



Contents lists available at ScienceDirect

International Journal of Infectious Diseases

journal homepage: www.elsevier.com/locate/ijid

Increasing vaccine acceptance using evidence-based approaches and policies: Insights from research on behavioural and social determinants presented at the 7th Annual Vaccine Acceptance Meeting[☆]



Katie Attwell^{a,b,*}, Cornelia Betsch^c, Eve Dubé^d, Jonas Sivelä^e, Arnaud Gagneur^f,
L. Suzanne Suggs^{g,h,i}, Valentina Picot^j, Angus Thomson^{k,1}

^a School of Social Science, University of Western Australia, 35 Stirling Highway, Crawley, WA, 6009, Australia

^b Wesfarmers Centre of Vaccines and Infectious Diseases, Telethon Kids Institute, Perth Children's Hospital, 15 Hospital Ave, Nedlands, WA, 6009, Australia

^c University of Erfurt, Nordhäuser Str. 63, 99089, Erfurt, Germany

^d Centre de Recherche du CHU de Québec-Université Laval, 2400 D'Estimauville, Québec, QC, G1E 7G9, Canada

^e Infectious Disease Control and Vaccinations, Finnish Institute for Health and Welfare (THL), Mannerheimintie 166, Helsinki, Finland

^f Department of Pediatrics, Faculty of Medicine and Health Sciences, Université de Sherbrooke, 3001 12e Avenue Nord, Sherbrooke, Québec, J1H 5N4, Canada

^g BeCHANGE Research Group, Institute of Public Health, Faculty of Communication Sciences, Università della Svizzera Italiana, via C. Buffi 13, Lugano, Switzerland

^h Swiss School of Public Health (SSPH+), Zurich, Switzerland

ⁱ Institute for Global Health Innovation, Imperial College London, London, UK

^j Scientific Conferences and Public Health Initiatives, Fondation Mérieux, 17 Rue Bourgelat, 69002, Lyon, France

^k Sanofi Pasteur, 14 Espace Henry Vallee, 69007, Lyon, France

ARTICLE INFO

Article history:

Received 20 November 2020

Received in revised form 25 January 2021

Accepted 3 February 2021

Keywords:

Vaccine hesitancy

Vaccine acceptance

Vaccine uptake

Vaccination

Health communication

ABSTRACT

Background: In 2019, the World Health Organization (WHO) flagged vaccine hesitancy as one of the top 10 threats to global health. The drivers of and barriers to under-vaccination include logistics (access to and awareness of affordable vaccines), as well as a complex mix of psychological, social, political, and cultural factors.

Increasing vaccine uptake: There is a need for effective strategies to increase vaccine uptake in various settings, based on the best available evidence. Fortunately, the field of vaccine acceptance research is growing rapidly with the development, implementation, and evaluation of diverse measurement tools, as well as interventions to address the challenging range of drivers of and barriers to vaccine acceptance. **Annual Vaccine Acceptance Meetings:** Since 2011, the Mérieux Foundation has hosted Annual Vaccine Acceptance Meetings in Annecy, France that have fostered an informal community of practice on vaccination confidence and vaccine uptake. Mutual learning and sharing of knowledge has resulted directly in multiple initiatives and research projects. This article reports the discussions from the 7th Annual Vaccine Acceptance Meeting held September 23–25, 2019. During this meeting, participants discussed emergent vaccine acceptance challenges and evidence-informed ways of addressing them in a programme that included sessions on vaccine mandates, vaccine acceptance and demand, training on vaccine acceptance, and frameworks for resilience of vaccination programmes.

© 2021 The Author(s). Published by Elsevier Ltd on behalf of International Society for Infectious Diseases. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

[☆] The 7th Vaccine Acceptance Meeting, organized by the Mérieux Foundation, September 23–25, 2019.

* Corresponding author at: School of Social Science, University of Western Australia, 35 Stirling Highway, Crawley, WA, 6009, Australia.

E-mail addresses: katie.attwell@uwa.edu.au (K. Attwell), cornelia.betsch@uni-erfurt.de (C. Betsch), eve.dube@inspq.qc.ca (E. Dubé), jonas.sivela@thl.fi (J. Sivelä), Arnaud.Gagneur@USherbrooke.ca (A. Gagneur), Suzanne.suggs@usi.ch (L. S. Suggs), valentina.picot@fondation-merieux.org (V. Picot), angusthompson@protonmail.com (A. Thomson).

¹ Current affiliation: UNICEF – United Nations Children's Fund Program Division, UNICEF House, 3 United Nations Plaza, New York, NY 10017, USA.

Introduction

The World Health Organization (WHO) flagged vaccine hesitancy as one of the top 10 threats to global health in 2019 (World Health Organisation, 2019b). Vaccine hesitancy has resulted in recent measles outbreaks, such as that in Samoa in 2019, with almost 6000 cases of measles and 83 deaths due to under-vaccination resulting from hesitancy compounded by structural and systemic problems (Thornton, 2020; World Health Organisation, 2019a). While public health organisations strive to provide interventions to promote vaccination at the population level, these are not always based on data about the vaccination drivers and barriers and may instead reflect entrenched practices (McCoy, 2019). Accordingly, there is a need for effective strategies, based on the best possible evidence regarding drivers and barriers, to enhance vaccine demand, acceptance, and uptake in all settings. Drivers and barriers include logistics, as well as complex psychological, social, political, and cultural factors. The field of vaccine acceptance research is growing rapidly with the development, implementation, and evaluation of diverse measurements and interventions to address this challenge (Cella et al., 2020; Olson et al., 2020; World Health Organisation, 2020).

Several ongoing global initiatives are focusing on the question of which drivers and barriers are important and how to address them. For example, the WHO and United Nations Children's Fund (UNICEF), in partnership with Gavi, the Vaccine Alliance (GAVI), the US Centers for Disease Control and Prevention (CDC), and the Gates Foundation, have set up 'The Vaccination Demand Hub' to improve coordination and harmonise the delivery of support and technical assistance to countries (Vaccination Demand Hub, 2021). The Vaccination Acceptance Research Network (VARN) has launched a global network of multidisciplinary researchers and immunisation programme managers to address immunisation programme challenges and improve vaccination acceptance (Vaccination Acceptance Research Network (VARN), 2019). The Vaccine Safety Net (VSN), which the WHO established in 2003 to counterbalance unbalanced, misleading, and alarming vaccine safety claims published on the Internet (World Health Organisation, 2003), collates a worldwide network of websites that provide reliable, balanced information on vaccine safety for healthcare professionals and the public. Before being included in VSN, websites are evaluated using criteria for good information practices. In September 2019, there were 75 websites from 34 countries in 24 languages, with another 20 being evaluated (Vaccine Safety Net (VSN), 2020).

Another initiative is the annual Vaccine Acceptance Meetings, hosted by the Mériex Foundation in Annecy, France, initiated in 2011. These meetings have fostered an informal community of practice on vaccination confidence and vaccine coverage that facilitates mutual learning and sharing of knowledge (Fondation Merieux, 2011). Many initiatives and research projects have resulted (Thomson et al., 2018). This article presents a summary report of the topics and conclusions from the 7th annual meeting held in September 2019, attended by 79 people from 24 countries and diverse sectors. Participants discussed emergent vaccine acceptance challenges and evidence-informed ways of addressing them in a programme that included sessions on acceptance and uptake, training, frameworks for resilience of vaccination systems, and vaccine mandates.

Presentations on vaccine acceptance and uptake

Influences of motivation

Motivation to accept vaccination and get vaccinated is influenced by various social and practical factors (Brewer et al., 2017). Understanding these factors will help country and sub-

national immunisation programmes to develop, monitor, and evaluate tailored evidence-based strategies to improve and sustain vaccination uptake. In November 2018, a WHO global expert group called 'Measuring Behavioural and Social Drivers of Vaccination' (BeSD) was established to oversee the development of tools, including quantitative surveys and interview guides for measuring and addressing the reasons for under-vaccination, and tracking consistent, comparable data. Following the introduction to BeSD's work, many subsequent presentations focused on specific aspects of the behavioural and social drivers of vaccination.

Clinical encounters with medical and allied health providers are a key example. While it is generally agreed that family physicians are trusted sources of vaccination information, only minimal attention has been given to the role of complementary and alternative medicine (CAM) providers in parental decision-making about vaccinations, despite CAM being used by 25–50% of the population in Western countries (Attwell et al., 2018b; Wardle et al., 2016). In Switzerland, the results of a study involving 17 CAM providers showed that they dialogued with their patients in terms of individual choice and personal context, rather than focusing on public health benefits and consequences (Deml et al., 2019). CAM providers were not categorically opposed to vaccination, but expressed nuanced, vaccine-specific attitudes and argued in favour of patient choice.

Educating children

Educating children is another approach for building vaccine confidence in future generations by increasing technical knowledge, generating positive associations with vaccination, harnessing gamification, and supporting the rollout of vaccines to those in less prosperous nations. A school-based Internet learning resource in Canada, called 'Kids Boost Immunity,' is leading the field (Kids Boost Immunity, 2020). Teachers have access to over 60 free lessons and quizzes to engage digital-age students in grades 4–12, developed by teachers and health professionals in collaboration with government and non-governmental organizations, including UNICEF Canada, and some funding from private companies. The content is aligned with the school curriculum and includes topics such as evaluating online information sources, global inequality in health, the immune system, antibiotics, germs and infections, how diseases spread, outbreaks, and vaccines. When children get >80% of the quiz questions right, they earn a vaccine for a disadvantaged global child, donated through UNICEF Canada. The spirit of competition is encouraged, and the programme displays rankings of the schools by the number of vaccines earned.

Other initiatives

The Sabin Vaccine Institute led the launch of the VARN to respond to the WHO's call for concerted efforts to tackle the challenge of vaccine hesitancy (Vaccination Acceptance Research Network (VARN), 2019). VARN's mission is to build and advance a multidisciplinary network that uses social and behavioural science to address vaccination acceptance and demand challenges in global immunisation programmes. Since the launch of the VARN website, nearly 90% of those who have registered have said that they are interested in connecting with experts, about 80% are looking for networking opportunities with colleagues from other disciplines or research funding, and 75% are interested in professional meetings and conferences.

Behavioural insights

Behavioural insights, popularised by Thaler and Sunstein's influential book *Nudge*, are also used in vaccine acceptance

research, as recognised in the growing use of terminology about behavioural and social drivers of uptake, and the drawing of lessons from cognate areas (Thaler and Sunstein, 2008). In the United Kingdom, the Behavioural Insights Team, created in 2010, assesses how psychological and behaviour insights, i.e. the way people make choices, respond to options, perceive the world, and behave, can be used to improve the design of policy (Behavioural Insights Team, 2010; Institute for Government, 2010). Behavioural scientists conceptualise two systems for thinking about behaviour, one intuitive for immediate actions and the other deliberate for long-term actions. The Behavioural Insights Team built on this insight to develop the EAST framework (Easy, Attractive, Social, Timely) (Behavioural Insights Team, 2012). Using this approach, the efficacy of different online prompts as a means of improving registration for the UK organ donor programme following renewal of a vehicle tax disc were assessed. An important lesson for vaccine acceptance initiatives is that it is difficult to know what will work, and it is important to test messages on individuals from the target audience.

Behavioural insights are already being used in the field of vaccination promotion and acceptance to encourage parents to vaccinate, for example, in the PromoVac study in Canada. The results from this study demonstrated how an intervention based on motivational interviewing of parents at birth lowered vaccine hesitancy and increased both their intention to vaccinate their infant at 2 months of age and the actual vaccination coverage up to 24 months (Gagneur et al., 2019a; Lemaitre et al., 2019). Using motivational interviewing in an educational session fosters a patient-oriented and tailored session, welcoming parents at their individual level of knowledge while respecting their beliefs. Parents can discuss their concerns freely and ask questions about vaccination without feeling judged, which helps to forge a strong relationship with healthcare practitioners. Healthcare practitioners can thus identify parental concerns or misconceptions about vaccination and provide tailored information. The parents can then explore their own ambivalence, find their own arguments for change, and make an informed decision to vaccinate their child or not. Information should be given at the right time, which in the case of PromoVac was 2 months before the first childhood vaccine, allowing parents sufficient time to take their decision (Gagneur et al., 2018).

Vaccine hesitancy and acceptance studies in low- and middle-income countries

Many studies focusing on vaccine hesitancy and acceptance have been conducted in the more economically developed countries (MEDC); however, we need more studies from low- and middle-income countries (LMICs) that take into consideration their unique characteristics. In LMICs, study participation is sometimes motivated by political, social, and economic factors, e.g., the provision of free medical care. For example, the decision to participate in malaria vaccine trials in three LMICs was primarily driven by the provision of health care and community and domestic hierarchies versus individual choice (van den Berg et al., 2019). There are also other technical limitations and enablers that need to be considered in LMICs, such as SMS to mobile phones, which could be a cost-effective way to reach larger populations to improve health outcomes. One study in Pakistan found that automated mobile phone-based personalised messages (SMS or automated call) improved childhood vaccination uptake at 6, 10, and 14 weeks of age compared with a usual care control group in those who received the messages (Kazi et al., 2019).

In Rwanda, a branded narrative story-based intervention has been implemented to increase vaccine uptake; this has been done via Ni Nyampinga, which is a platform for girl empowerment covering a variety of subjects. A proof-of-concept study is

underway to assess an intervention to promote human papillomavirus (HPV) vaccination using an ‘agony aunt’, Baza Shangazi, who answers questions about health, including HPV vaccination.

Results from a study among parents in Diapé, Côte d’Ivoire, showed that almost 30% of the children were not fully vaccinated and that there is a need to strengthen maternal awareness-raising activities on diseases, immunisation schedule, and knowledge about the benefits of immunisation. A study from Sudan reported that although parental attitudes and negative beliefs played a role in measles vaccine hesitancy, programmatic aspects of vaccine delivery were also important.

Presentations on training in vaccine acceptance

Training initiatives for health professionals

As health professionals are reported to be the most trusted source of vaccine information, they need suitable training in vaccine acceptance to help them to identify parents’ concerns and provide targeted information to parents to help them make informed decisions about vaccinating. This training should increase their confidence for discussing vaccination with their patients by increasing their knowledge about immunisation, and teach them how to communicate with vaccine-hesitant individuals. In Quebec, a three-module e-learning programme has been developed to train vaccination counsellors in the governmental EMMIE programme based on the PromoVac strategy outlined above, i.e., an educational session with parents at birth using motivational interviewing techniques (Gagneur et al., 2019a, b; Gagneur et al., 2018; MSSS, 2019). In the USA, training in an announcement approach for HPV vaccination involving a 1-h in-person session using a standard slide set and script, was shown to improve vaccination uptake on the same day as the visit (Malo et al., 2018).

The International Pediatric Association Vaccine Trust Project is a multi-stakeholder global initiative that will aim to equip, empower, and galvanize health professionals to advocate vaccination, through a blended-learning ‘train-the-trainer’ programme containing eight evidence-based modules (International Pediatric Association, 2018).

In addition to these more formal initiatives, healthcare providers need access to the right resources for effective communications that address hesitancy. A scoping review showed that although many no-cost, downloadable interventions have been developed to support healthcare providers to communicate with vaccine-hesitant parents/individuals, many are hard to find (Karras et al., 2019). Efforts should be focused on making such existing resources more easily available, for example via a central repository.

In Australia, a multi-component P3-MumBubVax intervention for pregnant women has been developed in the context of influenza and pertussis vaccination (Kaufman et al., 2019). The intervention includes practice-level prompts, training for midwives based on motivational interviewing (drawn from North American experiences described above), identification of midwife vaccine champions, and a comprehensive website with portals for midwives and parents. A pilot study demonstrated that self-reported maternal vaccine uptake was 82% for influenza and 93% for pertussis following the MumBubVax intervention package (Kaufman et al., 2020).

Presentations on resilience of vaccination systems

Health system resilience can be defined as the capacity of health actors, institutions, and populations to prepare for and effectively respond to crises, to maintain core functions when a crisis hits, and, informed by lessons learned during the crisis, reorganise if

conditions require it (Kruk et al., 2015). The global aim of having resilient health systems is to protect human life and produce good health outcomes for all during a crisis and in its aftermath. Resilient vaccination programmes require funding, which in turn requires proof that vaccination makes a difference. They also require trust in vaccination, which comes from utilisation and communication with the health system (Ozawa et al., 2016). It is important to distinguish between populations that are hard to vaccinate because of their low demand and populations that are hard to reach because of supply issues, as these groups will need different strategies (Ozawa et al., 2019).

Resilience-building should draw from empirical research about existing and emerging threats to systems and populations. For example, in Australia, annual influenza vaccination is recommended for children aged 6 months and older and pregnant women, but uptake is low. Influenza is responsible for more children being hospitalised than any other vaccine-preventable disease. Semi-structured interviews of parents of hospitalised children highlighted that lack of knowledge, inconvenient vaccination pathways, and perceived non-seriousness of influenza contributed to non-vaccination of their hospitalised child (Carlson et al., 2019). Hence multifaceted interventions, including improving access, awareness, recommendations, and opportunities, are needed to increase vaccination coverage (Dubé et al., 2018; Habersaat and Jackson, 2020).

The priority areas defined by the WHO for providing technical support and partnering to improve childhood vaccination uptake within multicomponent strategies include service quality (targeting individuals), equity (targeting the community), and resilience (targeting the public) (World Health Organisation, 2017a, b). Multicomponent strategies that ensure equitable access to vaccination services and quality of vaccination services (including training for healthcare professionals), as well as interventions to enhance vaccine confidence and ensure informed vaccination decision-making, are needed to promote vaccination programmes resilience. There is a need for country-level data to inform evidence-based communication strategies to address vaccination hesitancy.

Misinformation on vaccination on the Internet and social media also needs to be addressed as part of resilience-building. Understanding the different online communication strategies used by pro- and anti-vaccination organisations will assist with this. Although both pro- and anti-vaccination websites use personal stories and emotional posts to communicate, these tools are more central to the overall anti-vaccination communication strategy (Kata, 2012). In addition, anti-vaccination strategies claim a loss of freedom of choice, generate institutional mistrust, and promote information on alleged (i.e., non-proven) safety issues, whereas pro-vaccination communication strategies use proven facts and scientific authority to debunk myths and disinformation. The capacity to mobilise effective strategies promptly will be central to a resilient vaccination system.

Effective oversight and engagement with social media is another key pillar of vaccination systems resilience. Exposure to Twitter in the USA was reported to be more strongly associated with lower one-dose HPV vaccine coverage in females in 2015 than socio-economic factors (Dunn et al., 2017). Another study reported that misinformation travels about six-times faster on Twitter than valid information (Vosoughi et al., 2018). However, directly confronting disinformation may legitimize the disinformation in people's minds (Broniatowski et al., 2018). It is also important that social media platforms work to limit the spread of vaccine misinformation, and some progress has been made: since September 2019, Facebook apps and Twitter have directed individuals looking for information on vaccines to 'validated' websites such as the WHO, CDC, UNICEF, and Gates Foundation websites (World Health Organisation, 2019c).

Promoting vaccination resilience needs collaboration between governments, individuals, and communities, the private sector, healthcare professionals, and healthcare systems. The multi-agency Vaccination Demand Hub will produce a strategic communications guide to build a positive information environment, a quick reference guide on how to communicate about vaccination for media professionals, and the vaccination literacy content for 10–13-year olds (Vaccination Demand Hub, 2021).

Presentations on mandatory vaccination

In some regions, governments are embracing mandatory vaccination as a tool to increase vaccine uptake (Attwell and Navin, 2019). In Samoa, a 6-week state of emergency was declared in 2019 when 5600 cases of measles and 81 deaths were reported (Reuters, 2019a, b). One measure under the state of emergency was mandatory measles vaccination for all unvaccinated citizens. Australia, Italy, France, and California have all adopted restrictive mandates with no personal belief opt-outs. In 2019, additional American states required measles vaccine for day-care school entry, with only medical exemptions. In 2020, Germany implemented a similar measles mandate for day-care and preschool entry, with a fine for those who refuse (Attwell et al., 2019, 2018a; CDC, 2016; Eddy, 2019).

When jurisdictions modify their existing mandatory vaccination policies, this can involve making them more comprehensive (adding vaccines, as in France and Italy), removing pre-existing non-medical exemptions (Australia and California), imposing new consequences for non-compliance (Italy, Australian states), and ramping up enforcement practices (France and Italy). Governments utilise a variety of levers from fines to exclusion from services such as schools and childcare and from welfare benefits, to impose consequences intended to motivate the vaccine-hesitant and change the behaviour of refusers.

While restrictive mandates may play an important role in behaviour change and disease prevention, they also provoke concerns about balancing individual choice and liberty with disease prevention. In some settings, they provoke ethical or constitutional questions about rights and duties that are not easily answered. However, answers should relate to the specific structure of the mandate under consideration, including its consequences (Navin and Attwell, 2019). Public and private institutions are the gatekeepers responsible for enforcing the mandate, which can generate conflicts of interest for employees, business operators, and healthcare professionals in public and private healthcare and educational settings. They may also have financial or medical interests not to exclude children from education and care, as this may conflict with their public health values (Navin and Attwell, 2019).

There are also concerns that jurisdictions implementing restrictive mandatory vaccination policies may not be exhausting persuasive options and eliminating barriers to access. For example, vaccines in France are still not fully funded by the government, and while most people can access them without cost through health insurance, some families are left behind (Ward et al., 2019). Best practice resorts to restrictive mandatory vaccination policies only after other tools have failed (Omer et al., 2019).

Evidence from the USA, which provides a type of 'natural experiment' because there is wide variation in state school entry vaccination requirements, shows more exemptions, lower vaccine coverage, and more disease outbreaks in states that are more permissive (Bradford and Mandich, 2015; Omer et al., 2008, 2006; Omer et al., 2012; Vaz et al., 2020). Accordingly, some experts propose a 'sweet spot' with nudge-based policies making exemptions difficult, but not impossible, to obtain (Omer et al., 2018). This approach can then be bolstered by following up other categories of children, such as those who were enrolled

conditionally in school but are not up to date with their vaccines. This latter strategy has had a greater impact on reducing the number of unvaccinated children in California than the state's new, strict mandatory law (Delamater et al., 2019).

The California case shows that mandates are not guaranteed solutions to the problem of vaccine refusal. The suitability and effect of mandates are context-specific, and what works in one setting may not work in another. Historically, states with less accessible non-medical exemptions, and therefore more restrictive mandates, have higher numbers of medical exemptions (Stadlin et al., 2012). California has seen a 'replacement effect' of this nature, whereby unvaccinated families are now inflating categories of 'medical exemption' and 'mandates not applicable', meaning they are home schooling or utilising federal disability provisions to maintain some school access (Delamater et al., 2019). Through such mechanisms, clusters of children who are not up to date persist in the state's north, despite the abolition of non-medical exemptions (Pingali et al., 2019).

Since January 2018, France has had 11 mandatory childhood vaccines. In April 2019, it was reported that there was a 36.4% increase (75.7% vs 39.3%) in coverage with the first dose of meningococcal C vaccine at 7 months of age for infants born between January and May 2018, compared with those born between January and May 2017 (French Government, 2019).

In jurisdictions that implement more restrictive mandates, attention should be paid to the epidemiology and regional variations in coverage and also to adverse consequences for the socially disadvantaged. As governments try to attain target vaccine coverage to ensure community protection (herd immunity), particularly for measles, restrictive mandates may prove legitimate and useful tools, depending on their political and cultural acceptability and if they do not raise concerns about individual rights and freedom. The devil, as always, lies in the detail, and any requirements to vaccinate should be just one element in a multifaceted intervention in which governments fund vaccines, invest in properly researched and targeted communications, employ nudges, and empower health professionals to have productive conversations with families (Omer et al., 2019).

Conclusions

The community of practice that has grown from the Fondation Mérieux annual meetings once again shared their experience with diverse, inspirational approaches to vaccine hesitancy that can be adapted to other settings. Some members provided updates of their ongoing initiatives, such as EMMIE, BeSD, and VARN. Others were new to the community, such as the school-based programme 'Kids Boost Immunity' initiative. Health systems need to build resilience so that they can respond to vaccination crises and, very importantly, recover from them. This requires proactive actions, such as media monitoring and occupation of the communication space to avoid leaving vacuums for others to fill. All through the meeting, the importance of collaboration with partners and stakeholders and tailoring strategies to the specific needs was emphasized.

During this 7th annual meeting, we saw that through the informal community of practice it is possible to foster collaborations and to cross-fertilise by sharing new and exciting approaches, many of which themselves come from collaborations between members of the community of practice. The attendance at these meetings has increased over the years, and while we had to defer the 8th Annual Meeting planned for September 2020, the community of practice will be geared up to share many new insights regarding maintaining vaccine demand during and after the coronavirus disease 2019 (COVID-19) pandemic and will be well placed to lead global discussions about the rollout of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) vaccines.

Funding source

The 7th Annual Vaccine Acceptance Meeting was supported by an unrestricted grant from Sanofi Pasteur and MSD to the Fondation Mérieux. None of the authors received direct support from this grant. Medical writing and editorial services, provided by Margaret Haugh (MediCom Consult, Villeurbanne, France), were funded from the unrestricted grant.

Ethical approval

Not applicable.

Conflicts of interest

All authors are members of the Scientific Committee for the annual Vaccine Acceptance Meetings organized by the Fondation Mérieux. In addition, Katie Attwell receives research funding from the Australian Government as an Australian Research Council Discovery Early Career Researcher Award fellow, under grant number DE190100158, and she has received travel, accommodation and conference registration support from GSK and speaker's fees from Merck. Suzanne Suggs served on a European Vaccine Advisory Board, advising on communication and behaviour, and was a consultant on communication and behavioural aspects of HPV vaccine acceptance in Switzerland for MSD in 2019. Angus Thomson was employed by Sanofi Pasteur at the time of the meeting and held company shares/stock options. None of the other authors have additional potential conflicts of interest to declare.

Acknowledgements

The authors would like to thank all of the participants for their contributions during the meeting. They would also like to thank the staff at the 'Les Pensières Center for Global Health' for their logistical support. The authors acknowledge medical writing and editorial support from Margaret Haugh, MediCom Consult, Villeurbanne, France.

References

- Attwell K, Navin M. Childhood vaccination mandates: scope, sanctions, severity, selectivity, and salience. *Milbank Q* 2019;97(4):978–1014.
- Attwell K, Navin MC, Lopalco PL, Jestin C, Reiter S, Omer SB. Recent vaccine mandates in the United States, Europe and Australia: a comparative study. *Vaccine* 2018a;36(48):7377–84.
- Attwell K, Ward PR, Meyer SB, Rokkas PJ, Leask J. "Do-it-yourself": Vaccine rejection and complementary and alternative medicine (CAM). *Soc Sci Med* 2018b;196:106–14.
- Attwell K, Dube E, Gagneur A, Omer SB, Suggs LS, Thomson A. Vaccine acceptance: science, policy, and practice in a 'post-fact' world. *Vaccine* 2019;37(5):677–82.
- Behavioural Insights Team. The MINDSPACE report. 2010 Available from: <https://www.bi.team/publications/mindspace/>. [Accessed 26 May 2020].
- Behavioural Insights Team. EAST: four simple ways to apply behavioural insights. 2012 Available from: https://www.bi.team/wp-content/uploads/2015/07/BI-Publication-EAST_FA_WEB.pdf. [Accessed 26 May 2020].
- Bradford WD, Mandich A. Some state vaccination laws contribute to greater exemption rates and disease outbreaks in the United States. *Health Aff (Millwood)* 2015;34(8):1383–90.
- Brewer NT, Chapman GB, Rothman AJ, Leask J, Kempe A. Increasing vaccination: putting psychological science into action. *Psychol Sci Public Interest* 2017;18(3):149–207.
- Broniatowski DA, Jamison AM, Qi S, Alkulaib L, Chen T, Benton A, et al. Weaponized health communication: twitter bots and Russian trolls amplify the vaccine debate. *Am J Public Health* 2018;108(10):1378–84.
- Carlson SJ, Scanlan C, Marshall HS, Blyth CC, Macartney K, Leask J. Attitudes about and access to influenza vaccination experienced by parents of children hospitalised for influenza in Australia. *Vaccine* 2019;37(40):5994–6001.
- CDC. State vaccination requirements. 2016 Available from: <https://www.cdc.gov/vaccines/imz-managers/laws/state-reqs.html>. [Accessed 26 May 2020].
- Cella P, Voglino G, Barberis I, Alagna E, Alessandrini C, Cuda A, et al. Resources for assessing parents' vaccine hesitancy: a systematic review of the literature. *J Prev Med Hyg* 2020;61(3):E340–73.

- Delamater PL, Pingali SC, Buttenheim AM, Salmon DA, Klein NP, Omer SB. Elimination of nonmedical immunization exemptions in California and school-entry vaccine status. *Pediatrics* 2019;143(6).
- Deml MJ, Notter J, Kliem P, Buhl A, Huber BM, Pfeiffer C, et al. "We treat humans, not herds!": a qualitative study of complementary and alternative medicine (CAM) providers' individualized approaches to vaccination in Switzerland. *Soc Sci Med* 2019;240:112556.
- Dubé E, Leask J, Wolff B, Hickler B, Balaban V, Hosein E, et al. The WHO Tailoring Immunization Programmes (TIP) approach: review of implementation to date. *Vaccine* 2018;36(11):1509–15.
- Dunn AG, Surian D, Leask J, Dey A, Mandl KD, Coiera E. Mapping information exposure on social media to explain differences in HPV vaccine coverage in the United States. *Vaccine* 2017;35(23):3033–40.
- Eddy M. The New York Times: Germany mandates measles vaccine. 2019 Available from: <https://www.nytimes.com/2019/11/14/world/europe/germany-measles-vaccine.html>. [Accessed 26 May 2020].
- Fondation Merieux. Meeting report: Re-invigorating immunisation policy. Available from: <https://www.globe-network.org/sites/default/files/documents/public/resources/conferences/2011/re-invigorating-immunisation-policy-implementation-and-success-from-parent-to-partner-and-from-broad-cast-to-engagement/report-re-invigorating-immunisation-policy.pdf>. [Accessed 26 May 2020].
- French Government. Vaccination coverage is increasing significantly in France | La couverture vaccinale est en nette augmentation en France. 2019 Available from: <https://www.gouvernement.fr/la-couverture-vaccinale-est-en-nette-augmentation-en-france>. [Accessed 26 May 2020].
- Gagneur A, Lemaitre T, Gosselin V, Farrands A, Carrier N, Petit G, et al. A postpartum vaccination promotion intervention using motivational interviewing techniques improves short-term vaccine coverage: PromoVac study. *BMC Public Health* 2018;18(1):811.
- Gagneur A, Battista MC, Boucher FD, Tapiero B, Quach C, De Wals P, et al. Promoting vaccination in maternity wards horizontal line motivational interview technique reduces hesitancy and enhances intention to vaccinate, results from a multicentre non-controlled pre- and post-intervention RCT-nested study, Quebec, March 2014 to February 2015. *Euro Surveill* 2019a;24(36).
- Gagneur A, Gosselin V, Bergeron J, Farrands A, Baron G. Development of motivational interviewing skills in immunization (MISI): a questionnaire to assess MI learning, knowledge and skills for vaccination promotion. *Hum Vaccin Immunother* 2019b;15(10):2446–52.
- Habersaat KB, Jackson C. Understanding vaccine acceptance and demand—and ways to increase them. *Bundesgesundheitsblatt Gesundheitsforschung Gesundheitschutz* 2020;63(1):32–9.
- Institute for Government. MINDSET: influencing behaviour through public policy. 2010 Available from: <https://www.instituteforgovernment.org.uk/sites/default/files/publications/MINDSPACE.pdf>. [Accessed 26 May 2020].
- International Pediatric Association. IPA vaccine trust project. 2018 Available from: <https://ipa-world.org/ipa-vaccine-trust-project.php>. [Accessed 13 January 2021].
- Karras J, Dube E, Danchin M, Kaufman J, Seale H. A scoping review examining the availability of dialogue-based resources to support healthcare providers engagement with vaccine hesitant individuals. *Vaccine* 2019;37(44):6594–600.
- Kata A. Anti-vaccine activists, Web 2.0, and the postmodern paradigm—an overview of tactics and tropes used online by the anti-vaccination movement. *Vaccine* 2012;30(25):3778–89.
- Kaufman J, Attwell K, Hauck Y, Omer SB, Danchin M. Vaccine discussions in pregnancy: interviews with midwives to inform design of an intervention to promote uptake of maternal and childhood vaccines. *Hum Vaccin Immunother* 2019;15(11):2534–43.
- Kaufman J, Attwell K, Tuckerman J, O'Sullivan J, Omer SB, Leask J, et al. Feasibility and acceptability of the multi-component P3-MumBubVax antenatal intervention to promote maternal and childhood vaccination: a pilot study. *Vaccine* 2020;38(24):4024–31.
- Kazi AM, Ahsan N, Khan A, Jamal S, Kalimuddin H, Ghulamhussain N, et al. Personalized text messages and automated calls for improving vaccine coverage among children in Pakistan: protocol for a community-based cluster randomized clinical trial. *JMIR Res Protoc* 2019;8(5):e12851.
- Kids Boost Immunity. Kids Boost Immunity. 2020 Available from: <https://kidsboostimmunity.com/>. [Accessed 26 May 2020].
- Kruk ME, Myers M, Varpilah ST, Dahn BT. What is a resilient health system? Lessons from Ebola. *Lancet* 2015;385(9980):1910–2.
- Lemaitre T, Carrier N, Farrands A, Gosselin V, Petit G, Gagneur A. Impact of a vaccination promotion intervention using motivational interview techniques on long-term vaccine coverage: the PromoVac strategy. *Hum Vaccin Immunother* 2019;15(3):732–9.
- Malo TL, Hall ME, Brewer NT, Lathren CR, Gilkey MB. Why is announcement training more effective than conversation training for introducing HPV vaccination? A theory-based investigation. *Implement Sci* 2018;13(1):57.
- McCoy CA. Adapting coercion: how three industrialized nations manufacture vaccination compliance. *J Health Polit Policy Law* 2019;44(6):823–54.
- MSSS. Motivational interviewing in maternity wards for infant vaccination) Entretien Motivationnel en Maternité pour l'Immunisation des Enfants (EMMIE). 2019 Available from: <https://www.msss.gouv.qc.ca/professionnels/vaccination/programme-d-entretien-motivationnel-en-maternite-pour-l-immunisation-des-enfants-emmie/>. [Accessed 26 May 2020].
- Navin MC, Attwell K. Vaccine mandates, value pluralism, and policy diversity. *Bioethics* 2019;33(9):1042–9.
- Olson O, Berry C, Kumar N. Addressing parental vaccine hesitancy towards childhood vaccines in the United States: a systematic literature review of communication interventions and strategies. *Vaccines* 2020;8(4).
- Omer SB, Pan WK, Halsey NA, Stokley S, Moulton LH, Navar AM, et al. Nonmedical exemptions to school immunization requirements: secular trends and association of state policies with pertussis incidence. *JAMA* 2006;296(14):1757–63.
- Omer SB, Enger KS, Moulton LH, Halsey NA, Stokley S, Salmon DA. Geographic clustering of nonmedical exemptions to school immunization requirements and associations with geographic clustering of pertussis. *Am J Epidemiol* 2008;168(12):1389–96.
- Omer SB, Richards JL, Ward M, Bednarczyk RA. Vaccination policies and rates of exemption from immunization, 2005–2011. *N Engl J Med* 2012;367(12):1170–1.
- Omer SB, Allen K, Chang DH, Guterman LB, Bednarczyk RA, Jordan A, et al. Exemptions from mandatory immunization after legally mandated parental counseling. *Pediatrics* 2018;141(1).
- Omer SB, Betsch C, Leask J. Mandate vaccination with care. *Nature* 2019;571(7766):469–72.
- Ozawa S, Portnoy A, Getaneh H, Clark S, Knoll M, Bishai D, et al. Modeling the economic burden of adult vaccine-preventable diseases in the United States. *Health Aff (Millwood)* 2016;35(11):2124–32.
- Ozawa S, Yemeke TT, Evans DR, Pallas SE, Wallace AS, Lee BY. Defining hard-to-reach populations for vaccination. *Vaccine* 2019;37(37):5525–34.
- Pingali SC, Delamater PL, Buttenheim AM, Salmon DA, Klein NP, Omer SB. Associations of statewide legislative and administrative interventions with vaccination status among kindergartners in California. *JAMA* 2019;322(1):49–56.
- Reuters. Samoa declares state of emergency over deadly measles epidemic. 2019 Available from: <https://www.theguardian.com/world/2019/nov/17/samoa-declares-state-of-emergency-over-deadly-measles-epidemic>. [Accessed 26 May 2020].
- Reuters. Samoa ends measles state of emergency as infection rate slows. 2019 Available from: <https://www.theguardian.com/world/2019/dec/29/samoa-ends-measles-state-of-emergency-as-infection-rate-slows>. [Accessed 26 May 2020].
- Stadlin S, Bednarczyk RA, Omer SB. Medical exemptions to school immunization requirements in the United States—association of state policies with medical exemption rates (2004–2011). *J Infect Dis* 2012;206(7):989–92.
- Thaler RH, Sunstein CR. *Nudge: improving decisions about health, wealth, and happiness*. United States: Yale University Press; 2008.
- Thomson A, Vallee-Tourangeau G, Suggs LS. Vaccine hesitancy: towards a better understanding of drivers and barriers to awareness, acceptance and activation. 2018 Available from: <https://www.sciencedirect.com/journal/vaccine/vol/36/issue/44>. [Accessed 26 May 2020].
- Thornton J. In the aftermath: the legacy of measles in Samoa. *Lancet* 2020;395(10236):1535–6.
- Vaccination Acceptance Research Network (VARN). VARN Call for action. 2019 Available from: <https://vaccineacceptance.org/>. [Accessed 22 December 2020].
- Vaccination Demand Hub. Vaccination Demand Hub. Available from: The vaccination demand hub; 2021. <https://www.demandhub.org>.
- Vaccine Safety Net (VSN). VSN network and members. 2020 Available from: <https://www.vaccinesafetynet.org/vsn/network>. [Accessed 22 December 2020].
- van den Berg M, Ogutu B, Sewankambo NK, Merten S, Biller-Andorno N, Tanner M. Clinical trials in low-resource settings: the perspectives of caregivers of paediatric participants from Uganda, Tanzania and Kenya. *Trop Med Int Health* 2019;24(8):1023–30.
- Vaz OM, Ellingson MK, Weiss P, Jenness SM, Bardaji A, Bednarczyk RA, et al. Mandatory vaccination in Europe. *Pediatrics* 2020;145(2).
- Vosoughi S, Roy D, Aral S. The spread of true and false news online. *Science* 2018;359(6380):1146–51.
- Ward JK, Peretti-Watel P, Bocquier A, Seror V, Verger P. Vaccine hesitancy and coercion: all eyes on France. *Nat Immunol* 2019;20(10):1257–9.
- Wardle J, Frawley J, Steel A, Sullivan E. Complementary medicine and childhood immunisation: a critical review. *Vaccine* 2016;34(38):4484–500.
- World Health Organisation. Vaccine Safety Net. Available from: 2003. www.vaccinesafetynet.org.
- World Health Organisation. 2017 assessment report of the Global Vaccine Action Plan Strategic Advisory Group of Experts on Immunization. Geneva: WHO; 2017.
- World Health Organisation. South-East Asia Regional Immunization Technical Advisory Group (SEARITAG) meeting report. New Delhi: World Health Organisation, Regional Office for South-East Asia; 2017.
- World Health Organisation. Measles – Pacific Island Countries and Areas. 2019 Available from: <https://www.who.int/csr/don/15-december-2019-measles-pacific-island-countries-and-areas/en/>. [Accessed 26 May 2020].
- World Health Organisation. Ten threats to global health in 2019. 2019 Available from: <https://www.who.int/emergencies/ten-threats-to-global-health-in-2019>. [Accessed 26 May 2020].
- World Health Organisation. Vaccine misinformation: statement by WHO Director-General on Facebook and Instagram. 2019 Available from: <https://www.who.int/news-room/detail/04-09-2019-vaccine-misinformation-statement-by-who-director-general-on-facebook-and-instagram>. [Accessed 26 May 2020].
- World Health Organisation. Improving vaccination demand and addressing hesitancy. 2020 Available from: http://awareness.who.int/immunization/programmes_systems/vaccine_hesitancy/en/. [Accessed 13 January 2021].