

THE SABIN-ASPEN
**VACCINE SCIENCE
& POLICY GROUP**



Foreword by Harvey V. Fineberg and Shirley M. Tilghman

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THE SABIN-ASPEN VACCINE SCIENCE & POLICY GROUP



ABOUT THE SABIN-ASPEN VACCINE SCIENCE & POLICY GROUP

The Sabin-Aspen Vaccine Science & Policy Group brings together senior leaders across many disciplines to examine some of the most challenging vaccine-related issues and drive impactful change. Members are influential, creative, out-of-the-box thinkers who vigorously probe a single topic each year and develop actionable recommendations to advance innovative ideas for the development, distribution, and use of vaccines, as well as evidence-based and cost-effective approaches to immunization.

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May 2020

We are pleased to introduce the second annual report of the Sabin-Aspen Vaccine Science & Policy Group: *Meeting the Challenge of Vaccination Hesitancy*. The package of “big ideas” presented here, and the rigorous evidence and consensus-driven insights on which they rest, reassure us that smart strategies are available not only to maintain, restore, and strengthen confidence in the value of vaccines, but also to underscore the broad societal obligation to promote their use.

Implementing those strategies requires concerted commitment, and we are deeply grateful to the members of the Vaccine Science & Policy Group, who have helped us identify pathways to progress. Co-chairing the Vaccine Science & Policy Group are Harvey V. Fineberg, president of the Gordon and Betty Moore Foundation, and Shirley M. Tilghman, president emerita and professor of molecular biology and public affairs at Princeton University. They are joined by 22 remarkable individuals drawn from the ranks of government, industry, and advocacy—both within the U.S. and globally—whose cross-disciplinary knowledge includes public health and regulatory science, philanthropy and venture capital, biotechnology, ecology, ethics, and journalism. Our appreciation for their dedication, talent, and wisdom runs deep. Thanks, too, are owed to the Bill & Melinda Gates Foundation—without its support, this year’s convening and publication would not have been possible—and to FluLab, the launch funder of the Vaccine Science & Policy Group.

Equally important is the rich partnership that has been forged between the Sabin Vaccine Institute, with its decades of vaccine science and global immunization expertise, and the Aspen Institute’s Health, Medicine and Society Program, with its extraordinary convening power. Both organizations have a long track record of engaging in non-partisan, cross-disciplinary dialogue that helps to meet the greatest challenges facing society. We are proud of the synergy we have built together and thankful for the opportunity all of us have had to learn from one another.

The strength and credibility of our collaboration has already been reflected in the positive response to our inaugural report, *Accelerating the Development of a Universal Influenza Vaccine*, issued in July 2019. We are confident that this current report will also generate welcome attention from policymakers, immunization leaders, researchers, and journalists—and contribute to lifesaving advances in the use of vaccines.

A handwritten signature in black ink that reads "Dan Porterfield".

Dan Porterfield
President and Chief Executive Officer
The Aspen Institute

A handwritten signature in black ink that reads "Amy Finan".

Amy Finan
Chief Executive Officer
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Shirley M. Tilghman, Ph.D.
Co-Chair



Harvey V. Fineberg, M.D., Ph.D.
Co-Chair

FOREWORD

Nothing in recent memory has underscored the urgency of a strong vaccine enterprise more than COVID-19, the coronavirus that struck with such force in early 2020. While development of an effective vaccine to control the resulting pandemic is likely at least a year away, the danger of infectious diseases has been made shockingly real across the globe, and the gift of effective immunization has once again become apparent.

Yet COVID-19 arrived at a time when hesitancy about long-established vaccines has become a real and present danger. Although vaccination remains a well-accepted social norm worldwide, a combination of factors—including misinformation spread on social media; decreased trust in institutions including government, science, and industry; and weaknesses within health systems—has emerged to diminish confidence among some populations.

As co-chairs of the Sabin-Aspen Vaccine Science & Policy Group (the Group), we recognize a profound responsibility to bring forward an innovative plan to strengthen vaccine acceptance and tame the risk of hesitancy. In September 2019, the 22 highly distinguished members of the Group gathered for their second annual meeting at the Aspen Institute's campus in Aspen, Colorado, where they spent 2-1/2 days exploring this issue. We are truly grateful to

this able team of leaders, who represent both domestic and global perspectives and bring professional experience across a wide range of disciplines to our convening. They have been exceptionally generous with their time and talent.

Their vigorous discussions, informed by background research papers and expert presentations, generated three “big ideas” for addressing vaccine hesitancy and promoting the critical importance of timely immunization. These ideas—as well as the principal findings that support them and an evidence-based review of the challenges to vaccine acceptance—are presented in the Group’s consensus paper that opens this compendium, *Getting Back on Track: Restoring Vaccine Confidence and Confirming Vaccination as a Social Norm*.

The commissioned papers included here are frank in exploring the potential barriers to vaccine acceptance and bold in the solutions they identify:

- *The Challenge of Vaccination Hesitancy and Acceptance: An Overview*, by Arthur Allen and Robb Butler
- *What Do We Know About Movement Emergence and Success?* by Doug McAdam
- *What Works to Increase Vaccination Uptake*, by Noel T. Brewer
- *The Complex Contagion of Doubt in the Anti-Vaccine Movement*, by Damon Centola
- *Online Misinformation about Vaccines*, by Renée DiResta and Claire Wardle

This body of work clarifies many of the reasons for vaccine hesitancy, including the tempting retreat to the perceived safety of inaction; considers how social movements emerge and succeed and how to build such a movement to broaden vaccine acceptance; and examines the value of activities that foster behavior change to drive vaccine use.

The three big ideas that emerged from the Group’s dialogue are to: create a new collaborative partnership between the vaccination community and social media platforms; develop a prioritized research agenda to generate much needed knowledge about sources of vaccine hesitancy and the evidence to inform the most effective mechanisms to counter it; and craft a strategy to shift

This body of work clarifies many of the reasons for vaccine hesitancy, including the tempting retreat to the perceived safety of inaction.

the conversation around immunization to one that focuses on its many benefits. Together, these ideas address the primary barriers to vaccine acceptance and provide a framework for progress.

Our work does not end with the publication of this report. We are committed to sharing these big ideas through the rich networks of the Group, the Sabin Vaccine Institute, the Aspen Institute, and our many partners, and advocating for strategies that will turn them into action. Through these efforts, the Sabin Institute carries on the legacy of Albert B. Sabin, M.D., whose oral polio vaccine helped drive polio to the brink of extinction. We build, too, on the Aspen Institute's Health, Medicine and Society Program's stellar tradition of advancing changes that can improve the health of individuals, families, communities, the nation, and the world.

Along with our dedicated members, we are especially grateful to our funder, the Bill & Melinda Gates Foundation, which understood the urgency of combatting vaccine hesitancy and gave us the support so essential to doing so. The teams at Sabin and at the Health, Medicine, and Society Program are deeply committed to this initiative, and offer leadership, insight, and attention to detail.

Together, we can overcome the risks posed by vaccine hesitancy and ensure continued and widening support for one of the most powerful tools ever developed to protect public health.



Harvey V. Fineberg, M.D., Ph.D.
Co-chair



Shirley M. Tilghman, Ph.D.
Co-chair

Part 1

SABIN-ASPEN VACCINE SCIENCE & POLICY GROUP REPORT

Getting Back on Track: Restoring Vaccine Confidence and
Confirming Vaccination as a Social Norm

GETTING BACK ON TRACK

Vaccination, a keystone of public health throughout the world, faces a growing challenge of confidence. Parents and caregivers in many countries have doubts about the safety or value of vaccination (Facciola et al., 2019), and in some communities this breakdown in trust has resulted in vaccine rejection and delays that leave large groups of children vulnerable to sickness and death from vaccine-preventable illnesses. The World Health Organization (WHO) defines vaccine hesitancy as a “delay in acceptance or refusal of vaccines despite availability of vaccination services” (WHO, 2014) and in 2019 declared it one of 10 threats to global health (WHO, 2019d).

Lower-than-optimal vaccination rates arise from a variety of problems, including vaccine shortages, restrictions in the convenience and affordability of vaccines, diminished confidence in government authority structures, and ironically, the very success of vaccines in making vaccine-preventable illnesses less common and

feared. Because the dimensions of hesitancy are complex and not fully understood, the medical and public health communities and their allies must rapidly expand their understanding of the problem and the actions needed to address it. A global resurgence of measles since 2018 has underscored the pressing need to bolster vaccine acceptance (“Vaccine hesitancy: A generation at risk,” 2019).

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Vaccines are a remarkably safe and effective method of preventing deadly and disabling infectious diseases. With the assistance of governments, international and non-profit organizations, healthcare providers, researchers, and community immunizers, vaccination programs have expanded to protect a significant majority of the world’s population against diseases ranging from polio and tetanus to meningitis and pneumonia. Vaccines save some two to three million lives every year (WHO, 2020).

But millions of children—especially but not exclusively those living in areas of conflict and poverty—still miss out on lifesaving vaccines because of a lack of access. Despite the ample base of reassuring evidence behind it, vaccination requires an ongoing, high degree of social confidence and trust in the system that delivers it—including discovery and development;

manufacturing and distribution; and the clinic, nurse, or traveling vaccinator who administers the vaccines—as well as monitoring to ensure that when used broadly in the population, vaccines perform as expected.



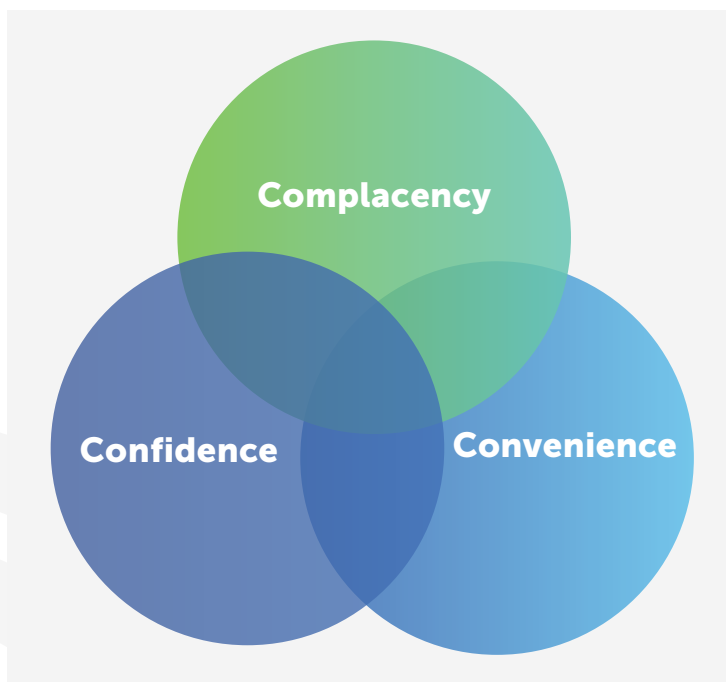
The Sabin-Aspen Vaccine Science & Policy Group (the Group) met at the Aspen Institute in Colorado in September 2019 to examine the trends and drivers of vaccination acceptance and devise approaches to counter the growing trend of hesitancy. Over 3 days, the Group heard from individuals with relevant expertise, including pediatricians with direct experience trying to effectively communicate with parents; officials from global vaccination organizations such as the WHO, UNICEF, the Bill & Melinda Gates Foundation, and the U.S. Centers for Disease Control and Prevention (CDC); scholars in the social and behavioral sciences; and experts on social media. These discussions led to a clear recognition of three points: (1) vaccination levels, after reaching record heights, have plateaued or even declined slightly in many countries (Paules, Marston, & Fauci, 2019); (2) various factors have undermined confidence in or contributed to complacency about vaccination (Wellcome Global Monitor, 2019); and (3) the vaccination enterprise needs new knowledge and tools to overcome challenges to vaccine acceptance.

FRAMING THE CHALLENGE

Vaccination rates are a key indicator of the strength of a country’s health care system. Globally, vaccination is a success and has been established as a norm throughout the world. One indicator—coverage with three doses of the diphtheria, tetanus, and pertussis (DTP) vaccine—reached 86% of the world’s children in 2018, up from 72% in 2000 and 20% in 1980. Another indicator is measles—a highly contagious infection that can be effectively prevented with two doses of a vaccine that has a long track record of safety and effectiveness—which declined 80% worldwide from 2000 to 2018, saving some 23 million lives. However, in some areas of the developed (Iacobucci, 2019; Paules et al., 2019) and developing worlds (WHO, 2019c), vaccination rates have fallen, setting up the potential for outbreaks.

The potentially catastrophic impact of a loss in confidence in vaccination is nowhere more evident than in the tiny Pacific island nation of Samoa, where a 2019–20 measles epidemic killed 83 people, mostly small children, and sickened more than 5,700 out of a total population of 200,000. The epidemic arose amid a crisis in vaccination confidence sparked by the deaths of two children who had received measles, mumps, and rubella (MMR) vaccines erroneously mixed with muscle relaxant instead of water (Clarke, 2019). Local

The 3 C’s of Vaccine Hesitancy: Confidence, Complacency, and Convenience



vaccine skeptics, supported by foreign activists, helped fuel mistrust, contributing to a dismal 31% vaccination rate before the epidemic caught fire (Knowles, 2019).

Human errors such as the one that contributed to the Samoa tragedy directly affect confidence in vaccination programs and acceptance of vaccines, but mistakes of this severity are rare. Meanwhile, access problems—such as low-quality services, poorly designed vaccination campaigns, temporary vaccine shortages, and inconvenient vaccination hours—can stymie even the best-intentioned parents and lead the skeptical, ill-informed,

Source: World Health Organization, 2014; Report of SAGE.

or indifferent to avoid bringing children in for vaccination. A 2014 report by the WHO's Strategic Advisory Group of Experts identified the elements of vaccine hesitancy broadly as convenience, confidence, and complacency (WHO, 2014).

In a world where parents face many challenges in caring for their children, the importance of making vaccination easily accessible can't be overstated. The circulation of false information about vaccines, when combined with faltering trust in the institutions that deliver them, undercuts confidence in vaccination. In places where vaccination, and medicine in general, have lowered the deadliest risks of vaccine-preventable infectious disease, vaccination can come to seem less pressing. Such complacency stands in contrast to incidents such as the novel coronavirus (COVID-19) pandemic, in which the deadly threat of an infectious disease is all too real and immediate, leading to urgent and widespread calls to develop and deploy a vaccine rapidly.

The value of vaccination speaks for itself to those who understand the historical decline of the targeted diseases, but vaccines and vaccination have long attracted skepticism and generated conspiracy theories (Colgrove, 2006). Unlike climate change and evolutionary theory—other areas where noisy polemics have engendered challenges to scientific fact—vaccination is a tangible and personal issue for every family. As with any complex subject, many people continue to rely on surrogate authority figures to inform their decisions. But in the information age, the internet and social media have brought crushing waves of vaccine misinformation to new parents, raising doubts among enormous groups of people who previously might have been unaware of any “controversy” over this eminently sensible activity.

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There are documented instances where misinformation has directly led to falling vaccine uptake; the publication of fraudulent evidence linking the MMR vaccine to autism, which contributed to a global measles epidemic, is the classic example (Paules et al., 2019). Yet the extent to which misinformation contributes to declines in vaccination is not always clear, in part because comprehensive data describing which communities are under-vaccinated, and why, is lacking.

This hampers an effective response to both the misinformation and the disease. A polarized, politicized, post-fact environment has an undeniable impact both on trust and

on vaccinations. But demand problems may also reflect poor experiences in the clinics of a failing public health system or real or perceived failures in immunization safety. Access, rather than demand problems—ranging from wars and refugee movements to limited clinic hours for two-job parents—can be a further cause of vaccination gaps that officials misattribute to parental hesitation.

While acknowledging these many challenges, the Group’s deliberations focused on improving demand for vaccines. The Group examined findings on why people accept or delay vaccines, or reject them altogether, and explored ways to shape education, communication, and methods of behavioral change to maintain vaccination as a social norm. It also discussed strategies to counter misinformation as it arises in different contexts.

| Trust: Community Immunity Versus Herd Mentality

Trust in vaccination depends not only on the nurse, doctor, or mobile team that administers the vaccine, but also on the authorities who enable and drive vaccination. Thus, vaccine uptake may be threatened in any country, region, or community where there is waning confidence in the government, doctors, or public health officials who recommend, oversee, and mandate vaccination, as Muhammad Ali Pate of the World Bank told the Group. In countries such as Nigeria, Sudan, Afghanistan, and Congo, conflicts and gravely polarized societies have led entire groups to identify vaccinators and their mission with their foes, and



therefore to consider them untrustworthy (Hussain, Boyle, Patel, & Sullivan, 2016). Scores of vaccinators have lost their lives while on the job in these countries (Smith, 2014)—including 95 in Pakistan alone since 2012 (Janjua, 2019). In countries where corruption and violence have created fear, mistrust, or open opposition to government-endorsed vaccination programs, the problem of trust may extend beyond the scope of vaccination policy. That said, public health authorities have managed to convince warring parties in countries such as El Salvador and Colombia in the 1980s, and more recently in Yemen, to give safe passage to vaccination teams (Ferguson, 2019).

Outside regions of conflict, similar trust issues arise in close-knit, semi-autonomous communities that tend to access information through more restricted sources. In some tribal regions in India, for example, a history of neglect has lowered confidence in government-run vaccination programs unless they employ local healers (Priya, Pathak, & Giri, 2020). In the United States, outbreaks of vaccine-preventable diseases have been reported among Amish (Gastañaduy et al., 2018), Somali immigrant (Dyer, 2017), and Orthodox Jewish communities (McDonald et al., 2019) in recent years—not because their religious beliefs or cultural practices are inclined against vaccination, but rather because influential individuals became lightning rods for the spread of anti-vaccine misinformation. Anti-vaccine groups can make inroads through such leaders; by the same token, leaders who are immune to such propaganda can reassure followers and tamp down the influence of falsehoods. During the 2018–19 measles epidemic, vaccine refusal spread quickly through certain Hasidic communities in New York, but an influential rabbi prevented other outbreaks in the area by speaking out for the value of vaccination (Boodman, 2019b).



Decades of assiduous vaccination campaigns have created herd immunity—where the percentage of a population immune to a disease is high enough to prevent its spread—in most U.S. communities, even during the 2018–19 measles epidemic. Smaller pockets of non-vaccinating families were often sheltered within larger, more fully vaccinated populations that kept out disease. However, because of its extreme contagiousness, immunization rates against measles must remain above 95% to provide this community-level protection, which is at risk in many U.S. communities. In

July 2019, Colorado reported that only 87.4% of its kindergartners had documented measles vaccination (Staver, 2019), well below the threshold for preventing an epidemic. In countries such as France and the United Kingdom—as well as Ukraine and Pakistan—the lack of herd immunity has enabled measles outbreaks in broad swaths of the population.

| Social Networks and Social Norms

Developing strategies to counter vaccine hesitancy will require the public health community to engage with new disciplines, especially from the social and behavioral sciences, and to improve its communication strategies, building on a base of expanded research into the nature and volume of the hesitancy problem. While the WHO has labeled hesitancy

as a global threat, public health officials lack clear ways to measure it, assess upward or downward trends or their causes, or predict the social and cultural factors that shape hesitancy and how best to counter them.

Work in areas such as behavioral economics and cognitive psychology indicates that people frequently base difficult decisions less on rational processes than values and heuristics—that is, on cognitive shortcuts. The current peril in which vaccination programs find themselves results from the interaction of these basic human foibles with false and misleading information carried on massive social media platforms (DiResta & Wardle, this volume). What’s dangerous about widely broadcast vaccine debates, in a sense, is the debate itself: by putting out misleading information to people with little fundamental understanding of the performance and value of vaccines, the anti-vaccine movement and its social media echo chambers create doubt when, in fact, there is not a true scientific debate (Ropeik, 2013).

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Sociologist Damon Centola (2019) describes anti-vaccine sentiment as a “complex contagion” that requires reinforcement by multiple social peers to reinforce its legitimacy. This process takes place in real and virtual communities when people who don’t understand an issue wait for a subset of their peers to respond to it. Once ideas and images that aren’t supported by the weight of evidence have become accepted parts of a “controversy,” it legitimizes the notion that vaccines may be harmful and creates a bias toward inaction. People in general feel a greater moral responsibility for any harm that comes about through something they have done than for a task they have neglected, and the hypothesized harm from vaccination may appear more immediate than the danger of the pathogens against which vaccines protect. Depending on a person’s awareness of the diseases and confidence in the vaccination enterprise, a vaccination decision may be tilted toward “better safe than sorry” because individuals discount the future benefit of vaccination. Beyond that fundamental decision, external factors that impinge on behavior, such as convenience, incentives, costs, and mandates, also affect vaccination decision-making.

Since 2018, the Global Demand Hub—an international effort involving UNICEF, the WHO, GAVI, the Vaccine Alliance, and other organizations—has worked to improve coordination across the global immunization community. It has been sharing best practices, including gathering data on vaccine demand and hesitancy in low- and middle-income countries in

order to use this knowledge to nudge and support national programs (VaccinesToday, 2019). The Demand Hub also has begun to engage with social media companies to examine the vaccine-related content of searches and conversations.

The group hopes to anticipate problems with vaccine confidence, such as the collapse in measles vaccination in the Philippines after a dengue virus vaccination campaign was suspended. The suspension occurred after children vaccinated during the campaign died, some of them possibly as a result of complex immune responses to the vaccine and subsequent dengue infection (Wilder-Smith, Flasche, & Smith, 2019). The Demand Hub is also focused on the ongoing global polio eradication campaign. While the latter has successfully eradicated wild Type 2 and Type 3 polio strains, its endgame increasingly involves battling outbreaks linked to mutant viruses from the live attenuated polio vaccine and the communication challenges that surround this phenomenon.

| The Mechanization of Doubt

Changes in how people gather and digest science and health information have fed vaccination hesitancy. As local and regional newspapers disappear, internet sites of varying intent and quality provide an increasing percentage of the public's news intake. While newspapers once presented a relatively unitary—and therefore unifying—version of basic political and health facts, the internet fragments information. Search engines and social media companies target readers based on their previous selections under the assumption that they will click on information that interests them already, or perhaps, that confirms their biases (Del Vicario, Scala, Caldarelli, Stanley, & Quattrocioni, 2017; DiResta, 2018).



While news coverage has always trended toward topics that stimulate fear, doubt, outrage, and polarizing attitudes, journalistic principles of fairness and accuracy, if unevenly achieved, have had a salutary impact on the presentation of health news. A recent survey found that those who rely on social media for news are far more likely than traditional media consumers to be misinformed about the safety of vaccines (Stecula, Kuru, & Jamieson, 2020). This is part of a larger problem of bias confirmation among consumers of social media (Self, 2016).

Anti-vaccine activists, small in number but robust and enduring, can draw on wellsprings of mythology and unease that go back centuries, revolving around ideas of purity and bodily integrity; distrust of science, industry, government, and media; and compelling accounts of childhood injury that parents blame on vaccines (Allen, 2007). For decades, public health essentially ignored the anti-vaccine movement and its theories, concentrating on presenting facts and fact-based information in response to any unsubstantiated theories of harm. But while the core of the movement remains small, the internet and social media allow its ideas to circulate much more broadly than in the past.

Foes of the vaccination enterprise generate fear by claiming that vaccines don't work as well as they are portrayed, contain harmful ingredients, or trigger pathologic processes leading to long-term physical and mental health problems, such as asthma, diabetes, and autism spectrum disorders. Some even claim that vaccines have been intentionally laced with ingredients that cause cancer or infertility. Anti-vaccine communications inevitably include testimony from people whose children have diseases or conditions allegedly brought on by vaccination. Since these maladies infrequently occur during a child's development, such assertions can trigger doubt about the safety of vaccines, leading to inaction or resistance.

Proponents of vaccination have generally been unable to resort to the same tactics when describing the risks of vaccine-preventable illness because vaccinations' very success has greatly diminished outbreaks of disease that would otherwise have provided fodder for powerful messages. Thus, the emotional battlefield is asymmetric—on the one hand, naive parents see serious infirmities that loud voices attribute to vaccines, while on the other, they hear gentle admonitions to continue a procedure whose benefits may be nearly invisible. Public health scientists have demonstrated little expertise in creating stories that generate emotion and engage popular attention, and vaccine foes have manipulated internet search engines to steer people toward false information—in the United States and Europe, as well as in Pakistan, the Philippines, Brazil, Egypt, India, and Nigeria (DiResta & Wardle, this volume).

In the past, social media and search engines generally ranked sites by popularity rather than any evaluation of their worth, meaning parents seeking information about vaccines for the first time were likely to encounter distorted information about their safety before arriving at reliable sources

(Centola, 2019). In addition, anti-vaccine activists on social media have found ways to

Anti-vaccine activists on social media have found ways to expand their constituency by reaching out to groups with other unconventional, paranoid, or conspiratorial beliefs.

expand their constituency by reaching out to groups with other unconventional, paranoid, or conspiratorial beliefs. As the California legislature moved to tighten restrictions on vaccine exemptions in 2015, for example, anti-vaccine activists repeatedly changed their messaging to attract people interested in tangential controversies and theories, as internet researcher Renee DiResta has reported (DiResta & Lotan, 2015).

Although their contribution to U.S. anti-vaccine messages is small, there are examples of Russian internet activists posting critical comments on social media from “both sides” of the vaccination “debate,” apparently with the intention of sowing further divisiveness in Western societies (Jenco, 2018). However, revelations about the clandestine use of social media to sway audiences, including the massive Russian campaign against the 2016 U.S. presidential election, have led social media companies to begin trying to limit the influence of disinformation on their platforms. Companies such as Facebook, Twitter, YouTube, and Google have recently devoted more resources to nudge viewers toward science-based health information. They have changed the way they present information on vaccination to highlight more legitimate sources, but do not ban or earmark verifiably false information (DiResta & Wardle, this volume; Schiff, 2019).

| Communication and Education

Research is under way to assess how people encounter and evaluate sources of vaccine information and to test communication strategies in different settings. This research is beginning to yield valuable information, but a great deal remains to be learned (Brewer, Chapman, Rothman, Leask, & Kempe, 2017).



Vaccine uptake is influenced by three realms, according to University of North Carolina behavioral scientist Noel Brewer and colleagues: (1) what people think and feel; (2) social processes, such as networks and social norms; and (3) direct behavior change. While thoughts and feelings motivate people to get vaccinated, research has shown that campaigns targeting thoughts and feelings may do little to increase uptake. Interventions affecting social networks and norms are promising but not yet proven. Messaging that reminds parents of the social pro-vaccine norm has had a modest impact, as have social network interventions in which promoters “hang out” with people from similar socioeconomic and educational levels. Interventions that reliably increase uptake focus on changing the behavior without changing what people think and feel or their social experiences. Techniques that have reliably improved uptake, at least modestly, target behaviors—for example, by mandating or incentivizing vaccination, crafting better experiences for first-time visits to providers, or providing reminders (Brewer et al., 2017).

As has been well-documented, the single most powerful way to increase vaccination is through provider recommendations (Smith, Kennedy, Wooten, Gust, & Pickering, 2006). In almost all regions of the world, people who trust doctors and nurses tend to believe vaccines are safe (Wellcome Global Monitor, 2019). In the United States, parents are largely trusting of the providers they encounter at well-child visits, making this an excellent opportunity to win people over to vaccines (Freed, Clark, Butchart, Singer, & Davis, 2011). Provider recommendations are most effective when they assume the parent is ready to vaccinate (Brewer et al., 2017).



However, there are few clearly effective ways to convince parents who have their minds made up before they enter the doctor’s office (Danchin et al., 2018). Because vaccination has dramatically reduced the incidence of vaccine-preventable illnesses in many communities, physicians are less able to vividly communicate their dangers. In addition, the constraints of a busy clinic can make it impractical for immunization providers to talk through parental skepticism about vaccination and allay concerns. These same pressures may increase mistrust if parents feel a physician or nurse is exasperated or impatient about a decision the parent regards as deeply significant.

Because few countries offer medical school students specific training in vaccine communication (Williams & Swan, 2014), each country's practice has its own approach to hesitant parents (Kimmel & Wolfe, 2005). There have also been broader attempts to identify effective communication strategies. Some countries, including the United Kingdom, have designated communicators, such as nurses, in clinic settings (Bell, Edelstein, Zatoński, Ramsay, & Mounier-Jack, 2019). Motivational interviewing—a communication technique that attempts to sway people to make positive decisions—has worked in some instances (Opel et al., 2013). In Quebec, an experiment placed a trained group of individuals in pediatric clinics to listen to parents' vaccination concerns and seek to gently lead them to accepting vaccination (Boodman, 2019a).

But there will be no magic-bullet communication strategy, as there is no proven way to sway hesitant parents or caregivers during clinical visits. No single intervention will convince people who have already made up their minds, nor will it move a large percentage of hesitant persons to a clear “yes” (Brewer et al., 2017). The best results will be obtained by framing the vaccination decision and focusing on vaccination uptake rather than philosophical transformation.

There will be no magic-bullet communication strategy, as there is no proven way to sway hesitant parents or caregivers.

Behavioral Change and Mandates

The most direct way to increase childhood vaccine uptake may be to require it. Vaccination mandates are nearly 2 centuries old, yet while they have been successful in many settings, there are also good reasons to employ them with caution.

Vaccination proponents are leery of mandates in countries where vaccine laws are associated with authoritarian regimes, such as the former Soviet bloc countries (Hoch, 1997), many of which have experienced low levels of vaccine confidence and broad opposition to vaccines as well as logistical failures in vaccination programs (Hadjipanayis et al., 2020). Clearly, mandates are also not appropriate in countries where steady and consistent supplies of vaccines are not always available. Democratic countries or regions that ban philosophical and religious opt-outs altogether are seen as morally bound to adopt correspondingly vigorous vaccine safety and injury compensation programs; to the degree that vaccination is required, there must be guarantees that everything is being done to assure safety and make whole those who suffer adverse events (MacDonald et al., 2018).

To date, the United States has had a relatively positive experience with mandates, which have significantly aided uptake since they began being rigorously imposed in the late 1960s to battle recurrent measles outbreaks in school settings (Hinman, Orenstein, & Papania, 2004). While anti-vaccine activists have increasingly engaged state legislatures, no significant state vaccination mandate has been weakened in nearly 2 decades (Wang, Clymer, Davis-Hayes, & Buttenheim, 2014). To the contrary, outbreaks of vaccine-preventable disease over the past decade inspired legislative efforts to tighten school-entry requirements in at least 24 states. Efforts to loosen strictures failed in Texas (Byrne & Cheng, 2019) and Arizona, while California, Maine, and New York have each tightened vaccine exemption laws since 2015, joining West Virginia and Mississippi as the only states that no longer have religious or philosophical exemptions (National Conference of State Legislators, 2020). States with tighter vaccine exemptions, in general, have fewer outbreaks of measles and whooping cough (Phadke, Bednarczyk, Salmon, & Omer, 2016).

However, efforts to limit exemptions in an era of resurgent measles in the United States have not been an unalloyed success. In Oregon, Colorado, and New Jersey, states where legislative efforts failed, the anti-vaccine groups that turned out in strength to defeat them added to their numbers in the process. The apparent popularity of messages that stressed parental autonomy and libertarian views of public health struck a chord among Republican state legislators. Most of them voted against tighter vaccination restrictions, pointing to a disturbing partisan divide over vaccination mandates. Fortunately, mandates still enjoy nearly unanimous bipartisan support in the U.S. Congress (Allen, 2019).



A group of researchers who have studied hesitancy, mandates, and their impact have put forward what Yale University's Saad Omer calls a "Goldilocks" approach in the form of model legislation: Salmon and colleagues (2005) suggest that states remove laws that specify religious or philosophical objections to vaccination and replace them with policies that allow opt-outs for all parents who strongly object to vaccination. At the same time, these researchers urge the tightening of laws in states where currently it is easier to opt out of vaccination than to take a child to a pediatrician for repeated vaccinations. Evidence from European countries shows that selective mandates for specific vaccines lead people to shun vaccines that aren't mandated (Betsch & Böhm, 2015), while uptake is higher in European countries and regions that have imposed mandates (Vaz et al., 2020).

The segregation of non-vaccinating families poses a quandary on a community-wide scale because it may push them to outlier practices where anti-vaccine opinions and behaviors may become further entrenched.

Some pediatricians in the United States have resorted to dismissing families that refuse vaccination. Practitioners may see it as morally untenable to have an unvaccinated child in their care, or view their removal as necessary to prevent the spread of vaccine-preventable illnesses within their practice.

The American Academy of Pediatrics has acknowledged the right of its members to dismiss families, but urged that any such decision not be taken lightly (Edwards, Hackell, Committee on Infections Diseases, & Committee on Practice and Ambulatory Medicine, 2016). The segregation of non-vaccinating families poses a quandary on a community-wide scale because it may push them to outlier practices where anti-vaccine opinions and behaviors may become further entrenched, while sharpening the risk of vaccine-preventable illnesses among these groups.

Building a Movement for Vaccines

Before engaging in the effort to bolster vaccine confidence, clear objectives are needed. Campaigns to counter hesitancy must consider whether their aim is to blunt the reception of anti-vaccine messages; strengthen the number, type, and volume of pro-vaccine voices; or simply bypass negativism or skeptical voices about vaccination and push to increase uptake in communities where vaccination is still the trusted norm among large majorities. Research has shown that social movements rarely succeed, according to Stanford University sociologist Doug McAdam (this volume), although there are certainly examples of those that have. One highly successful health-related social movement, fostered by the grassroots activist group ACT UP, employed bottom-up pressure to push the U.S. Food and Drug

Administration and the drug industry to speed up the availability of effective HIV medicines, and eventually joined with institutional actors that shared its objectives (Bryant, 1991). The ACT UP experience demonstrates that vaccination advocates need to find the right allies and messengers for sharing their messages.

When the non-profit Public Good Projects (PGP) was organizing a campaign to encourage influenza vaccination for patients in the Kaiser Permanente health system, it found that the adults most enthusiastic about vaccination viewed it as an altruistic act to protect others, as Joe Smyser, PGP's CEO, told the Group at its 2019 meeting. The non-profit drew from among the 5,000 "influencers" it has recruited, who fashioned messages in their own words that were broadcast during influenza season in low-vaccination communities, highlighting the value and impact of peer-to-peer influence.

One way to address the emotional asymmetry in vaccination messages available to parents may be to create media campaigns that include parents of children who have suffered severe illness or died as a result of vaccine-preventable infections. However, such cases are thankfully not plentiful in countries with effective vaccination campaigns, and parents whose children have suffered as a result of their poor decisions may not wish to serve as public exemplars. Media campaigns might also pursue other individuals put at risk by unvaccinated populations, such as cancer patients (Shelal et al., 2019) or children with compromised immune systems, who rely on herd immunity for protection. There is suggestive but incomplete evidence that hearing or reading relevant narratives can drive people to affirm vaccination, and not just to avoid it (Winterbottom, Bekker, Conner, & Mooney, 2008).



The Group discussed the degree to which public health officials should contest and debunk anti-vaccine messages as part of efforts to reach vaccine-hesitant caregivers. Research has shown that debunking parents' anti-vaccine beliefs does not increase their likelihood of having their children vaccinated and may even make it less likely (Nyhan, Reifler, Richey, & Freed, 2014). By the same token, McAdam (this volume) notes that any movement intended to rouse public support for vaccination must be wary of unintended consequences, such as stirring up further resistance.

Online research has shown that a small number of people are responsible for most anti-vaccine posts (DiResta & Lotan, 2015), although their influence can seem larger. Researcher Renee DiResta told the Group that while only a few hundred people were responsible for social media messages opposing a 2015 move to eliminate philosophical and religious exemptions to requirements for school-age vaccination in California, they were the dominant voice in the debate. However, some 85% of voters supported the measure, and it passed with the support of concerned parents and their allies in the California legislature.



PRINCIPAL FINDINGS

The Group has put forward a set of principles as the foundation for new efforts to counter vaccine hesitancy and strengthen the vaccination enterprise.

> Vaccine hesitancy is a troubling global phenomenon.

Evidence from around the world shows that hesitancy, in combination with access problems, is affecting vaccine uptake in disconcerting ways. One person at the Group meeting described the global vaccination endeavor as a beautiful Victorian house, built with care over decades, that now stands at risk of an encroaching fire.



> There is an urgent need to better understand the causes and dimensions of vaccine hesitancy.

Countries and communities need to intensify their surveillance of vaccine hesitancy to understand how to address it. Better ways of measuring hesitancy are needed at the community level, as is an understanding of the degree to which hesitancy is affecting vaccination coverage rates. Countries and communities also need to fully understand the threat itself, the “signal-to-noise” ratio of anti-vaccine propaganda and its actual impact on vaccination uptake. Without validated metrics and a clearer understanding of the underlying problems and their root causes, efforts to shore up vaccination endeavors may be misguided and fail.

Efforts should be made to gather a body of experience from the community of practitioners who have developed innovative ways to help patients, parents, and guardians move from hesitance to acceptance, using communications as well as behavioral approaches derived from social science (sociology, anthropology, and economics) and psychological research. In this nuanced field, context is supremely important.

➤ | **Efforts are needed to address hesitancy even as efforts to understand it are incomplete.**

The Group highlighted the imperative of developing evidence-based approaches to hesitancy in a range of settings, particularly in lower- and middle-income countries where those insights are severely lacking. There was consensus that the primary end objective is to increase vaccination; the means to achieve this outcome include efforts to reinforce the value of vaccination and highlight the fact that it is an overwhelmingly accepted social norm. At the same time, the Group stressed that erroneous social media messages cannot go unchecked and that monitoring and rapid-response actions are needed, as is research on communication strategies; educating parents, providers, and children; and addressing value systems to reinforce vaccination norms.



These approaches must be multipronged and targeted. Solutions for overcoming hesitancy should include testing and adoption of approaches that address the values, feelings, and emotions of the audience, as well as communication methods and talking points. While many of the issues are context-dependent, the goal should be to identify scalable approaches to implementation.

➤ | **Focus on improving vaccination services and reducing access barriers.**

Efforts to address vaccination hesitancy should be aimed at hesitant parents rather than the foes of vaccination. Trying to convince people with entrenched views is ineffective, and countering anti-vaccine narratives aggressively each time they arise may be further polarizing. While contesting misinformation with facts will be a component of any solution, ultimately the objective is to halt vaccine-preventable diseases by increasing vaccination, especially in vulnerable communities. In part, this means taking care to ensure vaccines can be obtained in a convenient and affordable way so that logistical obstacles do not contribute to dissatisfaction or disengagement with the vaccination enterprise. More public health work is needed to identify pockets of under-immunized children and adults, and care must be taken to understand the distinction between “hesitant” communities and those where poor-quality services are the real obstacle to getting vaccinated.

➤ **A dedicated media strategy—targeted on the role and impact of social media—is needed.**

The increased availability of detailed vaccine-questioning narratives, concentrated through effective manipulation of social media (DiResta & Wardle, this volume), poses new challenges to the defense of vaccination.

Public health officials need a media strategy targeted—though not exclusively—to social media platforms and the people who use them. The vaccination enterprise must bring in grassroots and “influencer” allies who believe strongly in vaccination and have the means to spread the word. Finding and activating these partners in countries and communities around the world is a key objective of this strategy, one which must focus on traditional and social media in a way that is both flexible and global. Some 4.4 billion people gather information on the internet (We Are Social, 2019), yet the concerns that provoke mistrust or doubts about the vaccination enterprise often vary, even within countries.

The community needs to establish local networks of data, vaccine champions, and playbooks for effective engagement while finding new messages that resonate with different publics. A global engagement center for vaccines might be able to monitor, weigh, and if appropriate, counteract such traffic.

➤ **Vaccine use should be viewed as a key, lifelong component of a healthy lifestyle.**

Educational efforts focused on the value of vaccination must be targeted at different age groups to promote lifelong reminders and understanding (WHO, 2019b). Promoting vaccines, along with explanations of their value in training the immune system to fight diseases, will help bolster understanding of the role they play in good health, with the objective of establishing vaccination as a sensible norm. Lessons may be drawn from teaching experiences establishing the primacy of environmental awareness and climate change.

People who adhere to social norms on vaccination deserve and need more reinforcement from public health and medical communities. If the vaccination enterprise can support and applaud their behavior, giving them the sense they are contributing to an activity that helps their families and communities, it may strengthen their commitment to vaccination.

➤ | **Use vaccine mandates carefully.**

Mandates, incentives, and other measures aimed at directly affecting behavior should be used with care. While requirements may be an expeditious means of increasing vaccine uptake with the stroke of a pen, the social and historical context of each country is important, and tighter mandates should not be used reflexively in response to the challenges of declining vaccination.

➤ | **Efforts to boost vaccination coverage and reduce hesitancy must be coordinated.**

The work of the Global Demand Hub to improve vaccination rates in lower- and middle-income countries is a necessary start but it is not enough. Such efforts must be supported and extended so that other parts of the world with similar challenges can benefit from improved coordination and a dedicated focus on improving vaccine acceptance and uptake. reinforcing vaccination as a social norm. While the appropriate strategies will differ by country, everything learned along the way through research, practice, and social media endeavors should be shared as part of a global effort.



THREE BIG IDEAS

Based on its findings and principles, the Group proposes the following three big ideas to help reverse the trend toward vaccine hesitancy and reestablish full uptake of vaccines as a social norm.

- **Structure.** The creation of a new media collaborative to serve as an interface between the vaccination community and social media platforms.
- **Knowledge.** A research agenda to create ample evidence-based knowledge about the sources of vaccine hesitancy and the best ways to counter it.
- **Strategy.** Building a new narrative to shift the conversation around immunization to one that focuses on its achievements and promise and helps build resiliency in the vaccination enterprise.

Structure

A new media collaborative, recognizing the growing influence of the internet and social media on vaccination decisions, would catalyze research on the best ways to use these platforms to enhance vaccine uptake through intelligent education and communication strategies. The collaborative would:

- Consist of a consortium of global and local public health institutions, with non-traditional allies coming from sectors as diverse as tech, marketing, entertainment, and the social sciences. Together, they would develop new approaches on social media and other information platforms, creating rapid-response teams to identify and help social media companies deal with misinformation. Efforts that include grassroots proponents of vaccination in combination with established public health actors may be more effective than official efforts given the mistrust of government in many countries. The Group heard conflicting views about whether the work on social norms should be seen as “creating a social movement.” While some see



this as an important vehicle for the agenda of solidifying vaccine norms, others cautioned that the idea of a social movement creates expectations which may be unachievable and risks a backlash.

- Help develop coherent and aligned positive communications on vaccination that can be used by social media networks, health professionals, and educators. The collaborative would also conduct pilot programs and share best practices.
- Assist public health authorities with the development and evaluation of targeted messages for vaccination campaigns. These should involve the activation of local and national vaccination proponents, influencers whose messages can reach under-vaccinated communities. Key opinion leaders would bring back timely information on local issues (such as lagging immunization rates or particular anti-vaccine messages) and take information and messages from the collaborative to deal with these problems. This structure would allow for a rapid social media response in real time to crises in the field that are affecting vaccine uptake at a local or national level.
- Support and enhance the Global Demand Hub's existing efforts to use its organizational capacity and strategies in helping countries and regional officials improve vaccine uptake.

The media collaborative's organization—whether centralized or decentralized, and how it might be staffed and funded—remains to be determined, as does its relationship with other organizations, such as the CDC and WHO.

Knowledge

Build a knowledge base adequate to launch an effective fight against vaccine hesitancy, with a comprehensive yet focused research agenda supported by additional funding. Steps should include:

- Encourage funders—government and philanthropic—such as the National Institutes of Health (NIH), CDC, Gates Foundation, Wellcome Trust, and WHO—to expand social science portfolios aimed at studying the mechanisms of vaccine demand creation, including the impact of social media, clinical encounters, national/state/regional messaging, and regulations and laws on vaccine uptake.

- Explore the deployment of research methodologies used in the private sector, such as understanding the mixture of rational choice and emotional or intangible associations that drive decision-making on immunization. Before starting social media campaigns, deploy assessment tools to understand how the groups being targeted engage with social media and who their trusted sources are.
- Seek deeper understanding of the factors that feed into vaccination decision-making (beliefs underlying vaccine hesitancy) in order to inform education and outreach activities.
- Build an evidence base for innovative approaches to vaccination uptake by analyzing current approaches, testing and piloting new ideas and approaches, and intensifying the development of demonstrably effective interventions that win over hesitant parents and caregivers.
- Intensely deploy demonstrably effective interventions while studying their impact in different settings as part of an ongoing learning approach to immunization science.

Strategy

Shift the conversation to focus on the achievements of vaccination. Through education and outreach, activate awareness and support of vaccines and immunity-related health. These approaches should include doctors and nurses, medical students, and other health care providers, and give voice to a “silent majority” with positive beliefs about vaccination. Toward this end, research should be undertaken as to the value of earlier educational interventions, ranging from conversations with pregnant mothers to teenage visits for HPV as well as meningitis vaccinations to middle-school classes.



This strategy involves reaching beyond traditional public health and vaccine advocacy groups to non-traditional players, including local activists, entertainers, politicians, patients, and members of disease advocacy groups.

The focus of the conversation should be the positive attributes of vaccination and a lifelong awareness of the need to protect individuals from vaccine-preventable disease. The proposed structure and research initiative are built upon a strategy of changing the conversation around immunization.

The community strategy should include a concerted effort to find and engage local influencers as well as people who are passionate about the value of vaccination for personal reasons. These influencers could include parents of children who have died or suffered serious sequela from (1) vaccine-preventable illnesses; (2) patients or parents of patients with immunological problems that preclude them from vaccination and render them especially vulnerable to vaccine-preventable diseases; (3) teachers or school principals who must struggle with outbreaks of disease like whooping cough that originate in under-vaccinated children attending their schools; and (4) pediatricians who struggle with whether to dismiss non-vaccinating families from their practices.



MOVING FORWARD

Vaccine hesitancy poses a serious threat to vaccination's success in preventing life-threatening and crippling infections around the world. It stems in part from parental and community-wide attitudes and beliefs that are specific to vaccination and are interwoven in complex, context-specific ways with supply issues, such as the convenience and affordability of vaccines, as well as trust and confidence in authority structures. Precisely because the dimensions of the hesitancy problem are not fully understood, the public health community and its allies need to act now to expand their understanding of the problem and identify the best ways to resolve it.

While the COVID-19 pandemic focuses the world's attention on the creation of a safe and effective vaccine that will allow us to get back to normal, we must insure that any such vaccine is accepted by those who need it. The COVID-19 crisis brings with it a powerful reminder of the essential value of vaccination, yet it must not distract us from the fight against currently vaccine-preventable illnesses.

The gravity of the global measles epidemic and evidence of faltering confidence in vaccines underline the need to act now to reignite vaccine acceptance on a variety of fronts. The reasons for declining vaccine uptake in a given community or country will vary; what is key is to gain an understanding of them and take action. This moment offers a solemn opportunity to confront the problem of mistrust in a resolute way so that the lifesaving achievements of vaccination continue to serve current and coming generations.

REFERENCES

- Allen, A. (2007). *Vaccine: The controversial story of medicine's greatest lifesaver*. New York, NY: W. W. Norton.
- Allen, A. (2019, April 16). Republicans attack Democratic attempts to tighten vaccine laws. *Politico*. Retrieved from <https://www.politico.com/story/2019/04/16/republican-reject-democrat-vaccines-1361277>
- Bell, S., Edelstein, M., Zatoński, M., Ramsay, M., & Mounier-Jack, S. (2019). 'I don't think anybody explained to me how it works': Qualitative study exploring vaccination and primary health service access and uptake amongst Polish and Romanian communities in England. *BMJ Open*, 9(7), e028228. <https://doi.org/10.1136/bmjopen-2018-028228>
- Betsch, C., & Böhm, R. (2015). Detrimental effects of introducing partial compulsory vaccination: Experimental evidence. *European Journal of Public Health*, 26(3), 378–381. <https://doi.org/10.1093/eurpub/ckv154>
- Boodman, E. (2019a). The vaccine whisperers: Counselors gently engage new parents before their doubts harden into certainty. *STAT*. Retrieved from <https://www.statnews.com/2019/08/05/the-vaccine-whisperers-counselors-gently-engage-new-parents-before-their-doubts-harden-into-certainty>
- Boodman, E. (2019b). What a Grand Rabbi's request might teach us about combating vaccine hesitancy. *STAT*. Retrieved from <https://www.statnews.com/2019/05/10/measles-rabbi-combating-vaccine-hesitancy>
- Brewer, N. T., Chapman, G. B., Rothman, A. J., Leask, J., & Kempe, A. (2017). Increasing vaccination: Putting psychological science into action. *Psychological Science in the Public Interest*, 18(3), 149–207. <https://doi.org/10.1177/1529100618760521>
- Bryant, M. (1991). ACT UP: Playing the inside & the outside. *Faulkner & Gray's Medical Health*, 13(1), 45–49.

- Byrne, E., & Cheng, S. (2019, June 12). Texas vaccine exemption rates have reached an all-time high. Did Texas make it too easy for parents to opt out? *The Texas Tribune*. Retrieved March 24, 2020, from <https://www.texastribune.org/2019/06/12/texas-vaccine-exemption-rates-school-district-look-up>
- Centola, D. (2019). Influential networks. *Nature Human Behaviour*, 3(7), 664–665. <https://doi.org/10.1038/s41562-019-0607-5>
- Clarke, M. (2019, December 8). Anatomy of an epidemic: How measles took hold of Samoa. Retrieved March 24, 2019, from <https://www.abc.net.au/news/2019-12-09/anatomy-of-an-epidemic:-how-measles-took-hold-of-samoa/11773018>
- Colgrove, J. (2006). *State of immunity: The politics of vaccination in twentieth-century America*. Berkeley, CA: University of California Press.
- Danchin, M. H., Costa-Pinto, J., Attwell, K., Willaby, H., Wiley, K., Hoq, M. ... Marshall, H. (2018). Vaccine decision-making begins in pregnancy: Correlation between vaccine concerns, intentions and maternal vaccination with subsequent childhood vaccine uptake. *Vaccine*, 36(44), 6473–6479. <https://doi.org/10.1016/j.vaccine.2017.08.003>
- Del Vicario, M., Scala, A., Caldarelli, G., Stanley, H. E., & Quattrociocchi, W. (2017). Modeling confirmation bias and polarization. *Scientific Reports*, 7(1), 40391. <https://doi.org/10.1038/srep40391>
- DiResta, R. (2018, October 12). Free speech in the age of algorithmic megaphones. *Wired*. Retrieved March 24, 2020, from <https://www.wired.com/story/facebook-domestic-disinformation-algorithmic-megaphones>
- DiResta, R., & Lotan, G. (2015, June 8). Anti-vaxxers are using Twitter to manipulate a vaccine bill. *Wired*. Retrieved March 24, 2020, from <https://www.wired.com/2015/06/antivaxxers-influencing-legislation>
- Dyer, O. (2017). Measles outbreak in Somali American community follows anti-vaccine talks. *BMJ*, 357, J2378. <https://doi.org/10.1136/bmj.j2378>
- Edwards, K. M., Hackell, J. M., Committee on Infections Diseases, & Committee on Practice and Ambulatory Medicine. (2016). Countering vaccine hesitancy. *Pediatrics*, 138(3), e20162146. <https://doi.org/10.1542/peds.2016-2146>

- Facciola, A., Visalli, G., Orlando, A., Bertuccio, M. P., Spataro, P., Squeri, F., ... Di Petro, A. (2019). Vaccine hesitancy: An overview on parents' opinions about vaccination and possible reasons of vaccine refusal. *Journal of Public Health Research*, 8(1), 1436. <https://doi.org/10.4081/jphr.2019.1436>
- Ferguson, S. (2019, March 26). A massive vaccination campaign is saving lives in war-torn Yemen. *UNICEF USA*. Retrieved March 24, 2019, from <https://www.unicefusa.org/stories/massive-vaccination-campaign-saving-lives-war-torn-yemen/35730>
- Freed, G. L., Clark, S. J., Butchart, A. T., Singer, D. C., & Davis, M. M. (2011). Sources and perceived credibility of vaccine-safety information for parents. *Pediatrics*, 127(1), S107–S112. <https://doi.org/10.1542/peds.2010-1722P>
- Gastañaduy, P. A., Funk, S., Paul, P., Tatham, L., Fisher, N., Budd, J., ... Grenfell, B. (2018). Impact of public health responses during a measles outbreak in an Amish community in Ohio: Modeling the dynamics of transmission. *American Journal of Epidemiology*, 187(9), 2002–2010. <https://doi.org/10.1093/aje/kwy082>
- Hadjipanayis, A., van Esso, D., del Torso, S., Dornbusch, H. J., Michailidou, K., Minicuci, N. ... Grossman, Z. (2020). Vaccine confidence among parents: Large scale study in eighteen European countries. *Vaccine*, 38(6), 1505–1512. <https://doi.org/10.1016/j.vaccine.2019.11.068>
- Hinman, A. R., Orenstein, W. A., & Papania, M. J. (2004). Evolution of measles elimination strategies in the United States. *Journal of Infectious Diseases*, 189(1), S17–S22. <https://doi.org/10.1086/377694>
- Hoch, S. L. (1997). *The social consequences of Soviet immunization policies, 1945–1980*. Washington, DC: National Council for Eurasian and East European Research. Retrieved from <https://www.ucis.pitt.edu/nceeer/1997-812-03g-Hoch.pdf>
- Horne, Z., Powell, D., Hummel, J. E., & Holyoak, K. J. (2015). Countering antivaccination attitudes. *Proceedings of the National Academy of Sciences*, 112(33), 10321–10324. <https://doi.org/10.1073/pnas.1504019112>
- Hussain, S. F., Boyle, P., Patel, P., & Sullivan, R. (2016). Eradicating polio in Pakistan: An analysis of the challenges and solutions to this security and health issue. *Globalization and Health*, 12(1), 63. <https://doi.org/10.1186/s12992-016-0195-3>

- Iacobucci, G. (2019). Child vaccination rates in England fall across the board, figures show. *BMJ*, 366, 15773. <https://doi.org/10.1136/bmj.l5773>
- Janjua, H. (2019, April 25). Polio vaccinator is shot and killed in Pakistan. *New York Times*. Retrieved March 24, 2020, from <https://www.nytimes.com/2019/04/25/world/asia/polio-vaccine-pakistan.html>
- Jenco, M. (2018, November 13). Russian trolls on Twitter aim to sow discord about vaccines. *AAP News*. Retrieved March 24, 2020, from <https://www.aappublications.org/news/2018/11/13/trolls111318>
- Kemp, S. (2020). *Essential insights into how people around the world use the internet*. Retrieved March 24, 2020, from <https://p.widencdn.net/kqy7ii/Digital2019-Report-en>
- Kimmel, S. R., & Wolfe, R. M. (2005). Communicating the benefits and risks of vaccines. *The Journal of Family Practice*, 54, S51–S57.
- Knowles, H. (2019, November 26). Deadly measles outbreak hits children in Samoa after anti-vaccine fears. *Washington Post*. Retrieved March 24, 2020, from <https://www.washingtonpost.com/health/2019/11/26/deadly-measles-outbreak-hits-children-samoa-after-anti-vaccine-fears>
- MacDonald, N. E., Harmon, S., Dube, E., Steenbeek, A., Crowcroft, N., Opel, D. J., ... Butler, R. (2018). Mandatory infant & childhood immunization: Rationales, issues and knowledge gaps. *Vaccine*, 36(39), 5811–5818. <https://doi.org/10.1016/j.vaccine.2018.08.042>
- McDonald, R., Ruppert, P. S., Souto, M., Johns, D. E., McKay, K., Bessette, N., ... Zucker, H. A. (2019). Notes from the field: Measles outbreaks from imported cases in Orthodox Jewish communities — New York and New Jersey, 2018–2019. *Morbidity and Mortality Weekly Report*, 68(19), 444–445. <https://doi.org/10.15585/mmwr.mm6819a4>
- National Conference of State Legislators. (2020, January 3). States with religious and philosophical exemptions from school immunization requirements. Retrieved March 24, 2020, from <http://www.ncsl.org/research/health/school-immunization-exemption-state-laws.aspx>
- Nyhan, B., Reifler, J., Richey, S., & Freed, G. L. (2014). Effective messages in vaccine promotion: A randomized trial. *Pediatrics*, 133(4), e835–e842. <https://doi.org/10.1542/peds.2013-2365>

- Opel, D. J., Heritage, J., Taylor, J. A., Mangione-Smith, R., Salas, H. S., DeVere, V., ... Robinson, J. D. (2013). The architecture of provider-parent vaccine discussions at health supervision visits. *Pediatrics*, *132*(6), 1037–1046. <https://doi.org/10.1542/peds.2013-2037>
- Paules, C. L., Marston, H. D., & Fauci, A. S. (2019). Measles in 2019 — Going backward. *The New England Journal of Medicine*, *380*(23), 2185–2187. <https://doi.org/10.1056/NEJMp1905099>
- Phadke, V. K., Bednarczyk, R. A., Salmon, D. A., & Omer, S. B. (2016). Association between vaccine refusal and vaccine-preventable diseases in the United States: A review of measles and pertussis. *JAMA*, *315*(11), 1149–1158. <https://doi.org/10.1001/jama.2016.1353>
- Priya, K., Pathak, V. K., & Giri, A. K. (2020). Vaccination coverage and vaccine hesitancy among vulnerable population of India. *Human Vaccines and Immunotherapy*. Advance online publication. <https://doi.org/10.1080/21645515.2019.1708164>
- Ropeik, D. (2013). How society should respond to the risk of vaccine rejection. *Human Vaccines & Immunotherapeutics*, *9*(8), 1815–1818. <https://doi.org/10.4161/hv.25250>
- Salmon, D. A., Sapsin, J. W., Teret, S., Jacobs, R. F., Thompson, J. W., Ryan, K., & Halsey, N. A. (2005). Public health and the politics of school immunization requirements. *American Journal of Public Health*, *95*(5), 778–783. <https://doi.org/10.2105/ajph.2004.046193>
- Schiff, A. (2019, March 7). *Schiff receives official responses from Google, Facebook regarding anti-vaccine misinformation* [Press release]. Retrieved March 24, 2020, from <https://schiff.house.gov/news/press-releases/schiff-receives-official-responses-from-google-facebook-regarding-anti-vaccine-misinformation>
- Self, W. (2016, November 28). Forget fake news on Facebook: The real filter bubble is you. *New Statesman*. Retrieved March 24, 2020, from <https://www.newstatesman.com/science-tech/social-media/2016/11/forget-fake-news-facebook-real-filter-bubble-you>
- Shelal, A., Cho, C., Urbauer, D. L., Lu, Q., Ma, B. Y., Rohrer, A. M., ... Ramondetta, L. M. (2019). Knowledge matters and empowers: HPV vaccine advocacy among HPV-related cancer survivors. *Supportive Care in Cancer*, *28*, 2407–2413. <https://doi.org/10.1007/s00520-019-05035-1>

- Smith, A. (2014, November 28). Polio-related murders kill more than the disease itself. *Newsweek*. Retrieved March 24, 2020, from <https://www.newsweek.com/polio-related-murders-kill-more-disease-itself-287880>
- Smith, P. J., Kennedy, A. M., Wooten, K., Gust, D. A., & Pickering, L. K. (2006). Association between health care providers' influence on parents who have concerns about vaccine safety and vaccination coverage. *Pediatrics*, *118*(5), e1287–e1292. <https://doi.org/10.1542/peds.2006-0923>
- Staver, A. (2019, June 13). Colorado's worst-in-the-nation measles vaccination rate drops again: Gov. Jared Polis announces efforts to educate and encourage immunizations. *Denver Post*. Retrieved March 24, 2020, from <https://www.denverpost.com/2019/06/13/colorado-vaccination-measles-immunization-2019>
- Stecula, D. A., Kuru, O., & Jamieson, K. H. (2020, January 14). How trust in experts and media use affect acceptance of common anti-vaccination claims. *Harvard Kennedy School Misinformation Review*. <https://doi.org/10.37016/mr-2020-007>
- Vaccine hesitancy: A generation at risk. (2019). *The Lancet Child & Adolescent Health*, *3*(5), 281. [https://doi.org/10.1016/s2352-4642\(19\)30092-6](https://doi.org/10.1016/s2352-4642(19)30092-6)
- VaccinesToday. (2019, February 19). Boosting global vaccine uptake—through immunization managers. Retrieved March 24, 2020, from <https://www.vaccinestoday.eu/stories/boosting-global-vaccine-uptake-through-immunization-managers>
- Vaz, O. M., Ellingson, M. K., Weiss, P., Jenness, S. M., Bardaji, A., Bednarczyk, R. A., & Omer, S. B. (2020). Mandatory vaccination in Europe. *Pediatrics*, *145*(2), e20190620. <https://doi.org/10.1542/peds.2019-0620>
- Wang, E., Clymer, J., Davis-Hayes, C., & Bутtenheim, A. (2014). Nonmedical exemptions from school immunization requirements: A systematic review. *American Journal of Public Health*, *104*(11), e62–e84. <https://doi.org/10.2105/AJPH.2014.302190>
- Wellcome Global Monitor. (2019). *Wellcome Global Monitor 2018: How does the world feel about science and health?* Retrieved March 24, 2020, from <https://wellcome.ac.uk/reports/wellcome-global-monitor/2018>

- Wilder-Smith, A., Flasche, S., & Smith, P. G. (2019). Vaccine-attributable severe dengue in the Philippines. *The Lancet*, *394*(10215), 2151–2152.
[https://doi.org/10.1016/S0140-6736\(19\)32525-5](https://doi.org/10.1016/S0140-6736(19)32525-5)
- Williams, S. E., & Swan, R. (2014). Formal training in vaccine safety to address parental concerns not routinely conducted in U.S. pediatric residency programs. *Vaccine*, *32*(26), 3175–3178. <https://doi.org/10.1016/j.vaccine.2014.04.001>
- Winterbottom, A., Bekker, H. L., Conner, M., & Mooney, A. (2008). Does narrative information bias individual's decision making? *Social Science & Medicine*, *67*(12), 2079–2088.
<https://doi.org/10.1016/j.socscimed.2008.09.037>
- World Health Organization. (2014, November 12). *Report of the SAGE Working Group on Vaccine Hesitancy*. Retrieved March 24, 2020, from https://www.who.int/immunization/sage/meetings/2014/october/SAGE_working_group_revised_report_vaccine_hesitancy.pdf
- World Health Organization. (2019a). *Immunisation agenda 2030: A global strategy to leave no one behind*. Retrieved March 24, 2020, from https://www.who.int/immunization/immunization_agenda_2030/en
- World Health Organization. (2019b, December 5). Measles. Retrieved March 24, 2020, from <https://www.who.int/news-room/fact-sheets/detail/measles>
- World Health Organization. (2019c, February 26). Questions and answers on the measles outbreak in the Philippines. Retrieved March 24, 2020, from <https://www.who.int/philippines/news/feature-stories/detail/questions-and-answers-on-the-measles-outbreak-in-the-philippines>
- World Health Organization. (2019d). Ten threats to global health in 2019. Retrieved March 24, 2020, from <https://www.who.int/news-room/feature-stories/ten-threats-to-global-health-in-2019>
- World Health Organization. (2020). Immunization. Retrieved March 24, 2020, from <https://www.who.int/topics/immunization/en>

Part 2

BACKGROUND PAPERS

THE CHALLENGE OF VACCINATION HESITANCY AND ACCEPTANCE: AN OVERVIEW

Arthur Allen and Robb Butler, M.A.

INTRODUCTION

Vaccination is one of the world's most important medical interventions. Generally safe, effective, and relatively inexpensive, vaccines save about three million lives every year and protect hundreds of millions of people against acute and chronic infections and their consequences (World Health Organization [WHO], 2017). While administering a vaccine is a fairly simple process, the enterprise of vaccination is complex. To invent, test, and produce a vaccine is difficult, and protecting a population of people against infectious diseases requires high levels of organization and participation.



Vaccination programs aim to protect individuals—often children—and to provide population-wide barriers of immunity that will shield vulnerable individuals for whom vaccination is not possible, recommended, or effective. Vaccine-preventable infectious diseases can be controlled without 100% vaccine coverage, but the rates must be high—generally in the 80–95% range, depending on the disease in question (Plotkin, Orenstein, & Offit, 2004)—to reliably protect against outbreaks. The WHO estimates that one in seven children around the world are

unvaccinated or under-vaccinated, and that three lives are lost to vaccine-preventable diseases every minute (WHO, 2017).

Immunization programs face many overlapping, context-related logistical, economic, and sociocultural challenges that contribute to sub-optimal and uneven coverage. Health systems sometimes struggle to effectively engage caregivers and communities, leading to weak demand and acceptance of vaccination, inequities in coverage, and stagnating

or declining coverage rates (Strategic Advisory Group of Experts on Immunization, 2017). The root causes of suboptimal vaccination uptake are numerous; one analysis groups these challenges as the “5As”: access, affordability, awareness, acceptance, and activation (Thomson, Robinson, & Vallée-Tourangeau, 2016). The salience of each obstacle to reaching vaccination goals depends on many interrelated factors. As in clinical medicine, proper diagnosis is key before initiating a treatment plan. If little affordable vaccine is available, or people are unaware of its availability or can’t get to where it is being administered, a community’s willingness to be vaccinated isn’t necessarily relevant.

Vaccine supply and demand go hand in hand. Gaps in demand or acceptance—and gaps between caregiver intention to vaccinate and actual follow-up—contribute to stagnating or declining coverage rates. As new initiatives have expanded global access to vaccines, new challenges to their acceptance have arisen. Over the past 2 decades, parental doubts about the importance and safety of vaccines, and the growing politicization of the issue, have increasingly threatened efforts to eradicate or control vaccine-preventable disease (Gowda & Dempsey, 2013). In response, immunization programs and partners are amplifying efforts to build awareness of the value and acceptance of vaccines, even as they continue to expand and strengthen delivery and access to them.

It is important to note that vaccination hesitancy and skepticism are not the major causes of missed vaccinations on a global scale; a host of other factors come into play. In Pakistan, to cite one recent example, 35% of parents who did not vaccinate a child were simply unaware of the need to do so (Riaz et al., 2018). Nonetheless, the current global measles outbreak, characterized by a tripling of cases around the world in 2019, has focused renewed attention on the role of vaccination hesitancy and skepticism in the broader context of under-vaccination. Measles epidemics—from Congo to Ukraine, France to the United States—sickened hundreds of thousands of people, mostly children, and caused thousands of deaths and disabilities. In the United States, where measles had been declared eliminated in 2000 (defined as the absence of continuous disease transmission for more than 12 months), the Centers for Disease Control (CDC) reported more than 1,282 cases in 31 states in 2019, the highest number in 27 years (CDC, 2020b). Most of the local outbreaks were linked to cases imported from epidemic areas of the world into inadequately vaccinated U.S. communities.

It is important to note that vaccination hesitancy and skepticism are not the major causes of missed vaccinations on a global scale; a host of other factors come into play.

Measles is among the most contagious diseases, yet it can be prevented effectively with two doses of vaccine. As such, many experts see measles outbreaks as an indicator of inadequate primary health care (WHO, 2016), and symptomatic of gaps in national immunization programs. Though the current global measles epidemic has multiple causes (WHO, 2019b), this setback has focused the world's attention on vaccine hesitancy, leading the WHO (2019c) to declare it one of 10 major threats in 2019.



In this paper, we refer to “vaccination” rather than “vaccine” hesitancy, acceptance, and demand because these behaviors are not solely determined by vaccines or antigens, but by a host of influences. It would be unwise to suggest that the responsibility for vaccination rests completely with the caregiver or parent. Hesitancy is complex and determined by a range of factors that lie outside their control, including the quality of immunization services and the actions of government authorities and manufacturers that provide and administer them. In this context, the term “hesitancy” may divert attention from the fuller picture. Parental decision-making plays a role, but health services have the responsibility to provide equitable, accessible, high-quality, affordable, and appealing immunization services to their constituents. Hesitancy as a concept is here to stay in the vaccine world, but we insert a caveat to acknowledge the broader context.

VACCINATION HESITANCY

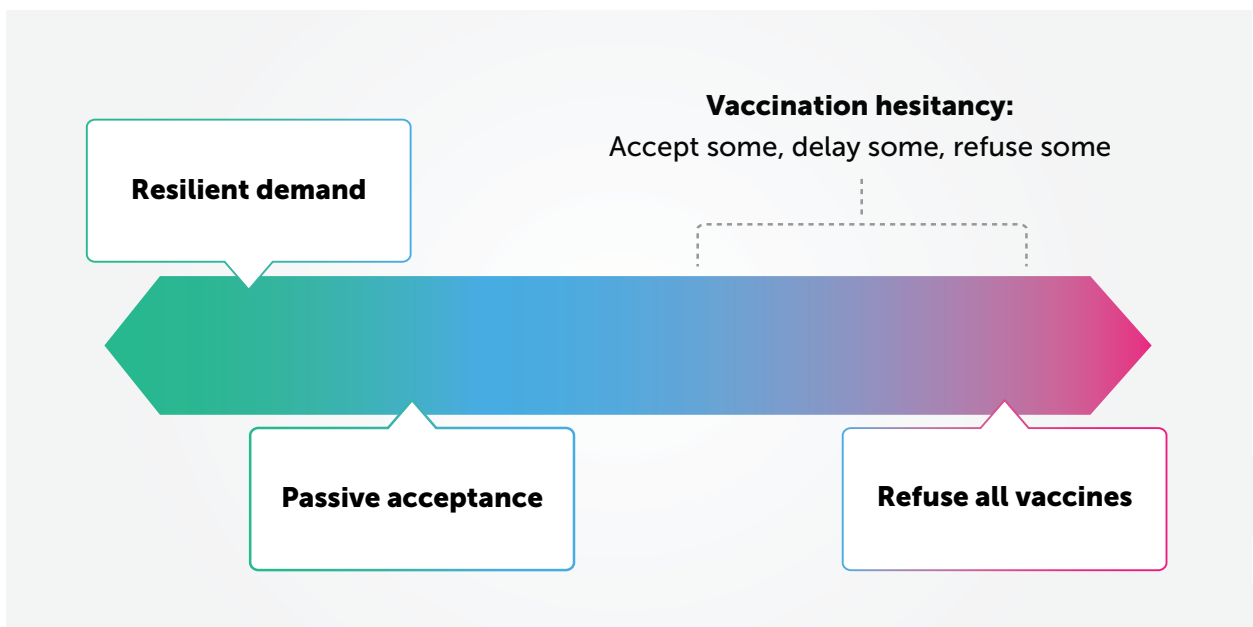
Trepidation about vaccines is as old as vaccination itself, as demonstrated by a letter that Massachusetts landowner Adam Winthrop wrote while struggling with the decision to have his grandson vaccinated during a smallpox epidemic in 1721. “I should have less distress in burying many children by the absolute acts of God’s providence,” Winthrop wrote, “than in being the means of burying one by my own act and deed” (Allen, 2007). The risk/benefit equation of vaccination, and the overall confidence in medicine’s efficacy, have improved significantly since Winthrop’s time, yet hesitancy remains in many guises.

A WHO expert panel has defined hesitancy as a “delay in acceptance or refusal of vaccines despite availability of vaccination services,” in which “complacency, convenience and confidence” play a role (MacDonald & the SAGE Working Group on Vaccine Hesitancy, 2015). The extent of parental acceptance of vaccines lies on a continuum, with vaccination-hesitant parents (and other caregivers) falling along the middle range (Figure 1). Vaccination

hesitancy is by no means equivalent to vaccination rejection, which is generally confined to a very small percentage of parents who refuse all recommended vaccines. Vaccination hesitancy is complex and context-specific, varying across time, place, and vaccines (Opel et al., 2011). Vaccination-hesitant individuals are a heterogeneous group, and the roots of their hesitancy range from physical fear of vaccination to distrust of government, science, and the pharmaceutical industry. Some parents accept all vaccines but remain concerned; others may refuse or delay some vaccinations while accepting others. Some doubt vaccination in general but accept it in some specific instances (Leask et al., 2012).

Vaccination acceptance tends to be greatest in countries where the perception of risk from vaccine-preventable diseases is highest (Wellcome Global Monitor, 2019), although the phenomenon has not been rigorously examined in all regions of the world. A review of studies from the United States, Europe, Australia, and New Zealand characterizes 30–40% of parents as “unquestioning vaccine acceptors,” with another 25–35% vaccinating their children despite minor concerns. An additional 20–30% also vaccinate but have significant concerns, typically based on safety allegations, such as those levied against the measles-mumps-rubella (MMR) vaccine. In this group, trust in the clinician is particularly key. Up to 27% of parents delay vaccination or accept only some recommended vaccines, while about 2% decline any vaccination—with higher percentages in given places and times (Leask et al., 2012).

Figure 1. The vaccination behavior continuum



Source: UNICEF and the WHO Regional Office for Africa’s Regional Immunization Technical Advisory Group (RITAG), January 2019; Presentation.

The Three Cs

The 2014 report by the WHO’s Strategic Advisory Group of Experts (SAGE) on vaccination hesitancy offers a framework for understanding hesitancy in terms of the “three Cs”—*convenience*, the logistical arrangements available to individuals, and their awareness of them; *complacency*, which is determined by the perception of vaccine-preventable diseases in a given setting; and *confidence* in the efficacy and safety of vaccines, the system that delivers them, and the motivation of policymakers who decide how and when to administer them (WHO, 2014).

Reluctance to accept vaccination because of fear or mistrust of the vaccine itself—or those who produce, recommend, administer, or order it—is not the only barrier to acceptance. Especially in resource-poor countries or populations, complacency and convenience play important roles. This suggests that those responsible for immunization campaigns should be sure to look for shortcomings in their own performance before assuming that a less-than-desired uptake is the fault of parents or those who prey on their doubts.

Convenience. In principle, convenience is a discrete problem of logistics that can be identified and dealt with in a relatively straightforward fashion (though it may be anything but easy). Yet the importance of the convenience factor is hard to understate, and it may overlap with, or compound, lack of confidence as an obstacle to vaccine uptake.



Research into hesitancy in the United States has shown clearly that inaction is easier than action when it comes to vaccination. For example, states that make it easier to obtain a philosophical or religious exemption for childhood vaccination than to get the child vaccinated (e.g., Colorado, Oregon) have higher rates of exemption—and vaccine-preventable diseases—than those in which the decision not to vaccinate requires additional effort (Omer et al., 2006). And when states, such as California, have made it more difficult to get exemptions, vaccination rates have increased (Pingali et al., 2019).

Not all missed vaccinations are due to fully conscious parental actions; technology also plays a role in convenience. Influences here include the degree of difficulty in getting a pediatrician to report a vaccination to a child's school; the availability of pharmacies as an alternative to a doctor's visit (Finnegan, 2012); more convenient vaccine delivery methods, such as micro-array patches that could obviate the need for children to get shots; and enhanced training of nurses to make inoculation less painful (UNICEF, 2018).



A recent study in Australia (Beard, Hull, Leask, Dey, & McIntyre, 2016) found that among the population of under-vaccinated children, 40% of the failures to vaccinate were due to an active decision on the part of the parents and 60% to simple inaction, which, in part, suggests a lack

of convenience. The framework used by Gavi, the Vaccine Alliance to generate demand stresses that delivery of high-quality vaccine services is key to ensuring positive parent and child experiences in vaccination settings. It is also crucial that players in the vaccination enterprise improve community awareness and knowledge, creating and continually reinforcing positive social norms toward immunization and providing reminders and nudges through appropriate communications media. While community demand is fostered by governments, immunization program managers, clinicians, and local leadership and civil society organizations (Hickler, MacDonald, Senouci, Schuh, & the Informal Working Group of Vaccine Demand, 2017), convenience may make it easier for a parent who is inchoately hesitant about vaccination to carry through with it.

Complacency. Complacency is a complex issue. Like any medical procedure, vaccines require the consent and participation of the patient or, in the case of children, a parent or guardian. But unlike procedures used to treat an existing malady, vaccines are a tool of prevention whose purpose is not always obvious. This is especially so in countries where vaccination programs and campaigns have succeeded to the extent that the diseases they target have largely disappeared or no longer appear as significant threats. Even where they do occur, intensive-care medicine has lowered the death rate from common vaccine-preventable illnesses (Offit, 2015). Yet success against infectious disease is never permanent, as shown by the 2018-19 measles resurgence in the United States. When a community stops worrying about a disease threat, complacency can paradoxically cause it to resurface.

Confidence. The third “C”—confidence and its component parts—has attracted research interest in recent years. There is growing awareness in the public health sector of the need for more study of the attitudes that lie at the heart of an individual’s trust or mistrust of vaccines. Medical authorities have traditionally viewed popular education and scientific understanding as key to the success of vaccines; one could also say that scientific understanding of people is just as important. Unfortunately, behavioral research has yet to yield a silver bullet in the form of a communications approach that always increases trust in science or in vaccines.

THE FOUNDATION OF MISTRUST

Attitudes toward health systems and vaccines “are wrapped in context,” stated one of the authors of a recent Wellcome Global Monitor report (Wellcome Global Monitor, 2019), the world’s largest study of how people around the world view science and major health challenges. If scientists don’t understand the context, they aren’t likely to bridge the gap in trust (Allen, 2019a). This fourth “C” of context includes the social norms around vaccination, which may stray under a variety of social, political, and cultural influences. To take a drastic example, health workers administering Ebola vaccines in the midst of the 2019 outbreak in Congo were attacked by crowds of villagers who simply didn’t trust outsiders because they had repeatedly been brutalized by military and paramilitary forces.



The Wellcome report, released in June 2019, gathered views about science—and in particular, about vaccination—from some 145,000 people in 144 countries. As suggested by previous studies, the highest levels of vaccine mistrust exist in Europe and North America, where the mortality from vaccine-preventable diseases is lowest. The study found that 79% of the world’s population “somewhat” or “strongly” agreed with the statement that vaccines are generally safe. That figure was 72% in North America, 59% in Western Europe, and only 50% in Eastern Europe, while 95% of South Asians and 88% of Central Americans agreed with the statement.

Confidence in vaccines, the Wellcome survey indicates, does not necessarily correlate with trust in all component parts of vaccination programs. Trust in government institutions was generally low where trust in vaccines was low. However, while vaccination programs generate lower levels of trust in developed countries, trust in doctors and nurses, and in

science in general, is higher. The reverse appears true as well. Confidence in science overall was lowest in Latin America, one of the regions with the highest confidence in vaccines. The survey appeared to validate the WHO's focus on doubts about vaccine safety, and the welter of data it produced suggested some causes. The authors note that France, the country with the highest percentage of people who disagreed with a statement that vaccines are generally safe (one in three), has faced a series of vaccine scares and allegations of pharmaceutical influence over national vaccine programs. These appear to play a key role in the relatively low social confidence in vaccination campaigns in that country (Warren, 2019).

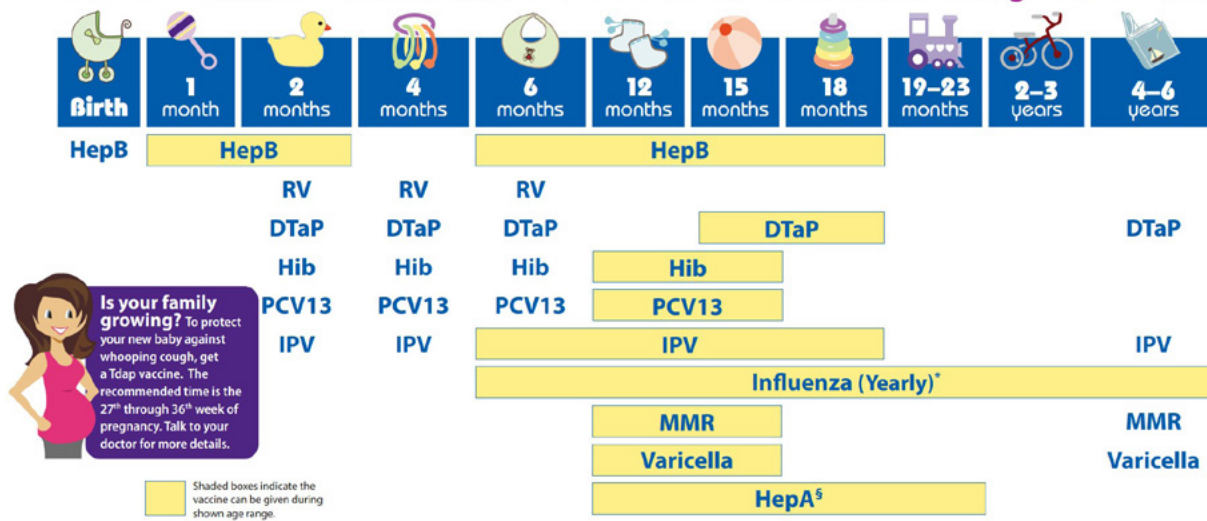
Some of the foundations of mistrust in vaccines are intrinsic to human psychology, while others are contextual and depend on education levels, news media accounts, social norms, and social networks. In many

Misinformation plays a role by creating scares or feeding into doubts that parents may already have developed.

cases, misinformation plays a role by creating scares or feeding into doubts that parents may already have developed. The global measles resurgence can be traced, in part, to a 1998 article in *The Lancet* by a British gastroenterologist, Andrew Wakefield, which suggested that measles vaccination caused childhood autism (Wakefield et al., 1998). The article was later retracted, and Wakefield's medical license revoked for fraud and malpractice (General Medical Council Preliminary Proceedings Committee, 2010), but the meme of a vaccine-autism link continues to circulate in social media. Another major factor undercutting vaccination is the perception in many communities that the diseases targeted by vaccines are no longer a threat to children's health. Fewer clinicians have seen the diseases, which undercuts their ability to give parents a vivid, convincing sense of the dangers those vaccines prevent. As vaccine-preventable diseases fade in perceived importance, possible vaccine harms loom larger (Jacobson, St. Sauver, & Finney Rutten, 2015).

Parental hesitancy about vaccination has a large psychological component (Brewer, Chapman, Rothman, Leask, & Kempe, 2017). Research on risk assessment has shown that vaccination anxiety far exceeds the actual risks because it keys into uncertainty, dread, and the tendency to favor inaction over action in an ambiguous situation (Wroe, Bhan, Salkovskis, & Bedford, 2005). Ironically, the biomedical advances that have enabled the development, licensure, and widespread use of numerous vaccines has resulted in a vaccine schedule that alarms parents, who can intuitively be swayed by the argument that "too many vaccines, too soon" may "overwhelm" a child's immune system (Rodriguez, 2016).

2020 Recommended Immunizations for Children from Birth Through 6 Years Old



Source: Centers for Disease Control and Prevention, February 2020.

Parents may have difficulty digesting the scientific response: that today’s vaccine schedule exposes children to lower quantities of pathogenic particles than in the 1970s, and that a child’s immune system is primed every day by exposure to organisms that dwarf the immunologic “challenge” of vaccines (Offit et al., 2002). Cognitive science has provided many explanations for why parents may prefer to go with a “gut” reaction over scientific evidence (Kolbert, 2017). Survey research indicates that parents with needle anxiety, conviction of moral purity, or openness to conspiracy theories are particularly likely to delay or shun vaccination for their children (Browne, 2018; Callaghan, Motta, Sylvester, Lunz Trujillo, & Blackburn, 2019). The Dunning-Kruger effect (over-regard for one’s understanding of an issue) can also lock in a false understanding of the safety risks of vaccines (Kruger & Dunning, 1999).

In much of the world, vaccination hesitancy is associated with inequities arising from poverty, geographic remoteness, security problems, gender discrimination, and other barriers. Mothers are typically the primary caregivers of children, but their lower status in many communities limits their capacity to act on their own behalf and that of their children. In conflict settings, fear and mistrust of vaccines and the authorities who administer them intensifies with increased fear and suspicion of outsiders. Such tensions have perhaps been a factor in the 2019 measles outbreak in Congo, which caused some 2,000 deaths and 115,000 cases in the first 6 months of the year (WHO, 2019d). That was a more deadly result than the concurrent, and much more well-publicized, Ebola outbreak (WHO, 2019a).

Hesitancy, in general, is a potential threat to any vaccination program at any time, anywhere.

Misinformation has been linked to increased vaccine refusals in Afghanistan, Indonesia, Malaysia, and Pakistan (Ahmed et al., 2018). Disinformation drove a boycott of polio vaccination in Nigeria (Kaufmann & Feldbaum, 2009) and a neonatal tetanus vaccination program in Kenya (Kenya Conference of Catholic Bishops, 2014). Media-

fed and advocacy-led safety concerns caused human papilloma virus (HPV) vaccine coverage to collapse in Japan (Okuhara, Ishikawa, Okada, Kato, & Kiuchi, 2019), Denmark (Suppli et al., 2018), and Ireland; a similar panic triggered decreased vaccination rates in Colombia (Simas, Munoz, Arregoces, & Larson, 2018). The anti-vaccine movement is very small, but when parents are susceptible to fear, it can have great influence by providing false information that appears to confirm their worries.



Since 2010, vaccine-preventable disease outbreaks have been reported in marginalized, hard-to-reach populations in Europe, including anthroposophical communities in Germany and Switzerland; ultra-Orthodox Jewish groups in Belgium, Israel, and the United Kingdom; and Roma and Sinti populations in southeastern Europe. But outbreaks have not been exclusively the province of isolation, as there have also been more generalized outbreaks in France (2011), the United Kingdom (2014), Germany (2015), and Ukraine (2018–19).

THE STRUCTURE AND GROWTH OF VACCINATION PROGRAMS

The formidable logistical challenges of vaccination include creating effective vaccines and testing them extensively for safety and efficacy in real-world settings; these requirements are particularly high for vaccines intended for healthy children. Once national or global agencies have accepted a vaccine as appropriate for a given population, batches must be successfully produced and transported from the manufacturer to individuals and communities in far-flung places. Vaccination programs require extensive planning and resources to address everything from cost to proper storage to the arrangements required to get vaccines and vaccinators to the places they are needed in a timely fashion. Any failure in these arrangements can affect the demand for vaccines and confidence in the enterprise.



Although cruder immunization techniques preceded him, Edward Jenner kicked off what we consider to be the era of vaccination in the late 18th century when he discovered that infection with cowpox, a virus carried by cattle, could protect people against smallpox (Baxby, 1999). Largely thanks to Jenner’s vaccine, the deadly scourge of smallpox, which killed up to 500 million people in the 20th century alone, was declared eradicated globally in 1980 (WHO, 2020b). Vaccination against diphtheria, tetanus, and pertussis (DTP) became widespread starting

in the 1950s in the United States and later in Europe; the successful trial of the inactivated polio vaccine in 1955 was a landmark in the reputation of vaccination, given its efficacy against a widely feared disease that paralyzed and killed people of all ages and classes (Baicus, 2012). Vaccines against measles, mumps, and then rubella were introduced in the 1960s in the United States, followed in the 1980s by vaccines against *Haemophilus influenzae* type B (HiB), and, in the 1990s, by hepatitis B, with hepatitis A, chickenpox, rotavirus, pneumococcus, influenza, and HPV following. The result is that children now generally receive multiple vaccinations against at least 14 diseases (Children’s Hospital of Philadelphia, 2019).

Beginning in the 1970s, the addition of new antigens dramatically expanded the size and complexity of vaccine schedules. Some vaccines, such as DTP, are administered up to five times in the first four years of a child’s life. In the United States, a child could theoretically receive nine vaccinations during a single physician’s visit. In 1984, a child might have gotten three DTP shots, an MMR shot, and two sugar cubes with oral polio vaccine during her first two years of life; today, she might get 22 shots and three doses of oral rotavirus vaccine in that same period (CDC, 2020a). As vaccination programs expand, they increasingly attack childhood diseases that parents are less likely to view as life-threatening—such as mumps and chickenpox—or are unlikely to have heard of, such as rotavirus and pneumococcal disease.

Although the newer vaccines were introduced more slowly in routine schedules—and in Europe, some were not initially included at all—by 2019, most countries recommended routine vaccination against most of these diseases (Vaxopedia, 2017). In each case, the new vaccine was introduced after significant analyses demonstrated the health and health care burden of the targeted disease and the cost-effectiveness of introducing vaccination.

VACCINE SCARES AND THE ROLE OF ANTI-VACCINE MOVEMENTS

Aspects of vaccination that frequently alarm parents often originate in belief systems, or theories of harm, that the anti-vaccine movement has mined in ways that further aggravate such fears. Some of these tropes have existed since the 18th century; they tap into deep-seated ideas about purity, contamination, and conspiracy, and have a rich textual and visual history (Durbach, 2005). These include religious or spiritual beliefs asserting that vaccination contravenes divine will or sullies the body by introducing an unnatural or foreign substance; that drug companies, governments, and health care providers are indifferent to or conspiring to cover up harms from vaccines (Coulter, 1990); and that vaccination mandates abridge liberty or parental authority.



Whatever their ideological or philosophical bent, anti-vaccination materials inevitably come with claims that vaccines are hurting large numbers of healthy children and are often accompanied by personal stories of vaccine injury. Anti-vaccination activists “tell a good story,” often about a healthy child who suffers a heartbreaking physical or mental reversal following vaccination (Brewer et al., 2017).

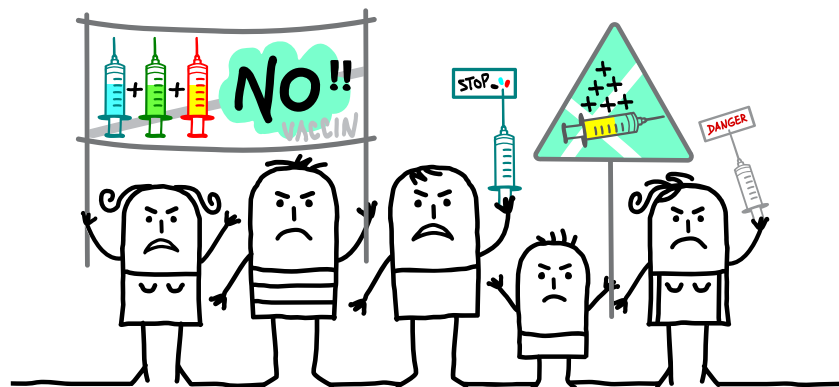
Compelling anti-vaccine messages in the media are not new (Rosner, 2012); indeed, they are nearly as old as vaccination itself. But current media structures have expanded and deepened the reach of troubling messages about vaccines and made them more vivid. Search engine and social media algorithms put anti-vaccine propaganda at virtually anyone’s fingertips, and the internet is something of a hall of mirrors that confirms and expands fearful assumptions (Strandberg, Himmelroos, & Grönlund, 2017). The technology readily allows anti-vaccine activists to expand their movements by carefully targeting users with information in response to their previous browsing habits.

Contemporary Western anti-vaccine movements emerged in the 1970s in response to statements by scientists examining the toxicity of the whole-cell pertussis (whooping cough) vaccine, which produced frequent febrile seizures (Barlow et al., 2001). Although the vaccine had significantly reduced whooping cough, a study by Gordon Stewart claimed that “not less

than 1 in 50,000” pertussis shots resulted in permanent brain damage (Stewart, 1979). Large epidemiological studies eventually concluded that such events were much rarer (Institute of Medicine, 1991), but, to quote Jonathan Swift, “Falsehood flies, and truth comes limping after it, so that when men come to be undeceived, it is too late; the jest is over, and the tale hath had its effect.”

Concerns about the safety of the DTP vaccine provoked a global scare, growing anti-vaccine activism, and dramatic declines in vaccination, perhaps most notably in Sweden and Japan (Baker, 2003), which suspended vaccination against whooping cough altogether. Use of the vaccine declined in England and Wales from 77% to 30% from 1974 to 1978 (CDC, 1982). In all three countries, whooping cough quickly returned as a routine childhood disease. Five thousand English children were hospitalized with it during a 1977–79 epidemic, and hundreds of children were hospitalized in Sweden each year until a new vaccine, lacking the reactivity of the previous one, was introduced in the mid-1990s. Nearly 20% of those hospitalized with pertussis suffered pneumonia or neurological damage (Romanus, Jonsell, & Bergquist, 1987).

The scare reached the United States in the form of a 1982 television “exposé” of the supposed dangers of the shot, accompanied by many lawsuits against the pharmaceutical industry by parents of disabled children. The resulting liability



concerns led many vaccine makers to leave the market, threatening the supply of DTP and other essential vaccines (Hinman, 1984). Worried that manufacturers would withdraw from the vaccine business and threaten supplies, Congress created a no-fault administrative court in 1986 to consider allegations of vaccine harm and provide monetary awards on a case-by-case basis, shielding manufacturers from responsibility (Cook & Evans, 2011).

In the late 1990s, two new theories arose alleging that vaccines were responsible for a burgeoning incidence of childhood autism. Andrew Wakefield’s 1998 *Lancet* paper was widely discussed in the news media, although it was quickly refuted, and an investigation found his work to be fraudulent and unethical. About the same time, federal officials and the American Academy of Pediatrics urged manufacturers to provide DTP, hepatitis B, and Haemophilus influenzae type B (Hib) vaccines in single-dose vials that did not contain the

mercury-containing preservative thimerosal (Halsey, 1999). The July 1999 recommendation reflected an abundance of caution in response to Environmental Protection Agency (EPA) data on potential neurodevelopmental impacts of mercury exposure. But few other countries followed suit, and repeated studies have not supported a link between autism and either the MMR vaccine or thimerosal (Baker, 2008).

The idea of neurological problems resulting from vaccination continues to circulate in corners of social media where allegations of government and scientific cover-ups prosper.

Yet the idea of neurological problems resulting from vaccination continues to circulate in corners of social media where allegations of government and scientific cover-ups prosper and has often become a political issue. Wakefield, environmental lawyer Robert F. Kennedy Jr., and others have traveled around the United States filing suits against states and manufacturers in a well-funded effort to encourage parents to shun vaccination (Kim, 2019).

The theory of an autism link to vaccines caught hold among parents worried about environmental contaminants and their impact on child development. The scare corresponded with a rapid increase in the diagnoses of autism and a community of parents seeking explanations for that. Although changes in diagnostic criteria and guidelines aimed at earlier recognition and interventions to treat autistic children were largely responsible for the growing incidence (Spence, Sharifi, & Wiznitzer, 2004), a secular increase has not been ruled out (Arvidsson, Gillberg, Lichtenstein, & Lundström, 2018). Older parenting, maternal viral infections, and exposure to environmental toxins are generally considered the most likely contributors to any true increase. Nonetheless, lacking clear answers, some parents concluded they should avoid “too many” vaccines “too soon” (Cooke & Lewandowsky, 2012).

While fears of cognitive damage dominate in the United States, other anxieties have aroused suspicion of vaccination campaigns elsewhere. In Kenya, a Catholic doctors’ association has accused the government of putting an abortifacient chemical in tetanus vaccines (Kenya Conference of Catholic Bishops, 2014) and in some Muslim countries, allegations that polio vaccines are laced with HIV or birth control drugs have spread (Murakami et al., 2014). Vaccine scares seldom remain confined to the country in which they originate, although they don’t spread uniformly. For example, the MMR vaccine scare found traction in the Somali immigrant community in Minnesota, while Japan’s HPV scare spread to Denmark, Colombia, and Ireland (Larson, Wilson, Hanley, Parys, & Paterson, 2014).

SOCIAL MEDIA AND PUBLIC HEALTH RESPONSE

Vaccination programs rely on fragile networks of trust, especially when public confidence in the government and the pharmaceutical industry is weak. This means that public health officials may need to carefully consider whether some approaches to vaccine promotion could backfire by feeding public perceptions of an unholy alliance among manufacturers, public health, and doctors.



Politicians have, at times, openly instrumentalized disease and vaccine scares for political purposes. In 1976, Gerald Ford was worried about appearing weak during his presidential campaign when he pushed for swine flu vaccination of the entire country, long after it became evident that the virus was not nearly as serious as public health officials had originally feared. In Ukraine in 2009, Prime Minister Yulia Tymoshenko, then running for office, closed schools and banned mass gatherings in an overwrought response to the possibility of another swine flu epidemic (Hong,

2014). In these and similar instances, exaggerating the threat of a vaccine-preventable disease hurt confidence in the reliability of the government's advocacy for vaccination. Similarly, the political opposition in Indonesia (Rose, 2018) and India (Purnell, 2019) have spread false rumors about vaccines on social media in attempts to paint governments in a bad light.

Sometimes, the underlying concerns about vaccination are aggravated by governmental missteps. In 2013, the Japanese government suspended its recommendation for routine HPV vaccination after a series of alleged adverse events were reported in the Japanese news media. As in the thimerosal episode in the United States, an initial precautionary step appears to have increased fears of the vaccine despite subsequent and swift reassurances that the vaccine was safe (Larson et al., 2014). In the Philippines, deaths during a vaccination campaign against dengue fever, allegedly caused by cross-reactivity with existing dengue fever antibodies, undermined confidence in vaccination campaigns in general. In a country whose immunization system was already flawed, the dengue vaccine scare contributed to a plunge in acceptance of measles vaccination; significant outbreaks quickly followed (Seeman & Mukerjee, 2019), with 37,000 measles cases reported in 2019 alone (WHO, 2020a). In Pakistan, the revelation that the CIA had used a fake hepatitis B vaccination campaign in

2011 to locate Osama bin Laden caused militants to target vaccinators as suspected foreign spies (Gostin, 2014). This and other factors have contributed to low levels of trust in the polio vaccination campaign along the Afghan-Pakistan border, where scores of vaccinators have been killed (Hussain, Boyle, Patel, & Sullivan, 2016).

Fragile confidence in immunization campaigns puts public health officials in difficult positions as they consider how to communicate potential risks that surface during post-marketing monitoring of vaccination campaigns. Following the swine flu epidemic of 2009, critics accused European health officials of having suppressed or ignored evidence of an increased risk of narcolepsy in children who received the Pandemrix flu vaccine, which contained a new adjuvant designed to improve immune response (Doshi, 2018). Confidence was also undercut by claims that the WHO had exaggerated the threat of the H1N1 virus in order to boost the income of vaccine makers (Schnirring, 2010).

Mistaken policies can cause mistrust in the vaccine enterprise in less dramatic ways as well. When Merck attempted to accelerate the rollout of its new HPV vaccine in 2006 with an ad and lobbying campaign, it provoked criticism, not only from parents concerned about the supposed “moral hazard” of a vaccine against a sexually transmitted virus, but also from public health figures accustomed to more gentle introduction of pediatric vaccines for widespread use. Noting that HPV infections did not spread in schools, and complaining of the \$300 cost for three doses, some officials saw the push as rushed and imprudent (Schwartz, Caplan, Faden, & Sugarman, 2007).

Vaccination campaigns may also generate resentment and opposition in the context of poor overall health care services. Repeated polio eradication campaigns in poor areas of India and Pakistan have sometimes encountered outrage because health systems in these areas aren't meeting basic needs (Alexander, Zubair, Khan, Abid, & Durry, 2014). Similar distrust may arise when vaccines against diseases that are not generally understood as life-threatening, such as rotavirus or chickenpox, are introduced in communities where people struggle with basic health care coverage.

One author has written that while “harmonizing vaccine schedules across countries in Europe might please politicians, it doesn't impress parents.” Blaming vaccine hesitation on



anti-vaccine activists “obscures the possibility that resistance to vaccination may somehow reflect failings in the way vaccination programs work, or still more fundamental anxieties,” such as a more diffuse sense of dissatisfaction and concern about “increasingly technological and dehumanized medical practice” (Blume, 2017).

HESITANCY IN A NEW MEDIA ENVIRONMENT

The anti-vaccine movement is still tiny, but in some places, aided by the amplifying power of the internet and social media, which makes tendentious, distorted, or incorrect information readily available, it has gained prominence out of proportion to its size. Still, it is important not to equate those who have doubts and questions about vaccines with vaccination’s foes. A high degree of vaccination hesitancy does not automatically equate with low vaccine uptake if the logistical, legal, and cultural supports for vaccination are strong enough in a given country or setting.

That said, the media structures that inform popular understandings pose new challenges, though it is not clear that sources of bad information have become more influential than they were in the past. Until recently, when Google altered its search algorithm, anti-vaccine websites appeared prominently in routine searches about vaccines. The same was true of Facebook and Instagram before they began filtering anti-vaccine misinformation. Vaccine queries on Amazon still steer the searcher immediately to anti-vaccine literature. Social media are structured to intensely focus and channel information to affinity groups based on friendship, neighborhoods, and parental status, as well as on cultural (lifestyle) and political affiliations. Influential parties on social media often cherry-pick findings that fit preconceived notions and create spurious patterns of fact (Evrony & Caplan, 2017). The spread of tendentious information accelerates when opponents of vaccination use the anonymity of social media to multiply false or conflicting messages (Kata, 2012).

Although most anti-vaccine propaganda originates in groups with genuine anti-vaccine beliefs, researchers recently discovered that social media trolls affiliated with a Russian intelligence service had been spreading pointed commentaries about vaccines, with the apparent intent of sowing discord around an issue perceived to be divisive in the United States (Broniatowski et al., 2018). In public health and



medicine, fears of vaccination are countered with scientific evidence for vaccine safety. But since proponents of an anti-vaccine message also claim to

use “evidence” to make their case, confidence in vaccines may be modulated through an individual’s trust in the authority of the government, established medicine, and the prescription drug industry. Because cases of vaccine-preventable illness are hard to find in countries where the disease burden is low and parents of unvaccinated children who become ill may be reluctant to share their stories, it can be difficult to offer a counter-narrative to claims about children allegedly hurt by vaccines. As DiResta and Wardle (this volume) point out, science-based information on vaccines is seldom produced by people who are inclined to create “content that is engaging, dynamic, and is designed to touch people’s emotions.” But, clearly, there is an unmet need for stories to counter the alarm generated by foes of vaccination.

Clearly, there is an unmet need for stories to counter the alarm generated by foes of vaccination.

People tend to reject information that runs counter to their existing biases or the beliefs of their affinity groups (Bahns, Crandall, Gillath, & Preacher, 2017). Such confirmation bias is an increasing threat in an environment of intensifying political and cultural polarization. As sociologist Damon Centola has noted, just the knowledge that a social media post is from someone of a different political party is often enough to turn an individual off to its message (Guilbeault, Becker, & Centola, 2018). In the United States, vaccination advocates have grown concerned that political polarization could alter social norms around vaccination. The issue surfaced during the 2018–19 measles outbreak, which led 24 states to consider tightening vaccine exemption laws. In many of these states, legislators have taken sides along partisan lines, with Republican legislators arguing that new limits on vaccine exemptions would unjustifiably sacrifice parental rights (Allen, 2019b). While beliefs are polarized around the duties of parents to vaccinate their children, a high percentage of Americans of both parties distrust the drug industry (Politico & Harvard T.H. Chan School of Public Health, 2019), and there is no evidence they consider vaccine manufacturers differently (Reich, 2016).

The easy availability of medical information of widely varying quality has forced clinicians to reassess how they manage communications with parents (Neuberger, 2000). In many subcultures, there is an expectation that patients—or in this case, parents—will educate themselves before accepting medical recommendations. Medical paternalism is no longer routinely accepted. In the United States, the increased consolidation of medicine into large group practices, frequent changes in medical staff, administrative workload, and consequent

medical burnout are seen by many as having weakened the patient-doctor bond (Enke, 2018). The growth of customer ratings puts pressure on doctors to “please” their patients, and could, in principle, lead them to bend the vaccine schedule in response to parental doubts. It might also improve attentiveness to parental concerns and questions, but this is tempered by time pressures, which limit the ability of pediatricians to engage in lengthy conversations. Yet numerous studies have shown that a parent’s relationship with their child’s provider is key to instilling trust in vaccination (Larson, 2018).

WHAT WE KNOW AND DON'T KNOW, AND WHAT WE STILL NEED TO DO

In response to the 2014 SAGE report’s call for better metrics on hesitancy, the WHO has sought information from member countries about vaccination concerns. Meanwhile, several groups have created survey tools to assess the nature and degree of hesitancy (Betsch et al., 2018), and a number of recommendations for reducing it have been advanced. More research is needed to understand the problem, because there is not yet strong evidence to recommend interventions that effectively address vaccination hesitancy in every situation and setting.

A continuum of approaches, ranging from entirely voluntary to gently coercive mandates, has shown different degrees of efficacy in increasing immunization rates.

Much of what we have learned so far about improving vaccine confidence centers on what *doesn't* work. The latter includes many strategies to change parents’ thoughts and feelings about vaccines, and efforts to try to convince people to vaccinate their children

if they have already decided against it (Thomson et al., 2016; Brewer et al., 2017). Studies of Europe’s vaccination hesitancy landscape over the past decade found that confrontation and adversarial situations rarely change outcomes. Public health officials and governments have recognized that there is no single solution, given the relevance of local context. The efficacy of evidence-based practices or communication strategies for convincing vaccine-hesitant parents is not well-established, but it is essential to address the widely heterogeneous group. Mandates may be effective in raising vaccine uptake but can also bring a level of discord to public discussions. An in-depth 2018 Sabin Vaccine Institute study of recent legislation in Europe found that a continuum of approaches, ranging from entirely voluntary to gently coercive mandates, has shown different degrees of efficacy in increasing immunization rates. This study, too, concluded that no one approach could be appropriate for all settings (Sabin Vaccine Institute, 2018).

MANDATES AND INCENTIVES

In addition to efforts that build on favorable intent—such as reducing logistical barriers to vaccination and providing reminders, based on the presumption that parents intend to vaccinate their children—policymakers may consider shaping behavior through mandates, incentives, or sanctions. These range in severity from pay incentives to physicians to withholding public benefits or even jailing parents who refuse vaccination for their children. Mandates are a controversial area, one in which policymakers must be attuned to national traditions and attitudes on vaccination responsibilities. Studies generally show that requiring vaccination can improve vaccine uptake in high-income countries, but there is limited evidence of the impact in low- or middle-income countries (Omer, Betsch, & Leask, 2019). Compulsory vaccination programs have had varying degrees of success, and experts who have studied them recommend that policymakers pay careful attention to context and ethical concerns before creating or enforcing mandates.

The first efforts to require vaccination were harsh and created a major backlash. Beginning in 1853, Britain confiscated property and declined to make welfare payments to those who refused smallpox vaccination. The vaccines of the time frequently caused severe adverse reactions, and the laws inspired a nationwide protest movement that reviled mandatory vaccination as illiberal, iniquitous, and a violation of citizens' privacy (Durbach, 2005) until the law was lifted in 1907. In the United States, 19th-century German immigrants' disgust with their home country's harsh vaccination regime was so intense that they shunned the smallpox vaccine in their adopted country merely because the federal Public Health Service ordered it (Leavitt, 1996).



Mandatory vaccination has been an element of the U.S. public health system for more than a century, with increasing enforcement since the late 1960s. At that time, federal officials pursuing the elimination of measles nudged states to enforce school-age vaccination requirements, and by 1980, those laws were on the books in all 50 states (Hinman, Orenstein, & Papania, 2004). While officials frustrated by lagging vaccination in certain communities have on occasion called for federal mandates (Parmet, 2019), state laws, while not uniform, have fostered local control and cultural accommodation, coupled with competition among neighboring states to keep vaccination levels strong.

Most countries outside the United States do not mandate childhood vaccines as a condition of school entry, although Argentina, China, France, Italy, and several Eastern European countries are notable exceptions (Holzmann & Wiedermann, 2019). In Japan and most of Western Europe, governments offer recommended vaccines for free but do not require them; in many countries, the government funds required vaccines while private sources must be used to cover others. In the United Kingdom, the state incentivizes general practitioners who provide recommended vaccinations to a certain percentage of their patients. A trend toward tightening vaccine requirements or adding vaccines to required schedules has emerged in a few European countries and in Australia in recent years (Bozzola et al., 2018).



All U.S. states allow children with medical contraindications to avoid vaccination, but California, Maine, and New York recently joined Mississippi and West Virginia in banning all non-medical exemptions. Forty-five U.S. states permit religious exemptions to vaccination, and 15 allow philosophical (sometimes called “personal belief”) exemptions (National Conference of State Legislators, 2020). Mandatory school-age vaccination laws are generally regarded as a success in the United States because high rates of vaccination have maintained herd immunity

against most diseases, despite the controversies in some communities. Australia, Belgium, France, Italy, and other countries that have enforced mandates for some vaccines have also found evidence that this leads to higher uptake (Ricciardi, Boccia, & Siliquini, 2018). During the whooping cough vaccine scare of the 1970s and 1980s, and again during the autism controversy, U.S. public health officials could point to relatively stable vaccination levels among American children. In the United Kingdom, by contrast, plunging DTP vaccination uptake in 1974 caused a massive increase of infections and hospitalization; likewise, the autism scare of the early 2000s coincided with a decline in MMR vaccination, thousands of reported measles cases, and some deaths.

Mandatory vaccination regimens can cause unintended harm if they are associated with other unpopular policies. The former Soviet bloc countries had strong vaccination requirements and high uptake rates, but with the collapse of the Soviet Union, alternative theories and disinformation challenged relatively weak states and damaged their authority to implement the vaccination rigor that had been associated with the Communist past.

For years, Ukraine has had the lowest childhood vaccination rate in Europe, with frequent measles epidemics that also sparked outbreaks in other countries (McDonald et al., 2019).

Because of an MMR scare, a measles vaccination campaign that targeted 7.5 million Ukrainians reached only 116,000. Romania, Serbia, and Poland have each seen large protests against compulsory vaccination laws (Miner, 2018). And in Germany, angry reactions to limited compulsory vaccination requirements actually increased resistance to vaccines that are recommended, but not required (Betsch & Böhm, 2015).



Some authors have argued that while compulsory vaccination may be effective, mandates will generally be accepted only if they are accompanied by strong immunization programs that guarantee reliable access to an adequate supply of safe and effective vaccines—as well as a compensation program for those who suffer post-vaccination injuries (MacDonald et al., 2018; Salmon et al., 2006).

However, few countries have such compensation programs in place (Attwell, Drislane, & Leask, 2019). Mandates are often inspired by the perception among politicians and the public that vaccine refusal by parents is the biggest barrier. But poverty, social exclusion, and access difficulties also depress rates; in many settings, that has a more significant impact than refusal. In Germany, for example, barriers to access probably explain why children of immigrant parents have a 10% lower immunization rate for booster doses (such as for tetanus or HPV) than children who were born there (Giambi et al., 2019).

As mandates went into effect in the 1970s in the United States, critics observed that they were an exception to the general trend away from paternalism in medicine in democratic countries (Larson, Cooper, Eskola, Katz, & Ratzan, 2011), since school-entry requirements in effect offer most parents little choice (Colgrove, 2006). The bioethicist LeRoy Walters argued in 1978 that mandates obliged the state to provide an easy-to-navigate system for people who believed their children were harmed by required vaccines (United States Congress, 1999). Eventually, such a system was established in the United States, but it was fundamentally designed to protect the vaccine industry from lawsuits. Some have argued that the most effective approach to mandating vaccination is to allow non-medical exemptions, but to make them hard to obtain (Salmon & Omer, 2006). Otherwise, such mandates may place unfair demands on individuals who have logistical difficulties accessing vaccination. Penalties for failure to comply are likely to worsen inequity by disproportionately affecting the poor, and in undemocratic countries, restrictive laws and regulations can easily be abused, they point out. Finally, creating more difficulties for exemption is likely to increase the anger and activism of those who refuse vaccination (Omer et al., 2019).

CONCLUSION

Experts at Gavi, the WHO, UNICEF, and elsewhere believe it is important not to make the countering of anti-vaccine messages the focus of immunization campaigns (WHO, 2018). Instead, doubts should be supplanted with confidence and appeals to the benefits of vaccination, with the idea of building a broad social movement that embraces it. Gavi calls for well-designed and well-executed interventions that engage and mobilize caregivers, communities, and others to increase coverage and equity and reduce dropout and missed opportunities to vaccinate, while building resilience against vaccine safety scares, rumors, and misinformation (Gavi, the Vaccine Alliance, 2020).

Global vaccine agencies and non-governmental organizations increasingly frame vaccination acceptance as “demand promotion.” Demand promotion aims to ensure that all parents, caregivers, and other key partners value and trust immunization; have the necessary information, capacity, and motivation to seek out services; and actively pursue immunization for their children. The goal of demand promotion is to help build up vaccination as a positive social norm—one that embodies resilient and sustained demand across the life-course of individuals and throughout the community.

Building a consensus about the soundness of vaccination campaigns is key to bolstering demand and support for vaccines.

Most people in any setting passively accept vaccination as a normative behavior.

In general, this serves society well by maintaining high levels of vaccination.

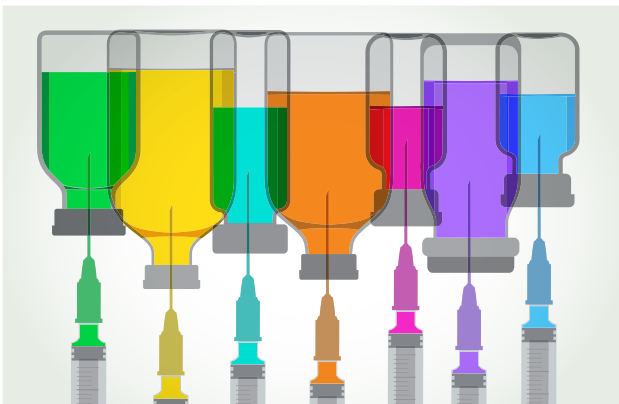
However, passive acceptance is vulnerable

to vaccine safety fears, poor service quality, out-of-pocket expenses, misperceptions and myths, any of which can lead to hesitancy or outright refusal to vaccinate (Faulkner, Brown, & Quinn, 2018). A study on the impact of climate change denial showed that people who believe scientists disagree on global warming also feel less certain that it is occurring, and are less supportive of restorative climate policy. The authors argue that this indicates the potential importance of correcting misperceptions about the scientific consensus on global warming (Ding, Maibach, Zhao, Roser-Renouf, & Leiserowitz, 2011). The same might be said for vaccination; building a consensus about the soundness of vaccination campaigns is key to bolstering demand and support for vaccines. Creating resiliency in lower-income countries will hopefully prevent mistrust of vaccines from developing into the serious issue it has become in the United States or Europe.

Scholars who have recently examined the hesitancy issue agree that vaccination programs and providers need more evidence-based tools to efficiently convince vaccine-hesitant patients and parents. This clearly requires communication strategies that consider the context of science and vaccine literacy, social media, and other sources of popular information and influence. Recently, scholars at the London School of Hygiene & Tropical Medicine created the Vaccine Confidence Project, an effort to track vaccine confidence around the world and provide insights into the causes of hesitancy and effective social and behavioral science approaches to deal with them.



While few strategies have been evaluated, there is a growing consensus about the need to bolster awareness of the positive impact of vaccination. One new strategy is to add educational materials about vaccination to health programs for middle-school and older children. Since vaccine scares can derail immunization programs in ways that are costly to repair, interventions that promote demand and community resilience in favor of vaccination are key. Resilience, in the context of public health campaigns, might be defined as the degree to which a system or community expresses capacity for learning and adaptation, and the ability to bounce back in the face of turbulence. A resilient community is one in which demand for vaccination is an inherent part of the community; for this reason, UNICEF in 2018 created a Demand Hub to support collaborative efforts on immunization demand among immunization partners, donors, and countries, and to improve the support and technical assistance offered to countries to drive and maintain demand (UNICEF, 2018).



Gavi's partners have likewise designed a framework to generate demand. This includes enhancing service quality and accountability to ensure that parents and caregivers have a positive experience at a health facility; engaging communities to continually reinforce positive social norms toward immunization while providing reminders and nudges for vaccination; and managing risks and building resilience by

having rapid response plans in place to counter scares, with ongoing media monitoring and social listening to stay on the qui vive. They also recommend that immunization programs

build political will from the grassroots level upward to make sure vaccination programs are prioritized and resourced. The framework includes a call for countries to develop strategies for understanding vulnerable populations and the barriers they face, and equipping health care providers with tools to communicate with parents about vaccines. In some communities, awareness of the right to be vaccinated may be key (Gavi, the Vaccine Alliance, 2020).

While research to identify optimal approaches remains critical, positive action to reinforce vaccination can't wait for perfect solutions. Recognizing that context is crucial to any action plan, public health officials, clinicians, and others dedicated to the benefits of vaccination need to deepen their outreach to affected groups as they continue to pursue new strategies for rebuilding confidence in vaccination.



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REFERENCES

- Ahmed, A., Lee, K. S., Bukhsh, A., Al-Worafi, Y. M., Sarker, Md. M. R., Ming, L. C., & Khan, T. M. (2018). Outbreak of vaccine-preventable diseases in Muslim majority countries. *Journal of Infection and Public Health*, *11*(2), 153–155. <https://doi.org/10.1016/j.jiph.2017.09.007>
- Alexander, J. P., Jr., Zubair, M., Khan, M., Abid, N., & Durry, E. (2014). Progress and peril: Poliomyelitis eradication efforts in Pakistan, 1994–2013. *Journal of Infectious Diseases*, *210*(1), S152–S161. <https://doi.org/10.1093/infdis/jiu450>
- Allen, A. (2007). *Vaccine: The controversial story of medicine's greatest lifesaver*. New York, NY: W. W. Norton.
- Allen, A. (2019a, June 19). Study: Around the world, troubling levels of vaccine mistrust. *Politico*. Retrieved March 26, 2019, from <https://www.politico.com/story/2019/06/19/study-vaccine-mistrust-1370526>
- Allen, A. (2019b, May 27). How the anti-vaccine movement crept into the GOP mainstream: 'Appeals to freedom are like the gateway drug to pseudoscience.' *Politico*. Retrieved March 26, 2020, from <https://www.politico.com/story/2019/05/27/anti-vaccine-republican-mainstream-1344955>
- Arvidsson, O., Gillberg, C., Lichtenstein, P., & Lundström, S. (2018). Secular changes in the symptom level of clinically diagnosed autism. *Journal of Child Psychology and Psychiatry*, *59*(7), 744–751. <https://doi.org/10.1111/jcpp.12864>
- Attwell, K., Drislane, S., & Leask, J. (2019). Mandatory vaccination and no-fault vaccine injury compensation schemes: An identification of country-level policies. *Vaccine*, *37*(21), 2843–2848. <https://doi.org/10.1016/j.vaccine.2019.03.065>
- Bahns, A. J., Crandall, C. S., Gillath, O., & Preacher, K. J. (2017). Similarity in relationships as niche construction: Choice, stability, and influence within dyads in a free choice environment. *Journal of Personality and Social Psychology*, *112*(2), 329–355. <https://doi.org/10.1037/pspp0000088>

- Baicus, A. (2012). History of polio vaccination. *World Journal of Virology*, 1(4), 108–114. <https://doi.org/10.5501/wjv.v1.i4.108>
- Baker, J. P. (2003). The pertussis vaccine controversy in Great Britain, 1974–1986. *Vaccine*, 21(25–26), 4003–4010. [https://doi.org/10.1016/s0264-410x\(03\)00302-5](https://doi.org/10.1016/s0264-410x(03)00302-5)
- Baker, J. P. (2008). Mercury, vaccines, and autism. *American Journal of Public Health*, 98(2), 244–253. <https://doi.org/10.2105/AJPH.2007.113159>
- Barlow, W. E., Davis, R. L., Glasser, J. W., Rhodes, P. H., Thompson, R. S., Mullooly, J. P., ... Chen, R. T. (2001). The risk of seizures after receipt of whole-cell pertussis or measles, mumps, and rubella vaccine. *New England Journal of Medicine*, 345(9), 656–661. <https://doi.org/10.1056/NEJMoa003077>
- Baxby, D. (1999). Edward Jenner's inquiry: A bicentenary analysis. *Vaccine*, 17(4), 301–307. [https://doi.org/10.1016/s0264-410x\(98\)00207-2](https://doi.org/10.1016/s0264-410x(98)00207-2)
- Beard, F. H., Hull, B. P., Leask, J., Dey, A., & McIntyre, P. B. (2016). Trends and patterns in vaccination objection, Australia, 2002–2013. *Medical Journal of Australia*, 204(7), 275. <https://doi.org/10.5694/mja15.01226>
- Betsch, C. & Böhm, R. (2015). Detrimental effects of introducing partial compulsory vaccination: Experimental evidence. *The European Journal of Public Health*, 26(3), 378–381. <https://doi.org/10.1093/eurpub/ckv154>
- Betsch, C., Schmid, P., Heinemeier, D., Korn, L., Holtmann, C., & Böhm, R. (2018). Beyond confidence: Development of a measure assessing the 5C psychological antecedents of vaccination. *PLOS ONE*, 13(12), e0208601. <https://doi.org/10.1371/journal.pone.0208601>
- Blume, S. (2017). *Immunization: How vaccines became controversial*. London: Reaktion.
- Bozzola, E., Spina, G., Russo, R., Bozzola, M., Corsello, G., & Villani, A. (2018). Mandatory vaccinations in European countries, undocumented information, false news and the impact on vaccination uptake: The position of the Italian pediatric society. *Italian Journal of Pediatrics*, 44(1), 67. <https://doi.org/10.1186/s13052-018-0504-y>

- Brewer, N. T., Chapman, G. B., Rothman, A. J., Leask, J., & Kempe, A. (2017). Increasing vaccination: Putting psychological science into action. *Psychological Science in the Public Interest*, 18(3), 149–207. <https://doi.org/10.1177/1529100618760521>
- Broniatowski, D. A., Jamison, A. M., Qi, S., AlKulaib, L., Chen, T., Benton, A., ... Dredze, M. (2018). Weaponized health communication: Twitter bots and Russian trolls amplify the vaccine debate. *American Journal of Public Health*, 108(10), 1378–1384. <https://doi.org/10.2105/ajph.2018.304567>
- Browne, M. (2018). Epistemic divides and ontological confusions: The psychology of vaccine scepticism. *Human Vaccines & Immunotherapeutics*, 14(10), 2540–2542. <https://doi.org/10.1080/21645515.2018.1480244>
- Callaghan, T., Motta, M., Sylvester, S., Lunz Trujillo, K., & Blackburn, C. C. (2019). Parent psychology and the decision to delay childhood vaccination. *Social Science & Medicine*, 238, 112407. <https://doi.org/10.1016/j.socscimed.2019.112407>
- Centers for Disease Control and Prevention. (1982). International notes pertussis—England and Wales. *Morbidity and Mortality Weekly Report*, 31(47), 629–631. Retrieved March 26, 2020, from <https://www.cdc.gov/mmwr/preview/mmwrhtml/00001197.htm>
- Centers for Disease Control and Prevention. (2020a). *2020 recommended immunizations for children from birth through 6 years old*. Retrieved March 26, 2020, from <https://www.cdc.gov/vaccines/schedules/easy-to-read/child-easyread.html>
- Centers for Disease Control and Prevention. (2020b). *Measles cases and outbreaks*. Retrieved March 26, 2020, from <https://www.cdc.gov/measles/cases-outbreaks.html>
- Children’s Hospital of Philadelphia. (2019, December 18). Vaccine history: Developments by year. Retrieved March 26, 2020, from <https://www.chop.edu/centers-programs/vaccine-education-center/vaccine-history/developments-by-year>
- Colgrove, J. (2006). *State of immunity: The politics of vaccination in twentieth-century America*. Berkeley, CA: University of California Press.

- Cook, K. M., & Evans, G. (2011). The national vaccine injury compensation program. *Pediatrics*, *127*(1), S74–S77. <https://doi.org/10.1542/peds.2010-1722K>
- Cooke, J., & Lewandowsky, S. (2012). *The debunking handbook* [Epub]. Retrieved March 26, 2020, from https://skepticalscience.com/docs/Debunking_Handbook.pdf
- Coulter, H. L. (1990). *Vaccination, social violence, and criminality: The medical assault on the American brain*. Berkeley, CA: North Atlantic Books.
- Ding, D., Maibach, E. W., Zhao, X., Roser-Renouf, C., & Leiserowitz, A. (2011). Support for climate policy and societal action are linked to perceptions about scientific agreement. *Nature Climate Change*, *1*(9), 462–466. <https://doi.org/10.1038/nclimate1295>
- Doshi, P. (2018). Pandemrix vaccine: Why was the public not told of early warning signs? *BMJ*, *362*, k3948. <https://doi.org/10.1136/bmj.k3948>
- Durbach, N. (2005). *Bodily matters: The anti-vaccination movement in England, 1853–1907*. Durham, NC: Duke University Press.
- Enke, R. (2018, February 25). The patient-physician relationship is in critical condition [Blog post]. *KevinMD.com*. Retrieved March 26, 2020, from <https://www.kevinmd.com/blog/2018/02/patient-physician-relationship-critical-condition.html>
- Evrony, A., & Caplan, A. (2017). The overlooked dangers of anti-vaccination groups' social media presence. *Human Vaccines & Immunotherapeutics*, *13*(6), 1475–1476. <https://doi.org/10.1080/21645515.2017.1283467>
- Faulkner, L., Brown, K., & Quinn, T. (2018). Analyzing community resilience as an emergent property of dynamic social-ecological systems. *Ecology and Society*, *23*(1), 24. <https://doi.org/10.5751/es-09784-230124>
- Finnegan, G. (2012, April 25). Pharmacists can play key role in immunization. *VaccinesToday*. Retrieved March 26, 2020, from <https://www.vaccinestoday.eu/stories/pharmacists-can-play-key-role-in-immunisation>

- Gavi, the Vaccine Alliance. (2020). Additional guidance by topic. Retrieved March 26, 2020, from <https://www.gavi.org/support/process/apply/additional-guidance>
- General Medical Council Preliminary Proceedings Committee; Professional Conduct Committee (Procedure) Rules Order of Council 1988. *Andrew Wakefield, determination of serious professional misconduct*. (2010, May 24). Retrieved March 26, 2020, from https://web.archive.org/web/20110809092833/http://www.gmc-uk.org/Wakefield_SPM_and_SANCTION.pdf_32595267.pdf
- Giambi, C., Del Manso, M., Marchetti, G., Olsson, K., Ali, K. A., & Declich, S. (2019). Immunisation of migrants in EU/EEA countries: Policies and practices. *Vaccine*, *37*(36), 5439–5451. <https://doi.org/10.1016/j.vaccine.2019.06.068>
- Gostin, L. O. (2014). Global polio eradication: Espionage, disinformation, and the politics of vaccination. *Milbank Quarterly*, *92*(3), 413–417. <https://doi.org/10.1111/1468-0009.12065>
- Gowda, C. & Dempsey, A. F. (2013). The rise (and fall?) of parental vaccine hesitancy. *Human Vaccines & Immunotherapeutics*, *9*(8), 1755–1762. <https://doi.org/10.4161/hv.25085>
- Greene, S. A., Ahmed, J., Datta, D., Burns, C. C., Quddus, A., Vertefeuille, J. F., & Wassilak, S. G. F. (2019). Progress toward polio eradication — Worldwide, January 2017–March 2019. *Morbidity and Mortality Weekly Report*, *68*(20), 458–462. <https://doi.org/10.15585/mmwr.mm6820a3>
- Guilbeault, D., Becker, J., & Centola, D. (2018). Social learning and partisan bias in the interpretation of climate trends. *Proceedings of the National Academy of Sciences*, *115*(39), 9714–9719. <https://doi.org/10.1073/pnas.1722664115>
- Halsey, N. A. (1999). Limiting infant exposure to thimerosal in vaccines and other sources of mercury. *JAMA*, *282*(18), 1763–1766. <https://doi.org/10.1001/jama.282.18.1763>
- Hickler, B., MacDonald, N. E., Senouci, K., & Schuh, H. B., & the Informal Working Group of Vaccine Demand. (2017). Efforts to monitor global progress on individual and community demand for immunization: Development of definitions and indicators for the Global Vaccine Action Plan Strategic Objective 2. *Vaccine*, *35*(28), 3515–3519. <https://doi.org/10.1016/j.vaccine.2017.04.056>

- Hinman, A. R. (1984). The pertussis vaccine controversy. *Public Health Reports*, 99(3), 255–259. Retrieved March 26, 2020, from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1424579>
- Hinman, A. R., Orenstein, W. A., & Papania, M. J. (2004). Evolution of measles elimination strategies in the United States. *Journal of Infectious Diseases*, 189(1), S17–S22. <https://doi.org/10.1086/377694>
- Holzmann, H., & Wiedermann, U. (2019). Mandatory vaccination: Suited to enhance vaccination coverage in Europe? *Eurosurveillance*, 24(26). <https://doi.org/10.2807/1560-7917.es.2019.24.26.1900376>
- Hong, C. (2014, December). The polarization of disease. *The Princeton Review*. Retrieved from <https://pphr.princeton.edu/2014/12/07/the-politicization-of-disease>
- Hussain, S. F., Boyle, P., Patel, P., & Sullivan, R. (2016). Eradicating polio in Pakistan: An analysis of the challenges and solutions to this security and health issue. *Globalization and Health*, 12(1), 1–9. <https://doi.org/10.1186/s12992-016-0195-3>
- Institute of Medicine. (1991). *Adverse effects of pertussis and rubella vaccines*. Washington, DC: National Academies Press.
- Jacobson, R. M., St. Sauver, J. L., & Finney Rutten, L. J. (2015). Vaccine hesitancy. *Mayo Clinic Proceedings*, 90(11), 1562–1568. <https://doi.org/10.1016/j.mayocp.2015.09.006>
- Kata, A. (2012). Anti-vaccine activists, Web 2.0, and the postmodern paradigm – An overview of tactics and tropes used online by the anti-vaccination movement. *Vaccine*, 30(25), 3778–3789. <https://doi.org/10.1016/j.vaccine.2011.11.112>
- Kaufmann, J. R., & Feldbaum, H. (2009). Diplomacy and the polio immunization boycott in northern Nigeria. *Health Affairs*, 28(4), 1091–1101. <https://doi.org/10.1377/hlthaff.28.4.1091>
- Kenya Conference of Catholic Bishops. (2014, October 7). *Press statement by the Catholic Health Commission of Kenya—Kenya Conference of Catholic Bishops on the National Tetanus Vaccination Campaign scheduled for 13th – 19th October 2014*. Retrieved March 26, 2020, from <http://www.kccb.or.ke/home/news-2/press-statement-5>

- Kim, C. (2019, May 15). Anti-vaccination rallies are drawing crowds—even during the measles epidemic. *Vox*. Retrieved March 26, 2020, from <https://www.vox.com/science-and-health/2019/5/15/18624715/antivax-vaccines-measles-new-york-orthodox-jews-rallies>
- Kolbert, E. (2017, February 27). Why facts don't change our minds. *The New Yorker*. Retrieved March 26, 2020, from <https://www.newyorker.com/magazine/2017/02/27/why-facts-dont-change-our-minds>
- Kruger, J., & Dunning, D. (1999). Unskilled and unaware of it: How difficulties in recognizing one's own incompetence lead to inflated self-assessments. *Journal of Personality and Social Psychology*, 77(6), 1121–1134. <https://doi.org/10.1037//0022-3514.77.6.1121>
- Larson, H. J. (2018). The state of vaccine confidence. *The Lancet*, 392(10161), 2244–2246. [https://doi.org/10.1016/s0140-6736\(18\)32608-4](https://doi.org/10.1016/s0140-6736(18)32608-4)
- Larson, H. J., Cooper, L. Z., Eskola, J., Katz, S. L., & Ratzan, S. (2011). Addressing the vaccine confidence gap. *The Lancet*, 378(9790), 526–535. [https://doi.org/10.1016/s0140-6736\(11\)60678-8](https://doi.org/10.1016/s0140-6736(11)60678-8)
- Larson, H. J., Wilson, R., Hanley, S., Parys, A., & Paterson, P. (2014). Tracking the global spread of vaccine sentiments: The global response to Japan's suspension of its HPV vaccine recommendation. *Human Vaccines & Immunotherapeutics*, 10(9), 2543–2550. <https://doi.org/10.4161/21645515.2014.969618>
- Leask, J., Kinnersley, P., Jackson, C., Cheater, F., Bedford, H., & Rowles, G. (2012). Communicating with parents about vaccination: a framework for health professionals. *BMC Pediatrics*, 12(154). <https://doi.org/10.1186/1471-2431-12-154>
- Leavitt, J. W. (1996). *The healthiest city: Milwaukee and the politics of health reform*. Madison, WI: University of Wisconsin Press.
- MacDonald, N. E., & the SAGE Working Group on Vaccine Hesitancy. (2015). Vaccine hesitancy: Definition, scope and determinants. *Vaccine*, 33(34), 4161–4164. <https://doi.org/10.1016/j.vaccine.2015.04.036>

- MacDonald, N. E., Harmon, S., Dube, E., Steenbeek, A., Crowcroft, N., Opel, D. J., ... Butler, R. (2018). Mandatory infant & childhood immunization: Rationales, issues and knowledge gaps. *Vaccine*, *36*(39), 5811–5818. <https://doi.org/10.1016/j.vaccine.2018.08.042>
- McDonald, R., Ruppert, P. S., Souto, M., Johns, D. E., McKay, K., Bessette, N., ... Zucker, H. A. (2019). Notes from the field: Measles outbreaks from imported cases in Orthodox Jewish communities — New York and New Jersey, 2018–2019. *Morbidity and Mortality Weekly Report*, *68*(19), 444–445. <https://doi.org/10.15585/mmwr.mm6819a4>
- Miner, L. (2018, February 6). Thousands of people in Warsaw protest against compulsory vaccinations. *EuroNews*. Retrieved March 26, 2020, from <http://www.euronews.com/2018/06/02/thousands-of-people-in-warsaw-proteted-against-compulsory-vaccinations>
- Murakami, H., Kobayashi, M., Hachiya, M., Khan, Z. S., Hassan, S. Q., & Sakurada, S. (2014). Refusal of oral polio vaccine in northwestern Pakistan: A qualitative and quantitative study. *Vaccine*, *32*(12), 1382–1387. <https://doi.org/10.1016/j.vaccine.2014.01.018>
- National Conference of State Legislators. (2020, January 3). States with religious and philosophical exemptions from school immunization requirements. Retrieved March 26, 2020, from <http://www.ncsl.org/research/health/school-immunization-exemption-state-laws.aspx>
- Neuberger, J. (2000). The educated patient: New challenges for the medical profession. *Journal of Internal Medicine*, *247*(1), 6–10. <https://doi.org/10.1046/j.1365-2796.2000.00624.x>
- Offit, P. (2015). *Bad faith: When religious belief undermines modern medicine*. New York, NY: Basic Books.
- Offit, P. A., Quarles, J., Gerber, M. A., Hackett, C. J., Marcuse, E. K., Kollman, T. R., ... Landry, S. (2002). Addressing parents' concerns: Do multiple vaccines overwhelm or weaken the infant's immune system? *Pediatrics*, *109*(1), 124–129. <https://doi.org/10.1542/peds.109.1.124>

- Okuhara, T., Ishikawa, H., Okada, M., Kato, M., & Kiuchi, T. (2019). Newspaper coverage before and after the HPV vaccination crisis began in Japan: A text mining analysis. *BMC Public Health*, *19*(1). <https://doi.org/10.1186/s12889-019-7097-2>
- Omer, S. B., Betsch, C., & Leask, J. (2019). Mandate vaccination with care. *Nature*, *571*(7766), 469–472. <https://doi.org/10.1038/d41586-019-02232-0>
- Omer, S. B., Pan, W. K. Y., Halsey, N. A., Stokley, S., Moulton, L. H., Navar, A. M., ... Salmon, D. A. (2006). Nonmedical exemptions to school immunization requirements. *JAMA*, *296*(14), 1757. <https://doi.org/10.1001/jama.296.14.1757>
- Opel, D. J., Taylor, J. A., Mangione-Smith, R., Solomon, C., Zhao, C., Catz, S., & Martin, D. (2011). Validity and reliability of a survey to identify vaccine-hesitant parents. *Vaccine*, *29*(38), 6598–6605. <https://doi.org/10.1016/j.vaccine.2011.06.115>
- Parmet, W. E. (2019, February 28). Gottlieb's threat of federal vaccine mandates: Questionable legality, poor policy. *Stat*. Retrieved March 26, 2020, from <https://www.statnews.com/2019/02/28/gottlieb-federal-action-vaccine-mandates>
- Pingali, S. C., Delamater, P. L., Bутtenheim, A. M., Salmon, D. A., Klein, N. P., & Omer, S. B. (2019). Associations of statewide legislative and administrative interventions with vaccination status among kindergartners in California. *JAMA*, *322*(1), 49–56. <https://doi.org/10.1001/jama.2019.7924>
- Plotkin, S. A., Orenstein, W. A., & Offit, P. A. (2004). *Vaccines*. Philadelphia, PA: Saunders.
- Politico & Harvard T.H. Chan School of Public Health. (2019, March). *The public and high U.S. health care costs*. Retrieved March 26, 2020, from <https://www.politico.com/f/?id=00000169-c65a-d8dc-ade9-d6db23ff0000>
- Purnell, N. (2019, April 13). WhatsApp users spread antivaccine rumors in India. *Wall Street Journal*. Retrieved March 26, 2020, from <https://www.wsj.com/articles/whatsapp-users-spread-antivaccine-rumors-in-india-11555153203>

- Reich, J. A. (2016). *Calling the shots: Why parents reject vaccines*. New York, NY: NYU Press.
- Riaz, A., Husain, S., Yousafzai, M. T., Nisar, I., Shaheen, F., Mahesar, W., ... Ali, A. (2018). Reasons for non-vaccination and incomplete vaccinations among children in Pakistan. *Vaccine*, 36(35), 5288–5293. <https://doi.org/10.1016/j.vaccine.2018.07.024>
- Ricciardi, W., Boccia, S., & Siliquini, R. (2018). Moving towards compulsory vaccination: The Italian experience. *European Journal of Public Health*, 28(1), 2–3. <https://doi.org/10.1093/eurpub/ckx214>
- Rodriguez, N. J. (2016). Vaccine-hesitant justifications. *Global Qualitative Nursing Research*, 3, 1–10. <https://doi.org/10.1177/2333393616663304>
- Romanus, V., Jonsell, R., & Bergquist, S.-O. (1987). Pertussis in Sweden after the cessation of general immunization in 1979. *Pediatric Infectious Disease Journal*, 6(4), 364–371. <https://doi.org/10.1097/00006454-198704000-00005>
- Rose, D. (2018, September 1). "Non-halal" measles-rubella vaccine hits resistance in Muslim Indonesia. This Week in Asia. Retrieved March 26, 2020, from <https://www.scmp.com/week-asia/society/article/2162079/non-halal-measles-rubella-vaccine-hits-resistance-muslim-indonesia>
- Rosner, L. (2012, March 30). What's in a name? Or, will vaccination turn your children into cows? *The History of Vaccines*. Retrieved March 26, 2029, from <https://www.historyofvaccines.org/content/blog/what%E2%80%99s-name-or-will-vaccination-turn-your-children-cows>
- Sabin Vaccine Institute. (2018, December). *Legislative landscape review: Legislative approaches to immunization across the European region*. Retrieved from https://www.sabin.org/sites/sabin.org/files/legislative_approaches_to_immunization_europe_sabin_0.pdf
- Salmon, D. A., & Omer, S. B. (2006). Individual freedoms versus collective responsibility: Immunization decision-making in the face of occasionally competing values. *Emerging Themes in Epidemiology*, 3(1). <https://doi.org/10.1186/1742-7622-3-13>

- Salmon, D. A., Teret, S. P., MacIntyre, C. R., Salisbury, D., Burgess, M. A., & Halsey, N. A. (2006). Compulsory vaccination and conscientious or philosophical exemptions: Past, present, and future. *The Lancet*, *367*(9508), 436–442.
[https://doi.org/10.1016/s0140-6736\(06\)68144-0](https://doi.org/10.1016/s0140-6736(06)68144-0)
- Schnirring, L. (2010, January 26). European hearing airs WHO pandemic response, critics' charges. *CIDRAP*. Retrieved March 26, 2020, from <http://www.cidrap.umn.edu/news-perspective/2010/01/european-hearing-airs-who-pandemic-response-critics-charges>
- Schwartz, J. L., Caplan, A. L., Faden, R. R., & Sugarman, J. (2007). Lessons from the failure of human papilloma virus vaccine state requirements. *Clinical Pharmacology & Therapeutics*, *82*(6), 760–763. <https://doi.org/10.1038/sj.clpt.6100397>
- Seeman, Y., & Mukerjee, M. (2019). How the world's first dengue vaccination drive ended in disaster. *Scientific American*. Retrieved March 26, 2020, from <https://www.scientificamerican.com/article/how-the-worlds-first-dengue-vaccination-drive-ended-in-disaster>
- Simas, C., Munoz, N., Arregoces, L., & Larson, H. J. (2018). HPV vaccine confidence and cases of mass psychogenic illness following immunization in Carmen de Bolivar, Colombia. *Human Vaccines & Immunotherapeutics*, *15*(1), 163–166.
<https://doi.org/10.1080/21645515.2018.1511667>
- Spence, S. J., Sharifi, P., & Wiznitzer, M. (2004). Autism spectrum disorder: Screening, diagnosis, and medical evaluation. *Seminars in Pediatric Neurology*, *11*(3), 186–195.
<https://doi.org/10.1016/j.spen.2004.07.002>
- Stewart, G. T. (1979). Toxicity of pertussis vaccine: Frequency and probability of reactions. *Journal of Epidemiology & Community Health*, *33*(2), 150–156.
<https://doi.org/10.1136/jech.33.2.150>
- Strandberg, K., Himmelroos, S., & Grönlund, K. (2017, June 26). Do discussions in like-minded groups necessarily lead to more extreme opinions? Deliberative democracy and group polarization. *International Political Science Review*, *40*(1), 41–57.
<https://doi.org/10.1177/0192512117692136>

- Strategic Advisory Group of Experts on Immunization. (2017, October). *2017 assessment report of the global vaccination plan*. World Health Organization. Retrieved from https://www.who.int/immunization/sage/meetings/2017/october/1_GVAP_Assessment_report_web_version.pdf
- Suppli, C. H., Hansen, N. D., Rasmussen, M., Valentiner-Branth, P., Krause, T. G., & Mølbak, K. (2018). Decline in HPV-vaccination uptake in Denmark: The association between HPV-related media coverage and HPV-vaccination. *BMC Public Health, 18*(1). <https://doi.org/10.1186/s12889-018-6268-x>
- Thomson, A., Robinson, K., & Vallée-Tourangeau, G. (2016). The 5As: A practical taxonomy for the determinants of vaccine uptake. *Vaccine, 34*(8), 1018–1024. <https://doi.org/10.1016/j.vaccine.2015.11.065>
- UNICEF. (2018, October). *Accelerating universal immunization coverage by 2030*. Retrieved March 26, 2020, from https://www.who.int/immunization/sage/meetings/2018/october/Global_Immunization_Strategy_Concept_Note.pdf
- United States Congress. (1999, September 28). House Committee on Government Reform, Subcommittee on Criminal Justice, Drug Policy, and Human Resources. Compensating vaccine injuries: Are reforms needed? Hearing before the Subcommittee on Criminal Justice, Drug Policy, and Human Resources of the Committee on Government Reform, House of Representatives, 106th Congress, First Session. Retrieved from <https://www.govinfo.gov/content/pkg/CHRG-106hrg66079/html/CHRG-106hrg66079.htm>
- Vaxopedia. (2017, April 23). Immunization records for other countries. Retrieved March 26, 2020, from <https://vaxopedia.org/2017/04/23/immunization-schedules-from-other-countries>
- Wakefield, A., Murch, S., Anthony, A., Linnell, J., Casson, D., Malik, M., ... Walker-Smith, J. (1998). Retracted: Ileal-lymphoid-nodular hyperplasia, non-specific colitis, and pervasive developmental disorder in children. *The Lancet, 351*(9103), 637–641. [https://doi.org/10.1016/S0140-6736\(97\)11096-0](https://doi.org/10.1016/S0140-6736(97)11096-0)

Warren, M. (2019). Vaccination rates rise in Italy and France after law change. *Nature*.
<https://doi.org/10.1038/d41586-019-02193-4>

Wellcome Global Monitor. (2019). *Wellcome Global Monitor 2018: How does the world feel about science and health?* Retrieved March 26, 2020, from
<https://wellcome.ac.uk/sites/default/files/wellcome-global-monitor-2018.pdf>

World Health Organization. (2014, November 12). *Report of the SAGE Working Group on Vaccine Hesitancy*. Retrieved March 26, 2020, from
https://www.who.int/immunization/sage/meetings/2014/october/SAGE_working_group_revised_report_vaccine_hesitancy.pdf

World Health Organization. (2016). *Measles and rubella global and strategic plan 2012–2020 midterm review*. Retrieved March 26, 2020, from
https://www.who.int/immunization/sage/meetings/2016/october/1_MTR_Report_Final_Color_Sept_20_v2.pdf

World Health Organization. (2017, May 23). *The power of vaccines: Still not fully utilized*. Retrieved March 26, 2020, from
<https://www.who.int/publications/10-year-review/vaccines/en>

World Health Organization. (2018). *2018 assessment report of the Global Vaccine Action Plan: Strategic Advisory Group of Experts on Immunization*. Retrieved March 26, 2020, from <https://apps.who.int/iris/handle/10665/276967>

World Health Organization. (2019a, August 8). Ebola Virus disease: Democratic Republic of the Congo. Retrieved March 26, 2020, from
<https://www.who.int/csr/don/08-august-2019-ebola-drc/en>

World Health Organization. (2019b, August 12). New measles surveillance data from WHO. Retrieved March 26, 2020, from
<https://www.who.int/immunization/newsroom/new-measles-data-august-2019/en>

World Health Organization. (2019c). Ten threats to global health in 2019. Retrieved March 26, 2020, from <https://www.who.int/emergencies/ten-threats-to-global-health-in-2019>

World Health Organization. (2019d, July 11). *Vaccination to contain severe measles outbreak underway in the Democratic Republic of the Congo amidst Ebola and mass displacement* [Press release]. Retrieved March 26, 2020, from <https://www.unicef.org/press-releases/vaccination-contain-severe-measles-outbreak-underway-democratic-republic-congo>

World Health Organization. (2020a, March 13). *Measles and rubella surveillance data*. Retrieved March 26, 2020, from https://www.who.int/immunization/monitoring_surveillance/burden/vpd/surveillance_type/active/measles_monthlydata/en

World Health Organization. (2020b). Smallpox. Retrieved March 26, 2020, from <https://www.who.int/csr/disease/smallpox/en>

Wroe, A. L., Bhan, A., Salkovskis, P., & Bedford, H. (2005). Feeling bad about immunising our children. *Vaccine*, 23(12), 1428–1433. <https://doi.org/10.1016/j.vaccine.2004.10.004>

WHAT DO WE KNOW ABOUT MOVEMENT EMERGENCE AND SUCCESS?

Doug McAdam, Ph.D.

Prior to the 1970s, there was little academic interest in the study of social movements, and what little scholarship there was tended to depict movements as an expression of irrationality and pathology in social life (Adorno, Frenkel-Brunswick, Levinson, & Sanford, 1950; Hoffer, 1951; Le Bon, 1960; Smelser, 1962). The turbulence of the 1960s changed all of that. A new generation of scholars, with sympathies for, if not roots in, the popular struggles of the



period, rejected the overly psychological, irrationalist view of movements and began to fashion very different theoretical accounts. Since then, the interdisciplinary field of social movement studies has grown exponentially, becoming one of the largest subfields in sociology, with significant presence in political science, education, and organizational studies, among other social science disciplines. Empirical work in the field reflects a wide range of research questions, focused at all levels of analysis: macro, meso, and micro.

Here, I will restrict myself to the two questions that seem most relevant to the immediate goal of the Group: stimulating grassroots action on the issue of vaccine hesitancy. The two questions are:

- What factors or dynamic processes appear to shape the emergence of social movements?
- What factors or features of movements shape their development over time and their prospects for success?

MOVEMENT EMERGENCE

Before I review scholarship on the first question, a caution is in order. Lest anyone think that I will offer a recipe for how to launch a movement, let me disabuse you of the expectation at the outset. Sustained social movements are exceedingly rare events, difficult to catalyze, and even harder to direct toward a successful outcome. Let me briefly describe a recent research project to add empirical ballast to that caution.



Between 2006 and 2011, Hilary Boudet and I (McAdam & Boudet, 2012) carried out a comparative case analysis of 20 communities that had been proposed as sites for major energy infrastructure projects that the U.S. Environmental Protection Agency saw as posing significant environmental risks. As such, it mandated formal review under the terms of the National Environmental Protection Policy Act. For us, this highly

public declaration of environmental risk transformed these otherwise normal communities into ones “at risk” for NIMBY (not in my backyard)-style opposition movements. We hoped to answer several questions with our study, but none more important than the two centrally concerned with movement emergence: How many opposition movements developed across these 20 “at-risk” communities? Also, what causal factors explain the variation in the level of oppositional mobilization within them?

For me, the project grew out of a longstanding methodological critique of the heavy reliance by social movement scholars on single case studies of major social movements. For all the virtues of the case study method, it comes with a significant liability: the hoary problem of “selection on the dependent variable.” For a good many research questions—particularly those focused on internal movement dynamics—treating movements or movement organizations as the key unit of analysis is perfectly appropriate. But for those interested in understanding something about the factors and processes that shape the emergence and ultimate success of social movements, the longstanding practice of selecting major movements for study must be regarded as a serious problem. Selecting on the dependent variable in this way inevitably exaggerates the frequency of social movements and obscures the dynamics likely to shape their emergence.

The practical methodological solution to this problem is simple, though certainly not easy to execute. To understand movement emergence, we should be systematically comparing mobilization attempts, or better yet, communities (or populations) “at risk” for mobilization, rather than the rare, and almost certainly atypical, cases of mobilization that result in sustained, successful social movements. From a methodological standpoint, however, shifting the phenomenon of interest in this way poses challenges. How does one study non-events? Or more accurately, how do researchers identify or define communities “at risk” for mobilization? Fortunately, in our case, federal environmental requirements allowed for a simple and, we thought, ultimately convincing answer to the latter question.



So, how many of our communities generated movements in opposition to the proposed risky projects? Answer: exactly one. And even this movement was short-lived and very tame compared to the stereotypic image of protest movements we tend to carry around in our heads. Across all 20 communities, there were a total of 28 protests, and all but four took place in that single community. And there was nary an arrest, injury, or property damage across all protests. What makes these numbers even more remarkable is that they were not gathered in a random sample of all communities, but rather in locales subject to the objective risks associated with specific proposed projects—that is, in communities where, based on the received wisdom of some 40 years of social movement scholarship, we might have expected to find considerable contention.

And there is more. Far from generating opposition movements, in almost one-third of our study cases the communities in question came to view the proposed projects positively as sources of jobs and economic stimulus. All this conduces, in my view, to a critically important point: as much as law enforcement officials, intelligence analysts, and indeed, many scholars want to understand movements as a predictable response to a determinant stimulus, real-world movements rarely conform to this kind of simplistic cause-and-effect dynamic. And yet, much movement scholarship on the question of origins continues to advance a determinant view. Two broad categories have been stressed as the effective catalyst of social movements: threats and political opportunities.

Threats

Objective threats, such as those we saw in the energy infrastructure projects discussed above, are the first possible catalyst we examine. And indeed, a great many movements do seem to arise in response to threats of various kinds. NIMBY-style movements opposed to all manner of proposed projects—e.g., drug treatment facilities, homeless shelters, high-speed rail lines, incinerators, low-level radioactive waste sites, and high-rise buildings—are ubiquitous in American life. Scholars of ethnic conflict have long stressed demographic threats to the integrity of ethnic boundaries as the critical catalyst for episodes of racial/ethnic unrest and violence (Lieberson, 1980; Olzak, 1992, 2006).

A host of contemporary movements would also seem to be products of threats to the interests of specific groups. Black Lives Matter emerged in the days immediately following the shooting death of Michael Brown in Ferguson, Missouri as African Americans responded to the threat of police violence. The rising tide of climate-change activism clearly reflects a shared sense that global warming poses an existential threat to the survival of the planet. Anti-abortion



activists date the origin of the pro-life movement to the *Roe v. Wade* Supreme Court decision and the shared sense of threat to the sanctity of human life. Virtually every mass shooting incident sets in motion myriad grassroots efforts to press for more stringent gun controls or other measures to reduce the threat of gun violence.

I could name countless other movements—both contemporary and historical—that would seem to be clear responses to the stimulus of some kind of threat. For all the appeal of this determinant theory, however, we would do well to remember that 19 of the 20 communities proposed as sites for objectively risky energy projects did not respond with the kind of reactive NIMBY-style opposition movements the literature would seem to predict. The key word in the prior sentence is “objectively.” If the McAdam and Boudet (2012) study is any guide, *objective* opportunities are a poor predictor of emergent movements. But *subjective, socially constructed threats* to group interests are quite another matter.

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| Expanding Political Opportunities

A second impetus for social movements is political opportunity. “Rights movements,” the popular struggles by traditionally disadvantaged groups, are among the most consequential and widely studied of social movements. No U.S. movement has generated more scholarship than the African American civil rights movement (Andrews, 2004; Eskew, 1997; Garrow, 1978; Hall, 2005; McAdam, 1999 [1982]; Morris, 1984; Payne, 1996). That said, there is also substantial literature on the 19th-century women’s rights movement in the United States, the women’s suffrage movement in both its British and American manifestations, third-wave feminism in the United States, the anti-apartheid movement in South Africa, and the Gandhian movement for Indian independence, to name just a few prominent examples. For all their importance in other movements, threats appear to play little or no role in rights movements. For traditionally disadvantaged groups, threats—to physical safety, to economic well-being, to human dignity, and more—are a daily reality, and rarely catalysts for action.

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Opportunities to act and address their marginalized status are a different matter. Under ordinary circumstances, stigmatized, disadvantaged groups face enormous obstacles in their efforts to advance group interests. Marginalized groups exercise little or no influence within institutional politics precisely because their bargaining position, relative to that of political and economic elites, is so weak. But the particular set of power relationships that defines the political system at any point in time does not constitute an immutable structure of political life. As Michael Lipsky (1970), one of the earliest proponents of “political opportunity” theory, argued:

...attention is directed away from system characterizations presumably true for all times and places... We are accustomed to describing communist political systems as “experiencing a thaw” or “going through a process of retrenchment.” Should it not at least be an open question whether the American political system experiences such stages and fluctuations? Similarly, is it not sensible to assume that the system will be more or less open to specific groups at different times and at different places?

Lipsky, like all other political opportunity theorists, clearly believed that the answer to both questions is an emphatic “yes.” The opportunities for marginalized groups to engage in successful collective action *do* vary over time. And it is these variations that came to be viewed as the key to understanding the ebb and flow of movement activity. Under normal conditions, disadvantaged groups confronting a unified and hostile political and economic establishment lack the leverage to sustain a successful movement. Instead, rights movements develop when shifting political, social, or economic conditions (i.e., political opportunities) make movement opponents newly vulnerable or receptive to protest.

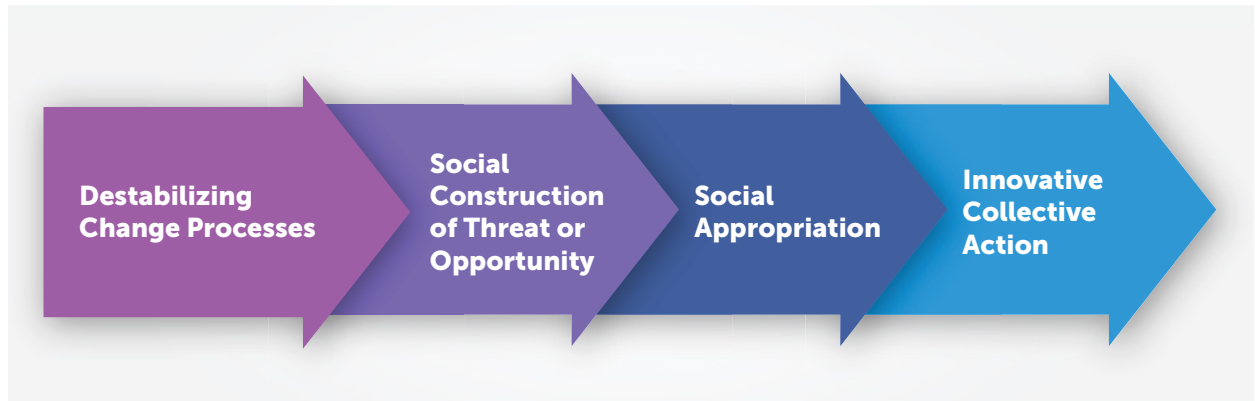
Indeed, history shows that many rights movements coincide with such periods of expanding political opportunities. The emergence and development of movements as diverse as the modern U.S. women’s movement (Costain, 1992), liberation theology (Smith, 1991), peasant rebellions in Central America (Brockett, 1991), the American civil rights movement (Jenkins, Jacobs, & Agnone, 2003; McAdam, 1999 [1982]), the farm workers’ movement (Jenkins & Perrow, 1977); the nuclear freeze movement (Meyer, 1990), and the Italian new left (Tarrow, 1989) have been attributed to the expansion and contraction of political opportunity.

The problem, however, is the same as the one raised above regarding the concept of threat. For every instance of objective opportunity that appears to stimulate collective action, there are countless others that don’t. And here is where the problem of selecting on the dependent variable rears its head again. If we only study sustained, visible movements, we will inevitably find many that seem to confirm the catalytic effect of either threat or opportunity, but miss all those where objective threats or opportunities fail to set movements in motion.

Does that mean that the concepts of threat and opportunity have no analytic value in the study of movement emergence? No. It simply means that the stress on objective, macro-level threats or opportunities must give way to an emphasis on perceived—or subjective—threats or opportunities and to the group-level processes of social construction and collective attribution that give rise to these crucially important shared perceptions. In place of the simple stimulus/response models that have tended to guide the study of movement origins, we need to view emergent collective action as a rare event that depends on several highly contingent group-level processes. A dynamic model of movement emergence (Figure 1) highlights two especially critical processes in this regard.

For every instance of objective opportunity that appears to stimulate collective action, there are countless others that don’t.

Figure 1. Dynamic model of movement emergence



| Social Construction of Threat or Opportunity

Human beings are voracious meaning-makers. The monitoring and interpretation of events and environmental conditions provide the foundation for all social life, routine no less than contentious. Consistent with this view, initial movement mobilization depends on an emerging collective account of some new threat to, or opportunity for, realizing group interests. Normally, this account is a response to objective change processes. In rare cases, these changes are so dramatic as to virtually compel their own interpretation. The 9/11 terrorist attacks are a good case in point.

Far more often, however, the emerging accounts of a threat or opportunity are highly contingent social constructions that are in no simple sense determined by the change processes themselves. Indeed, in rare instances such interpretations may even arise in the absence of any objective changes in the life circumstances of the group in question (Kurzman, 1996).

In their 1982 book, *Encounters with Unjust Authority*, Gamson, Fireman, and Rytina (1982) report the results of an ingenious study designed to better understand these crucial mediating processes. The researchers began by placing an ad in a local paper inviting individuals to participate in “research involving group discussion of community standards” and to be paid for their time. When each of the 33 groups of participants assembled, they were told that their discussions would establish the “community standards” for determining the guilt or innocence of a gas station owner who was being stripped of his station by a national oil company for failing to live up to the “moral turpitude” clause of his contract. They were further told that the firm running the videotaped discussion session was working for the oil company, but was simply gathering information to aid the trial process.

As the session unfolded, the person in charge became increasingly coercive in his efforts to elicit statements supporting the oil company's position in the case. By the session's end, it was all too apparent to the participants that the supposed research project was little more than a front to advance the interests of the oil company. Given that the group was clearly being used to subvert the criminal justice system, one might assume that the participants would resist this transparent injustice. In fact, slightly fewer than half did so, reminding us again that objective grievances are not sufficient to produce collective action. Key to transforming these objective grievances into a shared resolve to act was the social construction of an "injustice frame" (Gamson et al., 1982).

| Social Appropriation

As Gamson et al. (1982) go on to show, the emergence of a shared frame is not sufficient for collective action. For collective attributions to trigger action, the interpreters must share enough of a sense of "we-ness" to make conjoint action viable. This is almost certainly why movements develop within established groups or networks—they are settings in which a well-defined collective identity and elaborate structure of solidarity incentives already exist. The point is, as a prerequisite for action, would-be insurgents must either create an embryonic collective identity or appropriate an existing one. Without minimizing the difficulties inherent in the process, social appropriation is far easier than creating a sense of "we-ness" from scratch. No doubt, much of the difficulty Gamson's would-be insurgents faced owed to the absence of any pre-existing collective identity.

As a prerequisite for action, would-be insurgents must either create an embryonic collective identity or appropriate an existing one.

But incipient movements require much more than a shared sense of identity to be successful. They also require some sort of action vehicle. Again, these can be created from whole cloth, but it is much more efficient to have access to an existing structure. The other virtue of appropriation is that it typically affords the burgeoning movement a ready-made mobilizing structure. That is, social appropriation typically involves transforming an established social group into an effective site of emergent contentious action.

A well-known example of this process may help to make it more comprehensible. Movement scholars have thoroughly documented the central role played by the black church in helping to launch the civil rights movement (McAdam, 1999 [1982]; Morris, 1984;

Oberschall, 1973). But while the movement's debt to the black church is widely acknowledged, the standard narrative obscures cultural and social psychological processes of great importance. Until the rise of the movement, it was common for observers—black and white—to depict the black church as a generally conservative institution with a decided emphasis, not on the “social gospel in action,” but rather on realizing rewards in the afterlife (Johnson,



1941; Mays & Nicholson, 1969; Myrdal 1944). Moreover, the traditional conservatism of the institution did not entirely disappear during the movement. Charles Payne's (1996) exceptional book on the movement in Mississippi makes it clear that the conservative nature of local black clergy remained a significant obstacle to local organizing even during the movement's heyday.

Given this complicated portrait of the black church, the highly contingent nature of initial mobilization attempts should be clear. To turn even some black congregations into vehicles of collective protest, movement leaders had to engage in a lot of creative cultural work, through which the aims of the church and its animating collective identity were redefined to accord with the goals of the emerging struggle. This is, first and foremost, a social psychological process that has far more to do with social construction, collective attribution, and re-socialization than with any kind of objective inventory of organizational resources. Organization and resources matter little if their use is not governed by shared meanings and identities legitimating collective action.

This brings us to the key explanatory question: What factors make successful social appropriation more likely? The question takes on added force in the face of the powerful inertial force of most social settings. That is, with few exceptions, established groups, institutions, and networks are geared toward reproducing (or at least accommodating), rather than challenging, the status quo. Religious institutions are houses of worship, colleges are centers for learning, and so forth. To transform any routine social setting into a site of incipient rebellion poses a distinct challenge to anyone making the attempt. What factors or processes offer some hope of successfully engaging the challenge? Alas, the structural bias in social movement studies means we have almost no empirical work to draw on to answer that question. For now, informed speculation must fill the void.

I close this section by briefly discussing two factors that appear to facilitate social appropriation. The first is what Snow and Benford (1988) refer to as “frame resonance.” By that, they mean system-critical interpretative schema that resonate with deeply held cultural beliefs and values. It makes sense to hypothesize that, all things being equal, attempts at appropriation are more likely to succeed if they are framed in especially resonant terms. But if the message is important, I am inclined to believe the messenger is even more important. That is, the single most important factor shaping the prospects for successful appropriation may well be the social status of the would-be appropriator.

This is little more than an extension of years of diffusion research (Rogers, 1995). The success and speed with which innovations diffuse depends centrally on the social status of the innovators and initial adopters. If we regard appropriation attempts as *social* innovations, it makes sense to assume the same pattern would hold. So, for example, I would expect the established leaders of an organization to have an easier time redefining its purposes than a rank-and-file member of the group. For example, much of the stunning and immediate success of the Montgomery, Alabama, bus boycott was due to the vocal support—sponsorship, really—it received from the town’s established ministerial elite. Redefining the Christian duties of their congregations to include staying off busses, the ministers effectively appropriated their churches in service to the burgeoning movement.



These two processes—social construction of threat and opportunity and social appropriation—are, in my view, the keys to movement emergence. The inertial force of social life makes both processes highly unlikely and hard to achieve. Moreover, three additional processes must occur if a movement is to fully develop. Having succeeded in motivating an existing group to address some new threat or opportunity, there is still the critical issue of strategy and tactics. How is the threat or opportunity to be

approached? By definition, social movements rely, at least in part, on unconventional or non-institutionalized forms of collective action. Had Montgomery’s ministers simply urged their congregants to write letters protesting segregated seating in city busses, there may never have been a civil rights movement, or at least it would not have arisen in Montgomery.



Finally, imagine what would have had happened if the one-day symbolic boycott that launched the movement had failed—if only half the riders observed the boycott, rather than the estimated 90–95% who did so. Instead of the sense of elation shared by the black community at the end of the day, black residents would likely have felt deflated and pessimistic about the prospects for meaningful change in Montgomery. The point is that absent a clear sense that its initial actions were successful, most would-be movements die quickly. But should all these processes come together, it is very likely that a sustained movement would result. Whether it is successful in achieving its goal, however, is quite another matter.

MOVEMENT SUCCESS

The scholarship on social movements tends to be bifurcated when it comes to movement success or outcomes. In accounting for the success or failure of a given movement, many analysts focus on significant changes in the external social and political environment that either strengthen or weaken the hand of insurgents. The implication is that movements are not fully in control of their fate; rather, their influence is shaped by perturbations in the broader environment within which they operate.

The “movement-centric” emphasis of recent scholarship (McAdam & Boudet, 2012) is in sharp contrast to this external focus. With its stress on movement-framing processes, strategies, tactics, and resource mobilization, the social movement literature often ignores environmental influences in favor of an emphasis on the decisions made by insurgents. This implicitly locates the source of change, agency, and outcomes within the movement itself. So, too, does much of the narrower literature on non-violence (Ackerman & Duvall, 2000; Bleiker, 2000; Chenoweth & Stephan, 2011; Schock, 2005). The suggestion in much of this literature is that adherence to non-violent principles confers great strategic advantage on movements that adopt such tactics. In the extreme, work in this tradition implies that, through the tactical and value choices they make, activists control their own fate. In both bodies of work, environmental influences are elided in favor of an emphasis on internal movement dynamics and decisions.



In truth, these distinct emphases capture an important truth about the ongoing development and ultimate impact of movements over time. Movements are powerfully shaped by the environments—social, political, and economic—in which they are embedded. As we have seen, movements typically benefit from prior, destabilizing change processes that render opponents more vulnerable or receptive to movement influence. But again, this is not to posit simple environmental determinism. Successful movements also depend critically on the capacity of movement actors to recognize and respond strategically to the evolving opportunities and constraints afforded them by environmental changes. Indeed, in practice, it is often hard to distinguish external changes from the internal movement efforts to exploit these changes. It is this ongoing interaction between insurgents and the broader environment that ultimately shapes relative success.

Movements are powerfully shaped by the environments—social, political, and economic—in which they are embedded.

Having sketched this general analytic framework for considering the development and impact of social movements, it is important to introduce the distinction between what Gamson (1975) first termed “members” and “challengers.” *Members* are groups possessing sufficient political and economic resources and social connections to ensure that their interests are generally taken into account in formulating public policy. *Challengers*, on the other hand, are marginalized groups whose interests are routinely “organized out” of institutionalized political deliberations because they lack insider status and bargaining leverage. Social movements organized by members and challengers tend to look very different, reflecting stark differences in resources and connections. Chief among these differences are the breadth of their goals, their tactics and strategies, and the support they can expect from other insiders.

Movements spearheaded by members are very likely to involve only limited reforms pursued primarily, if not exclusively, through institutionalized channels and conventional means. Moreover, because of the connections and conventional social, political, and economic capital enjoyed by these insiders, as well as their narrow reform aims, these movements can generally count on considerable support from other members. Challenger movements, on the other hand, typically involve broader and potentially more threatening goals pursued through a mix of strategies, but with a much heavier reliance on disruptive, or otherwise unconventional, tactics. While these hallmark characteristics shape the popular perception of social movements overall, the factors and processes that shape the prospects for success by members or challengers are actually quite different.

| Challenger Movements

The characteristics shaping the fate of popular struggles organized on behalf of traditionally disadvantaged groups differ from insider movements in two principal ways. First, challenger movements depend for their emergence and ultimate success on expanding political opportunities far more than insider movements. That's because the power and resource disparities between challengers and their insider opponents is typically so great as to limit any chance of success. Broad changes that reduce these disparities are thus critical if the movement is to achieve any measure of success.

The other difference between outsider and insider movements is the much greater reliance of the former on non-institutional, and often disruptive, forms of collective action. Lacking insider connections and the kinds of conventional political and economic resources enjoyed by members, the success of challengers often depends on their ability to disrupt or threaten to disrupt "business as usual" in order to compel their opponents to grant concessions as a condition of restoring order. On those rare occasions when challenger movements succeed, they typically do so because of this combination of top-down political opportunities and sustained bottom-up disruptive pressure.

| Member Movements



Insider movements, which represent the great majority of social movements, are typically characterized by very different dynamics. A movement to promote vaccination or counter the burgeoning anti-vaccination movement would almost certainly fall into this category. What might such a movement—or movements—look like? I bring the paper to a close by describing three very different movement strategies and affiliated targets, using social movement theory to assess the relative merits and potential liabilities of each approach.

Pro-vaccination efforts to counter the anti-vaccination movement. While anti-vaccination sentiment and behavior have existed in some form for two centuries (Wolfe & Sharp, 2002), there has clearly been a significant rise in recent decades. And while rates of vaccination have remained relatively stable, the worry is that we may be at an inflection point, with escalating

anti-vaccination activism poised to have an increasingly corrosive effect on vaccination rates and norms. Research on the cognitive and affective content of the anti-vaccination narrative serves to reinforce this concern. As Brewer, Chapman, Rothman, Leask, and Kempe (2017) put it: "...antivaccination activists tell a good story... the stories elicit emotions such as anger, fear, and regret, as well as medical mistrust... As a result, antivaccine messages are interesting, memorable, and in demand." In contrast, "messages from official sources tend to be factual, cryptic and forgettable."



Given the apparent effectiveness of the anti-vaccination effort, one tempting strategy would be to mobilize a pro-vaccination countermovement committed to systematically contesting the anti-vaccination narrative whenever and wherever it makes sense to do so. In his presentation to the Group, Joe Smyser made a compelling case for just this kind of countermovement. In my view, however, there are a host of potential liabilities to this approach. First, if the fundamental goal of any pro-vaccination effort is to increase rates of inoculation, it is not at all clear that even an effective effort to

counter the narrative of diehard anti-vaccination activists and bloggers will move the needle very much. The hardcore group is not going to change its views, and it isn't clear how many "hesitants" or "fence-sitters" are actually influenced by their narrative.

More worrisome, perhaps, is the very real possibility that the counternarrative will prove ineffective, or worse, backfire and grant more visibility and legitimacy to the anti-vaccination activists. There are at least three reasons for worrying about this outcome. First, if we trust the comparison drawn by Brewer et al. (2017) between the effectiveness of anti-vaccination spokespersons and the ineffective, "forgettable" quality of the typical pro-vaccination narrative, we might want to think twice before orchestrating a highly public confrontation between these two sets of actors. Second, quite apart from the resonance of the competing narratives, we should also worry about the institutional identities associated with the typical pro-vaccination spokespersons. In an era of rising anti-government, anti-science, anti-elite sentiment, one can imagine pronouncements by leading public health or other government officials reinforcing, rather than allaying, the fears and suspicions of those inclined toward anti-vaccination views.

Third, there is one final potential danger associated with a concerted attack on the hardcore wing of the anti-vaccination movement, which the concept of “radical flank effect” from the social movement literature helps us understand (Haines, 2013). Somewhat counterintuitively, movement scholars have amassed considerable evidence that a movement benefits from having a highly visible extremist wing. While one might think that an extremist wing would serve to discredit the movement as a whole, studies of the phenomenon have found something different.

Radical flank effects occur when the actions of radical groups work to the benefit of the moderate core of the movement. For instance, disruptive tactics or inflammatory rhetoric employed by radicals may attract greater public attention to issues that moderate actors have sought to address with limited success. The presence of a radical flank may also allow moderates to portray themselves as the reasonable and responsible voices within the larger movement (Connor & Epstein, 2007; Elsbach & Sutton, 1992; Hoffman & Bertels, 2009). And by enhancing the reputation of the moderates in this manner, the radical flank may also increase their attractiveness to potential funders and political allies. The fear is that a highly public, sustained effort to counter the narrative of extreme anti-vaccination groups or individuals will actually enhance their visibility and usher in the effects described here.



A pro-vaccination movement aimed at persuading “fence-sitters.” Given all the potential risks associated with a sustained countermovement, a safer and potentially more successful strategy might be to orchestrate a broad-based “insider” campaign to increase vaccination rates by persuading those on the fence to get inoculated. To be effective, the movement would need to enlist a broad coalition of institutional allies from the worlds of public health, medicine, philanthropy, and health-related non-profits.

One component of the movement might involve conventional public health education campaigns targeting specific communities with especially low vaccination rates (e.g., Orthodox Jews and African Americans).

In my view, however, the centerpiece of the effort would be a renewed commitment to using clinical settings as sites for proactive vaccine counseling and education where nurses and

doctors primarily target fence-sitters. For this to work, however, the current trend of health care providers denying service to those who hesitate or choose not to be vaccinated would have to be reversed. Instead of sharpening the boundary between those who do and do not get vaccinated by pushing fence-sitters toward providers willing to cater to them, the goal would be to continue providing care to those who are hesitating. The hope is that with repeated efforts at persuasion, their fears and misconceptions can be overcome.

Finally, to maximize the benefits of the campaign, I would suggest it be designed not only as a proactive effort to increase vaccination rates, but also as a systematic research project to determine which clinical approaches are most effective in transforming fence-sitters into those who get vaccinated. By doing so, pro-vaccination researchers and advocates should be able, over time, to devise increasingly effective clinical practices to overcome vaccine hesitancy.

Coordinated top-down, bottom-up political movement in receptive jurisdictions.

Based on the successful legislative lobbying efforts in California and elsewhere, another promising form of mobilization would seem to be coordinated top-down and bottom-up efforts to press legislators to pass vaccine mandates or other pro-vaccination measures. While member movements often succeed in the absence of significant grassroots activism, insider reform combined with pressure from grassroots groups would certainly increase the chances of movement success. This seems to be the formula that worked well in California and several other states. One caution: I would restrict these legislative movements to the most receptive states or other jurisdictions. Achieving legislative gains in even a limited set of states would create policy models for others and pressure them to at least engage the issue. On the other hand, creating a visible pro-vaccination grassroots movement in hostile states would almost certainly trigger reactive mobilization by anti-vaccination groups, without any chance of achieving legislative success. Better to leave sleeping dogs lie in non-receptive states, while concentrating pro-vaccination efforts in states reliably committed to immunization.



CONCLUSION

In bringing this paper to a close, I return to the two questions I posed at the outset. First, "What factors or dynamic processes appear to shape the emergence of social movements?" And second, "What factors or features of movements shape their development over time and their prospects for success?" Having thoroughly engaged the complexities of these two



questions, I use the conclusion to offer straightforward answers to both.

While most theories and popular accounts of social movements persist in depicting their beginnings as a predictable response to some objective threat or opportunity, such threats or opportunities generally fail to trigger collective action. Rather, the origin of a movement reflects the subjective significance attached to that threat or opportunity by a specific group, which then begins to engage in sustained collective action in response to their shared perception. The vaccine hesitancy movement did not emerge because of an increase in the objective risk posed by vaccines, but because specific groups constructed an account of increased risk and began acting collectively to counter that perceived threat.

And what of the equally important question of movement success? While the characteristic features and typical dynamics of insider and outsider movements tend to be quite different, the long-term success of either generally reflects the interaction of two factors. On the one hand, the prospects for movement success are powerfully shaped by the environments in which they are embedded. As we have seen, successful movements typically benefit from prior, destabilizing change processes that render their opponents more receptive to movement influence. And they also depend critically on the capacity of movement actors to recognize and respond strategically to the evolving opportunities and constraints afforded them by environmental changes. This ongoing interaction between movement groups and the broader strategic environment ultimately shapes the relative impact of the movement.



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REFERENCES

- Ackerman, P., & Duvall, J. (2000). *A force more powerful*. New York, NY: St. Martin's Press.
- Adorno, T. W., Frenkel-Brunswick, E., Levinson, D. J., & Sanford, R. N. (1950). *The authoritarian personality*. New York, NY: Harper & Brothers.
- Andrews, K. (2004). *Freedom is a constant struggle*. Chicago, IL: University of Chicago Press.
- Bleiker, R. (2000). *Popular dissent, human agency, and global politics*. Cambridge, UK: Cambridge University Press.
- Brewer, N. T., Chapman, G. B., Rothman, A. J., Leask, J., & Kempe, A. (2017). Increasing vaccination: Putting psychological science into action. *Psychological Science in the Public Interest*, 18(3), 149–207. <https://doi.org/10.1177/1529100618760521>
- Brockett, C. D. (1991). The structure of political opportunities and peasant mobilization in Central America. *Comparative Politics*, 23(3), 253–274. <https://doi.org/10.2307/422086>
- Chenoweth, E., & Stephan, M. (2011). *Why civil resistance works: The strategic logic of nonviolent conflict*. New York, NY: Columbia University Press.
- Connor, A., & Epstein, K. (2007). Harnessing purity and pragmatism. *Stanford Social Innovation Review*, 61–65. Retrieved March 27, 2020, from https://ssir.org/articles/entry/harnessing_purity_and_pragmatism
- Costain, A. W. (1992). *Inviting women's rebellion: A political process interpretation of the women's movement*. Baltimore, MD: Johns Hopkins University Press.
- Elsbach, K. D., & Sutton, R. I. (1992). Acquiring organizational legitimacy through illegitimate actions: A marriage of institutional and impression management theories. *Academy of Management Journal*, 35(4), 699–738. <https://doi.org/10.2307/256313>
- Eskew, G. T. (1997). *But for Birmingham: The local and national movements in the civil rights struggle*. Chapel Hill, NC: University of North Carolina Press.

- Gamson, W. A. (1975). *The strategy of social protest*. (2nd ed.). Belmont, CA: Wadsworth.
- Gamson, W. A., Fireman, B., & Rytina, S. (1982). *Encounters with unjust authority*. Homewood, IL: Dorsey Press.
- Garrow, D. (1978). *Protest at Selma*. New Haven, CT: Yale University Press.
- Haines, H. (2013). Radical flank effects. In D. A. Snow, D. della Porta, B. Klandermans, & D. McAdam (Eds.), *The Wiley-Blackwell encyclopedia of social movements* (vol. 3, pp. 1048–1049). Malden, MA: Wiley-Blackwell.
- Hall, J. D. (2005). The long civil rights movement and the political uses of the past. *Journal of American History*, 91, 1233–1263. <https://doi.org/10.2307/3660172>
- Hoffer, E. (1951). *The true believer: Thoughts on the nature of mass movements*. New York, NY: New American Library.
- Hoffman, A. J., & Bertels, S. (2009, January). *Who is part of the environmental movement? Assessing network linkages between NGOs and corporations* (Ross School of Business, University of Michigan, working paper no. 1125). Retrieved March 27, 2020, from <https://deepblue.lib.umich.edu/handle/2027.42/61512>
- Jenkins, J., Jacobs, D., & Agnone, J. (2003). Political opportunities and African American protest, 1948–1997. *American Journal of Sociology*, 109, 277–303. <https://doi.org/10.1086/378340>
- Jenkins, J. C., & Perrow, C. C. (1977). Insurgency of the powerless: Farm workers movements. *American Sociological Review*, 42(2), 249–268. <https://doi.org/10.2307/2094604>
- Johnson, C. S. (1941). *Growing up in the black belt*. Washington, DC: American Council on Education.
- Kurzman, C. (1996). Structural opportunity and perceived opportunity in social movement theory: The Iranian revolution of 1979. *American Sociological Review*, 61(1), 153–170. <https://doi.org/10.2307/2096411>

- Le Bon, G. (1960). *The Crowd*. New York, NY: Viking Press.
- Liebertson, S. (1980). *A piece of the pie*. New York: Free Press.
- Lipsky, M. (1970). *Protest in City Politics*. Chicago, IL: Rand McNally.
- Mays, B., & Nicholson, J. W. (1969). *The Negro's Church*. New York, NY: Arno Press and the New York Times.
- McAdam, D. (1999 [1982]). *Political process and the development of black insurgency, 1930–1970*. Chicago, IL: University of Chicago Press.
- McAdam, D., & Boudet, H. (2012). *Putting social movements in their place*. New York, NY: Cambridge University Press.
- Meyer, D. S. (1990). *A winter of discontent: The nuclear freeze and American politics*. New York, NY: Praeger.
- Morris, A. D. (1984). *The origins of the civil rights movement: Black communities organizing for change*. New York, NY: Free Press.
- Myrdal, G. (1944). *An American dilemma*. New York, NY: Harper & Brothers.
- Oberschall, A. (1973). *Social conflict and social movements*. Englewood Cliffs, NJ: Prentice-Hall.
- Olzak, S. (1992). *The dynamics of ethnic competition and conflict*. Stanford, CA: Stanford University Press.
- Olzak, S. (2006). *The global dynamics of racial and ethnic mobilization*. Stanford, CA: Stanford University Press.
- Payne, C. (1996). *I've got the light of freedom*. Berkeley, CA: University of California Press.
- Rogers, E. M. (1995). *Diffusion of innovations*. (4th ed.). New York, NY: Free Press.

- Schock, K. (2005). *Unarmed insurrections: People power movements in non-democracies*. Minneapolis, MN: University of Minnesota Press.
- Smelser, N. (1962). *Theory of collective behavior*. New York, NY: Free Press.
- Smith, C. (1991). *The emergence of liberation theology*. Chicago, IL: University of Chicago Press.
- Snow, D. A., & Benford, D. A. (1988). Ideology, frame resonance, and participant mobilization. In B. Klandermans, H. Kriesi, & S. Tarrow (Eds.), *From structure to action: Social movement participation across cultures* (pp. 197–217). Greenwich, CT: JAI Press.
- Tarrow, S. (1989). *Democracy and disorder*. Oxford: Oxford University Press.
- Wolfe, R. M., & Sharp, L. K. (2002). Anti-vaccinationists past and present. *British Medical Journal*, 325, 430–432. <https://doi.org/10.1136/bmj.325.7361.430>

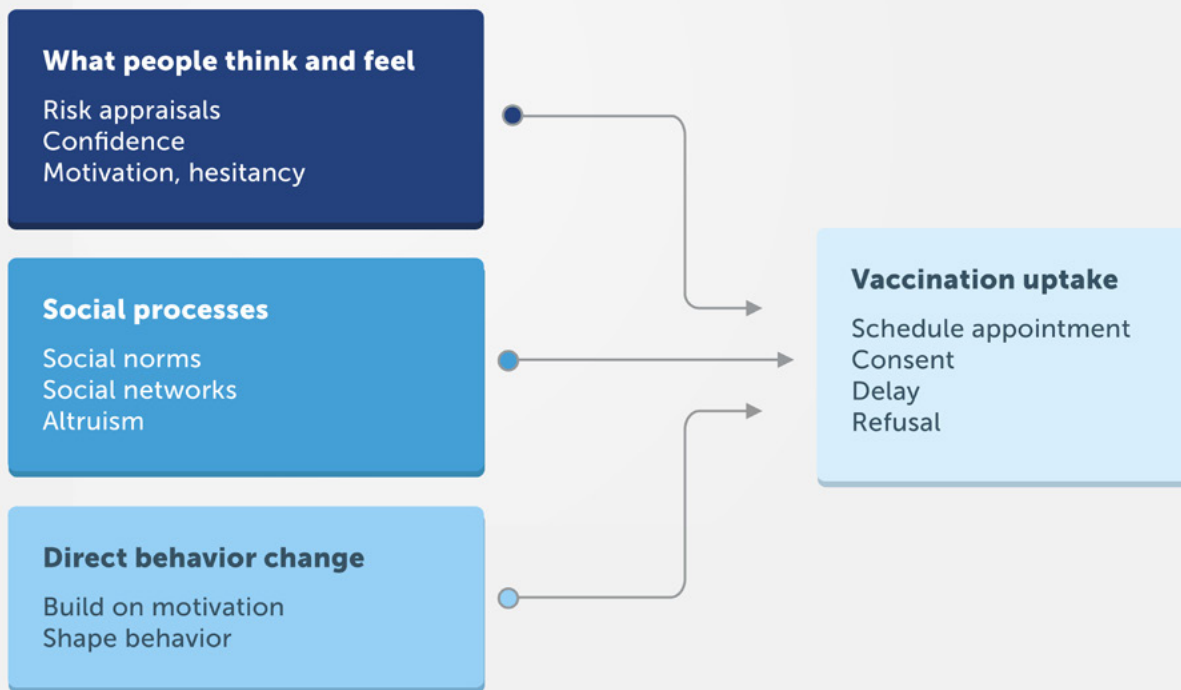
WHAT WORKS TO INCREASE VACCINATION UPTAKE

Noel T. Brewer, Ph.D.

INTRODUCTION

Behavioral science offers several ideas about what it takes to get people to vaccinate. The three main propositions are that vaccination results from: (1) what people think and feel, (2) social processes, and (3) direct behavior change (Figure 1). Colleagues and I previously reviewed the evidence for these propositions and put forward what has become known as the Increasing Vaccination Model (Brewer, Chapman, Rothman, Leask, & Kempe, 2017).

Figure 1. The increasing vaccination model



Source: Adapted from Brewer et al. in *Psychological Science in the Public Interest*, 2017.

That paper generated substantial interest from public health organizations, including the World Health Organization (WHO), the Centers for Disease Control and Prevention (CDC), vaccine manufacturers, researchers, and practitioners (Brewer et al., 2017). However, its length and complexity have been barriers to its use by some practitioners. To facilitate wider

adoption of the model, this paper summarizes the main insights from the earlier work and describes the use of the model by a WHO working group as it considers opportunities to address low vaccination uptake globally, especially through effective interventions.

Vaccination is one of the most widely accepted health behaviors. Globally, 86% of children have received a measles vaccine, and that percentage is higher in North America and Europe as of 2018 (World Health Organization, 2018). Coverage is even higher for the diphtheria, tetanus, and pertussis (DTP) vaccine. These high rates have caused the incidence of many infectious diseases to plummet in the decades since relevant vaccines have been introduced. Such successes have led to calls for complete eradication of polio and regional elimination or control of other diseases through vaccination. Indeed, at the start of this decade, the WHO and other organizations designated 2011–20 as the Decade of Vaccines.

However, by 2019, the WHO had declared vaccination hesitancy to be one of the top 10 threats to global public health. This threat could have several consequences. *Inadequate coverage* is the uptake of vaccination that fails to meet an agreed-on quality marker (e.g., 90% coverage). While global vaccination coverage rates have steadily drifted upwards, they have stalled in some regions and even slipped backwards in a few countries. *Delay* is getting

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vaccines after the recommended age or spreading the doses out over time. Despite clear findings that the current vaccination schedule is safe, parents are increasingly choosing to spread out or delay vaccines in the mistaken belief that having fewer

vaccines at one time will reduce the risk of harm. *Instability* is variability in coverage over time, most often a sharp drop. Some countries with generally high vaccination coverage have experienced periods of dramatic instability. For example, Japan had achieved 70% coverage for HPV vaccination, yet coverage fell to 7% within a year of an unsubstantiated safety scare. Denmark had a similar issue that it was able to turn around, but only after coverage had fallen by half (Hansen, Schmidtlaicher, & Brewer, 2020).

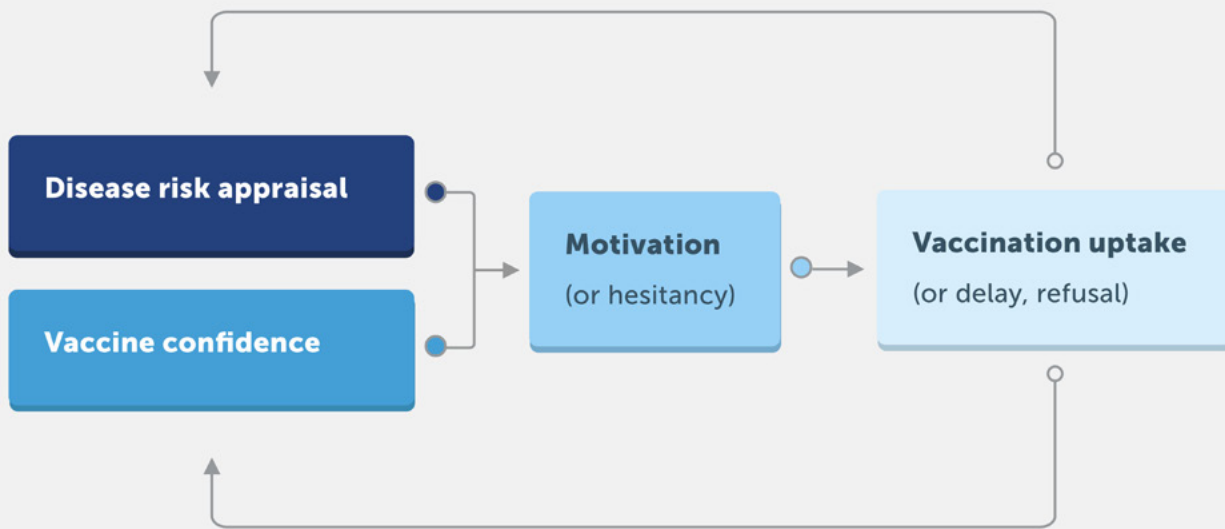
The model presented here is about what works to increase vaccination uptake, which results from a series of behaviors by various actors. A family may talk about vaccines with friends, search for information online, schedule an appointment, travel to a clinic, consent to vaccination, return for any needed follow-up doses, and pay any related costs, such as an administration fee or travel expenses. Providers stock vaccines, recommend them, track their use in medical records, flag who is due and overdue, and manage their vaccine stock.

All of this is in a context of a system in which the state funds some vaccines and, in some countries, private insurance covers other vaccines. In sum, vaccination uptake results from a web of interconnected players, resources, and behaviors, all of which follow predictable patterns.

WHAT PEOPLE THINK AND FEEL

The model’s first broad proposition is that what people think and feel motivates vaccination uptake (Figure 2). On the left side of the figure, *disease risk appraisals* are thoughts and feelings about potential health problems caused by infectious agents (perceived risk and fear); *vaccine confidence* is the attitude that vaccines are good (effective) or bad (unsafe). Risk appraisals and confidence *motivate* people to vaccinate or not to do so, as shown in the middle. Another term for low motivation to vaccinate is *hesitancy*. While some people use the terms “confidence” and “hesitancy” interchangeably, it is helpful to separate these ideas: low confidence is a cause of low motivation to vaccinate in the model and, indeed, in research going back 50 years (Sheeran et al., 2016). Finally, motivation to vaccinate leads to *vaccination uptake*, shown on the right. Getting vaccinated can lower some appraisals of disease risk and increase vaccine confidence, as shown by the arrows going from the far right back to the left (Brewer, Weinstein, Cuite, & Herrington, 2004).

Figure 2. What people think and feel



Source: Adapted from Brewer et al. in *Psychological Science in the Public Interest*, 2017

Findings from observational studies support the thoughts and feelings proposition. Vaccine uptake is associated with higher disease risk appraisals, including thinking infectious diseases are likely, serious, and regrettable (Brewer et al., 2007; Brewer, DeFrank, & Gilkey, 2016). Similarly, vaccine uptake is associated with higher vaccine confidence, as shown by believing that vaccines are important, save lives, and have few side effects. Finally, motivation to vaccinate, also called “intention,” is one of the strongest predictors of health behaviors, including vaccine uptake (Sheeran, 2002).

However, experimental evidence from randomized trials generally does *not* support the thoughts and feelings proposition. This stronger body of evidence better answers the question of whether interventions focused on thoughts and feelings can increase vaccine uptake. Risk communication interventions do not appreciably increase vaccine uptake, according to a recent meta-analysis of 16 studies, although the interventions somewhat increased the belief that infectious diseases are likely (Parsons, Newby, & French, 2018). An older meta-analysis, restricted to five risk communication interventions that increased risk appraisals, did find increases in vaccine uptake (Sheeran, Harris, & Epton, 2014).

Similarly, interventions to boost vaccine confidence have generally not increased uptake, and none have shown that increased confidence explains each intervention’s impact. While some intervention studies have increased vaccine confidence, including beliefs that vaccines are safe and effective (Horne, Powell, Hummel, & Holyoak, 2015; Shah et al., 2019), others have not (Nyhan, Reifler, Richey, & Freed, 2014).

Finally, interventions to increase motivation to vaccinate have not shown reliably that they can influence hesitant people, despite success at increasing motivation for other behaviors (Webb & Sheeran, 2006). Decision aids have little support. Motivational interviewing, while promising, has yet to be shown effective in a randomized trial, although it has been included as one component of several effective multicomponent interventions (Dempsey et al., 2018) and has shown promise in quasi-experimental studies (Gagneur et al., 2018).

In sum, while thoughts and feelings motivate people to get vaccinated, interventions targeting thoughts and feelings have shown little promise for reliably increasing vaccine uptake. Furthermore, there is no apparent logic as to when interventions boost vaccine risk appraisals and confidence, have no

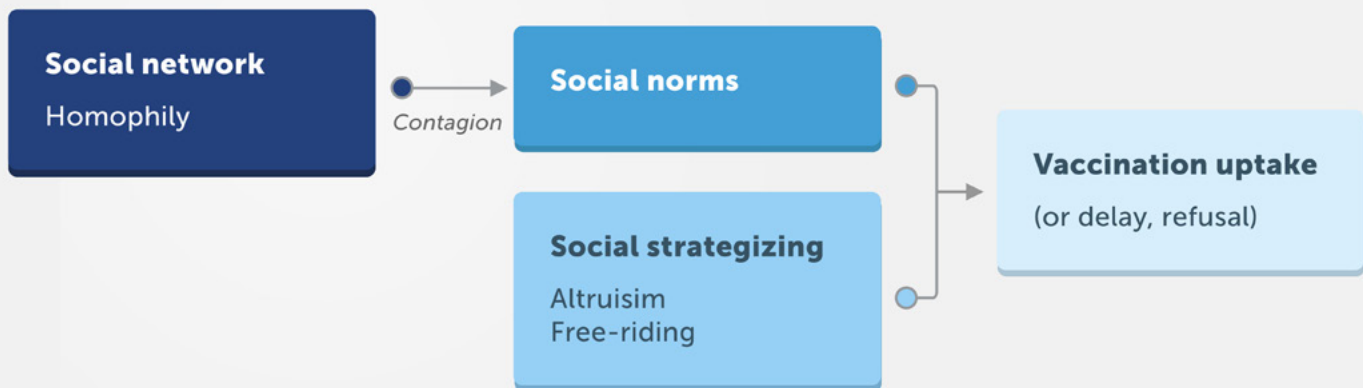
While thoughts and feelings motivate people to get vaccinated, interventions targeting thoughts and feelings have shown little promise for reliably increasing vaccine uptake.

effect, or even have pernicious effects. I return later to the question of whether thoughts and feelings interventions might generate support for vaccination policies and programs, an important outcome that is distinct from vaccination uptake.

SOCIAL PROCESSES

The model’s second broad proposition is that social processes motivate vaccine uptake (Figure 3). The *social network*, the collection of connections among people, is shown on the left side of the figure. These networks have the characteristic of similarity or homophily—birds of a feather flock together. Social networks exert influence through contagion—that is, through the spread of ideas and behaviors. This spread, shown in the middle, establishes *social norms*—what most people do or expect others to do—along with *social preferences* (altruism, vaccinating to protect others, free-riding, and not vaccinating because others already have). Finally, social norms and preferences about vaccination lead to *vaccination uptake*, as shown on the right.

Figure 3. Social processes



Source: Adapted from Brewer et al. in *Psychological Science in the Public Interest*, 2017.

Findings from observational studies reliably support the social processes proposition. Social networks are well characterized and show robust clustering of people with similar ideas about vaccination in social spaces (Dunn et al., 2017). Social norms are reliably associated with vaccine uptake (Schmid, Rauber, Betsch, Lidolt, & Denker, 2017), with somewhat less evidence showing smaller associations for social preferences. Behavioral scientists have generated substantial and convincing experimental evidence on these questions in the context of vaccination, but almost all of it has non-behavioral outcomes.

No published randomized trials to date have established that social process interventions increase vaccine uptake, but this is a very promising area for future research. Some quasi-experimental studies suggest that social processes show potential, and several currently unpublished studies may soon fill this gap.

When experts bring research papers to a firefight, they have lost before they have even started talking.

Research on other health behaviors suggests why social process interventions may succeed where thoughts and feelings interventions fail. The “one communicator and one receiver” model of education is the way to change what people know. However, to change what people do, information must come from multiple people in the person’s social network (Centola, 2010; Centola, 2015). Such social processes are especially pertinent in an era defined by social media, anti-vaccine activists, and misinformation. Stories that go viral evoke strong feelings, include rich narrative detail, and offer a simple “gist” or take-home message (Reyna, 2012). Scientists and their research rarely offer any of these things. When experts bring research papers to a firefight, they have lost before they have even started talking. The consequence is that anti-vaccine activists had, for a while, locked down many social media platforms.

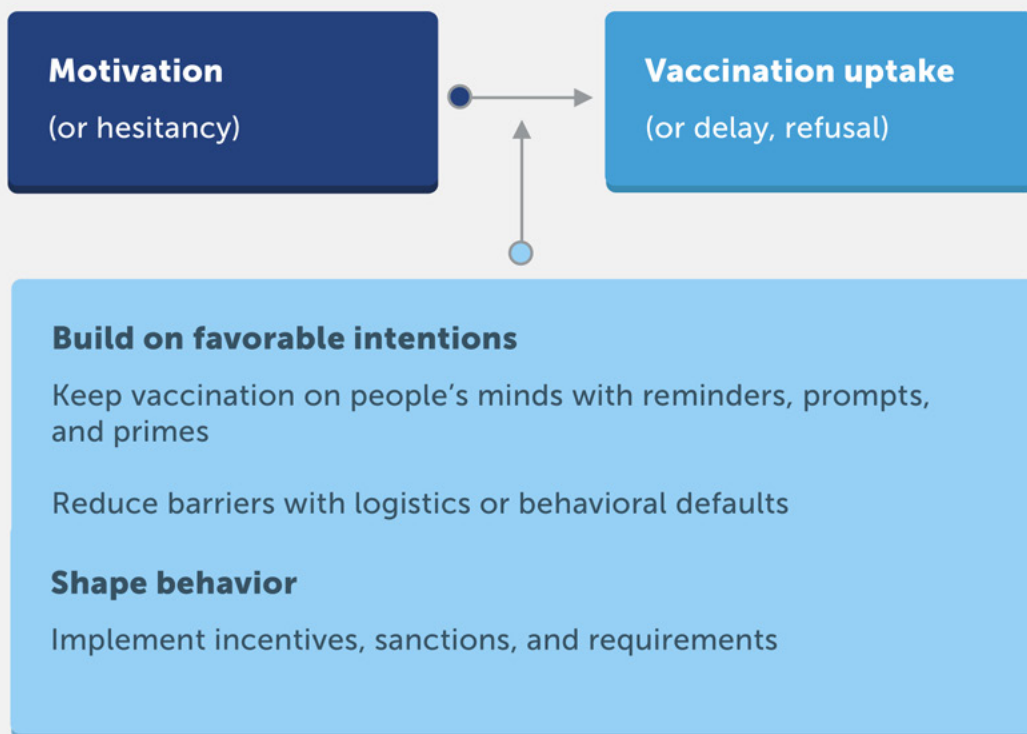
More recently, citizen and scientist activists have fought back with increasingly effective tools. Examples include the National HPV Vaccination Roundtable, which created videos of people affected by HPV cancers and their doctors in order to make the consequences of the diseases more vivid. The WHO created a manual for addressing vaccine deniers in public (World Health Organization/Europe, 2016). Shots Heard Round the World has developed a rapid-response collective of volunteers to defend health care providers attacked for their vaccine advocacy. Quantifying the impact of anti- and pro-vaccine activism and tools is an important area for new research.



DIRECT BEHAVIOR CHANGE

The third broad proposition in the model is that fostering direct behavior change increases vaccine uptake (Figure 4). The general idea is that one can increase vaccine uptake without ever changing what people think and feel or the social world they encounter. Thus, direct behavior change takes *motivation* as a given. One can *build on favorable intentions* to vaccinate by keeping vaccination on people’s minds and reducing barriers to it. Alternatively, one can ignore intentions altogether and *shape behavior* with incentives, sanctions, and requirements—techniques that do not rely on predisposition to vaccinate. These interventions lead to *vaccination uptake*, shown on the right.

Figure 4. Direct behavior change



Source: Adapted from Brewer et al. in *Psychological Science in the Public Interest*, 2017.

One approach to direct behavior change is to build on people's good intentions. That means, first, to identify the people who already intend to vaccinate or are open to it, and then to make it as easy as possible for them to do so. Interventions include keeping vaccination on people's minds with reminders and prompts and reducing barriers with default appointments, standing orders, and other logistical and behavioral defaults. Randomized trials generally support the use of building on vaccination intentions to increase uptake. Another approach is to shape behavior with incentives, sanctions, or requirements, including work and school vaccination mandates. Again, randomized trials have repeatedly found support for the effectiveness of behavior-shaping interventions. The key shared characteristic of these strategies is that they use policies and practices to increase vaccination without changing what people think or feel.

Direct behavior change interventions are the most reliably effective option available, but they do have limitations. For example, while vaccination reminder/recall interventions are effective, few clinics effectively implement them. In one randomized trial, less than 1% of families received a reminder/recall letter or call when the task was assigned to clinics, but 87% received the notices when the county health department handled the responsibility (Kempe et al., 2015). Furthermore, notices from a centralized source are more effective when they include the name of the patient's provider (Kempe et al., 2015). In another example, school requirements (sometimes called mandates) effectively increase uptake of most vaccines (Greyson, Vriesema-Magnuson, & Bettinger, 2019) but do not raise HPV vaccine uptake among adolescent girls (Moss, Reiter, Truong, Rimer, & Brewer, 2016). As well, the process of implementing requirements can create substantial work for immunization programs and distract their staff from other essential tasks (Omer, Betsch, & Leask, 2019). All of this suggests that the right implementation strategy is critically important for direct behavior change interventions.

OTHER CONSIDERATIONS

Several important considerations should guide any application of this model.

| Provider Recommendations

By far, the single most potent intervention for increasing vaccine uptake is a provider recommendation (e.g., Newman et al., 2018). However, it is still unclear whether

recommendations are effective because they increase confidence, set a social norm, or reflect a direct behavior change technique. Quite possibly, provider recommendations exert influence through all three of the model's behavioral propositions. The most active aspect of the model from the standpoint of provider recommendations may be direct behavior change, given the few barriers present in many clinics: the vaccine is in stock, staff can deliver it, and a state program or private insurance generally covers the cost. Given that providers have more power than patients in clinical interactions, injunctive social norms are also likely to play some role. It may even be that providers persuasively shape what people think and feel by building on their unique relationships with the families they see. Research is needed to elucidate basic questions about what makes provider recommendations most effective.

While most evidence for provider recommendations is correlational, several trials have focused on the impact of training providers to communicate more effectively about vaccination. In my own research (Brewer, Hall, et al., 2016), colleagues and I have trained providers to raise the topic of adolescent vaccination using presumptive language (Opel et al., 2013) that we call an "announcement" and then to use a structured communication approach if questions come up. A presumptive announcement might sound like this: "Now that Sophia is 12, she is due for three vaccines. Today, she'll get vaccines against meningitis,



HPV cancers, and whooping cough." The Announcement Approach Training is a one-hour, physician-led, in-clinic training, offered with continuing medical education credits (materials are available at hpvIQ.org). The training increased HPV vaccine uptake by 5% within three months (Brewer, Hall, et al., 2016) and has now been delivered to over 1,200 providers in the United States and the United Kingdom. This communication approach builds on direct behavior change principles by assuming most parents just need a prompt to vaccinate.

Interactions Among the Propositions

No strong data are available to explain how the three parts of the model interact, but I offer my own speculation, based on correlational studies and insights I have gathered from people on the front lines of vaccination. First, although interventions to change what people think

and feel may not change behavior directly, they may provide other indirect benefits. Most of the policies and programs aimed at direct behavior change—by far the most effective way to increase vaccination uptake—require public confidence in vaccination. Thus, interventions that increase vaccine confidence may create an environment that supports direct behavior change interventions.

Second, interventions to change social processes may also change what people think and feel about diseases and vaccination. Although this has not yet been well-documented in the context of vaccination, it is a reasonable speculation based on social network studies in other areas.

Third, implementing direct behavior change interventions almost certainly affects other parts of the model. For example, establishing or removing vaccine recommendations, or imposing requirements for certain vaccines, likely affects confidence in vaccination. Similarly, leaders standing up for existing policies may bolster confidence, while setting these policies aside in the face of public opposition may erode confidence in vaccination.

Interventions to change social processes may also change what people think and feel about diseases and vaccination.

| Global Settings

Most vaccination intervention studies are from the United States, and some are from other high-income countries. Only a handful of intervention studies from low- and middle-income countries have examined vaccination incentives and educational programs. While these have generally shown the same results as studies in high-income countries, caution is warranted in applying these interventions in global settings until formative work is done within the local communities and, perhaps, trial-level evaluations are conducted. Such research could be a two-way street, with vaccination programs in high-income countries benefitting from learning what is effective in increasing vaccine uptake in low- and middle-income countries.

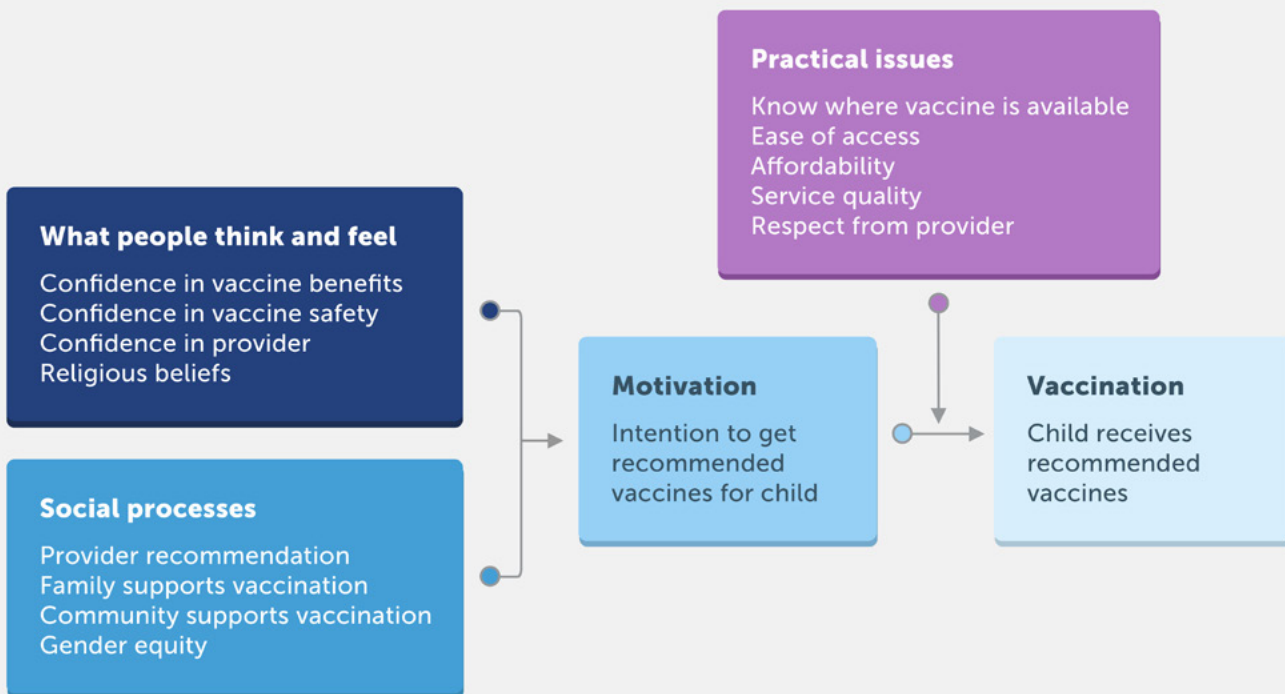
| Timeliness and Stability

The available evidence primarily examines vaccine uptake. Because few studies are available on vaccination timeliness and stability, application of the model to these outcomes remains preliminary and warrants additional study. An area of growing interest is in understanding what leads to and sustains the resilience of vaccination programs.

ADAPTATION OF THE MODEL BY THE WORLD HEALTH ORGANIZATION

Following on its designation of vaccine hesitancy as one of the top 10 threats to global public health, the WHO established an expert working group to identify the behavioral and social drivers of vaccination uptake around the world. The working group has adapted the Increasing Vaccination Model, as shown in Figure 5, as the basis for its work. The boxes in the model have remained the same over time, even as the working group has continued to winnow the list of variables in each box.

Figure 5. Adaptation of the increasing vaccination model



Source: Adapted from Brewer et al. in *Psychological Science in the Public Interest*, 2017

Among the noteworthy highlights from this adaptation:

- Motivation to vaccinate is in its own box, allowing the working group to emphasize the distinction between confidence and hesitancy.
- Provider recommendation is in the social process box. This categorization was not a settled issue in the original paper, but it allowed the working group to keep track of this important variable.

- The direct behavior change section is renamed “Practical issues.” Many working group members had roles in vaccination programs globally which led them to see barriers and practical issues as especially important. They felt that the new name emphasized barriers that vaccination programs can address.

Before using the model, the working group had not engaged with several of the concepts related to social processes. The model shifted their thinking in that domain, leading the group to consider the roles of families, community leaders, and gender equity.

Based on this model, the WHO working group has developed a survey on the behavioral and social drivers of vaccination around the world. The survey is being piloted in six low- and middle-income countries and should be available for use globally in 2021.



CONCLUSION

Direct behavior change is clearly the most promising approach to increasing vaccination uptake, and research supports the use of many different techniques, as shown at the bottom of Table 1 (Brewer et al., 2017). No single intervention is effective on its own, however, making it necessary to adopt more than one. Insofar as each intervention acts on different parts of the system that provides vaccination, their combination may be truly additive or even multiplicative in its effects. It is also possible that the initial intervention activates the “easy” cases to vaccinate and that additional interventions add little. More information is needed on this topic, but given the high cost of trials, such knowledge may be out of reach.

In contrast, interventions to change what people think and feel are often expensive and hard to sustain, and they may not be especially effective (as shown at the top of Table 1). An important caveat here is that interventions by providers in clinical settings may be influential if they effectively use communication approaches based on information, persuasion, and engaged listening.

Interventions targeting social processes are promising insofar as they build on multiple nodes of social networks or happen in clinical settings. In this era of social media and vocal vaccine activism, the conversations about vaccination, both in the

In this era of social media and vocal vaccine activism, the conversations about vaccination, both in the public sphere and in private settings, have an outsized influence on programs and policies.

Table 1. Impact of interventions to increase vaccination uptake

	LIKELY IMPACT
<p>Intervention targets what people think and feel</p> <p>Messages that increase disease risk appraisals</p> <p>Education campaigns that increase confidence</p> <p>Decision aids</p> <p>Motivational interviewing</p>	<p>○</p> <p>○</p> <p>○</p> <p>○</p>
<p>Intervention targets social processes</p> <p>Messages that change altruism or free-riding beliefs</p> <p>Descriptive norm messages</p> <p>Social network interventions that build on contagion</p> <p>Healthcare provider recommendations</p>	<p>○</p> <p>◐</p> <p>◐</p> <p>●</p>
<p>Intervention targets direct behavior change</p> <p>Reminders and recalls</p> <p>Presumptive healthcare provider recommendations</p> <p>Onsite vaccination</p> <p>Default appointments</p> <p>Incentives</p> <p>School and work requirements (mandates)</p> <p>Sanctions</p>	<p>◐</p> <p>●</p> <p>●</p> <p>●</p> <p>●</p> <p>●</p> <p>●</p>

LIKELY IMPACT ○ no or very small | ◐ modest | ● substantial

public sphere and in private settings, have an outsized influence on programs and policies. What this adds up to remains to be seen, but research is under way that should shed light on the pitfalls and promises of social processes.

Thinking more broadly about public support for vaccination, work is needed to understand how to ensure resilience in the face of safety scares. Interventions to boost vaccine confidence may not increase vaccination uptake directly, but they may have a side benefit of increasing support for effective policies and programs. Interventions through social media—to add supportive stories and information or to limit misinformation—may also increase

vaccination support. Other strategies can also be considered, including targeted efforts when new vaccines are launched and to address unsubstantiated vaccine scares. Indeed, data are accumulating to support the value of efforts by countries to bolster confidence during such scares (Hansen et al., 2020).

As we move into a new decade, it is essential to ensure the resilience of vaccination programs and the global success story they represent. The Increasing Vaccination Model offers important insights to support such efforts. Building on the large existing body of evidence can ensure a steady path forward for vaccination programs globally.



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Noel T. Brewer, Ph.D., has published more than 280 papers on health behaviors that prevent cancer. His current work focuses on increasing HPV vaccination, improving tobacco warnings, and encouraging the appropriate use of medical screening tests. Brewer chairs the U.S. National HPV Vaccination Roundtable and has been an advisor on vaccination for the World Health Organization, the Centers for Disease Control and Prevention, the President's Cancer Panel and the National Vaccine Advisory Committee. Brewer co-edited *Communicating Risks and Benefits: An Evidence-Based User's Guide* (FDA, 2011).

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REFERENCES

- Brewer, N. T., Chapman, G. B., Gibbons, F. X., Gerrard, M., McCaul, K. D., & Weinstein, N. D. (2007). Meta-analysis of the relationship between risk perception and health behavior: The example of vaccination. *Health Psychology, 26*(2), 136–145. <https://doi.org/10.1037/0278-6133.26.2.136>
- Brewer, N. T., Chapman, G. B., Rothman, A. J., Leask, J., & Kempe, A. (2017). Increasing vaccination: Putting psychological science into action. *Psychological Science in the Public Interest, 18*(3), 149–207. <https://doi.org/10.1177/1529100618760521>
- Brewer, N. T., DeFrank, J. T., & Gilkey, M. B. (2016). Anticipated regret and health behavior: A meta-analysis. *Health Psychology, 35*(11), 1264–1275. <https://doi.org/10.1037/hea0000294>
- Brewer, N. T., Hall, M. E., Malo, T. L., Gilkey, M. B., Quinn, B., & Lathren, C. (2016). Announcements versus conversations to improve HPV vaccination coverage: A randomized trial. *Pediatrics, 139*(1), e20161764. <https://doi.org/10.1542/peds.2016-1764>
- Brewer, N. T., Weinstein, N. D., Cuite, C. L., & Herrington, J. E. (2004). Risk perceptions and their relation to risk behavior. *Annals of Behavioral Medicine, 27*(2), 125–130. https://doi.org/10.1207/s15324796abm2702_7
- Centola, D. (2010). The spread of behavior in an online social network experiment. *Science, 329*(5996), 1194–1197. <https://doi.org/10.1126/science.1185231>
- Centola, D. (2015). The social origins of networks and diffusion. *American Journal of Sociology, 120*(5), 1295–1338. <https://doi.org/10.1086/681275>
- Dempsey, A. F., Pyrznowski, J., Lockhart, S., Barnard, J., Campagna, E. J., Garrett, K., ... O'Leary, S. T. (2018). Effect of a health care professional communication training intervention on adolescent human papillomavirus vaccination: a cluster randomized clinical trial. *JAMA Pediatrics, 172*(5), e180016–e180016. <https://doi.org/10.1001/jamapediatrics.2018.0016>

- Dunn, A. G., Surian, D., Leask, J., Dey, A., Mandl, K. D., & Coiera, E. (2017). Mapping information exposure on social media to explain differences in HPV vaccine coverage in the United States. *Vaccine*, *35*(23), 3033–3040. <https://doi.org/10.1016/j.vaccine.2017.04.060>
- Gagneur, A., Lemaître, T., Gosselin, V., Farrands, A., Carrier, N., Petit, G., ... De Wals, P. (2018). A postpartum vaccination promotion intervention using motivational interviewing techniques improves short-term vaccine coverage: PromoVac study. *BMC Public Health*, *18*(1). <https://doi.org/10.1186/s12889-018-5724-y>
- Greyson, D., Vriesema-Magnuson, C., & Bettinger, J. A. (2019). Impact of school vaccination mandates on pediatric vaccination coverage: A systematic review. *CMAJ Open*, *7*(3), E524–E536. <https://doi.org/10.9778/cmajo.20180191>
- Hansen, P. R., Schmidtlaicher, M., & Brewer, N. T. (2020). Resilience of HPV vaccine uptake in Denmark: Decline and recovery. *Vaccine*, *38*(7), 1842–1848. <https://doi.org/10.1016/j.vaccine.2019.12.019>
- Horne, Z., Powell, D., Hummel, J. E., & Holyoak, K. J. (2015). Countering antivaccination attitudes. *Proceedings of the National Academy of Sciences*, *112*(33), 10321–10324. <https://doi.org/10.1073/pnas.1504019112>
- Kempe, A., Saville, A. W., Dickinson, L. M., Beaty, B., Eisert, S., Gurfinkel, D., ... Herlihy, R. (2015). Collaborative centralized reminder/recall notification to increase immunization rates among young children: A comparative effectiveness trial. *JAMA Pediatrics*, *169*(4), 365–373. <https://doi.org/10.1001/jamapediatrics.2014.3670>
- Moss, J. L., Reiter, P. L., Truong, Y. K., Rimer, B. K., & Brewer, N. T. (2016). School entry requirements and coverage of nontargeted adolescent vaccines. *Pediatrics*, *138*(6), e20161414. <https://doi.org/10.1542/peds.2016-1414>
- Newman, P. A., Logie, C. H., Lacombe-Duncan, A., Baiden, P., Tepjan, S., Rubincam, C., ... Asey, F. (2018). Parents' uptake of human papillomavirus vaccines for their children: A systematic review and meta-analysis of observational studies. *BMJ Open*, *8*(4), e019206. <https://doi.org/10.1136/bmjopen-2017-019206>

- Nyhan, B., Reifler, J., Richey, S., & Freed, G. L. (2014). Effective messages in vaccine promotion: A randomized trial. *Pediatrics*, *133*(4), e835–e842. <https://doi.org/10.1542/peds.2013-2365>
- Omer, S. B., Betsch, C., & Leask, J. (2019). Mandate vaccination with care. *Nature*, *571*(7766), 469–472. <https://doi.org/10.1038/d41586-019-02232-0>
- Opel, D. J., Heritage, J., Taylor, J. A., Mangione-Smith, R., Salas, H. S., DeVere, V., ... Robinson, J. D. (2013). The architecture of provider-parent vaccine discussions at health supervision visits. *Pediatrics*, *132*(6), 1037–1046. <https://doi.org/10.1542/peds.2013-2037>
- Parsons, J. E., Newby, K. V., & French, D. P. (2018). Do interventions containing risk messages increase risk appraisal and the subsequent vaccination intentions and uptake? A systematic review and meta-analysis. *British Journal of Health Psychology*, *23*(4), 1084–1106. <https://doi.org/10.1111/bjhp.12340>
- Reyna, V. F. (2012). A new intuitionism: Meaning, memory, and development in Fuzzy-Trace Theory. *Judgment and Decision Making*, *7*(3), 332–359. Retrieved March 27, 2020, from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4268540>
- Schmid, P., Rauber, D., Betsch, C., Lidolt, G., & Denker, M. L. (2017). Barriers of influenza vaccination intention and behavior: A systematic review of influenza vaccine hesitancy, 2005–2016. *PloS One*, *12*(1), e0170550. <https://doi.org/10.1371/journal.pone.0170550>
- Shah, P. D., Calo, W. A., Gilkey, M. B., Boynton, M. H., Dailey, S. A., Todd, K. G., ... Brewer, N. T. (2019). Questions and concerns about HPV vaccine: A communication experiment. *Pediatrics*, *143*(2), e20181872. <https://doi.org/10.1542/peds.2018-1872>
- Sheeran, P. (2002). Intention-behavior relations: A conceptual and empirical review. *European Review of Social Psychology*, *12*(1), 1–36. <https://doi.org/10.1080/14792772143000003>
- Sheeran, P., Harris, P. R., & Epton, T. (2014). Does heightening risk appraisals change people's intentions and behavior? A meta-analysis of experimental studies. *Psychological Bulletin*, *140*(2), 511–543. <https://doi.org/10.1037/a0033065>

- Sheeran, P., Maki, A., Montanaro, E., Avishai-Yitshak, A., Bryan, A., Klein, W. M. P., ... Rothman, A. J. (2016). The impact of changing attitudes, norms, and self-efficacy on health-related intentions and behavior: A meta-analysis. *Health Psychology, 35*(11), 1178–1188. <https://doi.org/10.1037/hea0000387>
- Webb, T. L., & Sheeran, P. (2006). Does changing behavioral intentions engender behavior change? A meta-analysis of the experimental evidence. *Psychological Bulletin, 132*(2), 249–268. <https://doi.org/10.1037/0033-2909.132.2.249>
- World Health Organization/Europe. (2016). *Best practice guidance: How to respond to vocal vaccine deniers in public*. (1st ed.). Retrieved March 27, 2020, from https://www.who.int/immunization/sage/meetings/2016/october/8_Best-practice-guidance-respond-vocal-vaccine-deniers-public.pdf
- World Health Organization. (2018). Global health observatory data: Measles-containing-vaccine first-dose (MCV1) immunization coverage among 1-year-olds. Retrieved from <https://www.who.int/gho/immunization/measles/en>

THE COMPLEX CONTAGION OF DOUBT IN THE ANTI-VACCINE MOVEMENT

Damon Centola, Ph.D.

“FUD” is the *fear, uncertainty, and doubt* that IBM salespeople instill in the minds of potential customers who might be considering [competitors’] products.... The idea, of course, was to persuade buyers to go with safe IBM gear rather than competitors’ equipment.

— *The Jargon File* (cited in Raymond, 1991)

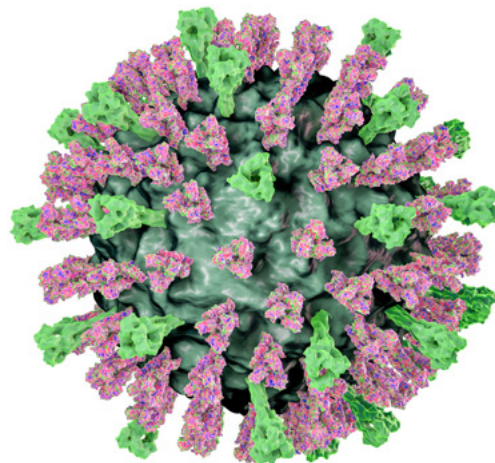
INTRODUCTION

The measles virus is a “simple contagion” that is transmitted through contact between an infected person and a susceptible person. When someone who is newly infected becomes contagious, that person can transmit the disease to someone else who is susceptible, who in turn can transmit it to another, and so on. The result: One highly connected person can trigger an epidemic.

Information can act like a simple contagion as well. If I tell you recent news about the availability of a new measles, mumps, and rubella (MMR) vaccine, you can easily repeat it to someone who can then repeat it to someone else. Each new contact and repetition leads to more transmission of the information. The result is the same: One highly connected person can accelerate word-of-mouth transmission of news, allowing it to spread “virally” across a community (Centola & Macy, 2007).

But anti-vaccine sentiment is different. It is a “complex contagion.” Simply hearing a piece of anti-vaccine propaganda does not change a person’s beliefs. Rather, people need to be convinced—the hallmark of a complex contagion—through contact with several peers who can reinforce the legitimacy of a point of view. That kind of social reinforcement confers credibility to the idea that vaccines may be harmful (Centola, 2018).

Measles virus



The spread of vaccine hesitancy comes from the increased acceptance of the possibility that vaccines can be harmful, which grows not through the sharing of specific information (or misinformation), but rather from having that information socially reinforced to the extent that citizens believe it to be credible. Therefore, once the anti-vaccination view is perceived to be a legitimate side of a debate, it has already won because the goal is to create credibility for that view and spread doubt about vaccination.

THE PERCEIVED SAFETY OF INACTION

Doubt is a complex contagion reinforced through repeated contact with actors on both sides who unwittingly reinforce the belief that the debate itself is valid. A contagion of doubt is effective because it is asymmetric, benefitting one side more than the other. In this instance, the contagion of doubt benefits the anti-vaccination view and disadvantages public health campaigns (Jamieson, 2018).

Why?

Because the contagion of doubt raises the possibility that a parent's own actions may harm a child, while inaction will keep the child safe. Action and inaction are perceived differently. People feel greater moral responsibility for harms that they inflict through their own action than for harms that may or may not have been a result of their own inaction. The causal inference from action to harm is easier to understand and carries greater moral weight. Therefore, the contagion of doubt amplifies the moral urgency of *not* taking a wrong action—that is, of doing no harm (Oreskes & Conway, 2010).



In the vaccination arena, the contagion of doubt is framed as a contest between a safe behavior (inaction) and a potentially dangerous behavior (vaccination). The goal of the contagion of doubt is to trigger “fear, uncertainty, and doubt” about the possible consequences of action (Raymond, 1991). The logic that follows is not strictly rational, but is fairly clear and predictable: People retreat to the safety of inaction.

The contagion of doubt engages individuals in a series of cognitive biases. The two most pernicious ones are:

- Inferring future from past: Nothing bad has happened so far, so nothing bad will continue to happen as long as I don't make a dangerous decision.
- Post hoc ergo propter hoc: If something goes wrong after vaccination, it can be traced back causally to my decision to vaccinate.

The second of these biases is particularly difficult to address. Although there is enormous variation in human physiology (often compounded by environmental and social factors), and the causes of medical complications in an infant or very young child are too many to enumerate, the contagion of doubt focuses the vague anxiety of almost any parent into a specific threat. Anti-vaccination theories soothe that anxiety by suggesting that parents can protect their children from an unnamed multitude of harms by simply *not* taking the dangerous action of vaccinating their children.

Because anti-vaccine sentiment is not a simple contagion, a single voice will be ineffective at persuasion. But if this contagion is socially reinforced, then a contagion of doubt may spread through the peer networks of close-knit parent communities. A successful campaign of anti-vaccine sentiment does not need to convince every parent of every anti-vaccine fact or falsehood; it simply needs to generate sufficient credibility for the anti-vaccination perspective to engage the reasoning processes of fear, uncertainty, and doubt. These cognitive biases will typically lead citizens to choose inaction (anti-vaccination) over potentially dangerous action (vaccination).

A successful campaign of anti-vaccine sentiment does not need to convince every parent of every anti-vaccine fact or falsehood; it simply needs to generate sufficient credibility for the anti-vaccination perspective to engage the reasoning processes of fear, uncertainty, and doubt.

Speaking of IBM's use of the tactic of fear, uncertainty, and doubt, industry analyst Eric Raymond (1991) says, "The implicit coercion was traditionally accomplished by promising that Good Things would happen to people who stuck with IBM, but Dark Shadows loomed over the future of competitors' equipment or software. After 1991, the term [FUD] has become generalized to refer to any kind of disinformation campaign used as a competitive weapon."

“WEAPONIZING HEALTH CONVERSATIONS”

In 2015, the Defense Advanced Research and Projects Administration (DARPA) within the U.S. Department of Defense launched the Bot Challenge, an open competition for researchers to study the influence of social media bots (automated software programmed to pattern human behavior) on U.S. vaccination conversations (Broniatowski et al., 2018).



The results showed that Russian agencies were indeed hacking into Twitter conversations in the United States and using highly sophisticated tactics to engage in the vaccination debate.

Instead of merely promoting anti-vaccination messages, these malicious actors were seeding ersatz messages on both sides. Their goal was not simply to spread misinformation, but rather to amplify the scale of the debate, spreading not only doubt but going one step further by creating disruptive political animosity as well.

Here are a few examples of the conflicting messages from Russian trolls:

- “#VaccinateUS mandatory #vaccines infringe on constitutionally protected religious freedoms.”

- "Your kids are not your property! You have to #vaccinate them to protect them and all the others! #VaccinateUS."
- "#VaccinateUS natural infection almost always causes better immunity than #vaccines."
- "#VaccinateUS You can't fix stupidity. Let them die from measles, and I'm for #vaccination!"
- "Did you know there was a secret government database of #vaccine-damaged children? #VaccinateUS."
- "Most parents in Victorian times lost children regularly to preventable illnesses. #vaccines can solve this problem #VaccinateUS."
- "Did you know #vaccines cause autism? #VaccinateUS."



The impact of these digital messages on Twitter is difficult to measure, but at least one direct effect is known: Although none of these tweets were generated by sincere users, the conversations were picked up and retweeted, creating the illusion of an active debate. Citizens who engaged with these tweets, or simply read them, perceived controversy despite a complete

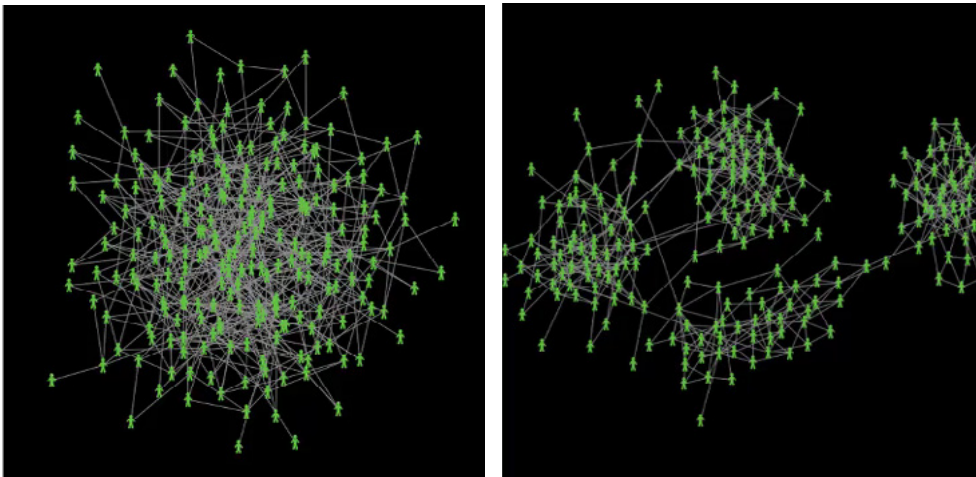
lack of scientific disagreement on the issue. The perception of a true debate fueled further conversations, spreading seamlessly from social media to face-to-face interactions with neighbors and fellow parents, allowing the messages to be reinforced and further propagated (Broniatowski et al., 2018).

The conclusion from researchers engaged in DARPA's challenge was that these messages were activating the same principles of fear, uncertainty, and doubt first pioneered by IBM. They were, in essence, "weaponized health communications." Their aim was to encourage citizens to stick with the safe and known choice—namely, inaction—in the face of the vague, looming dangers presented by vaccination.

HOW SOCIAL NETWORKS SPREAD BEHAVIOR

Let's consider what all of this means for the ways in which social networks affect the success of anti-vaccination campaigns and their impact on the likelihood of a measles epidemic. The panel on the left side of Figure 1 represents a "random network" typical of an urban community in which people randomly encounter strangers on most days. Let's assume that this network lacks local community clusters and densely interconnected ties. The panel on the right represents a "clustered network" typical of some tight-knit suburban communities in which people are more likely to interact with their neighbors and their neighbors' neighbors at local events, school fundraisers, and so forth. Which network is more susceptible to a measles epidemic?

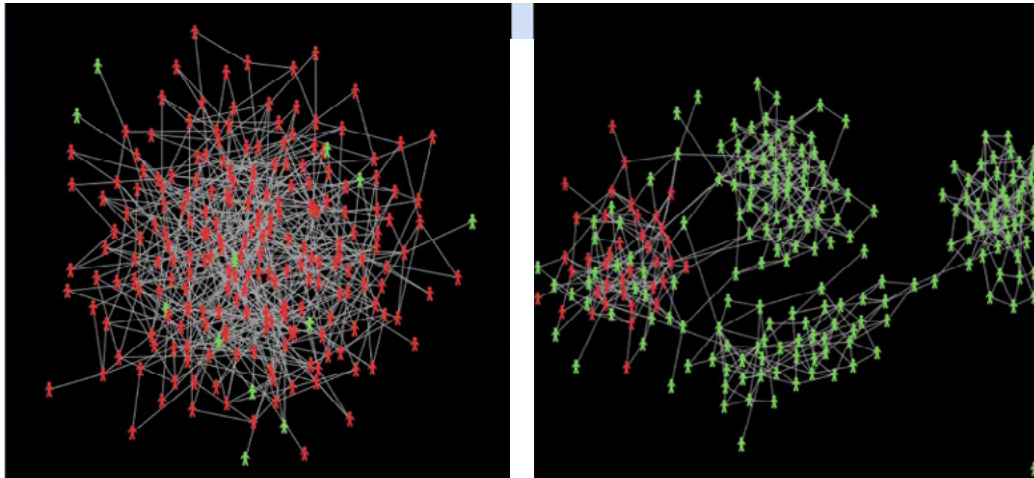
Figure 1. Urban and suburban social networks



If no one is inoculated, then one infected person who enters the urban (random) network will have contact with, and infect, lots of strangers. They will, in turn, infect other strangers with whom they come into contact, giving rise to an exponential growth of infections—an epidemic is almost certain. Contrast this with the situation in a suburban (clustered) network. One infected person will infect a small cluster of peers, but once the outbreak starts, the contagion is easy to contain. Unlike the urban network, in which each infected person's newly infected contacts have random contacts all over the city, the infected person's

contacts in the suburban network are likely to know one another. This social overlap limits the reach of the infection. In this instance, the urban network is clearly more vulnerable to a measles epidemic than the suburban network (see Figure 2; Campbell & Salathé, 2013; Centola & Macy, 2007).

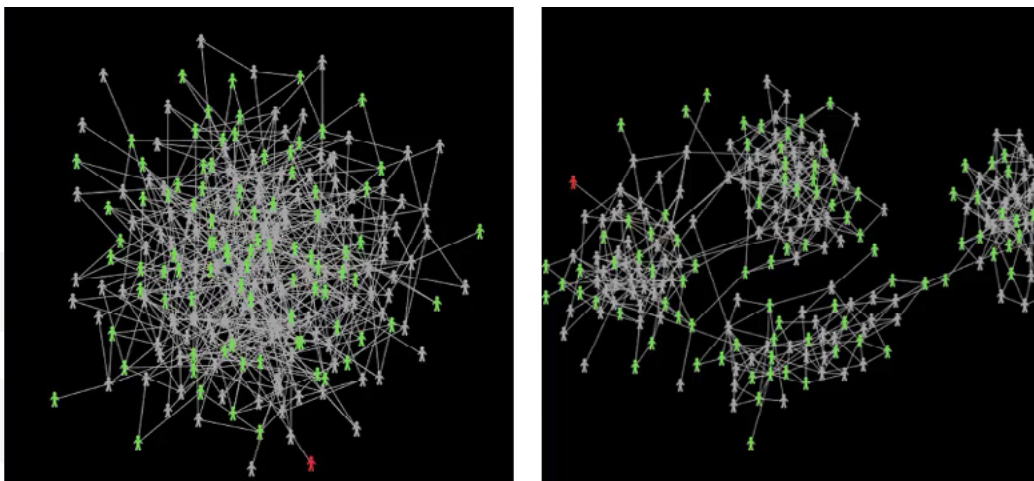
Figure 2. Measles outbreaks in urban and suburban social networks



Red = those infected with measles

Now, let's imagine that there is an inoculation campaign in the United States by the Centers for Disease Control and Prevention (CDC). Public health messages are broadcast throughout the urban and suburban networks with great informational saturation, resulting in the majority of both communities becoming vaccinated (Figure 3).

Figure 3. Effectiveness of vaccination campaigns in urban and suburban social networks



Gray = the inoculated; Green = the not inoculated

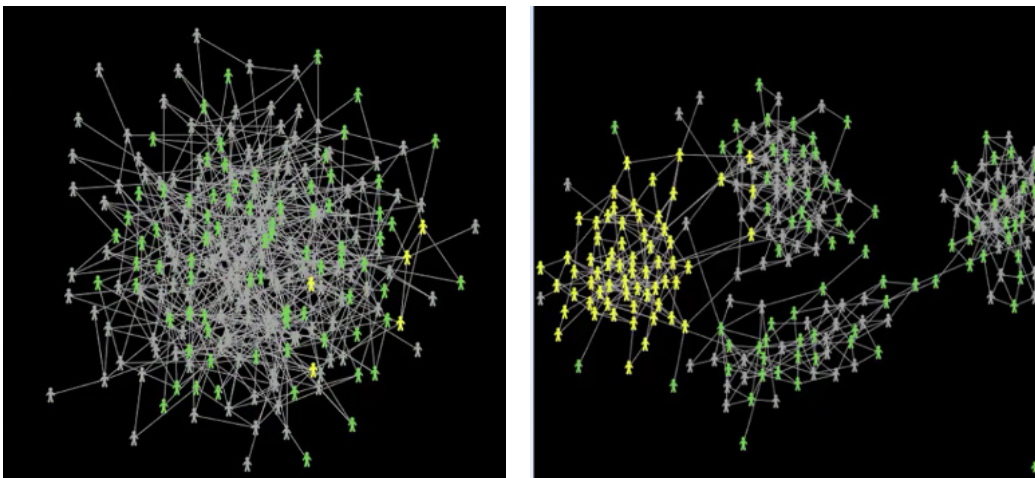
In this case, both communities have some protection and neither is susceptible to an outbreak. The vaccination campaign has effectively closed down the contagion pathways of spread, even if an infected person enters. In both communities, inoculation has eliminated the dangers of a measles epidemic and the virus simply cannot take hold.

Finally, let's suppose that there is an anti-vaccination movement within each network. A small group of anti-vaccination activists tries to spread the contagion of doubt in the urban network and an equivalent group attempts to do the same in the suburban network.

Let's assume that in the urban network, the activists are not well connected to one another's friends, nor are they internally terribly coherent. Rather, they are a few disconnected individuals, each trying to spread an anti-vaccination message. Because the urban network does not provide any social reinforcement, the messages are not convincing. There is not enough social support within the community to make these informational signals credible, and the contagion of doubt does not take hold (Centola, 2010). If the inoculation campaign succeeds as before, the anti-vaccination activists have not put anyone at risk but themselves (Figure 4).

The vaccination campaign has effectively closed down the contagion pathways of spread, even if an infected person enters.

Figure 4. Success of anti-vaccine movements in urban and suburban social networks



Yellow = anti-vaccination campaign success

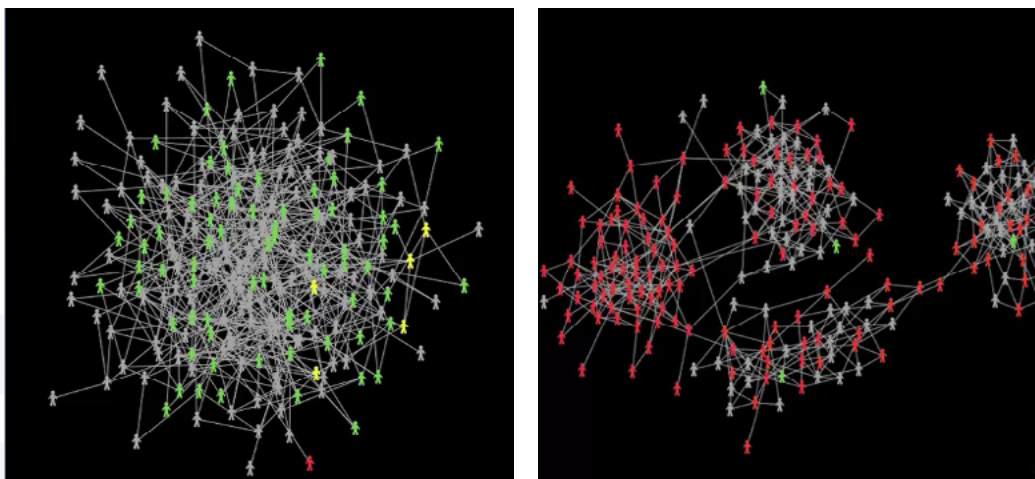
In the suburban network, the anti-vaccination activists cluster together within a small part of the community. Because they have less exposure to the population as a whole, they appear to be at a disadvantage compared to the activists in the urban network. However, because

they share contacts within their social cluster, they can reinforce the anti-vaccination message and propagate doubt among their peers. Those peers may then become convinced that there is a real debate and that concerns about the safety of vaccination are valid. As they, in turn, talk to other peers, social reinforcement within this network can lead to a contagion of doubt (Centola, 2010; Centola, 2011). Even if we assume that a vaccination campaign succeeds as before for the rest of the population, there will be no takers among the cluster of fearful anti-vaxxers.

As a result, an infected person entering this anti-vaccination cluster will infect everyone within it. This cluster then generates a critical mass of infected individuals that can overwhelm the herd immunity serving the rest of the population, allowing every non-vaccinated person in the suburban community to contract measles (Campbell & Salathé, 2013).

In summary, the urban network will be more vulnerable to epidemic outbreaks than the suburban network in the absence of an anti-vaccination movement, but a successful vaccination campaign can reduce that vulnerability (Figure 5). Even with a vaccination campaign, however, suburban networks become vulnerable to epidemic outbreaks if an anti-vaccination movement takes hold. The complex contagion of doubt changes the dynamics of disease spread, making the clustered suburban network a far more vulnerable social setting.

Figure 5. Measles outbreaks after anti-vaccine movements and vaccination campaigns in urban and suburban social networks.



Yellow = anti-vaccination campaign success

CONCLUSION

To put these issues in a larger context, consider the difference in public attitudes about antibiotics and vaccines. Why do some U.S. residents zealously overuse antibiotics, while fearfully underusing vaccines? The attraction of antibiotics reflects the perceived danger of immediate infection compared to the remote individual risk of antibiotic resistance. Temporal discounting and poor reasoning about risk can explain why an immediate danger has more influence on decision making than a remote risk (Thaler & Sunstein, 2008). The logic of the vaccination debate is the opposite. A possible viral epidemic is a distant risk, but the perceived danger from vaccination is that it can cause immediate harm, which encourages people to recoil into a position of safety—that is, a position of inaction (Raymond, 1991).

The complexity of social contagion is that it requires social reinforcement to spread. But, if the contagion of doubt spreads most effectively through clustered networks of peers, it may be possible to counteract that contagion with the same strategy. Creating networked communities—online and offline—in which social reinforcement is strategically harnessed to delegitimize the anti-vaccine arguments, is one promising approach. The strategies of complex contagions provide useful guidance for targeting places in the social network where reinforcement can either increase the credibility of the anti-vaccination movement or decrease its legitimacy (Centola, 2018).



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Damon Centola, Ph.D. is one of the world's leading experts on social networks and behavior change, whose work has been published in *Science*, *Nature*, *Proceedings of the National Academy of Sciences*, *The American Journal of Sociology*, *Circulation*, and *The Journal of Statistical Physics* and widely covered in the popular press. Centola has received numerous awards for his research, including, most recently, the James Coleman Award for Outstanding Research in Rationality and Society in 2017; and the Harrison White Award for Outstanding Scholarly Book in 2019. He was a developer of the NetLogo agent-based modeling environment and was awarded a U.S. patent for inventing a method to promote diffusion in online networks. He is a series editor for Princeton University Press and the author of *How Behavior Spreads: The Science of Complex Contagions*.

REFERENCES

- Broniatowski, D. A., Jamison, A. M., Qi, S., AlKulaib, L., Chen, T., Benton, A., ... Dredze, M. (2018). Weaponized health communication: Twitter bots and Russian trolls amplify the vaccine debate. *American Journal of Public Health, 108*(10), 1378–1384. <https://doi.org/10.2105/ajph.2018.304567>
- Campbell, E., & Salathé, M. (2013). Complex social contagion makes networks more vulnerable to disease outbreaks. *Scientific Reports, 3*(1). <https://doi.org/10.1038/srep01905>
- Centola, D. (2010). The spread of behavior in an online social network experiment. *Science, 329*(5996), 1194–1197. <https://doi.org/10.1126/science.1185231>
- Centola, D. (2011). An experimental study of homophily in the adoption of health behavior. *Science, 334*(6060), 1269–1272. <https://doi.org/10.1126/science.1207055>
- Centola, D. (2018). *How behavior spreads: The science of complex contagions*. Princeton Analytical Sociology. Princeton, NJ: Princeton University Press.
- Centola, D., & Macy, M. (2007). Complex contagions and the weakness of long ties. *American Journal of Sociology, 113*(3), 702–734. <https://doi.org/10.1086/521848>
- Jamieson, K. H. (2018). *Cyberwar: How Russian hackers and trolls helped elect a president: What we don't, can't, and do know*. New York, NY: Oxford University Press.
- Oreskes, N., & Conway, E. M. (2010). *Merchants of doubt: How a handful of scientists obscured the truth on issues from tobacco smoke to global warming*. London: Bloomsbury Press.
- Raymond, E. S. (1991). *The new hacker's dictionary* (2nd ed.). Cambridge, MA: MIT Press.
- Thaler, R. H., & Sunstein, C. R. (2008). *Nudge: Improving decisions about health, wealth, and happiness*. New Haven, CT: Yale University Press.

ONLINE MISINFORMATION ABOUT VACCINES*

Renée DiResta and Claire Wardle, Ph.D.

INTRODUCTION

“Vaccine hesitancy” was one of 2019’s 10 most notable threats to global health, according to the World Health Organization ([WHO], 2019a). With high-profile measles outbreaks in Brooklyn, Samoa, the Democratic Republic of the Congo, and Italy; misinformation impacting the polio eradication program in Pakistan (Bhattacharjee & Dotto, 2019); and a controversial rollout of Dengvaxia in the Philippines (Mason & Smith, 2020), vaccine-related headlines have become a feature of contemporary life.



The main reasons people do not vaccinate their children when vaccines and vaccination services are otherwise available include cost; convenience; moral, philosophical, or religious objections; or lack of information about when and how to obtain vaccinations. More

* This article has been updated to reflect evolving developments since the September 2019 meeting of the Sabin-Aspen Vaccine Science & Policy Group. An earlier draft of this paper informed the group’s in-person discussion. While the conclusions have not changed substantially, some more recent trends are also included here.

troublesome is the misinformation that has infiltrated the conversation about vaccinations online and via social media. For example, people express doubts about the undue influence that “big pharma” plays in vaccination efforts (Lyman, 2019); there is the belief that “the West” uses vaccines for population control in other countries (College of Physicians of Philadelphia, 2020a); and parents are still impacted by the ongoing “zombie rumor” that the measles, mumps, and rubella (MMR) vaccine causes autism, which is based on discredited research published in 1998 by Andrew Wakefield. Other concerns are country- or region-specific. For example, there are ongoing questions in Pakistan about “Western influence” (Robbins, 2011) which arose after CIA operatives posed as UNICEF vaccination workers to obtain DNA samples from Osama bin Laden’s family.



All of this creates the backdrop for vaccine conversations between individuals and on public forums that can be based on misleading and false conspiracy theories and rumors, whether they sit in Google search results, YouTube videos, or Facebook, Instagram, or WhatsApp messages. A study published in February 2020 demonstrated that people exposed to vaccine content on social media were more likely to be misinformed than those

exposed to it on traditional media. The study, based on a nationally representative survey of nearly 2,500 U.S. adults, found that up to 20% of respondents were at least somewhat misinformed about vaccines and that “people who received their information from traditional media were less likely to endorse common anti-vaccination claims” (Stecula, Kuru, & Jamieson, 2020).

The focus of initiatives to address misinformation and disinformation online over the past few years has largely been on the integrity of elections. But more recently, health and science misinformation—particularly related to climate, food safety, vaccines, dangerous alternative “cures,” manipulative cancer quackery, and misinformation about the new coronavirus (COVID-19)—have attracted interest as well. As concerns have been raised about the impact of social media on vaccine decision-making, social media platforms have been rolling out new initiatives, including advisories (Twitter) and removing certain anti-vaccination content from search results (Pinterest) and recommendation engines (YouTube; Seyoum, 2019). Experiments around election interference have demonstrated that comprehensive real-time

monitoring of social spaces; rapid response policies such as downranking and removing problematic and harmful content; and well-timed and carefully designed debunking can help slow down false or misleading information. There are clear lessons to be learned and applied to tackling the challenges posed by the online anti-vaccine movement.

GLOBAL LANDSCAPE OF ONLINE MISINFORMATION

Online anti-vaccine messages are also becoming an increasing problem in other countries, resulting in less trust in vaccinations during the yellow fever outbreak in Brazil (Kaiser, 2018), rising levels of misinformation circulating on WhatsApp in India (Purnell, 2019), sudden panic around polio vaccinations in Pakistan (Bhattacharjee & Dotto, 2019), fuel for ongoing conspiracies around Dengvaxia in the Philippines (Mason & Smith, 2020), and an apparent impact on large measles outbreaks in the Democratic Republic of the Congo (BBC News, 2019a) and Samoa (Gerson, 2019).

A study of online vaccine misinformation in Brazil—a country with a very robust national vaccination program—shows that a downward trend in the number of people getting vaccinations began around 2015 (Zorzetto, 2018). The study indicated that 8% of Brazilians found vaccines “partially unsafe” and 72% had seen negative news about vaccines on social media or messaging apps. Another 6% said they found vaccines “totally unsafe” and 59% had seen negative news about vaccines on social media or messaging apps (Avaaz, 2019). While this survey cannot disentangle causality, the percentage of people reporting that they had seen negative information about vaccines on social media is an important data point.

To counter online misinformation, we must understand how the rumors, conspiracy theories, and misleading content that we see in digital spaces intersects with existing barriers to vaccination in different countries.

To counter online misinformation, we must understand how the rumors, conspiracy theories, and misleading content that we see in digital spaces intersects with existing barriers to vaccination in different countries.

CHALLENGES OF STUDYING MISINFORMATION

It is almost impossible to answer questions about the prevalence of online misinformation and its impact on people's beliefs and behaviors without access to the data locked in individual platforms. The process of sharing this data has been complicated by the challenge of building databases based on differential privacy that would protect users' identities. In February 2020, however, Facebook finally released the largest-ever dataset of URLs that have been shared over 100 times (over an exabyte of data; King & Persily, 2020), allowing researchers to better study the flow of misinformation on Facebook. Scholars hope this might lead other platforms to release data so that researchers can better understand how misinformation is shared and consumed.

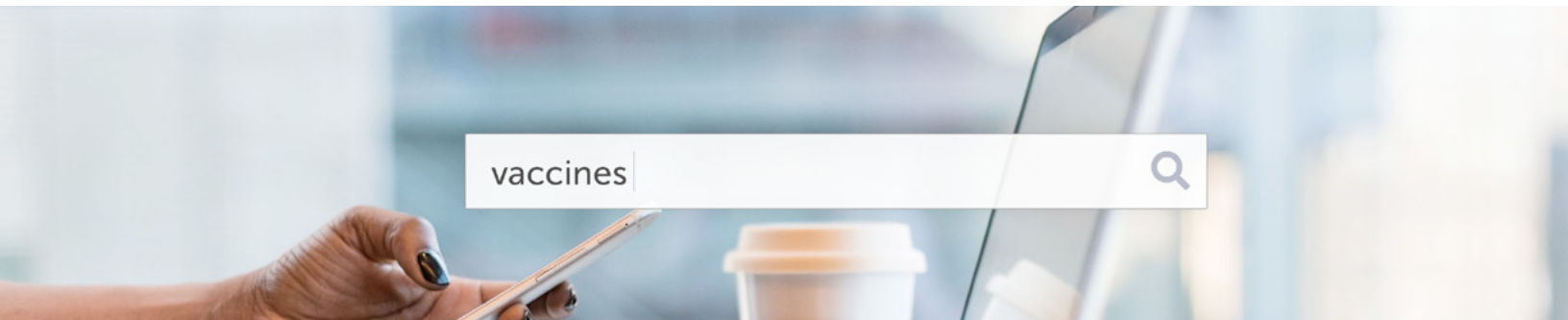
While the release of this dataset is a positive development, it focuses exclusively on URLs (as does much of the research around misinformation since 2016). However, much of the potentially harmful content does not sit exclusively on websites, but in Facebook posts, Instagram memes, misleading tweets, and conspiratorial YouTube videos. Without access to this data, measuring the full scale and impact of this type of content is impossible.

In April 2019, Claire Wardle (a co-author of this paper) and Alexios Mantzarlis used a new method to understand prevalence. They asked people in 12 countries (including Australia, Brazil, Egypt, India, Nigeria, and the Philippines) to perform two tasks (Wardle & Mantzarlis, unpublished, 2019).

1. *Enter the query they would use on a search engine to find information related to vaccines online (Figure 1).*

The results in English are shown to the right (note that the wording is reproduced as it appeared on the search string, underscoring the challenges related to identifying misinformation):

Figure 1. Query results for vaccines search (English)



How safe are vaccines • Vaccines Australia info • Vaccines immunisation • Immunisation Australia • child vaccines guide • vaccination for kids, safety and regulations • Vaccines safe • Child vaccination safe to use • Children vaccines and its safety • Vaccinating your child • Vaccination • Pros and cons of vaccinating • Vaccinations in early childhood • vaccines in children side effects safety • are children's vaccinations safe • Pros of vaccines or dangers of not vaccinating children • vaccines for children Australian government • is it safe to vaccinate a child • are vaccines harmful • Child vaccinations Adelaide • Vaccinations for children and safety • Evidence from credible sources that child vaccination is safe • Vaccine safe • is vaccination safe for children? • Child Safety and Vaccines • information about child vaccines • Information on vaccines for newborn babies • child vaccination schedule • Vaccination for child. • top child vaccines manufacturing brand in the world • Is vaccination dangerous for child? • Vaccine for new born in India • vaccines and child safety • Vaccine and Immunization centres for new born India • How to safe from vaccines of a child • Child vaccination precaution • vaccine information to be administered age wise • Child safety • VACCINATION FOR INFANTS • name of vaccines safe for child • Vaccines Centre • How do I know if it is safe to vaccinate a child • is it safe to vaccinate child • Are Vaccines safe for Infants/ Children? • WHAT ARE THE BEST VACCINES AND CHILD SAFETY GUIDELINES • Tetnus • Health vaccines information • vaccines and child safety • vaccination for new born baby • is it good for a newborn baby to be vaccinated • baby care instruction • vaccines and their advantages • Vaccines for new born baby • child vaccines • Are child vaccines safe? • Is it safe to vaccinate your child? • How to vaccines children 2019 • Is getting your child vaccinated best • Is it safe to vaccinate my child • vaccines child safety • Should I vaccinate my child • Are travel vaccines safe for children • Vaccines information for kids • Safe vaccines for children • vaccines for kids • Child vaccinations • vaccines debunked • Vaccination children • 111 or mums net • Safety of vaccinations • vaccines and child safety • Vaccination safety • Vaccines on kids • vaccines for children • is it safe to use this certian vaccination • what are recommendations for vaccinating children? • safe or not to vaccinate children uk • Nhs safe

Some of the search queries in different languages are shown here:

Figure 2. Query results for vaccines search (different languages)

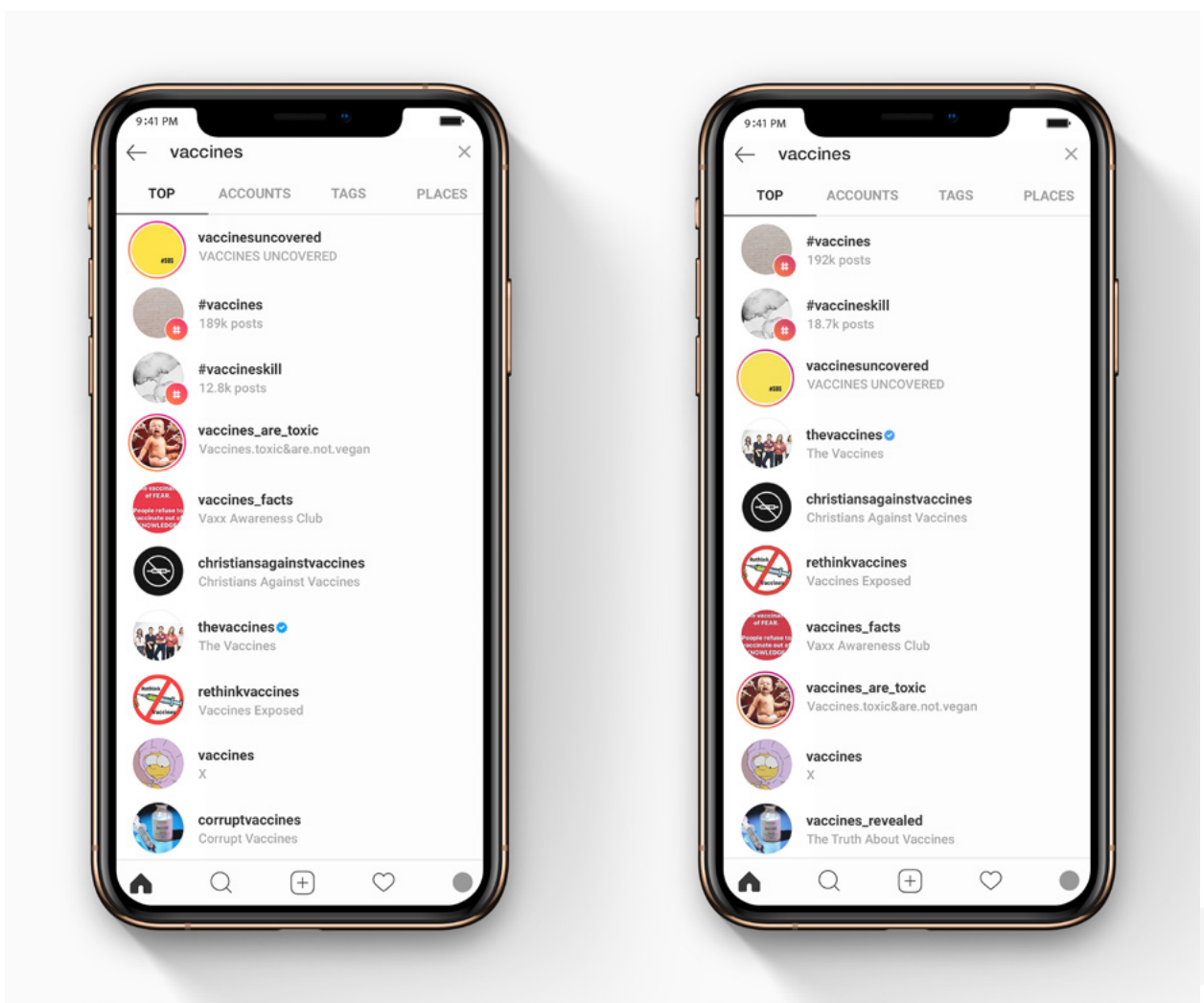


Vacinação em crianças é seguro? • O nome da vacina • vacina para... por exemplo “vacina anti-tetânica” • vacinas para crianças • Informações seguras sobre vacinas • “vacinas” + “segurança infantil” • Vacinas para crianças • Vacinar é seguro ou não? • Vacinar crianças é realmente importante para a saúde delas? • vacina em criança é seguro • quais as vacinas infantil necessárias? Elas são confiáveis? • Como identificar vacinas infantil seguras • Para que serve a vacinação • vacina recém nascido • quais as vacinas que devem ser tomadas por bebês • vacinas para crianças • seguro vacinar crianças? • É seguro vacinar crianças? O que devo fazer? Onde posso encontrar e quem deve fazer essa vacinação? • Se o remédio ou vacina faz algum mal para a criança • quais as vacinas disponíveis para uma criança tomar quais são os efeitos colaterais • efeitos adversos vacinação infantil • queria busca infomacoa sobre vacinas • vacinas segurança • Vacinas para criança doente • vacinas infantis • Pesquisaria, no google ou yahoo sobre o sintomas do meu filho • Vacinas importantes para crianças • vacinas são seguras para crianças, o que acontece se elas não forem vacinadas • É seguro vacinar crianças? • com quantos meses eu posso vacinar o meu filho? • Vacinação para crianças é seguro? • Vacinas são seguras? • qual medicamento tomar para gripe • Vacinas prós e contras • Vacinação para crianças é segura? • Vacinas infantis • é seguro tomar vacinas ? • Qual vacina de segurança infantil escolher para seu filho tomar? • Segurança para vacina infantil • o nome da vacina e as recomendações • vacinação riscos • Procuraria saber o tipo da doença que a criança apresenta, e procuraria saber o tipo de vacina mais indicada pra ela, incluindo a faixa etária pra idade dela, e tomando cuidado com os possíveis efeitos colaterais. • لافطال قس نلاب تاحاقل ل اروطخ • لافطال امي عطتو حاقل صخي ام • لافطال تاحاقل فلم • تاحاقل ل ن ع تامول عم • حاقل ل ا هي فيك • من مال لافطال تاحاقل • لافطال نام او تاحاقل • لافطال قن مال تاحاقل ل • لي صفت ل اب لافطال تاحاقل • لافطال و حي ق ل تل • Vaccins enfants • vaccins risques • sécurité vaccins • les vaccins et la sécurité des enfants • Vaccination enfants ou la vaccination des enfants est elle sécurisé • risque liée à la vaccination • vaccin et sécurité

The findings are a reminder of the challenges that search and social media companies face. The range of search strings makes it especially difficult to ensure quality search results on every possible search string. Research by Michael Golebiewski and danah boyd (2019) on data voids explores these challenges in greater depth.

2. Search specifically for the search string “should I vaccinate my child” on Google, YouTube, and Facebook, and for #vaccines on Instagram, and then supply screenshots of the results (Figure 3).

Figure 3. Screenshots from Instagram submitted from participants in the United States (left) and India (right)



There was very little localization of high-quality sources of vaccination information in search results. While Google highlighted the Centers for Disease Control and Prevention (CDC) in the United States and the National Health Service (NHS) in the United Kingdom, there was a lot of focus on the CDC and the WHO globally. More recently, there appears to be a greater awareness of local sites, probably because of partnerships with the Vaccine Safety Net (a global network of websites established by the WHO that helps validate quality vaccine information providers online; WHO, 2019b). For example, in Brazil, if you click on “anti-vaccination groups,” a pop-up message at the top of the group reads in Portuguese, “This group discusses vaccines.” The warning goes on to encourage people to seek out quality sources of information and provides a link to the Brazilian Ministry of Health.

These findings were not published because the technology companies all made public changes to their vaccine policies around the same time and it appeared these policy changes would significantly impact the search results. The methodology bears replication though, because without this kind of screenshot auditing, it is impossible to know just how people search and what people in different countries actually see in their search results. (As an aside, the variation in results was extremely small with almost no evidence of personalized results.)

The response of these platforms to COVID-19 also suggests a much more aggressive position toward health misinformation online.

Since this research was conducted, the major social media platforms have updated their policies around vaccines and misinformation, amending their ranking and curation policies to take into account a range of criteria

(discussed in more detail below) and partnering with international health authorities (WHO, 2019c). The response of these platforms to COVID-19 also suggests a much more aggressive position toward health misinformation online. The question remains whether similar steps will be taken to counter vaccine misinformation.

While some of the steps over the past 12 months are promising, recent reporting demonstrates that real concerns still exist about whether these promised changes to vaccine-related policies are having the desired effect. For example, Jesslyn Cook reported in the *Huffington Post* in February 2020, almost a year after new policies were rolled out across Facebook products, that a search for the term “vaccines” on Instagram produced top results that were disproportionately pushing anti-vaccination positions. Perhaps more troubling, the reporter explained how Instagram then recommended dozens more anti-vaccination Instagram accounts that users could follow (Cook, 2020). Another report by Brandy Zadrozny at NBC discussed the impact of anti-vaccination Facebook groups that convinced a mother not to give her son Tamiflu, and whose son subsequently died (Zadrozny, 2020).

| Personal Experience as Evidence

The 2018 Wellcome Global Monitor demonstrated that there is still high overall global trust in doctors, nurses, and scientists and confidence in vaccines (Wellcome Global Monitor, 2019). However, there are stark differences around the world. Almost all survey respondents in Bangladesh (98%), for example, believe vaccines are both safe and effective. But in France, one-third of people don't think vaccines are safe, while in Ukraine only 50% of the population think vaccines work. Some countries, like Brazil, that have had very successful national immunization programs are now reporting declining vaccination rates (Sato, 2018).



However, expert “gatekeepers” no longer control information flows because of the presence and popularity of social media. As a result, some people, such as new mothers, are balancing expert advice from their medical practitioners with the personal experiences they see shared on Facebook groups, even by people they know only through their online presence. Exemplification theory

exposes the ways in which humans group and compare different but similar “experiences” and, as a result, can over-index on their perceptions of risk (Zillmann & Brosius, 2000). While more research is needed, Facebook groups where people share first-person experiences of supposed vaccine side-effects can potentially have a disproportionate impact on parents trying to assess the risk of vaccinating their child.

These personal experiences, illustrated with upsetting images of babies covered in rashes shortly after being vaccinated, are juxtaposed against scientific, peer-reviewed evidence—with anti-vaccination mothers claiming that the real evidence is revealed in the vivid images that accompany these claims. Anecdotes are used as evidence on both sides, as Shelby and Ernst (2013) and Shermer (2008) document. Emotion is the currency of social media networks because facts are rarely as engaging, unless they are packaged in incredibly appealing ways.

Another ongoing theme in the anti-vaccination community is that its members are the ones with all the facts (Figure 4). The communities of anti-vaccine advocates share a sense of being more informed than those who support and promote vaccinations. The dominant narrative is that they are the only ones who have done sufficient research on the impact of vaccination and that the “real” story is being kept from the people by complicit media and institutions. For example, mothers holding “binders of evidence” has become a common meme.

Figure 4. Instagram post implying that only those who have done their “research” have all the facts



Poor Online Content from Professional, Credible Sources: Getting in the Game

Unfortunately, those with professional health expertise are not often experts in generating engaging, dynamic content designed to touch people’s emotions. Experts in these spaces are typically academics, scientists, and professionals—at international organizations such as the WHO, the CDC, and UNICEF, and in academia—who excel at creating official reports and peer-reviewed science, not compelling Instagram memes. The absence of visual imagery and videos in much of their work is a particular challenge, given the popularity of YouTube and Instagram (the second and sixth most popular platforms globally, respectively), and the increasing popularity of the online video platform TikTok (now the seventh most popular platform globally) (Kemp, 2020).

In addition, many national health authorities have very poor websites that lack visual content, if they have a website at all. As a result, social media and search companies have to rely on limited sources of authoritative content globally. These authorities are also challenged by each population's differing levels of trust. In some countries, for example, the WHO is trusted more than the local health authority, while in others, the opposite is the case.

In contrast, those who oppose vaccinations are very well organized. In addition to the large national anti-vaccine communities that exist within Facebook groups, there are Facebook pages for "vaccine freedom" legislative

There are Facebook pages for "vaccine freedom" legislative advocacy organizations in nearly every state in the United States.

advocacy organizations in nearly every state in the United States. And this isn't just a U.S. problem. For example, during the measles outbreak in Samoa in November 2019, a local influencer described the government's mass vaccination program as a crime against the Samoan people. Communicating largely through Facebook, this individual not only criticized vaccines but also promoted ineffective remedies, such as papaya leaf extract and Vitamin C, to cure children with measles (BBC News, 2019b).

The reach of media extends beyond national borders as anti-vaccination activists from around the world, and particularly from the United States, also target other countries. This was the case in Samoa, where U.S. anti-vaccination activists were leaving one-star reviews on the official Samoan government Facebook page ("Measles deaths," 2019). The same pattern was observed in Brazil, where a study by the Brazilian Society of Immunizations and Avaaz (a nonprofit human rights activist network) showed that a single U.S. anti-vaccination website, Natural News, accounted for almost one-third of all vaccine misinformation found on social media in Brazil (Gilbert, 2019). The researchers emphasized that the posts were translated word for word into Portuguese, suggesting that this was a deliberate process rather than an automated one.

Anti-vaccination activists have gained a deep understanding of how to communicate effectively on social platforms and have developed techniques to take advantage of their unique characteristics, such as groups, ads, and trending topics. Along with aggressively promoting their own views, they also actively target and harass those who take opposing positions, effectively silencing many voices (Thielking, 2019; Wong, 2018).

In early 2020, a doctor who published a pro-vaccine video on TikTok was aggressively harassed online by an anti-vaccination swarm. Her colleagues created a 24/7 rotation of volunteers to block those who were harassing her and report them to the social platform. They created a “Block List” spreadsheet that they are now sharing with other doctors who are struggling with similar harassment campaigns so that they can preemptively ban the worst harassers from commenting on their pages (Glyn, 2020). Understanding the tactics of the anti-vaccination community is a critical first step when considering possible actions in these spaces.

| Understanding the Increasingly Politicized Anti-Vaccine Movement

The disproportionate impact of the U.S. anti-vaccination movement on the rest of the world (BBC News, 2019b; Gilbert, 2019) makes it worthwhile to explore current trends in more detail. The U.S. anti-vaccine movement is very politically active in its pursuit of clearly defined policy goals, particularly related to childhood immunizations. This generally takes the form of opposing any strengthening of vaccination requirements or immunization-level transparency and sponsoring or supporting state legislation to create new types of exemptions to school-based immunization requirements.



In the United States, vaccine policy is set at the state level rather than the national level. As such, dozens of bills are introduced in state legislatures each year, including by anti-vaccine legislative advocacy groups. Grassroots activities in support of these bills appear to be coordinated by the National Vaccine Information Center, which runs a legislative advocacy portal and mailing lists, in addition to a regional or state sponsor. Some of the bills attempt to create personal belief exemptions—the right to opt-out based on philosophical objections—in

states that do not currently offer them, or to require burdensome disclosure frameworks for physicians, such as mandates to discuss vaccine ingredients and manufacturing processes as part of the requirement to obtain informed consent. Some proposed legislation focuses on introducing or protecting “vaccine choice” for workers such as nurses in industries that mandate immunizations.

Besides sponsoring legislation themselves, anti-vaccine advocates mobilize their supporters to staunchly oppose laws that aim to close loopholes or improve immunization rates. Messaging around liberty, choice, and resisting government overreach has been the most successful narrative for galvanizing opposition, particularly among libertarian and Republican constituencies. In many states, public health bills often appear to be politicized along party lines. Most states now have at least one “health choice” group that takes a personal liberty angle to fundraise and activate local members to oppose school vaccination requirements. In California and elsewhere, these groups hire lobbyists to communicate with state legislators and oppose specific legislation. Fundraising appeals appear in anti-vaccine groups on social platforms (Call, 2019; Kirkner, 2019).

| Dominant Anti-Vaccination Narratives and How They Work Online

Concerns about vaccinating began to emerge in the mid-1800s, with the introduction of the smallpox vaccination inspired by Edward Jenner’s demonstration of the impact of this approach. The concerns “included sanitary, religious, scientific, and political objections” (College of Physicians of Philadelphia, 2020b). Religious leaders were troubled by the incorporation of material from cowpox because it introduced material from an animal into a human. Some distrusted medicine and Jenner’s process, while others had alternative theories about how the disease spread. What’s more, following an outbreak in which the government response was to make vaccination mandatory, political concerns emerged about individual liberty (Williamson, 1984).

Anti-vaccine sentiment has ebbed and flowed since then, but many of the movement’s narratives have remained largely consistent (Smith, 2017):

- **Toxicity:** This narrative focuses on the claim that vaccines are unnatural or contain toxic ingredients and that homeopathy and healthy behaviors (such as eating organic foods and handwashing) are just as effective at preventing the spread of disease.
- **Religiosity:** This narrative often overlaps with concerns about what is “natural.” It may include the idea that vaccines contain materials that are objectionable on religious grounds (such as cell culture systems originally obtained via abortion, or porcine ingredients) or that the human body is perfect as God made it, suggesting that vaccines are unnecessary or against God’s law.

- **Liberty:** This narrative claims that individuals should enjoy unfettered “health freedom” and “medical choice” and that no government or employer should be able to tell people what to put in their bodies. The liberty argument is primarily related to political activism around immunization requirements for schools or professionals (e.g., flu shots for nurses).
- **Distrust of industry:** This narrative asserts that vaccines are produced by profit-motivated pharmaceutical companies, often leveraging anecdotes of past abuses by companies in which they ignored or concealed harm in pursuit of profit.
- **Safety:** This narrative claims that vaccines are unsafe (e.g., causing sudden infant death syndrome [SIDS], autism, or seizures); that they are under-tested or untested, particularly across the entirety of the childhood immunization schedule; and that the risks outweigh the benefits. The safety narrative occasionally overlaps with conspiratorial narratives in the form of claims that the CDC is concealing findings of harm.
- **Conspiracy:** Distrust of government and authority is heavy in anti-vaccine narratives and there are a myriad of conspiratorial claims: that the U.S. government has covered up information about vaccines and a link to autism; that George Soros and Bill Gates are part of a population control program; that those behind pro-vaccine activism online are paid shills; that doctors and politicians have been bought off by “big pharma”; that anti-vaccine doctors have been murdered for revealing the truth about vaccines; and that vaccines disproportionately cause autism in young black males.

As Amin et al. (2017) argue, it is necessary to understand how these moral values are associated with vaccine hesitancy. The researchers found that values associated with “purity” and “liberty” are correlated with vaccine hesitancy and therefore need to be woven more frequently into pro-vaccine messaging.

Since anti-vaccination narratives have been present since the 1800s, the question of what is new in the era of social networks must be addressed. First, the consolidation of extremely large, global audiences onto a handful of social platforms ensures that

anyone with a message to spread can have significant reach. In contrast, when the audience ecosystem was more fragmented, activists had to work harder on multiple platforms or with multiple media entities to spread their message.

The consolidation of extremely large, global audiences onto a handful of social platforms ensures that anyone with a message to spread can have significant reach.

Second, it is easier than ever to target precisely the right message to the audience most likely to receive it. The ad-based business model of social platforms enables them to develop detailed profiles of individual users and to sell the means to target those users. As a result, anti-vaccine activists are able to grow their movement by targeting users based on the narrative most likely to resonate, leveraging paid ads and demographic or interest-based targeting tools. Ads also enable a specific user to be retargeted; if someone demonstrates interest by clicking through to an anti-vaccine site, the owner of the site can later retarget that individual with related content.

Reporting from *The Guardian* in February 2019 (Wong, 2019) and BuzzFeed in January 2020 (Haskins, 2020) demonstrates that the targeting of anti-vaccination advertising was and remains a problem on Facebook. Haskins's reporting showed that Facebook is hosting ads for an online pamphlet falsely claiming that the vaccine for whooping cough is unsafe. When asked for comment, Facebook clarified that it "does not have a policy that bans advertising on the basis that it expresses opposition to vaccines"; the policy only bans ads containing specifically false information (based on the findings of Facebook's third-party fact-checking partners) related to vaccines.

Additionally, in millions of online groups and message boards, users declare their affinity for certain topics simply by joining. Members of groups for new mothers, organic or vegan recipe groups, "crunchy" lifestyle boards, and even Twitter conversations involving community-preferred hashtags enable the anti-vaccine movement to spread its content much as a savvy marketer would. As political activity around vaccines has increased in

I am so glad I let the doctor bully me into getting the HIB vaccine at my daughter's 3 month check up, that lead to her having a 14 month sleep disorder and constant screaming fits.

#SAIDNOMOTHER

response to recent outbreaks, the anti-vaccine movement has made it a priority to change the perception that it is a movement of the affluent, "hippie" left. The liberty-oriented "vaccine choice" argument has been targeted at libertarian and right-wing communities, where it often merges with the religious choice argument. Similarly, the black community has been targeted with the conspiracy theory

that young black males are disproportionately vulnerable to autism if they receive the MMR vaccine (Lacapria, 2015; Schumaker, 2019).

Finally, social media platform algorithms play a role in spreading content across a broader network. These content curation and recommendation algorithms tend to amplify content that is emotionally resonant, while sharing features enable virality at high velocity. Several of the anti-vaccine communities on Facebook have tens of thousands of members or more; these individuals re-share content, serving as amplifiers to their broader networks. Furthermore, the first-person narratives and sometimes sensational conspiratorial claims of anti-vaccine content may generate significant user engagement, prompting the algorithm to identify the content as something worth pushing into the feeds of more users. As a December 2019 article by NBC News reported, “The most viral pieces of fake health news pushed far-reaching conspiracies between governments and medical communities and suggested ditching common medical treatment of life-threatening diseases for unproven cures. The top 50 articles garnered more than 12 million shares, comments and reactions this year, mostly on Facebook” (Zadrozny, 2019).

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We must also address the role of the mainstream media, particularly as professional content is often then shared on the social web. Narratives are delivered to the public via both online grassroots action and media coverage of prominent influencers. For example, Jenny McCarthy, a popular TV personality, was a primary disseminator of the safety narrative via her Green Our Vaccines events in which she repeatedly emphasized that she was not anti-vaccine, but rather pro-*safe*-vaccine (PBS FRONTLINE, 2015). This mantle has been taken up by Robert F. Kennedy Jr. and other prominent personalities such as Andrew Wakefield and Del Bigree, producers of the documentary *Vaxxed*. In Australia, Taylor Winterstein, the wife of a National Rugby League player, has created a following because of her position supporting “informed consent,” “freedom of choice,” and “vaccine injury awareness” (Scanlan, 2019).

The press coverage that these individuals generate allows them to spread a variety of narratives related to autism, conspiracies, toxicity, and religion, and then to declare that their primary motivation is simply to facilitate more safety studies. The strategy is to “move the goalposts,” deeming that none of the peer-reviewed studies conducted over many years of research are sufficient.

PLATFORMS: ANTI-VAX MESSAGES AND THE CORPORATE RESPONSE

Anti-vaccine activists have established a presence on all mainstream social platforms as well as on several emergent niche sites and apps and the platforms have responded with a range of policies. We expect the companies will continue to adjust these policies over time. As the firm response to COVID-19 has demonstrated, social media and search companies have become more willing to take stronger steps to ensure that users can easily access quality information and are less likely to encounter rumors and conspiracies. It will be interesting to see whether other health-related policies are strengthened as a result.

In this section, we outline how anti-vaccination content plays out on the different platforms and how policies compare for Facebook, Instagram, Google, YouTube, and Pinterest.

| Facebook

Figure 5. Example of Facebook's pop-up box directing users to the WHO website for accurate health information



Update on September 4, 2019 at 8AM PT: We are starting to roll out more ways to connect people with authoritative information about vaccines on Facebook and Instagram.

The anti-vaccine movement is active across all of Facebook's primary features. There are Facebook pages created by organizers, influencers, and anti-vaccine media properties, and Facebook groups, some affiliated with pages and others organized by parents and grouped by region. Activists and media personalities also leverage Facebook Live for real-time communication with fellow activists. Until recently, some groups purchased ads to encourage users to join their communities or to send people to their websites or storefronts, but Facebook now prohibits ads that include false information about vaccinations.

On March 7, 2019, Facebook published a blog post titled "Combatting Vaccine Misinformation," detailing the company's initial response to curbing the spread of vaccine misinformation on the platform. In September 2019, Facebook made an addition to the existing policy and announced that educational pop-up windows would appear when a user searches for vaccine-related content or visits vaccine-related Facebook groups and pages. U.S.-based users would be connected via a pop-up window to the CDC to receive credible information on vaccines. If the user is outside the United States, Facebook would connect them to the WHO (see Figure 5; Bickert, 2019).

| Instagram

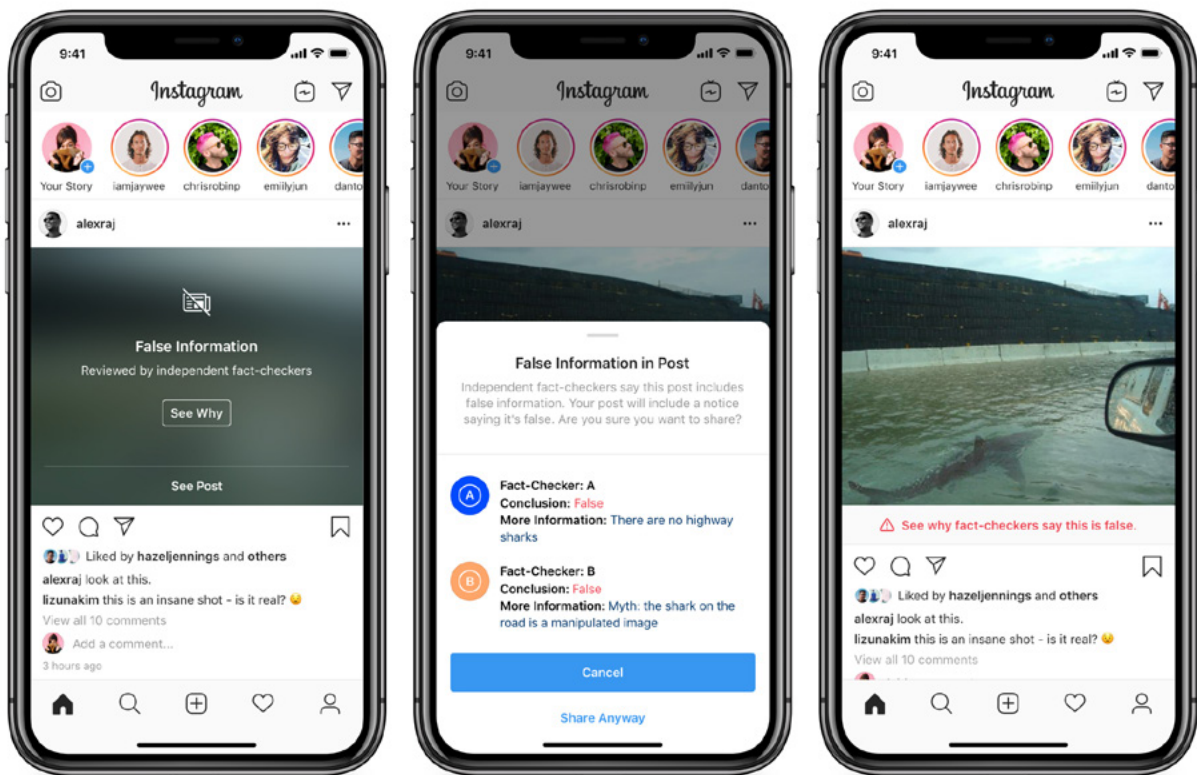
Instagram is leveraged primarily as a tool for sharing memes or short videos. Instagram content producers include high numbers of hashtags on their posts to improve discoverability and cross-promote content to potentially receptive audiences. Anti-vaccination content might include a hashtag like #vaxtruth or #vaccine, as well as some related to tangential topics with high ideological alignment, such as #NoGMO.

Despite the fact that Facebook owns Instagram, its policies sometimes differ slightly from those of its parent company. Shortly after the Facebook blog post about vaccine misinformation was published, Instagram announced its own policies, including the following:

- Instagram would begin hiding search results for hashtags that consistently return false information about vaccines.
- In May 2019, Instagram began working with third-party fact-checkers in the United States to help identify, review, and label false information (see Figure 6; Facebook, 2019). These partners independently assess false information to help the platform identify and reduce its distribution. When identified, the content also gets removed from the explore and hashtag pages.

- In August 2019, Instagram announced a new tool that allows users in the United States to flag content on the platform they believe to be false (Reuters, 2019). This mirrors a feature that already exists on Facebook.
- In December 2019, Instagram announced a global expansion of its fact-checking program (Facebook, 2019).

Figure 6. Example of Instagram’s pop-up feature that appears when content has been fact-checked by Facebook’s third-party partners



At a press conference in May 2019 when the U.S. rollout of the fact-checking partnership was announced, an Instagram spokesperson explained, “If the hashtag was #vaccines1234, if it contained a high proportion of known vaccine misinformation, we would block that hashtag entirely.” “Known vaccine misinformation,” the company explained, refers to claims that the WHO, the CDC, and similar organizations have verified as false. Instagram also clarified that other posts expressing anti-vaccine views but not confirmed as false can remain (Newton, 2019).

| Twitter

Anti-vaccine activists are also prominent on Twitter. In addition to their own tweets, activists employ coordination to maximize message repetition and create the perception of a large movement and influencer outreach to maximize message amplification. Users network in groups to execute coordinated messaging strategies, targeting the same handles (press and legislators) at the same time or sharing identical memes in an attempt to achieve a dominant share of the voice within a hashtag and create a perception of broad support. Influencers with a large number of followers are leveraged in much the same way as a brand would employ them to market a product: sympathetic celebrities and media personalities re-share, repost, and otherwise amplify anti-vaccine memes, content, and political efforts (such as petitions). Anti-vaccine political activity on Twitter related to California Law SB-277, which was introduced to eliminate the personal-belief exemption to school vaccine requirements, is one example of how Twitter has been used to manipulate legislation (DiResta & Lotan, 2015).

Twitter is a vehicle for disinformation in many countries around the world. During the panic around the polio vaccine in Pakistan in 2019, tweets were a significant source of disinformation. A tweet posted by a prominent local influencer whose account has over 270,000 followers amplified rumors about children getting sick due to the polio vaccine. The tweet then received hundreds of retweets and likes.



By law, no medicine can be sold or administered in Pakistan without certain preconditions.
Registered manufacturer.
Date of expiry.
Complete medical brochure explaining ingredients/their side affects etc.
Polio vaccine is the only medicine where end users are denied this info

Anti-vaccine activists similarly use social media marketing best practices to cross-promote hashtags, linking anti-vaccine hashtags to unrelated popular topics (e.g., posting vaccine conspiracies about black children using the popular hashtag #blacklivesmatter). They also attempt to co-opt “establishment” hashtags created by public health entities such as the CDC (#VaxWithMe, #Vaccines, or #VaccinesWork). Anti-vaccine activists have prioritized developing the groups and networks required to execute coordinated actions more effectively than pro-vaccine organizations, which means the former are often better positioned to create more activity in a targeted hashtag, even if it was originally created by the pro-vaccine community. As a result, positive vaccine messages are buried under a flood of opposing content. Harassment is also a common strategy on Twitter, with coordinated

groups of anti-vaccine activists attacking doctors, public health officials, organizations, and parents who have spoken out in favor of vaccines or shared a story in which they were personally impacted by vaccine-preventable disease.

Anti-vaccine activists also curate their own persistent hashtags:

- #CDCWhistleblower, a hashtag dedicated to the conspiracy theory that a CDC scientist attempted to expose a government cover-up related to MMR and autism in young black males but was silenced.
- #Vaxxed and #PrayBig, to share content related to the movie *Vaxxed*.
- #WeDid and #HearThisWell, a visual-meme-driven hashtag in which users share photos and videos of autistic children or SIDS cases. The text or audio contains a variant of the statement “#wedid vaccinate and look what happened.”

Bots, or automated accounts, are also a known issue on Twitter, but their use by anti-vaccine activists represents a small fraction of overall activity. When automated tools are deployed, they are used primarily to push out a steady stream of content into hashtags deemed important.

Figure 7. The pop-up advisory Twitter users see when they search for keywords associated with vaccines



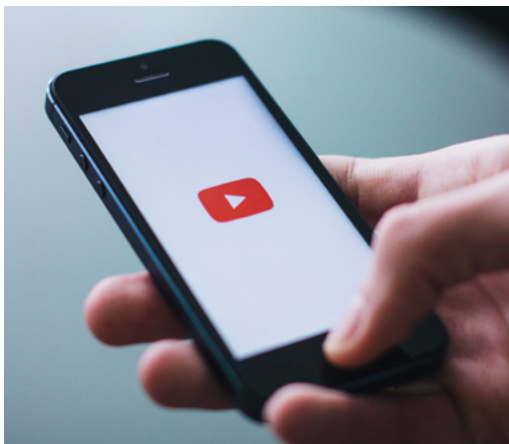
On May 10, 2019, Twitter announced the launch of a new tool to tackle anti-vaccination content on the platform. When someone searches for certain keywords associated with vaccines, a prompt directs individuals to a credible public health resource (Harvey, 2019). The company

partnered with the U.S. Department of Health & Human Services for #KnowTheFacts and an in-app message appears when users search for vaccine-related terms that points them to vaccines.gov for factual health information (Figure 7).

| YouTube

A popular platform for hosting anti-vaccine videos, YouTube offers a distribution mechanism of its own via a recommendation engine that suggests new videos to users. Many anti-vaccine organizers and influencers maintain their own YouTube channels. Following the release of *Vaxxed*, the movie's production team traveled the country in a bus, recording "vaccine injury" anecdotes from parents. The videos, which were often live-streamed to other apps such as Periscope, were designed for maximum emotional resonance. Many include severely autistic, nonverbal children and feature a parent warning others not to make the same mistake they allegedly did.

Many other channels are conspiratorial in nature, purporting to expose the cover-up of a link between vaccines and autism. In one 2018 study, academics analyzed 560 YouTube videos "related to the link between vaccines and autism or other serious side effects on children" (Donzelli et al., 2018). They found that most of the anti-vaccine videos (392 of the 560) focused on supporting this misinformation and that the number of anti-vaccine videos posted to YouTube was increasing every year.



On January 25, 2019, YouTube announced that it would be redesigning its recommendation engine to prevent the platform from promoting conspiracies and false information to users. Vaccine-related content wasn't discussed explicitly as part of this announcement, but a month later, on February 22, 2019, YouTube announced that it would prevent channels that promote anti-vaccination content from running advertisements. In emails to journalists, the company stated, "We have strict policies that govern what videos we

allow ads to appear on, and videos that promote anti-vaccination content are a violation of those policies. We enforce these policies vigorously, and if we find a video that violates them, we immediately take action and remove ads" (Shu, 2019).

On March 7, 2019, YouTube announced that it would be rolling out a feature that shows fact-checks when people search for sensitive topics. This feature is currently available to some users in India (Dixit, 2019). While particularly motivated by misinformation circulating during the most recent conflict between India and Pakistan, the fact-check pop-up will also apply to false health information.

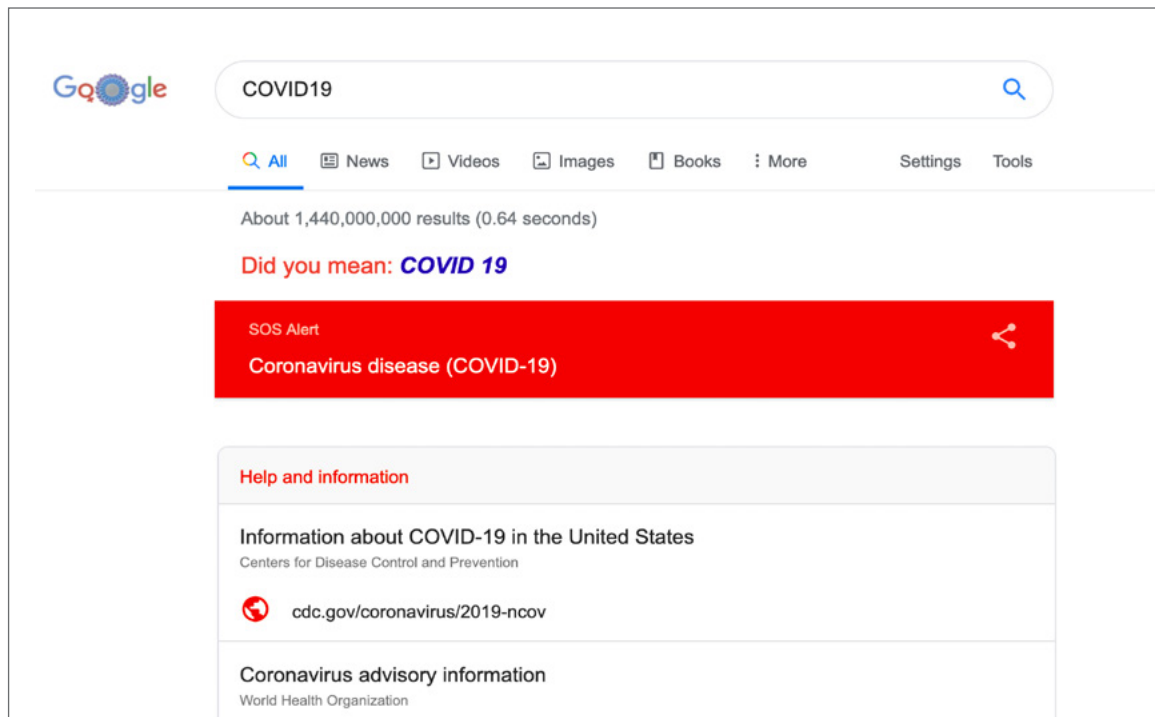
Google Search

While not a social network, Google Search is important as a central source of information for those seeking out vaccine narratives. Google does incorporate social signals into results but tries to ensure that it is returning high-quality information related to public health as part of a longstanding framework called “Your Money or Your Life” (McGee, 2013). The framework recognizes the unique role that Google Search plays as one of the first tools that people turn to as they look for health information and the responsibility the company bears for returning accurate information.

On March 20, 2018, Google announced a partnership with the National Academies of Sciences, Engineering, and Medicine to explore ways to mobilize expertise to counter misinformation on the web related to science, engineering, and health (McNutt, Mote, & Dzau, 2018). However, there has been little concrete discussion of how this partnership impacts search results.

The new “SOS” treatment from Google for COVID-19—which pops up as a highly visible red alert and accompanying knowledge panel populated with the latest overview, symptom, and treatment information from authoritative sources—suggests a model for linking clearly to the WHO, the CDC, and other authoritative sources related to vaccinations (Figure 8).

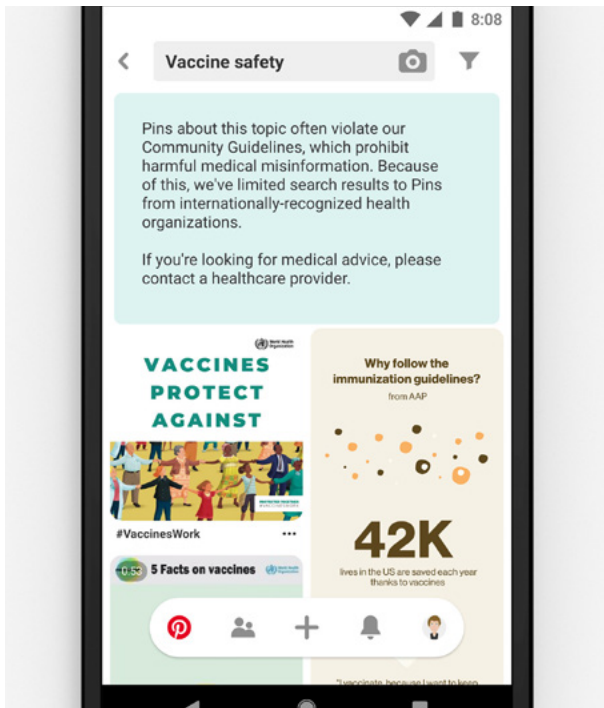
Figure 8. The new SOS search result that appears on Google when someone searches for information related to COVID-19



Pinterest

On August 29, 2019, Pinterest introduced a new experience for vaccine-related searches. Someone searching for “measles,” “vaccine safety,” and other related health terms can explore reliable results about immunizations from leading public health organizations, including the WHO, the CDC, the American Academy of Pediatrics (AAP), and the WHO-established Vaccine Safety Net, a global network of websites providing reliable vaccine safety information in various languages (see Figure 9; Ozoma, 2019).

Figure 9. Advisory on Pinterest when someone searches for vaccine-related content that links to a pin created with the AAP



A blog post announcing the changes explained, “This new search experience only shows content from leading public health institutions—you won’t see any recommendations or comments on Pins in these results. We also won’t show ads. We’re taking this approach because we believe that showing vaccine misinformation alongside resources from public health experts isn’t responsible.

“As we continue to tackle health misinformation, we remove it and the accounts that spread it from our service. But we also want to bring expert content onto Pinterest. We know we aren’t medical experts, which is why we’re working with professionals to inspire Pinners with reliable information about health” (Ozoma, 2019).

Closed Messaging Apps

Another major area of concern beyond social media and search companies are messaging apps such as WhatsApp. While WhatsApp has global dominance (1.5 billion users worldwide), other messaging apps are popular in certain countries, such as WeChat in China, LINE in Thailand, KakaoTalk in South Korea, Telegram in Iran, and Viber in Myanmar. These apps are either encrypted or their one-to-one nature makes it impossible to monitor what content is being shared.

CONCLUSION

It is important to understand that social media is fundamentally a peer-to-peer form of communication (Dubé et al., 2016). Online anti-vaccine communities share highly personal “lived experience” stories which may be far more persuasive than a top-down message from an authority figure (Brunson, 2013). User participation facilitates the development of personal connections and in many communities is considered a breach of social norms to challenge or attempt to contextualize a personal narrative, meaning that individual stories about vaccines supposedly leading to a child’s autism largely go unchallenged. Furthermore, social media design choices have provided a dispersion mechanism for stories that eliminate traditional gatekeepers (such as fact-checkers and editors).

While online platforms have begun to take meaningful steps to combat vaccine misinformation, the anti-vaccine narrative endures. The ability of the pro-vaccine community to tell a more compelling story more persuasively and to spread its evidence-based message to broader audiences online is an imperative for public health.



Renée DiResta, Technical Research Manager of the Stanford Internet Observatory

Renée DiResta is an expert on disinformation and media manipulation, with a particular focus on how social media platforms are used to distort public opinion. DiResta serves as the Technical Research Manager of the Stanford Internet Observatory, where she investigates the spread of malign narratives across social networks. She has advised Congress, the U.S. State Department, and senior executives on how best to understand and respond to the problem, and led a research team convened by the Senate Select Committee on Intelligence to investigate Russian interference in the 2016 presidential election. In 2017, DiResta was a scholar in the Presidential Leadership Scholars program.

Disclosure: Renée DiResta co-founded the parental advocacy organization Vaccinate California in 2015.

Claire Wardle, US Director of First Draft

Claire Wardle, Ph.D., is one of the world's experts on user-generated content, verification, and misinformation. Currently, she leads strategic direction and research for First Draft, a nonprofit that supports newsrooms focused on the challenges of reporting in an age of disinformation. In 2017, she authored the report *Information Disorder: An Interdisciplinary Framework for Research and Policy* for the Council of Europe. Wardle was previously a TED fellow working to improve the quality of the information ecosystem. She has also been a fellow at the Shorenstein Center for Media, Politics and Public Policy at Harvard's Kennedy School and held positions at the Columbia University Graduate School of Journalism and at the United Nations Refugee Agency. Wardle was a member of the World Economic Forum's Global Agenda Council on the Future of Information and Entertainment.

REFERENCES

- Amin, A. B., Bednarczyk, R. A., Ray, C. E., Melchiori, K., Graham, J., Huntsinger, J. R., & Omer S. B. (2017). Association of moral values with vaccine hesitancy. *Natural Human Behavior*, 1(12), 873–880. <https://doi.org/10.1038/s41562-017-0256-5>
- Avaaz. (2019). *Is fake news making us sick? How misinformation may be reducing vaccination rates in Brazil*. Retrieved April 2, 2020, from <https://avaazimages.avaaz.org/AVAAZ-%20Is%20Fake%20News%20Making%20Us%20Sick%3F%20%28EN%29.pdf>
- BBC News. (2019a, November 21). DR Congo measles: Nearly 5,000 dead in major outbreak. Retrieved from <https://www.bbc.com/news/world-africa-50506743>
- BBC News. (2019b, December 6). Samoa arrests vaccination critic amid deadly measles crisis. Retrieved from <https://www.bbc.com/news/world-asia-50682881>
- Bhattacharjee, S., & Dotto, C. (2019). First Draft case study: Understanding the impact of polio vaccine disinformation in Pakistan. *First Draft News*. Retrieved April 2, 2020, from <https://firstdraftnews.org/long-form-article/first-draft-case-study-understanding-the-impact-of-polio-vaccine-disinformation-in-pakistan/>
- Bickert, M. (2019, March 7). Combatting vaccine misinformation [Blog post]. Retrieved April 2, 2020, from <https://newsroom.fb.com/news/2019/03/combating-vaccine-misinformation>
- Brunson, E. K. (2013). The impact of social networks on parents' vaccination decisions. *Pediatrics*, 131(5), e1397–e1404. <https://doi.org/10.1542/peds.2012-2452>
- Call, J. (2019, June 25). Anti-vaccination group lobbies up and plans a statewide Florida protest. *Tallahassee Democrat*. Retrieved April 2, 2020, from <https://www.tallahassee.com/story/news/politics/2019/06/25/anti-vaxxers-lobby-up-and-plan-statewide-protest/1545956001>

College of Physicians of Philadelphia. (2020a). Cultural perspectives on vaccination. Retrieved April 2, 2020, from <https://www.historyofvaccines.org/index.php/content/articles/cultural-perspectives-vaccination>

College of Physicians of Philadelphia. (2020b). History of anti-vaccination movements. Retrieved April 2, 2020, from <https://www.historyofvaccines.org/content/articles/history-anti-vaccination-movements>

Cook, J. (2020, February 3). Instagram's search results for vaccines are a public health nightmare. *HuffPost*. Retrieved April 2, 2020, from https://www.huffpost.com/entry/instagram-promoting-anti-vax-anti-vaccine_n_5e347c50c5b69a19a4aede0c

DiResta, R., & Lotan, G. (2015, June 8). Anti-vaxxers are using Twitter to manipulate a vaccine bill. *Wired*. Retrieved April 2, 2020, from <https://www.wired.com/2015/06/antivaxxers-influencing-legislation>

Dixit, P. (2019, March 7). YouTube is rolling out a feature that shows fact-checks when people search for sensitive topics. *Buzzfeed*. Retrieved April 2, 2020, from <https://www.buzzfeednews.com/article/pranavdixit/youtube-debunk-information-panels-india>

Donzelli, G., Palomba, G., Federigi, I., Aquino, F., Cioni, L., Verani, M., ... Lopalco, P. (2018). Misinformation on vaccination: A quantitative analysis of YouTube videos. *Human Vaccines & Immunotherapeutics*, *14*(7), 1654–1659. <https://doi.org/10.1080/21645515.2018.1454572>

Dubé, E., Gagnon, D., Ouakki, M., Bettinger, J. A., Guay, M., Halperin, S., ... MacDougall, H. (2016). Understanding vaccine hesitancy in Canada: Results of a consultation study by the Canadian Immunization Research Network. *Plos ONE*, *11*(6), e0156118. <https://doi.org/10.1371/journal.pone.0156118>

Facebook. (2019, December 16). Combatting misinformation on Instagram. Retrieved April 2, 2020, from <https://about.fb.com/news/2019/12/combating-misinformation-on-instagram>

- Gerson, M. (2019, December 9). Samoa has become a case study for 'anti-vax' success. *Washington Post*. Retrieved April 2, 2020, from https://www.washingtonpost.com/opinions/samoa-has-become-a-case-study-for-anti-vax-success/2019/12/09/76848830-1ac8-11ea-b4c1-fd0d91b60d9e_story.html
- Gilbert, D. (2019, November 11). The U.S. is exporting viral anti-vaxxer content to Brazil. *Vice*. Retrieved April 2, 2020, from https://www.vice.com/en_us/article/59n83k/the-us-is-exporting-viral-anti-vaxxer-content-to-brazil
- Glyn, E. (2020, January 17). Doctor's pro-vaccine TikTok went viral. Then came hate and threats from around the world, *USA Today*. Retrieved April 2, 2020, from <https://www.usatoday.com/story/tech/2020/01/17/vaccines-tiktok-video-of-cincinnati-doctor-nicole-baldwin-goes-viral/4505330002>
- Golebiewski, M., & boyd, d. (2019). Data voids: Where missing data can be exploited. *Data & Society*. Retrieved April 2, 2020, from <https://datasociety.net/wp-content/uploads/2019/11/Data-Voids-2.0-Final.pdf>
- Harvey, D. (2019, May 10). Helping you find reliable public health information on Twitter [Blog post]. Retrieved April 2, 2020, from https://blog.twitter.com/en_us/topics/company/2019/helping-you-find-reliable-public-health-information-on-twitter.html
- Haskins, C. (2020, January 8). Facebook is running anti-vax ads, despite its ban on vaccine misinformation. *Buzzfeed News*. Retrieved April 2, 2020, from <https://www.buzzfeednews.com/article/carolinehaskins1/facebook-running-anti-vax-ads-despite-ban-anti>
- Kaiser, A. J. (2018, February 18). Brazil battles yellow fever — and a “dangerous” anti-vaccination campaign. *Washington Post*. Retrieved April 2, 2020, from https://www.washingtonpost.com/world/the_americas/brazil-battles-yellow-fever--and-a-dangerous-anti-vaccination-campaign/2018/02/17/fccb9528-0d1e-11e8-998c-96deb18cca19_story.html

- Kemp, S. (2020, January 30). Digital 2020: 3.8 billion people use social media [Blog post]. *We Are Social*. Retrieved April 2, 2020, from <https://wearesocial.com/blog/2020/01/digital-2020-3-8-billion-people-use-social-media>
- King, G., & Persily, N. (2020, February 13). Unprecedented Facebook URLs dataset now available for academic research through Social Science One [Blog post]. *Social Science One*. Retrieved April 2, 2020, from <https://socialscience.one/blog/unprecedented-facebook-urls-dataset-now-available-research-through-social-science-one>
- Kirkner, R. M. (2019, November 11). Anti-vaxxers flexing political, public relations muscle, managed care. Retrieved April 2, 2020, from <https://www.managedcaremag.com/archives/2019/10/anti-vaxxers-flexing-political-public-relations-muscle>
- Lacapria, K. (2015, February 3). Fraud at the CDC uncovered? *Snopes*. Retrieved April 2, 2020, from <https://www.snopes.com/fact-check/bad-medicine>
- Lyman, S. (2019, June 25). Pharma's tarnished reputation helps fuel the anti-vaccine movement. *Stat*. Retrieved April 2, 2020, from <https://www.statnews.com/2019/02/26/anti-vaccine-movement-pharma-tarnished-reputation>
- Mason, J., & Smith, R. (2020). First Draft case study: Exploring the controversy around Dengvaxia and vaccine misinformation in the Philippines. *First Draft News*. Retrieved April 2, 2020, from <https://firstdraftnews.org/long-form-article/exploring-the-controversy-around-dengvaxia-and-vaccine-misinformation-in-the-philippines-draft>
- McGee, M. (2013, December 3). In quality raters' handbook, Google adds higher standards for "your money or your life" websites. Retrieved April 2, 2020, from <https://searchengineland.com/quality-raters-handbook-your-money-or-your-life-177663>

- McNutt, M., Mote, C. D., Jr., & Dzau, V. J. (2018, March 20). *Statement by NAS, NAE, and NAM presidents on effort to counter online misinformation*. National Academies of Sciences, Engineering, and Medicine. Retrieved April 2, 2020, from http://www8.nationalacademies.org/onpinews/newsitem.aspx?RecordID=3202018&_ga=2.231411551.1187801799.1521532646-1183654223.1502808575
- Measles deaths: Anti-vaxxers flood Samoa govt's Facebook page with 1-star reviews. (2019, December 8). *New Zealand Herald*. Retrieved April 2, 2020, from https://www.nzherald.co.nz/world/news/article.cfm?c_id=2&objectid=12291921
- Newton, C. (2019, May 9). Instagram will begin blocking hashtags that return anti-vaccination misinformation. *The Verge*. Retrieved April 2, 2020, from <https://www.theverge.com/2019/5/9/18553821/instagram-anti-vax-vaccines-hashtag-blocking-misinformation-hoaxes>
- Ozoma, I. (2019, August 28). Bringing authoritative vaccine results to Pinterest search [Blog post]. *Pinterest Newsroom*. Retrieved April 2, 2020, from <https://newsroom.pinterest.com/en/post/bringing-authoritative-vaccine-results-to-pinterest-search>
- PBS FRONTLINE. (2015, March 23). Jenny McCarthy: "We're not an anti-vaccine movement ... We're pro-safe vaccine." Retrieved April 2, 2020, from <https://www.pbs.org/wgbh/frontline/article/jenny-mccarthy-were-not-an-anti-vaccine-movement-were-pro-safe-vaccine>
- Purnell, N. (2019, April 13). WhatsApp users spread anti-vaccine rumors in India. *Wall Street Journal*. Retrieved April 2, 2020, from <https://www.wsj.com/articles/whatsapp-users-spread-antivaccine-rumors-in-india-11555153203>
- Reuters. (2019, August 15). Instagram to let U.S. users report false content. *The Guardian*. Retrieved April 2, 2020, from <https://www.theguardian.com/technology/2019/aug/16/instagram-to-let-us-users-report-false-content>

- Robbins, M. (2011, July 15). Vaccines, the CIA, and how the war on terror helped spread polio in Nigeria. *The Guardian*. Retrieved April 2, 2020, from <https://www.theguardian.com/science/the-lay-scientist/2011/jul/15/1>
- Sato, A. P. S. (2018). What is the importance of vaccine hesitancy in the drop of vaccination coverage in Brazil? *Revista De Saúde Pública*, 52, 96. <https://doi.org/10.11606/S1518-8787.2018052001199>
- Scanlan, R. (2019, March 11). NRL wife Taylor Winterstein running \$200 anti-vax workshops. *news.com.au*. Retrieved April 2, 2020, from <https://www.news.com.au/lifestyle/parenting/babies/nrl-wife-taylor-winterstein-running-200-antivax-workshops-after-connecting-dots-when-son-fell-ill-postjabs/news-story/295221c729467d7ac92ac2221e9edc5a>
- Schumaker, E. (2019, November 10). Anti-vaccine leaders targeting minority becomes growing concern at NYC forum. *ABC News*. Retrieved April 2, 2020, from <https://abcnews.go.com/health/rfk-jrs-york-city-vaccine-forum-highlights-concerns/story?id=66158336>
- Seyoum, M. (2019, July 15). Social media fuels the anti-vaxx movement. Now what? *YR Media*. Retrieved April 2, 2020, from <https://yr.media/tech/social-media-fuels-the-anti-vaxx-movement-now-what>
- Shelby, A., & Ernst, K. (2013). Story and science: How providers and parents can utilize storytelling to combat anti-vaccine misinformation. *Human Vaccines & Immunotherapeutics*, 9(8), 1795–1801. <https://doi.org/10.4161/hv.24828>
- Shermer, M. (2008, August 1). How anecdotal evidence can undermine scientific results: Why subjective anecdotes often trump objective data. *Scientific American*. Retrieved April 2, 2020, from <https://www.scientificamerican.com/article/how-anecdotal-evidence-can-undermine-scientific-results>
- Shu, C. (2019, February 22). YouTube demonetizes anti-vaccination videos. *TechCrunch*. Retrieved April 2, 2020, from <https://techcrunch.com/2019/02/22/youtube-demonetizes-anti-vaccination-videos>

- Smith, T. C. (2017). Vaccine rejection and hesitancy: A review and call to action. *Open Forum Infectious Diseases*, 4(3). <https://doi.org/10.1093/ofid/ofx146>
- Stecula, D. A., Kuru, O., & Jamieson, K. H. (2020). How trust in experts and media use affect acceptance of common anti-vaccination claims. *The Harvard Kennedy Misinformation Review*, 1(1). <https://doi.org/10.37016/mr-2020-007>
- Thielking, M. (2019, June 28). 18-year-old who has advocated for vaccines is now target of harassment. *Stat*. Retrieved April 2, 2020, from <https://www.statnews.com/2019/06/28/ethan-lindenberger-vaccines-harassment>
- Wellcome Global Monitor. (2019, June 19). *Wellcome Global Trust Global Monitor: How does the world feel about science and health?* Retrieved April 2, 2020, from <https://wellcome.ac.uk/reports/wellcome-global-monitor/2018>
- Williamson, S. (1984). Anti-vaccination leagues. *Archives of Disease in Childhood*, 59(12), 1195–1196. <https://doi.org/10.1136/adc.59.12.1195>
- Wong, J. C. (2018, February 28). Anti-vaxx 'mobs': Doctors face harassment campaigns on Facebook. *The Guardian*. Retrieved April 2, 2020, from <https://www.theguardian.com/technology/2019/feb/27/facebook-anti-vaxx-harassment-campaigns-doctors-fight-back>
- Wong, J. C. (2019, February 15). Revealed: Facebook enables ads to target users interested in 'vaccine controversies.' *The Guardian*. Retrieved April 2, 2020, from <https://www.theguardian.com/technology/2019/feb/15/facebook-anti-vaccination-advertising-targeting-controversy>
- World Health Organization. (2019a). Ten threats to global health in 2019. Retrieved April 2, 2020, from <https://www.who.int/emergencies/ten-threats-to-global-health-in-2019>
- World Health Organization. (2019b). The Vaccine Safety Net. Retrieved April 2, 2020, from <https://www.vaccinesafetynet.org>
- World Health Organization. (2019c, September 4). Vaccine misinformation: Statement by WHO Director-General on Facebook and Instagram. Retrieved April 2, 2020, from <https://www.who.int/news-room/detail/04-09-2019-vaccine-misinformation-statement-by-who-director-general-on-facebook-and-instagram>

Zadrozny, B. (2019, December 29). Social media hosted a lot of fake health news this year. Here's what went most viral. *NBC News*. Retrieved April 2, 2020, from <https://www.nbcnews.com/news/us-news/social-media-hosted-lot-fake-health-news-year-here-s-n1107466>

Zadrozny, B. (2020, February 6). On Facebook, anti-vaxxers urged a mom not to give her son Tamiflu. He later died. *NBC News*. Retrieved April 2, 2020, from <https://www.nbcnews.com/tech/social-media/facebook-anti-vaxxers-pushed-mom-not-give-her-son-tamiflu-n1131936>

Zillmann, D., & Brosius, H.-B. (2000). *Exemplification in communication: The influence of case reports on the perception of issues*. London: Routledge.

Zorzetto, R. (2018, August 17). As razões da queda na vacinação. *Pesquisa*. Retrieved April 2, 2020, from <https://revistapesquisa.fapesp.br/2018/08/17/as-razoes-da-queda-na-vacinacao/>

IMAGE CITATIONS



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p.9: Daniel Bayer photographer



p.15: Daniel Bayer photographer



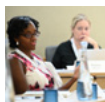
p.16: 3 Cs graphic, WHO 2014 (chosen by Aspen Institute – not required by author)



p.18: Photo by UC Rusal Photo Gallery on Wikimedia Commons



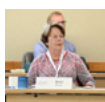
p.19: Daniel Bayer photographer



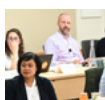
p.23: Daniel Bayer photographer



p.24: Daniel Bayer photographer



p.26: Daniel Bayer photographer



p.28: Daniel Bayer photographer



p.29: Vaccinate California



p.30: House on Fire Illustration, The Difference



p.36: Positivity Illustration, The Difference



p.37: Photo by Johnny Silvercloud on Wikimedia Commons



p.48: James Gathany photographer, CDC



p.50: Photo from the Centers for Disease Control and Prevention's Public Health Image Library



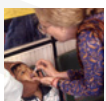
p.53: <https://www.gavi.org/>



p.56: <https://www.cdc.gov/vaccines/schedules/index.html>



p.62: Photo from the Centers for Disease Control and Prevention's Public Health Image Library



p.63: Photo by Chris Zahniser on STOP Transmission



p.67: <https://usphs.gov/>



p.71: <https://www.vaccineconfidence.org/>



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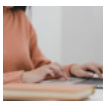
p.113: National HPV Vaccination Roundtable



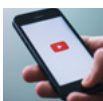
p.113: <https://www.shotsheard.com/>



p.141: Christina Morilla photographer, Pexels



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