaboration covers 35 courses, from all regions of the world. Amongst these courses is the Alumni Refresher Vaccinology Course (ARVAC), an annual, free, online course of 3 half days and 9 plenaries, open to Alumni of ICAVT courses and other collaborators.

In Europe, the Advanced Course of Vaccinology (ADVAC, University of Geneva, Fondation Mérieux) is a 2 week-course for mid-career and experts to facilitate critical decision making in vaccinology. The alumni are decision makers (immunization program managers, NITAG members, industry), with a third of participants coming from LMIC. Mirroring immunization programmes, these training courses are now evolving from an initial focus on paediatrics to a lifelong approach with additional training on vaccines for adults.

Communicating with the public about vaccines: implementation considerations

There are several prerequisites for vaccine communication to the public. Good knowledge of the evidence-base around the vaccine and the disease burden and where to easily find the data and figures is warranted. Knowledge of the population's attitude towards vaccination and the identification of barriers and enablers is equally important. Important resources, both financial and human, should be allocated to the task and are not to be underestimated. Overall, for successful vaccine communication, trust, transparency, availability and flexibility are required.

Trust is a cornerstone of effective vaccine communication, where trust is to believe *someone* is good and honest and will not harm you (e.g., public health official, HCWs, government), or that *something* is safe and reliable (the vaccine). Trust can be gained through transparency, in which all knowns, both positive or negative effects, and all unknowns around the vaccine are communicated. Communicating on uncertainty may however have mixed results on trust and will depend on the source of the statement. In high trusting societies, such as Norway, communicating on uncertainty is believed to build trust (55).

When communicating about vaccines, availability is to be prioritised, to avoid non-professionals answering journalist questions or questions from the public. Social media is an excellent tool for vaccine communication, allowing for direct communication with the public, and an excellent listening post to detect remaining concerns and questions that are circulating. Social media requires a high level of availability, with adequate staffing and resources to rapidly respond and moderate comments according to a clear set of predefined rules.

Despite the advantages of social media, one size does not fit all, and flexibility is key. Vaccine communications and their channels need to be multiplied and tailored to the targeted population (e.g., traditional media, magazines, tabloids, SMS, social media). For subgroups that are not reached by traditional mass campaigns, direct engagement through focus groups or through local influencers (e.g., community and religious leaders, HCWs with migrant backgrounds,

pharmacies) are needed. These subgroups are to be identified upfront through prior knowledge of acceptance and attitudes towards vaccination.

4. Monitoring and evaluation

After the introduction of a new vaccine and the implementation of a vaccination programme, continuous monitoring of effectiveness, safety, and impact is crucial. Evaluations of the introduction and/or programme will help identify strengths and gaps, allowing for continuous improvement. As example, four monitoring and assessment activities carried out in Europe were presented during the technical meeting: use of behavioural and cultural insights in impact evaluation, monitoring costs and investments of the NIPs, monitoring vaccine effectiveness (VE), and monitoring of vaccine safety.

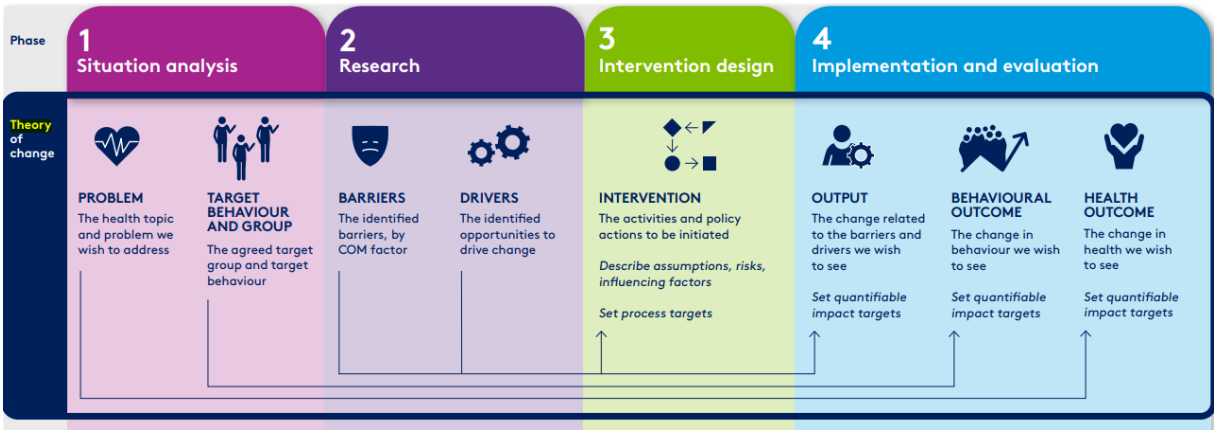
Impact evaluation: using behavioural and cultural insights to increase vaccine uptake

Behavioural and cultural insights (BCI) is a comprehensive approach that involves understanding the contextual and individual factors that affect health behaviour. By leveraging BCI we can develop evidence-informed policies, services and communication strategies that target health behaviours, improve health and well-being and reduce inequities, and evaluating these interventions. In WHO's European Programme of Work 2020-2025, BCI was identified as one of four flagship area (56), followed by a regional resolution and action framework (57) and then a global resolution (WHA76.7) (58) underlining the political mandate for this area of work.

Challenges and observations in the WHO European Region pointed the need for a targeted approach to achieve high and equitable vaccination uptake, tailoring interventions to the needs of specific groups. BCI helps to understand the 'why' of low uptake in certain groups. The Tailoring Health Programmes approach of the WHO can be used to support the application of BCI (59). The approach is built upon an adaptation of the COM-B model of Behaviour (60), referring to three essential conditions of behaviour:, Opportunity, and Motivation. The Tailoring Health Programmes approach is shown in Figure 2 and can be summarised as follows:

1. Situation analysis: Use data to define target groups. Start with available data to understand the problem and zoom in on groups experiencing gaps in coverage.
2. Research: Conduct insights research on identified target groups to identify their barriers and drivers to vaccination.
3. Intervention design: Design tailored interventions based on insights to close gaps in coverage.
4. Implementation and evaluation: Implement, evaluate and revise if needed.

Figure 2. Phases and steps of a Tailoring Health Programmes project and the resulting theory of change. Source: WHO, A guide to tailoring health programmes (61).



For the technical meeting, a case example on increasing influenza vaccine uptake among hospital health workers in Georgia was used to illustrate the process. The phases and steps of the Tailoring Health Programmes approach evolve into an evidence-informed theory of change. The theory of change explains how and why change will occur by describing and illustrating the process, including all the key elements from problem to solution and the connections between them. The theory of change allows to be explicit on why a given intervention is selected, and to evaluate its effect.

Despite clear opportunities around these processes, scaling-up and effectively integrating the use of BCI into NIPs remains a challenge.

Cost assessment of immunization programme

Cost of a vaccination programme can be assessed in multiple ways, with various levels of complexity and exhaustivity. Nevertheless, basic ballpark numbers can sometimes be sufficient to demonstrate high impact. This was shown through a study by Fernandez Conde et al. looking into health expenditures and immunization costs in Spain (62). Vaccinating according to the 2023 NIP costs 1,500€ for a healthy person's lifetime, from birth to 83 years of age (1,542 € for a woman, 1,498 € for a man). For a person with chronic disease, the amount increases to 1,735-3,160 €. With a total health expenditure of 115,512 million euros, the estimated costs for vaccination in a year with vaccines included in the 2023 NIP, assuming 100% coverage, is about 565 million €, or about 23% of health expenditure for prevention and public health services, and only 0.5% of total health expenditure, a low cost for a high impact on burden of disease. For example, the average cost of income for influenza and meningitidis accounts for 3,276 and 9,712€, respectively.

Putting numbers and costs into perspective should be used for promoting and strengthening immunization programmes, in order to ensure access to all populations in every stage of life.

Monitoring Influenza and COVID-19 Vaccine Effectiveness in Europe – from I-MOVE to VEBIS

Vaccine effectiveness (VE) studies, based on observational data, allow the evaluation of vaccination-induced protection in the real-world setting (world population, field conditions), as opposed to the controlled environment of randomised clinical trials. VE studies are essential to

estimate and monitor vaccine-induced protection in different risk groups and over time (e.g., waning, emergence of new variants), and can provide rapid information to inform policy decisions.

Vaccine effectiveness research in the EU was conducted between 2007-2022 by I-MOVE (Influenza - Monitoring Vaccine Effectiveness in Europe) and is now under the ECDC VEBIS umbrella (Vaccine Effectiveness, Burden and Impact Studies). VEBIS research is based on the well-established I-MOVE/I-MOVE+/I-MOVE-COVID-19 networks, covering over 20 study sites across 19 European countries and multiple partnerships with national and regional public health institutes of the region. The project catalyses technical capacity in EU/EEA and beyond and receives only public funding.

The primary objective of the VEBIS Programme is to estimate COVID-19 and influenza VE in the EU/EEA. Ongoing studies are established in four different settings and populations: electronic health register-based cohorts of community-dwelling individuals (cohort study with COVID-19 related hospitalisation and death as monitored outcome), HCW cohorts (cohort study with SARS-CoV-2 infection of influenza infection as outcome), primary care attendees with acute respiratory infection (ARI; test-negative case control design study), and patients hospitalised with severe acute respiratory infection (SARI; test-negative case control design study). The studies covering ARI and SARI are mainly embedded in existing ARI/SARI surveillance systems, with VE as only one of the surveillance systems' objectives. The studies apply generic common protocols and pool multi-country results to increase sample sizes and precision to answer key questions. All estimates are adjusted for key confounders (generally age, sex, time and underlying condition). Key research questions include VE by time since vaccination (to help understand the dynamics of potential VE decline due to waning of immunity or virological changes), clade- and variant- specific VE, immunological imprinting, VE against outcomes of different severity, VE by vaccine type or platform, effect of repeated vaccination, hybrid immunity, and vaccine programme impact.

There are multiple challenges for such platforms, such as long-term sustainability (funding, human resources, data accessibility), its robustness in crisis (dependent on local health care structures), geographical diversity (in terms of vaccines and their coverage), validity of data (use of variable sources), and residual confounding. Evaluation studies are necessary to ensure the outputs generated remain of high quality.

I-MOVE/VEBIS results have been used for timely reporting to key stakeholders, including the Global influenza VE report that informs WHO influenza vaccine strain selection committee meeting and during the COVID-19 pandemic. The protocols, reports and articles published by I-MOVE/VEBIS are available on the I-MOVE and ECDC websites: https://www.imoveflu.org/; https://www.ecdc.europa.eu/.

Safety monitoring of COVID-19 and other vaccine for adults in the EU

Both the European Medicines Agency (EMA) and EU Member States continuously monitor the safety of vaccines to ensure any possible risks are detected and managed as early as possible. Post-marketing safety monitoring is ensured through multiple pathways: extended clinical trials data (phase IV), medical literature, post-authorisation safety studies (PASS), and spontaneous

reports from patients and healthcare professionals, including those captured by EudraVigilance, the European database of suspected adverse reactions to medicines (https://eudravigilance.ema.europa.eu/human/index.asp).

Safety monitoring of COVID-19 vaccines was unparalleled, being characterised by multiple innovations (related to mRNA and viral-vector vaccines), the targeting of high-risk populations that typically have less clinical trial data, the identification of new clinical entities (e.g., thrombosis with thrombocytopenia syndrome (TTS)), and an unprecedented global mass vaccination. This mass vaccination led to a volume of adverse events data of 500-1000 events per week at European level to assess and evaluate.

To prepare for mass roll out, the EU Regulatory Network for COVID-19 vaccines published its Pharmacovigilance plan in 2020 (63). The plan detailed the enhanced monitoring activities to be carried out in the EU for COVID-19 vaccines, including the roles, responsibilities and interactions between the involved stakeholders. The plan used lessons learnt from H1N1 pandemic, outlined the signal detection methods for rapid detection, exchange, prioritisation, and assessment of safety signals, the active surveillance systems to be in place, and the communication strategies to adopt - enhanced and transparent with public, patients and HCWs.

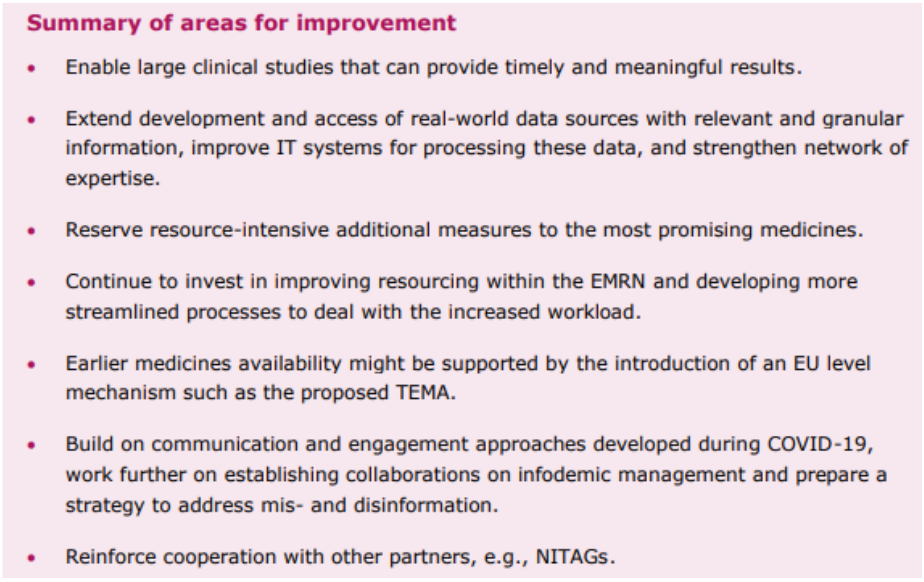
The foundations of good safety monitoring are prompt detection, evaluation, communication and high-level transparency to protect public health and ensure public's trust. Good data is essential, not only on the adverse events themselves, but also on patient vaccine exposure data and the background incidence rates of adverse events of special interest (AESI). The ACCESS programme (vACcine Covid-19 monitoring readinESS) funded by EMA is a public-academic partnership of 22 European research centres, led by University of Utrecht, for the research to monitor safety, effectiveness and coverage of COVID-19 vaccines. The partnership developed protocols for various safety studies to be used both by manufacturers and public entities (e.g., EMA, ECDC), and calculated background rates for adverse events of special interest. The list of AESI for COVID-19 was produced by the Brighton collaboration, a programme of the Task Force for global health (https://brightoncollaboration.org/) and was based on an the SPEAC AESI list (Safety Platform for Emergency vACcines; a Brighton Collaboration and Coalition for Epidemic Preparedness Innovations (CEPI) partnership; https://speacsafety.net/tools/) for vaccination in general. In practise, member states report the detected AESI to EMA and the member state rapporteur for the product in question collaborates with EMA for assessment. In 2021, 992 potential signals related to COVID-19 vaccines were reviewed through weekly screening of EudraVigilance, with 21 validated signals at EU level that were further investigated. Overall, all safety issues of COVID-19 vaccines were successfully identified through spontaneous reporting.

To optimise AESI signal detection in pandemic context and allow for rapid benefit-risk assessment, all safety assessments methods (observed verses expected analysis, imbalance analysis that compare vaccines, time to onset to AESI) are to be combined using specific features normally not available for routine pharmacovigilance. Risk minimization activities are also essential: a good risk management plan (RMP), including traceability of vaccines, (monthly) periodic safety update reports, and a skilled team for signal management and communication of the data. For COVID-19 vaccines, exceptional EMA and network efforts

allowed the rapid detection, conclusion, and contextualised communication over serious risks such as TTS.

Lessons learnt from the safety monitoring of COVID-19 vaccines are to be leveraged for future pandemic preparedness. COVID-19 lessons learnt have been published in a joint report by EMA and the Heads of Medicines Agencies (HMA) (64), with the report's summary of areas for improvement shown in Figure 3. Communication (including infodemics) and cooperation are among the flagged items. Potential game changers of safety monitoring may come from big data and registry linking initiatives, such as DARWIN EU® (Data Analysis and Real-World Interrogation Network; https://www.ema.europa.eu/en/about-us/how-we-work/big-data/data-analysis-real-world-interrogation-network-darwin-eu).

Figure 3. Summary of areas of improvement. Source: HMA-EMA joint report on COVID-19 lessons learnt (64).



Abbreviations: EMRN: European Medicines Regulatory Network; NITAGs: National immunization technical advisory groups; TEMA: Temporary Emergency Marketing Authorisation.

5. Primary barriers to the effective introduction and implementation of vaccines for adults in national immunization schedules and NIPs, and strategies to overcome them.

Although adults are a heterogenous population and barriers to the introduction and implementation of a vaccine will differ according to the targeted population (e.g., older adults, pregnant women, high-risk groups or HCWs), common barriers exist. In a dedicated break-out session of the technical meeting, such barriers as well as strategies to overcome them were identified and discussed. These are summarised in Table 2 below.

Table 2. Barriers to the introduction and implementation of vaccines for adults, and strategies to overcome them.

Primary barriers	Strategies to overcome barriers
Evidence-generation and data availability:	

- High quality data related to burden of disease, vaccine efficacy and effectiveness (particularly in certain risk groups), post-authorisation safety, duration of protection, and/or country-specificities can be insufficient.	- Collaborations, mutualisation of efforts, and combining of datasets when possible. - Increased NITAG collaborations and sharing of agenda, positions, and documentation (e.g., SLRs). - Increased visibility in EU-NITAG initiatives and deliverables. - Harmonisation and sharing of CEA models.
Feasibility issues and ethical considerations:	
- Fitting new vaccine in schedule. - Risk of vaccine fatigue with multiplicity of vaccines (e.g., maternal vaccination). - Impact on the uptake of other vaccines. - Non-equity in vaccine accessibility.	- Reflection over prioritisation and vaccine accessibility.
Political and financial barriers:	
- Vaccines seen as costs rather than investments. - High complexity related to sub-national coordination and negotiations with stakeholders in certain countries.	- Political engagement. - Common negotiation of prices. - Harmonisation of regulations (e.g., guidelines governing interactions between decision-makers and industry).
Population and HCW confidence and literacy:	
- Vaccine hesitancy. - Multiplicity of vaccines. - Divergences in country policies. - Maintaining trust under uncertainty. - Lack of institutional trust. - Cultural and language barriers. - Lack of data on public perception. - Low perception of risk. - Poor training of HCWs on immunization.	- Tailored and transparent communication. - Open publication on decision-making. - Working with community champions. - Collaboration with specialist societies. - Collaboration with social science specialist to improve understanding of the BCI and targeted communication. - Surveys on public perceptions. - Harmonising medical curricula across EU to establish a minimum standard for infectious disease prevention and regular training of HCW on vaccinations
Infrastructure:	
- Production and manufacturing capabilities and sustainability. - Insufficient infrastructure to ensure good accessibility. - Insufficient vaccination documentation.	- Innovation funding models for vaccine - Diversification of access points. - Improved registration system/ documentation of vaccination. - Digitalisation.

Abbreviations: BCI: Behavioural and Cultural Insights: CEA: cost effectiveness analysis; EU: European Union; HCW: healthcare workers; SLR: systematic literature review; NITAG: National Immunization Technical Advisory Group

6. Conclusions

The AIB Technical meeting of 2024 provides updated information on the introduction and implementation of vaccines for adults in European countries, specifically on decision-making processes, planning and management activities, and vaccine programme monitoring and evaluation.

In the EU/EEA, burden of disease and benefit-risk balance (opposing vaccine efficacy or effectiveness to safety) are universally used criteria for decision-making on adult vaccine introduction. Economic evaluations including CEA are being increasingly integrated in the

decision process, while public acceptance, equity, and feasibility are lesser used criteria. Expanded research on decision-making processes in Europe could provide greater insight into the enabling factors of successful (adult) vaccine introductions.

Vaccine introduction and implementation are multifaceted and multi-sectorial processes, requiring careful planning, coordination and organisation. These involving defining and identifying the target population, ensuring distribution and access, managing logistics and infrastructure, making comprehensive cost predictions (from purchase to delivery and administration), all within a legislative framework. In addition, implementation requires tailored vaccine communications to the public and adequate training of HCWs. Insights from previous vaccine introduction strategies and implementation activities, discussed at the AIB Technical meeting, are crucial for informing and shaping new implementation strategies.

Once operational, vaccination programmes are to be monitored in terms of safety, effectiveness, and impact. Pre-defined goals or targets (e.g., vaccine uptake thresholds) help evaluate and adapt a programme. Implementation science and BCI can also be used for a rigorous assessment of implementation, with the aim to identify tangible interventions to improve vaccine uptake.

The AIB Technical meeting allowed for the identification of barriers to the effective introduction and implementation of vaccines for adults in European NIPs, and specific strategies to overcome them. The majority of proposed solutions were based on greater cooperation, collaboration and coordination across the EU. Although most vaccination programmes in Europe are evolving towards life-long strategies, unfortunately many inter- and intra-country differences remain. Rather than a caveat, these differences should be considered as a unique opportunity to identify and leverage vaccine implementation success stories and problem-solving strategies.

Additional reading and tools:

- Background document for the AIB Technical meeting: https://www.adultimmunizationboard.org/wp-content/uploads/2024/04/Background-document.pdf
- Adult Immunization Board website: https://www.adultimmunizationboard.org
- WHO Europe. Introducing new vaccines into national routine immunization programmes: https://www.who.int/europe/activities/introducing-new-vaccines-into-national-routine-immunization-programmes

References

1. Wensing M. Implementation science in healthcare: Introduction and perspective. Z Evid Fortbild Qual Gesundhwes. 2015;109(2):97-102.
2. Eccles M, Mittman B. Welcome to Implementation Science. Implementation Science. 2006;1(1).
3. Donadel M, Panero MS, Ametewee L, Shefer AM. National decision-making for the introduction of new vaccines: A systematic review, 2010-2020. Vaccine. 2021;39(14):1897-909.
4. Burchett HE, Mounier-Jack S, Griffiths UK, Mills AJ. National decision-making on adopting new vaccines: a systematic review. Health Policy Plan. 2012;27 Suppl 2:ii62-76.

5. Martinelli D, Quattrone F, Fortunato F, Di Maggio E, Filia A, Rota MC, et al. Role of the National Immunisation Technical Advisory Groups in 13 European countries in the decision-making process on vaccine recommendations. Euro Surveill. 2023;28(43).
6. Levin A, Yeung KHT, Hutubessy R. Systematic review of cost projections of new vaccine introduction. Vaccine. 2024;42(5):1042-50.
7. St-Martin G, Lindstrand A, Sandbu S, Fischer TK. Selection and Interpretation of Scientific Evidence in Preparation for Policy Decisions: A Case Study Regarding Introduction of Rotavirus Vaccine Into National Immunization Programs in Sweden, Norway, Finland, and Denmark. Front Public Health. 2018;6:131.
8. RSV immunisation programme: JCVI advice, 7 June 2023 (updated 11 September 2023).Joint Committee on Vaccination and Immunisation. Available from: https://www.gov.uk/government/publications/rsv-immunisation-programme-jcvi-advice-7-june-2023.
9. Falsey AR, Hennessey PA, Formica MA, Cox C, Walsh EE. Respiratory syncytial virus infection in elderly and high-risk adults. N Engl J Med. 2005;352(17):1749-59.
10. Korsten K, Adriaenssens N, Coenen S, Butler C, Ravanfar B, Rutter H, et al. Burden of respiratory syncytial virus infection in community-dwelling older adults in Europe (RESCEU): an international prospective cohort study. Eur Respir J. 2021;57(4).
11. Thompson WW, Shay DK, Weintraub E, Brammer L, Cox N, Anderson LJ, et al. Mortality associated with influenza and respiratory syncytial virus in the United States. Jama. 2003;289(2):179-86.
12. Branche AR, Saiman L, Walsh EE, Falsey AR, Sieling WD, Greendyke W, et al. Incidence of Respiratory Syncytial Virus Infection Among Hospitalized Adults, 2017-2020. Clin Infect Dis. 2022;74(6):1004-11.
13. Loubet P, Fernandes J, de Pouvourville G, Sosnowiez K, Elong A, Guilmet C, et al. Respiratory syncytial virus-related hospital stays in adults in France from 2012 to 2021: A national hospital database study. J Clin Virol. 2024;171:105635.
14. Osei-Yeboah R, Spreeuwenberg P, Del Riccio M, Fischer TK, Egeskov-Cavling AM, Bøås H, et al. Estimation of the Number of Respiratory Syncytial Virus-Associated Hospitalizations in Adults in the European Union. J Infect Dis. 2023;228(11):1539-48.
15. Havers FP, Whitaker M, Melgar M, Chatwani B, Chai SJ, Alden NB, et al. Characteristics and Outcomes Among Adults Aged ≥60 Years Hospitalized with Laboratory-Confirmed Respiratory Syncytial Virus - RSV-NET, 12 States, July 2022-June 2023. Am J Transplant. 2023;23(12):2000-7.
16. Moghadas SM, Shoukat A, Bawden CE, Langley JM, Singer BH, Fitzpatrick MC, et al. Cost-effectiveness of Prefusion F Protein-based Vaccines Against Respiratory Syncytial Virus Disease for Older Adults in the United States. Clin Infect Dis. 2023.
17. Standard Operating Procedure of the German Standing Committee on Vaccinations (STIKO) for the systematic development of vaccination recommendations. Robert Koch Institute. 2018. Available from: https://www.rki.de/EN/Content/infections/Vaccination/methodology/SOP.pdf?__blob=publicationFile. Last accessed on 09 July 2024.
18. Modelling methods for predicting epidemiological and health economic effects of vaccinations. Guidance for analyses to be presented to the German Standing Committee on Vaccination
(STIKO). Robert Koch Institute. 2024. Available from: https://www.rki.de/EN/Content/infections/Vaccination/methodology/Guidance_for_analyses.pdf?__blob=publicationFile. Last accessed on 09 July 2024.
19. Falkenhorst G, Remschmidt C, Harder T, Wichmann O, Glodny S, Hummers-Pradier E, et al. Background paper to the updated pneumococcal vaccination recommendation for

older adults in Germany. Robert Koch-Institut, Infektionsepidemiologie; 2016. Available from: https://www.rki.de/DE/Content/Infekt/EpidBull/Archiv/2023/Ausgaben/39_23.pdf?__blob=publicationFile Last accessed on 09 July 2024.
20. Superior Health Council. Vaccination against Herpes Zoster. Brussels: SHC; 2022. Report 9684.
21. Dominique R, Renate Z, de Noordhout Charline M, Nancy T. Evaluation of shingrix vaccine against herpes zoster. Health Technology Assessment (HTA). Brussels. Belgian Health Care Knowledge Centre (KCE). 2022. KCE Reports 360. Report No.: KCE Reports 360.
22. Giannelos N, Ng C, Curran D. Cost-effectiveness of the recombinant zoster vaccine (RZV) against herpes zoster: An updated critical review. Hum Vaccin Immunother. 2023;19(1):2168952.
23. Cassimos DC, Effraimidou E, Medic S, Konstantinidis T, Theodoridou M, Maltezou HC. Vaccination Programs for Adults in Europe, 2019. Vaccines (Basel). 2020;8(1).
24. Maltezou HC, Effraimidou E, Cassimos DC, Medic S, Topalidou M, Konstantinidis T, et al. Vaccination programs for pregnant women in Europe, 2021. Vaccine. 2021;39(41):6137-43.
25. Statement: Control, elimination, eradication: three actions we need to take on three different public health emergencies in the European Region in the coming months. Statement by Dr Hans Henri P. Kluge, WHO Regional Director for Europe. Available from: https://www.who.int/europe/news/item/30-08-2022-statement--control--elimination--eradication--three-actions-we-need-to-take-on-three-different-public-health-emergencies-in-the-european-region-in-the-coming-months.
26. Global strategy to accelerate the elimination of cervical cancer as a public health problem. WHO. 2020. Available from: https://www.who.int/publications/i/item/9789240014107. Last accessed on 17 July 2024.
27. WHO Immunization dashboard. Available from: https://immunizationdata.who.int/.
28. Bruni L, Saura-Lázaro A, Montoliu A, Brotons M, Alemany L, Diallo MS, et al. HPV vaccination introduction worldwide and WHO and UNICEF estimates of national HPV immunization coverage 2010-2019. Prev Med. 2021;144:106399.
29. Lehtinen M, Bruni L, Elfström M, Gray P, Logel M, Mariz FC, et al. Scientific approaches toward improving cervical cancer elimination strategies. Int J Cancer. 2024;154(9):1537-48.
30. Human papillomavirus vaccines: WHO position paper, December 2022. Weekly Epidemiological Record No 50, 2022, 97, 645–672. Available from: https://www.who.int/publications/i/item/who-wer9750-645-672.
31. Bosch FX, Robles C, Díaz M, Arbyn M, Baussano I, Clavel C, et al. HPV-FASTER: broadening the scope for prevention of HPV-related cancer. Nat Rev Clin Oncol. 2016;13(2):119-32.
32. Dillner J, Elfström KM, Baussano I. Prospects for accelerated elimination of cervical cancer. Prev Med. 2021;153:106827.
33. Vaccines against influenza: WHO position paper – May 2022 Weekly Epidemiological Record, 2022, vol. 97, 19. Available from: https://www.who.int/publications/i/item/who-wer9719.
34. Palache A, Billingsley JK, MacLaren K, Morgan L, Rockman S, Barbosa P. Lessons learned from the COVID-19 pandemic for improved influenza control. Vaccine. 2023;41(40):5877-83.
35. European Centre for Disease Prevention and Control. Seasonal influenza vaccination

recommendations and coverage rates in EU/EEA Member States – An overview of vaccination recommendations for
for 2021–22 and coverage rates for 2018-19 to 2020–21 influenza seasons. Stockholm: ECDC; 2023. . Available from: https://www.ecdc.europa.eu/en/publications-data/seasonal-influenza-vaccination-recommendations-and-coverage-rates-eueea-member.
36. Kassianos G, Banerjee A, Baron-Papillon F, Hampson AW, McElhaney JE, McGeer A, et al. Key policy and programmatic factors to improve influenza vaccination rates based on the experience from four high-performing countries. Drugs Context. 2021;10.
37. Technical report. Assessing and Improving the Accuracy of Target Population Estimates for Immunization Coverage. World Health Organization. Working Draft. Revised November 2015. Available from: https://www.who.int/publications/m/item/assessing-and-improving-the-accuracy-of-target-population-estimates-for-immunization-coverage.
38. Strategy to Achieve Global Covid-19 Vaccination by mid-2022. WHO. COVID-19: Scientific briefs 2021. Available from: https://www.who.int/publications/m/item/strategy-to-achieve-global-covid-19-vaccination-by-mid-2022.
39. Surveillance report. Interim COVID-19 vaccination coverage in the EU/EEA during the 2023–24 season campaigns. ECDC. 2024. Available from: https://www.ecdc.europa.eu/sites/default/files/documents/interim-vaccine-overage-eu-eea-2023-24.pdf.
40. Overview of the implementation of COVID-19 vaccination strategies and deployment plans in the EU/EEA, 3 March 2023. ECDC. Available from: https://www.ecdc.europa.eu/en/publications-data/overview-implementation-covid-19-vaccination-strategies-and-deployment-plans.
41. Statement – COVID-19 vaccines saved at least 1.4 million lives in the European Region. Statement by Dr Hans Henri P. Kluge, WHO Regional Director for Europe. 16 January 2024. . Available from: https://www.who.int/europe/news/item/16-01-2024-statement---covid-19-vaccines-saved-at-least-1.4-million-lives-in-the-european-region.
42. Forman R, Shah S, Jeurissen P, Jit M, Mossialos E. COVID-19 vaccine challenges: What have we learned so far and what remains to be done? Health Policy. 2021;125(5):553-67.
43. Amri M, Chatur A, O'Campo P. An umbrella review of intersectoral and multisectoral approaches to health policy. Soc Sci Med. 2022;315:115469.
44. Diaz Crego, Maria, Costica Dumbrava, David De Groot, Silvia Kotanidis, and Maria-Margarita Mentzelopoulou. 2022. Legal Issues Surrounding Compulsory Covid-19 Vaccination. Available from: https://www.europarl.europa.eu/RegData/etudes/BRIE/2022/729309/EPRS_BRI(2022)729309_EN.pdf. Last accessed on 09 July 2024.
45. van Kessel R, Forman R, Milstein R, Mastylak A, Czabanowska K, Czypionka T, et al. Divergent COVID-19 vaccine policies: Policy mapping of ten European countries. Vaccine. 2023;41(17):2804-10.
46. Melgar M, Britton A, Roper LE, Talbot HK, Long SS, Kotton CN, et al. Use of Respiratory Syncytial Virus Vaccines in Older Adults: Recommendations of the Advisory Committee on Immunization Practices - United States, 2023. MMWR Morb Mortal Wkly Rep. 2023;72(29):793-801.
47. Fleming-Dutra KE, Jones JM, Roper LE, Prill MM, Ortega-Sanchez IR, Moulia DL, et al. Use of the Pfizer Respiratory Syncytial Virus Vaccine During Pregnancy for the Prevention of Respiratory Syncytial Virus-Associated Lower Respiratory Tract Disease in Infants: Recommendations of the Advisory Committee on Immunization Practices - United States, 2023. MMWR Morb Mortal Wkly Rep. 2023;72(41):1115-22.

48. O'Leary ST, Riley LE, Lindley MC, Allison MA, Crane LA, Hurley LP, et al. Immunization Practices of U.S. Obstetrician/Gynecologists for Pregnant Patients. Am J Prev Med. 2018;54(2):205-13.
49. Nordholm AC, Emborg HD, Nørgaard SK, Nygaard U, Ronayne A, Nielsen LB, et al. Pertussis epidemic in Denmark, August 2023 to February 2024. Euro Surveill. 2024;29(14).
50. Isenor JE, Edwards NT, Alia TA, Slayter KL, MacDougall DM, McNeil SA, et al. Impact of pharmacists as immunizers on vaccination rates: A systematic review and meta-analysis. Vaccine. 2016;34(47):5708-23.
51. Anderson C, Thornley T. "It's easier in pharmacy": why some patients prefer to pay for flu jabs rather than use the National Health Service. BMC Health Serv Res. 2014;14:35.
52. Le LM, Veettil SK, Donaldson D, Kategeaw W, Hutubessy R, Lambach P, et al. The impact of pharmacist involvement on immunization uptake and other outcomes: An updated systematic review and meta-analysis. J Am Pharm Assoc (2003). 2022;62(5):1499-513.e16.
53. PGEU Position Paper on the Role of Community Pharmacists in Vaccination. Available from: https://www.pgeu.eu/publications/pgeu-position-paper-on-the-role-of-community-pharmacists-in-vaccination/.
54. Does pharmacy vaccination increase overall uptake? VaccinesToday. 2018. Available from: https://www.vaccinestoday.eu/stories/does-pharmacy-vaccination-increase-overall-uptake/.
55. Ihlen Ø, Fladmoe A-T, Steen-Johnsen K. Uncertainty Communication in a High-Trust Society: Source Type, Political Preference, and Trust. International Journal of Communication. 2024;18:219-47.
56. European Programme of Work 2020-2025: United Action for Better Health. 8 June 2021. Report. World Health Organization. Regional Office for Europe. Available from: https://www.who.int/europe/publications/i/item/WHO-EURO-2021-1919-41670-56993.
57. WHO. European regional action framework for behavioural and cultural insights for health, 2022–2027. Available from: https://www.who.int/europe/publications/i/item/WHO-EURO-2023-8004-47772-70522 .
58. World Health Organization. Seventy-sixth World Health Assembly Geneva, 21–30 May 2023 resolutions and decisions annexes. Available from: https://apps.who.int/gb/ebwha/pdf_files/WHA76-REC1/A76_REC1_Interactive_en.pdf#page=1 .
59. Tailoring Immunization Programmes (TIP). Copenhagen: WHO Regional Office for Europe; 2019. . Available from: https://www.who.int/europe/publications/i/item/9789289054492.
60. Michie S, Atkins L, West R. The Behaviour Change Wheel: A Guide to Designing Interventions. . London: Silverback Publishing; 2014.
61. A guide to tailoring health programmes: using behavioural and cultural insights to tailor health policies, services and communications to the needs and circumstances of people and communities. 20 April 2023. Report. World Health Organization. Regional Office for Europe.
62. Fernández Conde S, Cifo Arcos D, Sánchez-Cambronero Cejudo L, Olmedo Lucerón C, Fernández Dueñas A, Cantero Gudino E, et al. [Updated cost of vaccinating throughout life in Spain in 2023]. Rev Esp Salud Publica. 2023;97.
63. Pharmacovigilance Plan of the EU Regulatory Network for COVID-19 Vaccines. EMA. 2020. Available from: https://www.ema.europa.eu/en/documents/other/pharmacovigilance-plan-eu-regulatory-network-covid-19-vaccines_en.pdf.

64. COVID-19 Lessons learned Joint report on the response to the Public Health Emergency. HMA-EMA. 2023. Available from: https://www.ema.europa.eu/en/news/eu-medicines-agencies-reflect-lessons-learned-covid-19.