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VACCINATION PROGRAMMES AND HEALTH SYSTEMS IN THE EUROPEAN UNION

Report of the
Expert Panel on effective ways of investing in Health (EXPH)

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EXPERT PANEL ON EFFECTIVE WAYS OF INVESTING IN HEALTH

(EXPH)

Vaccination Programmes and Health Systems in the European Union

The EXPH adopted this opinion at the 11th plenary on 26 September 2018
after public hearing on 13 September 2018

About the Expert Panel on effective ways of investing in Health (EXPH)

Sound and timely scientific advice is an essential requirement for the Commission to pursue modern, responsive and sustainable health systems. To this end, the Commission has set up a multidisciplinary and independent Expert Panel, which provides advice on effective ways of investing in health (Commission Decision 2012/C 198/06).

The core element of the Expert Panel's mission is to provide the Commission with sound and independent advice in the form of opinions in response to questions (mandates) submitted by the Commission on matters related to health care modernisation, responsiveness, and sustainability. The advice does not bind the Commission.

The areas of competence of the Expert Panel include, and are not limited to, primary care, hospital care, pharmaceuticals, research and development, prevention and promotion, links with the social protection sector, cross-border issues, system financing, information systems and patient registers, health inequalities, etc.

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http://ec.europa.eu/health/expert_panel/experts/working_groups/index_en.htm

SUMMARY

Vaccination is one of the most cost-effective public health interventions available and the main tool for primary prevention of communicable diseases. However, the EU is facing increasing outbreaks of vaccine preventable diseases, while some fatal cases of measles and diphtheria have been reported.

This opinion identifies the main factors (enablers and obstacles) influencing vaccination uptake, and assesses measures that can be expected to improve vaccination coverage. After providing a systems approach to national vaccination programmes (including an appropriate legislative framework, governance arrangements, existence of a register of the target population, funding mechanisms and monitoring), a range of obstacles and enablers of high rates of vaccination coverage are identified.

Obstacles to vaccination coverage include individuals' and parents' concerns or fears about vaccine safety and side effects, lack of trust, social norms, exposure to rumours and myths undermining confidence in vaccines, failure by some healthcare providers to counter these myths and provide evidence-informed advice, access barriers (e.g. poor availability, copayments), and failure to understand the underlying mechanisms that decrease vaccination confidence.

Enablers include sources of reliable information about vaccination, exposure to positive media messages, building trust in institutions and providers, building confidence in vaccination, easy access and availability to healthcare services, ease of administration, active involvement and engagement by healthcare providers, and targeting of high-risk groups.

There is a range of policy options that countries can implement to increase vaccination coverage. Communication strategies about the benefits of vaccination are important but need to be combined with opportunities for *dialogue* with vaccine hesitant groups and participatory approaches. These strategies need to be targeted not only at the uninformed (i.e. the lack of information) but also at the misinformed (when the information is incorrect) or disinformed (when information is spread with the intention to deceive).

Vaccination is mandatory in some countries and recommended in others. When mandatory, it can be unpopular with some individuals or groups, which reinforces the case for good communication strategies to improve acceptability. One policy option is to allow individuals to opt out of vaccination subject to certain conditions to be determined depending on the institutional context (e.g. an exception process which includes a mandatory consultation and dialogue with a healthcare worker who can make individuals and parents aware of the risk of not being covered) but only if vaccination coverage levels are sufficiently high to ensure herd immunity.

Family physicians are well positioned to improve child vaccination rates given frequent interactions with parents and children with other illnesses or attending check-ups. These interactions can be used as opportunities to raise awareness. Family physicians and nurses do not have to be the exclusive providers of vaccines. Better access could be achieved by improving availability of vaccines from other providers (e.g. pharmacists, providers of community services, subject to appropriate training) and ensuring equity-driven vaccination programmes. Healthcare and other workers engaging in communication and dialogue related to vaccination should be supported with specific training to address vaccine concerns from hesitant individuals, in particular in relation to safety and side effects.

There is scope for strengthening the monitoring and the surveillance systems at international, national and sub-national level to ensure up-to-date data to guide policy and planning at a regional and country level that will optimise coverage and impact, and identifying areas where low coverage is concentrated.

Finally, as a comprehensive programme considers populations and individuals, there is scope for close co-operation and better integration of public health and primary care services, strengthening accountability towards a population of primary care.

Keywords: Vaccination coverage, Immunisation, Enablers, Obstacles, Hesitancy, Policies, EXPH, Expert Panel on effective ways of investing in Health, scientific opinion.

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BACKGROUND

Vaccination is one of the most cost-effective public health interventions developed in the 20th century and the main tool for primary prevention of communicable diseases. Targets were established to eliminate some vaccine preventable diseases in Europe by 2000. However, even in 2018 the EU is experiencing continuing outbreaks of these diseases, with some reports of fatalities from measles and diphtheria. As an example, Figure 1 gives the number of measles cases in 2017, and Figure 2 vaccination coverage.

The case for co-ordination of action against vaccine preventable diseases at the EU level is clear as they pose a significant cross-border health threat. The Commission has taken the initiative to present a proposal for a Council Recommendation to strengthen cooperation on this issue. This should build on existing global and European initiatives, including the World Health Organization (WHO) Global Vaccine Action Plan 2011-2020, the annual European Immunisation Week, and the exchange of information co-ordinated by the European Centre for Disease Prevention and Control (ECDC), as well as existing national initiatives designed to improve vaccination coverage and uptake.

Vaccination programmes vary considerably between and within countries. These variations are often due to differences in the way healthcare systems are organized at national or regional level. While there is consensus, based on evidence, about the various core components of an immunization system, there is a need to better understand how these components can be effectively integrated within the overall health system.

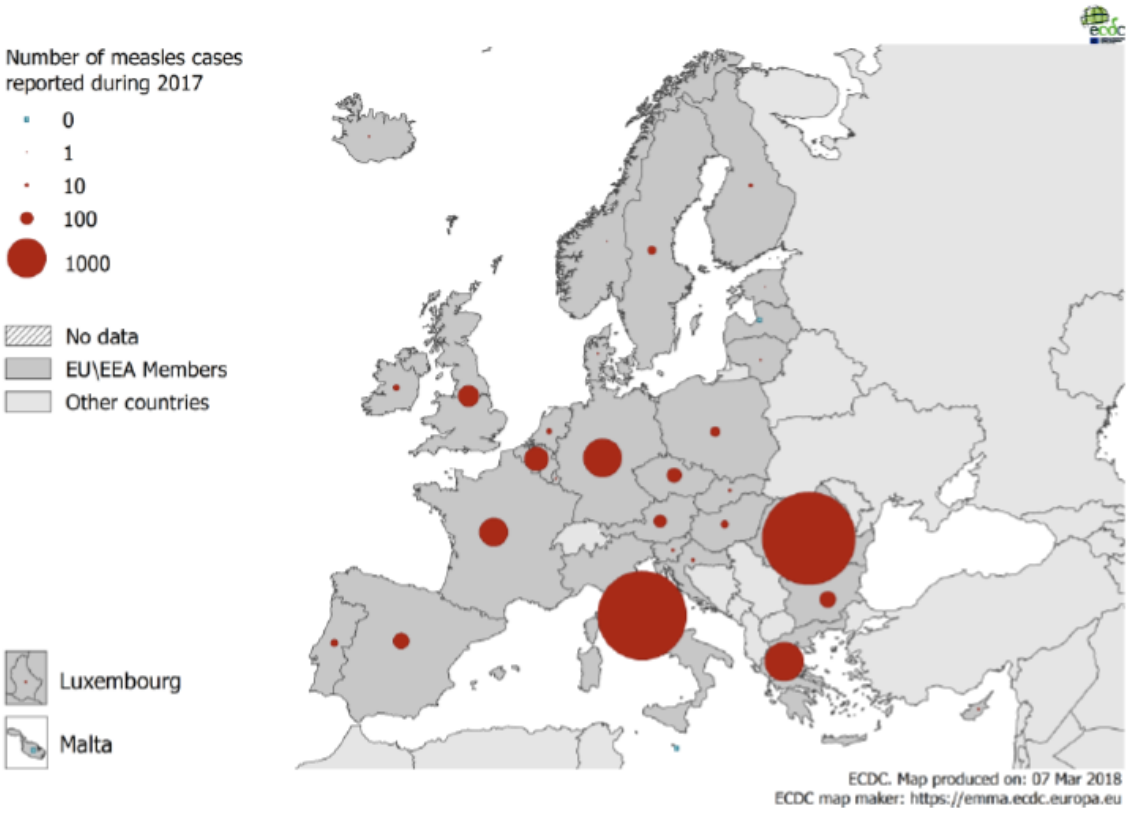
Improving the delivery of immunization services should be seen as an integral part of health system strengthening efforts and not as a complementary or separate element. The ability to deliver a sustainable vaccination programme that prevents disease is one measure of the extent to which a health system is resilient, fit for purpose and responsive.

Attainment of this goal will require a concerted effort to achieve high levels of access, quality and sustainability.

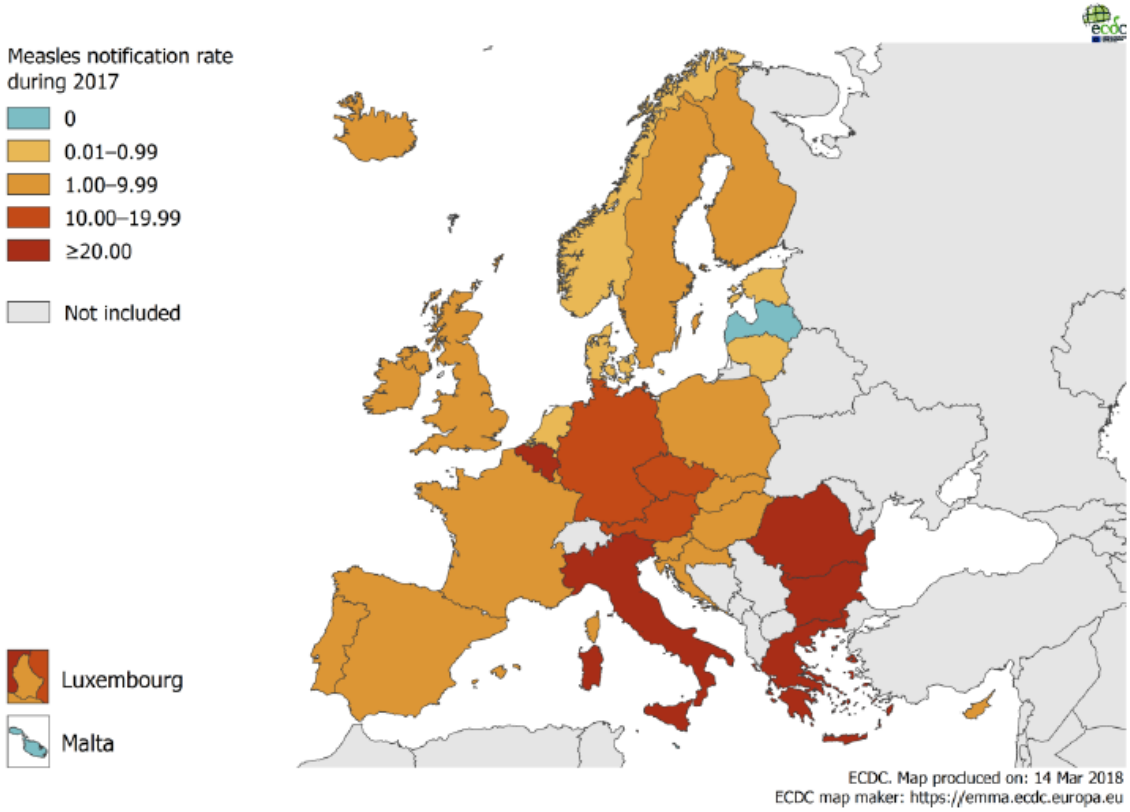
The purpose of this opinion is to review information on the effectiveness and efficiency of vaccination programmes, with reference to the organization of the health system in general and of the vaccination programmes in particular; to identify and characterize the main factors (enablers and obstacles) influencing vaccination uptake; and to select and assess measures and actions that can be expected to improve vaccination coverage.

Figure 1. Measles cases

Distribution of measles cases by country, EU/EEA, 2017 (n=14600)



Measles cases per million population by country, EU/EEA, 2017



Source: ECDC (2018)

Figure 2. Measles vaccination coverage in 2017

Country	Vaccination coverage[1] (%)		Incidence of endemic cases[2] per 1 000 000
	First dose	Second dose	
Target**	≥95	≥95	<1
Austria	95	89	9.7
Belgium	96	85	-
Bulgaria	92	88	23.1
Croatia	90	96	1.7
Cyprus	90	88	1.2
Czech Republic	98	93	13.5
Denmark	94	85	0.4
Estonia	93	92	0
Finland	94	85	0.7
France	90	79	7.3
Germany	97	93	10.5
Greece	97	83	89.4
Hungary	99	99	3.2
Iceland	91	95	3.0
Ireland	92	-	5.3
Italy	85	83	83.3
Latvia	93	89	0
Lithuania	94	92	0
Luxembourg	99	86	1.7
Malta	93	86	0
Netherlands	94	91	0.6
Norway	96	91	0
Poland	96	94	1.4
Portugal	98	95	3.1
Romania	86	76	282.8
Slovakia	95	97	0.9
Slovenia	92	93	2.4
Spain	97	95	3.0
Sweden	97	95	3.0
United Kingdom	92	89	2.3
EU/EEA	**93.8**	**86.7**	**27.5**

Source: ECDC (2018)

TERMS OF REFERENCE

The Expert Panel on Effective Ways of Investing in Health is requested to focus on the following points:

1. On the basis of a literature review, identify and characterize the main factors (enablers and obstacles) influencing the outcomes to vaccination uptake, with a focus on child vaccination, and influenza vaccination (as an example of adult vaccination).

2. Based on the analysis of the main factors enabling/impeding the vaccination uptake (from 1 above), select and assess measures and actions that can be expected to improve vaccination coverage.

1. OPINION

1.1. Main factors influencing vaccination coverage

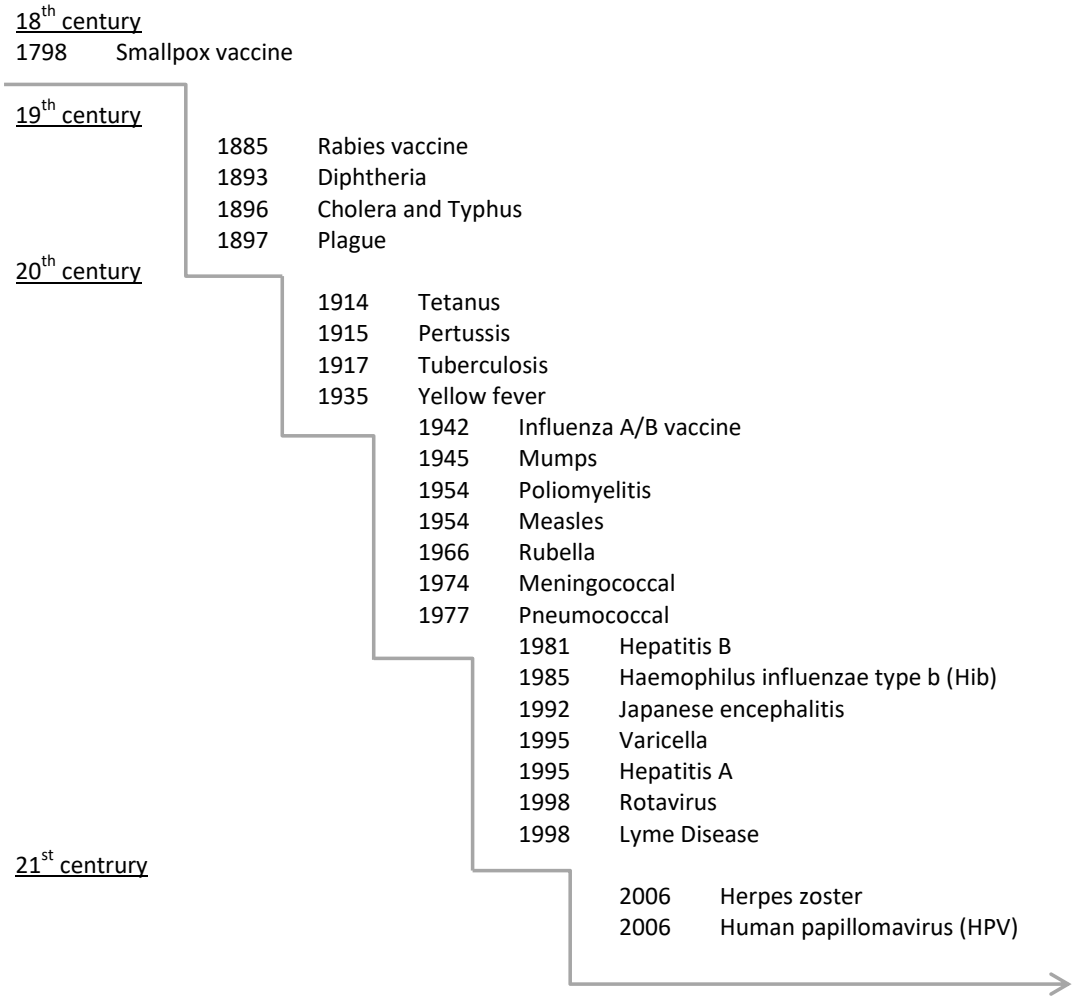
1.1.1. Background information

A vaccine is a biological preparation that stimulates immunity to a particular infectious agent. A vaccine contains an antigen derived from weakened or killed forms of a disease-causing microorganism, one of its surface proteins, or in some cases, any toxin that it produces. The antigen stimulates the body's immune system to recognize it as foreign, to destroy it, and to "remember" it, so that the immune system can more easily recognize and destroy any of these microorganisms that it later encounters (WHO, 2016).

The historical target diseases of vaccines are virus- or bacteria-induced communicable diseases. Traditionally, vaccines against viruses are produced by using small amounts of the virus in question that can be grown in cells. Various cell types can be used such as from chicken embryos. Bacteria can be grown in bioreactors, similar to fermenters. Some antigens are manufactured within bacteria or yeast. Adjuvants (other compounds) are added to enhance immune-response, stabilize and preserve the vaccines (CoPP, 2011, Stevens et al, 2017). In the last 2-3 decades a variety of new techniques have been developed for producing vaccines: examples include molecular techniques that mimic pathogens or the screening of the entire pathogenic genome and the synthesizing of DNA vaccines in-vitro. Such new techniques offer potential for rapid development of vaccines against emerging public health threats such as Ebola (Stevens et al, 2017).

The first successful vaccine was introduced in the 18th century (against smallpox). Since then many other vaccines have been developed. As of today, at least 26 individual vaccines are available on European markets (but not always available in all countries) and recommended in numerous combinations and bundles in European vaccination schedules (ECDC) (Figure 3).

Figure 3. Historical timelines of vaccine development



Source: CoPP (2011), IAC (2018)

Looking ahead, vaccines to treat some other target diseases and populations, including some non-communicable disorders such as autoimmune diseases, some cancers, and allergies, are in research or in development and, in a few cases, are in advanced clinical trials. There are also some micro-organisms against which vaccines already exist but more effective ones would be desirable. These are presented in Figure 4 (Delaney, 2014):

Figure 4. 21st century vaccine[1]

BACTERIA	VIRUSES
• Mycobacterium tuberculosis (TB) • Group A Streptococcus (GAS) • Group B Streptococcus (GBS) • Staphylococcus aureus • Shigella and pathogenic E.colli • Salmonella • Chlamydia • Pseudomonas aeruginosa • Non-typeable Haemophilus Influenza • Klebsiella pneumoniae • Clostridium difficile	• Hepatitis C virus (HCV) • Human immunodeficiency virus (HIV) • Dengue • Respiratory syncytial virus (RSV) • Cytomegalovirus (CMV) • Epstein Barr virus (EBV) • Herpex simplex virus (HSV) • Enteroviruses • Ebola • Marburg hemorrhagic fever • Parvovirus • Norovirus
PARASITES	**THERAPEUTIC VACCINES**
• Plasmodium • Leishmania • Schistosoma • Trypanosoma • Brucella • Cryptosporidium • Entamoeba	• Cancer • Autoimmune diseases • Inflammatory disorders • Allergies

Source: Delaney (2014)

Immunization has been recognized as one of the most cost-effective public health interventions. A high level of coverage of the entire population is essential, since vaccination not only protects individuals but also those who have not been vaccinated by breaking the chain of transmission. This phenomenon known as "herd immunity" arises because if a sufficient proportion of the population is vaccinated it is less likely that the bacteria or virus will spread as there are fewer people who are vulnerable and because individuals who do acquire the disease often have a milder form of disease and may be less infectious (Stevens et al, 2017). We refer to vaccination coverage as the percentage of the relevant population who receive the vaccine. It is an indicator of the level of protection, which a population has against a vaccine-preventable communicable disease.

[1] The table is reproduced as published but the Expert Panel notes that Brucella, a bacterial species, is usually categorised under the heading of bacteria.

Some diseases have been eradicated (smallpox at a global level and the transmission of polio has been stopped in all but a few of the world's poorest countries) or very infrequent because of vaccination (tetanus and diphtheria are now very rare, pertussis is significantly much less frequent than in the past) and therefore may appear to be of limited (or insignificant) threat to current generations. Achieving rates that confer herd immunity is essential. Decreasing coverage rates, as currently observed, caused by lack of confidence in immunization is accordingly of great public health concern.

Moreover, there is an ever present risk of vaccine shortages due to complex manufacturing processes, the relatively small number of manufacturers, and the challenges of storing and handling of vaccines. Timely vaccine production, bundling-arrangements among manufacturers and vaccine distribution are challenging governance issues for health systems.

1.1.2. A systems approach for national immunisation

The seemingly simple act of injecting a vaccine into someone's arm muscles depends on the existence of a complex set of structures and functions that can, collectively, be thought of as a national immunisation system. Drawing on the literature on soft systems, this system is made up of a series of interacting sub-systems, each shaped by their context, operating at the national, regional and community level. If high levels of immunisation are to be achieved in a population, and especially if herd immunity is to be achieved, it is essential that each of these subsystems operate effectively and in concert with all of the others. In practice, however, some of the sub-systems may not exist at all, their operations may be sub-optimal, or they may be poorly coordinated with the others.

The sub-systems involved are shown in Figure 5, which are described in turn.

Registering the target population. The prerequisite of a national immunisation system is the establishment of an integrated system for registering the target population. Without an accurate and up-to-date population-based register, it is impossible to manage a population-based programme and to establish vaccination coverage, and therefore, to identify any problems. Ideally, such a system should include not just the number of individuals but also some information on characteristics known to be correlated with low uptake. However, this may be complicated by national rules on confidentiality. There are also challenges created by increasingly mobile population, exacerbated in countries where systems for data sharing among sub-national units is sub-optimal. A comprehensive evaluation of an immunisation system should understand who is

responsible for maintaining such a register, how individuals join or leave it, how frequently it is updated, how accurate it is, and whether there are any groups that are systematically excluded, formally or informally. Such a registration system is necessary not only to assess coverage at the national level, but also to identify pockets of low coverage rates at the sub-national level where a targeted policy approach may be required.

A legislative framework. The creation of a legislative framework within which immunisation policy can be developed will determine whether vaccination is compulsory or voluntary, and if compulsory, whether there are any exemptions, and will provide a mechanism for creating certain incentives to maximise uptake. Legislation is also required to establish several of the other systems, such as those for monitoring uptake and providing the basis for professional regulation of those administering vaccines. The procurement and distribution of vaccines is important for vaccines that are in short supply or for which there is variation in supply, such as seasonal influenza, as it is necessary to produce a new version each year, and for the Bacillus Calmette-Guérin (BCG) vaccine, which is not routinely provided in all countries. However, this sub-system also includes functions such as negotiating with providers and ensuring that vaccines are distributed effectively within a country, in particular to remote and isolated areas, and to facilities providing services to vulnerable and marginalised groups.

A system for appraising the evidence. The development of new vaccines has been a high priority for the pharmaceutical industry, leading to a large number of new products coming onto the market. However, national authorities must make decisions about whether or not to recommend them, and in some cases, whether to replace one existing product with a newer one. This requires some system for appraising the available evidence (health technology assessment), based on detailed knowledge of the epidemiology of the condition in question and relevant economic analyses. However, in some smaller countries, these skills are in short supply. In other countries, the appraisal is not routinely performed.

A system for authorising new vaccines. There should be some system in place to review the evidence on safety and effectiveness of new vaccines and issue marketing authorisations.

Evaluating performance of the immunisation programme requires a system of *surveillance*, based on accurate knowledge of both the target population and the numbers being immunised. Ideally, it will go beyond simple coverage rates to identify

vaccination gaps and inequitable coverage, including those groups where vaccine hesitancy is clustered or concentrated. This will often require collection of data on socio-economic, ethnic, and geographic characteristics of those being immunised and the populations from which they are drawn.

Governance of the system. If coverage is to be optimised, it is important for relevant authorities to be responsible for making this happen. Authorities responsible for achieving high levels of coverage need to be equipped with the levers to bring about the necessary changes. If different authorities are responsible, they need to act in a coordinated manner. In any health systems, coordination may also be challenging because of the various actors involved on the supply side. For example primary care physicians, nurses, pharmacists, and others have different contracts of employment and lines of accountability. Thus, to understand the overall immunisation system, it is necessary to analyse the various lines of accountability between different providers and authorities, and the extent to which they are consistent with achieving the overall aim.

Funding of the immunisation programme. In addition to the funding required to pay for the vaccines, their storage and distribution, it is also necessary to pay for those who are administering them. Here, a key question is who pays for what, and specifically, whether the person being vaccinated, or the parents in the case of a child, are required to contribute to the immunisation process (e.g., in the form of a co-pay). It is also relevant to consider other costs that may fall on those being vaccinated, such as travel costs and opportunity costs of taking time off work.

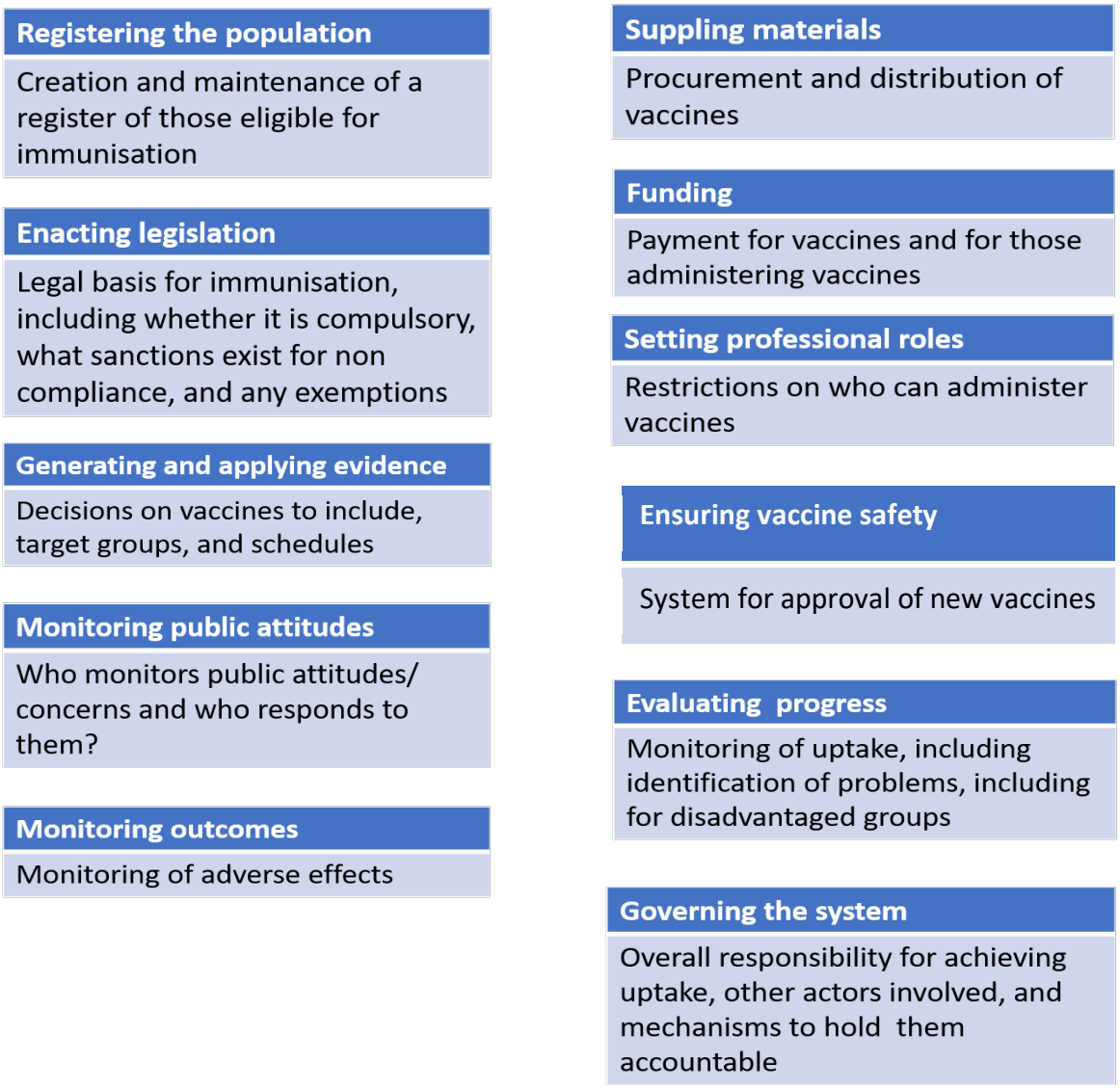
Monitoring the outcomes of the immunisation programme. This includes identification of cases of disease, which are preventable through vaccinations. These cases may act as sentinel events to highlight problems with the overall programme, as well as any adverse effects of vaccines, in particular where the vaccines concerned are relatively new.

Professional regulations that govern the administration of vaccines. Within Europe, there are wide variations in who can administer vaccines. While medical practitioners and nurses can do so everywhere, some countries also permit pharmacists to administer them. This has several advantages, including greater accessibility for those being immunised. However, whatever approach is being adopted, it is important that it should be linked to the system for monitoring uptake. This is to ensure that those responsible for the governance of the system have the necessary information to assess coverage and, where necessary, to identify and act on any emerging problems.

Monitoring public attitudes. There are many reasons why coverage is suboptimal in particular countries, but one of them is that there may be widespread public concerns about the safety of vaccines, concerns that are actively encouraged by certain groups peddling misinformation. An optimal immunisation system will include a function for monitoring public attitudes to vaccination and, where necessary, correcting emerging misconceptions.

In summary, achievement of a high level of vaccination coverage to ensure herd immunity requires the creation of a complex system of interrelated functions. These include not only the provision of vaccines and the employment of the personnel required to administer them, but also systems to monitor uptake and to act where this is sub-optimal (e.g. below herd immunity levels). In turn, this requires a well-functioning system of governance, which is a challenge in health systems that are weak or fragmented.

Figure 5. A system approach to optimizing vaccination uptake in a population



Source: authors' compilation

1.1.3. Overview of factors influencing vaccination coverage

The key factors affecting an individual's decision to vaccinate relate to their assessment of the benefits and costs of vaccinating. Individuals will be willing to vaccinate if their *perceived* benefits overcome the perceived costs. Similarly, parents will vaccinate their children if their assessment of the benefits overcome the costs of vaccination.

Individual or child immunization through vaccination provides private benefits. By vaccinating an individual protects herself/himself (or the parent protects her/his child) against contracting disease. This private benefit depends on i) the health loss, which would arise if the disease is contracted, and ii) the perceived risk of contracting the disease. Failure to immunize can lead to severe health consequences, which can include death or permanent disability.

Individual or child immunization also generates private costs. The latter are broadly defined to include monetary and non-monetary individual costs. Non-monetary costs include side effects, adverse effects, safety concerns, discomfort, fear of injection, worries that the vaccine itself could cause the disease, difficulties to access vaccine provider due to distance or appointment delays. Monetary costs include the price, for example in a co-payment, that individuals might be charged, and monetary expenses to reach the provider. There are also private costs in term of taking time off from work or other activities.

But immunization has social (or societal) benefits since it reduces the risk of contagion and of an outbreak around her, therefore benefiting other unvaccinated people in the community, e.g., family, neighbours, friends, colleagues as well as any other people she gets in touch with in daily activities (social benefit). The latter is a form of *positive externality*, which is related to the herd immunity (as described in the background section) and is obtained when a sufficiently high proportion of the community is immunized against the disease (the herd immunity threshold).

Low perceived benefits and/or high costs are the source of what is known as vaccine hesitancy leading to refusal. Hesitancy was defined by the WHO working group, as "the delay or refusal of vaccination despite the availability of vaccine services". Three key drivers of vaccine hesitancy, the so-called 3 Cs, are (MacDonald, 2015):

(i) *Complacency* is related to a perceived low risk from vaccine preventable diseases or low value. Complacency leads to low perceived benefits;

(ii) Low *Confidence* reflects concerns about the safety of vaccines and those who administer them, or more broadly a lack of trust. Lower confidence increases the private cost from vaccination;

(iii) Lack of *Convenience*, where access to services is difficult. More difficult access also increases the private cost of vaccination.

Some individuals may fail to recognise the social benefits that vaccination has on the rest of the community (i.e., the positive externality they exert on others). Some individuals may also act strategically and be tempted to "free ride": if everyone else in the community is vaccinated, then the probability of an outbreak goes to zero. The individual obtains the benefits from herd immunity but does not have any (even small) costs or inconveniences (e.g., in the form of side effects) from vaccination.

The same WHO working group has developed a model of determinants of vaccine hesitancy. This identifies three domains of influences (factors) which affect the decision to vaccinate (Figure 6). (i) Contextual influences include historic, socio-cultural, environmental and political factors, as well as factors that relate to the health system, the institutions and the economy. (ii) Individual and group influences include factors arising from personal perception of the vaccine or influences of the social or peer environment, especially in the online milieu. (iii) Vaccine and vaccination-specific issues relate directly to characteristics of the vaccine or the vaccination process (Larson et al, 2014).

Figure 6. The SAGE Working Group model of determinants of vaccine hesitancy

Source: The Strategic Advisory Group of Experts (SAGE) Working Group

Vaccines can generate concerns amongst the population that are distinct from those associated with other healthcare interventions. Individuals regularly take medicines and other treatments when they fall ill (sometimes with non-negligible side effects) to obtain a health improvement. But healthy individuals can be more reluctant to avoid an uncertain future health loss, as opposed to acquire an immediate health gain, by being vaccinated or to act in ways that provide protective (private and social) health benefits.

The individual decision is, therefore, the outcome of a complex voluntary set of behaviours. Benefits are *delayed* as protection is against possible future infection. Benefits are *hypothetical*, as not everyone will be exposed to the infectious agent or become infected. Benefits cannot be precisely defined, as severity for those infected may range from mild to severe (Cairns et al, 2012).

The risk of *side effects* associated with vaccination is small. However, a very different impression is created by social media, which abounds with conspiracy theories, many linked to a more general distrust of authority. This phenomenon has many similarities with campaigns against other collective health measures. At least in some cases, anti-vaccine messages are linked to populist political views that see public health interventions, and even the adoption of scientific methods, as a conspiracy by shadowy elites, views that reflect a wider distrust in institutions.

There are, however, other factors. Some who are vaccine-hesitant may not be actively vaccine-resistant or vaccine refusers. As advances in vaccine develop, fewer people will have personal experience with certain diseases, which may contribute to lowering perceived risk. Not receiving a vaccine and experiencing no repercussions can reinforce decisions not to get vaccinated in the future (Brewer et al, 2017). These factors introduce a rationale for effective public health, health literacy and communication strategies which are perceived as personally relevant, credible and trustworthy.

These two scenarios, although superficially similar, are actually very different. The latter is an example of being *uninformed*. Those reluctant to accept vaccination are genuinely uncertain and are often amenable to explanation of the reasons for providing it, or are at least willing to assess the risks and benefits even if the utilities that they place, as individuals, on different outcomes vary. The former is often an example of *disinformation*, where information is actively disseminated knowing it to be false, or *misinformation*, where those spreading it do so with the intention to mislead. In practice, it can be difficult to ascertain with certainty. In such cases, the provision of information is either useless or counter-productive, where it can actually "backfire" (see later). Concerns about vaccine safety often reflect deeper issues, such as attitudes to the legitimacy of state action or perceived threats to the autonomy of the individual.

This section focuses on the situation where there is misinformation. Risk and communication about risk is a key factor in the individual decision to vaccinate. Risk communication is concerned with the exchange of information and opinions about risk between risk communicators (organisations) and those who could be at risk (key

stakeholders/members of the public). The aim of risk communication is to increase awareness of risks and provide sufficient, meaningful and relevant information about risks to empower stakeholders to make well informed choices and give them a sense of control over their own health and safety (Menon, 2008; Adil, 2008; WHO, 2005). Much of the literature on addressing infectious disease risk communication focuses on one-way transmission of information to the public by experts, based on the transmission of facts through official channels (Holmes, 2008). However, this type of risk communication has been criticised for this assumption as the perception of risk is determined by many other factors including beliefs, understanding and previous experience and knowledge about the risk (Adil, 2008). The theoretical basis of infectious disease risk communication has been somewhat neglected. Holmes (2008) highlights the need for understanding the ethics of risk communication for infectious disease, and how the increasing focus on empowerment and individual choice may conflict with the goal of behavioural compliance to reduce the risk of infectious disease.

It has been acknowledged that risk communication should be a participatory *dialogue* with the public to build a shared understanding of risk rather than a one-way communication process from experts to the public. The public is not a homogeneous group. The literature highlights the importance of engaging different population groups with different needs and interests in the risk communication process (Cairns et al, 2011).

In developing communication strategies, information will need to be adapted to the needs of specific groups, including, for example, specific efforts to reach population groups facing substantial barriers in routine vaccination programmes (Fournet et al, 2018), such as Roma (Duval et al, 2016) and other ethnic minorities.

Trust. The effectiveness of risk communication also depends on the trust the public has in the communication organisation (Wynia, 2006; Adil, 2008; Larson et al, 2015). Trust relates to at least three domains:

i) Trust in the recommended vaccines,
ii) Trust in the provider that administers the vaccine (health care organisation),
iii) Trust in those who make decisions about vaccine provision (policymakers).

The literature highlights the importance of a participatory approach to communication that includes two-way engagement with stakeholders and building stakeholder relationships. As perceptions of reputation and trustworthiness have an impact on public support for and compliance with behavioural advice, reputation management and public

relations are key elements of effectiveness for provider organisations (Cairns et al, 2011).

Transparency and *openness* have also been identified as two critical factors in building and maintaining trust, requiring open acknowledgment and communication of uncertainty around risk (WHO, 2005). A study on parental information-seeking behaviour in childhood vaccinations in the Netherlands (Harmsen et al, 2013) identified parents who felt they had not received enough information about the side effects of vaccination. Parents were more likely to search for additional information online if they were more negative about vaccination and if they were more highly educated. When so doing, they were likely to find vaccine critical websites, possibly reinforcing negative attitudes. It is, therefore, important to address the concerns and information needs of those parents who come from a position where they are already more negative about vaccination. Effective communication strategies and accessible websites, together with information from trusted health care workers can play a critical role in this respect, although these will need to take account of the often compelling, highly personalised, but false views promulgated by many anti-vaccination websites. Thus, Grant et al (2015) reviewed the features of pro-vaccine and vaccine-sceptical websites, finding that the former contained evidence-based research and government endorsed information, the latter were more personal and engaging, and focussed on creating communities who believed that they or their children had been harmed by vaccines. Finally, for vulnerable populations the presence of trusted members and role models in the community (or respected outsiders) who act as spokespersons in communicating risks can help building trust (Vaughan and Tinker, 2009).

Tools and resources have been developed by WHO and ECDC to increase vaccination uptake. These involve communication activities that educate people about the risks of vaccinating and not vaccinating, and address common myths and misconceptions. There is also scope for health promotion activities in the form of partnerships with heath care workers who are regarded as the most reliable and trusted source of health information in the community.

Trust in health authorities and their recommendations is essential. Communication of risks, advantages as well as disadvantages is crucial to reach out to the hesitant and sceptical citizens (parents, but also health professionals). The public perception of disease risk and severity can also be manipulated. An example is the HPV-vaccination marketed in Europe against the 2nd most prominent health threat for females caused by cancer: while this figure is correct for worldwide cancer threats for women, in Europe

cervical cancer is "only" the 11th most frequent cause of cancer death (Piso, 2010). Unbiased communication is therefore essential for credibility of all those involved in the vaccination process, including public institutions, professional bodies, and manufacturers.

Acceptability of vaccination depends not only on the essential ingredients of information (severity and risk of disease, safety of vaccines) but also on the framing of the information and the *choice architecture* of how the information is presented (Thomson et al, 2016). Balanced communication about effectiveness and side effects (or adverse events) presented in an easily understandable manner (infographics) as fact-sheets on MMR, pertussis and influenza vaccination might support informed decision-making, but on its own does not necessarily improve vaccination coverage. In contrast, techniques from behavioural economics are increasingly discussed. Arguments in favour of nudging include "bounded rationality", unavoidability and beneficence. There is evidence suggesting that the frame of information ("choice architecture") can have a strong effect on choices. Arguments against nudging include lack of transparency, crowding out of intrinsic values, and paternalism (Navim, 2017; Hofmann and Stanak, 2018).

The sources of the information also contribute to the credibility of the information provided. The anti-vaccination movement has ruthlessly exploited concerns about experts advising on vaccination policy who have real or perceived relations with vaccine manufacturers (WHO, STIKO, etc.), a situation exacerbated by occasional lack of disclosure of conflicts of interest of vaccine experts on public advisory panels (Carlowe, 2010; Gardiner, 2019; Goetzsche, 2013). Consequently, while it is not sufficient on its own to counter many conspiracy theories, it is a necessary aspect of increasing trust in public recommendations about vaccinations.

Role of providers. Whether individuals, or parents on behalf of their children, decide to vaccinate is the outcome of the interaction between the individual and a provider (most often a primary care provider). Healthcare providers have a dual role of administrating the vaccine but also in providing information and engaging in dialogue with individuals and parents. Primary care providers are particularly well suited to engage in dialogue with potentially hesitant individuals since individuals and parents receive a number of other health services that are distinct from vaccines. This provides an opportunity to reach out to vaccine hesitant individuals and initiate a dialogue with a trusted source of health information. Providers need to be supported with opportunities for specific training, which addresses the most important concerns of individuals about vaccination, i.e. safety and side effects.

1.1.4. Vaccine hesitancy and confidence in the European Union

A study by Larson et al (2016) gives an overview of vaccine confidence and hesitancy around the globe. Vaccine hesitancy was defined by the SAGE Working Group as the delay in acceptance or refusal of vaccines despite availability of vaccination services. Based on a survey of the confidence in immunization in 67 countries in 2015, this study examines perceptions of vaccine importance, safety, effectiveness, and religious compatibility among an overall sample of 65,819 individuals. The data are from The State of Vaccine Confidence (2016) project.

Below we use the same data only for the 20 EU countries for which the data are available. The data are publicly available and were extracted from the following website: www.vaccineconfidence.org/research/the-state-of-vaccine-confidence-2016/. Data from Croatia, Estonia, Cyprus, Lithuania, Luxemburg, Hungary, Malta, and Slovakia were not available.

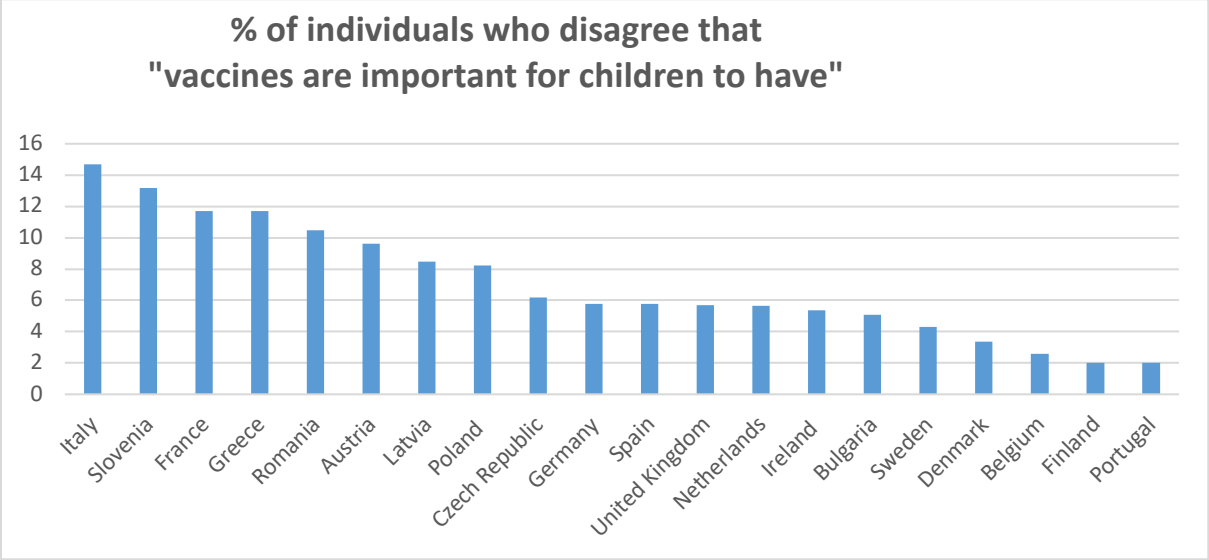
In figures 7-10 we describe the proportion of respondents who *disagree* with the following statements:

- "Vaccines are important for children to have";
- "Overall I think vaccines are safe";
- "Overall I think vaccines are effective";
- "Vaccines are compatible with my religious beliefs".

The category "disagree" has been computed as the sum of those who "tend to disagree" and "strongly disagree". The more detailed country-level data are available in the Annex, Tables A1-A4, for each of the five possible responses (strongly agree, tend to agree, don't know, tend to disagree, strongly disagree).

Figure 7 shows that, in 15 of the 20 countries, less than 10% of respondents in each country disagreed that vaccines are important for children to have. For 5 countries this was higher but always below 15%, and in 5 countries it was less than 5%.

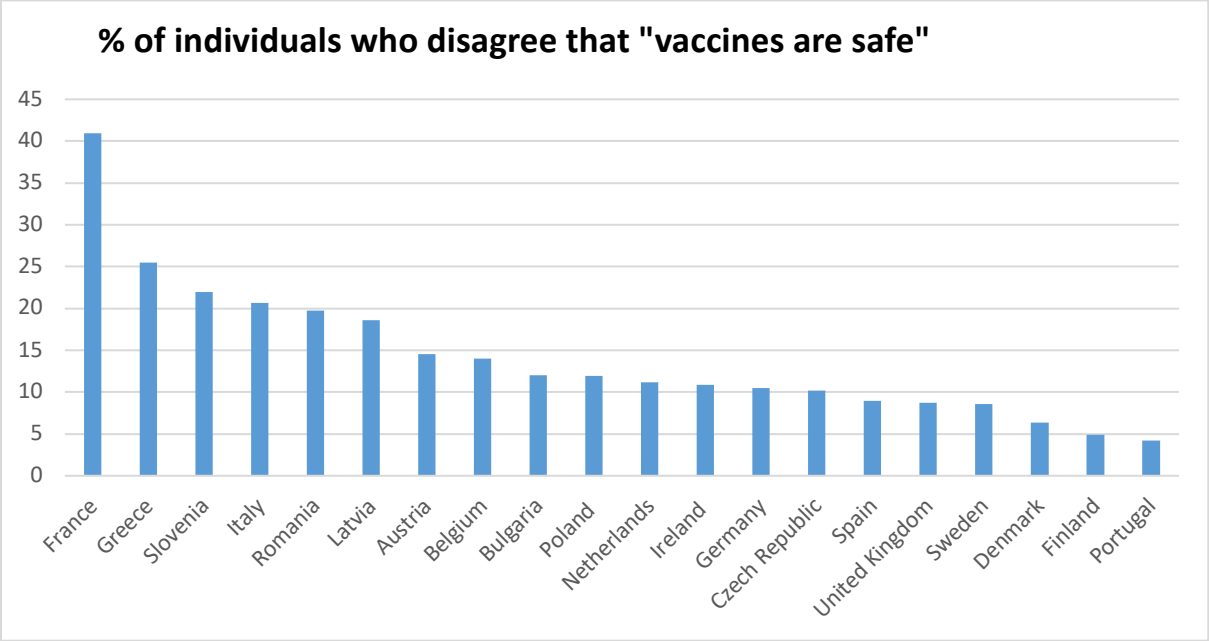
Figure 7. Vaccines are important for children (% response who disagree)



Source: The State of Vaccine Confidence (2016) project
www.vaccineconfidence.org/research/the-state-of-vaccine-confidence-2016/

Figure 8 highlights great variability in the proportion of respondents who disagree that vaccines are safe. This proportion is less than 10% of respondents in 6 countries, between 10% and 20% in 10 countries, but above 20% in 4 countries.

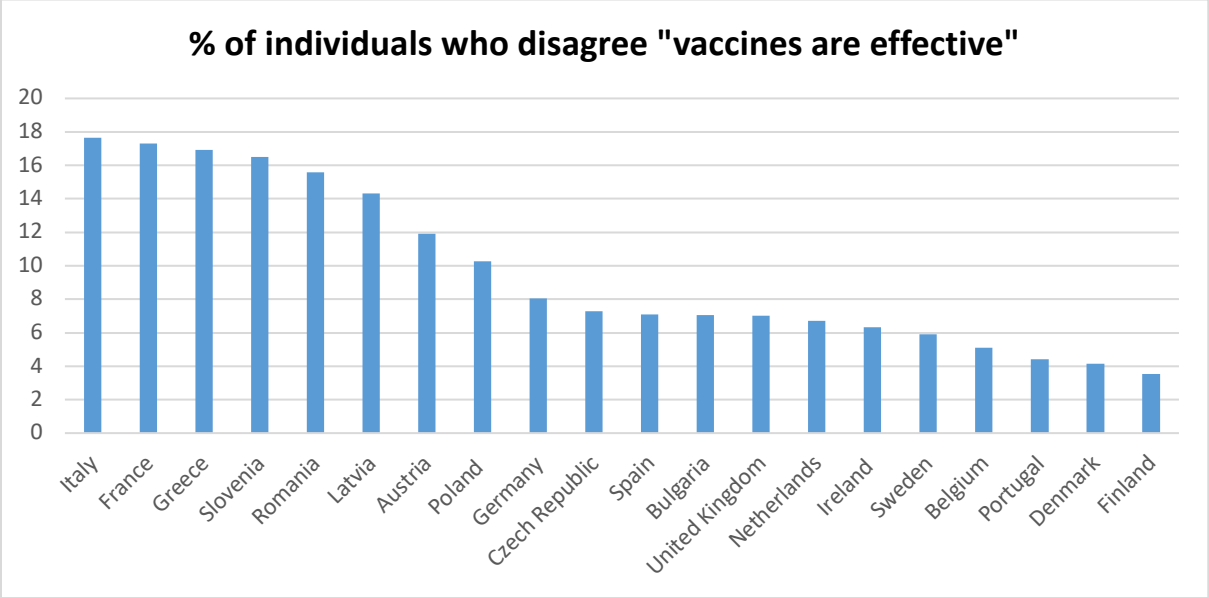
Figure 8. Overall, I think vaccines are safe (% response who disagree)



Source: The State of Vaccine Confidence (2016) project

Figure 9 shows that in 12 out of the 20 countries, less than 10% of respondents disagree that vaccines are effective. In the remaining 8 countries, this figure is less than 20%.

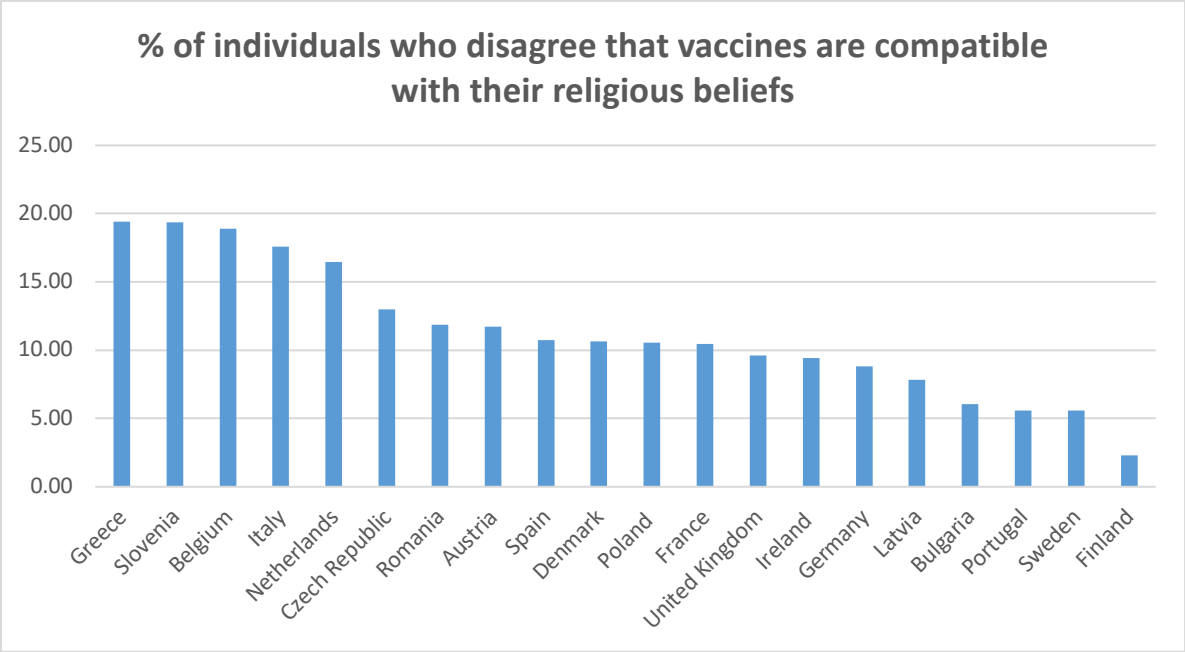
Figure 9. Overall, I think vaccines are effective (% response who disagree)



Source: The State of Vaccine Confidence (2016) project

Figure 10 shows that in 8 out of the 20 countries, less than 10% of respondents thought that vaccines were compatible with their religious beliefs, but in the remaining 12 this was between 10% and 20%.

Figure 10. Overall, I think vaccines are compatible with their religious beliefs (% response who disagree)



Source: The State of Vaccine Confidence (2016) project

Overall, these results show that although at least 85% of the respondents in each country think that vaccines are important, a sizeable minority of people in some countries have concerns about their effectiveness. They number about 10% of respondents in many countries but do not rise above 20%. Similar concerns are present in relation to compatibility with religious beliefs. The most significant concern relates to vaccine safety where there is the highest variability, which can reach 40% in France. Bearing in mind that herd immunity typically requires coverage rates in excess of 95%, the prevalence of these views is an obvious cause for concern.

Table 1 below explores the associations among the four sets of views discussed above. It shows that countries where a higher proportion of respondents disagree that vaccines are important are also the countries where most are unpersuaded that vaccines are effective (correlation coefficient 0.96). There is also a high correlation between countries where a higher proportion of respondents disagree that vaccines are safe and countries where they disagree they are important (correlation coefficient 0.78) or effective (correlation coefficient 0.86). As an illustration, Figure 11 plots the proportion of respondents who disagree that vaccines are important (on the vertical axis) in each country with the proportion who disagree they are safe (on the horizontal axis).

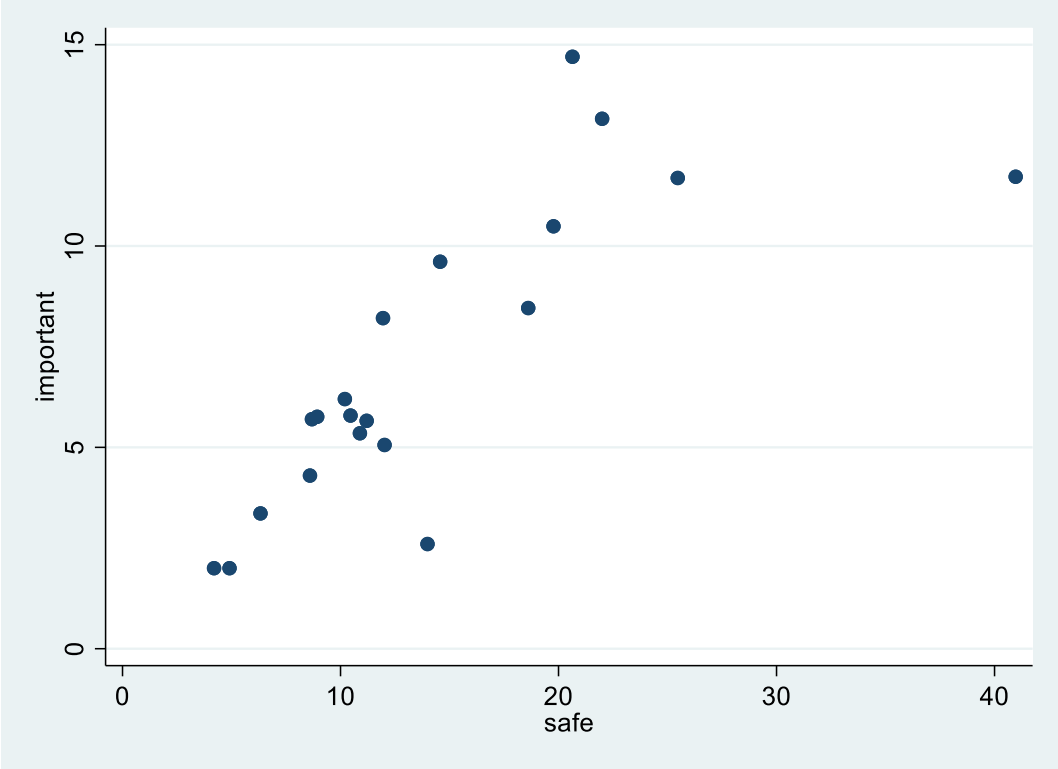
In summary, concerns about vaccines are "clustered" so that in countries where there are concerns about vaccine importance there are also concerns about their effectiveness and safety, and to a certain degree compatibility with religious beliefs.

Table 1. Country correlation in % of respondents who disagree vaccines are …

	Important	Effective	Safe	Compatible with religious beliefs
Important	1			
Effective	0.9663	1		
Safe	0.7815	0.8574	1	
Compatible with religious beliefs	0.5662	0.5033	0.4449	1

Source: Authors' calculations based on data from The State of Vaccine Confidence (2016) project

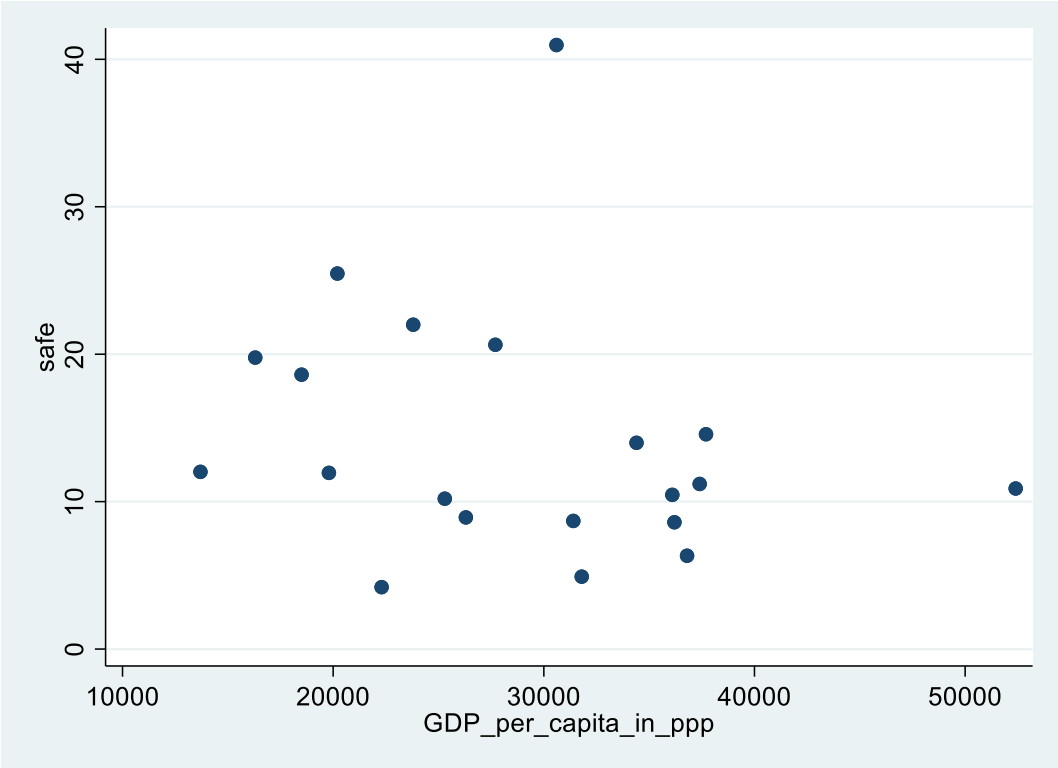
Figure 11. % who disagree vaccines are important and safe, country data



Notes: the proportion of individuals who disagree vaccines are important (by country) are plotted against the proportion of individuals who disagree vaccines are safe
Source: the authors based on data from The State of Vaccine Confidence (2016) project

Having shown evidence of clustering, we next look at whether national income is associated with these views. Are sceptical views more common in rich or poor countries? Figure 12 shows that there does not appear to be a clear association between the percentage of respondents who disagree that vaccines are safe and GDP per capita (at purchasing power parity). The correlation is negative and equal to -0.22.

Figure 12. % who disagree vaccines are safe and GDP per capita, country data



Notes: the proportion of individuals who disagree vaccines are important by country (on the vertical axis) are plotted against country GDP per capita (on the horizontal axis)
Source: the authors based on data from The State of Vaccine Confidence (2016) project

The recent report by Larsen et al. (2018) provides more up-to-date data on changes of confidence in vaccines over time (between 2015 and 2018). It shows that whether confidence increased or decreased is highly country-specific. For example, confidence increased in all domains in Greece, Italy, Slovenia and the UK, but decreased in all domains in Poland. Confidence in vaccine safety increased also in Demark, France, Netherlands, Spain and Romania, but decreased in Sweden, Finland, Germany and Czech Republic. Older (55+) and better educated citizens are more likely to hold positive vaccination beliefs than those who are younger and less educated.

1.1.5. Theoretical models to design communication interventions

Returning to the earlier distinction between misinformation and disinformation, while communication strategies based on the information-deficit model may improve uptake among some groups. Overall, they are not considered successful. Improved knowledge on its own does not result in improved vaccination uptake or even intention to be vaccinated (Cairns et al, 2011). Insight into the knowledge, beliefs, attitudes and current behaviours of different population groups or target audiences, and the environmental context in which they occur, is an important consideration in understanding risk appraisal and behaviour change in relation to vaccination uptake.

There are a number of theoretical models and frameworks that are used in the design of communication interventions in this area. These include The Health Belief Model (Rosenstock et al, 1988), Theory of Planned Behaviour (Ajzen, 1985, 1991) now re-formulated as the Reasoned Action Approach (Fishbein and Ajzen, 2010), Prospect Theory (Tversky et al, 1981), and the Theoretical Domains Framework (Michie et al, 2005), which integrates multiple behaviour change theories into 12 domains.

These theories can be broadly categorised as social cognition models based on the following core concepts: behaviour is mediated by cognitions (what people know and think affects how they act); knowledge is necessary but not sufficient to produce behaviour change; perceptions, motivations, skills and the social environment are key influences on behaviour (Rimer and Glanz, 2005).

The most widely used models are the Health Belief Model and the Theory of Planned Behaviour. Developed to inform the improved uptake of public health services in the US, the Health Belief Model encompasses six main constructs to predict preventative behaviours:

- Perceived Susceptibility
- Perceived Severity
- Perceived Benefits
- Perceived Barriers
- Self-efficacy
- Cues to Action.

Together the six constructs provide a framework for designing behaviour change strategies. The model underscores the importance of interventions being grounded in an understanding of how susceptible the target population feel to the health problem, whether they believe it is serious, whether they believe action can reduce the threat at an acceptable cost (i.e., that the benefits outweigh the costs), their confidence in their own ability to undertake the action and the level of exposure to factors that prompt action.

Research on the predictive utility of the model indicate that the constructs are significant predictors of behaviour, although effect sizes are small, and the most reliable predictors of behaviour are perceived barriers, followed by perceived susceptibility and perceived benefits together with improved self-efficacy in relation to the preventive action (Conner and Norman, 2005). Identification of specific perceived barriers, benefits and susceptibility to vaccination uptake, especially for under-vaccinated population groups, while simultaneously improving people's sense of efficacy in taking action is therefore an important first step in designing appropriate and effective intervention strategies.

The Theory of Planned Behaviour and the associated Reasoned Action Approach propose that behavioural intention - the desire to perform a certain behaviour - is the best indicator of whether a specific behaviour is performed. Specific health behaviours are determined by attitudes (behavioural beliefs and evaluation of behavioural outcomes), subjective norms (perceived normative beliefs about the behaviour and motivation to comply), and perceived behavioural control (confidence in one's ability to perform the behaviour, including internal and external barriers and facilitators, and that the behaviour will have the intended effect). Therefore, interventions need to influence the potentially modifiable attitudes, norms and perceptions of control that determine vaccination uptake, with the issue of perceived behavioural control being particularly influential.

While providing a theoretical framework for intervention development, these psychological theoretical models have been criticised for focusing almost exclusively on cognitive factors, placing too much emphasis on rationality, deliberative decision-making processes and ignoring factors such as emotional reactions, cognitive bias, unrealistic optimism and the role of wider social, economic and environmental factors. Policies and procedures influencing access to healthcare and the availability and affordability of vaccines also need to be taken into account (Batista, Ferrer et al, 2015). For example, in a study of under-vaccinated groups in Europe, Fournet et al (2018) found that improving access to health care more generally could lead to increased vaccination uptake for certain groups such as Roma and Irish Travellers.

Ecological frameworks, such as the socio-ecological model (McLeroy et al, 1998) employed in health promotion interventions, can provide a more comprehensive approach to take into account the multiple interacting determinants of health operating at different levels, including the role of the wider social, cultural and political context. Such an approach requires the implementation of comprehensive multilevel interventions addressing policy, community, organisational, interpersonal and intrapersonal factors with appropriate strategies targeting each level in an integrated fashion. Macro-level theories of behaviour change are needed alongside models of individual behaviour change in order to inform population-level interventions. Insight into the social dynamics that shape social norms, values and culture, as well as individual choice perspectives, will assist in designing more effective communication strategies and interventions to improve vaccination uptake and coverage (Brewer et al, 2017).

1.1.6. Evidence on factors affecting vaccination uptake among children

There are several psychological, social, and contextual factors that affect the decision by a parent not to vaccinate their child. We briefly summarize these factors following the recent systematic review by Smith et al (2017), which focuses on *psychological* factors as a key determinant of vaccination uptake, as described by parents' self-reported reasons for or against vaccination. The review included 68 published papers reporting 64 different studies.

Perceptions of adverse effects from vaccination. There was strong evidence for an association between perceived adverse effects and vaccination. Most studies find an association between refusal to vaccinate and perceiving vaccination to be unsafe. Most also find an association between refusal and perceiving a vaccine can cause side effects. Several studies found contemporaneous illness in the child to be associated with refusal, while two studies asked whether fever at the time of vaccination affected refusal, obtaining mixed results. One study found an association between refusal and a belief that vaccination is more dangerous than the illness that it protects against.

Parental appraisal of the illness being vaccinated against. There was strong evidence linking uptake and the perceived susceptibility of the child to the corresponding illness, but any association with perceived severity of the illness was tenuous, with the best quality studies finding no association. Other reasons identified included a belief that the child had already contracted the illness, belief that complications following illness were rare, and parental experience of having the illness without complications.

General attitudes to vaccination. All studies find refusal is higher among parents who believed that vaccination was neither necessary nor useful or disagree with it. On the other hand, uptake was higher among parents who perceived vaccination to be important.

The role of recommendations on vaccination. Most studies find an association between being recommended to have their child immunised by a health professional, friend, or family member. Several studies reported parents not having their child vaccinated because they had been advised against it, they received no or a weak recommendation from a health professional, or because a health professional had a negative influence.

Parental knowledge. Almost all studies find increased refusal among parents who had incorrect knowledge of the vaccination schedule and, in some, where the physician was also misinformed. Other factors included perceived inadequate knowledge of the vaccine and where to get it, or a belief that one dose was enough. Two out of three studies find that uptake was reduced where parents believed that it was unimportant if a child missed a dose.

Social influences. Here the evidence was more mixed with two out of three studies finding an association between perceived social disapproval of vaccination and refusal, while uptake was greater where the children of family and friends have been vaccinated.

Information about the vaccine. In general, uptake was higher where parents believed that the information available was adequate and helpful and less likely where they felt it was inadequate. Parents who actively sought out information were less likely to have their child vaccinated. Refusal was higher among parents who had greater faith in the media, who were influenced by alternative or complementary medicine practitioners, and perceived research findings to be important. There was some evidence of the role of adverse media publicity.

Trust in healthcare professionals. Parents who trusted healthcare professionals were more likely to have their child vaccinated, whereas those who believe that healthcare professionals administer vaccines without taking into account the individual circumstances of the child were less likely to do so. Evidence of an association between faith in the medical profession and uptake was mixed.

Perceived efficacy of vaccination. The evidence was mixed, with a similar number finding an association with increased uptake as those finding no effect.

Parental emotions. Anxiety about the vaccination and fear of the illness was associated with refusal. Anticipated regret if they refuse vaccination and the child later developed illness was instead associated with greater uptake.

Trust in government. The authors concluded that the evidence that trust in government played a major role was weak. Perception that there was government pressure to vaccinate was not associated with uptake but belief in a conspiracy by government was associated with refusal.

Multiple combination vaccines. The view that either combined vaccines or a sequence of multiple vaccines might overwhelm the immune system or harm the child in some other way is frequently invoked as a reason for not having a child vaccinated. Only one of three studies found an association between refusal and a belief that children had too many vaccines. However, a belief that combination vaccines are harmful or ineffective relative to a series of separate vaccines was associated with refusal in several studies.

Beliefs. There was some evidence associating refusal with a belief in the benefit of acquiring natural immunity through illness, that infections are good for the immune system, or that vaccination impaired natural immunity.

Procrastination. Several studies identified parents of unvaccinated children who expressed an intention to have their child vaccinated in the future, with one longitudinal study showing that this intention did predict their subsequent behaviour.

In summary, the perception that vaccination is associated with *adverse effects* is the most commonly reported reason for not having one's child vaccinated. Parents place more weight on whether they believe that their child was susceptible to an illness rather than the severity of it. Those parents who were satisfied with the information provided by friends, family, and health professionals were more likely to have their child vaccinated, whereas those who actively sought information from other sources, including the Internet and social media, were less likely to. This is presumably because those sources perpetuate a number of vaccine-related myths. There is lack of evidence on the role of social media, and on how interventions alter parental attitudes with vaccination uptake as an outcome.

Practicalities. The review by Smith et al (2017) did not examine health system barriers per se except to the extent that they created practical barriers to uptake, including logistical, financial, and informational considerations. The few studies that have looked at this issue find that logistical barriers are important, including inconvenient appointments times or locations and time pressures. Having to pay for the vaccination was associated with refusal in two of three studies. Evidence on the importance of the perception that it was difficult to get the vaccination or an appointment was mixed, as was having a course of vaccination in multiple doses.

Socioeconomic status. The systematic review by Larson et al (2012) contains eight studies in which socioeconomic status is a significant factor associated with vaccination. Both high and low socioeconomic status (as measured by income or level of education) can be associated with lower vaccination uptake. However, the evidence refers mostly to studies from outside the EU, from the US and low- and middle-income countries and is not specific to children. Studies from Greece and the Netherlands were available, and they found that better education promoted vaccination. This is in contrast to what has been found in several other non-EU countries, including the US, where high education was associated with greater refusal. Indeed the recent study by Larson et al. (2018) suggests that across the EU those with no education are less likely to be confident in vaccines than those with a university education. In summary, in the EU lack of confidence is systematically higher in individuals with lower education.

Communication and media environment. The same systematic review found that regular exposure to vaccination messages through mass media or community sources was positively associated with vaccination while exposure to news stories about vaccination, particularly negative ones, in the mass media reduced, though none of the studies were from EU countries.

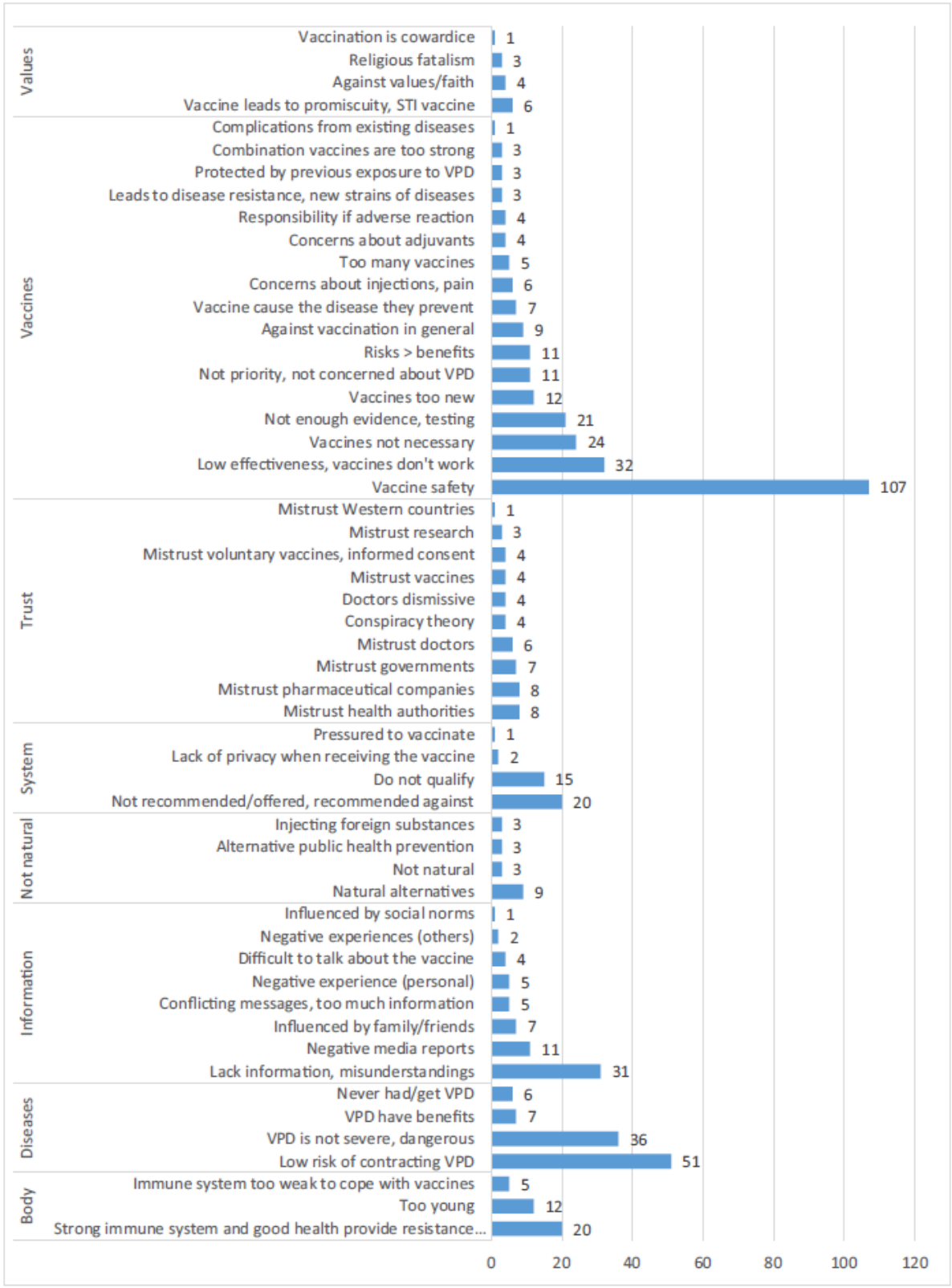
Access. Different types of costs (financial cost, time and distance to provider, administrative and general accessibility) have also been identified as factors associated with lower vaccination uptake (Larson et al, 2012). For example, in Greece, longer distances to a health facility offering vaccination were a significant barrier.

The recent study by Karafillakis and Larson (2017) summarises most common concerns in relation to benefits and risks from vaccination in Europe based on more than 140 studies. It covers studies from the UK (51 studies), the Netherlands (17), France (17), Germany (12), Greece (11), Sweden (9) and other 10 countries with 1-3 studies each. The study does not focus specifically on childhood vaccination, though more than 30

studies include parents, in addition to adults, high risk groups and other groups. Figure 13 below summarises the key findings. Again, vaccine safety is identified as the key concern, followed by low effectiveness, necessity and lack of evidence.

Box 1 summarises key obstacles and enablers of vaccination uptake.

Figure 13. Common concerns about risks and benefits of vaccination in Europe



Source: Karafillakis and Larson (2017)

Box 1. Key obstacles and enablers of vaccination uptake

Obstacles

Lack of adequate information and perceived medical need

Concerns or fears about vaccine safety (eg can cause severe diseases and side effects)

Dissemination of false and inaccurate information

Beliefs, attitudes and misperceptions (worries, doubts, concerns) about vaccines

Lack of trust towards vaccines (especially for new vaccines)

Lack of trust towards health institutions (information coming from public bodies)

Social norms (family, friends, peers)

Negative exposure to rumours and myths about vaccines in the general media

Cultural and religious factors

Conspiracy theories (vaccines serve specific economic/political interests)

Fear of injection

Lack of adequate encouragement (recommendation, advice) from healthcare providers

Overload of children vaccination (and parents)

Access issues (co-payment, availability, distance to health facility)

Enablers

Sources of reliable information for vaccination

Exposure to positive media messages

Building trust in institutions and providers

Building confidence in vaccines

Active involvement by doctors and healthcare providers

Easy access and availability of services

Ease of administration

Active involvement of healthcare providers in various settings

Targeting of high-risk groups

1.2. Measures and actions that can improve vaccination coverage

1.2.1. A conceptual framework for action

While there are many measures that could be adopted to increase the vaccination uptake in the population, it is helpful to place them within a broad conceptual framework. The following framework draws on that used in public health to influence the use of other products, specifically those that are harmful to health, such as tobacco or junk food. In this case, the goal is to increase vaccination uptake.

The available measures can first be divided into those that involve mandating and those that seek to change behaviour through incentives (e.g., recommending rather than mandating vaccination, and encouraging vaccination uptake through a range of actions).

Turning first to *mandating*, in the same way that certain products may be banned, such as illegal drugs, it is possible to make other interventions mandatory. Several Member States and other OECD countries have already done so with childhood immunisation, making school entry contingent on the child in question being immunised (with different penalties for non-compliance). Australia is adopting a "no jab, no play" law (yet to be evaluated), which places responsibility for enforcement on nursery schools, fining those that admit an unvaccinated child (Kirby, 2017). Germany passed a new law in 2017 requiring nurseries (kindergartens) to notify authorities when parents refuse to vaccinate their children. Parents with no proof of vaccination face fines and their child is not admitted until vaccinated (Kirby, 2017). Recent data from Italy provide evidence for a positive impact of law reinforcement of existing compulsory vaccinations on coverage. In June 2017, a decree-law (73/2017) was issued stipulating that the number of mandatory vaccinations, for minors up to 16-years, would be increased from four to 10 vaccinations. Vaccination coverage increased between 2016 and 2017, ranging from 0.9% for vaccination against tetanus at 24 months to 4.4% for MMR vaccination at 24 months (d'Ancona et al, 2018). School and nursery entry are a monitoring possibility, but others may exist.

Other policy options include making vaccinations mandatory but with the option to be exempted on the basis of some explicit criteria and a formal process. Exemption can also be made conditional on the vaccine hesitant individual or parent having spoken with a trained healthcare worker who explains the risk of being unvaccinated and engages in

dialogue about vaccination concerns. This partly addresses the concern among some groups who oppose mandatory vaccination on the grounds that it violates individual rights as it simply seeks to ensure that the parent makes an informed decision (while noting the concerns about disinformation discussed above), consistent with the duty of the state to uphold the rights of the child. This approach is viable, however, only as long as herd immunity levels are achieved.

The second set of measures involve creating incentives to change behaviour. These can be divided into three broad categories: social marketing (e.g., vaccine recommendation), removal of price barriers, and improving other (non-price) dimensions of access.

The way that products are marketed has changed greatly in recent years. In the context of vaccination, this most often takes the form of a *recommendation* supported by communication campaigns. As noted above, in the past these would have taken the form of simply providing education on the benefits of immunisation, based on the premise that people may be uninformed. More recently, the focus has shifted to tackling the problem of people being misinformed or disinformed, rather than uninformed. To reiterate, it is not that they lack information, but rather that the information that they have is incorrect. Drawing on the literature reviewed earlier, this involves a detailed understanding of how people perceive the risks and benefits of immunisation, and of different approaches to it, such as the desirability of single versus multiple doses. It often requires detailed ethnographic research, as well as studies of the vehicles through which misinformation is being transmitted, including social media. It recognises that these messages may be conveyed for purposes that have nothing to do with health, but rather as a manifestation of distrust in authority. As noted above, a failure to appreciate the power of misinformation may lead traditional messages on the benefits of immunisation to backfire. There is need for more effective and concerted advocacy efforts to promote a greater understanding of the value of vaccination, helping to create a greater public demand for safe and accessible vaccines as an integral element of the right to health.

With regards to *price*, the cost of being immunised for the individual or the parent should be reduced as low as possible. A positive price for the individual or the parent would introduce a barrier to vaccination, bringing vaccination coverage even to lower levels. Thus, there is a strong case for both the vaccine and its administration to be free. Yet, even where this is the case, there may still be price barriers related to accessing the health facility or loss of pay because of the need to take time off work so any ancillary costs, such as transport to a health facility should be minimised. It may also be argued that there may be a case for setting a negative price, in the form of conditional cash

transfers. However, although these have been shown to improve uptake of a number of child health interventions, a systematic review found no association with vaccination uptake (Bassani et al, 2013). Other research has found that offering money to people that would involve a trade-off between acceptance of a reward and their moral values can backfire, leading to moral outrage and reduced likelihood of engaging in the desired behaviour (Tetlock, 2003).

With regards to other dimensions of *access*, it is essential that the vaccines and the staff to administer them can be accessed by those requiring immunisation with vaccines. Access has several dimensions, including distance, so that the facility should be near to where people live or work, or for children, perhaps in schools, which may make it easier where there is an older sibling at school. A second dimension is temporal, so that facility should be open at times that are convenient to those being immunised. This may require operating outside normal working hours. Availability can also be improved by expanding the range of providers who administer vaccine. These do not have to be restricted to medically-qualified primary care providers, but can include pharmacists, nurses, community care providers and other qualified professionals, subject to adequate training. This diversity in provision is particularly important in relation to reaching out to remote or underserviced areas and disadvantaged population groups.

There is *heterogeneity* across and within countries in relation to mandating and recommending vaccination. Out of 29 surveyed European countries (EU-27, Iceland and Norway) in 2010, 14 countries had at least one mandatory vaccination. Vaccination against polio was mandatory for both children and adults in 12 countries; diphtheria and tetanus vaccination was mandatory in 11 countries and Hep B in 10 countries. All 29 countries included (as either mandatory, recommended, or reimbursed) eight vaccinations against diphtheria, Hep B, Hib (Haemophilus influenza b), influenza, MMR (measles, mumps, rubella), pertussis, polio and tetanus in their programmes. In contrast, only 9 countries recommended rotavirus vaccination (Havarkate et al, 2012). 15 countries (among them Austria, Germany, etc.) did not have any mandatory vaccinations, but seemed to achieve equal (or better) coverage rates as countries with mandatory (e.g., Italy, France, Poland etc.) vaccinations (Havarkate et al, 2012). The following Table 2 provides the details.

Table 2. Mandatory and recommended vaccination

Modality of implementation of childhood vaccination programme by country, the European Union countries, Iceland and Norway, 2010 (n=29)

A Country	Diphtheria	*Haemophilus influenzae* type B	Hepatitis A	Hepatitis B	Human papillomavirus[a]	Influenza	Invasive disease caused by *Neisseria meningitides* group C
Austria	RA	RA	RR	RA	R	RR	RA
Belgium	RA	RA	RR	MR/RA[b])	R	RR	RA
Bulgaria	MA	MA	RR	MA	R	RR	A
Cyprus	RA	RA	RR	RA	A	RR	RA
Czech Republic	MA	MA	MR	MA	R	RR	RR
Denmark	RA	RA	RR	RR	R	RR	RR
Estonia [6]	RA	RA	RA[e]	RA	R[e]	RA[e]	RR[e]
Finland	RA	RA	RR	RR	A	RA	A
France	MA/MR/RA[f]	RA	RR	MR/RA[b]	R	RR	RA
Germany [7]	RA	RA	RR	RA	R	RR	RA
Greece	MA	RA	RA	MA[h]	R	RR	RA
Hungary	MA	MA	MR	MA	A	RR	A
Iceland	RA	RA	RR	RR	A	RR	RA
Ireland	RA	RA	RR	RA	R	RR	RA
Italy	MA[l]	RA	A[l]	MA	R	RR	RA/RR[k]
Latvia	MA	MA	RR	MA	MA	RR	RR
Lithuania	RA	RA	RR	RA	A	RR	RR
Luxembourg [8]	RA	RA	RR	RA	R	RR	RA
Malta	MA	RA	RR	RA	A	RA	A
The Netherlands [9]	RA	RA	RR	RR	R	RR	RA
Norway	RA	RA	A	RR	R	RR	A
Poland	MA	MA	RR	MA	R	RR	RR
Portugal	RA/MR	RA	A	RA	R	RR	RA
Romania	MA	MA	RR	MA	R	RR	A
Slovakia	MA	MA	MR/RR[p]	MA	R	MR/RR[o]	RR
Slovenia	MA	MA	RR	MA	R	RR	RR
Spain	RA	RA	RR/RA[k]	RA	R	RR	RA
Sweden	RA	RA	A	RR	R	RR	A
United Kingdom	RA	RA	RR	RR	R	RR	RA

A: absence of recommendation, MA: mandatory for all; MR: mandatory for people at risk; R: recommended; RA: recommended for all; RR: recommended for people at risk.

[b] Mandatory for healthcare workers.
[d] RA: conjugated vaccine to children younger than two years of age.
RR: polysaccharide vaccine to older persons.
[e] Not included in the national immunisation programme, but recommended by the Ministry of Social Affairs [10].
[f] MA: children up to 18 months of age.
MR: healthcare workers.
RA: bolder than 13 years of age.
[g] MA: children up to 13 years of age.
MR: healthcare workers.
RA: older than 13 years of age.
[h] No penalty exists for non-compliance.
[l] One of 20 regions does not have any mandatory vaccination as of 2008.
[k] Regional variability.
[m] Rubella: mandatory for girls by the age of 14.

Source: Haverkate et al (2012)

There are, however, major gaps in our knowledge that make it difficult to produce fully evidence-informed policies. Thus, whether mandatory vaccinations achieve better

adherence than regimes based on recommendations is not well studied but intensively discussed in terms of autonomy, beneficence, non-maleficence, and justice (Golanakis et al, 2013; Hendrix et al, 2016; Navin et al, 2017).

Similarly, there is a need for more research on the merits or otherwise of using single or polyvalent vaccines as means to increase uptake, and whether this differs in sub-groups of the population is needed. Such research could usefully draw on the growing body of research on incentives (nudges) for reducing unhealthy behaviour (on the big four public health issues: smoking, alcohol consumption, nutrition and physical activity) (NHS 2013, Stanak and Winkler, 2015). Thus, there are various approaches, including simple voluntary, proactive voluntary, declination policies, mandatory policies, or combinations, which may improve uptake. Compared to incentives, which attempt to motivate and encourage the rational individuals to perform an action or inaction, nudging, among other subtle strategies, involves subconscious cues, altering of the profile of different choices or changing which options are the default. The EAST (Easy, Attract, Social, Timely) framework developed by the UK-Behavioural Insights Team (BIT) set up to apply nudge theory (behavioural economics and psychology) to actual policy would make is a good starting point for systematic research on effectiveness of incentives for increasing immunization.

ECDC (2017) has developed a "catalogue" of 40 interventions, strategies and tools that may help to address vaccine hesitancy. Ten of these interventions are diagnostic tools, developed to measure or monitor vaccine hesitancy. 27 are based on dialogue and communication, such as tools to convey information to parents or healthcare workers. One intervention was based on an advocacy campaign, one on a reminder-recall system (a range of tools to remind patients or healthcare workers about vaccination), and one on a multi-component approach, using both reminder-recall tools and dialogue-based tools. No incentive-based intervention addressing vaccine hesitancy, financial or non-financial, was identified.

Most of these interventions focus on addressing misinformation (23 interventions) and/or safety issues (20 interventions). Some target trust (9 interventions), religious and philosophical views (8 interventions), and perceived benefits or need for vaccination (5 interventions). 14 interventions aimed to improve vaccine hesitancy in general, without targeting specific determinants. Most interventions were developed to take place in healthcare facilities (15/40) and to be delivered by vaccine providers. Some interventions were delivered online (9/40). Several interventions focus on parents, including mothers (21/40) and on either all vaccines (19/40) or childhood vaccines (8/40). Few

interventions were vaccine-specific (HPV, influenza, MMR, Polio, etc.). Importantly, nearly all identified interventions were outside of Europe.

1.2.2. Inform: communication strategies with informational messages

Communication strategies remain a key policy lever to improve vaccination coverage. However, these need to be carefully designed and tailored for groups who are more hesitant. They are also likely to involve a dialogue between institutions and such groups. General messaging campaigns might have unintended consequences. We elaborate on these issues below.

There are at least three types of interventions (Larson et al, 2011; Cairns et al, 2012).

- Mass communication campaign
- Personalized communication campaign
- Training and educational interventions

Many of the interventions attempt to address personal and structural barriers to immunisation, as well as communicating the benefits.

Larson et al (2011) conclude that "Traditional principles and practices of vaccine communication remain valid, especially those that ensure timely and accurate communication of information about where, when, and why vaccines are given, and those that ensure mutual respect in health provider–patient interaction. However, additional emphasis should be placed on listening to the concerns and understanding the perceptions of the public to inform risk communication, and to incorporate public perspectives in planning vaccine policies and programmes."

The review by Cairns et al (2012) concluded that there was an absence of explicitly stated theoretical underpinnings in most of the intervention studies, although many were based on the information deficit model. This gap can by addressed by formulating communication interventions that are based on clearly stated theoretical frameworks, as vaccine-related knowledge, attitudes, perceptions and behaviours are useful indicators of effectiveness; by prioritising interventions that can support population-scale behaviours; by developing macro-level theories of behaviour change, models of individual behaviour, integrated with the use of social marketing principles.

Building public confidence remains the key to building public trust in each community. Trust is built through dialogue and exchange of information and opinion (Larson et al,

2011). Cairns et al (2012) include the following recommendations in relation to *communication strategy*:

i) Vaccination advocacy: credible and trusted champions for immunisation to build support and trust in vaccine efficacy and safety, and raise awareness of benefits.
ii) Personalised information: face-to-face exchange is associated with improved uptake and can be helpful in particular for risk groups demonstrating vaccine-hesitant behaviour.
iii) Education and training of health care workers: pre-service and in-service training for health care staff is needed to improve their capacity and competencies with regard to the advocacy and delivery of effective vaccination programmes, including access to expertise in communication design, delivery and evaluation of promotional communications for improved attitudes and improved vaccination uptake.

Unintended consequences of messaging on childhood vaccination

The declining rates of vaccination in many countries have occurred despite extensive evidence of their safety and efficacy, in many cases coupled with widespread campaigns to correct misconceptions and to promote uptake. Rossen et al (2016) criticise the widespread use of the Information Deficit Model of communication, based on the idea that people are rational and misconceptions arise from inadequate knowledge. Thus, they note that when individuals were presented with information reporting both myths and facts about influenza vaccination, they were able to separate the two immediately afterwards. Yet, only 30 minutes later, most had difficulty in identifying which were true and which were false. They suggest that the problem may be because the strategies that have been adopted to promote uptake are based on intuition rather than insights from psychology. In particular, they argued that many of the interventions that have been proposed actually "backfired", reducing uptake rather than promoting it. They identified a series of mechanisms by which such backfiring might occur (Table 3).

Table 3. Backfire effects in communicating public health messages

Backfire effect	Description
Familiarity	Repeated exposure to misinformation increases familiarity with it, leading to assumption that it is true
Overkill	Multiple counterarguments to misinformation is cognitively taxing and may lead individuals to favour a simpler explanation based on the misinformation
Attitude polarisation	When given information that is contrary to their beliefs, individuals selectively recall evidence and arguments that oppose it, thereby reinforcing the pre-existing beliefs
Sacred values	If ideas are viewed as sacred, or part of deeply held beliefs, monetary incentives to change behaviour may create moral outrage and increase resistance
Social norms	Highlighting an undesirable behaviour as being frequent may suggest that it is socially approved by many
Group directed threat	Messages that criticise a particular group can lead them to strengthen group identity and reject arguments perceived as criticising them
Fear appeals	Messages that induce fear may trigger defensive responses

Source: Rossen et al (2016)

The role of backfire can be seen in some illustrative examples. A study by Skurnik et al (2005) examines the well-known finding that correcting a myth can, paradoxically, reinforce it among those whose pre-existing views are challenged. Thus, parents presented with text from the US Centers for Disease Control correcting the widespread myth that MMR causes autism did reduce the level of belief in the false claims, it also reduced the stated intention to have their child vaccinated among those already holding an unfavourable view of vaccination (Nyhan et al, 2014). Similarly, research has confirmed the role of motivated reasoning, whereby people search for information that supports their preconceived view and disregards anything that conflicts with it. Thus, a study of acceptance of evidence on the HPV vaccine (Kahan et al, 2010) found that those whose worldview was unsupportive, either because they believed in individual

responsibility or traditional gender norms, seeing vaccination as condoning sexual activity, actively sought to discredit evidence of efficacy.

Another risk of public health campaigns is to portray a problematic behaviour as being frequent, and therefore a source of concern. This plays to the tendency of many people to act in accordance with what they perceive as social norms. Thus, it communicates the idea that refusal to have one's child vaccinated is now socially acceptable (Cialdini et al, 2006).

A related relevant concept is social identity theory (Tajfel, 2010). People's self-esteem derives from the groups that they identify with. If they feel that that group has been portrayed negatively, those who are more highly committed will seek to demonstrate a strong affiliation. This is now becoming an issue because of the growth of networks, including on social media, adopting attitudes that are critical of authority, whether in relation to vaccination or other behavioural norms. Thus, messages promoting vaccination may be seen as threatening the identity of the group in question, causing them to become more cohesive and adhere to their beliefs more strongly than ever. A recent Australian study found that parents identify vaccination as a marker of parental conformity to the 'toxic practices of mass industrial society' (Attwell et al, 2018).

Public health campaigns can also appeal to fear, highlighting the risks of not being vaccinated. It has been suggested that one of the reasons for the decline in uptake is because the fear of the consequences of not being vaccinated has declined because of the reduced incidence of vaccine preventable illness. meta-analysis of what are called fear appeals doors found that they are effective in general, but they can also induce negative effects, especially among those who are less likely to engage in the desired health behaviour or if individuals feel that they are unable to adopt the recommendations (Tannenbaum et al, 2015).

Rossen et al (2016) do, however, make a number of proposals to avoid messages backfiring. For example, in addressing myths, it is better to start by stating the facts, then introduce the myth, debunk it, and finally replace it with a scientific fact. It is important that the myth should never be repeated (Cook et al, 2011). It is also important to avoid overkill, as multiple counterarguments require more cognitive efforts to process. They also suggest that it may be helpful to ignore the facts altogether, instead appealing to individuals' pre-existing beliefs and values, especially where the behaviour change desired is not consistent with their values (Feinberg et al, 2013). They suggest this may be particularly helpful where individuals believe in alternative lifestyles or that

governments should not intrude into their personal lives. They suggest messages that appeal to individual's desire to act in ways that are consistent with social norms, noting how other campaigns seeking to reduce harmful behaviours have succeeded where they, correctly, point out that these behaviours are much less frequent than is often believed. Finally, they suggest that it may be possible to use fear appeals selectively, but only when designed to promote positive emotions, including a powerful message that the individual can accept the recommendations and linkage to messages that promote a positive view of themselves and their deeply held values (Tannenbaum et al, 2015).

Overall, there seems to be a strong case for a much more nuanced approach to the messages used to promote vaccination uptake. As highlighted earlier, this includes the use of theory-based communication strategies that can be adapted to the needs of population groups that encounter substantial barriers in routine vaccination programmes such as Roma, Travellers and other ethnic minorities.

1.2.3. Prioritisation of vaccination schemes

In recent decades, many vaccines have been introduced into European health care systems. Around 15 – 20 different vaccines are listed in most National Vaccine Plans. Most vaccinations are intended for everyone at a particular age; others are only for high-risk groups. Since not all of vaccines are equally effective, health systems have to make choices about which vaccines to prioritise to achieve public health impact based on available evidence.

Several tools and instruments have been developed to support prioritisation and decision-making. The report by the US Institute of Medicine (IOM) on Ranking Vaccines introduced an analytical model that employed multi-criteria decision-analysis tools primarily as support to prioritize vaccines in development, but was later tested to make "smart choices" in relation to different goals (e.g. eradication or elimination of a disease or improvement of delivery modes, etc.) (IOM, 2015).

Frameworks supporting rational approaches and comprehensive evaluation of choices provide a structured approach (Piso and Wild, 2009) and lay the basis for consistent decisions on vaccination national programmes. At the core of these frameworks are criteria of public health relevance (burden of disease: incidence, case fatality rate, death, permanent impairment, morbidity) and vaccine characteristics (effectiveness, length of immunity, adverse events, doses required, costs per dose and for administration, cost-effectiveness and feasibility) (IOM, 2015; Piso and Wild, 2009; Kimman et al, 2006;

WHO, 2014). Decisions over the prioritized vaccines will have to be made public in a comprehensible manner (Hulsey and Bland, 2015), which in turn might facilitate public confidence and acceptability of vaccines by citizens and health professionals.

If EU countries differ in the list of vaccinations that are freely provided (or heavily subsidized) to their population, there may be scope for confusion by the public and may give the impression of lack of consensus on the vaccines that are to be provided. There may be a rationale for such differences (in particular in relation to sub-groups of the population and different epidemiology) but then these differences need to be articulated and explained. This gives a rationale for improved coordination across countries.

1.2.4. Primary care (and other providers) interventions

Primary care is well positioned to improve child vaccination rates. Primary care providers have frequent interactions when parents visit the practice due to other illnesses and check-ups. These interactions can be used as opportunities to raise awareness. As mentioned above, physicians do not need to be the sole providers of vaccination, and other qualified providers can be included to improve access.

Reminder systems for parents and providers. Cost-effective strategies to increase uptake are reminder systems targeting parents of preschool who are due or overdue for a routine primary vaccination and reminder systems for healthcare providers (Williams et al, 2011; Jacob et al, 2016). Parental reminders for pre-school children can increase immunization rates up to 34%. Positive effects on vaccination uptake have been obtained with both generic and specific reminders and with other methods of reminders and recall (Williams et al, 2011). Personalised and tailored reminders have also shown to be effective to increase influenza vaccination rates of those 60 years and older in the community (Trivedi, 2015).

Strategies targeting vaccination providers are also effective in increasing vaccination rates in children (Williams et al, 2011), but not for increasing influenza vaccination rates among older people (Trivedi, 2015). Increases of 7% in child vaccination rates have been shown when using reminders to notify either with paper or computer-based chart prompts that the vaccination is due or overdue, and 8% when educational programmes are used. The latter is aimed at enhancing the knowledge of the provider. This can be part of continuing medical education or one-off sessions, using peer support and the use of educational resources. Another effective strategy on the provider side is to feedback evaluation information to the healthcare provider on the performance of providers in childhood vaccinations. Increases in vaccination coverage of 19% have been shown. This

strategy could be combined with financial incentives or provider education (Williams et al, 2011).

Some countries have started to prioritize electronic vaccination cards through the introduction of Electronic Immunization Record including the option for e-services (proactive reminders). Advantages of electronic vaccination records are the uniform recording of all vaccinations and point-of-time knowledge of vaccination status. Most pilot projects are still in their infancy and evidence on the effect on uptake is very limited (Heidebrecht, 2014). Different technological options to support the user-friendliness of electronic vaccination records and eventually European solutions are necessary elements for the successful introduction of electronic vaccination records and registers (Euractiv, 2017).

Provider-parent communication and trust in the provider. To improve compliance among vaccine hesitant parents, it is important that healthcare providers communicate about vaccination effectiveness during an encounter. Concerns of parents may vary, e.g., ranging from concerns about the number of shots at a visit or the side effects of a single vaccine or the belief that vaccines weaken the immune systems or cause autism. A personalised approach should, therefore, be taken by the provider to effectively discuss the specific concerns a parent may have. A non-confrontational, participatory discussion, that is personalized seem to be the best approach to improve compliance (Connors et al, 2017). Even when parents remain hesitant to vaccinate their children, the patient-provider relationship needs to stay intact to convey respect, build trust, and allow for other opportunities to discuss immunization (Diekema, 2012). Face-to-face interventions are particularly effective in populations where lack of awareness of (e.g., new or optional) vaccinations is identified as a barrier (Kaufman et al, 2018).

Parental trust in the provider is crucial for establishing vaccine compliance (Busse et al, 2011; Mollema et al, 2012; Gust et al, 2008). To increase the willingness of parents to consider vaccination, they need to believe their provider is primarily motivated by the welfare of their child rather than an abstract public health goal. Conducive to building this trust relationship is to demonstrate the willingness to listen, encourage questions, and acknowledge parental concerns and to provide accurate information about the risks and benefits of vaccinations.

Integrating public health and primary health care. Immunization is part of the prevention of disease and injury function of the health care system that lies at the intersection of primary care and public health. This implies that primary care and public health can

share the responsibility for this. Combining primary care and population health management is a powerful means to improve the vaccination uptake.

There are various ways through which primary care and public health can reinforce each other linking their traditional functions and roles for a common objective: improving population health. Depending on context specific opportunities to create facilitating circumstances, and remove barriers, various degrees of integration could be achieved, ranging from awareness to merger.

All these forms of integration must address, apart from alignment of services delivery, governance and financing. To successfully integrate primary care and public health there has to be a shared goal of those responsible for population health improvement, especially in public health and primary care services; community engagement in defining and addressing population health needs; aligned leadership and governance; the establishment of a shared infrastructure; sustainable funding and financing; and sharing and collaborative use of data and analysis (Martin-Misener et al, 2012). It is particularly this latter function, where an important opportunity for the increase of vaccination uptake lies.

Public health services can be delivered in the framework of primary health care, preferably, based on a comprehensive "empanelment" (i.e. by assigning individual patients to individual primary care providers and care teams). This could involve the use one single registration platform, documenting the vaccination-status and accessible for all health care providers and the patients themselves. The definition of vaccination goals need to be documented in a centralised way (as much as possible crossing national borders), and the achievement of these goals needs to be monitored. The monitoring system needs to be closely linked to centralised action, taking advantage of non-health care related opinion leaders to support the campaigns.

Bundling of vaccines. One possible policy option to improve vaccination uptake is to reduce the number of injection-sessions if parents or individuals are less likely to visit the provider when multiple visits are required to achieve vaccination coverage. On the other hand, some hesitant individuals might have concerns of possible consequences of bundling which need to be discussed with the provider. Therefore, the decision on whether to bundle different vaccines together requires careful assessment of not only the economic cost of an extra visits for vaccination, but also the psycho-social costs it will require and compare this to the expected benefits.

Financial incentives for health care providers. There may be also scope for appropriately designed financial incentive schemes, which encourage providers to achieve herd immunity levels. One example is within the Quality and Outcome Framework in England, which among others gave financial rewards for family practices to four separate influenza immunization rates for patients with coronary heart disease, chronic obstructive pulmonary disease, diabetes, and stroke (Kontopantelis et al, 2012).

1.3. Recommendations

The Expert Panel on Effective Ways of Investing in Health formulates the following recommendations in relation to the intervention to organize vaccination programmes in order to increase the vaccination uptake in the European Union:

- Communication strategies about the benefits of vaccination remain important but need to be combined with opportunities for **participatory** approaches enabling **dialogue** with vaccine hesitant and hard to reach groups. These strategies need to be targeted not only at the uninformed (i.e., the lack of information) but also at the misinformed (when the information is incorrect) or disinformed (when information is spread with the intention to deceive). At the EU and national level, there is scope for improving advocacy and communication strategies to promote the value and safety of vaccines and effective intervention strategies, incorporating participatory methods, for addressing vaccine hesitancy. Healthcare and other workers in charge of such communications need to be supported with adequate and specific training.

- Vaccination can be mandatory or recommended as long as **high coverage** rates to achieve **herd immunity** are obtained. Mandatory vaccination can be unpopular with some individuals or groups, which reinforces the case for good communication and advocacy strategies to improve acceptability. Depending on the institutional and political context, a policy option is to allow individuals to opt out of vaccination subject to a formal process (to be defined and designed by the country) that ensures that individuals and parents are fully aware of the risk of not being covered (e.g., an exception process, which includes a mandatory consultation and dialogue with a healthcare worker) but only if vaccination coverage levels are sufficiently high to ensure herd immunity. Therefore, achieving herd immunity should remain the priority, and achieving **herd immunity should guide the design of policies to achieve high coverage**.

- **Primary care** is well positioned to improve child vaccination rates given the trust held by doctors and the frequent interactions with parents and children with other illnesses or attending check-ups. These interactions can be used as opportunities to raise awareness. Reminder systems for providers and parents have also proved successful.

- Primary care physicians do not have to be the exclusive providers of vaccines. Better **access** can be achieved by improving availability of vaccines from **other providers** (e.g., community pharmacists, nurses, community care providers, and other qualified providers including within schools) subject to having received appropriate training, and outside normal working hours. This diversity in provision, which requires an integrated (electronic) vaccination record, is particularly important in relation to reaching out to remote or underserviced areas. Moreover, if coverage rates are low, the cost of being immunised for the individual or the parent (the price, co-payment) should be reduced as low as possible, ideally making vaccination free of charge.

- Differing lists of vaccines that are freely provided (or heavily subsidized) to their population across EU countries can generate scope for confusion by the public and may give the impression of lack of consensus on the vaccines that are to be provided. There may be a rationale for such differences (in particular in relation to sub-groups of the population and different epidemiology) but then these differences need to be articulated and explained. There is a rationale for **improved coordination and consistency** across countries on issues such as vaccines list and schedules, and decision tools for prioritization, including HTA and an **evidence-based approach**. There is scope for strengthening evidence-based guidance on effective vaccination policies and operational plans, including quality assurance of vaccines, harmonisation of optimal vaccine schedules, standards and regulations, procurement mechanisms etc.

- There is scope for strengthening the monitoring and the **surveillance** systems to ensure up-to-date data to guide policy and planning at a regional, country and sub-national level that will optimise coverage and impact. This could be achieved with integrated data systems.

- As a comprehensive programme considers populations and individuals, there is scope for close **co-operation**, or even integration, **of public health and primary health care services**.

- **Equitable access** to vaccination needs to be ensured especially for hard-to-reach, marginalized and disadvantaged population groups, including migrants. The development of equity-driven vaccination programmes should be included as an integral component of the public health system in EU countries.

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