

# Vaccine Hesitancy: A Top 10 Threat to Global Health

January 16, 2021 | Article No. 37

## Contributors

**Ellen Scholl** B.Ed

**Mohit Bhandari** MD FRCS PhD  
Editor-in-Chief, OrthoEvidence

“Developing a safe, effective coronavirus vaccine will be a monumental achievement, but it might not be enough. Encouraging people to actually get the vaccine might be the real battle, and people are even less predictable than viruses.” (1)

————— **Khazan, O (2020)** —————

As researchers race to develop and manufacture COVID-19 vaccines, it seems a new type of resistance is mounting – and it's not the virus. Studies have revealed concerning patterns of vaccine hesitancy and as a result, there is growing apprehension for how this may impact our capacity to achieve herd immunity. In a previous insight ([\(Mis\)leading During a Crisis: Social Media and the Weaponisation of Dis-Information](#)), we discussed the power of social media during this pandemic to spread misinformation and explored what makes correcting this misinformation so difficult. While vaccine hesitancy is often attributed to circulating misinformation, there may be more fueling this growing sense of suspicion. It turns out, it may have less to do with an individual's relationship with science alone and more to do with a variety of cultural and social anxieties that surround the process itself. When it comes to vaccinations both present and future, understanding and addressing these psychological underpinnings will be crucial in creating and implementing public health campaigns and structuring these sensitive conversations in a way that will continue to inspire belief in vaccines.

## Insights

- Reaching the herd immunity threshold for any transmissible disease is an important step in controlling an outbreak.
- There is growing evidence that vaccine hesitancy is increasing in some countries and this may be impacting vaccination rates.
- Current vaccine hesitancy estimates are raising concerns for how this may impact the success of the new COVID-19 vaccine, as well as vaccines for pre-existing and future transmissible diseases.
- In 2019, the World Health Organization (WHO) deemed vaccine hesitancy as one of the top ten global health threats.
- Circulating misinformation can have an impact on an individual's attitude towards vaccines, however the underlying reasons for vaccine hesitancy can be quite complex.
- Vaccine hesitancy may be rooted in concerns for vaccine efficacy and safety, distrust in government, healthcare or pharmaceutical companies, or the cultural and social complexities that surround the process of vaccination creation and implementation itself.
- Being a source of information, being unbiased and being honest are important strategies when engaging in conversations about vaccines.

## Achieving Herd Immunity

“Early disease fighters, such as Edward Jenner, Louis Pasteur, and William Farr, suspected if enough people were vaccinated, it could eradicate a disease. At the dawn of the 20th century, veterinarians more interested in livestock than people seized on the idea and coined the term “herd immunity.” By the 1920s, clever studies with hundreds of thousands of mice vaulted the idea into the mainstream, stirring optimism that making a fraction of a population immune could forestall a devastating outbreak.

But even the trailblazers researching herd immunity were mystified by how to deploy it in practice. This conundrum has featured in battles against many modern plagues—such as smallpox, polio, and measles. And now it is part of the debate as the COVID-19 pandemic continues to flourish around much of the world.” (2)

———— Akpan, N (2020) ————

**Herd immunity**, also known as “population immunity” or “community immunity”, is defined by the World Health Organization (WHO) as “the indirect protection from an infectious disease that happens when a population is immune either through vaccination or immunity developed through previous infection”. (3) The main idea behind herd immunity is that those who are vaccinated or those who have developed immunity to a disease through exposure will extend an “umbrella of immunity” to those who have not. By ensuring immunity in a substantial portion of a population, we effectively limit disease transmission to a small portion of the population. As a result, if an outbreak were to occur, the spread would be slow and quick to disappear since the majority of individuals surrounding that infected individual would be immune. (3)(4)(5) Another aim of herd immunity is to also extend this protection to those who are most vulnerable and unable to be vaccinated, such as newborn babies and those who are elderly, sick, or who may have an allergy to the vaccine. (3)(4)

In order to attain the benefits of herd immunity, a substantial proportion of a population must first be vaccinated. (3)(4) This proportion is known as the **herd immunity threshold** and is supported by a simple threshold theorem. On the most basic level, this theorem calculates that in order to flatten an outbreak's growth, one person for every four (or 25%) at most should be able to be infected. Therefore, 75% of a population will need to have immunity. (5) However, this threshold will vary for each infectious disease as each disease will also have its own **reproduction number**, also known as  $R_0$  or R-naught. (5) For COVID-19,  $R_0$  is estimated to be between 2 and 4. If we assume an  $R_0$  of about 2.5, this would mean that someone with COVID-19 would be able to infect just over two people in a 100% susceptible population. (6) Taking into account the  $R_0$  as well as vaccine efficiency, the herd immunity threshold can be calculated for a variety of different transmissible diseases. Polio for example, has a herd immunity threshold of around 80% while Measles has a threshold of around 95%. The exact threshold for COVID-19 has yet to be determined. (3) However, a study by Anderson et al. (2020) has estimated that for a COVID-19 vaccine with 100% efficacy and considering a  $R_0$  between 2.5 to 3.5, herd immunity required is estimated to be between 60 -72%. (7) For a vaccine with 80% efficacy, this threshold jumps to 70-90%. (7) Calculating this threshold is further compounded by the notion that certain subpopulations will also have closer contact rates and may require even higher levels of immunity. (6)

The exact path that is taken to achieving herd immunity has also been greatly debated. Some countries, such as Sweden, have taken an approach that has so far relied heavily on building up herd immunity by allowing the virus to run its course. (6) The other approach of course, is building immunity through vaccination. The advantages and disadvantages of each approach are outlined in Exhibit 1. It should be noted that the WHO has stated their support for reaching herd immunity through vaccination, as allowing the virus to run its course through a population would result in unnecessary cases and deaths. (3)

Approach	Advantages	Disadvantages
<p>Achieving herd immunity through <u>natural disease transmission</u>.</p> <p>A disease is allowed to run its course with minimal restrictions or interruptions to daily life.</p>	<ul style="list-style-type: none"> <li>● Most businesses remain open, reducing the impact on the economy.</li> <li>● People can continue to live relatively normal lives, reducing the mental toll of lockdowns and other restrictions.</li> <li>● Herd immunity will likely eventually be achieved, although evidence on this is lacking.</li> <li>● Less reliance on vaccines which can be expensive, require strategic planning, and can be in short supply.</li> </ul>	<ul style="list-style-type: none"> <li>● Healthcare system burden will increase, potentially causing disruptions to healthcare services that may affect quality of care.</li> <li>● A large number of people will need to become infected, resulting in more deaths.</li> <li>● Vulnerable populations will likely be disproportionately affected.</li> <li>● Long term sequelae of COVID-19 infection are unknown and may have repercussions later on.</li> <li>● Assumes herd immunity can be achieved given the lack of evidence.</li> <li>● Relies on the idea that reinfection is not possible.</li> <li>● Immunity may be short-lived.</li> </ul>
<p>Achieving herd immunity through <u>vaccination</u>.</p> <p>Restrictions continue to be implemented while a population waits for a vaccine.</p>	<ul style="list-style-type: none"> <li>● Restrictions put in place while waiting for a vaccine can help to reduce the number of cases at any one time.</li> <li>● Healthcare burden will be reduced which could mean less disruption to healthcare services overall.</li> <li>● Vulnerable populations will be more protected. The number of deaths will be reduced.</li> </ul>	<ul style="list-style-type: none"> <li>● Relies on expensive vaccines that also require a lot of strategic planning.</li> <li>● Business closures could also affect access to healthcare services and quality of care.</li> <li>● The safety and effectiveness of a vaccine and other factors associated with their success are unknown.</li> <li>● More closures will negatively impact the economy. More restrictions can have a toll on mental health status.</li> </ul>

**Exhibit 1.** Advantages and disadvantages of achieving herd immunity through (1) natural disease transmission and (2) vaccination. (6)

“Achieving herd immunity through natural infection, to me, is very dangerous. And I don't see how that would be protective, because basically you are allowing uncontrolled infection to go on. And when infection is uncontrolled, it can hit vulnerable populations, like nursing home residents, because all you need is one introduction.” (6)

————— **Walter A. Orenstein, MD** —————

Associate Director of the Emory Vaccine Center  
Director of Emory Vaccine Policy and Development

“A safe and effective vaccine is much better than relying on natural infection to result in herd immunity...Given that COVID-19 can be fatal and that many people have risk factors for severe disease, it is just too risky to let COVID spread. We will lose too many people, and it will devastate our country.” (6)

————— **Rajesh T. Gandhi, MD, FIDSA** —————

Professor of medicine at Harvard Medical School and Massachusetts General Hospital  
Chair of the HIV Medicine Association

## The Threat of Vaccine Hesitancy

Vaccine hesitancy, the reluctance or refusal to vaccinate despite vaccine availability, has been identified by the WHO as one of the top ten threats to global health in 2019. (8) According to the WHO, vaccine hesitancy “threatens to reverse progress made in tackling vaccine-preventable diseases” – vaccines that currently prevent 2-3 million deaths every year. (8) One pressing example of this is the recent surge in measles cases stemming from decreased vaccination rates. First introduced in 1968, the vaccine was able to bring the number of infections in the United States down from 3-4 million to zero by the year 2000. (9) Despite the success and recognised effectiveness of the vaccine, countries who were once close to eliminating the disease are now seeing a resurgence in cases. (8) In the United States for example, only 20 states have reached the 95% herd immunity threshold despite a comprehensive vaccine plan and high accessibility. Recent outbreaks (such as the 1200 cases recorded in 2019) have emphasised the importance of remaining vigilant with vaccinations as over 2.5 million children in the United States had not received their first dose of the vaccine between 2010 and 2017. (9)

“Measles cases have continued to climb into 2019. Preliminary global data shows that reported cases rose by 300 percent in the first three months of 2019, compared to the same period in 2018. This follows consecutive increases over the past two years.” (8)

————— The World Health Organization (WHO) —————

Other more recent outbreaks have been recorded in The Democratic Republic of the Congo (>310,000 cases), Ukraine (57,000 cases) and Brazil (>50,000 cases). (9) However, as the WHO points out, not all reasons for this increase are due to vaccine hesitancy. For some countries, access to vaccines is a major factor. (8) In Sub-Saharan Africa for example, 20 countries have not yet introduced the necessary second dose into their national vaccination schedule. (9) In response, the United Nations Children's Fund (UNICEF), the Measles and Rubella Initiative, and the Vaccine Alliance (GAVI) are helping to address this crisis by negotiating vaccination prices, identifying underserved areas, procuring vaccines and other supplies, supporting vaccination campaigns, working to introduce a second measles vaccine dose into national immunization schedules and introducing technologies to help maintain vaccine temperature. (8) Other outbreaks are more political in nature. In the Philippines for example, a recent outbreak has largely been fueled by dwindling vaccination rates brought on by distrust in the government after the flawed introduction of a new Dengue vaccine in 2017. (9)

## Estimating Vaccine Hesitancy

“Ironically, progress in immunization has left parents—and clinicians—far less familiar with measles and other serious vaccine-preventable conditions. Many younger health professionals may have never seen a case. For parents, near eradication has brought the luxury of equivocation, especially in a social media environment where instantly disseminated—though scientifically discredited—misinformation can skew perceptions of social norms. Vaccines should not become the victims of their own success.”

“For some people, invisible benefits that might materialize in the future are just not enough to get them over the clear and present fears common to all parents that something we're exposing our children to could result in harm. As Melinda noted recently, most Americans “have forgotten what measles deaths look like.” Because of that luxury, a thin needle and glass vial can look scary.” (10)

————— Bill Gates (2020) —————

Estimating vaccine hesitancy globally is no easy feat but it is a crucial step towards understanding the extent of vaccine hesitancy in regions across the world and its impact on current and future vaccination initiatives. Identifying the underlying reasons for vaccine acceptance (or hesitancy) could provide valuable information for both the creation and implementation a meaningful vaccine campaign.

Exhibit 2 and 3 outline the results of two recent polls from both Canada and the United States. Results of a recent Statistics Canada poll show that roughly 76.5% of Canadians are likely or somewhat likely to get the COVID-19 vaccine when it becomes available while 14.1% remain vaccine hesitant, expressing they were somewhat unlikely or very unlikely to get the vaccine. (Exhibit 2)(11) In the United States, the number of people who are willing to get a vaccine is slightly less, at around 71% (those who would definitely or probably get the vaccine) while the number expressing vaccine hesitancy (those who would definitely or probably not get the vaccine) was much greater by comparison (27%). (Exhibit 3)(12) However, it is promising to see that willingness to get the vaccine increased by 8% from 2015 to 2019. A positive trend that was also indicated in other countries as well (Exhibit 4).

Poll Question	Likely	Somewhat Likely	Somewhat Unlikely	Very Unlikely	Don't Know
Willingness to get a COVID-19 vaccine when it becomes available	57.5%	19%	5.1%	9.0%	9.4%
<b>Less likely to be vaccine hesitant</b>	Ages 65+ (70.3%), women (58.9%), postgraduate degree (72.7%), no children under 18 (60.4%), Canadian-born (59.4%)				
<b>More likely to be vaccine hesitant</b>	Ages 15-64 (52-58%), men (55.9%), undergraduate degree (60.3%), below bachelor's degree (52.9%), children under 18 (51.6%), immigrants (52%)				
<b>Most common reasons for vaccine hesitancy</b>	Not confident in vaccine safety (54.2%), concerns about risks and side effects (51.7%), will wait until it seems safe to get the vaccine (34.8%), do not consider it necessary to get the vaccine (25.9%), do not believe in vaccination (9.7%)				

**Exhibit 2.** Vaccine hesitancy in Canada. Statistics Canada June 2020 poll results (n = 4,000). (11)

Poll Question	Date	Definitely Get it	Probably Get it	Probably not get it	Definitely not get it
Would get a vaccine if it were free and deemed safe by scientists	September 2020	34%	29%	14%	20%
	December 2020	41%	30%	12%	15%
<b>Less likely to be vaccine hesitant</b>	Democrats (12%), ages 50-64 (26%), ages 65+ (15%), suburban residents (27%), urban residents (25%), Hispanic adults (26%), white adults (26%), women (26%)				
<b>More likely to be vaccine hesitant</b>	Republicans (42%), ages 18-29 (28%), ages 30-49 (36%), rural residents (35%), black adults (35%), essential workers (33%), independents (31%), health care workers (29%), men (29%)				
<b>Most common reasons for vaccine hesitancy</b>	Worried about possible side effects (59%), lack of trust in the government to ensure vaccine safety and efficacy (55%), vaccine is too new (53%), concerns over the role of politics in the development process (51%)				

**Exhibit 3.** Vaccine hesitancy in the United States. Kaiser Family Foundation (KFF) September 2020 and December 2020 poll results (n = 1,676). (12)

Interestingly, all three surveys revealed similar sociodemographic trends that seemed to influence vaccine hesitancy. In Canada, the United States, and globally, individuals who were older and women were less likely to be hesitant towards a COVID-19 vaccine. (12)(13)(14) In the United States, a link was also found between political affiliation (republican), living location (rural), racial ethnicity (black adults), and increased vaccine hesitancy. (12) In Canada, a link was identified between education level (below undergraduate degree), child status (those with children under 18), and increased vaccine hesitancy. (12) Globally, a higher level of science education and trusting healthcare workers for medical advice were also important factors that improved vaccine uptake. (13)

Poll Question	Reported Change	Countries
Vaccine confidence; (1) I think vaccines are safe, (2) I think vaccines are important for children to have, (3) I think vaccines are effective	Decrease in vaccine confidence from 2015-2019	Afghanistan, Indonesia, Pakistan, the Philippines, South Korea, Azerbaijan, Bosnia and Herzegovina, Georgia, Japan, Malaysia, Nigeria, and Serbia
	Increase in vaccine confidence from 2015-2019	France, India, Mexico, Poland, Romania, and Thailand
<b>Determinants of improved vaccine uptake</b>	High confidence in vaccines (66 countries), trusting health care workers more than others for medical and health advice (43 countries), higher level of science education (35 countries), women more likely to report any child having at least one vaccine (41 countries), younger age groups (43 countries), high information seeking behaviour (18 countries)	

**Exhibit 4.** Global vaccine hesitancy. Figueiredo et al. (2020) global poll results (number of countries = 149; number of participants = 284,381). (13)

In all three surveys, confidence in vaccine safety and efficacy seemed to play a large role in individual acceptance of a vaccine. These findings are mirrored by another study by Kreps et al. (2020) which found that adult participants living in the United States thought more favourably about choosing a vaccine when certain characteristics of the vaccine were changed. The study found that the probability of choosing a vaccine increased as vaccine efficiency improved from 50% to 70% to 90%. (14) A similar increase was also observed when vaccine protection was extended from 1 year to 5 years duration, when the incidence of adverse events decreased, and when endorsement came from the Centers for Disease control (CDC) or the WHO as opposed to political figures. (14) On the other hand, the probability of choosing a vaccine decreased with the existence of a Federal Drug Administration (FDA) emergency use authorization and a vaccine that originated from a country other than the United States. (14)

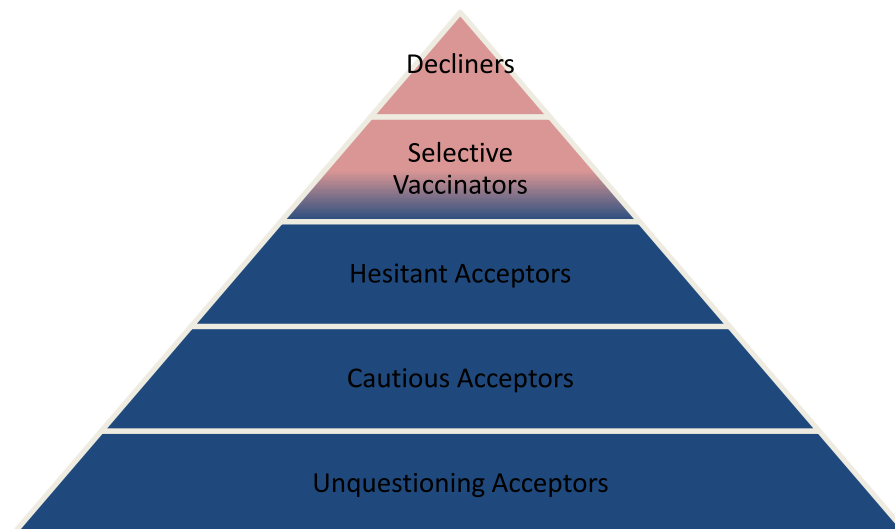


“If history and recent surveys are any guide, one in six Canadians, and one in four Americans, will balk, and their hesitation will take a number of forms. Some will flatly refuse; others will hold off, waiting to see what happens when the rest of society gets it first. Plenty will think of themselves as too busy to line up, or fear potential side effects, or figure they've survived this long without the vaccine so they should be fine.” (15)

———— Hutchins, A (2020) ————

## Setting the Record Straight

In the world of healthcare, it is inevitable that we will encounter individuals with a variety of different views on vaccination. Social Science professor at the University of Sydney, Julie Leask, believes that “while misinformation online is a problem, there is a much more complex reality”. (16) In the vaccine debate, the issue is often depicted as black and white and people are labelled as either pro or anti-vaccine, with nothing in between. However, Leask sees vaccine acceptance as a spectrum and depicts this range of attitudes in a five-level vaccine acceptance pyramid. The goal of Leask's pyramid is to demonstrate there are a variety of different stances that people can take on vaccination. (16) At the base are the “unquestioning acceptors” or people who will not hesitate to vaccinate when a new vaccine becomes available. (16) Moving up through subsequent higher levels, the number of people becomes increasingly small yet also increasingly resistant (Exhibit 5). (16) With the greatest majority of a population typically falling into the category of “unquestioning acceptor”, often anyone in a different category will get easily lumped together as members of a more extreme advocacy group that is working to dissuade others.(16) Leask reminds us that only a small proportion of people with fall into this “decliner” category and that with the right approach, no position is static. (16)



**Exhibit 5.** The five vaccine acceptance groups. (16)

“In an era when trust in just about every institution is waning, those of us who are working to increase vaccination rates face a daunting convergence of fears. What can we do to address them? First, we cannot just dismiss them as ignorant or “anti-science.” Second, I believe we have to accept that good news about vaccines is inherently slow and fears are inherently fast. The words of national experts and eloquent writers like Biss [author of the book *On Immunity*] can make a difference, but when it comes to slow ideas, people are most influenced by those they know and trust—friends, family members, doctors, and teachers.” (10)

Bill Gates

When it comes to setting the record straight, there are a few strategies we can use to help those navigating their vaccine hesitancy.

**1. Be a source of information.** Of course, following the evidence and helping others to do the same is an important step; one that is also perhaps the most instinctual step for any healthcare worker to take. This is especially important given the fact that trusted healthcare professionals are usually considered a very credible source of information on vaccines. (17) Psychology professor Stephen Lewandowsky at the University of Bristol agrees that healthcare professionals “need to inoculate people against misinformation by telling them ahead of time what they’re going to be exposed to”. He also believes that being informed will reduce susceptibility to misinformation. (17)

“When science communicators encounter an individual who holds attitudes in violation of scientific evidence, the most tempting and intuitive response is to keep repeating the evidence, and to do so as clearly and deftly as possible (i.e., explication). Epistemologically, this is satisfying: it is the defining mission of many scientists to defend facts and to defeat mis-information, and explication is consistent with that mission. It is also likely that, for people who are new to an issue or who have a genuinely open mind, explication is effective. However, when it comes to converting skeptics, it is widely understood that there are limitations to this approach.” (18)

Hornsey et al. (2018)

It is important to keep in mind that there will likely be a whole slew of **other factors at work**. For example, it could seem like vaccine safety is someone's main concern on the surface, but there are often other underlying factors beneath the surface. This makes simply providing correct information on vaccines less effective, as this information would no longer be addressing the main concerns. Instead, an individual may be asking other questions as well, like “Can I trust medicine?”, “Can I trust expert knowledge?” and “Can I trust the government and pharmaceutical companies?”. (16) Some parents of young children may hesitate when it comes to vaccines as a way to manage the grief of their child developing an illness after a vaccination or they may simply want to have the choice in how they choose to raise their children. Some individuals may have even had a bad interaction with the healthcare system which has led to distrust and put a stop to critical discussions on vaccines. (16) Things can also get a bit more complicated when we think about the social pressures that exist within communities where acceptance of a vaccine is uncommon. Individuals may be influenced to decline vaccination even if they believe vaccines are effective and safe. (16)

Also, it is important to remember that **not all people will respond well to evidence** based approaches, especially ones that simply attempt to reveal antivaccination beliefs as myths. In fact, a study by Horne et al. (2015) found that attempts to provide correct information had no effect on vaccine attitudes. (19) Another study by Betsch et al. (2013) found that risk negation messages could also have the completely opposite effect. Results showed that these messages actually increased perceptions of vaccination risk (20). This can be explained in part through the concept of **motivational reasoning**. This concept explains how people often develop specific attitudes based on emotional or gut reactions, making them extra difficult to change. This is because there is a tendency for people to selectively critique evidence in ways that reinforce existing beliefs; weak evidence will simply be embraced and stronger evidence discounted for being corrupt, incorrect or irrelevant. (18) Therefore, repeating evidence may not be an effective strategy for this group “because it fails to address the underlying reason why they are processing the information in a biased way in the first place”. (18) Instead of looking to address why someone would reject evidence about vaccines, we should instead be thinking, “Why would someone want to reject this evidence?”. (18)

**2 Be unbiased.** Take the time to listen, understand concerns and answer any questions without judgement. While some vaccine hesitant individuals may avoid asking questions or engaging in this type of conversation altogether, chances are the majority will have questions they are interested in asking. So, for vaccine advocates, it is important to be able to “recognize that the vaccine-hesitant, like most people, want to be heard, not mocked.” (1) Finding a way to address concerns without implying those concerns are invalid will therefore be very important. It is also important to note that, from the perspective of an antivaccination activist, any information that might offer reassurance on the safety of vaccines “needs to be unbiased, it needs to be apolitical, and come directly from the source.” (1)

**3 Be honest** about the realities of disease. As discussed above, an evidence-based approach, one that is more geared towards providing correct information and debunking misconceptions, is a strategy that may not work for everyone. Instead, this “scare” strategy is meant to speak directly to the reality of a disease and what it would truly mean to contract it. (18)

In a 2019 study by Johnson et al., 68% of vaccine hesitant college students who were enrolled in a course that assigned them to interview people with a vaccine-preventable disease ended up becoming pro vaccine. This is compared to 27% of participants in the control group who shifted their attitudes from anti to pro-vaccine. (21) These results suggest that for some groups of people, an honesty approach may be an effective way to influence attitudes towards vaccines.

When it comes to choosing the right strategy to address vaccination attitudes effectively, use one or maybe even use them all. A variety of different strategies will be necessary if we are to truly get to the heart of what triggers vaccine hesitancy. These conversations will require respectful engagement, an open narrative and a personal approach that will help us to address vaccine hesitancy in the most constructive way. (22)



“You need to have lots of different strategies aimed at reaching lots of different people. And if you can move a couple of percentage points here and a couple of percentage points there, ultimately you put something together that gets us the herd immunity.” (1)

————— Khazan, O (2020) —————

## Final Words

Moving forward, vaccine hesitancy will undoubtedly remain an important global health issue. Addressing vaccine hesitancy both on a large and small scale will require governments, public health teams and health workers to work together to develop a deeper understanding of vaccine attitudes that will allow us to address hesitancy more effectively. Healthcare workers will continue to play an integral role in this process as they remain “the most trusted advisor and influencer of vaccine decisions.” (8) Each of our encounters will play a critical role in continuing to reduce vaccine hesitancy.

## Contributors



### Ellen Scholl, B.Ed

Ellen Scholl has a degree in Physical Education and Kinesiology from Brock University and a B.Ed from the University of Ottawa.



### Mohit Bhandari, MD, PhD

Dr. Mohit Bhandari is a Professor of Surgery and University Scholar at McMaster University, Canada. He holds a Canada Research Chair in Evidence-Based Orthopaedic Surgery and serves as the Editor-in-Chief of OrthoEvidence.

## References

1. Khazan O (2020, October 16). Inside the Mind of an Anti-vaxxer. The Atlantic. Retrieved from: <https://www.theatlantic.com/health/archive/2020/10/how-change-mind-anti-vaxxer/616722/>
2. Akpan N (2020, October 2). A 'herd mentality' can't stop the COVID-19 pandemic. Neither can a weak vaccine. National Geographic. Retrieved from: <https://www.nationalgeographic.com/science/2020/10/natural-herd-immunity-mentality-cannot-stop-coronavirus-weak-vaccine-cvd/#close>
3. World Health Organization (2020, December 31). Coronavirus disease (COVID-19): Herd immunity, lockdowns and COVID-19. Accessed January 8th, 2020. Retrieved from: <https://www.who.int/news-room/q-a-detail/herd-immunity-lockdowns-and-covid-19>
4. Immunization Coalition. Herd immunity. Accessed January 8th, 2020. Retrieved from: <https://www.immunisationcoalition.org.au/immunisation/herd-immunity/>
5. United Nations News (2019, April 24). Vaccinations create 'umbrella of immunity' against global measles outbreaks, says UNICEF. Retrieved from: <https://news.un.org/en/story/2019/04/1037271>
6. Rosenthal M (2020, January 3). COVID-19: great debates, Sweden and herd immunity. Clinical Oncology News. Retrieved from: <https://www.clinicaloncology.com/COVID-19/Article/01-21/COVID-19-Great-Debates-Sweden-and-Herd-Immunity/61555>
7. Anderson RM, Vegvari C, Truscott J, Collyer BS. Challenges in creating herd immunity to SARS-CoV-2 infection by mass vaccination. Lancet. 2020 Nov 21;396(10263):1614-1616. [https://doi.org/10.1016/S0140-6736\(20\)32318-7](https://doi.org/10.1016/S0140-6736(20)32318-7)
8. World Health Organization. Ten threats to global health in 2019. Accessed January 7th, 2020. Retrieved from: <https://www.who.int/news-room/spotlight/ten-threats-to-global-health-in-2019>
9. Koh HK, Gellin BG. Measles as metaphor—what resurgence means for the future of immunization. JAMA. 2020;323(10):914–915. <https://doi.org/10.1001/jama.2020.1372>
10. Gates, B (2015, March 30). Where do vaccine fears come from? GatesNotes. Retrieved from: <https://www.gatesnotes.com/Books/On-Immunity>
11. Frank K, Arim R (2020, August 25). Canadians' willingness to get a COVID-19 vaccine: Group differences and reasons for vaccine hesitancy. Statistics Canada. Retrieved from: <https://www150.statcan.gc.ca/n1/pub/45-28-0001/2020001/article/00073-eng.htm>
12. Hamel L, Kirzinger A, Muñana C, Brodie M (2020, December 15). KFF COVID-19 vaccine monitor: December 2020. Kaiser Family Foundation. Retrieved from: <https://www.kff.org/coronavirus-covid-19/report/kff-covid-19-vaccine-monitor-december-2020/>
13. de Figueiredo A, Simas C, Karafillakis E, Paterson P, Larson HJ. Mapping global trends in vaccine confidence and investigating barriers to vaccine uptake: a large-scale retrospective temporal modelling study. Lancet. 2020 Sep 26;396(10255):898-908. [https://doi.org/10.1016/S0140-6736\(20\)31558-0](https://doi.org/10.1016/S0140-6736(20)31558-0)
14. Kreps S, Prasad S, Brownstein JS, Hswen Y, Garibaldi BT, Zhang B, Kriner D. Factors associated with US adults' likelihood of accepting COVID-19 vaccination. JAMA network open. 2020;3(10):e2025594. <https://doi.org/10.1001/jamanetworkopen.2020.25594>
15. Hutchins, A (2020, July 22). How anti-vaxxers could disrupt the cure for the COVID-19 pandemic. Maclean's. Retrieved from: <https://www.macleans.ca/society/health/how-anti-vaxxers-could-disrupt-the-cure-for-the-covid-19-pandemic/>
16. Leask J, Mann L (2019, November 19). Addressing vaccine hesitancy and refusal [Webinar Summary]. The Royal Australian College of General Practitioners. Retrieved from: <https://www.racgp.org.au/education/professional-development/online-learning/webinars/communicable-disease/addressing-vaccine-hesitancy-and-refusal>
17. Shepherd T (2020, June 6). 'It's psychologically easier': how anti-vaxxers capitalised on coronavirus fears to spread misinformation. The Guardian. Retrieved from: <https://www.theguardian.com/society/2020/jun/06/its-psychologically-easier-how-anti-vaxxers-capitalised-on-coronavirus-fears-to-spread-misinformation>

18. Hornsey MJ, Harris EA, Fielding KS. The psychological roots of anti-vaccination attitudes: A 24-nation investigation. *Health Psychol.* 2018 Apr;37(4):307-315. <https://doi.apa.org/doi/10.1037/hea0000586>
19. Horne Z, Powell D, Hummel JE, Holyoak KJ. Countering antivaccination attitudes. *Proc Natl Acad Sci USA.* 2015 Aug 18;112(33):10321-4. <https://doi.org/10.1073/pnas.1504019112>
20. Betsch C, Sachse K. Debunking vaccination myths: Strong risk negations can increase perceived vaccination risks. *Health Psychol.* 2013;32(2):146–155. <https://doi.org/10.1037/a0027387>
21. Johnson DK, Mello EJ, Walker TD, Hood SJ, Jensen JL, Poole BD. Combating Vaccine Hesitancy with Vaccine-Preventable Disease Familiarization: An Interview and Curriculum Intervention for College Students. *Vaccines (Basel).* 2019;7(2):39. <https://doi.org/10.3390/vaccines7020039>
22. Leask J, Willaby HW, Kaufman J. The big picture in addressing vaccine hesitancy. *Hum Vaccin Immunother.* 2014;10(9):2600-2. <https://doi.org/10.4161/hv.29725>

## How to Cite:

(January 16, 2021- No 37)

Citation: OrthoEvidence. Vaccine Hesitancy: A Top 10 Threat to Global Health. *OE Insights.*2021;2(1):3.

Available from: <http://www.myorthoevidence.com/Download/ec946544-0ac1-481e-8b5b-1ff24a69e6d0>