THE SCIENCE OF COVID–19 VACCINES AND ENCOURAGING VACCINE UPTAKE

HEARING

BEFORE THE

COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY HOUSE OF REPRESENTATIVES

ONE HUNDRED SEVENTEENTH CONGRESS

FIRST SESSION

FEBRUARY 19, 2021

Serial No. 117–1

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C O N T E N T S

February 19, 2021

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Appendix II: Additional Material for the Record

THE SCIENCE OF COVID–19 VACCINES AND ENCOURAGING VACCINE UPTAKE

FRIDAY, FEBRUARY 19, 2021

HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY,
Washington, D.C.

The Committee met, pursuant to notice, at 11:25 a.m., via Webex, Hon. Eddie Bernice Johnson [Chairwoman of the Committee] presiding.

U.S. HOUSE OF REPRESENTATIVES
COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY
HEARING CHARTER

The Science of COVID-19 Vaccines and Encouraging Vaccine Uptake

Friday, February 19, 2021
11:00 a.m. ET
Cisco WebEx

Purpose

On February 19, 2021, the Committee on Science, Space, and Technology will hold a hearing to discuss some of the processes and research achievements that allowed for several safe and effective COVID-19 vaccines to be designed, manufactured, and distributed at a record pace. The Committee will also consider how vaccine hesitancy and impediments to access may affect the pace of our national recovery from COVID-19, strategies for increasing vaccine uptake, and how scientists and vaccine developers are responding to new variants of the virus.

Witnesses

- **Dr. Kathleen Neuzil, MD, MPH,** Professor in Vaccinology and Director, Center for Vaccine Development and Global Health, University of Maryland School of Medicine
- **Dr. Philip Huang, MD, MPH,** Director and Health Authority, Dallas County Department of Health and Human Services
- **Mr. Keith Reed, MPH, CPH,** Deputy Commissioner, Oklahoma State Department of Health
- **Dr. Alison Buttenheim, PhD, MBA**, Scientific Director, Center for Health Incentives and Behavioral Economics and Associate Professor of Nursing and Health Policy, University of Pennsylvania School of Nursing

Overarching questions

- What are the safety and effectiveness profiles of the vaccines currently authorized for preventing COVID-19? How do they work?
- How should the federal government direct research funding to accelerate the administration of COVID-19 and other vaccines?
- How will slow vaccine acceptance affect the pace of the national recovery from COVID-19?
- What are the drivers of vaccine hesitancy and what are some evidence-based strategies for improving vaccine uptake?
- What additional research and disease surveillance activities are needed to ensure COVID-19 vaccines are useful against mutations of the SARS-CoV-2 virus?

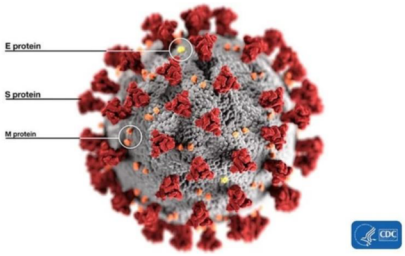
Background

As of February 16, 2021, the Centers for Disease Control and Prevention (CDC)'s Center for Health Statistics has recorded 456,689 deaths due to COVID-19 in the United States,[1] and over 1.4 million Americans have been hospitalized.[2]

As of February 16, two vaccine formulations have been granted an emergency use authorization (EUA) from the U.S. Food and Drug Administration (FDA), allowing them to be distributed for use in the United States to prevent illness from COVID-19. **Pfizer-BioNTech** began its Phase 3 trial of 43,661 participants on July 27, 2020, and concluded the trial on November 18.[3] Its trial results showed efficacy of 95% in preventing COVID-19 after the second dose, consistent across subgroups defined by age, gender, race, ethnicity, body mass index (BMI) and presence of other co-morbidities.[4] Pfizer applied to FDA for an EUA for its formulation two days later, November 20, and FDA issued the EUA on December 11. Pfizer's is a messenger RNA (mRNA) vaccine.

Moderna's formulation is also an mRNA type. Phase I clinical trials for mRNA-1273 began on March 16, 2020, just 65 days after NIH researchers first accessed the SARS-CoV-2 virus sequence.[5] The Phase 3 trial for safety and efficacy, which included 30,000 participants, began on July 27, 2020. On November 30, Moderna applied to FDA for its EUA. Its trial results showed vaccine efficacy against COVID-19 of 94.1%, efficacy against severe COVID-19 of 100%, and no serious safety concerns were identified in the cohort. Moderna was granted its EUA on December 18, 2020. Moderna announced in early January that it would increase production to provide 600 million doses in 2021.[6]

mRNA technology had never been used in a vaccine prior the Pfizer and Moderna vaccines for COVID-19. Unlike viral vector and protein-based vaccines, mRNA formulations do not put a weakened or inactivated germ into a patient. Instead, they teach cells how to make a harmless protein which is the same shape as the coronavirus spike protein, called S-2P – i.e., the protruding red nodes on the now-famous renderings of the viral structure.



The harmless protein triggered by the mRNA vaccine is recognized by our immune systems as a threat, which triggers the production of antibodies that can defend against the real SARS-CoV-2 when it is encountered.[7] The scientific foundation for mRNA vaccines and the strategy for stabilizing the protein of a virus in order to develop a vaccine was laid by researchers at the National Institutes of Health's

[1] https://www.cdc.gov/nchs/nvss/vsrr/covid19/index.htm
[2] https://gis.cdc.gov/grasp/covidnet/COVID19_5.html
[3] https://www.pfizer.com/news/press-release/press-release-detail/pfizer-and-biontech-conclude-phase-3-study-covid-19-vaccine
[4] https://www.pfizer.com/news/press-release/press-release-detail/pfizer-and-biontech-announce-publication-results-landmark
[5] https://clinicaltrials.gov/ct2/show/NCT04283461
[6] https://www.cnbc.com/2021/01/04/moderna-says-increases-2021-covid-vaccine-production-by-20percent-to-6doses-this-year.html
[77] https://www.cdc.gov/coronavirus/2019-ncov/vaccines/different-vaccines/mRNA.html?ACSTrackingID=USCDC_2067-DM47392&ACSTrackingLabel=Understanding%20mRNA%20COVID-19%20Vaccines%20%7C%20COVID-19&deliveryName=USCDC_2067-DM47392

National Institute of Allergy and Infectious Disease (NIAID) and their partners from Scripps Research, Dartmouth College and the University of Texas-Austin.[8]

As with other, non-mRNA vaccines, the Pfizer and Moderna formulations work by ensuring the body's physical defenses (antibodies) are already in place and prepared to defeat infection before the patient is exposed to the virus, thus preventing symptoms of illness. It is not yet known whether either of these vaccines can prevent transmission of the virus that causes COVID-19, known as SARS-CoV-2, from someone who has been vaccinated to someone else who does not have immunity and may be susceptible to dangerous infection. Clinical trials for both shots that took place in 2020 were only designed to evaluate whether the formulations prevented disease. Pfizer is recruiting volunteers who have been vaccinated to be tested regularly for the virus to see whether its formulation prevents viral transmission as well as symptoms. Until more research is available, public health officials are assuming that vaccinated patients can still receive, carry, and transmit the virus – and as such, should continue wearing masks and adhering to social distancing guidelines. Like all other vaccines approved for use in the United States, mRNA formulations do not use the live virus that causes COVID-19 and cannot give a patient the virus. mRNA vaccines (and any other type of vaccine) do not affect or interact with DNA.[9]

On February 4, **Johnson & Johnson** applied to FDA for an EUA for its single-shot vaccine candidate, which was developed by its Belgian subsidiary Janssen Pharmaceuticals. Phase 3 trials evaluated 43,783 participants, ages 18 and older. The vaccine candidate protected against moderate to severe COVID-19 infection in 72% of patients, was 85% effective at preventing severe disease and provided 100% protection against COVID-related hospitalization and death.[10] Johnson & Johnson reported that unlike the Moderna and Pfizer formulations, the Janssen candidate is stable when stored in regular refrigerators, eliminating special cold chain requirements in the distribution logistics. The FDA Vaccines and Related Biological Products Advisory Committee (VRBPAC) meeting to debate and vote on an EUA for single-shot version of the Janssen candidate will take place on February 26.[11]

Vaccine uptake

As of February 16, more than 55 million COVID-19 vaccines have been administered in the United States, reaching 11.5% of the population, and 4.2% of Americans have received both doses of either the Pfizer or Moderna regimen. The rate of administration has reached 1.6 million shots per day.[12] In the earliest weeks of commercial rollout for COVID-19 vaccines, demand has far outstripped supply. But as the rate of production increases and new formulations enter the marketplace, vaccine hesitancy may begin to affect the pace and equitability of our national recovery more significantly.

The World Health Organization defines *vaccine hesitancy* as a "delay in acceptance or refusal of vaccines despite availability of vaccination services." Vaccine hesitancy is growing worldwide and was identified

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[8] See 2016 Nature Magazine publication, "Pre-fusion structure of a human coronavirus spike protein" at https://www.nature.com/articles/nature17200 and 2017 PNAs publication, "Immunogenicity and structures of a rationally designed prefusion MERS-CoV spike antigen" at https://www.pnas.org/content/114/35/E7348.

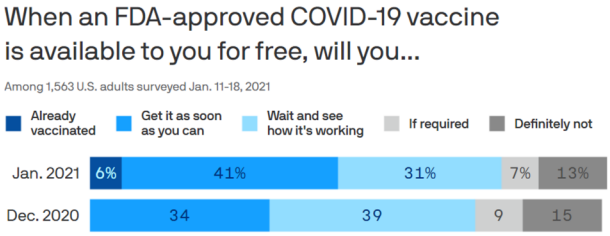
[9] https://www.cdc.gov/coronavirus/2019-ncov/vaccines/different-vaccines/how-they-work.htm

[10] https://www.jnj.com/johnson-johnson-announces-single-shot-janssen-covid-19-vaccine-candidate-met-primary-endpoints-in-interim-analysis-of-its-phase-3-ensemble-trial

[11] https://www.fda.gov/news-events/press-announcements/coronavirus-covid-19-update-fda-announces-advisory-committee-meeting-discuss-janssen-biotech-incs

[12] https://www.npr.org/sections/health-shots/2021/01/28/960901166/how-is-the-covid-19-vaccination-campaign-going-in-your-state

by the WHO as one of the top ten global health threats in 2019. For COVID-19 in particular, a Kaiser Family Foundation poll in December found that 27% of Americans "probably or definitely" would not get a vaccine even if it were available for free.[13] The incidence of hesitancy appears to be falling.[14,15] A September survey by KFF found 63% of the American public saying they would "definitely or probably" get a vaccine for COVID-19 if it was determined to be safe and available for free. That number had increased to 71% by December.[16] KFF saw further upticks in acceptance between December and late January 2021.



Reproduced from Kaiser Family Foundation COVID-19 Vaccine Monitor; Axios Chart Visuals.

Public polling also suggests that patients who are unsure about whether they will accept a COVID-19 vaccine greatly outnumber those who refuse the vaccine outright.

However, the incidence of vaccine hesitancy is not evenly distributed across the United States. While vaccine trust is trending in the right direction, KFF found that Black adults (43%) and Hispanic adults (37%) are more likely than white adults (26%) to say they want to "wait and see." Hesitancy in communities of color does seem to be a factor in the larger pattern of racial inequality during COVID-19. Data from early February indicates that White Americans are being vaccinated at rates up to three times higher than Black Americans.[17] Furthermore, several states have reported disproportionately high levels of vaccine refusals – around 50% – among nursing home workers.[18]

Variants in the Virus

Several new mutations of the original virus that causes COVID-19 have been reported around the world. A new variant called B117, which seems to be more transmissible than the initial strain, emerged in the United Kingdom in December. As of January 22, infections with the B117 variant had been detected in 12 U.S. states. A new strain first identified in South Africa, B1.351, caused a regional spike in cases of COVID-19 in January. Virologists have observed that this variant is more contagious than SARS-COV-2 and that it can infect people who already have antibodies from a prior infection. A third variant dubbed P.1 emerged as early as July 2020 around Rio de Janeiro, Brazil.

[13] https://www.kff.org/coronavirus-covid-19/report/kff-covid-19-vaccine-monitor-december-2020/
[14] https://www.axios.com/vaccine-hesitancy-improving-disparities-ff23b84e-b3bc-4370-ab70-8c340d7b5427.html
[15] https://www.kff.org/report-section/kff-covid-19-vaccine-monitor-january-2021-vaccine-hesitancy/
[16] https://www.kff.org/coronavirus-covid-19/report/kff-covid-19-vaccine-monitor-december-2020/
[17] https://khn.org/news/article/black-americans-are-getting-vaccinated-at-lower-rates-than-white-americans/
[18] https://www.npr.org/2021/01/31/962529002/patience-is-key-when-reacting-to-health-care-workers-who-refuse-the-covid-19-vac

As the virus mutates, vaccine manufactures are working to determine the efficacy of their formulations against new variants. Pfizer and Moderna have reported that the effectiveness of their vaccines against the British variant is similar to that of SARS-COV-2, and they are slightly less protective against the South African variant. As a result, companies are working to determine whether booster shots or slight reformulations may be necessary.[19]

The percentage of people who need to be immune to a disease to achieve herd immunity, either through vaccination or immunity developed during an earlier infection, varies as a function of the transmissibility of the disease. For example, to achieve herd immunity for measles 95% of the population must be immune, while for polio that number is 80%.[20] Recent research suggests that 60-90% of a population must be vaccinated for herd immunity against COVID-19.[21] Additional study is needed to refine the estimate.[22] In any event, where more transmissible COVID mutations are taking hold, higher vaccination coverage rates may be needed to achieve herd immunity.[23] The emergence of viral variants increases the urgency to administer vaccines as quickly and widely possible in order to both reduce the spread of these more transmissible variants and to avoid the development of new mutations.

In November, CDC launched a national Strain Surveillance program to identify and track new variants of SARS-COV-2 in the United States by conducting genomic surveillance and sequence analysis.[24]

[19] https://www.nytimes.com/2021/01/25/health/coronavirus-moderna-vaccine-variant.html
[20] https://www.who.int/news-room/q-a-detail/herd-immunity-lockdowns-and-covid-19
[21] https://www.lung.org/blog/understanding-covid-herd-immunity
[22] https://www.news-medical.net/news/20201204/Herd-immunity-threshold-far-higher-than-previously-thought-say-researchers.aspx
[23] https://www.cdc.gov/mmwr/volumes/70/wr/mm7003e2.htm
[24] Ibid.

Chairwoman JOHNSON. So I'll call this meeting to order, and without objection, the Chair is authorized to declare recess at any time.

Pursuant to *House Resolution 8*, today, the Committee is meeting virtually, and I want to announce a couple of reminders to the Members about the conduct of this remote hearing. First, Members, they should keep their video feed on as long as they are present in the meeting. Members are responsible for their own microphones. And please also keep your microphones muted until you are speaking. And finally, if Members have documents they wish to submit to the record, please email them to the Committee Clerk, whose email address was circulated prior to this hearing.

And so, again, good morning and welcome to the Space—Science, Space, and Technology Committee for the 117th Congress. We have an accomplished set of Members on our Committee—I just listened to one—and we bring diverse backgrounds and perspectives to our oversight and legislative work, and I look forward to a productive and stimulating 117th Congress.

It is fitting that our first hearing focus on the COVID pandemic and the role of vaccination in fighting this virus and its devastating impacts. As the first nurse elected to Congress, I'm deeply committed to understanding how basic research supports healthcare solutions, and I'm also a firm believer in vaccines.

Many of you are too young to know anyone who suffered from polio, but it was a devastating viral disease. I was a student nurse during that time, and I helped administer the polio vaccine as a student nurse. And thanks to scientific breakthroughs by brilliant virologists in the 1950's, the tremendous vaccine administration campaign that followed, this country has been polio-free since 1979. And we didn't get there by accident. We took great care to educate the public, ensured vaccine access in marginalized communities, and to assist other nations in vaccinating their own populations.

Like polio, COVID–19 kills. The last 12 months have been of great suffering. But they have also seen astounding achievements in virology. Researchers at the National Institute for Allergy and Infectious Disease (NIAID) and their research partners laid the scientific foundation over the past decade for a new type of vaccine called mRNA. When the news of the viral outbreak in Wuhan reached the United States, NIAID quickly deployed partnerships with drug companies to develop safe, effective vaccines in record time.

I cannot overstate what an incredible achievement it is that we have two safe, effective vaccines that have reached our shores. A third vaccine is being evaluated by FDA (Food and Drug Administration) as we speak, and we may have an answer on whether it is authorized as soon as next week.

We have an opportunity to take the lessons learned from polio, from measles, and so on to make sure that these vaccines reach their potential. Here's one lesson: Vaccines don't save lives. Manufacturing billions of doses and distributing them are the supply part of the question, but in order to get needles into arms as quickly as possible, we also have to think about demand. There are a lot of factors that make up consumer demand for a vaccine, but perception of risk is a big one. We must build high public con-

fidence in these vaccines. We simply cannot and will not bring this virus to an end unless we vaccinate a high percentage of the American population and, in fact, the globe.

I hope our hearing today will help illuminate the methods that allowed these vaccines to be developed and approved quickly with scientific rigor, and that we will learn more about how vaccine hesitancy might threaten the pace of our national recovery. The Science, Space, and Technology Committee may not have primary jurisdiction over Health and Human Services (HHS), but we absolutely have a role in supporting public health outcomes through good science.

I welcome our esteemed panel of witnesses and thank Dr. Huang in particular for joining us, as Dallas is facing unprecedented power outages and freezing temperatures this week, and I know the demands on his time are intense right now because we're also with much of an uptick with the virus.

[The prepared statement of Chairwoman Johnson follows:]

Good morning and welcome to the first hearing of the Science, Space & Technology Committee in the 117th Congress. We have an accomplished set of Members on our Committee who bring diverse backgrounds and perspectives to our oversight and legislative work. I look forward to a productive and stimulating 117th Congress.

It is fitting that our first hearing in the 117th Congress focus on the COVID pandemic and the role of vaccination in fighting this virus and its devastating impacts. As the first nurse elected to Congress, I am deeply committed to understanding how basic research supports healthcare solutions, and I'm also a firm believer in vaccines.

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We have an opportunity to take the lessons learned from polio, from the measles, and so on to make sure these vaccines reach their potential. Here's one lesson: Vaccines don't save lives; vaccinations do. Designing the vaccine, manufacturing millions of doses and distributing them are the "supply" part of the equation. But in order to get needles into arms as quickly as possible, we also have to think about "demand." There are a lot of factors that make up consumer demand for a vaccine, but perception of risk is a big one. We must build high public confidence in these vaccines. We simply will not bring this virus to an end unless we vaccinate a high percentage of the American population and in fact, the globe.

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I welcome our esteemed panel of witnesses and thank Dr. Huang in particular for joining us, as Dallas is facing unprecedented power outages and freezing temperatures this week, and I know the demands on his time are intense right now.

Thank you, and I now yield to Ranking Member Lucas.

Chairwoman JOHNSON. So the Chair will recognize Mr. Lucas. Did he get in?

Mr. LUCAS. Yes, Madam Chair. And thank you——

Chairwoman JOHNSON. Well, thank you.

Mr. LUCAS. You and I both had challenges getting on board this morning, but we're both here. Good morning——

Chairwoman JOHNSON. Yes, thank you.

Mr. LUCAS. Chairwoman Johnson. Thank you for holding this important and timely hearing. And thank you to our expert witnesses for their participation today. I hope we can learn valuable information that we can share with our constituents as we continue to battle the COVID–19 pandemic.

Almost 1 year ago to date, the Science Committee held our first hearing on the COVID–19 pandemic. Since then, we've seen day-to-day life changes dramatically. Millions of people have suffered from this pandemic, and COVID–19 has claimed the lives of nearly 480,000 Americans.

In recent weeks, the United States reached a positive milestone, as more Americans have now received at least one dose of the vaccine than have tested positive for the virus since the pandemic began just over a year ago. According to CDC (Centers for Disease Control and Prevention) data, the United States has administered approximately 55 million doses of COVID–19 vaccines since the first shot was given on December 14, 2020, and approximately 12 percent of the total U.S. population has received at least one dose.

But as the original COVID–19 virus and new variants continue to spread across the globe, it is imperative that the United States take a more aggressive and ambitious approach to ramping up vaccine manufacturing and distribution. We need to get as many shots in arms as quickly as is possible.

It is also critical that rural and underserved communities are not left behind during the vaccine rollout. For example, many rural residents lack broadband internet connection and are unable to secure appointments, which are largely scheduled online. Residents in more isolated parts of the country also experience difficulties finding somewhere to get the vaccine if they do not live near pharmacies or community health centers. Distributing vaccines that require ultracold storage also presents challenges for these communities, as doses will expire if they're not properly stored.

The American research enterprise, including government, academia, and industry, has the expertise, resources, and talent to continue to fight this pandemic. From vaccine development at record speed to PPE (personal protective equipment) manufacturing, America's scientific community has stepped up to the plate, as scientists and researchers immediately pivoted at the start of the pandemic to focus on combatting COVID–19. With the integration of technologies such as artificial intelligence and high-performance computing, researchers have identified promising vaccine candidates quicker. Advanced manufacturing techniques also offer promising methods to bolster supplies and rapidly modify vaccines to address new strains of the disease.

These factors allowed the United States to approve two safe and effective COVID–19 vaccines just 1 year after the pandemic began. Scientists were able to develop these vaccines in record time

thanks to almost two decades of basic research on related viruses. These investments in basic research have truly been lifesaving. We must continue to make critical investments in American research for the health and safety of our Nation. As vaccine distribution ramps up and we continue to work to stop the spread of COVID–19, it is imperative that key decisions are grounded and backed by strong science and data. We simply cannot afford to ignore science during this critical time.

This morning, I sent a letter to the Chairwoman respectfully requesting a hearing regarding the science on safely reopening and maintaining the Nation's K–12 schools for in-person learning. Research has established that approved COVID–19 vaccines are safe, and the evidence shows it's also safe to open our Nation's schools with the appropriate precautions in place.

I look forward to hearing from our witnesses today about the current state of vaccine uptake, hesitancy, and access across the country. I'm also looking forward to hearing about Oklahoma's plan and learning more about the efforts taking place across the State to ensure that the underserved and rural communities are not forgotten. Thank you, Deputy Commissioner Reed, for your participation here today.

And I want to thank the witnesses for taking the time to be here to share your expertise and insights with us during this pivotal time to keep Americans healthy. I know we're all looking forward to the day all Americans can safely return to work, our children are back in school, and we can look our loved ones in the eye once again.

I yield back the balance of my time, Madam Chair.

[The prepared statement of Mr. Lucas follows:]

Good morning Chairwoman Johnson. Thank you for holding this important and timely hearing. And thank you to our expert witnesses for your participation today. I hope we can learn valuable information that we can share with our constituents as we continue to battle the COVID–19 pandemic.

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I want to thank the witnesses for taking the time to be here to share your expertise and insights with us during this pivotal time to help keep Americans healthy. I know we are all looking forward to the day all Americans can safely return to work, our children are back in school, and we can see our loved ones once again.

I yield back my time.

Chairwoman JOHNSON. Thank you very much.

At this time, we'd like to introduce our witnesses. Our first witness is Dr. Kathleen Neuzil. Dr. Neuzil is Professor of Vaccinology, Medicine and Pediatrics, as well as Director for the Center for Vaccine Development and Global Health at the University of Maryland. She was part of the leadership team which oversaw the evaluation strategy for COVID–19 clinical trials, and she has been a central figure throughout the COVID–19 vaccine development process. She has led a phase 1 trials of the—she led phase 1 trials of Pfizer vaccine and the co-author of a recent paper establishing the efficacy and safety of the Moderna vaccine.

And then after Dr. Neuzil, Dr. Philip Huang, Dr. Huang is the Director and Health Authority for the Dallas County Health and Human Services Department where he manages almost 500 public health professionals. Prior to that, he spent 11 years as Medical Director and Health Authority for the Austin Public Health Department. He also served as an Epidemic Intelligence Service Officer with the CDC where he conducted infectious disease outbreak investigations.

Our third witness, Mr. Keith Reed, is the Deputy Commissioner for Community Health Services with the Oklahoma State Department of Health. His public health career with the Department has spanned 19 years and multiple positions. Mr. Reed also is a Colonel in the Oklahoma Air National Guard and served multiple tours in support of Operation Iraqi Freedom and Enduring Freedom. He is currently assigned as Commander of the 137th Special Operations Medical Group at Will Rogers Air National Guard Base in Oklahoma City.

Our final witness is Dr. Alison Buttenheim. She is the Scientific Director of the Center for Health Incentives and Behavioral Eco-

nomics at the University of Pennsylvania. Her research is focused on vaccine exemption policy and zoonotic disease prevention. Dr. Buttenheim is a member of the National Academies' Committee on the Equitable Allocation of the Novel Coronavirus Vaccine and a lead author of the new National Academies report on "Strategies for Building Confidence in COVID–19 Vaccines."

Our witnesses should know that we will—you will have 5 minutes for your spoken testimony. Your written testimony will be included in the record of the hearing. And when all of you have completed your spoken testimony, we will begin with questions. Each Member will have 5 minutes to question the panel.

We will open our witnesses' testimony now with—starting with Dr. Neuzil.

TESTIMONY OF DR. KATHLEEN NEUZIL, MD, MPH, PROFESSOR IN VACCINOLOGY AND DIRECTOR, CENTER FOR VACCINE DEVELOPMENT AND GLOBAL HEALTH, UNIVERSITY OF MARYLAND SCHOOL OF MEDICINE

Dr. NEUZIL. Chairwoman Johnson, Ranking Member Lucas, and distinguished Members of the Committee, I appreciate the opportunity to elaborate on my written statement to you and to elucidate how investments in science and technology, effective partnership, and resource allocation enable the vaccine achievements of the past year.

The consequences of the COVID–19 pandemic on our health, our economy, and our social well-being have been staggering. While the urgent need for a vaccine was clear, vaccine development is a lengthy, risky, and expensive process. Researchers first evaluate experimental vaccines in the laboratory and in animals. If a vaccine is safe and appears promising, it may go on to be carefully tested in people, but only if there is funding to do so. Many vaccines never move beyond early testing simply because there is no perceived market value and no funding.

As part of the team that designed and conducted the early studies of the vaccines, I witnessed firsthand how the pandemic urgency shortened the vaccine development timeframe. Investments in basic science and technology were the key. Decades of work on understanding coronaviruses and other respiratory viruses enabled scientists to identify the appropriate target for the vaccine and to have a genetic sequence ready within days.

Investments in the mRNA technology for other vaccines, influenza, Zika, and Ebola, and prior partnerships with vaccine manufacturers meant we understood how to deliver the mRNA and at what doses. Likewise, government-funded researchers brought sophisticated animal models and innovative laboratory methods to the vaccine efforts.

The investment by NIH (National Institutes of Health) and others in clinical trials, infrastructure, and networks allowed experienced clinical scientists like myself to help design, execute, and analyze the studies in partnership with government and industry. Given my involvement from the start, I can attest that safety was never compromised by the speed of this effort. All trial designs were reviewed by ethics boards and the FDA. Experts with no ties to the products served on boards to monitor vaccine safety.

The first participants to receive the vaccine were healthy adults who would be the least likely to suffer ill effects. The trials began with low doses and worked up to higher doses. The volunteers were followed carefully in the hours, days, and weeks after receiving the vaccine. We learned that the vaccine caused more side effects at the highest dose, but the immune response was not as good at the lowest dose, so a middle dose was chosen to move forward into trials.

The first results of the mRNA vaccines were remarkable, showing more than 90 percent efficacy against disease and, importantly, against severe COVID–19. As most vaccine adverse events occur shortly after vaccination, the FDA required a median of 2 months of follow-up before emergency use authorization (EUA) would be granted.

Safety assessment does not stop at approval, however. The trials will continue for at least 2 years. As with all vaccines in the United States, the CDC, the FDA, and the manufacturers will continue to follow vaccine safety. Through these systems, we are learning more, for example, about the rare allergic reactions occurring after administration of the mRNA vaccines.

In summary, U.S. Government investments in science and technology enabled the COVID–19 vaccine development achievements. We don't know what pathogen will cause the next pandemic. Coronaviruses and influenza viruses have proven their pandemic potential. We must likewise be prepared for outbreaks from less-studied diseases due to arenaviruses, filoviruses, and togaviruses, for example. Our vaccine development can be better and faster but only with continued investments in technology. We have critical vaccine supply shortages, and people are dying.

Finally, this outbreak has reminded us again that little-known viruses causing disease in distant parts of the world are relevant. Variants are emerging in the absence of vaccines. The United States must work in partnership with the World Health Organization (WHO) and other international agencies to ensure an integrated, global response and to ensure that COVID vaccines are available to everyone in the United States and around the world. Thank you.

[The prepared statement of Dr. Neuzil follows:]

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STATEMENT OF

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BEFORE THE

U.S. House of Representatives
Committee on Science, Space and Technology

HEARING ON

"The Science of COVID-19 Vaccines and Encouraging Vaccine Uptake"

February 19, 2021

Online via Video Conferencing

Background on trials networks

The COVID-19 Prevention Network (CoVPN) was formed by the National Institute of Allergy and Infectious Diseases (NIAID) at the US National Institutes of Health (NIH) to respond to the global pandemic (coronavirusprevention network.org/about-covpn/). Using the infectious disease expertise of their existing research networks and global partners, NIAID has directed the networks to address the pressing need for vaccines and monoclonal antibodies against SARS-CoV-2. The CoVPN is led by Dr. Lawrence Corey, University of Washington and Fred Hutchinson Cancer Research Center and Dr. Kathleen Neuzil, University of Maryland School of Medicine. The CoVPN works in partnership with NIH, manufacturers and other organizations to develop and conduct studies to ensure rapid and thorough evaluation of US government-sponsored COVID-19 vaccines and monoclonal antibodies for the prevention of COVID-19 disease. The CoVPN brings together experienced NIH-funded clinical trial networks including the HIV Vaccine Trials Network (HVTN), hvtn.org, the HIV Prevention Trials Network (HPTN) hptn.org, the Infectious Disease Clinical Research Consortium Vaccine Treatment and Evaluation Units (IDCRC VTEU), idcrc.org, and the AIDS Clinical Trials Group (ACTG), actgnetwork.org.

Statement

By February 16, 2021, the global COVID-19 pandemic had claimed more than 2.4 million lives, with more than 108 million SARS-CoV-2 infections. The economic and social consequences have been equally staggering, with unemployment in the United States hitting a yearly total of nearly 9% in 2020 after a decade of jobs expansion. The commercial airline industry, the hospitality sector, pedestrian retail industry and the global tourism industry, among others, have suffered. The closure of schools and lack of extracurricular activities is impacting the academic, social and physical development of children, with a disproportionate impact on minorities. Persons of all ages are struggling with the effects of isolation, extreme lifestyle changes, and increased anxiety related to the pandemic and mitigation factors to contain it.

The U.S. government effort known as “Operation Warp Speed” (OWS) was officially announced in late April 2020 as a public-private partnership to facilitate and accelerate the development, manufacturing, and distribution of COVID-19 vaccines, therapeutics, and diagnostics. However, work was already underway as early as January 2020 among scientists, public health and government officials, and vaccine manufacturers, who recognized the urgent need for preventive and therapeutic options to curb the spread of the infection and to mitigate the devastating consequences of COVID-19. The result was the initiation of vaccine development and testing that resulted in the approval of two vaccines through FDA Emergency Use Authorization (EUA) in December 2020. **In this statement, I will describe how foundational science, effective partnership, and resource allocation enabled the unprecedented vaccine development achievements. Further, I will emphasize investments that are needed to ensure we are better prepared for the next pandemic.**

Vaccine development is a lengthy, risky, and expensive process that proceeds in deliberate stages, with evaluation after each step before proceeding to the next one. **The typical vaccine development process may take 10-20 years or more from early scientific discovery to licensure and distribution.** Researchers first evaluate experimental vaccines in the laboratory and animal models. If a vaccine candidate is safe and appears promising in these preclinical experiments, it may go on to be carefully tested in people, but only if there is funding to do so. Many vaccines never move beyond preclinical testing simply because there is no perceived market value and no funding.

Clinical testing begins with Phase 1 studies to establish safety and immune responses in small numbers of healthy adults. With satisfactory results, and the funding to do so, studies move to Phase 2, where larger numbers of people in the target population (the population that will benefit from the vaccine, e.g., older people or people with underlying diseases) are included, with careful safety assessment and further assessment of immune responses. Finally, Phase 3 studies are conducted. Phase 3 studies include large numbers of people, and their goal is to show an effect of the vaccine on clinical disease – either preventing the disease or lessening the severity of the disease- while demonstrating safety in larger numbers of people. Phase 3 studies are very expensive- generally in the tens to hundreds of millions of dollars. These expenses include developing and maintaining the infrastructure at the clinical trial sites, the staffing and investigator costs to conduct the trial and closely follow the volunteers, participant costs for their time and transportation, database set-up and data management and statistical analysis, regulatory oversight and monitoring costs, equipment and supply costs, and laboratory costs related to specimen collection, processing and performance of assays. Thus, many vaccines never make it to Phase 3 testing based on funding decisions alone. After a vaccine is licensed, FDA, CDC, and other federal agencies continue to monitor its safety and effectiveness. There is generally a lag time between licensure and full roll-out of a vaccine, as manufacturers generally do not take the risk of making vaccines at scale until they are licensed and recommended for use.

As part of the team that designed the first Phase 1 of the NIH-Moderna messenger RNA (mRNA) vaccine and the later Phase 3 studies, and as part of the investigative team that conducted the first Phase 1 trial of the Pfizer mRNA vaccine in the U.S., I witnessed firsthand how the pandemic urgency considerably shortened the vaccine development timeframe. Investments in basic science were the foundation to this success. Decades of work on understanding the structural biology and pathogenesis of coronaviruses and other viruses enabled scientists at the Vaccine Research Center at the NIH to identify the appropriate structural target for the vaccine (the outer spike or S glycoprotein of the coronavirus), stabilize that protein, and have an mRNA genetic sequence ready to test in animals and to send to a vaccine manufacturer to make clinical trial material within days. Prior partnerships with the vaccine manufacturer- Moderna- meant that the mRNA for this vaccine could be inserted into a lipid coat at dose ranges that had already been established and tested for other vaccines. Further, the investment by NIH in clinical trials infrastructure and networks allowed access to experienced and capable clinical scientists, like myself, who stepped forward to design, execute and analyze the studies in partnership with government and industry. Importantly, all of these stages, were conducted in parallel. Likewise, NIH-funded researchers who had studied coronaviruses for their entire careers were prepared to provide guidance on

coronavirus biology and to conduct the immunology assays, which would serve as the first indication that the vaccine could elicit an immune response in humans. Other NIH-funded researchers had developed animal models and innovative ways to assess immune responses to other pathogens and were able to transfer their learnings to the study of SARS-CoV-2. To do so required specialized skills, laboratories and equipment- without this prior research capacity and infrastructure, the effort would have slowed considerably. No one waited for the results of the animal studies to begin to prepare the laboratory to conduct the assays, or to design and plan the human studies; Phase 3 studies were planned "at risk" before Phase 1 results were available. Vaccines were manufactured "at risk" before animal results were available. This was all possible due to the resources provided for this effort; the dedication of laboratory and clinical scientists; the prior partnership between Moderna and NIH, and prior pandemic preparedness efforts that enabled regulatory teams to establish frameworks for reviews in record time.

We followed all required processes to ensure these vaccines were held to extremely high safety standards because they would be deployed broadly if successful. All trial designs were reviewed by independent ethics boards, and the FDA. Data safety and monitoring boards were convened and consisted of experts with no direct ties to the product or the trials to monitor trial safety. None of the vaccine platforms chosen for early testing in the U.S. consisted of the full virus or a weakened virus- so it was impossible for these vaccines to cause COVID-19. The vaccines being tested in the U.S. comprise either the protein or a piece of the virus to induce an immune response, or a genetic sequence to instruct our cells to make the desired protein antigen. In either case, the vaccine cannot cause SARS-CoV-2 infection.

Given my involvement from the start in the NIH-Moderna development effort, I can attest that safety was never compromised by the speed of this effort. While the usual stages of development were compressed, the confidence in the safety of the vaccines was established. The first-in-human trial of the NIH-Moderna SARS-CoV-2 mRNA vaccine began based on 1) historical safety data on the mRNA platform from previous and ongoing clinical trials using vaccines targeting a variety of viral pathogens such as influenza and Zika which indicated the platform was safe in humans; 2) historical safety and immunogenicity data of other coronavirus vaccines (e.g. SARS-1 and MERS) using coronavirus spike proteins, suggesting that the protein was safe and should elicit a robust immune response; and 3) previous experimental data using other coronavirus vaccines in animals confirming the immunogenicity and efficacy of vaccines against the spike protein. Data in animals for this construct were generated as Moderna worked to make the vaccine for human testing.

In designing the Moderna Phase 1, we specified that the first participants in the trial must be young and middle-aged healthy adults, who would be the least likely to suffer ill effects of a vaccine. The trials began with low doses and worked up to higher doses. Experienced investigators throughout the U.S. conducted the studies. The volunteers were observed for several hours after receiving the first vaccine and followed carefully with clinical and laboratory assessments in the days after receiving the vaccine before another small group of individuals was vaccinated. At my center, we were the first to vaccinate with the Pfizer-BioNTech vaccine and we followed this same pattern. Participants were counseled on how to recognize side effects of the vaccine, to recognize if they have any signs or symptoms of COVID-19 and were counseled in how to reduce their risk of acquiring COVID-19. Physicians

and other study personnel were available to the participants, as needed, 24 hours per day. Through this careful Phase 1 evaluation we learned that the vaccine caused more side effects at the highest dose, but the immune response was not as good at the lowest dose. So, a "middle dose" that had mild to moderate, self-limited side effects and induced a hearty immune response was chosen to take forward into Phase 2 and eventually Phase 3 testing.

It was clear from the start that given a pandemic of this severity and magnitude, multiple vaccines would be needed to vaccinate the U.S. and the global population. Further, the risky nature of vaccine development necessitated the parallel development of many vaccines, with the hopes that at least one would make it to the approval stage. Thus, a mechanism to harmonize protocols and share lessons learned was established early on. A critical collaborative program was spearheaded by NIH: the Accelerating COVID-19 Therapeutic Interventions and Vaccines (ACTIV) public-private partnership (nih.gov/research-training/medical-research-initiatives/activ). At this time of global urgency, this effort brought together the individual strengths of all sectors – Department of Health and Human Services (BARDA, CDC, FDA); other government agencies (Department of Defense and Veterans Affairs); and representatives from the European Medicines Agency, academics, philanthropic organizations, and numerous biopharmaceutical companies. The goal was to develop a coordinated strategy for prioritizing and speeding development of the most promising treatments and vaccines. I was part of this effort, serving on the Vaccines subgroup. The group shared lessons learned, debated challenges in the field, and publicly shared outputs from the group to benefit all. Involvement of regulators from the beginning facilitated the effort.

A further element of the effort was to establish a framework for conducting harmonized, vaccine efficacy trials that adhered to published regulatory guidance. The Phase 3 trials were large – at least 30,000 people per trial. This size ensured that results would be obtained quickly, and that a diverse population of Americans would be enrolled, including the elderly, minority populations and those with chronic illness. With a large trial, an understanding of the safety and efficacy of the vaccine in these subgroups would be possible. NIH-funded clinical trials networks worked in partnership with manufacturers and clinical research organizations to enroll the large trials quickly and with attention to safety detail and scientific rigor. Common laboratories and methodologies will allow for comparisons across trials to inform decisions on improving vaccines, if necessary; moving to broader populations (e.g., children, persons with weak immune systems); and vaccine policy recommendations. Likewise, statistical groups worked collaboratively to evaluate data in similar ways, and in the future to combine data from the trials to have statistical power to understand how well the vaccines work against less common outcomes, such as preventing death from COVID-19.

The rapid conduct of the trials and achieving an early answer on the efficacy of these vaccines was critical given the extreme need for a vaccine during this pandemic. The first results of the mRNA vaccines were remarkable – showing greater than 90% efficacy against any symptomatic COVID-19, and importantly against severe COVID-19. The prevention of severe disease is critically important, as severe COVID leads to health care encounters and hospitalizations that stress the health care system and lead to delays in receiving care for other reasons. As most vaccine adverse events occur shortly after vaccination, the FDA required a median of two months follow-up before EUA would be granted. However, a consequence of the rapid conduct of the trials is that at the time of EUA, only short-term effectiveness and safety data are available on the vaccines. The participants continue to be

followed as part of the trials, for at least 2 years. Further, as with all vaccines in the U.S., assessment does not stop at the time of approval. Systems are in place through the CDC, the FDA and the vaccine manufacturers for follow-up beyond EUA and licensure. Through these systems, we are learning more about the rare allergic reactions occurring after administration of the mRNA vaccines, for example. These anaphylactic reactions, with a rate of approximately 4-11 per million, were not seen in the trials of 30,000 people. Likewise, CDC has studies in place to ensure that vaccines work well "in the real world" as they are distributed broadly. Ensuring the capacity of the CDC and FDA to conduct this postmarketing follow-up is critical.

Summary

Our investments in pandemic preparedness, and in basic, translational, regulatory, and clinical science enabled the historic vaccine development achievements in response to the COVID-19 pandemic. Leadership at the federal government level united partners from different sectors around the common goal of combatting a global crisis – this partnership was key to success. Finally, the available resources and efficient use of those resources through harmonized efforts allowed this enormous undertaking to proceed without the usual delays. We have two COVID-19 vaccines currently – to prevent disease it must be delivered to people. We are seeing weaknesses in the system in two main areas – vaccine distribution, due to chronic underfunding of state and local health departments, and public confidence in vaccines, leading to suboptimal uptake in certain populations. Investments in public health, understanding vaccine hesitancy, and building trust in communities must complement our investments in science to optimally mitigate the effects of COVID-19 and future pandemics. Finally, the emergence of variant strains around the world emphasizes that this must be a global response to be successful.

Future Investments

- NIH must be well-funded. Investments and advances in science over the past several decades were the foundation of the successful COVID-19 pandemic response. We must continue to invest in basic, clinical, and epidemiologic science. This includes funding research in the areas of coronavirus immunology, pathogenesis, and the interaction between coronaviruses; and to better understand other pathogens with pandemic and outbreak potential – influenza, certainly, as well as lesser studied pathogens including other coronaviruses, arenaviruses (e.g. Lassa fever), filovirus (e.g. Ebola) and togaviruses (e.g. Chikungunya).
- The emergence of three severe coronaviruses in the past two decades should prompt an integrated, multidisciplinary effort to develop countermeasures for coronaviruses. This would include antivirals and "pan-coronavirus" vaccines that could work preventing all coronaviruses.
- We need continued investments in clinical trial infrastructure. The NIH-funded clinical trial networks have played a key role in this pandemic response and in the previous response to the H1N1 influenza pandemic. These networks advance our understanding of many vaccine-preventable diseases and allow for surge capacity during a pandemic.

- We need investments in the CDC, FDA and public health – the lack of funding and decline in state and local health departments has been evident in the challenges of vaccine distribution.
- We need investments in better understanding vaccine hesitancy in order to design programs that will restore confidence in vaccines and increase vaccine coverage.
- Finally, and importantly, a global pandemic requires a global response. Variants are emerging around the world in the absence of vaccines. We need an integrated global surveillance system for SARS-CoV-2 that can be modelled after the global influenza surveillance effort. Furthermore, the U.S. must fully participate in the activities of the WHO to ensure global equitable access to COVID-19 vaccines.

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Speaker biography

Kathleen Neuzil, MD, MPH is the Myron M. Levine MD DTPH Professor in Vaccinology, Professor of Medicine and Pediatrics, and the Director of the Center for Vaccine Development and Global Health at the University of Maryland School of Medicine (UMSOM, medschool.umaryland.edu/cvd/). She is an internationally recognized research scientist and advocate in the field of vaccinology. Throughout her career, Dr. Neuzil has conducted clinical and epidemiologic studies on vaccine-preventable diseases, yielding high-profile publications that inform policy decisions and public health actions. Dr. Neuzil has conducted research in the United States (U.S.) and around the world on multiple vaccines, including influenza, rotavirus, human papillomavirus, Japanese encephalitis, typhoid conjugate vaccines, and most recently, SARS-CoV-2. Dr. Neuzil has been central to the domestic response to COVID-19. In her role as Co-Director of the COVID-19 Prevention Network (CoVPN), described below, she is part of the leadership team designing and overseeing the clinical evaluation strategy for COVID-19 clinical trials in the U.S. She is a co-Principal Investigator of the NIH-funded Leadership Group for the Vaccine and Treatment Evaluation Unit network. In her role at UMSOM she is an investigator on COVID treatment, prevention, and post-exposure prophylaxis trials. Dr. Neuzil has more than 230 scientific publications on vaccines and infectious diseases. Dr. Neuzil's research capabilities are complimented by 20 years of involvement in domestic and international policy, including past membership on the US Centers for Disease Control and Prevention's Advisory Committee on Immunization Practices (ACIP). She is a member of the World Health Organization Strategic Advisory Group of Experts on Immunization and the ACIP working group on coronavirus vaccines. Dr. Neuzil was named the Baltimore Sun "Marylander of the Year" for her role in the response to the COVID-19 pandemic.

Chairwoman JOHNSON. Thank you very much.
Dr. Huang? Unmute.
Dr. HUANG. OK.
Chairwoman JOHNSON. One more click. That's it.
Dr. HUANG. Is it clicked?
Chairwoman JOHNSON. Yes, you got it. Click one more time. It keeps going off.
Dr. HUANG. Can you hear me?
Chairwoman JOHNSON. Yes.
Dr. HUANG. OK. Well, good morning, and thank you, Chairwoman Johnson, Congressman Lucas, and Members of the Committee, and greetings from frozen Dallas, Texas.
Chairwoman JOHNSON. You're off again. OK. It keeps clicking off.
STAFF. Sir, you seem to be hitting the mouse twice or hitting a button twice, and that's just unmuting you and then muting you again.
Dr. HUANG. [inaudible] unmuted. Can you hear me?
STAFF. Yes.
Chairwoman JOHNSON. Yes.
Dr. HUANG. OK. [inaudible] muted. OK.
Chairwoman JOHNSON. You're—OK.
Dr. HUANG. I'm not——
Chairwoman JOHNSON. We hear you now. But you just went off again.
Dr. HUANG. OK. I am not touching anything.
Chairwoman JOHNSON. Keep going. It went off again. I don't know what it is.

TESTIMONY OF DR. PHILIP HUANG, MD, MPH, DIRECTOR AND HEALTH AUTHORITY, DALLAS COUNTY DEPARTMENT OF HEALTH AND HUMAN SERVICES

Dr. HUANG. Can you hear me? Oh, there. There, that looks good. OK. Well, I apologize for technical difficulties. Again, my name is Dr. Phil Huang, and as you heard, I'm the Director and Health Authority for the Dallas County Health and Human Services Department where we serve over 2.6 million residents in Dallas County. I'm also a board member for the National Association of County and City Health Officials, NACCHO, which represent our Nation's nearly 3,000 local health departments. And I'm honored to be with you here today.

Over my career, I've worked at the Federal, State, and local governmental public health levels, and I've truly come to appreciate that not just politics but all things really happen locally. Local health departments know our communities block by block, including the assets and barriers to care, the industries and living situations that pose particular challenges, as well as the community-level partners that have to be included in order to be successful.

Even before a single case of the virus was detected on American soil, we at local health departments began to mobilize and engage our community and healthcare partners, as well as with our State and the Federal Government. This continues as we provide testing and contact tracing, and while standing up the largest mass vaccination campaign in our Nation's history.

To be successful, we have to have strong, predictable supply of vaccines, but supply, while absolutely necessary, is not enough. We must do more to build demand and facilitate equitable uptake of these vaccines. To do this, we must provide clear communication through trusted messengers and healthcare providers, allow for the opportunity for questions to be asked and an individual's concerns to be thoughtfully considered, as well as target outreach via the many unique formal and informal communication channels where people get their information. This takes a robust workforce, strong relationships, and time and resources so that individuals can get their questions answered and then access the vaccine within their community.

The challenge of vaccine hesitancy is not new to COVID–19, but with nearly half a million Americans who have lost their lives to this virus and more challenging variants emerging, it highlights the importance of a successful and efficient mass vaccination effort.

Addressing this is not a one-time event also. Instead, it requires engaging with hesitant populations on an ongoing basis to honestly address concerns, provide the information they need, and build the trust that is crucial to their confidence in COVID–19 vaccines and the systems that provide them.

In Dallas, we've seen vaccine hesitancy among communities of color, especially the African-American and Latino communities. The roots of vaccine hesitance, though, are varied. The mistrust from the African-American community seems to be deep-rooted history, including the horrific Tuskegee studies of untreated syphilis in rural Black men, while concerns in the Latino community might stem from mistrust of government and skepticism of the vaccine development process. Among the Hispanic community, we're also hearing questions around whether an undocumented person can receive the vaccine, as well as concerns about providing personal information to the government needed to receive the vaccine.

These challenges persist in healthcare workers as well. We saw that in some long-term care facilities, even though there was a Federal program with the pharmacies that guaranteed that delivery, the uptake of the vaccine from the staff could be very low with some facilities only having 42 percent of their healthcare staff taking the vaccine. Local health department's chief health strategists within their communities are actively working on these actions to support equitable COVID–19 vaccine administration and uptake across all communities, all races, ethnicities, and other demographics and geographies.

Currently in Dallas County we have over 650,000 people who have signed up on our vaccine registration list. However, our health department is only receiving 9,000 doses of vaccine per week. Vaccine hesitancy, combined with the digital and resource divide, has also meant that our registration list is skewed to the northern more affluent areas of Dallas County.

However, because we've focused on the data, we've been able to tailor our approach with an eye toward equity. We provided vaccine distribution based on our vulnerability index to ensure we equitably distribute the vaccine as opposed to first-come, first-serve approach. We've also set up a professional phone bank so individuals without internet access or a smartphone can call to register, and

we've partnered with community leaders to host in-person registration events. We're also launching a paid media campaign to address vaccine hesitancy and get information out to the community about the registration process.

We've seen firsthand how leveraging people that are respected by the community can increase vaccine confidence, and at one of our community registration events heard a 65-year-old African-American woman lean over to her friend and say that she decided to come because she saw the actor Tyler Perry on TV that morning say how important it was to get the vaccine.

While today's hearing is specific to vaccine hesitancy around COVID–19, I can't understate that this is an issue that was a challenge for us long before the pandemic, and our effort to build confidence in vaccines are long-term and continuous, but every day we work on it bringing us one step closer to getting our population fully vaccinated.

Thank you again for inviting me to testify today, and I look forward to your questions.

[The prepared statement of Dr. Huang follows:]

Written Testimony House Committee on Science, Space, and Technology
The Science of Covid-19 Vaccines and Encouraging Vaccine Uptake
February 19, 2021

Statement of Philip Huang, MD, MPH
Director and Health Authority, Dallas County Department of Health and Human Services
Board Member, National Association of County and City Health Officials

Good Morning Chairwoman Johnson, Congressman Lucas, and members of the Committee. My name is Dr. Philip Huang, and I am the Director and Health Authority for the Dallas County Department of Health and Human Services in Dallas, Texas. I have served in this position since February 2019, and before that started my career as an Epidemic Intelligence Service Officer with the CDC, then spent 15 years with the Texas Department of State Health Services and then 11 years as Medical Director and Health Authority with the Austin Public Health Department. So, I have had experience with the federal, state and local levels.

I am also a Board Member for the National Association of County and City Health Officials (NACCHO), the association that represents our nation's nearly 3,000 local health departments, which have been on the front lines of the COVID-19 response since the beginning. From this post, I have witnessed my colleagues' incredible efforts over the past year to keep their communities safe and the work that they are doing to ensure an equitable and efficient roll out of the COVID-19 vaccines. I am honored to be with you today to discuss the importance of vaccines and vaccine communication, as well as the role that local health departments play in improving vaccine acceptance and access. I mentioned that I have worked at the federal, state and local levels and I have truly come to appreciate that all things happen locally.

The Role of Local Health Departments in Responding to the Pandemic

Local health departments are the unit of local government responsible for safeguarding the public, responding to routine health threats as well as emergencies. We know our communities block-by-block, including the assets and barriers to care in our communities, the industries and living situations that pose particular challenges, as well as the community-level partners and organizations that must be included to be successful. We live in our community and serve our neighbors. We are the front lines of the many questions and concerns that are raised by families, local decision makers, and health care providers—whether they are asked through a call to the health department or in the parking lot of the grocery store. This gives us a both an important insight into both the concerns of the community, as well as helps us identify emerging issues. While the Dallas County Department of Health and Human Services serves over 2.6 million Dallas County residents, local health departments as a whole range in size and geographic location, autonomy, and resources. But no matter these differences, we all have the shared goal of protecting and promoting the public health of our communities.

Even before a single case of the virus was detected on American soil, we at local health departments began to mobilize and engage our community and health care partners. We have also worked closely with the entirety of the federal-state-local governmental public health

partnership, working to bring the local perspective to our national plans. This continues to be critical as we embark on the largest mass vaccination campaign in our nation's history. To be successful, we need to have strong, predictable supply of vaccines. But that is not enough. We must do more to provide clear communication through trusted messengers and health care providers, the opportunity for questions to be asked and an individual's concerns to be thoughtfully considered, as well as targeted outreach via the many unique formal and informal communications channels where people get their information. We need the resources and staff to allow for the time to ensure that individuals can get their questions answered and then strategically organized access points to get the vaccine to the populations we are trying to reach.

Vaccine Hesitancy Prior to COVID-19

In considering how current vaccine hesitancy and access barriers impact the pace of our national recovery from COVID-19, it is important for us briefly acknowledge how these challenges existed for us, at local health departments, prior to this pandemic.

Immunization is one of the most successful and safest public health measures available. In the United States, vaccines have led to the near elimination of several diseases and significant reductions in mortality and improvements in daily life. Despite this, vaccine hesitancy has been a persistent public health threat that has led to outbreaks of vaccine-preventable diseases, particularly among under-/un-immunized individuals and communities.[1]

Local health departments have a long track record of not only providing clinical immunization services, but also providing other essential immunization activities, such as conducting surveillance, providing education to health care providers and the public, and developing communication campaigns to bolster immunization rates. But local health departments have long faced numerous challenges to this work. In 2017, the National Association of County and City Health Officials (NACCHO) conducted an assessment of local health department immunization programs.[2] Fifty-six percent of respondents indicated vaccine hesitancy was one of the top barriers to their local immunization program. Along with this, respondents indicated insufficient staffing (44%), lack of vaccine education and confidence (37%), and lack of funding (27%) as other barriers their local immunization programs encountered.

The challenge of vaccine hesitancy is not new to COVID-19, but with nearly half a million Americans who have lost their life to this virus and more challenging variants emerging, it highlights the importance of a successful and efficient mass vaccination effort. While important federal, state, and local efforts were underway before the pandemic to strengthen vaccine confidence through implementing the Centers for Disease Control and Prevention's (CDC's)

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[1] See: https://www.nejm.org/doi/full/10.1056/NEJMoa1912514; https://www.cdc.gov/mmwr/volumes/66/wr/mm6627a1.htm; https://www.mass.gov/doc/guide-for-addressing-vaccine-hesitancy-among-clients/download

[2] https://www.naccho.org/blog/articles/local-health-department-immunization-programs-findings-from-a-2017-naccho-assessment

Vaccinate with Confidence framework, we are still facing substantial needs and work ahead to adequately strengthen vaccine confidence.

Vaccine Hesitancy During COVID-19

Over the course of the pandemic, clear and consistent messages, as well as building trust with the public, have been critical challenges to our work. The same is true when it comes to the vaccines authorized for COVID-19. With much attention being paid to the development push for an effective vaccine, surveys and polls conducted early on during the pandemic highlighted a significant number of adults who did not intend to get vaccinated when it was available. These data described variation in intent to get vaccinated by factors such as race, ethnicity, gender, age, and education with more hesitancy found among communities disproportionately impacted by COVID-19, such as among African Americans.

As communities continue to have questions as they form decisions about getting vaccinated against COVID-19, particularly those who have been historically marginalized by discrimination in the health care sector, engaging with them on an ongoing basis is an important approach to providing the information they need and building the trust that is crucial to their confidence in COVID-19 vaccines and the systems that provide them. In efforts funded by the Robert Wood Johnson Foundation and co-led by the Johns Hopkins Institute for Vaccine Safety and NACCHO, regional and local community conversations, including local conversations with African American, Native American, and Latinx communities, have yielded actions for local health departments to consider or adopt in supporting their communities. These include:

- **Demonstrating trustworthiness by being a transparent and candid partner in decision-making**. This includes recognizing that people are still forming their views around COVID-19 vaccination and that it is valid for them to have questions. This also includes providing answers where they exist while acknowledging when there are insufficient data to address other questions.
- **Seeking to understand the context and values of a community and how they contribute to vaccination decisions.** People consider COVID-19 vaccination in the context of their lived experience and it is equally important to acknowledge that, for some, this lived experience encompasses a deep history of systemic injustices and inequities.
- **Engaging with communities, either directly or through trusted community partners, including healthcare providers, to support decision-making and build trust.** Recognizing that ongoing, meaningful community engagement requires an all-hands-on-deck approach, it is especially critical to involve community partners, stakeholders, and local leaders that represent and serve our communities.
- **Decreasing barriers to vaccine access so that decision-making about vaccination is not encumbered by logistical hurdles.** While we still have a limited supply of COVID-19 vaccine, we must ensure that aspects such as registration, location, and scheduling support equitable access, particularly among those who have been disproportionately impacted by the pandemic.

In Dallas, we have seen vaccine hesitancy among communities of color, especially the African American and Latino communities. The mistrust from the African American community seems to be deep-rooted in history, including the horrific Tuskegee studies of untreated syphilis in rural Black men. Whereas some of the mistrust from the Latino community might stem from mistrust of the government and skepticism of the vaccine development process, such as concerns over the speed at which the vaccine was developed. I have heard that even the name "Operation Warp Speed" leads to people fearing that a vaccine developed under such a program must have been rushed and not fully vetted. Among the Hispanic community we are also hearing questions around whether an undocumented person can receive the vaccine as well as concerns about providing personal information to the government needed to receive the vaccine.

We have also seen a mistrust of the process from some of our healthcare workers. Despite being part of the federal pharmacy program and having early, guaranteed access to the vaccine, we saw that in some long-term care facilities the uptake of the vaccine from the staff was very low, with some facilities only having 42% of their healthcare staff take the vaccine. When questioned by DCHHS, these facilities said their staff were waiting to see how their coworkers responded to the vaccine before taking it for themselves.

During some of our community outreach events, we are seeing many with a general lack of knowledge about the vaccine – ranging from people who did not know a vaccine had been developed and was being distributed to people, to not knowing how to register and access the vaccine. During these events we have also experienced much misinformation circulating in the community, such as people thinking that the government is putting flu virus or something else into the COVID-19 vaccine to track their movements.

Currently, we have over 650,000 people who have signed up on our vaccine registration list and the Dallas County Health Department is only receiving 9,000 doses of vaccine per week. However, our early experiences in registering people highlighted a digital divide in Dallas County as a large percentage of the people who signed up online during the first couple of days were from the northern, more affluent areas of Dallas County. As a result, our registration list did not match the racial and ethnic makeup of the county as a whole. More tech-savvy residents were also able to "hack" into some of the appointment systems and make appointments for persons who were not yet in the high priority groups. While demand is currently outpacing supply of the vaccine, as we ramp up production of the vaccine allowing for larger-scale vaccine administration, we need to address several of the issues I have mentioned.

Local Health Department Roles and Actions to Address Vaccine Hesitancy

Local health departments, as health strategists within their communities, are actively working on these actions to support equitable COVID-19 vaccine administration and uptake across all communities, all races, ethnicities, and other demographics and geographies.

In Dallas, we have prioritized vaccine distribution based on a vulnerability index, which takes into consideration factors such as age, the Area Deprivation Index (ADI – a measure of socioeconomic disadvantage), the zip code a person lives in, chronic medical conditions, and proximity to recent COVID-19 cases, to ensure we equitably distribute the vaccine. This approach, rather than a first come first serve approach, helps address some of the digital divide issues. Additional steps we have taken to address the digital divide include setting up a professional phone bank so individuals without internet access or a smart phone can call the phone bank to register. We have also partnered with community leaders, from local elected officials to faith leaders, to host in-person registration events. We again use our vulnerability index to target the zip codes most in need of these registration events.

Here in Dallas County, we are also launching a paid media campaign to address vaccine hesitancy and get information out to the community about the registration process. We are again partnering with trusted community leaders and prominent figures to act as spokespersons for our vaccine registration campaign. We have seen first-hand how leveraging people that are respected by the community can decrease vaccine hesitancy. For example, at one of our community registration events a 65-year-old African American woman leaned over to her friend and said that she decided to come to the event and register because she saw the actor Tyler Perry on TV that morning saying how important it is that we all get the vaccine.

At our in-person community registration events in priority communities, we have had lines around the block of people wanting to get registered. This is good news and shows that there is demand in the community to receive the vaccine. But it also highlights the need for a comprehensive communications strategy to ensure all communities have access to accurate and reliable information on the vaccine and the vaccination process.

Other Challenges to Ensuring Equitable Vaccine Uptake

Building vaccine confidence is key, but it is only one piece of the puzzle. As previously mentioned, local health departments have had to navigate the current challenges of low vaccine supply, high demand, and hesitancy with insufficient resources, specifically funding and staff, and a lack of visibility and coordination. These challenges particularly hit our ability to ensure an equitable roll out of the vaccine and reinforce the need for us to focus on those populations who may be harder to reach, but who are also more impacted by the virus.

We need more vaccine in our communities, coordinated access points, strong data systems, enhanced planning across the federal-state-local public health partnership, as well as long term workforce and infrastructure investments.

Inclusion in Strategy and Planning

As local health departments, our role in the community gives us keen insight into what is needed to be successful, and our public health expertise gives us the tools to do so. This ground level expertise is critical to ensure that national and state plans and policies to fight the pandemic can be successful. However, when you look at the national picture, there has been varied engagement of local health department expertise in the state and federal planning. We

must strengthen this partnership to ensure that federal and state response and vaccination planning is informed by local health department expertise.

Workforce

Unfortunately, the work of governmental public health—and local public health in particular—has long been under resourced which has a direct impact on workforce. Local health departments were hit particularly hard by the 2008 recession. In many communities they never recovered, and when COVID-19 emerged our local health departments' network across the country was down 21% of their workforce capacity as a whole.

We have fewer staff serving larger populations with increasingly complex public health challenges to tackle. With these circumstances, local health departments are forced to shift resources from other public health activities to adapt to the demands of emergencies. The pandemic has been no exception. Since the start of the pandemic, local health department staff have been pulled away from other essential areas like food safety, HIV prevention, overdose prevention and response, and immunization. When NACCHO asked last spring how COVID-19 had impacted regular local health department immunization programs and services, most who responded (88%) indicated that they had to reassign their immunization staff to support the response. A number of local health departments (17%) also indicated that they needed to shift money from their regular immunization program budgets to support the response.[3]
While much has changed since the spring, this context is important as the same local health department staff who are responsible for vaccinations and protecting our communities from outbreaks of vaccine-preventable diseases like measles and influenza, were the same staff who were pulled away from those duties to support activities like COVID-19 contact tracing and supporting people who needed to isolate or quarantine. We are now relying on the same people to vaccinate us against COVID-19 and will need more support as vaccines become more widely available. We need a strong focus and investment in restoring jobs in local public health, but also in recruiting top talent and retaining them in the field.

Data

Local health departments also need data. While local health departments have firsthand knowledge of their communities, we need timely, comprehensive and granular data to track where vaccines have been allocated and what populations have been vaccinated, identify which populations are and aren't receiving vaccine, and what areas need to be targeted. This data is critical to doing our work. While some local health departments have access to this information, others have faced challenges with having full visibility. This poses significant challenges for prioritizing resources and vaccine access points, as well as confusion for the public.

Funding

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[3] https://www.naccho.org/blog/articles/report-from-the-field-the-impact-of-covid-19-on-local-health-department-immunization-programs

We are very grateful for Congress' emergency funding and the package passed in December to help support the vaccine roll out and administration. For the vast majority of local health departments, those funds are the first and only that we have/will receive to support this vaccination work, and frankly they are coming months into our vaccine rollout. Those funds have been sent to states who will decide if, how much, and when they will share those resources with local health departments. While the flow of funds has not been as big of a challenge in Texas, I know that some of my colleagues at health departments in other states have had a different experience, and we are hopeful that local health departments across the country will get the resources they need in a timely manner to actually build out their vaccine infrastructure.

Long-term investments

While today's hearing is about COVID-19 vaccine hesitancy, it cannot be understated that this is an issue that was a challenge for public health long before the pandemic and it will likely outlast the pandemic as well. Our efforts to build confidence in vaccines are long-term and continuous, but every day we work on it and build relationships within our community brings us one step closer to getting our population fully vaccinated. It is critical that we maintain a focus on and investments in this work now and after the pandemic to truly improve our nation's vaccine confidence. We can and must learn from these long-term failures to invest as we continue to work through the pandemic and prepare for the next crisis.

Closing

I am proud to serve the Dallas County community where I grew up, and to work with dedicated colleagues each day to address all aspects of the pandemic response. The opportunity that the authorized vaccines provide is incredible, but we can and must do more to address barriers to acceptance and access to achieve our goals in an equitable way. Local health departments across the country work directly with individuals in our communities and are ideally situated to address vaccine hesitancy, combat vaccine misinformation, and increase vaccine confidence. The efforts and lessons learned from local health departments and their community partners in supporting equitable COVID-19 vaccine uptake have the potential to also address vaccine hesitancy, build confidence in routinely-recommended vaccines more broadly, and better protect our nation against future vaccine-preventable diseases.

Thank you again for inviting me to testify today and I look forward to your questions.

Philip Huang, MD, MPH

Dr. Huang has been the Director and Health Authority for the Dallas County Health and Human Services Department since February 2019. Prior to this he served for 11 years as Medical Director and Health Authority for the Austin Public Health department. He received his undergraduate degree in Civil Engineering from Rice University, his MD from the University of Texas Southwestern Medical School, and his Master's in Public Health from Harvard with a concentration in Health Policy and Management. Dr. Huang completed his residency training in Family Medicine at Brackenridge Hospital in Austin, and served two years as an Epidemic Intelligence Service (EIS) officer with the Centers for Disease Control and Prevention assigned to the Illinois Department of Public Health where he conducted epidemiologic studies in chronic disease and infectious disease outbreak investigations. He is currently an Assistant Professor with the University of Texas at Austin, Dell Medical School, and an Adjunct Assistant Professor with the University of Texas School of Public Health, Austin Campus. He has served as Principal Investigator for numerous CDC and State-funded public health cooperative agreements.

Chairwoman JOHNSON. Thank you.

STAFF. Excuse me for a moment, Ms. Johnson. Real quick technical—if you press and hold the spacebar on the computer, that only temporarily unmutes you, and when you release the spacebar, it mutes you back.

Chairwoman JOHNSON. Thank you very much. Now we'll have Mr. Reed.

TESTIMONY OF MR. KEITH REED,
MPH, CPH, DEPUTY COMMISSIONER,
OKLAHOMA STATE DEPARTMENT OF HEALTH

Mr. REED. Madam Chair Johnson and Ranking Member Mr. Lucas, thank you for the opportunity to speak today. My name is Keith Reed, and I'm Deputy Commissioner of Health for the State of Oklahoma. I'm here today to discuss our State's efforts to efficiently distribute and administer the COVID–19 vaccine and how we have addressed issues with uptake, hesitancy, and equitable access, particularly for those in our rural and underserved communities.

To begin, we've been conducting surveys throughout the State to gauge vaccine hesitancy. As of our latest survey in January, we've determined that while most people are willing to receive the vaccine at some point, roughly 33 percent of Oklahomans do not plan to do so. Major reasons for hesitancy are lack of information on the vaccine and its development process and concerns about potential side effects.

In this initial stage of vaccine distribution where demand is greater than supply, we found success in hedging the initial uptake issues by taking an overlapping approach. In order to vaccinate as many Oklahomans as possible, we've opened eligibility to new priority groups before entirely vaccinating earlier groups. With this tactic, we hope to lengthen the window of opportunity for those that might be undecided about vaccination, providing an extended timeframe to build consumer confidence in our program,

To overcome hesitancy and access boundaries, and encourage high vaccine uptake, a few key conditions are needed. One, vaccine supply needs to improve. As we all are well aware, with increases in supply, we can provide more options for appointments, protect more of our vulnerable populations, and increase vaccine eligibility to more Oklahomans.

Two, vaccine access needs to increase. We are working to open up new access points to the vaccine. We currently have approximately 1,500 pandemic providers signed up to participate in vaccine distribution around the State but can only engage a limited number due to supply issues. Getting vaccine to these providers, which include local pharmacies and many primary care providers, enables us to engage the most trusted sources in rural Oklahoma, giving us our best chance for high vaccine uptake.

And three, communication about vaccine safety and availability needs to be clear, and it needs to be consistent. We've been using a diverse network of communication partners to make sure that communication with Oklahomans about the vaccine is consistent, transparent, and accessible to everyone. We hold virtual media events twice weekly to provide updates to the public and partner

with our local health departments to keep the lines of communication open so Oklahomans are informed on a daily basis. We work closely with regional health directors, family health departments, and other local partners to reach communities across the State. These partnerships are critical in determining the best communications approach for their local constituents as they understand what will resonate in their respective areas. We use social media and our website to provide timely, regular updates on the vaccine. Information is shared online and with partners across the State. Above all, we're ensuring that our communications across the board are clear and factual. Our top priority is to give Oklahomans the tools to make the—an informed decision about the COVID–19 vaccine. This requires regular, repeated, and reliable communication that is honest and direct in its approach.

Oklahoma's unique landscape poses a particular set of challenges. Many of our community members lack internet access, particularly in rural areas with limited reception, or they lack digital literacy, particularly in our 65-plus community, who are some of the most at risk for COVID–19.

People in underserved or rural communities have expressed higher rates of distrust in vaccines in general. Many people of color are wary of vaccines due to a history of medical mistreatment. There is a fear of being targeted due to immigration status or disclosure of race or ethnicity.

This is also, of course—there is also, of course, general misinformation about COVID–19, leading to skepticism of the actual risk posed by COVID–19 or even skepticism that the virus exists at all. This misinformation is perpetuated on social media where it can have an exaggerated and local influence.

Our goal with vaccine rollout is to address these concerns in a clear and compassionate way. We found that our partnerships with local entities have been invaluable in contributing to a much smoother rollout process and ensuring everyone's health and safety when they receive the vaccine.

In Oklahoma, our surveys and experiences on the ground have shown us that two things are sorely needed: clear, accurate information about vaccine safety and efficacy, and increase vaccine accessibility to ensure equity.

Thank you again to Chair Johnson and Ranking Member Representative Lucas for the opportunity to provide this testimony here in such a critical moment in our Nation's history. I hope you find this testimony helpful in your endeavors, and I'll be happy to address any further questions regarding Oklahoma's experience with the rollout of COVID–19 vaccine.

[The prepared statement of Mr. Reed follows:]

Federal Testimony for Feb. 19, 2021
Submission due date: Feb. 17

Madam Chair Johnson and Ranking Member Mr. Lucas, thank you for the opportunity to speak today. My name is Keith Reed, and I am Deputy Commissioner of Health for the state of Oklahoma. I am here today representing the Oklahoma State Department of Health to discuss our state's efforts to efficiently distribute and administer the COVID-19 vaccine, and how we have addressed issues with uptake, hesitancy and equitable access — particularly for those in our rural and underserved communities.

Summary of what I am seeing on the ground regarding vaccine uptake and hesitancy:

To begin, we've been conducting surveys throughout the state to gauge vaccine hesitancy and dig into exactly why people might be hesitant to take the COVID-19 vaccine. As of our latest survey in January, we've determined that while most people are willing to receive the vaccine at some point, roughly 33% of Oklahomans don't plan to do so. Our surveys so far have indicated that the major reasons for hesitancy are lack of information on the vaccine and its development process, and concerns about potential side effects — so our communications and community outreach efforts have targeted these concerns specifically. It's also important for us to acknowledge there is vaccine hesitancy in communities of color because of a history of medical mistreatment.

In this initial stage of vaccine distribution where demand is greater than supply, we've found success in hedging the initial uptake issues by taking an overlapping approach. In order to vaccinate as many Oklahomans as possible, we've opened eligibility to new priority groups before entirely vaccinating earlier groups. Additionally, in order to avoid excess waste, we have empowered our local providers to take a flexible approach to distribution in their communities. With this tactic, we hope to lengthen the window of opportunity for those that might be undecided about vaccination, providing an extended time frame to build consumer confidence in our program.

Vaccine administration conditions and logistics needed to support high levels of vaccine uptake:

To overcome hesitancy and access boundaries and encourage high vaccine uptake, a few key conditions are needed:

- One - Vaccine supply needs to increase. As we are all well aware, with increases in supply, we can provide more options for appointments, protect more of our vulnerable populations and increase vaccine eligibility to more Oklahomans. We're working closely with the federal government as more vaccine becomes available to distribute it as efficiently as possible.
- Two - Vaccine availability needs to increase. We are working with county health departments and pandemic providers across the state to open up new access points to the vaccine. We currently have approximately 1,500 pandemic providers signed up to

participate in vaccine distribution around the state, but can only engage a limited number due to supply issues. Getting vaccine to these providers, which include local pharmacies and many primary care providers, enables us to engage the most trusted sources in rural Oklahoma, giving us our best chance for high vaccine uptake.

- And three - Communication about vaccine safety and availability needs to be clear and consistent.

Oklahoma State Department of Health's public outreach campaign for COVID-19 vaccine awareness:

We've been using a diverse network of communication partners to make sure that communication with Oklahomans about the vaccine is consistent, transparent and accessible to everyone.

We hold virtual media events twice weekly to provide updates to the public and partner with our local health reporters to keep lines of communication open so Oklahomans are informed on a daily basis.

We also use paid radio and television advertising to reach target communities, particularly in rural areas with limited internet access and audiences with higher hesitancy rates.

We work closely with regional health directors, county health departments and other local partners to reach communities across the state. These partnerships are critical in determining the best communications approach for their local constituents, as they understand what will resonate in their respective areas.

We use social media and our website to provide timely, regular updates on the vaccine. Information is shared online and with partners across the state in English, Spanish and Vietnamese whenever possible.

Above all, we're ensuring that our communications across the board are clear and factual. Our top priority is to give Oklahomans the tools to make an informed decision about the COVID-19 vaccine. This requires regular, repeated and reliable communication that is honest and direct in its approach.

Unique challenges facing rural and underserved communities during the COVID-19 pandemic:

Oklahoma's unique landscape poses a particular set of challenges in serving rural and underserved communities during COVID-19.

Many of our community members lack internet access, particularly in rural areas with limited reception, or lack digital literacy, particularly in our 65+ community who are some of the most at-risk for COVID-19. This has been difficult to navigate as the state implemented an online

scheduling tool as the main public health avenue for appointment accessibility. Distributing the vaccine to rural areas with adequate cold storage for the Pfizer vaccine has also posed a challenge.

People in underserved communities have expressed higher rates of distrust in vaccines in general. As I mentioned previously, many people of color are wary of vaccines due to a history of medical mistreatment. There is also a fear of being targeted due to immigration status or disclosure of race or ethnicity.

There is also, of course, general misinformation about COVID-19 — leading to skepticism of the actual risks posed by COVID-19 or even skepticism that the virus exists at all. This misinformation is perpetuated on social media where it can have an exaggerated local influence.

There are a lot of reasons for vaccine hesitancy, and most of them are rooted in very valid concerns. Our goal with vaccine rollout is to address these concerns in a clear and compassionate way. We've found our partnerships with local entities have been invaluable in contributing to a much smoother rollout process and ensuring everyone's health, safety and privacy when they receive the vaccine.

Research, innovation, or data needed to advance public acceptance of vaccines, process improvements for vaccine administration, and improve health equity in vaccination:

In Oklahoma, our surveys and experiences on the ground have shown us that two things are sorely needed: Clear, accurate information about vaccine safety and efficacy, and increased vaccine accessibility to ensure equity.

Through the dissemination of transparent data and information, people who are undecided about the vaccine are better equipped to make an informed decision and overall feel more empowered about their choice.

We're working every day to improve access through targeted events, communications and more local partnerships to make sure every Oklahoman who wants or needs the vaccine is able to access it.

Thank you again to Madam Chair Johnson and Ranking Member Rep. Lucas for the opportunity to provide this testimony during such a critical moment in our nation's history. I hope you find this testimony helpful in your endeavors, and I will be happy to address any further questions regarding Oklahoma's experience with the rollout of the COVID-19 vaccine.

BIO
Keith Reed, RN, MPH, CPH

Keith Reed has worked for the State of Oklahoma for 24 years, the past 19 with the Oklahoma State Department of Health. While with OSDH, Keith has served in multiple positions within the agency, and currently serves as the Deputy Commissioner for Community Health Services. He obtained his Bachelor of Science in Nursing from Oklahoma's Northeastern State University and a Masters of Public Health degree from the University of Oklahoma. In addition to his public health career, Keith is also a Colonel in the Oklahoma Air National Guard, serving multiple tours in support of Operations Iraqi and Enduring Freedom. He is currently assigned as Commander, 137th Special Operations Medical Group, Will Rogers Air National Guard Base, Oklahoma City.

Chairwoman JOHNSON. Thank you very much, Mr. Reed.
We will now hear from Dr. Buttenheim.

TESTIMONY OF DR. ALISON BUTTENHEIM, PHD, MBA, SCIENTIFIC DIRECTOR, CENTER FOR HEALTH INCENTIVES AND BEHAVIORAL ECONOMICS AND ASSOCIATE PROFESSOR OF NURSING AND HEALTH POLICY, UNIVERSITY OF PENNSYLVANIA SCHOOL OF NURSING

Dr. BUTTENHEIM. Thank you. And good afternoon, Madam Chair, Ranking Member Lucas, and Members of the Committee. I am Alison Buttenheim. I'm an Associate Professor of Nursing and Health Policy at the University of Pennsylvania School of Nursing, and I'm a behavioral scientist who studies vaccine acceptance and vaccine hesitancy.

As Chairwoman Johnson mentioned, I had the honor of serving last year on the National Academies Committee on the Equitable Allocation of the COVID–19 Vaccine, and as part of that effort, recently co-authored another National Academies report entitled "Strategies for Building Confidence in the COVID–19 Vaccines," on which my written testimony was based. That report is chockful of very specific communication and engagement strategies to address hesitancy and ensure demand for our truly amazing COVID vaccines. We hope it will be a helpful guide to public health agencies at all levels working on vaccine rollout.

In my very brief time with you today, I'd like to expand on that report and share some additional insights and evidence that can further guide us as we tackle the last-mile challenge of getting shots in arms. Here are five science-based solutions that I hope Congress can endorse, fund, and promote.

No. 1, embrace the dual goal of vaccinating efficiently and equitably. This recently has been framed as sort of a false choice or an either/or with people saying that we can either be fast or be fair with vaccine rollout. We have the science to do both, but we have to be deliberate, intentional, and innovative in our approach to both tracking and achieving those complementary goals.

No. 2, fix the easy stuff. Hesitancy is definitely a barrier to vaccination, and I look forward to talking about that, but so are hassle factors. Even people who are motivated and excited about the vaccine can be deterred by the smallest amount of friction in the system, whether that's complex logistics, inconvenience, or confusing instructions. Making and keeping a vaccination appointment should be easy and hassle-free, and frankly, fixing those hassle factors is often easier than changing someone's mind.

No. 3, keep doing the hard stuff even if it doesn't scale. There are a lot of people with very legitimate concerns about the speed of vaccine development, diversity of trial participants, or trust in the medical research establishment. What's emerging as the most effective way to help those folks is sustained, repeated, one-on-one conversations with trusted peers or vaccine validators. Now, you can't bake that kind of engagement into a chat bot or a website FAQ (frequently asked questions) or a message on the side of a bus or even a TikTok video. We have to stand up and support those time-intensive interventions and get them to the people who need them even if they don't scale.

No. 4, use fun and delight. As Cass Sunstein has said, there's a deep human need to smile and laugh, and we can leverage that need through evidence-based messaging and promotions that exceeds people's expectations about the vaccine and about getting vaccinated in surprising ways. One example that I hope you've all seen is the "Sleeves Up, NOLA" public service announcement from New Orleans. If you haven't seen it yet, watch it right after the hearing today. It's on YouTube. I'll send you a link. It's a truly fantastic example of that idea of leveraging fun and delight.

Last, No. 5, fail fast, learn fast. Behavioral science advances in much the same way that lab science does. We generate hypotheses about an effective intervention, and then we test those hypotheses via experiments. We need to bring the same speed and rigor to vaccine acceptance research that we brought to vaccine development research so we can get it right in real time and also learn for next time because this is not our last rodeo. Both immediate and long-term investments in behavioral science research are needed.

So to recap, we can be fast and fair. We should address hassle barriers to vaccination in addition to hesitancy barriers. Some of our most effective strategies won't scale, and that's OK. Fun is effective, and learning what works is critical.

I want to thank the Committee for your time today and for your commitment to a science-driven vaccine rollout.

[The prepared statement of Dr. Buttenheim follows:]

COVID-19 VACCINE HESITANCY AND STRATEGIES FOR BUILDING VACCINE CONFIDENCE IN THE COVID-19 VACCINES

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STRATEGIES FOR BUILDING VACCINE CONFIDENCE IN THE COVID-19 VACCINES

This written testimony is excerpted from "**STRATEGIES FOR BUILDING CONFIDENCE IN THE COVID-19 VACCINES",** a February 2021 rapid expert consultation report produced through the Societal Experts Action Network (SEAN), an activity of the National Academies of Sciences, Engineering, and Medicine that is sponsored by the National Science Foundation and the Alfred P. Sloan Foundation. SEAN links researchers in the social, behavioral, and economic sciences with decision makers to respond to policy questions arising from the COVID-19 pandemic.

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UNDERSTANDING COVID-19 VACCINE HESITANCY

Ensuring strong demand for and promoting acceptance of the COVID-19 vaccines is critical to achieving herd immunity, protecting the most vulnerable populations, and reopening social and economic life (NASEM, 2020a). This rapid expert consultation is intended to assist decision makers in building public confidence in the COVID-19 vaccines and in communicating with the public about the vaccination process and rollout by highlighting strategies for public engagement and message delivery to ensure demand and promote acceptance.[1] While it does not outline a national vaccine marketing strategy, the principles and strategies outlined herein will be critical in the design of such a campaign.

Evidence from the behavioral, psychological, and social sciences demonstrates that people's motivations—their readiness, willingness, intention, or hesitancy—are informed by the information they process; by how they think and feel (their perceived risk, worry, confidence, trust, and safety concerns); and by social processes (recommendations from health care providers, social norms, gender norms, equity, and information processing and sharing). Evidence from anthropology indicates that individuals' motivations are further influenced by cultural understandings of the body, disease, and appropriate types of health care. Motivations can also be influenced by perceptions and beliefs about equitable allocation, distribution, and delivery of services as early vaccination programs roll out. Research from New Jersey's and

[1] A number of other organizations and agencies have produced guidance on this issue, and those references may also be of use to state and local decision makers. See, for example, "Language That Works to Improve Vaccine Acceptance Communications Cheat Sheet" (www.changingthecovidconversation.org) (accessed January 19, 2021); "COVID-19 Vaccination Communications Toolkit" (https://www.cdc.gov/vaccines/covid-19/health-systems-communication-toolkit.html) (accessed January 19, 2021); and "A Communicator's Tip Sheet for COVID-19 Vaccination" (https://obssr.od.nih.gov/wp-content/uploads/2020/12/COVIDTipSheet_Final.pdf) (accessed January 19, 2021).

Rhode Island's COVID-19 testing programs, for example, showed that customer experience challenges at point-of-care testing sites deterred some individuals intending to receive a COVID-19 diagnostic test and discouraged others from repeat testing (Policy Lab et al., 2020). Motivations thus formed interact with practical considerations (e.g., vaccine availability, costs, service quality) to determine vaccination uptake (Brewer et al., 2017).

Of course, context is also important. In particular, it is critical that the efforts of trusted messengers be coordinated. The public has already been receiving information about the COVID-19 vaccines and vaccination efforts from multiple sources, including state and local government entities, local news and community channels, physicians, and employers, among others. The messaging from these sources can be conflicting, which helps to undermine vaccine confidence and trust in public health authorities. Therefore, efforts to influence the shape of public discussion of vaccine issues may be as important as any direct persuasive communication.

Moreover, the pandemic conditions are dynamic and will continue to change as distribution of the COVID-19 vaccines continues and evolves, and ongoing monitoring of beliefs and attitudes will be needed so that messaging can be adjusted as the vaccines become widely available. The ways in which the principles described herein are operationalized will vary based on local context, so that ongoing testing of messages to learn which work best may be needed to optimize communication efforts. Dedicating more resources and technical assistance to local efforts in conjunction with national campaigns could support rapid learning and ultimately increase vaccine acceptance at the community level.

The public's opinions on vaccination fall along a continuum, ranging from those who fully accept vaccines, to those who are vaccine hesitant (two groups that collectively represent the majority of the population), to those strongly or unequivocally opposed to vaccination (a very

small minority of the population). It is the middle group that is most likely to respond positively to intervention (Gust et al., 2008a, 2008b). Previous research has found that communications focused on reaching those who are hesitant rather than those firmly opposed to vaccination will be most effective at increasing uptake (NASEM, 2020b), while focusing on those firmly opposed to vaccination will exaggerate and may contribute to the problem.

Since the first COVID-19 vaccine was authorized in December 2020 in the United States, public confidence in COVID-19 vaccines has risen relative to reported attitudes regarding a hypothetical vaccine in early 2020 (Hamel et al., 2020). Hesitant individuals are not a monolithic group, and hesitancy is not static. Much of the existing hesitancy regarding COVID-19 vaccination revolves around a desire to wait and see how others will respond physically to being vaccinated, as well as technical questions related to the vaccine's safety and efficacy (e.g., "Should I get the vaccine if I'm pregnant?"), which in some cases are accompanied by mistrust of medicine, public health, and government.

The desire to "wait and see" is not unique to the COVID-19 vaccination experience. Research on H1N1 vaccine uptake in 2009–2010 shows that, at least in some populations, concerns about the new vaccine affected confidence in the vaccine (Hausman et al., 2020). Although the H1N1 vaccine was approved through the standard FDA process, there were initial concerns that it could have been released under the Emergency Use Authorization mechanism. Quinn and colleagues (2009) found that in that case, intent to take such a vaccine was extremely low, with African Americans being the most reluctant. The phased rollout of available COVID-19 vaccines, all authorized under the EUA mechanism, may provide an opportunity for responding to hesitancy in this respect: officials can make safety and effectiveness data transparent and accessible, especially as additional vaccines are authorized. Acknowledging

people's uncertainty and their desire for more data becomes possible as vaccination programs continue.

Specific concerns among those who are vaccine hesitant vary widely, although they tend to cluster geographically and/or culturally. Mistrust of a vaccine in communities of color is of particular concern given that ethnic and racial minority groups in the United States have been disproportionately harmed by the pandemic: individuals from Black, Hispanic, and American Indian/Alaska Native communities all have experienced COVID-19 mortality rates nearly three times higher than the rate among White individuals, as well as higher rates of hospitalization due to the disease. These groups are also more likely to have underlying conditions that place them at higher risk for severe outcomes and complications related to the virus (CDC, 2020a, 2020b).

Mistrust of a vaccine in communities of color is grounded in current experience with structural inequities that permeate public health, medicine, and social services in the United States. Beyond a system that is not reliably trustworthy for many populations, a painful legacy of health care discrimination, medical research exploitation, and unconsented experimentation on Black, American Indian/Alaska Native, Latinx, and other communities that have experienced racism has contributed to justified distrust of government-sponsored medical research and resultant reluctance to become vaccinated (Frakt, 2020; Gamble, 1997; Hoffman, 2020; NASEM, 2020a).[2] This distrust will not be easy to overcome, but the glaring racial and ethnic disparities in the impact of the pandemic will only worsen if decision makers fail to address it.

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[2]"Examples include the infamous Tuskegee study—in which hundreds of Black men in Alabama were lied to about being treated for syphilis while the disease was allowed to run its course; the Edmonston-Zagreb vaccine trial, during which parents of immunized infants (mostly Black and Latinx) were not informed that the vaccine used was an unapproved experimental vaccine; and less well known but equally abhorrent instances of unconsented sterilization of Latinx and American Indian and Alaska Native women (Carpio, 2004; Gamble, 1997; University of Wisconsin, 2018). This legacy leaves many communities of color wary of participation in medical research, suspicious of initiatives to engage them in health promotion or surveillance efforts, and, in many cases, reluctant to become vaccinated (Hoffman, 2020)" (NASEM, 2020a, p. 190).

STRATEGIES FOR PUBLIC ENGAGEMENT TO COMBAT MISTRUST AND BUILD CONFIDENCE IN THE COVID-19 VACCINES

BOX 1
Six Strategies for Engaging Communities to Combat Mistrust and Build Public Confidence in COVID-19 Vaccines

1. Form Partnerships with Community Organizations
2. Engage with and Center the Voices and Perspectives of Trusted Messengers Who Have Roots in the Community
3. Engage across Multiple, Accessible Channels
4. Begin or Continue Working toward Racial Equity
5. Allow and Encourage Public Ownership of COVID-19 Vaccination
6. Measure and Communicate Inequities in Vaccine Distribution

Public engagement is critical to overcoming mistrust and building confidence in the COVID-19 vaccines. Public engagement is more likely to be impactful (and build trust beyond COVID-19 vaccination programs) if the process is established and designed so that public values (ascertained through engagement) can be translated into practice and policy. Public health practitioners—if given the necessary resources—can create a strong infrastructure that helps earn community trust by building relationships that encompass organizing for policy change, providing accessible COVID-19 testing and treatment, listening to the needs of communities, addressing the structural factors that create greater exposure to and poorer treatment for COVID-19, and ensuring the equitable allocation of vaccines. This section summarizes six public engagement strategies designed to combat mistrust and build confidence in the COVID-19 vaccines.

1. *Form Partnerships with Community Organizations*

Partnerships with community organizations that have strong existing community relationships are critical. These organizations are close to their audiences; know how to tailor information to those audiences effectively; and, most important, have trusted leaders who can be effective spokespersons. Research shows that credible partnerships require early two-way dialogue to establish trust and build a shared vision for addressing a problem, citizen involvement in the decision-making process, and sharing of information in a way that is understandable and responsive to local needs (NASEM, 2020a; Quinn et al., 2020). A good example is a communication planning strategy for building partnerships at a New Jersey environmental agency, which included the following steps: identify the issue; set goals; know the issue, audience, and constraints; assess audiences; identify messages and methods; implement a communication strategy; and evaluate, debrief, and follow up (Pflugh et al., 1992). Local governments thus could utilize or leverage existing relationships, social capital, and resources to build vaccine confidence. Potential partners might include faith-based networks, existing community health worker programs, or local advocacy and activism groups (e.g., organizers of get-out-the-vote efforts or the census, or neighborhood coalitions formed to improve walkability or green spaces).

2. *Engage with and Center the Voices and Perspectives of Trusted Messengers Who Have Roots in the Community*

Evidence suggests that efforts to counter vaccine hesitancy and promote vaccination need to emphasize putting "people at the center" of those efforts (Schoch-Spana et al., 2020). Research has highlighted the potential effectiveness of dialogue-based interventions, including social mobilization and engagement with community leaders and trusted community

representatives, as well as the importance of community involvement in creating, adjusting, and implementing these solutions to ensure adequate buy-in and trust (Dubé et al., 2015; Jarrett et al., 2015; NASEM, 2020a). Social media or advertising campaigns encouraging community members to share why they choose to get vaccinated—such as the "whatsyourwhy" factor and "blackwhysmatter" social media hashtags—can be persuasive.

Central to this strategy is developing long-term relationships with trusted community members—a process that takes time but is essential. If such relationships are not already in place, local health departments can begin by listening to community members' concerns and providing support and resources to ensure that they have culturally appropriate information about the vaccines and, most critically, equitable access to vaccination.

3. *Engage across Multiple, Accessible Channels*

Community engagement will need to occur across a variety of channels well suited to reaching vulnerable populations, including people who cannot attend public meetings (e.g., because they work, live remotely, are incarcerated, or are undocumented), who have limited broadband service, who speak languages other than English, or who cannot use written text (NASEM, 2020a). Determining which channels are most appropriate for particular populations is essential. State and local leaders can choose to communicate through town hall meetings, special community events, or faith-based gatherings.

4. *Begin or Continue Working toward Racial Equity*

Public engagement around vaccination, particularly with communities of color, needs to begin with acknowledgment of existing inequities. A health department could, for example,

garner supporters and allies—and elevate racial equity—by recognizing how systemic racism has disadvantaged these communities and explaining how the department is working to create health for all communities.

Talking about vaccines in isolation risks reinforcing deeply held beliefs that health (or ill health) is purely a matter of individual behaviors (such as choosing to get vaccinated) and obscuring the broader structural factors—such as housing, jobs, and health care access—that also impact health. It is critical for authorities to acknowledge these broader shortcomings in health equity, to frame the COVID-19 vaccines as one of several tools that can help advance equity in communities most affected by the pandemic, and to reassure those communities that this type of work will continue beyond the pandemic. The pandemic has exposed myriad health disparities, and public health policies and action, including vaccination, need to reflect a deeper commitment to equity (Berkowitz et al., 2020).

An example of such an effort is the Bay Area Regional Health Inequities Initiative, a coalition of health departments and community partners in California's Bay Area focused explicitly on the advancement of health equity, racial justice, and economic opportunity. The group works across nine counties and has recently focused its efforts on COVID-19 response while continuing to highlight the importance of broader social determinants of health in shaping community health outcomes, particularly among communities of color (Bay Area Regional Health Inequities Initiative, 2020; Kritz, 2020).

5. *Allow and Encourage Public Ownership of COVID-19 Vaccination*

As noted earlier, while trust is critical to vaccine acceptance, trust in public health is low within some populations, including many communities of color. Public ownership of COVID-19

vaccination through public oversight and community engagement can inspire greater confidence in COVID-19 vaccination. Best practices for public ownership include actively seeking engagement with the public, listening to feedback and adapting accordingly, establishing local public oversight committees, and implementing bottom-up approaches with community members leading solutions. Research has also highlighted the benefits of public ownership of vaccination through governance structures that involve community members, noting the potential for those mechanisms to drive trust and improve access (Schoch-Spana et al., 2020). Also beneficial is emphasizing vaccination as a public good (e.g., "I am doing this because my vaccination helps the community at large, and I care about my fellow citizens").

6. *Measure and Communicate Inequities in Vaccine Distribution*

Real-time measurement of inequities in vaccine distribution and communication of those findings to the public is critical to building trust. Communities could disaggregate vaccine distribution across the 15 factors that make up the Centers for Disease Control and Prevention's (CDC's) Social Vulnerability Index and publish that information on public dashboards, for example. Decision makers will need to monitor this information and work with community leaders to implement solutions as inequities arise.

BOX 2
Nine Communication Strategies for Ensuring Demand for and Promoting Acceptance of COVID-19 Vaccines

1. Meet People Where They Are, and Don't Try to Persuade Everyone
2. Avoid Repeating False Claims
3. Tailor Messages to Specific Audiences
4. Adapt Messaging as Circumstances Change
5. Respond to Adverse Events in a Transparent, Timely Manner
6. Identify Trusted Messengers to Deliver Messages
7. Emphasize Support for Vaccination Instead of Focusing on Naysayers
8. Leverage Trusted Vaccine Endorsers
9. Pay Attention to Delivery Details That Also Convey Information

There is no single solution to vaccine hesitancy. Rather, multiple nuanced approaches are key to ensuring that those who are hesitant do not evolve to outright vaccine refusal and that existing health inequities are addressed. This section summarizes nine best practices for communication strategies designed to build confidence in the COVID-19 vaccines.

1. *Meet People Where They Are, and Don't Try to Persuade Everyone*

Models identifying stages of behavior change suggest that information and resource needs differ for people who are "considering" a particular self-protective action, such as vaccination (Why should I adopt it?) versus those who have decided to take the action (How do I go about doing it?). Thus, it is important to develop different messages for those who are willing to be vaccinated and need information on how to do so and those who are hesitant but open to learning more. Moreover, trying to persuade those who are completely opposed to vaccination is not a wise use of resources (Public Health Institute, 2020), especially given that, as noted earlier,

most people who are unwilling to get vaccinated immediately can be considered hesitant or skeptical, with just a small portion of the population being absolutely opposed to vaccination (Bruine de Bruin et al., 2019).

Research on COVID-19 vaccination, and routine vaccination more broadly, emphasizes the importance of empathy as key to interacting with those who may be vaccine hesitant or skeptical, including through such techniques as motivational interviewing between providers and patients (Ferreri, 2020; Gagneur, 2020; Martin, 2021; Maurici et al., 2019). For these exchanges, it is important to use such phrasing as, "I understand that you might have questions about the vaccine, and I'm here to answer them as best I can…."

2. *Avoid Repeating False Claims*

Correcting information that is inconsistent with scientific evidence is difficult under most circumstances (Cook and Lewandowsky, 2011; Lewandowsky et al., 2012; NASEM, 2017). It should be noted, moreover, that repeating false claims and misinformation risks inadvertently amplifying and strengthening that information. Occasionally, however, public health practitioners may have to address false claims (Ecker et al., 2017). In these situations, it is important to warn recipients before confronting them with the false information (e.g., "The following claim is misleading…") and to emphasize the facts over the misinformation (MacFarlane and Rocha, 2020). Practitioners can also use a pivot approach to avoid addressing and correcting false claims and misinformation directly, instead diverting the listener to consider concerns about the risk of disease (Omer et al., 2017). According to MacFarlane and Rocha (2020), additional strategies for debunking misinformation and overcoming its effects include preemptively explaining flawed arguments, using visual representations to increase data

comprehension (Dixon et al., 2015), and providing alternative explanations of the debunked phenomenon (e.g., that purveyors of misinformation are interested in selling different remedies or support a political ideology) (Ecker et al., 2010).

The nation's polarized media environment also means that people are receiving very different messaging about the pandemic, and at the same time, the spread of information has become more "bottom-up" than "top-down." Evidence indicates that, instead of treating skeptics as the "other" and adopting a "those people" attitude toward vaccine-hesitant individuals, it is best to adopt an approach that encourages empathy (Hausman, 2020).

3. *Tailor Messages to Specific Audiences*

Messages will be received differently by different groups. To be effective, communication about the COVID-19 vaccines needs to reflect an understanding of the targeted audience, including their concerns and motivations and whom they trust. It is essential to recognize that the information needs of diverse audiences may or may not match communicators' assumptions about those needs. If the audience does not deem the information provided to be relevant or responsive to their information needs, they will ignore it.

Successful communication strategies therefore emphasize population segmentation, recognizing the need to develop different strategies for different subgroups, as characterized by epidemiological, psychographic, and demographic variables. Effective communication will use appropriate approaches to reach vaccine-hesitant audiences that differ by age, gender identity, marriage status, education level, refugee and immigration status, health behaviors/norms, and race and ethnicity, as well as the socially marginalized. Survey data can provide information relevant to target audiences, such as existing beliefs and content to avoid, which can inform

development of the messages they receive (see, e.g., Amin et al., 2017; Parvanta et al., 2013; Rutjens et al., 2018). Data from qualitative studies that rely on first-hand explanations can also be used to develop messages that will resonate with particular audiences.

It is important as well to consider tailored messaging needs down to the individual level, including through such strategies as the aforementioned motivational interviewing (Gagneur, 2020), despite the anticipated difficulty of widespread scale-up of such strategies. For example, messaging that explains why the COVID-19 vaccines cannot alter DNA might cause more harm than good if disseminated widely to an audience not already concerned about this misconception. However, particular individuals may benefit from hearing this message or others like it. This example highlights the importance of tailored individual conversations rather than broadly disseminated communications in certain contexts.

4. *Adapt Messaging as Circumstances Change*

Adaptive messaging is a core tenet of communication during the response to an infectious disease outbreak (Tumpey et al., 2018). Accordingly, what influences people's decisions is likely to shift as vaccine distribution goes forward, reflecting both individual experiences and months of media coverage. Ultimately, communication themes being emphasized today may be inappropriate or incomplete in several months as circumstances change, and campaigns will be forced to adapt accordingly. Recognition of the dynamism of COVID-19 vaccine hesitancy is key to the construction of effective communication strategies, which must mirror the dynamism of beliefs. Therefore, constant research to monitor and understand the addressable influences on vaccine confidence over time will be essential, as will feedback mechanisms to ensure that this information is used to inform planning processes. Rapid research methods will be needed to

identify relevant priorities, appropriate message formats, trusted messengers, and appropriate message frequency, along with funding to support this research (Schoch-Spana et al., 2020).

5. *Respond to Adverse Events in a Transparent, Timely Manner*

As vaccination becomes more common, people's experiences with the COVID-19 vaccines will become known. While the vaccines often cause mild and transitory side effects, serious adverse reactions are exceedingly rare (CDC, 2021; n.d.). The rarity of adverse events is not always appreciated, however, as such events are often disproportionately reported in the news media and spread widely on social media. Moreover, serious medical events may occur coincidentally soon after vaccination and be perceived as related to the vaccine (Salmon, 2020). It is important to communicate information about adverse events in a timely and transparent manner and to help people understand what is known, what is unknown, and what should be done. In addition, postvaccination surveillance is essential to identify rare adverse outcomes that may be vaccine related. Taking this approach will help mitigate concerns about safety, side effects, and adverse events moving forward.

6. *Identify Trusted Messengers to Deliver Messages*

Messages about a new COVID-19 vaccine will be novel to all target audiences. Trust in the person or institution that delivers a message, built over previous years, will boost its credibility. Different groups may have different trusted messengers and preferred mediums and channels. Decision makers can identify groups that represent trust gaps in their community and trusted sources within and outside their organization who can convey public health messages to those groups.

7. *Emphasize Support for Vaccination Instead of Focusing on Naysayers*

Research shows that people look to their peers for cues about how to behave in a wide range of areas, from voting to savings (Brunson, 2013; Schultz et al., 2007). Accordingly, making vaccine uptake visible will encourage a social norming of COVID-19 vaccine acceptance. Early on, one approach is to emphasize *increasing* support for vaccination as uptake increases, thus initiating a virtuous cycle. Just as voters receive "I voted" stickers after casting their ballots, vaccine distribution sites could provide "I got vaccinated" stickers, or encourage people to text their friends and family or post on social media that they received the vaccine (Milkman, 2020). Likewise, state and local jurisdictions could create publicly available dashboards with real-time data about the doses of vaccine administered in their communities or highlight evidence of community demand for vaccination (e.g., through news stories about people seeking vaccination).

8. *Leverage Trusted Vaccine Endorsers*

The immunization of thought leaders, community champions, and celebrities could help encourage members of the public to be vaccinated (Freed et al., 2011; Hoffman et al., 2017; Najera, 2019). Such vaccine promotion messengers should be relatable, trusted, and credible, and their messages should be consistent (Tumpey et al., 2018). This strategy could be paired with strategy 1 above.

A particularly effective way to implement this strategy could be to partner with people who have strong existing popular or community relationships with experts, adapting messages as needed. Examples of this approach include NBA star Stephen Curry's hosting Dr. Anthony Fauci

on his video series and national vaccine experts participating in local town hall meetings. Likewise, in Baltimore, public health experts and researchers have partnered with faith leaders in the Black community to reach out to and educate community members about both COVID-19 and influenza (Sokolow, 2020), an approach that could be adapted elsewhere. And in Prince George's County, Maryland, a long-time partnership involving the Maryland Center for Health Equity has focused on having local health care providers talk about the vaccine with barbers and stylists to shift them toward vaccine acceptance, the idea being that these individuals can help clarify misinformation and set social norms in their community.

9. *Pay Attention to Delivery Details That Also Convey Information*

Trust in a vaccination program may be undermined if the user experience with enrolling and getting vaccinated is poor. If exposed to reports of online sign-up portals crashing, dirty clinic sites, or long wait times, for example, people may infer that the vaccine itself is also faulty.

CONCLUSION

Public engagement and messaging are critical to addressing the issues discussed herein to promote public confidence and trust in the COVID-19 vaccines. Given the prevalence of local concerns and information needs, it is important to support local communities by providing the resources they need to engage community members and reinforce accurate, clear information. Accessible, consistent, and transparent communication is crucial to converting hesitancy about vaccination to acceptance. Strong community engagement to identify and understand concerns will help in determining what messaging, delivered by whom, will be most effective.

Everyone—employers, health care providers, faith leaders, elected leaders, and public

health officials—has a role to play. All strategies for increasing vaccine confidence need to take into account that vaccine decision making is part of a nuanced ecological model in which individual beliefs and behaviors are influenced by experiences at the community, organizational, and policy levels. As the COVID-19 vaccination campaign continues, it will be important to employ a coordinated approach that is supported at the federal and state levels and invests in local resources, expertise, and involvement. A variety of strategies at the national, state, and local levels will be required to change the pattern of interactions with the public, address vaccine hesitancy, build trust, and ultimately ensure a successful COVID-19 vaccination campaign.

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Alison M. Buttenheim, PhD MBA

Alison Buttenheim is Associate Professor of Nursing and Health Policy at the University of Pennsylvania. Dr. Buttenheim is a leading expert on the application of behavioral economics to infectious disease prevention generally, and to vaccine acceptance specifically. Recent research has focused on vaccine exemption policy in the US, HIV prevention in South Africa, and zoonotic disease prevention in Peru. She is Scientific Director of Penn's Center for Health Incentives and Behavioral Economics, as well as Director of Engagement at the Leonard Davis Institute of Health Economics at the University of Pennsylvania. She was appointed to the National Academies of Sciences, Engineering and Medicine's Framework Committee on the Equitable Allocation of the Novel Coronavirus Vaccine, and is a Commissioner on the Lancet Commission on Vaccine Refusal, Acceptance, and Demand in the United States. Dr. Buttenheim holds a Ph.D. in Public Health from the University of California, Los Angeles, and an MBA from the Stanford University Graduate School of Business.

Chairwoman JOHNSON. Thank you so very much. That completes the formal testimony of our witnesses, and now we will start our question-and-answer period. The Chair will recognize herself now for 5 minutes. And I'll start with Dr. Huang.

Let me first thank you again for being here with us today, and I'm glad that your family is safe and I hope you have power.

I toured the vaccination hub at the Kay Bailey Hutchison Convention Center in Dallas a couple of weeks ago, and I really was pleased to see how smoothly the operations are going. I attended the other one, but it was after the vaccines had run out, so it was not operational at Fair Park, so I commend all of the health professionals who are working tirelessly to get people their shots and the volunteers who are assisting.

You said in your testimony that reducing logistical barriers for patients is a big factor in encouraging vaccine uptake. Making it easy to register for a vaccine is one example. If you could advise the rest of the vaccine administrators in the United States about two or three specific strategies to deploy in making things easier, what would they be?

Dr. HUANG. So thank you, Chairwoman Johnson. We have certainly evolved as this has progressed and as mentioned by Alison Buttenheim, the—you know, this learning and learning fast has been sort of our experience. And so, you know, initially, we had to get large numbers through registering people online, getting these things, but we really want to be equitable and, you know, opening professional phone banks so people don't need to have those technical capacity to do the registration. We're trying to do that.

We're going out in the community with many of our community and political leaders to sign up people for that registration and to make the systems more easy for people to access this. You know, we're moving from in-person walk-up sites to drive-throughs are some of the ways especially for our older population with mobility challenges and with the cold and the weather, you know, again, it's trying to get that stood up. We have a partnership with FEMA (Federal Emergency Management Agency) that's going to be starting next week for some drive-throughs. I mean, those are some of the logistic and hassle factors that we're trying to address and make it more equitable and make it easier.

Chairwoman JOHNSON. Well, thank you very much. Mr. Reed, would you say the same, or do you have some other pointers you'd like to point out?

Mr. REED. I certainly would agree with Dr. Huang's assessment there. I think it's important to have options. We experience challenges with a registration pool. We quickly realized that you can't have a single point of failure. Not one option works for everybody. We've engaged our pandemic providers and encouraged them to use their own types of systems to help register or provide appointments for patients so that we don't depend on one single system. We've also had to use and encourage the use of manual type of systems. We use our 2-1-1 system for those that do not have good technology options, that they can call and provide name, address, and phone number, and we push that out to local health jurisdictions so that they can proactively reach out to them to get them registered for vaccine.

I think the biggest key is that we provide options. I think we need many options for the public because not one single thing works for everybody out there.

Chairwoman JOHNSON. Thank you very much. Dr. Buttenheim, in your testimony you acknowledged that there are high levels of—particular distressing levels with people of color, almost three times more likely to die. And as Dr. Huang and Mr. Reed have observed that—all of this firsthand in both Dallas and Oklahoma and you pointed out that the mistrust is real. And I enjoyed your testimony. I thought it was very good and right to the point.

But healthcare discrimination did not begin and end with the Tuskegee study, so we really need more than just P.R. campaign to overcome this distrust because it is deep and painful for many people. Can you help us a little as to why it's important to acknowledge some of the past but we've got to move on and see what we can do for the future? Because we still have minorities dying at a higher rate.

Dr. BUTTENHEIM. I think it's important to address those disparities for three reasons. One, they're the reality, so if we ignore that there are disparities and structural racism in health and healthcare now, we're not dealing with correct data or accurate data. It's also the root of some of the vaccine hesitancy that we're seeing, so if we want to close the gap on coverage, we have to acknowledge that. And I think being frank and honest about those conversations will also point us to the best kinds of interventions to make sure we're meeting people where they are, making vaccination services accessible and respectful, and hopefully that will convince people that vaccinating is the right thing to do.

Chairwoman JOHNSON. Thank you very much. Any further comment? Well, thank you very much. Excuse me, go right ahead.

Dr. NEUZIL. None from me.

Dr. HUANG. This is Phil Huang. I mean, I'd really say that on the ground level, you know, building that trust. But as was mentioned, you know, acknowledging the—some of the issues that are out there, but trying to be as factual in providing that information and addressing, but we're hearing—I mean, you know, some of the types of things we're hearing, you know, I mean, just—we hear from some people the distrust of government, people think we're putting something in the vaccine to—the government is putting something in the vaccine to track people. They're—you know, they're injecting influenza virus into this. A lot of different types of, you know, misinformation is out there, again, that the government is trying to get more information for undocumented persons, things like that. And so we have to acknowledge these but then, you know, try to explain in truth.

And that trusted individual, community partner, healthcare worker, Tyler Perry, whoever, I mean, it was really, you know, great to hear that story of how the impact that his statements on TV made.

Chairwoman JOHNSON. Well, thank you very much. I've completed my questioning period, so I'll now recognize Mr. Lucas for 5 minutes.

Mr. LUCAS. Thank you, Chair.

Mr. Reed, you know I represent a predominantly rural district, essentially the northwest half of the great State of Oklahoma, and you have experience in dealing with a unique set of challenges that that poses through the COVID–19 pandemic. Could you expand for a moment on the steps that are being taken to ensure in particular that rural communities are not left behind as we combat this virus?

Mr. REED. Yes, sir. So for us in Oklahoma we have been very deliberate about ensuring that we are meeting the needs of rural Oklahoma. One of our initial goals was to make sure that during the first week of the vaccine rollout we had citizens from all 77 counties that received some level of vaccination, and we were able to achieve that.

We've done that by really leveraging our local public health systems. We use a hub-and-spoke method to allocate vaccine, to push it out to local health jurisdictions. We do a lot of centralized planning, but we're very big on a decentralized execution plan. So we ask those local health jurisdictions to work with their local partners, who they've actually been planning for pandemic-type of events for years. We've asked them to engage those partners, go into those communities, and provide access points for vaccination.

And in doing so we have seen points of dispensing sites set up in churches, in fairgrounds, community centers, in some cases it's the health departments, but we have tried to leverage what is actually available in rural Oklahoma to meet these needs.

From a centralized standpoint, we watch closely the percentage of the population in these rural areas that is being vaccinated so they would continue to monitor our success and ensure that we have a program that is equitable and we don't have any part of the State that is being left behind.

But overall, I would say the No. 1 thing we're doing is engaging our local public health system and their partners and allowing them to make local decisions because they know what needs to be done on the ground to serve the citizens that they are responsible for.

Mr. LUCAS. Thank you, Mr. Reed.

Dr. Neuzil and Dr. Buttenheim, Mr. Reed referenced a recent survey in Oklahoma, that 33 percent of my fellow Oklahomans do not plan to get the COVID–19 vaccine, and they cite lack of information on the vaccine, concern about development, safety, all those sort of things. In the remaining time I have, what can we tell our constituents back home to emphasize the safety of the vaccines authorized for use? Yes, you're writing my town meeting speech for me here.

Dr. BUTTENHEIM. I mean, I can say from a communications standpoint, luckily, we have the amazing data that Dr. Neuzil and her colleagues have generated from these trials. One thing that I think is important is that people need to hear it more than once, and they need to hear it from trusted communicators. That might be clergy, that might be local government leadership, that might be other family members who, you know, are doing the online research for them. But the main—you know, the survey data that says the main concerns are the speed of the vaccine development, Dr. Neuzil just walked through that in an amazing way, that, you know, it wasn't tested on people who look like me. We actually had

quite robust diversity in the trials, and we don't know the long-term side effects. We're starting to accumulate that data, and we have incredible safety profiles. So I think it's sort of hitting those three again and again and again but making sure if people have another set of concerns, that we hear those and address them as well.

Dr. NEUZIL. Yes, and from my perspective, at the end of every conversation, I want people walking away thinking disease bad, vaccine good. And it comes down to being that simple. And others who are professional in the area can come up with those communication messages. But sometimes we forget the disease bad part. This pandemic is killing people. It's killing minorities. It's killing people with poor access to healthcare. It's hurting our schoolchildren. It's hurting our economy. So we do have to remind people that there is a real reason that we're asking them to get vaccine.

And then on the vaccine side, again, I have tried to emphasize the points that you heard, that safety is always paramount because we're giving vaccines predominantly to healthy people to prevent a disease. We did include high percentages of minority populations, of different age groups so everybody can point to the trial and say somebody that looked like me received this vaccine. But I think the disease bad, vaccine is good, is something to always remember.

Mr. LUCAS. And as we every 2 years as elected officials will note, you have to repeat it 17 times in a row to make an impression. I yield back the balance of my time, Madam Chair. Thank you for a wonderful hearing.

Chairwoman JOHNSON. Thank you very much. I'll depend on the staff now to call on the other Members.

STAFF. Ms. Lofgren is next.

Ms. LOFGREN. Thank you so much, and thank you, Madam Chairwoman and Ranking Member, for this hearing.

We have obviously a big challenge ahead of us in getting vaccine distributed in sufficient quantities that we are able to put this virus in the rearview mirror. And right now, we have the hesitancy problem, but we also have a supply problem where, you know, there are millions of people who are trying to get vaccinated but they can't because there's not enough vaccine available. So I'm looking ahead, I guess, to a few weeks from now when there will be more vaccine.

In Santa Clara County, for example, we have now managed to vaccinate more than half of the people who are 65 years or older, and we're moving into the next group, which is people with serious pre-existing health conditions, people who work in food, the grocery store workers, and other essential workers.

I'm wondering whether the construct of signing up and then having people come in is really the wrong approach for this pandemic. I remember when polio vaccine was first devised, I was in elementary school, and you had to have a permission slip from your parents, but the public health people came and they gave every kid in the school a vaccination. Why would we not go to every grocery store and offer the vaccine to every person there? Obviously, they have the right to decline, but I'm also mindful that peer pressure is a great educator, and if every other person around you is getting

vaccinated, it may cause you to question why wouldn't you? So who can answer that question?

Dr. HUANG. Well, this is Phil Huang. I would say, as you started out, the supply is the issue at this point. And as I think I mentioned, we have over 650,000 people who signed up to register who want to be on our waiting list to get vaccine and we're only getting—like the health department is getting 9,000 doses a week. So, you know, the sign-up at this point does allow us to distribute more equitably, so we are applying a vulnerability index, a proximity index to these and getting those appointments out. We started out with 75 years and older and then went down to 65-plus with an underlying health condition.

So—but absolutely when there is adequate supply, we want to make it with that availability that you're talking about, but the big limitation is we just don't have enough vaccine, so we're trying to get it and get it out equitably through some of these processes.

Ms. LOFGREN. But there's no medical constraint or ethical constraint to just going to the grocery store and saying now that we're in your tier, anyone who wants it can get it if we have supply?

Dr. HUANG. Oh, if we have supply, absolutely. I mean, we want it to be like the flu vaccine, the annual flu vaccine and you go to your drugstore or retail store, something like that.

Ms. LOFGREN. Here's a question that you may or may not be able to answer, any of you, because it has to do with distribution of vaccine, but all of us, each State has rural areas where the capacity for the very cold freezing is not as available. Is there a way to direct the J&J (Johnson & Johnson) vaccine to parts of the country where the freezing capacity is a real constraint to the program of vaccinations so that the J&J, which does not require that extreme measure, can be directed to the areas that might need it the most?

Dr. NEUZIL. Yes, so I—this will likely occur at the State level, and I'll let some of my colleagues comment. Here in the State of Maryland, even the differences between the Pfizer vaccine and storing in a minus–80-degree freezer versus storing in a minus–20-degree freezer have led to a distribution system at major medical centers versus outlying pharmacies and outlying clinics, so it can absolutely be done. It has to be orchestrated at the State and local level.

Ms. LOFGREN. And not at the Federal level you're saying? I mean, for example, the District of Columbia doesn't have any rural areas.

Dr. NEUZIL. I'm not sure I know enough about the Federal distribution to comment.

Ms. LOFGREN. OK. Fair enough.

Madam Chairwoman, I see my time is just about expired. Thank you again for this hearing, and I yield back.

Chairwoman JOHNSON. Thank you very much. Who's next?

STAFF. Mr. Posey is next.

Chairwoman JOHNSON. Mr. Posey.

Mr. POSEY. Thank you, Madam Chair, for holding this hearing on these important issues regarding the COVID–19 vaccination campaign.

Vaccines are a monumental achievement and a product of a massive governmentwide effort to defeat this pandemic.

Dr. Neuzil, you were part of the development of the protocols for the two vaccines that we're using today, and I'm pleased to hear your testimony that Operation Warp Speed played an important role in getting these vaccines developed, tested, and in use in less than a year. You state that, quote, "The closure of schools and lack of extracurricular activities is impacting the academic, social, and physical development of children with disproportionate impact on minorities. Persons of all ages are struggling with the effects of isolation, extreme lifestyle changes, and increased anxiety."

Florida schools are open, yet it's surprising that while the CDC says it's safe for schools to open, we have States that are still locked down. Would you provide for the committee record studies documenting the harm to children resulting from school closures that you alluded to?

Dr. NEUZIL. Yes. So thank you for your comment. And again, just to emphasize that the damages in terms of the pediatric population are disproportionate to minority communities, so we—as we're seeing in the adult population, the minority and disadvantaged communities are more likely to get COVID–19 and they're more likely to get severe disease from COVID–19.

Similarly, the disadvantaged communities are less likely to have the tools, whether it's the computers, the ThinkPads, the mechanisms, and the oversight for virtual learning. And so I can provide you references after the hearing, but they are following—falling more behind in their academics because of this disadvantage.

Mr. POSEY. Thank you very much, Doctor. And each of the panelists can comment on this, I'd appreciate it. And it seems like there is so much to learn from our experience with this pandemic. We need to better understand everything from the origins of the viruses and the development of the therapies and vaccines to the pandemic preparedness and collaborations between Federal, State, and local governments and public health officials.

After 9/11, Congress supported a commission to cut through the politics and finger-pointing and focus on the facts. Last week, I introduced legislation to do the same thing for COVID. Do you think, each of you, that we could benefit from such a commission? Starting left to right.

Dr. NEUZIL. Yes, thank you for the question. I think in science, as of others have suggested, you know, we have hypotheses, we test the hypotheses, and we look to move forward at every step. So I do believe that it's always helpful to evaluate what has happened, whether it's an experiment or whether it's a program, evaluate what went well, evaluate what we can do better in the future. So yes, I think—I don't know exactly what type of program or commission you're describing. I think it would be useful for lessons learned.

Mr. POSEY. Thank you.

Dr. HUANG. This is Phil Huang. I mean, certainly with most incidents we do after-actions and hot washes and find out lessons learned and what went right and what went wrong, so that's always a best practice for any event, I believe.

Mr. POSEY. Thank you.

Mr. REED. Yes, this is Keith Reed. I would say that we have learned a great deal and put into practice a lot of things we

learned after—for years of practice in emergency response based off of what you initially referenced occurred after 9/11 and such. Those partnerships we created have made a big difference in our ability to respond right now, but there were things that did not go as planned. There were things that we put into motion that certainly was not the way we expected it to roll out. So looking back on that and evaluating what worked and what did not would be incredibly valuable, and I think it would help us moving ahead to ensure that we are prepared for the next pandemic or other major emergency that comes down the pike.

Mr. POSEY. Thank you.

Dr. BUTTENHEIM. And I would just add, hopefully, we can also learn from some of the behavioral and policy interventions, how did we do at getting people to mask, how did different kinds of lockdowns and stay-at-home orders work and use the 50 States and local jurisdictions as sort of case studies to see what was effective.

Mr. POSEY. I thank the witnesses and see my time is expired and yield back, Madam Chair.

Chairwoman JOHNSON. Thank you very much.

STAFF. Ms. Bonamici next.

Ms. BONAMICI. Thank you so much. Thanks to Chair Johnson and all the witnesses. I also want to thank all the witnesses for the work that you've done to so quickly respond to the pandemic, and I applaud all the heroic efforts of the broader scientific and public health communities. There have been so many achievements made thus far in surveillance and testing strategies and therapeutics and now multiple vaccines that are safe and effective.

But, as we know, we're still facing many challenges. We've spoken about some of those, distribution and equity. I'm particularly concerned about some of the new problems that are emerging, for example, the viral variants. And evidence suggests that some of these variants may actually be more contagious than the original virus. The CDC reported that the highly contagious strain that emerged in the U.K. could become dominant in the United States in the next few months. They've already reported cases in 42 States. And there's also the South African mutation, the viral variant initially detected in Brazil. We're seeing all of these happening. So we know that work is underway to determine how well our current vaccines protect against the variants and whether booster shots or other approaches may be necessary.

So, Dr. Neuzil, can you tell us what you know so far about how effective the existing vaccines are against the new variants and what our options might be if we need to adapt to how the vaccines are formulated or administered and distributed?

Dr. NEUZIL. Sure. Thank you for the question. And you have absolutely articulated one of the biggest concerns right now with SARS-CoV–2, the emergence of these variants. The first point I would like to make is that these variants were emerging in a setting of no vaccination. And RNA vaccines make mistakes when they replicate. It's a feature of the virus. And so the more that they are replicating unmitigated and uncontrolled, the more variants and more mutations that we are going to see.

So the variants are yet another argument to get vaccine out, to get vaccine out fast, and to have a global response because variants that emerge anywhere are a threat everywhere.

In regard to the vaccines, we're just beginning to learn about their effectiveness against variants. Fortunately, these mRNA vaccines, for example, are highly effective vaccines. They have strong what we call neutralizing—which means you can stop the growth of the virus—antibody against the vaccine strain. It is diminished against some of these variants strains, but it's still effective. So when you're starting at 95 percent, you know, you can lose a little effectiveness and still be an extremely good vaccine.

Some of the variants emerging in other places, the variant first recognized in South Africa, for example, have some more dramatic effects, and yet we are still seeing this neutralizing ability. However——

Ms. BONAMICI. Dr. Neuzil, thank you. I want to get to a couple more questions, but——

Dr. NEUZIL. OK.

Ms. BONAMICI [continuing]. Thank you so much, Doctor.

Dr. Buttenheim, Johnson & Johnson, as we know, has applied for their Emergency Use Authorization for its vaccine, and that application will be considered soon by the FDA's independent science advisory board. So having more vaccines is clearly a good thing, but people may be understandably hesitant if a different option that is found to be somewhat less effective than Moderna or Pfizer at preventing mild and severe infection. And so the difference in these efficacy results received a great deal of media attention, but it's my understanding there have been zero cases of hospitalization or death in clinical trials for all three of these vaccines, including Johnson & Johnson.

So with the questions that are arising about the differences between the vaccines, how can we most effectively address the concerns with the public and really communicate complete and accurate information? And this is, I think, going to be an issue because it's my understanding the Johnson & Johnson is a one dose, although I know you probably likely saw this morning the news that perhaps Pfizer and Moderna could be effective as a one dose. But if we're using Johnson & Johnson, for example, in rural areas or with transient, migrant populations, there's going to be equity issues there. Why are we giving those populations something that is less—or looks to be less effective? So could you discuss that please?

Dr. BUTTENHEIM. Yes, this is going to be a challenge. And I think as we think about the sort of choice architecture, how we arrange environments for people make choices, one thing we don't want the average American doing is choosing their vaccine. This should be sort of your provider or this clinic is—or this State is using this vaccine in their program, and lucky you, you get it. Those sort of extra choices that cause kind of cognitive load are—do not have a place here. And yet we have the sort of wonderful problem that we've all anchored on the incredible effectiveness of Pfizer and Moderna, to something from J&J that looks maybe a tiny little bit less effective but is still a great vaccine is a sort of seen as second-best. So I think messaging, good risk communication, and sort of

evidence communication but also strategic allocation of that vaccine to areas, you know, that can use the different vaccines appropriately will also be important.

Ms. BONAMICI. Does anybody else want to weigh in on this issue, any more witnesses?

Dr. BUTTENHEIM. Maybe the folks who are actually doing vaccinating should weigh in.

Ms. BONAMICI. Exactly. Exactly. I'm going to ask Dr. Reed. You testified about vaccine availability in rural areas. I represent a district in northwest Oregon that has urban, suburban but also a lot of rural areas. So what are the sort of practical implications of Johnson & Johnson formulation that doesn't have the same cold chain requirements as other vaccines? How meaningful would it be to have that option in rural communities specifically?

Mr. REED. Well, it absolutely gives us more options when we're looking at rural communities. We've kind of worked out a hub-and-spoke model in order to handle the storage restrictions of the Pfizer vaccine, for example. The big advantage that we look at when we talk about Johnson & Johnson is some of these populations that—homeless populations, for example, when the likelihood of getting somebody back for a second dose is extremely difficult.

Another area we're looking at where this would be a great advantage for us is potentially some high resource-intense groups, homebound groups, things like that to where trying to get enough resources mobilized to get two doses to these individuals, which would be very difficult, so Johnson & Johnson provides us an option for that.

For us, it's about the logistical options of matching the requirement of one dose with a population that can really benefit from that and maximize their protection based off that.

Ms. BONAMICI. Thank you. And I see my time is expired. I yield back. Thank you, Madam Chair.

Dr. NEUZIL. May I make one comment answering?

Chairwoman JOHNSON. Yes.

Dr. NEUZIL. About the Johnson & Johnson, I just want to stress that the efficacy against severe disease for the Johnson & Johnson vaccine is very high. So while it's nice to prevent loss of taste and smell and cough and—what we really want to prevent are hospitalizations and death. And the Johnson & Johnson vaccine does that.

Chairwoman JOHNSON. Thank you. Thank you. The next witness?

STAFF. Mr. Babin is next.

Mr. BABIN. Can you hear me? I'm sorry.

Chairwoman JOHNSON. Yes, we can.

Mr. BABIN. OK. Yes, thank you. Thank you, Madam Chair. Great to have your expert witnesses with us today at such an important [inaudible]. Ms. Bonamici [inaudible] out now, and there was an article in the *Wall Street Journal* about [inaudible].

Chairwoman JOHNSON. You might have to repeat your question.

Mr. BABIN. Can you hear me, Madam Speaker—I mean, Madam Chair?

Chairwoman JOHNSON. Yes, we can hear you now.

Mr. BABIN. OK, I'm sorry.

Chairwoman JOHNSON. We can hear you now.

Mr. BABIN. OK, thank you. I was just trying to find out what the latest is on the Pfizer in order to get more distribution to more individuals on the first injection of Pfizer. Is that something in the works right now? Dr. Neuzil, are you——

Dr. NEUZIL. Yes.

Mr. BABIN [continuing]. Are you——

Dr. NEUZIL. Yes. So I didn't hear you directing that to me. So thank you for that question. You know——

Mr. BABIN. Sure.

Dr. NEUZIL [continuing]. The Moderna and Pfizer vaccines have very high efficacy after the first dose. If you take away that first week before your immune system has had a chance to respond to the vaccine and when many people were likely already exposed to the virus and maybe even incubating the virus, you get to about a 90 percent efficacy after a single dose for both vaccines. The problem is we only know that for a very short period of time because 2 to 3 weeks later we gave that second dose.

Now, the efficacy isn't going to drop from 90 percent to 0 overnight. It will take time to wane. But in order to change from a two-dose to one-dose regimen, you would really need to follow those people who got a single dose for a longer period of time. We believe that second dose is important for duration of protection and perhaps protection against these variant strains. But if somebody is a little late getting their second dose, they should not be worried. It starts to work very well after one dose.

Chairwoman JOHNSON. We can't hear you, Dr. Babin. Are we getting him some technical support?

STAFF. Yes, Mr. Babin, you may be experiencing some bandwidth issues. If you'd like to just turn your camera off momentarily, that will allow the audio to clear up a little bit and stop using as much bandwidth.

Mr. BABIN. Now can you hear me?

Chairwoman JOHNSON. Yes.

Mr. BABIN. OK. Following up on that question, your answer there, Dr. Neuzil, is there an antibody titer associated with this particular protection, and if it is the same antibody titer seen in a post-COVID infection? And if so, that leads me to the question of whether we need to vaccinate those who were previously infected. Is there any change there? I know that's a question that's still ongoing, but what is your opinion there and what is your knowledge concerning that?

Dr. NEUZIL. Yes, so that's a great question and a very active area of research is to be able to define exactly the amount of antibody that is protective because that will help us when we moved to other populations, as you've said, when we vaccinate people who have already been infected. So it's a very active area of research. You know, ironically, having vaccines that are so protective makes that hard to establish because all those——

Mr. BABIN. That's right.

Dr. NEUZIL [continuing]. Almost everybody in the vaccine group didn't get the disease.

However, we're pooling all of the information from all of the trials to try to understand that. Data indicate that if you have had

the infection before, you likely do respond better to a single dose of vaccine, but we don't yet——

Mr. BABIN. OK.

Dr. NEUZIL [continuing]. Have enough information to translate that into policy right now.

Mr. BABIN. I've got you. I don't know how much time I have left, but I was just wondering if there was evidence for like an anamnestic response like an antibody titer and T cell activity if they go below a certain point, is there evidence that re-exposure to the virus might trigger a rapid immunological activation or escalation, which would give you protection as well?

Dr. NEUZIL. Yes, so another great question, and in fact this was asked earlier. The companies now are very actively working on booster doses of vaccine with the same strain and with variant strains. So I would say within weeks to months we will have the answer to your question.

Mr. BABIN. I am so glad to hear. We are in the middle of a bad winter storm down here in Texas, and it's been very difficult. I have a large rural district as well. And getting vaccines out there and getting people—these questions that have already been asked, we have really a shortcoming when it comes to connectivity via getting information on the internet, so we certainly hope that some of you other panel members would be able to say how is this being addressed to get connectivity on the internet into these rural areas to get people this information. Can anybody answer that?

Mr. REED. I would say in Oklahoma we are trying to tap into every communication source we can for rural areas, radio, through local organizations, connecting with churches. We're really trying to work through our community resources, our community partners to get messaging out. It's a challenge. It's a definite challenge when we're trying to vaccinate the entire population or make it available to the entire population. It's obvious the easy way is to default toward some kind of media that requires internet, but we have to fight that urge in some of these areas, and we've got to access these other resources to be able to reach them.

Dr. HUANG. And I would add that in Dallas County we are trying to do paid media, we are trying to do phone—you know, making phone—a paid phone bank available, other community events in the community to sign people up and get them the direct connections.

Mr. BABIN. All right, great. That's great answers. I want to say thank you very much. And, Madam Chair, I don't see how—my time is not coming up, so I may already be expired. Am I?

Chairwoman JOHNSON. I can't tell.

Mr. BABIN. OK. I can't either.

Chairwoman JOHNSON. Staff people might be able to tell.

Mr. PERLMUTTER. You're way, way over time.

STAFF. Your time is expired.

Mr. BABIN. Way over time, OK, I'm sorry. So I'm going to yield back then. Thank you so very much.

Chairwoman JOHNSON. Well, thank you, though, good questions.

Mr. BABIN. Yes, ma'am.

STAFF. Mr. Bera is next.

Mr. BERA. Great. Thanks, Madam Chair. I want—I'm going to follow up on some of the questioning that Ms. Bonamici asked. And I'm a physician by training, come out of academics, and have done clinical trials. And I am extremely worried about how we're talking about the efficacy of the vaccines. And I even hear it in the discussion here today because in truth you have to design the clinical trial for a common event, which is catching the disease. But there are other outcomes that we're certainly trying to prevent with this vaccine, serious illness, hospitalization, and death.

And we talk about Moderna and Pfizer as being more efficacious than Johnson & Johnson. That may be accurate in prevention of disease, catching COVID, but each of these vaccines are super effective in preventing serious illness, super effective in preventing hospitalization, and super effective at preventing death, and that, you know, is the truth for AstraZeneca as well. That's the truth for Novavax on the data that we can see.

And we're extremely concerned that if we don't start with the positive message, it's remarkable that we have potentially five super effective vaccines that are going to prevent you from getting seriously ill, that absolutely are keeping people out of the hospital, and had—as far as I can tell, nobody's died who's received any of these vaccines.

And, you know, I see our best spokespeople from the administration on television, on cable news all the time, and we fall into this message. And the risk that we're going to run is someone's going to say, well, I heard someone say that Johnson & Johnson is not as effective, so I'm going to wait a while until I can get the Pfizer vaccine or the Moderna vaccine.

And maybe, Dr. Buttenheim, this is kind of your area of expertise, and I've seen you quoted in some articles, and I am extremely worried that we are setting ourselves up in a way that is going to slow down vaccinations. And again, those three other variables, serious illness, hospitalization, and death, all of these vaccines are incredibly effective. You know, would you give us—as Members of Congress and others, you know, again, because we fall into this trap—so what's the best way to message these vaccines?

Dr. BUTTENHEIM. You know, I think there are a couple strategies we can draw on. One is analogy, right? So no one asks what kind of vaccine they get when they go for their flu shot, right? It's not even an issue. You may not even know who makes your flu vaccine, and so we need to transition our vaccine promotion programs to be more like that. You're getting a COVID vaccine.

I think we also need to—and this is unsettled science, but we need to think about how to, as you said, really hone in on the adverse events, the severe events that are not happening because of these vaccines. And this is always a challenge for health promotion, right? We're trying to get people to do stuff so that something else doesn't happen. That's really hard. And if the thing that's not happening is even more rare and probabilistic, that's additionally challenging. So I think we need to pull in our best, you know, social marketing, marketing advertisement people to help with these frames and these messages that make most salient for people as they're making a decision, but the—any vaccine is a good vaccine decision here.

Mr. BERA. Right. And so starting with the process, right, it's starting with the—that all these vaccines are super effective at, you know, preventing serious illness, keeping us out of the hospital, and certainly, you know, preventing death. And if you can get a vaccine, get that vaccine, whichever one——

Dr. BUTTENHEIM. Exactly.

Mr. BERA [continuing]. Of those vaccines that are available.

Dr. BUTTENHEIM. The best vaccine is the one you can get tomorrow.

Mr. BERA. Exactly. And we probably ought to start with that message——

Dr. BUTTENHEIM. Yes.

Mr. BERA [continuing]. Because, you know, what I'm very worried about is in many rural communities and harder-to-reach communities, just logistically the Johnson & Johnson vaccine may be the easiest vaccine to get out there——

Dr. BUTTENHEIM. Yes.

Mr. BERA [continuing]. If you're [inaudible] homeless folks, you know, at a river bank, a single-dose vaccine is going to be a lot better. If you're vaccinating college students that may not come back for that second vaccine, a single-dose vaccine is going to be better.

I do worry, though, that, you know, there's that potential where folks might say, well, why are you using a less effective vaccine in some of these disadvantaged communities and you're using the—and again, I don't think that's—those aren't——

Dr. BUTTENHEIM. And you're right to worry about that because that is going to happen. So I think with J&J we can promote it's like the convenient vaccine, you know, like one and done on this one, isn't that great? But yes, the more we can take that choice away from people and not fall into the like, oh, I'm going to wait, I'm going to wait for Pfizer, the better off we'll be.

Mr. BERA. Right. So, again, just to my colleagues, if we can start with the positive that we are so lucky that, you know, we have potentially five great vaccines that are going to do a remarkable job, get that shot in your arm. So I think my time is up, and I will yield back.

Chairwoman JOHNSON. Thank you very much, great questions.

STAFF. Mr. Gonzalez is next.

Mr. GONZALEZ. Thank you, Chairwoman Johnson and Ranking Member Lucas, for holding this hearing and to our great witnesses for joining us.

I think we're all in agreement the COVID–19 vaccine development is a marvel of modern medicine, and to take a process that under most circumstances could take up to 10 years, have multiple successes in a matter of months is just incredible. We should all be incredibly grateful for the talented researchers and scientists.

And I want to especially thank Dr. Neuzil. I'd like to personally extend this thank you to you because I know you worked so hard on this as well.

At this stage in the pandemic it's important that we satisfy our strategies in the short-run and long-run categories. In the short run I think we need to increase vaccine supply. That's been evident, make efforts to rebuild trust, and lay the groundwork for building demand so that when vaccines are readily available, there

is sufficient uptake in the community. In the long run we need to sustain outreach to vaccine-hesitant communities and invest in research that improves our ability to identify people's perceptions of safety and tailor communication specifically to each population.

Dr. Neuzil, I want to start with you and I had a question. As these variants have come into play, what role do you think the Federal Government will need to continue to play from an investment standpoint? So obviously, we frontloaded a lot of the investment on the initial development of vaccines, but as the variants take hold, will we need to continue providing that or can the companies handle that themselves in your opinion?

Dr. NEUZIL. Yes, thank you for that question. I think on the variants it's going to have to be both. You know, for one, we need a better surveillance system to pick up these variants, and we're really not there yet. And so that is going to be critical, and that is going to have to be coordinated, and that will need to be government-funded.

Again, we have to think about where are the incentives. And if there is not a natural market value and a market-driven reason for the companies to do it, that's when the public-private partnerships thrive and the government needs to step in and help. You know, this is why we never had an mRNA influenza vaccine because who's going to take that to market when we have 10 other vaccines already on the market? And so that's the way we're going to have to think here and be strategic in the investments that are going to pay off for public health and won't naturally occur in a market-driven decisionmaking world.

Mr. GONZALEZ. Can I ask you a follow-up on the mRNA specific to the traditional flu? And you may have already answered this, but from your answer should I assume that if we did an mRNA vaccine for the traditional flu, that it would be more effective and we could potentially cut down drastically on flu-related deaths as well?

Dr. NEUZIL. So I don't think we can make that assumption. The mRNA vaccines for influenza have been in phase 1. They're immunogenic. Because of our ability to stabilize the virus, get the right sequence, and get it faster, they may be better, but that has yet to be tested.

Mr. GONZALEZ. Got it.

Dr. NEUZIL. They certainly have a speed advantage.

Mr. GONZALEZ. Thank you. And then the mRNA vaccine is easier to produce and manufacture, as you said. How easy will it be to alter the vaccine such as the J&J and AstraZeneca vaccines?

Dr. NEUZIL. Yes, so the J&J and AstraZeneca vaccines are also genetic-based vaccines. We're just using an adenovirus to deliver them instead of a lipid code to deliver them, so they will also be amenable to rapid sequence changes.

Mr. GONZALEZ. Great. And then with my last minute—I can't see the clock, but just quickly, I know we've talked a lot about increasing confidence in minority communities, which is obviously critically important. We've started to see some success in northeast Ohio in the Hispanic community with a program called Cover COVID, which is more of a national, international program. And the short and long of it is is it's not just about translating things

into Spanish, right? And for our community what we found is it's the translation but it's also having the cultural awareness to know that, you know, we have to do more than just translate to make sure that what we're translating hits the community in a way that they can receive it. I just draw that to everybody's attention. I know everyone is working on this in different ways, but we have seen some success in the Cleveland area, and I just would submit that to everyone for consideration. And thank you for your responses. I yield back.

Dr. BUTTENHEIM. If I can follow up for a moment on that, it's going to be so important to gather and collate those success stories and make them easily shareable across different populations so, again, we can learn fast what's working.

Dr. HUANG. And I would just add one thing. You know, even the term Operation Warp Speed we heard in the Hispanic community sort of gives a sense that it's rushed—been rushed through and that distrust of the government and things, so——

Mr. GONZALEZ. Thank you.

Chairwoman JOHNSON. Thank you.

STAFF. Is Mr. Sherman available?

Chairwoman JOHNSON. Who's next?

STAFF. Mr. McNerney is next.

Chairwoman JOHNSON. Mr. McNerney. I see him. He's here. Mr. McNerney, unmute.

Mr. MCNERNEY. There we go. Well, thank you, Madam Chairwoman, for holding this hearing. It's very interesting and informative.

I recently hosted a townhall meeting on a range of issues regarding vaccination. Fortunately, I had the help of Dr. David Relman of Stanford who was able to address some of these questions, but it's good to have experts that can give more information on this.

Dr. Neuzil, in your written testimony you mentioned the collaboration necessary for vaccine development that includes the Department of Health and Human Services and other relevant government agencies and partners abroad. Did the decision by the previous administration to withdraw from the World Health Organization put our country at a disadvantage in terms of the coronavirus in the last—and did our isolation approach do more harm than good?

Dr. NEUZIL. Yes, so thank you for that question. I've been involved with the World Health Organization for the past 15 years or so and done work in countries around the world. You know, again, as I said in my testimony, it's quite clear that we have to consider any infectious disease, any new pathogen anywhere to be consequential, and we must have a global response.

In terms of—it's always difficult to go backwards and say what would have happened if, but certainly now we should be cooperating fully with the World Health Organization. We should be setting up these global surveillance networks, and the influenza surveillance network is a model. And we must work together and get vaccines to everyone in the world or we all will remain at risk of SARS-CoV–2 infection.

Mr. MCNERNEY. Thank you. Well, in your testimony you said that the emergence of three severe coronaviruses in the last two

decades should encourage us to work toward a pan-coronavirus vaccine. Can you elaborate on that a little more and what work is being done at this point?

Dr. NEUZIL. Sure. I don't think a lot of work is being done yet. You know, we had the SARS virus, then we had the Middle Eastern Respiratory Syndrome virus, MERS, and now we have SARS-CoV–2. So in the same way we approach influenza as a class of viruses, in my view, we have to approach coronavirus as a class of viruses. For example, if we had antivirals the way we do for influenza, that can help bide some time, so medications, ideally, oral medications that people can take during this time while vaccines are being developed. So I think we are going to need to approach coronaviruses in that way rather than each one individually as it emerges, think of them as a class and what we can do either from the vaccine or the medication standpoint to develop countermeasures that would fight all coronaviruses.

Mr. MCNERNEY. Well, thank you. Dr. Buttenheim, I want to ask you about the same issue. I think it's safe to assume that we may see more variants in the coming months. What does the emergence of these variants tell us about the international approach to vaccinations?

Dr. BUTTENHEIM. Well, I mean, I think I'd go back to the, you know, none of us is protected until we're all protected. I think the—you know, it's a messaging challenge and a behavior-change challenge for folks in the United States because, of course, we're trying to think how can we get our population vaccinated as quickly as possible. We also need to motivate people for the United States to be a player globally in providing vaccines to other countries in order to do things that we like to do as Americans. Like we like to travel, we like to have people from other countries come travel here. And that will be impacted if the rest of the world can't vaccinate.

I look every evening on some of the amazing trackers that show how we're doing as a—you know, doses given per 100 people or per 100 million people compared to the rest of the world, and it's agonizing. I mean, we are doing great. We have a ways to go in the United States, and much of the world hasn't seen a single dose yet. That's tough. That's tough to swallow.

Mr. MCNERNEY. Yes, sure. Dr. Huang, you've discussed the difficulties faced in reaching and connecting with a variety of communities in our cities and States. How do you—how are you combating vaccine hesitancy and disinformation with the homeless population?

Dr. HUANG. So we have definitely been working with the homeless population on testing, dealing with some of the outbreak situations. We have a lot of partners. I think what has been discussed in particular with them, the Johnson & Johnson vaccine may be more amenable for that population. We have already been vaccinating those in Texas. It's been—the 1b's are defined by either 65 years of age or older or 16 to 64 with an underlying health condition, so we've been trying to do those populations within the homeless settings. And, again, it's that communication and partnering with the other groups that we have that long-standing relationship with them, and right now, it's more of a vaccine availability issue.

Mr. MCNERNEY. OK. Well, I want to again thank the witnesses for sharing your expertise and your time, and I yield back.

Chairwoman JOHNSON. Thank you very much.

STAFF. Mr. Baird.

Mr. BAIRD. Yes, I want to thank Chairwoman Johnson and Ranking Member Lucas for putting on such a timely [inaudible] we can share with our constituents. And, you know, I especially appreciated Madam Chair's mention of polio. One of the reasons I became involved in Rotary was because their efforts worldwide or internationally to help with polio, and so I think that really demonstrates the importance of the vaccination.

My question really deals with messenger RNA or mRNA as we've made reference to. That messenger RNA creates enough protein to stimulate our immune system or whatever we're dealing with's immune system, and that triggers the production of antibodies. And so I think that is a valuable asset in that we're not injecting modified live virus. If you go back in the animal industry over the years, we used different techniques to vaccinate animals, one of those being a modified live virus, but we altered it so that it did not cause the disease. We weakened it in some way. And so I really think the selling point for getting over this hesitancy is the fact that we're not really injecting people with a live organism. It's only partially there, and it's a protein that stimulates our immune system.

So, Dr. Neuzil, you mentioned [inaudible]——

Dr. NEUZIL. I lost him a little bit. I don't know if other people did.

Chairwoman JOHNSON. Yes.

Dr. NEUZIL. OK. So I didn't hear the question.

Chairwoman JOHNSON. We'll see if we can get him to repeat it. He's talking; we just can't hear him. But he is unmuted. We can't hear him.

STAFF. Yes, ma'am, I'm sending a message to Cisco now. I believe there's some bandwidth issues going on, and it looks to be across Webex, not just with one individual.

Chairwoman JOHNSON. OK.

Mr. BAIRD. So I'm going to try one more time, and otherwise, I'll say goodbye. Can you hear me now?

Chairwoman JOHNSON. Yes.

Dr. NEUZIL. We can.

Mr. BAIRD. OK. My question is to Dr. Neuzil. You mentioned animals, and I think that provides us a big data base, but I really want to address the mRNA and the fact that I think it provides some protection for these variants. So I would like to give you a chance to elaborate on that little more.

Dr. NEUZIL. Sure. First of all, I agree with you, and it's a really important point that these mRNA vaccines are not weakened viruses. They absolutely cannot cause COVID–19 infection, and that's a very important message. They do allow our own cells to make the protein, which stimulates a very effective immune response because our body does think, you know, it's the protein from the real virus.

And that broad response we have shown from people who have been vaccinated with these mRNA vaccines can neutralize even

these new variant viruses. So we don't know what difference that will make with disease, but at least in what we can measure in the blood, people who get these vaccines do have antibody that works against the new variants.

Mr. BAIRD. So, Madam Chair, thank you very much. I really appreciate that. And with that, I'm so close on time and I need to excuse myself anyway, but I can't tell you how much I appreciate this meeting, and I think it's very timely. And so thank you. I yield back.

Chairwoman JOHNSON. Thank you very much. Thank you. Our next witness?

STAFF. Mr. Tonko.

Mr. TONKO. Thank you, Madam Chair. Can you hear me?

Chairwoman JOHNSON. Yes.

Mr. TONKO. Oh, thank you for holding today's hearing on the critically important science and research behind COVID–19 vaccines.

Obviously, vaccines are one of the greatest success stories of public health. With them, we have eradicated smallpox, nearly eliminated wild poliovirus, and driven the number of people who experienced the devastating effects of many other preventable infectious diseases to an all-time low.

While I'm encouraged to see that so many people are getting vaccinated, including in my home district in New York's capital region, I know that many still have questions about the safety and effectiveness of COVID–19 vaccines. And this hesitancy might begin to affect the pace and equitability of our national recovery.

So, Dr. Neuzil, I—do we have any scientific consensus on how many Americans will need to immune—to be immune to COVID–19 for us to achieve herd immunity?

Dr. NEUZIL. Yes, so a very good question, a very popular question. You know, we have models that look at that. You probably know for a disease like measles we look for about 95 percent immunity. We're hoping that somewhere, you know, upwards of 75 to 80 percent might get us there for this virus. Some of this will depend on these variants and transmissibility and duration of immunity.

Mr. TONKO. Thank you. And, Dr. Neuzil, is herd immunity achieved through widespread vaccination, the quickest way to return to a more "normal" way of life?

Dr. NEUZIL. In my view, it is the quickest way to return to a normal way of life, and we have to remember with infectious diseases, we're talking a lot about relative efficacy numbers. But I am as protected by what the people around me do as what I do. So, again, the more people that get vaccinated, the closer we are to returning to normal.

Mr. TONKO. Thank you. And, Doctor, what do you know right now about the effect of vaccination on transmissibility? What advice would you give to the public as that research continues?

Dr. NEUZIL. Yes, it's a great question, and right now, the data that we have are in the early phases. However, the data are trending in a positive direction. We have data from AstraZeneca. We have data from Moderna, again, small numbers. The people who get these vaccines are less likely to have virus detected by a swab, so they have less virus in their nose. So the implication is

if you have less virus in your nose, you will spread virus less well. We will know a lot more about this in the next 3 to 6 weeks or more. And, again, we are very hopeful that these vaccines will also decrease transmission.

Mr. TONKO. Thank you. Well, we're all anxious to return to our lives, but there are several key measures we need to hit before that can happen obviously. In addition to vaccine availability, we also need to be moving as quickly as possible to produce good science-based research that we can share with the public and use to offer guidance in real-time. So, Dr. Buttenheim, do you believe that State and local public health departments have the information they need right now to engage with their communities and increase vaccine uptake?

Dr. BUTTENHEIM. They have the information. They do not have sufficient resources. So we're here in Philadelphia where I—we're our own CDC vaccine jurisdiction, right, one of the 64 jurisdictions. We have a fantastic Department of Public Health, huge shout out to PDPH, but there's a lot to do right now. You know, we need to set up vaccine providers in different kinds of clinics. We need to, you know, put messages on buses, as I said earlier, and we need to engage with, you know, community networks, community health workers to do all that reaching—outreach to folks who don't have—you know, aren't on the internet all day. That takes money, and if we're going to really rely on our local and State health departments to do vaccine rollout, which is appropriate, that's why we have jurisdictions, they need resources.

Mr. TONKO. And how can Congress best assist State and local public health departments in their effort to provide up-to-date information aimed at curbing COVID–19 vaccine hesitancy?

Dr. BUTTENHEIM. I think—again, I'll go back to the money. In addition to those resources, what I mentioned earlier with making sure we have sort of clearinghouses and compilations of best practices and what's working in different areas. I think also we need really good dashboards, especially if we want to, you know, do the sort of double punch on the equity and the efficient rollout. Every jurisdiction should be able to pull up a dashboard that shows, you know, how we're doing, how many doses are out, how many doses are in jurisdiction, how are we doing on race, ethnicity, and age, and social vulnerability index. And those are intensive, you know, data resources. Support to get those stood up and keep them active and dynamic is also really crucial.

Mr. TONKO. Dr. Buttenheim, thank you. I've exhausted my time. Madam Chair, thank you for your patience. I yield back.

Chairwoman JOHNSON. Thank you.

STAFF. Mr. Sessions is next.

Chairwoman JOHNSON. You might need to unmute.

STAFF. Sir, you are unmuted, but no audio is coming through.

Mr. SESSIONS. I hope that's better. We put a new microphone——

STAFF. Yes.

Mr. SESSIONS. Good, thank you very much. I'll start back over. Thank you.

Chairwoman Johnson, thank you very much for holding this hearing. Your leadership in this Committee for years has been very important to many people, not just your background as a nurse but

representing a huge number of people by speaking about them, also Ranking Member Lucas.

My question that I would like to direct—I believe it goes to Dr. Neuzil, which would give her a heads up that I'm going to ask this question. The first is just a comment that may or may not require an answer, but the last two I am looking for one. And it is that for a number of years I've been a blood donor, given 15 gallons of blood over my life, and I've watched at how these organizations come and work with local community-based organizations, including churches. And I wonder if it's appropriate ethically for us to consider going to churches and actually, you know, making sure you hit not just the Baptist and Methodist and the Catholics but other evangelical churches perhaps in an area, perhaps it might be a synagogue, but working through the churches, which would bring people together where they are together on a Sunday morning or a Monday or a Wednesday night. It seems to me that that may be a way that you could take care of what might be a disparity in the other communities that we're having problems with.

Now to my questions. No. 1, I'm a father of a Down syndrome young man and trying to stay up with issues related to disabilities. My question is that do you believe it's important for disabilities to have their own trial or would you suggest that they be involved in these trials that go on? We have people, some who are in wheelchairs, some who and may have an intellectual or a physical disability.

And secondly, evidently, we do not have our young students. I don't know the age whether it's 25 or 35 and below that really were not part of the adult study, but is a study necessary before we can get to all of our college students? Or what is that status, Dr. Neuzil? Thank you very much.

Dr. NEUZIL. Yes, so really great questions. And it's very difficult because when we do a clinical trial, even trials as large as were done for these vaccines, 30,000 or more, you're trying to represent the population in which the vaccine will be used, but at the same time, you're trying to be safe. So, as I said at the beginning, you want to start with people who are least likely to have the ill effects and then move to older people, move to younger people. So we've moved very fast in adults, in older adults, in adults with chronic conditions. We haven't moved as fast in children. We're down to about age 12 with enrolling children in these trials.

For the examples you give, Down syndrome, many other developmental diseases, neurologic diseases, if the immune system is intact, we can extrapolate that these vaccines will work well in any of those populations as they have in these trials. It's really populations where the immune system might be compromised where we don't have the data yet. These vaccines are likely to be safe, but we don't yet know how well they work, and companies and governments and academics are moving into those populations.

Mr. SESSIONS. Good, thank you very much. And once again, just a suggestion you might want to do. Where we're having problems, I think that when you have the availability of the vaccine, that's the time to go in an area that either is rural, hard to get to, or where there is a reluctance, and move to large groups of people, and that way your numbers grow. I think I heard you say go away

from failure and move to success, make friends with success is what I agree with.

And it still—I mean, I'm not saying anybody is more important than anybody else in any of those communities, but I think that it gets the word out that when you go to a church, that they communicate with other people and say I got mine, you ought to get yours, and that's, to me, success also. Thank you very much. Chairwoman Johnson, I yield back my time.

Chairwoman JOHNSON. Thank you very much.

STAFF. Mr. Foster is next.

Mr. FOSTER. Thank you. Am I audible and visible here?

Chairwoman JOHNSON. Yes.

STAFF. Yes, sir.

Mr. FOSTER. All right. Well, thank you, Madam Chair, and to our witnesses.

You know, one of the lessons that I take away from COVID–19 is that we have to—much to learn from the rest of the world. So, Dr. Neuzil, in Britain, the E.U., Singapore, and other countries, they're making three significant choices differently than in the United States, and I'd really be interested in your reaction to them and whether we might learn something from them.

First, they are—many countries are making the choice to use available doses to get the first shot of vaccine into as many people as possible on the grounds, that most of the protection comes from the first shot. And my understanding is that there is, as yet, no evidence that the efficacy of the second shot is reduced if it is delayed. The British scientific modeling at least indicates that this approach will save many thousands of lives, and yet the United States has not—has chosen not to pursue this approach.

So my question on this first item is if the data from the U.K. and also the E.U., Singapore, and other countries confirms that there is a net public health benefit from giving the first shot first, should we consider adopting their approach, and when might we consider making this switch?

Dr. NEUZIL. Yes, so this is an excellent question. And, as I said, as with many of you, I wear different hats and I'm part of the WHO committees that's evaluated the U.K. vaccines and vaccines from other countries. And, you know, most vaccines do well with a longer interval. So what you're really weighing are the pros and cons of getting as many people vaccinated as quickly as you can with the possibility that some then may never get a second dose, may have a delayed second dose and have a period of vulnerability.

So some of these issues—you know, to me, the U.K. decisions are based on science and the U.S. decisions are based on science. Some of these have to do with your medical care system, your culture, your understanding of the populations, and your aversion of risk. And so——

Mr. FOSTER. OK. So, yes, those don't sound too scientific. You know, I'm just trying to understand. I think—but you concur that at least in terms of the modeling, getting the first shot first is a lifesaver? And then the question is you need to talk about the sociology of your country and your culture to decide if that nets out well. But from a scientific point of view, first shot first is a winner. Is that something——

Dr. NEUZIL. I think the U.K. approach is based on solid science. The further out you go with the second dose, you're getting to less solid science.

Mr. FOSTER. OK. And the second choice they're making differently is that Britain and other countries are manufacturing and testing not only mRNA vaccines but so-called self-amplifying mRNA vaccines, which can be manufactured roughly 30 times faster since they're effective in roughly a 30 times smaller dose. You know, for example, one—if the 1 microgram effective dose means that 1 liter of self-amplifying mRNA is enough for 1 billion doses, and so the factor is small and can be turned around rapidly.

So if this plays out, self-amplifying mRNA vaccines may be the technology of choice not only for rapid turnaround to manufacture if new virulent strands are uncovered, but also for vaccinating the seven billion people from around the world.

So my question, you know, in the U.S. we are not pursuing Operation Warp Speed-style speculative investment in manufacturing self-amplifying mRNA, and is this something that we should consider?

Dr. NEUZIL. So we should absolutely be considering second-generation vaccines. The self-amplifying mRNA vaccines are being supported through NIH, not through the——

Mr. FOSTER. Yes, but not at the manufacturing level, right? That's the—you know, what they are doing, you know, Shattock and these guys in I think Imperial College are actually, you know, producing nontrivial amounts of this even as they are being tested in clinical trials, which is something we're not doing, so that if it turns out that this is the killer technology, they'll be ahead of us and once again we'll be dependent on, you know, other countries. So that's—anyway, if you have a more—something more complete for me to read, I'd be interested in your letting me know about that.

The third thing that is that they're doing in England and elsewhere are human challenge trials. These are currently ongoing in the U.K. As you know, all vaccines are very rapidly tested on monkeys, and they get the answer in 1 to 2 months by vaccinating them and then deliberately exposing them to the virus. And we regularly use challenge trials—human challenge trials to test flu vaccines and other vaccines, but after a lengthy debate, we decided not to do that for COVID–19 and instead we're using much more lengthy, you know, conventional field trials, which have taken 6 months or longer.

And so the situation I'm worried that we're going to be in is that with a combination of self-amplifying mRNA and preapproved human challenge trials in England and other countries, the British are going to be able to respond much faster than we will to new strains or new pandemics, you know, perhaps in as much as 4 months, many months faster than the United States will be able to do it. And are we missing something? Are there opportunities here that we should be thinking about taking?

Dr. NEUZIL. Yes, so I have published on the human challenge controversy, and I come down on the side of—and I've done human challenge studies for influenza virus. I come down on the side until we have an oral antiviral that works, I feel that there's too much

risk. However, we should be developing the challenge models now, preparing the challenge strains so that when we feel it's safe enough, we can quickly move into those challenge studies. And truthfully, the large clinical trials gave us the answer on vaccine efficacy before the challenge studies gave us the answer on vaccine efficacy.

Mr. FOSTER. Yes, because of the approval process. If we had preexisting approved facilities ready to go, then you would have seen the same turnaround for human challenge trials that we currently see for primate trials. And so the question is should, for the next pandemic, we have the approvals, the ethical considerations all set so that we'll be in a technically limited schedule for rapidly testing those vaccines? Had we had that in place and chosen to use it, we would have known many months ahead of time that the vaccines that we are currently deploying were very effective and would have been able to ramp up production even faster than we did.

So I think that, you know, whether—this is a debate I think that should continue even after this pandemic has ended because of its potential use in future pandemics.

Well, I just want to thank you for everything you've done here and so——

Dr. NEUZIL. Thank you.

Chairwoman JOHNSON. Thank you very much. Our next——

STAFF. Mr. Garcia is next.

Mr. GARCIA. All right. Good afternoon, and hopefully you can hear me OK. I want to thank the Chairwoman for her leadership on this, Ranking Member Lucas as well, and the witnesses here. I really appreciate everything you've done for our Nation's security. It actually is an impressive feat to have gotten where we are with so many vendors so quickly.

I'd like to start with just a quick nuanced comment here before I ask my question. I think to Dr. Buttenheim, your comments earlier and I mean this in a very constructive manner, so please don't take this critically, but I think it's important when we're in an effort to try to get everyone to get vaccinated to the max extent possible, that we don't necessarily push to ask people to not ask questions. I think this is different than a normal flu vaccination. It's got much more publicity. The average American is much more aware and they're much more informed about what's going on.

So I think when we say we need to try to remove cognitive load from people's decisionmaking process or discourage them from having choices, I understand what you're saying, but we have to be eyes wide open that when we use language like that, some demographics will actually become either more paranoid about the vaccine or less trustful of the government. We talked about the Hispanic community with the use of Warp Speed, trusting the process less because of just the language.

So I completely understand what you're saying and I agree with everything at an academic and science level. I think rather than discouraging people from asking questions, we should make the answers to those questions more readily available and in the end state I completely agree with you they're all great products and you're going to be saving your life with any of these vaccinations.

Just a nuance, but I think it's important, especially in public forums, which these all are, right?

So my question is to Mr. Reed, and we can follow up with Dr. Neuzil. In California here we're close to the bottom, you know, five States in terms of distribution and the supply chain failure [inaudible] not only dosages here but distributed. What are the three or four biggest barriers to getting the vaccine to a more widely distributed network at the CVS, the Walgreens, the Walmarts, wherever you would have normally gotten your flu shot or your birth control or your prescription refilled? Besides the cold storage, because if we get through that or if there's a vaccine that is sort of amenable to wider distribution, what are the follow-on barriers, I guess, to ensuring that wider distribution?

Mr. REED. So for us we did not initially engage a lot of those—the pharmacies and some of the smaller providers around the State that could have direct access to Oklahomans. We did that because in the initial stages when we had loads of vaccine, we were trying to move toward mass vaccination to get the vaccine out there much quicker and start to try to have an impact on interrupting the transmission of COVID.

We did initially within the first probably 3 to 4 weeks start to send some vaccine to some federally qualified healthcare centers and some other smaller outlets if you will other than mass vaccination. And the challenge for them is systems in which they can run through that vaccine rapidly, so we started seeing obstacles of diluting the vaccine inventory in one area, and in doing so, vaccine would start to sit on the shelf.

So I think it's important for us to engage all these outlets, our pharmacy partners. We're pleased with the Federal pharmacy retail program that's coming on board. Right now, we have 76 pharmacies in Oklahoma that are participating in that, but it's smaller doses, 100 doses here, maybe 200 there. And I think it's important for us that we give them inventory and ensure they have inventory that they can run through in a week's time because they don't have the resources set up, large volume, mass vaccination, so we want to equip them with the vaccine inventory that they can run through within a week or so so that we can ensure that vaccine is continually moving from freezers into arms a rapid manner.

Now, when vaccine inventory comes up, we have more vaccine, I think we're in much better shape to push out more vaccine to those individuals so that we do have that access to that trusted source at the local level.

Dr. HUANG. This is Phil Huang if I could add one thing to that just—you know, because initially that was what our plan in Texas was. Like we have 800—over 800 local providers signed up to be part of that distribution, and, you know, then the State published a map with all these—you know, and some of the pharmacies that had it, then they were getting overrun with calls, you know, but they only had about 100 or so doses to last a week. And that's where there was a big pivot to moving to these hubs and the mass vaccination site. But that was sort of given the current situation, the limited availability. I think we're trying to get toward that. I think it sounds like the Federal pharmacy program is to start to get that supply going and testing it out. And once there is much

more availability, then that will be a big part of certainly our efforts also.

Mr. GARCIA. Great, thank you. You guys, I have a bad connection here, so I apologize. Thank you, Madam Chair.

Chairwoman JOHNSON. Thank you. Our next Member?

STAFF. Mr. Casten is next.

Mr. CASTEN. Thank you, Madam Chair, and I think I feel I speak for all of us that I'm going to keep my fingers crossed that I don't have any Wi-Fi issues. [inaudible].

I really appreciate you all having this meeting and the thoughts you've all done in this. I feel like there's our need to communicate vaccine safety in public forums, and then there's the reality that all of us have as Members that I think every time I fly back and forth, someone on the airplane or someone at TSA (Transportation Security Administration) says, you know, this vaccine was rolled out too quick and I'm a little bit nervous and we have all of these little, small conversations.

And I don't know if I do a good job of that. I feel proud that I think I convinced a police officer at O'Hare a couple weeks ago to go get his vaccine, but you never know how all that works.

Dr. Neuzil, I wonder if you could comment. I saw some analysis early on that I found compelling, but I don't—I'm not a doctor—that the—that a part of the reason these vaccines [inaudible] so quickly was because the spread of—the community spread of COVID was so much more widespread and so much faster than we thought it was going to be. Is that accurate? And if so, can you explain for the layman how that works?

Dr. NEUZIL. Sure. That is accurate. So, as I've said, we have large numbers of people in these trials. The minimum was 30,000 up to 45,000 or more. And the way we look at a trial is we do sample size and power calculations. So when do we feel confident that the answer we are getting is the right answer? And that depends on how many cases of a disease—in this case, COVID–19—we get.

So because—so we may do—I just finished a typhoid vaccine trial. It took 3 years because that's a much rarer disease. So because we had so many people in this trial and there was so much COVID, we had hundreds of cases of COVID–19 in a short period of time that could tell us how well these vaccines worked.

Mr. CASTEN. How much—just—I mean, this is an estimate, but how much do you think that shortened the trial time from what people were—you know, because early on, you know, everybody was saying this is going to be 18 months. Did this—does that substantially explain the difference?

Dr. NEUZIL. It does. I think there are two parts that explain the difference. We ended up enrolling more people, so initially, we were going to enroll 5 to 10,000 people, and we increased that to 30,000. And partly it was so we could get these subgroups, the older adults, the minority populations and have good numbers in every subgroup. So the size of the trials helped shorten it, and then the extent of the pandemic.

Mr. CASTEN. OK. So the second one—and I want to be a little bit careful on how I ask this because it's a politically charged question and I don't mean to get political, but this—I don't know how you have a public health conversation and not inject some politics

into it because people—especially when it comes out of the mouths of people like us.

The—and this builds a little bit on the—on your exchange you had with Mr. Babin. With almost a half a million Americans dead from COVID, I hope we never, ever again talk about how herd immunity is a good strategy to protect the population. At the same time, I think the—there is some—there is a reasonable question that Dr. Babin was asking you of how protected are you if you got exposed and were either non-symptomatic or had, you know, minor symptoms?

And I take your point that we don't really know enough yet about COVID, but I wonder, if you're comfortable, can you speculate at all on, you know, the broader classes of coronaviruses or RNA viruses more general? Is there—can you say anything generally about the level of protection you get from a vaccine as opposed to the level of protection you get from community exposure? How durable is one versus the other? Is there a point where you're satisfied that one is going to be better? Can you say anything generically to help us answer that question when people who have been, I think, infected by a very dangerous political idea ask us what's on its face is a reasonable scientific question?

Dr. NEUZIL. Yes, so I think there's two answers. One is just to clarify. When we talk about herd immunity, it could be through exposure to the disease. And as you've alluded to, that comes with the risk of people getting sick and dying from the disease to get that immunity. What we'd ideally like is herd immunity to come through the rapid rollout of vaccines. But in fact it will be both of those added together that give us that herd immunity.

There are certain examples where the vaccine is better than the natural infection. HPV, human papilloma virus vaccines, are actually better at protecting you longer than getting the infection. With coronavirus, I would say the jury is still out, but it appears that both infection—reinfection is rare before about 6 months and maybe longer. We just haven't had enough experience with the virus. And similarly, about 6 months after these vaccines are given, we're still seeing relatively high levels of antibody. So time will tell how long that immunity lasts from a disease and from a vaccine.

Mr. CASTEN. Thank you. And I'm out of time, would love to talk longer, but I really appreciate it. I yield back.

STAFF. Mr. Feenstra is next.

Mr. FEENSTRA. Well, thank you. Thank you, Madam Chair. Thank you, Ranking Member Chair, also.

First, I want to thank each of you, the witnesses and their testimony today. It's very important that we discuss how we can both expand access and reduce skepticism of the vaccine to get our communities back to a state of normalcy.

So, Dr. Neuzil, Iowa State hosts a Nanovaccine Institute which received *CARES Act* funding to pursue nanovaccine research and development (R&D). As you may know, this technology will allow patients to self-administer an inhaler to receive a vaccination, which is likely a preferable method as a lot of people hate needles. For healthcare providers, it reduces exposure to contagious patients and avoids cases where providers have to be forced to throw away

vaccines because, you know, there's just not the storage to preserve them.

Your testimony mentioned the need to invest and prepare for future pandemics. Can you share if this is very critical or how we can further invest into this type of nanovaccine type of treatment?

Dr. NEUZIL. Yes, so thank you for the question. And I stressed in my testimony both the basic science as well as the technology. You know, I think people thought that mRNAs as a formulation for vaccines, you know, a few decades ago just did not seem realistic. And you're alluding to delivery strategies, which is actually a top priority of the World Health Organization in terms of the next innovations for vaccines and vaccine delivery. So I can't comment on the specific of the technology that you are referring to, but I can wholly endorse again investments in technology, investments in vaccine delivery methods that are alternatives to injections.

Mr. FEENSTRA. Thank you, Doctor. And I just want to say I applaud Iowa State University and others for looking at nanovaccinations. But I just think that's the way of the future when we start vaccinating. Hopefully, we never have a pandemic like this again, but we always have to be very aware of our future and the research that's out there. And I think nanovaccines come to light as sort of the next way of giving vaccinations. So, again, Dr. Neuzil, thank you for those comments. I yield back the balance of my time. Thank you.

STAFF. Representative Lamb is next.

Mr. LAMB. Thank you all for being here, and I'm going to proactively apologize if you hear a 2-month-old baby screaming while I'm talking to you. He's being quiet at the moment, but he's on the other side of this wall.

Ms. Neuzil, I just wanted to ask you quickly, you emphasized the importance of the NIH research leading up to the pandemic that put us in a position to develop the vaccine so quickly. Is it fair to say in layman's terms that if we had not made those specific NIH investments that it could've added years on to our vaccine development process, in other words, that the money that we spent in past years probably saved us years of time getting to the vaccine?

Dr. NEUZIL. I would say it saved us perhaps a year of time because the protein vaccines are being tested now, and that's the other technology. But I think it would be fair to say, you know, it saved us 10 to 12 months certainly.

Mr. LAMB. Thank you. And, Professor Buttenheim, thank you for your work in our great Commonwealth of Pennsylvania. I wanted to ask you a little bit about the vaccine uptake so far in Pittsburgh and Philadelphia, sort of two opposite ends of our State. But the common thing that we have seen in both places and many people have [inaudible] is a higher rate of very serious infection, particularly in the African-American and Hispanic communities, but a lower rate of vaccine uptake. So, for example, the numbers I have here that in Philadelphia, only 12 percent of people vaccinated in the first weeks of the rollout were African-American while the city's population is 44 percent African-American and a much higher share were going to hospitals. In Pittsburgh, we saw the exact same thing.

So what we are looking at is how to make these specific investments that will fix this problem. Obviously, beliefs related to vaccine are a big issue, but if we just kind of set that to the side, would you agree that the massive investments we're about to make in community health centers, federally qualified health centers, and the hiring of 100,000 people directly through local public health departments, do you think that those will help us make an impact on these disparities?

Dr. BUTTENHEIM. That's a compound question with a lot of complexity.

Mr. LAMB. Yes, I want to—I'll give you the rest of my time to answer it. I just kind of wanted to set up that in the COVID rescue package that we're about to pass——

Dr. BUTTENHEIM. Yes.

Mr. LAMB [continuing]. There are billions of dollars for these hiring people and sending them to these areas of need.

Dr. BUTTENHEIM. Yes.

Mr. LAMB. And our goal is to, you know, start to correct this disparity and who gets the vaccine and who's at risk—most at risk for infection. Do you think that will work?

Dr. BUTTENHEIM. I think it will work, and I think the other ingredient that's needed when—the implementation of those programs is that we are smart about what barriers different people are facing. So when you give us the statistics for Philly, let's say, 11 percent of the people who have been vaccinated are Black but our city is 40 percent Black, there's a lot of heterogeneity, there's a lot of variation underlying that. Some of those people don't want to be vaccinated, and the kinds of programs and outreach and support we need to get them to make a good decision for them look one way. Some of those people, you know, never got the email because they don't have email or, you know, have been confused by the portals or aren't, you know, easily able to hop on a bus and get to the vaccine site.

So back to my earlier testimony about making it as easy and hassle-free as possible, that's a different kind of intervention. So just like we want to, you know, accurately diagnose whether someone has COVID, we also want to accurately diagnose where people are in that journey let's call it to getting vaccinated and use those incredible Federal dollars that support to target and tailor interventions to help people along the journey.

A specific example——

Mr. LAMB. I think what I was trying to suggest is that the—by spending the money in this way directly to local public health departments and community health centers, we're going for a geographic distribution of manpower, you know, or person power rather than saying—you know, using all the money on FEMA setting up mass vaccination sites in every city that you have to transport to. So I just wanted to kind of get confirmation that you think that goes along with what you're calling it, making it easier, which could then help have kind of a snowball effect for people in those communities to get——

Dr. BUTTENHEIM. It does. And, you know, FEMA might work great in some jurisdictions, and the stadium might work great in others, so, you know, figuring out what assets we have locally to

leverage is really important because it's not one solution. You know, we know that pharmacies have worked differently in different areas.

Mr. LAMB. Great. Go Quakers, and thank you for participating, everybody. Madam Chairwoman, I yield back.

Chairwoman JOHNSON. Thank you.

STAFF. Mr. Obernolte is next.

Mr. OBERNOLTE. Well, thank you very much, and I want to thank our panelists for participating in the hearing. I think I speak for most of the Members of our Committee when I say that the development of human vaccines is probably one of the crowning scientific achievements of our human civilization, and that in the science of vaccination, that development of the coronavirus vaccines is probably going to rank as one of the crowning achievements in that field of science.

So, you know, having said that, I think it's really important for us to take a retrospective look at the development of the vaccine and our efforts to deploy it so that in the future the people that sit in our seats and make these decisions will have good information to rely on so that we can do it even better next time. And so I think that that's the line of questioning I like to pursue.

First of all, I have a question for Dr. Huang. I think many of us were encouraged by Pfizer's announcement yesterday that its vaccine might be stable at higher temperatures. Can you tell us what implications that has for our efforts in getting the vaccine distributed quickly?

Dr. HUANG. Certainly, the requirements for the ultracold freezers is a challenge. It's one of the logistic challenges for getting it out there. You know, it is surmountable, but it would certainly make it easier for delivery. Thus far, our local health department has been primarily dealing with Moderna, but we have partners that we're working with for that ultracold storage, so I would think certainly in rural settings and other settings certainly would simplify the ability to get vaccine out. And as Dr. Buttenheim mentioned, you know, just getting—making it simpler, addressing these sort of things—the barriers that we can, that would be one of them.

Mr. OBERNOLTE. Thank you very much.

And, Dr. Neuzil, I had a question for you. You know, it's very interesting that our States have kind of served as the laboratory of democracy during this epidemic because many different States took different approaches to economic shutdowns and efforts to reduce the spread and transmission of the virus. And, you know, it's kind of a scientist's dream, right, because we have lots of different settings that we can look at statistical evidence and figure out what worked and what didn't.

And I think a growing body of research is indicating that the virus followed similar trajectories in States with very different approaches to shutting down their economies. So can you tell us your view of what that means for future epidemics? Because we know that this is going to happen again. This won't be the last time. In the future, should we have pursued the policy that we did regarding economic shutdowns?

Dr. NEUZIL. Yes, so thank you for the question. It's a complicated question, and my conclusion might be a little different than yours.

I think that there are so many variables. We scientists like controlled experiments, so if I'm going to do a controlled experiment, I want everything to be the same except for one variable. You know, this group wears masks and this group doesn't. And as we know, a lot of the behaviors and actions that were taken tracked together. There is in fact evidence, and the CDC has provided evidence, that many of these mitigation measures did work. You know, certainly the masking, now the double masking, the social distancing, and the limiting large crowds has been shown to work. Again, it is hard to dissect what single variable might be contributing there.

So I think it's going to take a scientific approach, and we should have that scientific approach to how these differences—what's worked best, where did it work, et cetera.

Mr. OBERNOLTE. OK, thank you. Yes, I was talking less about masks and social distancing where the science is more clear, as you say, and more about shutting down, for example, indoor dining, forcing employers to do remote only instead of having controlled office environments, you know, where we've got States with very different approaches like Florida and California that seem to have similar trajectories of the spread of the virus and recovery from the epidemic.

And last question for Dr. Buttenheim, I was fascinated by your testimony the vaccine hesitancy and distrust of government. And I completely agree with you that this is less a discussion about virology and more of a discussion about psychology when we're talking about overcoming vaccine hesitancy.

However, you know, I think that something Dr. Huang said about distrust of government really resonated also, which is that people don't want to feel like their government is forcing them to get the vaccine, and I think we have to be very cautious about that because, in a way, we've said we're not going to make it mandatory, but in other ways we're kind of telling them that they are if we're telling them that their children had to be vaccinated to return to school, if we're telling them that they have to be vaccinated to get on a commercial aircraft.

What are your thoughts? You know, how do we tread this path toward steering people in the right direction to get vaccines but not alarming them by requiring them to get it and enhancing this distrust of government?

Dr. BUTTENHEIM. Yes, this is a question we are getting a lot, sort of where do mandates potentially fit in with this vaccine. And most of my research pre-COVID was on the childhood schedule and whether you had to vaccinate your kid to go to school—to have a kid go to school, so very relevant. You know, fortunately, just regulatorily, we're still in emergency use authorization and we don't actually have to contemplate mandates quite yet. We are very unlikely to mandate a vaccine that's under an EUA.

But it's going to be a fine line. I really think about this as not trying to get 100 percent or 80 percent of people vaccinating but trying to make sure that everyone's been reached with information and support to make the decision that's best for them. That's really different from how I talk about—think about sort of parents vacci-

nating their kids. I just like—I want you to get your kid to get the measles shot, sort of, you know, end of story.

But we are obviously going to have situations. We mandate flu vaccine for healthcare workers in some settings in some States. There are going to be airlines that are going to say, you know, just as you have to have your yellow fever vaccination to travel to certain areas, you have to have your COVID vaccination. What schools and colleges do about students coming back, especially, I think it's going to be more relevant for colleges with congregant living maybe than for elementary schools. But those—you know, luckily, we have sort of templates for those conversations.

But for the general public right now, this—there should not be even the feeling of mandate or must. You know, maybe there can be some language around should or it would be great or we're really gung ho about this and we hope you are, too, but we can absolutely steer clear of mandate language for now.

Mr. OBERNOLTE. OK. Well, thank you. Well, my time is expired, but thank you for that testimony. I completely agree with you. You know, I know my constituents pretty well. If they get the idea that they're being mandated to do this by the government, it's just going to enhance distrust, and it's going to make vaccine hesitancy worse, which is the wrong direction to go.

Dr. BUTTENHEIM. One hundred percent.

Mr. OBERNOLTE. So thank you very much, and, Madam Chair, I yield back.

STAFF. Ms. Stevens is next.

Chairwoman JOHNSON. Unmute.

Ms. STEVENS. Can you hear me?

Chairwoman JOHNSON. Yes.

Ms. STEVENS. Great, fabulous. Thank you, Madam Chair, for this phenomenal hearing, couldn't imagine a better way to kick off the Science Committee of the 117th Congress. And thank you to our expert witnesses.

I'm talking to all of you from snowy Michigan where the President is today. He's in Portage, Michigan, visiting Pfizer, the place where the first vaccine rolled out to our great expectations.

Dr. Neuzil, I want to thank you so much for your testimony, which was really thorough and historic in nature. And certainly today we've spoken a lot about the efficacy of the vaccine, and I know that's a topic on everyone's mind from my constituents in Michigan's 11th District who are working to get access to that vaccine.

But I would just love to talk to you a little bit more about the vaccine development of which Dr. Baird also touched on with his very specific questions around that mRNA but more so to just backup for a minute because one of the things that we focus on in this Committee are the scientific achievements. We focus on the milestones.

Many of us recall—and I say many because we've got some newbies in Congress on this Committee this time, freshmen, but those of us who were in the 116th Congress recall that the first thing that we voted on—and it was all of Congress, completely bipartisan, immediately signed into law, done at the beginning of March was the original money to go into the development of this

vaccine, to go into the R&D of the vaccine. And here we have it where we got it within the year, you touched on Operation Warp Speed.

But for somebody who is in this State, have you taken any moments to just pause and, if you have, what has been the thought? Is this something that surprised you? Was this expected? Did you think we were going to be able to get this done before the end of the year?

Dr. NEUZIL. Yes, that's a great question, and I've been involved in a lot of vaccine development, very large public-private partnerships in my career. And as you've said, this one is absolutely historic. I think last year at this time we were all saying, you know, best-case scenario we might have a vaccine by the end of the year. When you say stop and reflect on December 31st, I got my vaccine, and that was really a very powerful moment for me personally that within the same calendar year I actually received a vaccine when I was there at the beginning for development.

So I think without—certainly, without the resources but without the vision, you know, without the leadership of bringing a diverse community together, bringing partners together with different skill sets united to a common goal was absolutely key to this happening.

Ms. STEVENS. Great. And I think one of the privileges of being on the Science Committee last term—and it's worth reflecting on—we in March voted for the funding of the vaccine, voted for a second package around increasing our SNAP (Supplemental Nutrition Assistance Program) benefits for food assistance, paid family leave provision, and more money for the testing, and then we voted for the *CARES Act*. And being on the Science Committee, we got additional dollars out to our Manufacturing Extension Partnership network, yay, and we also got money over to the National Institute for Innovation in Manufacturing Biopharmaceuticals known as NIIMBL. And this is part of the Manufacturing USA network.

And, again, we talked a lot today about the distribution. This has come up in previous questions around where the supply is, how long the supply can last. And I just remember that conversation with Mr. Kelvin Lee, their Director, and asking him about the ability to distribute this vaccine given what we were seeing in the early stages. We remember about 13 months ago testing wasn't available.

And so I don't know if you all want to rate, you know, in terms of how this vaccine has gotten distributed, but if there's anything else that you'd want to reflect on in terms of getting the shots in the arms of, you know, I would say with my residents, but the American public and in particular what we're seeing with those who have adopted the models of working and coordinating with the pharmacies directly, those States versus those who haven't it. And this is just if anyone has anything left to add. I know I'm—Madam Chair, I'm right at my time, so, we might have to do it for the record, which would be fine, so I'll yield back.

STAFF. Ms. Kim, next.

Ms. KIM. Thank you. Thank you, Madam Chair and Ranking Member Lucas. I want to thank you for holding this very important hearing on the science of COVID–19 vaccines. I don't know if all of you are having technical difficulty like I have where you're in

and out because of that. But I also want to thank our very patient and expert panelists for doing this and answering our questions. I look forward to working with the Members of the Committee on both sides of the aisle to ensure that the United States stays at the forefront of science, research, and development, and innovation.

This is really exciting for me as a freshman being able to serve on this Committee because COVID–19 is affecting communities in different ways. And this so-called [inaudible] and individuals [inaudible] to weather the economic crisis much better than the low-income and minority families.

Unfortunately, the COVID–19 pandemic has also had the biggest negative impact among minority [inaudible] that minorities and low-income students have suffered the most as schools have [inaudible] with virtual learning. And the January 25th study by PACE (Policy Analysis for California Education), which is an independent, nonpartisan research center based on California found in a study of [inaudible] that, quote, [inaudible] students, especially low-income students [inaudible] language learners are falling behind more [inaudible] than others, end quote. Clearly, this study problematic because many of the students are falling way behind on math and reading skills, which are obviously critical skills if our country wants to have successful STEM (science, technology, engineering, and mathematics) students.

So, moving forward, we need to ensure that we have a seamless vaccine distribution so that we can get to that point where anyone who wishes to get a vaccine can have access to it. We must also ensure that our research and development of vaccines are keeping pace with the variants that have been recently found.

So I would like to pose a question to, first, Mr. Reed. Talking to my students in California's 39th District, it seems individuals often do not know which entity in the State is administering the vaccine distribution. And there's a lack of communication between the State and local government. And in your testimony you discuss how partnerships with regional health directors, family health departments, and other local partners are critical in determining the best communications approach for local constituencies as they understand what would work well within their respective communities. So could you elaborate further on these [inaudible] and provide examples of how different constituencies communicate with their residents?

Mr. REED. Certainly. And I was having a little trouble hearing you, so hopefully I heard the question. But, yes, our local partnerships have absolutely been key in our vaccination rollout. We've been very clear having a centralized planning, but we depend completely on a decentralized execution of that plan.

I'll give you an example. We are rolling out to teachers starting next week, and from the State level we have just identified that those are the—that's part of the next group that is coming online for vaccinations, and then we allocate vaccine to our health districts around the State. We leave it to them to work with partners on to develop those plans. In some cases, they are setting up specific pods that are for school districts and their teachers. In some cases, they are using strike teams that will go to some of these districts in order to vaccinate the teachers. In some cases, they are

pulling multiple districts together to come together for one pod. Some areas, they are using contractors that can go out and use strike teams. We've essentially left it up to them locally to determine what they can do best because they understand those resources. They understand the needs of their partners. They're in constant communication with those partners, and that's really what helps them to understand how best to move forward with vaccination efforts. I hope that answers your question.

Ms. KIM. I'm pretty sure you did. My apologies. As soon as I posed that question, my computer froze, and so I had to log back in. And sorry we're having this problem. But thank you for answering that. And I do have a follow-up question if I still have some time. Madam Chair, how much time do I have?

STAFF. Time has expired.

Ms. KIM. Thank you, I yield back.

STAFF. Mr. Sherman is next.

Mr. SHERMAN. Thank you. I want to thank [inaudible] distribution [inaudible] disadvantaged communities, communities of color, rural communities [inaudible]. There's one other group that has a very low level of acceptance of vaccine, and that is Trump voters. And I'm hoping that some of the Members of this Committee who have a better personal relationship with the former President than I do can prevail upon him to go public with his support of these vaccines and that [inaudible] when members of the Trump family get their vaccination [inaudible] wants to be vaccinated or thinks he shouldn't be because he's already had the disease if he were present where other members of the Trump family were getting the vaccine, that would go a long way.

I want to focus on the shortage of vaccine. Now, one concern I have—and this is the only thing I disagree with Dr. Fauci on—is he's been on the shows talking about how certain steps we could take that would conserve vaccine—studied how we could conserve vaccine [inaudible] because by the time we get the results from most Americans, all Americans will have access to the vaccine. It's not enough to vaccinate just the United States. We've got to vaccinate the world. That's a matter of world leadership. It's a moral issue. It's an international economics issue. But also, as Dr. Neuzil pointed out, it relates to our health. Every time anyone in the world gets this disease, [inaudible] a chance to replicate, mutate, and perhaps come back to the United States in a form that we can't deal with. So we do have an interest in the entire world being vaccinated as quickly as possible. It means not stopping our efforts to maximize the efficiency and production of the vaccine just when we all get vaccinated in the United States.

But one issue here, while we do want to vaccinate the whole world, we're most interested in vaccinating the United States, is that there's vaccine being manufactured in the United States that is being exported. And we have [inaudible] Trump Administration didn't, and so Pfizer and others signed contracts with other countries. We could legally interrupt that with the *Defense Production Act* [inaudible] we want to maintain our relationship with our friends [inaudible] being manufactured in the United States is being exported [inaudible]? Do any of our witnesses know?

[inaudible] another question. We can research to determine whether one Pfizer [inaudible] and one in the late summer is enough, whether 1/2 or 1/3 of the current dosages will be effective for people under 65. Those studies are going on now. They should've started a few months ago.

But I want to focus [inaudible] throw the bottle away after that. [inaudible]. God knows how much vaccine was wasted. Even now, I'm told that there's a half a dose available in this bottle, and then you get the next half a dose available in [inaudible], same manufacturing lot [inaudible] in that bottle for the full dosage, we throw it away. Is that the—does any [inaudible].

STAFF. Mr. Sherman, much of your audio was cutting in and out, so I think the witnesses weren't quite able to hear the questions exactly.

Mr. SHERMAN. I'm going to turn off my video and hopefully my audio will improve. Is my audio better now?

STAFF. It does sound a little better, sir, yes.

Mr. SHERMAN. OK. I don't know if I have the time to restate the question, but I'll ask any of our witnesses, are you familiar with the process by which if there's maybe 1/3 or 2/3 of a dose left in a bottle after—that you throw that bottle away rather than using some of the serum in this bottle and some of the serum in the next bottle, that next bottle being with the same manufacturing lot in order to administer a full dose? Are we throwing away 1/3 or 2/3 of a dose every time we finish a bottle?

Dr. HUANG. This is Phil Huang. I mean, I would say that, you know, we have certainly been very diligent in getting as much out of each vial as we can and have been getting more than what was on the [inaudible]——

Mr. SHERMAN. That was my second question. But let's say——

Dr. HUANG. But in terms—yes.

Mr. SHERMAN [continuing]. What you can get out of the bottle is half a dose, you can get half a dose out, you can't get a full dose out of the bottle. [inaudible] from the same manufacturing lot. Do you throw away that half dose in the bottle that has already been mostly used?

Dr. HUANG. You know, I—yes, I haven't specifically heard regarding that availability. We have tried to get different syringes that make it——

Mr. SHERMAN. Right.

Dr. HUANG [continuing]. Easier to——

Mr. SHERMAN. Not——

Dr. HUANG [continuing]. Maximize the amount, but——

Mr. SHERMAN. We've got the better syringes. We've stopped wasting whole dosages, but we are still wasting, on average, half a dose per bottle. So that would mean 1/12 of the serum is being thrown away. And that's—thank you, FDA. I think they'll correct that months from now.

And I yield back.

STAFF. Mr. Weber is next.

Mr. WEBER. Thank you, sir. And, Madam Chair, thank you for having this great hearing. And you, too, Mr. Ranking Member. We appreciate it.

Gosh, I don't know where to start. Let me do it this way. I think Alison Buttenheim, in your exchange with Dr. Bera, you said the best vaccine is the one you can get tomorrow. And so people are concerned about the—we've got two different kinds of vaccines, right? We have Moderna and Pfizer. How close are we on Johnson & Johnson? Do we know?

Dr. BUTTENHEIM. I think their EUA hearing is next week, but we also know that there will not be the amount of supply for that vaccine that we have for Pfizer and Moderna, so it's not like we'll suddenly have another 1/3 of, you know, supply that will be——

Mr. WEBER. Right.

Dr. BUTTENHEIM. We've been told in Philly we will have much more limited supply of J&J.

Mr. WEBER. And this may be a question for you and Dr. Neuzil I guess do we have a comparative analysis? In other words, how successful is the Pfizer and how successful is the Moderna? What are the numbers there that have been vaccinated? What are the numbers of adverse reactions? Do we have that kind of information?

Dr. BUTTENHEIM. I shouldn't speak to post-marketing surveillance. It's not my area of expertise, and unfortunately, I think Dr. Neuzil had to drop off. But in general, you know, the trials continue and that we still, through our different monitoring and surveillance systems, the local folks here who are vaccinating locally can attest to this, gather all sorts of adverse event data and we're starting to accumulate the longer-term safety and efficacy data. That's ongoing and will be for months.

Mr. WEBER. OK. In her exchange with Mr. Tonko, I think she said herd immunity was around 75 to 80 percent. I guess that's the ideal, herd immunity, quote/unquote. So where are we now? Do we know that?

Dr. BUTTENHEIM. Well, we know the number of doses that have been delivered, and we know the number of people who have had one dose versus two doses. The mystery number is how many people have actually had COVID and what—how much do they contribute to herd immunity meaning how long are they protected. I've seen ranges from about 20 to 40 percent—it's a big range—of residents in the United States have some form of protection now either through prior disease or through vaccination.

Mr. WEBER. OK. And you talked about the need for local jurisdictions to be able to track that progress.

Dr. BUTTENHEIM. Yes.

Mr. WEBER. Are we finding different jurisdictions, Texas or others, do things better and are tracking this better? Is there a model jurisdiction out there that you would recommend?

Dr. BUTTENHEIM. I should let Dr. Huang and Mr. Reed weigh in on what they're doing. North Carolina has a great dashboard. Many States have dashboards that are not being run by the government. They're stood up by, you know, talented citizens who want to be able to see this. But I think—again, we need to sort of rapidly share best practices and how to just collect and analyze and display that information to guide decisions.

Mr. WEBER. OK. Well, thank you for that. And I do want to hear Dr. Reed and Dr. Huang. Dr. Reed, what say you?

Mr. REED. So one thing I would say is that we're missing a key piece of information. We start to look at our vaccination rates in our different counties and try to put that out there so that we have an idea of the rates plus the amount of disease out there. Our Federal allocation that comes into the State, we don't have any visibility on what that data shows us, so that's been a source of frustration. We have a significant tribal population in Oklahoma. We have our Veterans Administration centers, so Federal allocation comes into the State, but it doesn't go into our immunization registry, so it's a blind spot for us. We don't know what those vaccination rates are contributing to in some of our counties.

So while we are putting out information about how we're doing at a county level and now we're looking at adding on to ZIP Code level to put that information, we really need additional data from the Federal allocation so we can better understand vaccination rates within our State because that data will help drive our decisions on future allocations and future efforts.

Mr. WEBER. Well, thank you. Dr. Huang, I've got about 20 seconds.

Dr. HUANG. Sure. And we've actually been working with a local group Parkland Center for Clinical Innovation, have been processing both our testing positivity results, as well as our vaccination, and so we've actually—they've been doing some projections based on the number of confirmed and probable cases but then also projections of how many other cases geographically might be out there. And we've looked at it by ZIP Code and also by census tract. Some of the ZIP Codes and census tracts may be about 30 percent perhaps protection and even up to 60 percent in some of the areas, but that's still preliminary data that we've been working on.

Mr. WEBER. OK, thank you, and I appreciate that. Madam Chair, I yield back. Thank you.

Chairwoman JOHNSON. Thank you.

STAFF. Ms. Ross is next.

Ms. ROSS. Great. Can you hear me? Great, thank you.

Well, perfect timing, Dr. Buttenheim, because I'm from North Carolina. I don't know if you saw me kind of doing my little happy dance about our dashboard. And I just this week had a roundtable with community health providers with our HHS, with NIH, and with our—all of the local hospitals here. And I'd like you to tell the folks why our dashboard is good and would be a model. We didn't have a fast start. We had some difficulties, but I believe we're catching up. And if you could talk a little bit about the dashboard. And then I have a couple of other questions that came out of that roundtable.

Dr. BUTTENHEIM. Sure. And I should clarify. The dashboard I had in mind when I said that is one of these that was set up by academic team Dr. Paul Delamater at UNC (University of North Carolina), and I actually don't know how well it complements the State dashboard.

But what's important to see for me is, for example, in Philadelphia, it is less helpful for me to just see how many doses have been given to different sociodemographic groups. I want to see rates. So, you know, we talked earlier about, you know, 11 percent of the doses in Philadelphia have gone to African-Americans, but 40 per-

cent of the population is African-American. Show me that in rates so I can very quickly see only 3 percent, you know, of this group versus 15 percent of that group.

And then the granularity is really important, especially for jurisdictions that are going to be using something like the social vulnerability index that was mentioned earlier to do equity-based allocation. You need to see that at a pretty fine level of detail. ZIP Code is OK, census tract actually better. So right now, for example, the—you know, you can sometimes see maps that show sort of ZIP Code of doses given but by provider, not by patient. So, you know, we need to use those data. And then it needs to be dynamic. You know, lots of us are checking these dashboards every night, and, you know, numbers that are really bumpy because we don't report over the weekend or, you know, 3- to 7-day lags are hard. So it's real-time data, granular data, and data that are presented as rates so that we can do comparisons are what's most useful.

Dr. HUANG. And this is Phil Huang. Could I add one thing in there? Just, I mean, it really highlights the need for investment in our data systems. You know, it was—it came out during our testing data and all of that, but then also, you know, as we've been going out with the vaccinations, the mass vaccination centers, you know, getting the reporting into our State ImmTrac systems. We were during the first weeks having to do it all paper-based, and so it really limited the timeliness, the amount of data we could get back. Now we've transitioned to a paperless system using QR codes. But all of these, you know, it shows how much there's been neglect of some of these basic data systems and infrastructure for public health that really are so key.

Ms. ROSS. Thank you so much. One final question. In that same roundtable we heard, and somewhat sadly, that there was vaccine hesitancy among healthcare workers for them to get the vaccine. And that's concerning obviously because they are in contact with patients, but it's also concerning because they're supposed to be our Ambassadors to good health care. Could you tell us what you've been learning about convincing all of our healthcare workers to get the vaccine?

Dr. BUTTENHEIM. So, you know, this was a really important area of focus because that was the first group that we vaccinated, so we had data quickly on sort of which groups were saying yes and were saying no. I will say the same race-, ethnicity-based disparities that we see in the general population, we got a signal about that in healthcare workers, also by occupational group, which is of course correlated in many cases with race, ethnic groups as well. And one area where we're particularly seeing gaps is in the long-term care or nursing home workforce.

So I think—the—there's nothing sort of different about how we're going to approach this. Some of this, again, is going to be these longer-term, more intensive face-to-face conversations, making sure people have repeated opportunities—it wasn't just like there was this one chance to get vaccinated and you missed it—and figuring out who are the sort of persuasive peers or the validators that can help bring people along.

Ms. ROSS. And are there—finally, are there any incentives to getting vaccinated? How does that work? And I know that there have been some folks in North Carolina who have looked at that as well.

Dr. BUTTENHEIM. It's hard to do justice to it in 20 seconds. Incentives are very controversial. You know, does a $20 gift card work? Does a $1,500, you know, big investment that looks like relief money work? My personal opinion as a researcher is that this is not—this is not a great place to use incentives. And one reason I'll say about that is that one thing incentives can do is signal to someone that the behavior you're incentivizing is difficult or risky or hard or unpleasant for some reason, and I think that's not the message we want to get with this vaccine. But I know there are lots of interesting programs and experiments who have tried incentives.

Ms. ROSS. Thank you. And I yield back.

STAFF. Representative Moore is next.

Ms. MOORE. Thank you so much, Madam Chair and Mr. Ranking Member. I have really, really enjoyed listening to this panel of experts. I have more questions than I do time, so let me just get right to it.

Madam Chair, I was—want to enter a couple of things into the record without objection? I would like to enter a Pew Center research report recommending quite frankly that pregnant women receive the COVID vaccine, the American College of Obstetricians and Gynecologists—I'm sorry, the—it's a—I want to—the American College of Obstetricians and Gynecologists has observed that pregnant women are more vulnerable to severe illness and death, and they recommended that they get the virus. Then I also want to put in the record a study from the Pew Research Foundation that talks about the—about the age gap between whites and other minorities. Without objection, Madam Chair?

Chairwoman JOHNSON. So ordered.

Ms. MOORE. Thank you. Thank you, Madam Chair.

I put those things in the record to tee up questions, and I'm not sure who is best to answer, but I'll start with Dr. Zydema. You know, when we talk about vaccine hesitancy, let me flip the script a little bit and say maybe some of the hesitancy has got to do with some of our organizations, the World Health Organization, the CDC. They have not been very clear about it. And so if you're pregnant, you may be hesitant to take the vaccine. You might not even be eligible based on States' priorities. I was wondering if you could comment on that briefly.

Dr. BUTTENHEIM. And, Representative Moore, to whom are you directing that question?

Ms. MOORE. Yes, Dr. Neuzil. I'm sorry, Dr. Neuzil.

Dr. BUTTENHEIM. Oh, she unfortunately had to—she had a hard stop at 2 o'clock p.m. so we are without her——

Ms. MOORE. OK. Well, I don't care. Dr. Buttenheim, I'll take you.

Dr. BUTTENHEIM. Not my area of expertise. I'm going to pitch it to a medical doctor.

Ms. MOORE. All right.

Chairwoman JOHNSON. We can submit your question——

Ms. MOORE. OK. I'm sorry. Dr. Huang, anybody. I'm running out of time.

Dr. HUANG. Yes, you know, I guess what I was hearing, you know, some—that the mixed messages or the lack of clear messages perhaps causing some of that hesitancy. I mean, I think that goes back to the point we do want to, you know, address the facts, you know, get—share them in an honest way, build that trust. Sometimes things aren't always clear, but then there are the recommendations that are resulting from that, and I think that, you know, making that clear and building that trust is part of building that—addressing the vaccine hesitancy. But——

Ms. MOORE. Thank you, Dr. Huang. I mean, because the reality is is that vaccines have been administered to pregnant women in the past, and there haven't been any bad outcomes that we know of.

The second thing I put in the record was just—I just want to point out that while we talk about all of the hesitancy among Blacks and other minority groups—I know we have our witness here from the Native American tribe. I just want to point out that the most common age among white people is 58, and that's double what the common age is for Black people, which is 27. And if you're just going to line up Hispanics and pick out a random Hispanic person, they're much more likely to be age 11. If you put that in more scientific terms like the median age, the median age of white people in the United States is about 44. It's about 34 for African-Americans, 10 years difference, and then 30 for Hispanics. So, you know, I don't—you know, so if a State rolls out a plan to vaccinate all the 65-year-olds first, that's fine. Then we're going to move down to the 55-year-olds. You know, you could be inadvertently, I would say, agreeing to vaccinate white people first. White people or the baby boomers, I'm 69, but literally, you know, my son, who got off the respirator on December 31st and is age 43, is wondering is it ever going to be his turn? So I just want a comment on that in my seven seconds.

Mr. REED. I would say for us——

Ms. MOORE. OK. Go on.

Mr. REED. Well, I would just say for us in Oklahoma, the—really the only age disparity that we created was we cutoff at 65-plus, and that was based off of the morbidity data that we had in Oklahoma. And then at this point we're moving to any adult under 65 with comorbidities. And we want to make sure that we are reaching out to our underserved communities, our communities of color, and work with our partners to make sure that we are reaching out to these communities and ensuring that we do get a level of vaccine equity that may not be based off of just the broad statewide plan. Again, we want to push that locally when we know that our local partners recognize the needs in their communities, and they can reach out to those individuals and help us to reach that level of equity we need to reach.

Ms. MOORE. And, Madam Chair, my time is expired. Thank you for your indulgence, and I yield back.

Chairwoman JOHNSON. Thank you.

STAFF. Is Mr. Kildee available?

Mr. KILDEE. Yes, I am.

STAFF. OK, you're next, sir.

Mr. KILDEE. OK. I got to start my video. There we go.

All right. Well, first of all, thank you to Chair Johnson for holding this meeting. I'm so happy to be a Member of this Committee. And this hearing, my first hearing as a Member of the Committee, completely affirms what I had hoped for, that we would have a meaningful and really fact-based conversation about this really important subject. So thank you, Chairwoman Johnson, for your leadership in holding this hearing.

I have been in and out of the hearing. I just had to jump off for a minute to wish my 15-year-old nephew in Ireland a happy birthday on Zoom, so I may have missed a bit. And some of this may be redundant, but the subject is so critical. I apologize for any redundancy here.

Two of the communities that I represent are Flint and Saginaw, Michigan, both majority minority communities. And, as we know, African-Americans are at significantly greater risk. I have lost several friends, four very close friends that were lifetime friends, to COVID, so this is obviously not just a big issue for us as a country but it's very personal for many of us.

For the people in my hometown of Flint, as you might expect, this trauma comes in addition to the ongoing trauma of the water crisis that many are still recovering from. And at the core of that crisis was a complete breach of trust between government and the people of the community. The lack of trust between the people of Flint and public institutions is even worse than it is in many other communities. And so many of you mentioned in your testimony the skepticism—natural skepticism of the—of communities of color for any institution but particularly medical—the medical system because of the legacy of exploitative research. So this is not going to be easy to overcome.

And I wonder, maybe starting with Dr. Buttenheim, if you could comment as if you're speaking to the people of Flint and Saginaw, what can you tell us, what can you tell them, what—especially for leaders in the community, what are the evidence-based actions that leaders should be taking to encourage vaccine uptake and to address the distrust in communities of color? I know you've addressed this, but if you could just reiterate that for the people I represent, it would be really helpful.

Dr. BUTTENHEIM. Sure. And the thing I put at the top of the list is to listen. You actually don't have to do all the talking and all the information conveying up front. A lot of this is tell me what's going on, tell me where you are with this, tell me about past experiences that have made—you know, have given you concerns about this vaccine, what questions do you need answered. I do think listening can go a long way here.

And then the other piece which will not be a surprise to you with Flint is of course to find those trusted sources, you know, who will people listen to? And if those people can share their why, what's your why, you know, if they can talk about their decision to get the vaccine in—you know, in sort of dialog with people, they can go a long way, too.

Finally, to the extent local and State health authorities can be transparent about the conversation and acknowledge—you know, I think if you just kind of skip over the fact that we maybe don't have trust in public health authorities, like you're already just be-

hind the 8-ball. I don't know if that's the right metaphor. I'm not a sports person. But incorporating the recognition and acknowledgement of those—of the history and the present of structural racism and institutional racism and making that part of this conversation can also be helpful.

Mr. KILDEE. I wonder if you could also, Dr. Buttenheim, zero in a bit. I was really interested in your testimony. I thought it was well-presented, the five points, but the third point you made about keep doing the hard stuff, I mean, this sort of falls into the category of hard stuff.

Dr. BUTTENHEIM. Yes.

Mr. KILDEE. If you could talk about how this relates to that point, that would be helpful.

Dr. BUTTENHEIM. Yes. Sure. And I will say this is, you know, science happening in real time. My guidance on this and my instinct is really coming from following some I will say mostly Black female physicians on social media and some I know here at Penn who are doing this work on top of everything else they're doing by having conversations every day with patients, with people they run into in their daily lives. I'm thinking of Dr. Kimberly Manning at Grady Hospital in Atlanta. I'm thinking of Dr. Gina South here at Penn Medicine. And in their—like literally in their Tweet threads about this they provide templates for how to have these conversations. And the first thing you realize is, wow, these women are very powerful and very effective at listening and reflecting and sharing their own stories, and, boy, this work is hard. And again, you couldn't turn this into something that, you know, you could suddenly reach 1,000 people with because it is these one-on-one conversations.

So that's sort of where that point No. 3 came from in my testimony as recognizing the power of that and also the limitations in that we—it's hard to scale and it's hard to keep asking of some of these people to keep doing this labor.

Mr. KILDEE. Great. Well, I really appreciate the testimony. I appreciate, again, as I said, the Chairwoman for holding this hearing. I wish I had an hour to ask questions because we have so many, but this has really been helpful. Thank you. I yield back.

STAFF. Ms. Wild is next.

Ms. WILD. Thank you so much. I really appreciate it. I would like to join in Mr. Kildee's comments regarding this Committee. I am new to the Committee. I am thrilled to be on it, and I think the very substantive nature of this hearing is exactly what I was looking for in terms of a committee, so thank you very much, Chairwoman.

My question—I'm rather late in the questioning order. My question was going to be for Dr. Neuzil. But I'm going to ask Dr. Buttenheim if she might be able to assist me with this question. In recent weeks we have seen news of viral variants reaching U.S. shores. Evidence suggests that some of these variants may be more contagious than the original SARS-CoV–2 virus. And I've seen a number of anecdotal stories about some severe concerns with how quickly the—one of the variants in particular is spreading. Can you tell us a bit about how we should expect the existing vaccines to perform against the new variants, and what if anything do we

know about the vaccines that are in the pipeline in terms of their effectiveness against the new variants?

Dr. BUTTENHEIM. Thank you, Representative Wild. I wish Dr. Neuzil were here because that is well out of my area of expertise. I'm neither a virologist, nor an epidemiologist or immunologist, so I will——

Ms. WILD. I was concerned about that. I don't know whether any of the other witnesses have any response on that. If not, I'll move on, but if you do, please feel free to comment, Dr. Huang or——

Dr. HUANG. That really would be a Dr. Neuzil question for expertise.

Ms. WILD. That's fine. That's fine. So I—let me move to a different question then. And I'll address this to anybody who might be able to answer it. A number of people have the sense that these vaccine processes have been rushed and that maybe safety took a backseat. Can you comment on the integrity and the vaccine trial data? And, you know, a follow-up to that would be that some people are queasy about the name Operation Warp Speed. I'm actually at a vaccination clinic today. I'm doing this from a hospital conference room where they just celebrated giving their 100,000th vaccination today. So that's obviously commendable, but there are still so many more people that we know are going to need to be vaccinated. Is there any indication that scientific integrity and the safety of patients ever took a backseat in the Federal Government's effort to support the vaccine development? Anybody——

Dr. HUANG. Again, I would say that probably Dr. Neuzil testimony earlier addressed that. You know, I mean, I think that there has been—yes, I mean, I think she covered a lot of that pretty quickly.

Regarding the interpretation of Operation Warp Speed, you know, I did express in my testimony we have heard that from the front, you know, people in the community that just that term, because of the fear or the concern that it was rushed, that that term does seem to reinforce that in some circles. So—and I've heard specifically that, and that is one of the vaccine hesitancy sort of concerns out there.

Ms. WILD. I'm hearing that a lot, too. Any best practices in terms of—that you can share with us in terms of convincing people who are more reluctant than others?

Dr. BUTTENHEIM. You know, where I've seen communications be persuasive, there are sort of two aspects. One is showing how parts of this vaccine have been worked on for a long time, right? Like we actually have decades of research that got us to this point, which is why we have a 1-year vaccine instead of a 4-year or a 10-year vaccine.

And I think the other persuasive piece is the confidence from experts like Dr. Neuzil that the approval process was not compromised in any way. You know, the FDA and the CDC have traditionally been two institutions that Americans have a lot of trust in that, you know, has had a rocky road the last couple years. But, you know, experts saying, yes, all the right, you know, i's were dotted and t's were crossed that got us to these emergency use authorizations, and sort of saying that over and over again also seems to be persuasive.

Ms. WILD. Thank you so much. Madam Chairwoman, I yield back.

Chairwoman JOHNSON. Thank you.

STAFF. No additional Members for questions, Ms. Johnson.

Chairwoman JOHNSON. Well, thank you very much. And let me thank our witnesses. I do have one more question before we close out. I apologize for it taking us so long to get through it, but it lets you know how interested we are in these questions.

And I know that some of these questions that I might have here might be more appropriate for Dr. Neuzil. If that is the case, we will send the questions to her.

But what are the side effects of the Pfizer and Moderna vaccines? Are they mild or severe? And how often do people experience the side effects?

Dr. HUANG. I mean, there are certainly some localized side effects, localized pain, redness, some of the common aches and pains, joint pain, body aches, headache, sometimes fever, typically short-lived. Some of the severe side effects, you know, I mean, that we would be worried about would be the severe allergic reaction, anaphylaxis. The only real contraindication, you know, is to have a history of anaphylaxis to any of the actual components in the vaccine or also then, you know, there's a delay recommended just if you had another vaccine in 14 days. But, again, there are—you know, and there's protocols in place for monitoring these vaccines. There's the V-safe program where everyone is being—you know, if they sign up, get daily text messages to report these side effects.

Chairwoman JOHNSON. OK. Is it possible for a vaccine to mutate into an active form of the virus or infect someone who is healthy?

Dr. HUANG. Again, it was addressed by Dr. Neuzil. It's not an actual live virus. These are—so it can't mutate into another virus that would infect persons.

Chairwoman JOHNSON. Thank you. What's going on with chemicals in vaccines in general, and do we need to be worried about them?

Dr. HUANG. Yes, I don't know that—maybe that might be something to talk to Dr. Neuzil about.

Chairwoman JOHNSON. OK. We will submit some questions to her. One last question. Is it possible for a vaccine to cause autism?

Dr. BUTTENHEIM. The great, great preponderance of data—and there's a lot of it and a lot of studies—you know, it's hard to prove a negative, but there has never—there has not been any credible research, sustained, replicated that gives any suggestion that there's a relationship between vaccines and autism.

Dr. HUANG. And the original research was actually disproved——

Dr. BUTTENHEIM. Exactly.

Dr. HUANG [continuing]. And the author has been discredited and it's been retracted and so——

Dr. BUTTENHEIM. It's an incredibly, incredibly sticky worry, very hard to unstick people from that worry, I will say, behaviorally, but no science to support it.

Chairwoman JOHNSON. Thank you very much. Does anyone else want to ask any questions before we close out?

Well, thanks to all of you. This has been incredibly important. And you—and I so apologize for the technology glitches at the be-

ginning. We will try to make sure that we can try to clear those up. This is a technology committee, and I'm the first to admit that I'm a little old for the era, and so I'm just as guilty as anyone else for not knowing exactly how to clear it up when it happens.

But before I close, I want to really thank all of you who testified and all of what you're doing and to say that this Committee certainly had interest in your coming today, as you can tell. We're sorry it went so long, but the record will remain open for 2 weeks for any additional statements from Members or our witnesses for any additional questions.

So before I excuse the witnesses, let me say one more time how much we appreciate you being here and how helpful your information has been.

Our witnesses are now excused, and our hearing is adjourned. Thanks to all of you.

[Whereupon, at 2:40 p.m., the Committee was adjourned.]

Appendix I

Answers to Post-Hearing Questions

ANSWERS TO POST-HEARING QUESTIONS

Responses by Dr. Kathleen Neuzil

Dr. Kathleen M. Neuzil, MD, MPH, FIDSA, FACP
The Myron M. Levine, MD, DTPH, Professor in Vaccinology
Professor of Medicine and Pediatrics
Director, Center for Vaccine Development & Global Health
University of Maryland School of Medicine
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March 25, 2021

Dylan Cohen
Research Assistant
Investigations and Oversight
Committee on Science, Space, and Technology
House of Representatives
Congress of the United States
2321 Rayburn House Office Building
Washington, DC 20515-6301

RE: The Science of COVID-19 Vaccines and Encouraging Vaccine Uptake - Questions for the Record
Response from: Dr. Kathleen Neuzil, Director, Center for Vaccine Development and Global Health
University of Maryland School of Medicine

Question Submitted by: Representative Bill Foster (IL-11)

One of the lessons of COVID-19 is that we have much to learn from rest of world. Britain, the EU, Singapore and other countries are making significant choices differently than in the US. One of these is using available doses to get the first shot of vaccine into as many people as possible, on the grounds that most of the protection comes from the first shot.

My understanding is that there is no evidence yet that the efficacy of the 2nd shot is reduced if it is delayed. British scientific modeling indicates that approach will save many thousands of lives, but the US has decided not to pursue this approach.

1. If the data for the UK, the EU, Singapore, and others confirm that there is a net public health benefit from giving the first shot first, should we consider adopting their approach?

The question of whether to use a single dose vaccine for products that were tested in two-dose regimens is a difficult one. While there is short-term high efficacy after the first dose for the U.S. vaccines the duration of that single dose protection is unknown. While the efficacy is unlikely to drop precipitously at the 3-4 week mark (the time point when the second dose is given), the timing of any drop-off in efficacy is not known. A further factor that must be considered is the emergence of variant strains, which may be able to evade suboptimal immune responses.

2. When might we make this switch?

Given the emergence of variants strains, I would not advise making this switch. Supply seems reasonable in the U.S. to ensure that all U.S. adults will have vaccine access to 1 dose (Johnson and Johnson) or 2 doses (Moderna, Pfizer and potentially Astra-Zeneca) by May.

3. Could you comment more fully on the pros and cons of delaying the second dose?

Pros: Additional supply in short term. Delayed second dose may lead to increased immune responses.

Cons: Some people may never return for the second dose. Immune response after a single dose may be inadequate for the variant strains.

Sincerely,

Kathleen M. Neuzil, MD, MPH
The Myron M. Levine, MD, DTPH, Professor in Vaccinology
Professor of Medicine and Pediatrics
Director, Center for Vaccine Development & Global Health
University of Maryland School of Medicine

Responses by Dr. Philip Huang

HOUSE COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY

The Science of COVID-19 Vaccines and Encouraging Vaccine Uptake

Questions for the Record to:

Dr. Phillip Huang
Director and Health Authority
Dallas County Department of Health and Human Services

Submitted by: Representative Stephanie Bice (OK-5)

1. Given our knowledge on how long a vaccine is viable, what would you recommend for the proper storage of vaccines from the Texas and Oklahoma winter storms that delayed many scheduled vaccination appointments? How many vaccines have we lost due to the severity of these recent weather patterns? We follow all of the storage and handling procedures that are recommended by the vaccine manufacturers. We also have backup generators in place to ensure that the vaccines can be properly maintained in case of power outages. We did not lose any vaccine as a result of the recent weather.

2. In our district, many constituents have voiced concerns of being unable to attend vaccination facilities due to their physical conditions that do not allow them to be transported. What would you recommend for disabled persons who cannot access a vaccination site? In Dallas County, we are working with some of our City partners, visiting nurses, Meals on Wheels and others, to try to develop plans to provide access to these populations. We are also working with community partners to provide transportation to our mass vaccination hub sites. I would recommend that those persons contact their local and state health departments to see what resources and accommodations are available. I know that the resources continue to increase each day.

3. All doses of the vaccine should be used to avoid wasting any available doses, but this can be difficult in smaller communities where residents are more spread out and may need to travel further to access a vaccine.
    a. If vaccines are limited to certain and risk groups at the moment but take the chance of expiring, what is the average loss of vaccines that expire before they are able to be used? We work at the local and state level to ensure that vaccines are administered before they expire. We have had minimal loss of vaccine.
    b. What strategies would you recommend to ensure we aren't wasting doses? Again, I would recommend continued monitoring at the local and state levels to make sure that allocated vaccines are being used quickly and with no waste.

4. The Biden Administration has announced a purchase of 200 million doses of a vaccine from an unnamed company. This will increase the weekly shipment of vaccines to states to 13.5 million.
    a. What does this mean for the manufacturing side of the vaccine production?
    b. What is the science of vaccine manufacturing and the roadblocks that might stand in the way of meeting vaccination goals?
    I defer to another speaker to answer manufacturing questions.
5. What are you doing to let the public know that this is available and letting them have access? We are implementing a paid media campaign and working with media and community leaders and community partners to get the word out. We are also having community sign up events to register and help people get appointments.

HOUSE COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY

The Science of COVID-19 Vaccines and Encouraging Vaccine Uptake
Questions for the Record to:

Dr. Phillip Huang
Director and Health Authority
Dallas County Department of Health and Human Services

Submitted by: Representative Mikie Sherrill (NJ-11)

Earlier this month I met with Black community leaders in New Jersey to discuss the impact of COVID on communities of color. In my conversation with these leaders including doctors, college presidents, pastors, health officials, mental health providers and others we addressed the challenges of vaccine uptake. In NJ, black people represent 15% of the population, but only 4% of the population that is vaccinated. While there is certainly earned distrust in communities of color that lead to vaccine resistance, as highlighted by the medical professionals on my roundtable, there are also true barriers to access that prevent people of color who want the vaccine from receiving it and we need to ensure we are addressing both of these issues. During our discussion several participants mentioned a number of these barriers including transportation, job flexibility, and access to technology to make appointments, to name a few. Leaders of our faith communities and educational communities who joined me also talked about the role that they play in improving access.

1. Could you please share what strategies you've seen work to try and help at the state and county level? What can the federal government be doing to support those efforts
   Work with local health departments, respected community leaders, local physicians, local organizations, churches,and others to provide factual information and answer questions. Support resources for local media messaging. Provide resources to support on-the-ground activities in the community, such as outreach sign-up events, transportation, vaccination provision at senior living facilities and other hard-to-reach settings.

You all are on the front lines of vaccine administration. You're seeing the nuances and challenges of turning vaccines into vaccinations first-hand.

2. How can the federal government direct research funding to better aid and accelerate the administration of COVID-19 vaccines?

   Support and incentivize that research funds be performed in partnership with local health departments, local community organizations, and others at the front lines.

Responses by Mr. Keith Reed

HOUSE COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY

The Science of COVID-19 Vaccines and Encouraging Vaccine Uptake

Questions for the Record to:

Keith Reed, MPH, CPH

Deputy Commissioner, Oklahoma State Department of Health

Submitted by: Representative Stephanie Bice (OK-5)

1. Given our knowledge on how long a vaccine is viable, what would you recommend for the proper storage of vaccines from the Texas and Oklahoma winter storms that delayed many scheduled vaccination appointments? How many vaccines have we lost due to the severity of these recent weather patterns?

Ideally, all vaccine should be stored with back-up generator systems that will automatically kick on when power fails. In Oklahoma, we maintained a constant vigilance during the winter storms ensuring that our vaccine continued to be stored in a temperature range approved by the manufacturer. In doing so, we continually moved vaccine as needed from areas experiencing power loss without the preferred generator back-up to those with a stable power source. Unfortunately, we had one temperature excursion resulting from a power loss that did result in the loss of 490 doses of Moderna vaccine. In this particular case, the power loss and subsequent re-establishment of power created a mechanical failure in the freezer unit. This resulted in a rapid rise in temperature versus the slow rise normally seen in a simple power loss. While no other vaccine was lost during the storms, we did have multiple episodes where power loss or the forced cancellations of clinics required moving vaccine that was 'on the clock' to parts of the state where clinics were able to continue. No other vaccine was lost during this time.

2. In our district, many constituents have voiced concerns of being unable to attend vaccination facilities due to their physical conditions that do not allow them to be transported. What would you recommend for disabled persons who cannot access a vaccination site?

Admittedly, this has been one of the more difficult logistical challenges to overcome as Oklahoma does not have a common transportation platform that can be leveraged as a solution. As such, we have encouraged local jurisdictions to work with non-profit partners in the community to assist with travel. In metro areas, we encourage vaccination PODS in proximity to public transportation stops. Regarding the homebound, or nearly homebound, we have partnered with the Department of Human Services (DHS) to host special clinics for those that struggle with physically navigating a larger POD. They are also leveraging their ADvantage health network (Home Health Providers) to take vaccine into the homes of those that cannot make it to a POD. Similar partnerships are taking place in rural parts of the state.

3. All doses of the vaccine should be used to avoid wasting any available doses, but this can be difficult in smaller communities where residents are more spread out and may need to travel further to access a vaccine.

a. If vaccines are limited to certain age and risk groups at the moment but take the chance of expiring, what is the average loss of vaccines that expire before they are able to be used?

We began our program with 4 core tenants, one of which was 'do not waste vaccine'. With that in mind, we have authorized providers that if they find at the end of the day they have vaccine that will be wasted if not used that day, they are to give it to someone from the next available priority group. We have authorized those exceptions to our roll-out plan in order to eliminate waste. Having said that, aside from the 490 doses mentioned earlier as lost due to freezer malfunction, we have wasted less than 500 doses of our first 1 million doses which is .05 percent. Most of this waste was due to broken syringes or vials, loss of needle sterility, or other human errors at the time of administration.

b. What strategies would you recommend to ensure we aren't wasting doses?

As we have done in Oklahoma, we must encourage local empowerment to deviate from priority if doing so means avoiding a wasted dose. We must also maintain clear expectations that no doses are to be wasted, which means diligent monitoring of storage equipment and use of back-up generators. We must encourage just in time training at PODS to emphasize safe handling practices of vaccine. From a state level programmatic standpoint, we monitor waste reports and follow-up to ensure issues leading to waste are corrected as soon as possible. There will always be some level of waste due to human error, but all effort must be exerted to ensure it is minimized.

4. The Biden Administration has announced a purchase of 200 million doses of a vaccine from an unnamed company. This will increase the weekly shipment of vaccines to states to 13.5 million.

a. What does this mean for the manufacturing side of the vaccine production?

I am no expert on the manufacturing side of vaccine production, but I know that increased vaccine supply enables us to engage more pandemic providers across the state. This means vaccine will be in the hands of the most trusted medical expert, the primary care provider. This is the person best suited to address vaccine hesitancy in those that are on the fence about vaccination. This is a critical part of our strategy to maximize vaccine uptake in the state.

b. What is the science of vaccine manufacturing and the roadblocks that might stand in the way of meeting vaccination goals?

This is not my area of expertise, but no doubt, vaccine supply is the absolute essential component of meeting our vaccination goals.

5. What are you doing to let the public know that this is available and letting them have access?

We do weekly media Q&As, typically twice a week, to keep the public informed of our vaccination progress and to inform of what is coming. This results in real time messaging via radio, print, television, and social media platforms. We also use social media heavily to tailor messages to local situations, such as special messaging about local opportunities. We have continued to improve upon our vaccine registration and scheduling portal. Messages are actively sent out to inform newly eligible groups that they can get an appointment. We also actively use our WIC and SNAP lists to send out text reminders and updates about vaccine availability. We have encouraged a multitude of platforms for appointment scheduling recognizing that one solution does not work for everyone. We have also utilized 211 to provide a bridge for the digital divide, where we can assist in seeking and making an appointment for someone.

HOUSE COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY

The Science of COVID-19 Vaccines and Encouraging Vaccine Uptake

Questions for the Record to:

Keith Reed, MPH, CPH

Deputy Commissioner, Oklahoma State Department of Health

Submitted by: Representative Mikie Sherrill (NJ-11)

Earlier this month I met with Black community leaders in New Jersey to discuss the impact of COVID on communities of color. In my conversation with these leaders including doctors, college presidents, pastors, health officials, mental health providers and others we addressed the challenges of vaccine uptake. In NJ, black people represent 15% of the population, but only 4% of the population that is vaccinated. While there is certainly earned distrust in communities of color that lead to vaccine resistance, as highlighted by the medical professionals on my roundtable, there are also true barriers to access that prevent people of color who want the vaccine from receiving it and we need to ensure we are addressing both of these issues. During our discussion several participants mentioned a number of these barriers including transportation, job flexibility, and access to technology to make appointments, to name a few. Leaders of our faith communities and educational communities who joined me also talked about the role that they play in improving access.

1. Could you please share what strategies you've seen work to try and help at the state and county level? What can the federal government be doing to support those efforts?

For Oklahoma, we have found our best success is in engaging trusted community level leaders that can partner and engage those most skeptical of the vaccination program. We have invited them to make the recommendations they feel will best reach their members in an accessible and trusted fashion. Most often, that involves faith-based initiatives with churches hosting vaccination clinics. In addition to churches, local non-profits that are themselves a continuous and trusted presence in the communities or neighborhoods offer a trusted source to reach these populations. As for the federal government's role in supporting these efforts, I think it includes ensuring the resources are available and easily accessible, but also ensuring that local flexibility is encouraged and allowed to make use of those resources. No one knows better how to reach these groups than those that directly represent the groups. We, at the state or federal level cannot presume to know better than those on the ground interacting on a day by day basis. We need to listen and respond to requests for assistance, and ensure opportunity to get vaccinated is always available.

You all are on the front lines of vaccine administration. You're seeing the nuances and challenges of turning vaccines into vaccinations first-hand.

2. How can the federal government direct research funding to better aid and accelerate the administration of COVID-19 vaccines?

The vaccination program has been exceptionally complicated considering that multiple manufacturers have different dosing regimens as well as uniquely challenging storage needs. This has exponentially challenged our efforts to efficiently roll out this program. Vaccines that are logistically more manageable and consistent would greatly enhance efficiency and accelerate vaccination efforts. Further, more research is needed to understand the length of immunity and efficacy in regard to new strains of COVID. We are experiencing significant hesitancy when we can only guarantee immunity for a few months, and cannot speak with absolute confidence in the efficacy as related to new strains. We need research that inspires confidence in the program as a long-term solution to this pandemic.

Responses by Dr. Alison Buttenheim

HOUSE COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY

The Science of COVID-19 Vaccines and Encouraging Vaccine Uptake

Questions for the Record to:

Dr. Alison Buttenheim
Scientific Director, Center for Health Incentives and Behavioral Economics

Submitted by: Representative Mikie Sherrill (NJ-11)

I'm on the phone with the providers in my district every week and we are often discussing vaccine hesitancy and how to address the barriers that lead to it. One hospital in my district, Hackensack Meridian Health, shared with us that recently--the day after a massive snow storm--there were a number of no-show appointments. So, they got creative. Instead of losing the vaccine doses they walked around the hospital and asked staff who had previously declined or neglected to make an appointment if they wanted the vaccine, right then and there. They were pleasantly shocked by the amount of people that happily agreed. This shows me that there are a whole host of barriers -- and that when we meet certain communities where they are they're more likely to accept a vaccine.

1. I was so happy when Hackensack Meridian shared this story with me, we need to take anecdotal successes like this one and apply strategies to reach a broader population that has vaccine hesitancy. What are some evidence-based strategies for improving vaccine uptake?

AGENDA

WELCOME /

Lisa Sherman, President & CEO, The Ad Council
John Bridgeland, Co-founder and CEO, COVID Collaborative

CONSUMER INSIGHTS / Charysse Nunez, The Ad Council

GUEST SPEAKER / Dr. Georges C. Benjamin, President & CEO, American Public Health Association

VACCINE EDUCATION CAMPAIGN / Kate Emanuel, The Ad Council

COALITION BUILDING / Sherry Thompson, The Ad Council

ad COUNCIL

COVID Collaborative

Welcome to the COVID-19 Vaccine Education Initiative Briefing

We will wait a few minutes to allow everyone to join the meeting.

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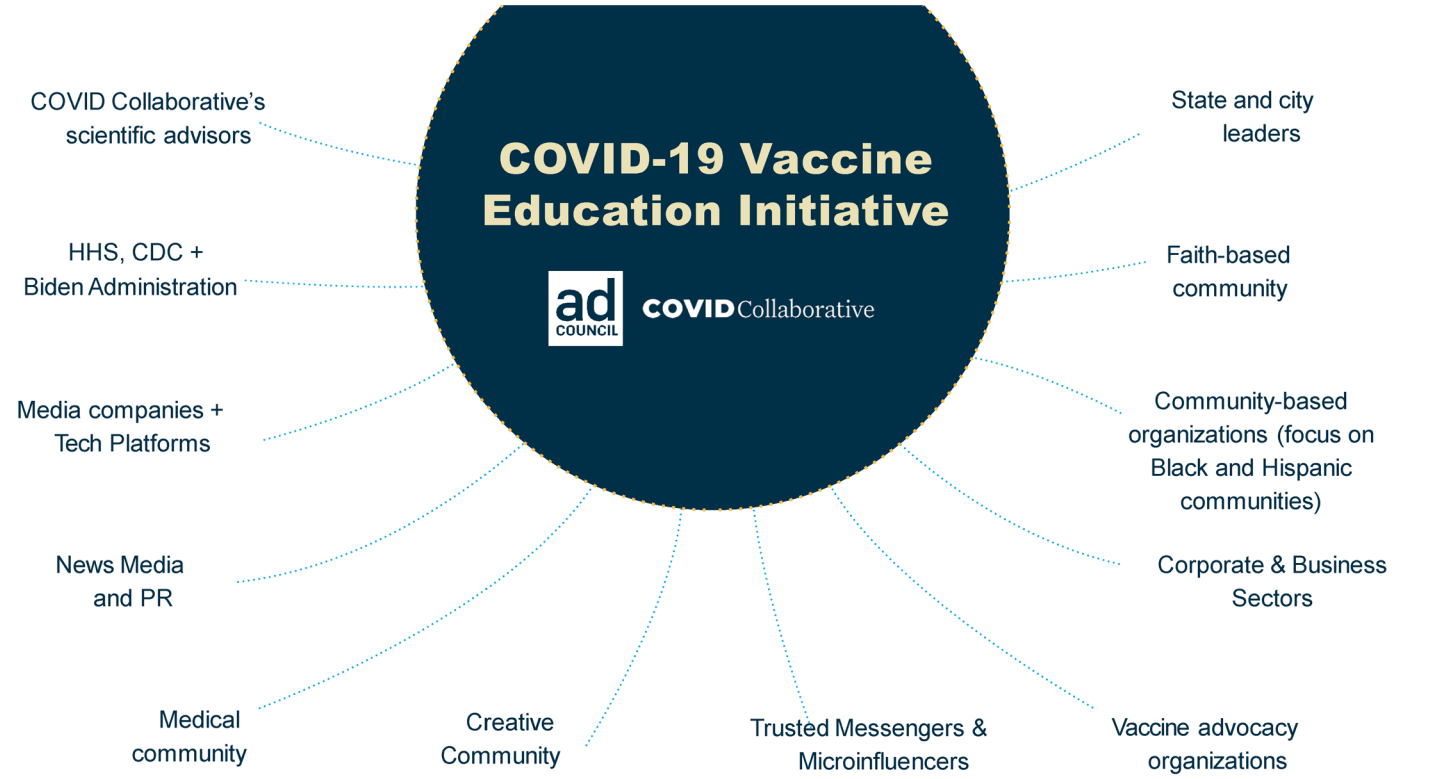

COVID-19 Vaccine Education Initiative
ad COUNCIL
COVID Collaborative
COVID Collaborative's scientific advisors
HHS, CDC + Biden Administration
Media companies + Tech Platforms
News Media and PR
Medical community
Creative Community
Trusted Messengers & Microinfluencers
Vaccine advocacy organizations
Corporate & Business Sectors
Community-based organizations (focus on Black and Hispanic communities)
Faith-based community
State and city leaders

ROBUST PARTNERSHIPS

ad COUNCIL

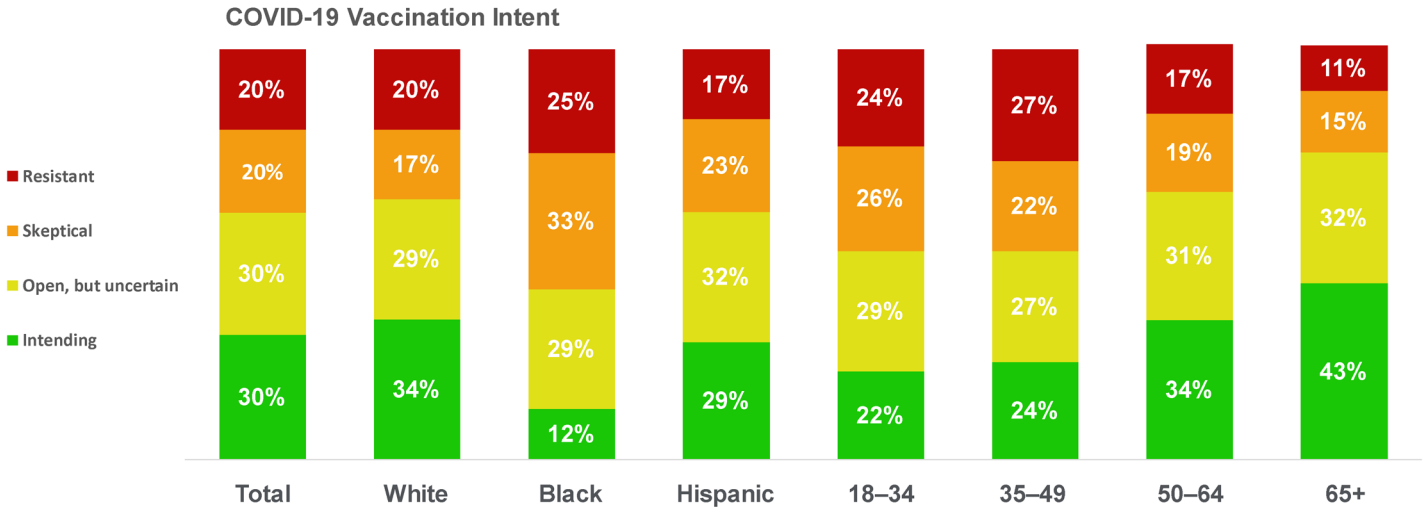
COVID-19 VACCINE DEMAND CONTINUUM

National survey conducted Dec 15-21, 2020 | n=1,992 adults 18+

Q: If a vaccine against COVID-19 were available to you today at no cost, how likely would you be to get it?
Absolutely certain; Very likely; Somewhat likely; Uncertain; Definitely will not

Q: If the COVID-19 vaccine were available to you, when would you become vaccinated?
Immediately when available; Wait about 1-3 months, Wait at least 4-6 months; Wait longer than 6 months; Not sure if, or when, I would get it, I would not get it at all

VACCINE INTENT IS LOWER AMONG BLACK AMERICANS AND YOUNG ADULTS



National survey conducted Dec 15-21, 2020 | n=1,992 adults 18+

Q: If a vaccine against COVID-19 were available to you today at no cost, how likely would you be to get it?
Absolutely certain; Very likely; Somewhat likely; Uncertain; Definitely will not
Q: If the COVID-19 vaccine were available to you, when would you become vaccinated?
Immediately when available; Wait about 1-3 months, Wait at least 4-6 months; Wait longer than 6 months; Not sure if, or when, I would get it, I would not get it at all

WHY ARE PEOPLE HESITANT

People's hesitancy is driven by four key areas where information deficits and misinformation exist

Concerns about safety and side effects from COVID-19 vaccination

Speed of the clinical development process

Distrust in the political and economic motives of the government and corporations

Established and novel conspiracy theories involving vaccines

Reasons behind distrust vary by race/ethnicity & political affiliation

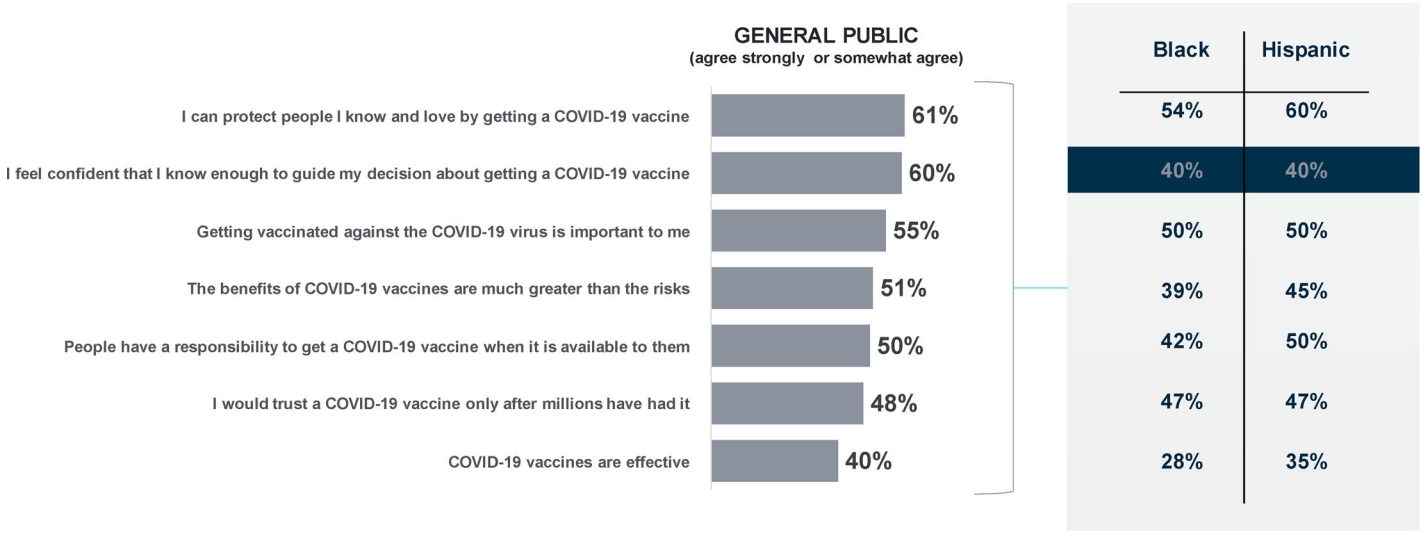
"I'm not sure if I trust a government vaccine. Before they were saying it would take much longer to have one ready."

"I heard that this is a new type of vaccine. How do they really know if it's safe, especially in the long term? At some point, are we going to be seeing ads from lawyers saying, 'Did you get the COVID vaccine in 2021 and have suffered serious problems?'"

"It's a good thing that they have a vaccine. But I don't want to get it until I know for sure that it really is safe and effective. I'm not going to get it right away."

COVID VACCINATION ATTITUDES

PUBLIC ATTITUDES IN FAVOR OF COVID VACCINATION OUTWEIGH NEGATIVE ATTITUDES,
BUT WE STILL FACE SIGNIFICANT CHALLENGES IN BRIDGING THE TRUST GAP



National survey conducted Dec 15-21, 2020 | n=1,992 adults 18+

MOVABLE MIDDLE SNAPSHOTS

White
68 million Americans

Demographic Skews

Women

White

Age 34-49

Rural or suburban

Lower educational attainment

Psychographic Skews

Low trust in government

Limited to no experience w/COVID

Republican

Hispanic
32 million Americans

Demographic Skews

Women

Age 18-59

Employed as essential worker

Resides in multi-generational household

Limited access to high quality healthcare

Uninsured

Psychographic Skews

Low trust in government

Regularly attend religious services

Black
20 million Americans

Demographic Skews

Women

Employed as essential worker

Resides in high-density Black neighborhood

Reside in South

Limited access to high quality healthcare

Psychographic Skews

Low trust in government

Suspicious of being 'guinea pigs'

Democrat

ad COUNCIL

Refer to Dentsu audience profiles for media targeting

MESSAGING ELEMENTS THAT RESONATE ACROSS AUDIENCES

Acknowledge Concerns

Acknowledge people's hesitancy rather than challenge it

Provide the promise of scientific unbiased answers

Moments Missed

Highlighting moments of human connection missed serve as a powerful reminder that vaccination is a pathway to regaining these moments

Protection

Emphasis on protecting myself, loved ones and those most vulnerable.

Positive Tone

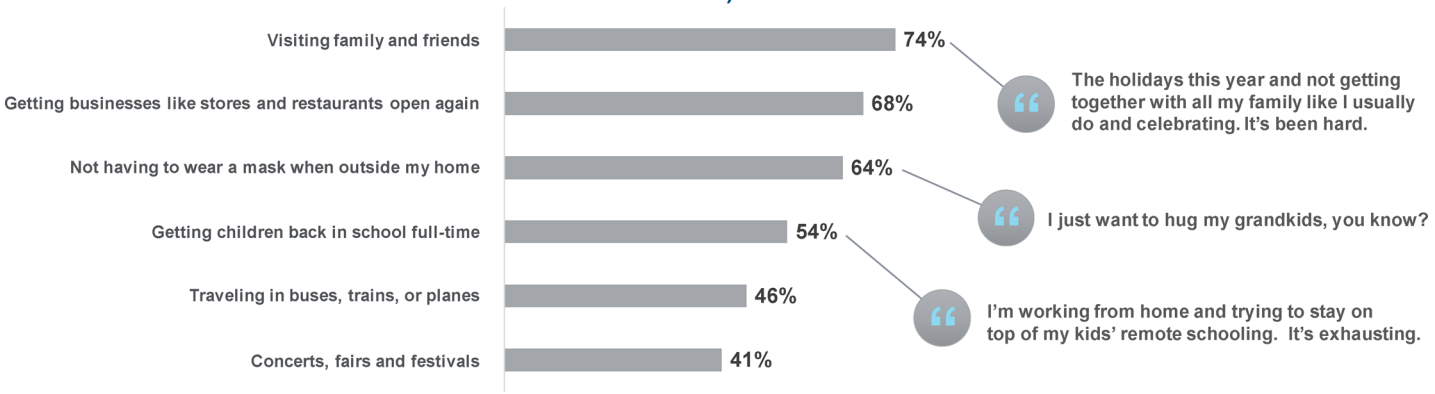
Inviting & respectful as opposed to demanding

Acknowledge that the choice is yours to make, which ties to deeply rooted American values of liberty and freedom

MOMENTS THAT WE MISS

ACROSS ALL AUDIENCES, MOMENTS OF IN-PERSON CONNECTION WITH FAMILY AND FRIENDS IS WHAT PEOPLE MISS MOST

Which of the following do you most want to get back to how it was before COVID-19? (Multiple select)



National survey conducted Dec 15-21, 2020 | n=1,038 vaccine hesitant adults

MESSAGING ELEMENTS REJECTED ACROSS AUDIENCES

Negativity & Fear

Avoid reminders of how difficult the year has been, as it can invoke a sense of hopelessness

Fear tactics don't generate trust or answer questions about vaccines

The Right Thing To Do

References to "many people already stepping up" can come off as pushy or accusatory

Overpromising or Obfuscation

Most understand that mass vaccination is a long-term process. Avoid messages that imply vaccine availability will "flip the switch"

'Back to Normal'

For most post-pandemic life will never be "the way it was"

It's more about getting back to life rather than back to normal

CONSUMER LANGUAGE DO'S & DON'TS

DO SAY	DON'T SAY
COVID Vaccination	COVID Injection or shot
A safe and effective vaccine	A vaccine developed quickly
Authorized by FDA based on clinical testing	Operation Warp Speed; Emergency Use Authorization
Get the latest information	There are things we still don't know
Keep your family safe; keep those most vulnerable safe	Keep your country safe
Public Health	Government
Medical experts and doctors	Scientists
People who have questions	People who are hesitant, skeptical, resistant, or "Anti-vaxxers"

Sources: de Beaumont BOLD SOLUTIONS FOR HEALTHIER COMMUNITIES.

Feedback Loop

Source: A/B testing & language evaluation
n= 434 vaccine hesitant adults. Conducted 11/24/20-12/1/20

DIFFERENT MESSENGERS EMBODY DIFFERENT LEVELS OF TRUST AND REACH

Analysis based on polling reports from multiple sources

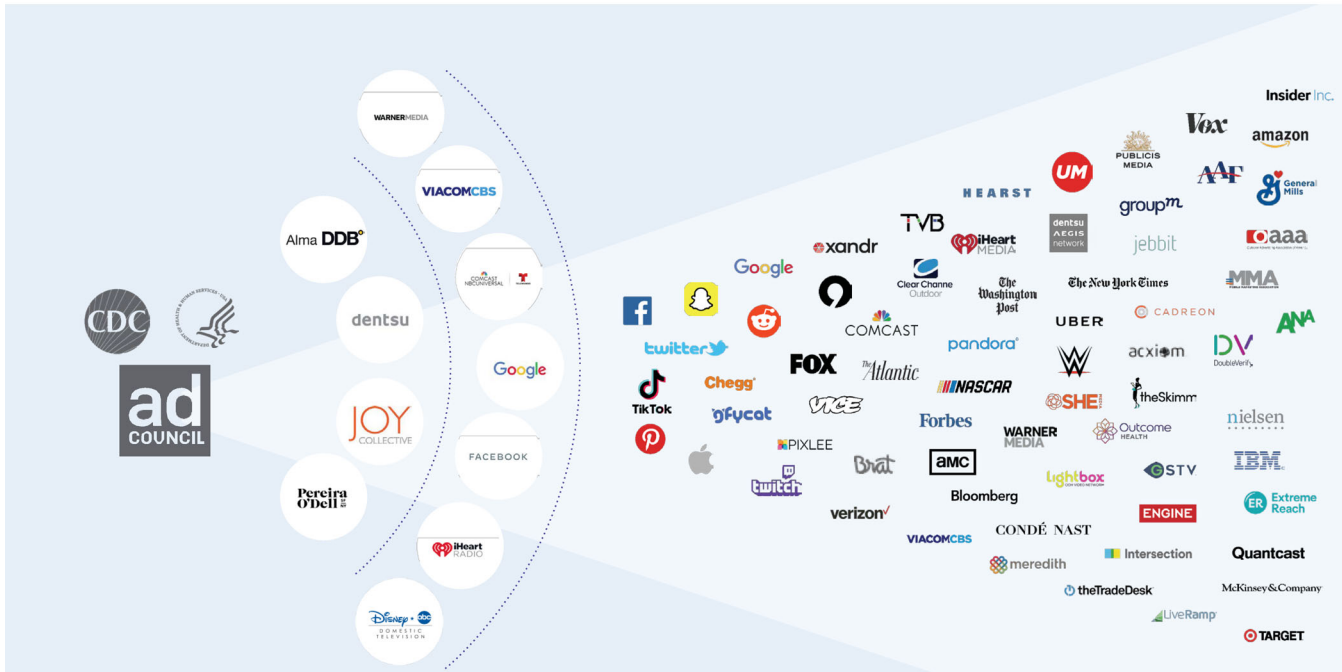
STRATEGIC FRAMEWORK

Facts about safety are key, but the messenger is critical—and medical experts are most trusted.

TIMING
PHASED APPROACH:

Our campaign will be timed to sync with the supply of vaccines and target priority audiences in phases:

December 2020	January 2021	February/March 2021	March/April 2021	Late Spring/Early Summer 2021
Healthcare/LTC Professionals: Launch of video/social assets featuring Dr. Fauci & nurses & doctors **Vetted FAQs**	**Initial PSAs** (social/digital assets) **targeting priority audiences** (priority on Black & Hispanic community) **Open-source toolkit** **Website** **Social/digital assets** (insights, briefs, messaging recommendations)	**Full suite of assets** (digital, mobile, social, TV, cable, radio, print)	**Continue to develop assets for priority audiences**	**General market and young adults** (depending on when vaccine is available for mass deployment)


CDC
ad COUNCIL
WARNERMEDIA
VIACOMCBS
Alma DDB
dentsu
Google
JOY COLLECTIVE
FACEBOOK
Pereira O'Dell
iHeart RADIO
Disney ABC DOMESTIC TELEVISION
Insider Inc.
Vox
amazon
PUBLICIS MEDIA
UM
AAF
General Mills
HEARST
groupm
TVB
dentsu AEGIS network
jebbit
aaa
xandr
iHeart MEDIA
Google
Clear Channel Outdoor
The Washington Post
The New York Times
MMA
CADREON
ANA
COMCAST
UBER
pandora
acxiom
DV
DoubleVerify
twitter
FOX
The Atlantic
Chegg
NASCAR
SHE
theSkimm
TikTok
tyfycat
VICE
Forbes
WARNER MEDIA
Outcome HEALTH
nielsen
PIXLEE
Brat
amc
lightbox
ESTV
IBM
twitch
Bloomberg
verizon
ENGINE
Extreme Reach
CONDÉ NAST
VIACOMCBS
meredith
Intersection
Quantcast
theTradeDesk
McKinsey&Company
LiveRamp
TARGET

CAMPAIGN TARGETING HEALTH CARE PROFESSIONALS

ad COUNCIL COVID Collaborative

CDC | HHS | NIH National Institute of Allergy and Infectious Diseases

NHMA · American Hospital Association · AMA American Medical Association · ANA · National Medical Association · NBNA · BCAC · Morehouse School of Medicine · NAHN National Association of Hispanic Nurses

- American Hospital Association American
- Medical Association American Nurses
- Black Coalition Against COVID-19
- Morehouse School of Medicine
- National Association of Hispanic Nurses
- National Black Nurses Association
- National Hispanic Medical Association
- National Medical Association

SHARED MATERIALS: Press release / FAQs / Customizable social copy
Website / email blurb / Talking points / Videos and cut downs

ad COUNCIL


7
things
we must do:
Pereira O'Dell
ad COUNCIL
7

WHAT WE NEED TO DO

Appeal to their desire to protect their loved ones.

Tap into their unifying aspiration.

#1

WHAT WE NEED TO DO

Respect their Independence.

Tell them to get informed, not to get the vaccine. This should be a choice, not a mandate.

#2

WHAT WE NEED TO DO

Accept their reluctance.

Recruit through empathy, honesty and kindness. Appreciate the concerns of specific groups such as African-Americans, Latinx, women, conservatives...

#3

WHAT WE NEED TO DO

Flip the burden of proof.

Some people try to plant the seed of doubt by saying the vaccine isn't safe. We need to flip it and make people doubt how safe they are if they don't get vaccinated.

#4

Perceira O'Dell SF NY ad COUNCIL

WHAT WE NEED TO DO

Regain trust through Radical Transparency.

Fight misinformation by using data to show what we know, what we don't know, and the risk of not taking a vaccine.

#5

WHAT WE NEED TO DO

Remind them of moments pre-COVID.

Getting back to human connection moments - the people and events we miss so much.

#6

WHAT WE NEED TO DO

Welcome their Questions

This is an important decision.
Having questions is completely ok.

#7

CAMPAIGN EVALUATION & OPTIMIZATION FRAMEWORK

EXPOSURE	• Donated, earned, paid, shared media
AWARENESS	• Awareness of messages and assets
ENGAGEMENT	• Digital and social media metrics
CONSIDERATION	• Taken steps to learn about vaccination • Shifts in intent to get vaccinated
IMPACT	• Got vaccinated (self-reported) • Vaccination rates and other COVID-19 public health indicators
ADVOCACY	• Vaccination endorsements via social media and word of mouth

COVID Collaborative-Langer monthly survey


BUILDING OUR GROUND GAME
COMMUNITY PARTNERSHIPS & RESOURCES
+
INFLUENCERS / TRUSTED MESSENGERS
+
DIVERSE COMMUNITY OUTREACH
ad COUNCIL

Building community partnerships is essential to our strategy

- State, County, & Local Organizations
- Nonprofit Networks
- Medical / Public Health Associations
- Diverse Community Organizations
- Academic & Research Institutions
- Faith Community
- Foundations

Created Advisory Councils to inform campaign & dissemination plans

We're committed to providing **helpful tools and resources** every step of the way

ONLINE TOOLKIT

Phase 1

Focused on sharing research, messaging guidance, & FAQs

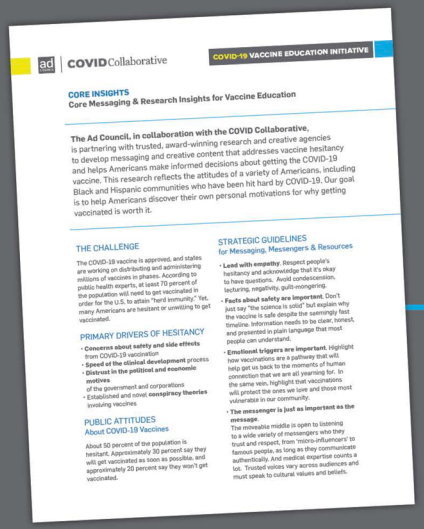
Launch Date:
Late Jan

ONLINE TOOLKIT

Phase 2

Expanded to include campaign assets, digital and social assets, briefs, etc.

Launch Date:
Early March



ad | COVIDCollaborative

COVID-19 VACCINE EDUCATION INITIATIVE

CORE INSIGHTS
Core Messaging & Research Insights for Vaccine Education

The Ad Council, in collaboration with the COVID Collaborative, is partnering with trusted, award-winning research and creative agencies to develop messaging and creative content that addresses vaccine hesitancy and helps Americans make informed decisions about getting the COVID-19 vaccine. This research reflects the attitudes of a variety of Americans, including Black and Hispanic communities who have been hit hard by COVID-19. Our goal is to help Americans discover their own personal motivations for why getting vaccinated is worth it.

THE CHALLENGE

The COVID-19 vaccine is approved, and states are working on distributing and administering millions of vaccines in phases. According to public health experts, at least 70 percent of the population will need to get vaccinated in order for the U.S. to attain "herd immunity." Yet, many Americans are hesitant or unwilling to get vaccinated.

PRIMARY DRIVERS OF HESITANCY

- **Concerns about safety and side effects** from COVID-19 vaccination
- **Speed of the clinical development** process
- **Distrust in the political and economic motives** of the government and corporations
- Established and novel **conspiracy theories** involving vaccines

PUBLIC ATTITUDES
About COVID-19 Vaccines

About 50 percent of the population is hesitant. Approximately 30 percent say they will get vaccinated as soon as possible, and approximately 20 percent say they won't get vaccinated.

STRATEGIC GUIDELINES
for Messaging, Messengers & Resources

- **Lead with empathy.** Respect people's hesitancy and acknowledge that it's okay to have questions. Avoid condescension, lecturing, negativity, guilt-mongering.
- **Facts about safety are important.** Don't just say "the science is solid" but explain why the vaccine is safe despite the seemingly fast timeline. Information needs to be clear, honest, and presented in plain language that most people can understand.
- **Emotional triggers are important.** Highlight how vaccinations are a pathway that will help get us back to the moments of human connection that we are all yearning for. In the same vein, highlight that vaccinations will protect the ones we love and those most vulnerable in our community.
- **The messenger is just as important as the message.** The moveable middle is open to listening to a wide variety of messengers who they trust and respect, from 'micro-influencers' to famous people, as long as they communicate authentically. And medical expertise counts a lot. Trusted voices vary across audiences and must speak to cultural values and beliefs.

Online Toolkit

Phase 1 Overview

- Messaging Recommendations
- Attitudes & Hesitancy
- Audience Snapshots: Black and Hispanic
- FAQs
- Videos targeting Healthcare Providers (Featuring Dr. Fauci, doctors, & nurses)


We've developed custom toolkits for communities
Public Health Toolkit
Media Playbook
Brand Playbook
Black Community Toolkit
Hispanic Community Toolkit
Faith-Based Community Toolkit (Black & Hispanic)
Business / Corporate Toolkit

INFLUENCER COMMS FRAMEWORK

Establish a communications framework across all types of influencer engagements

THE FACTS

Trusted and credentialed medical experts.

FACT AMPLIFIERS

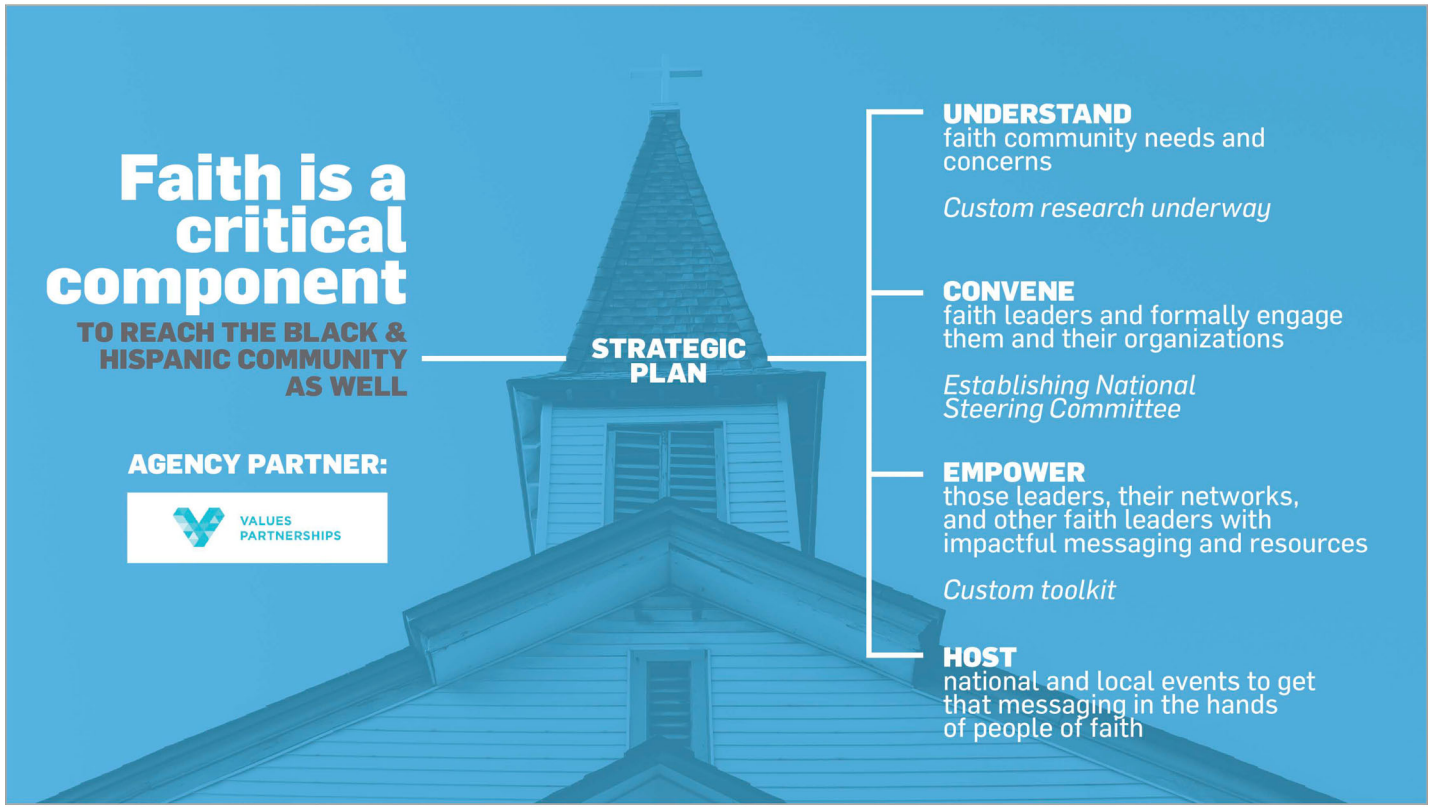
Trusted and relevant amplifiers- responsible for sharing, reposting or curating.

VACCINATION EXPERIENCES

Includes videos, images or text posts about personal experiences.

INFLUENCER CATEGORIES


Reaching & Engaging Diverse Communities...
BLACK & HISPANIC FOCUS GIVEN HESITANCY DATA
Culturally Relevant Agency Partners
JOY COLLECTIVE
VALUES PARTNERSHIPS
CIEN+
Coalitions & Partnerships
· Medical, non-profit, civil rights, and community organizations (sororities & fraternities)
· Strategic coalitions
· Customized toolkits
Virtual Events
· National programs
· Local, customized events
· Content partnerships


Faith is a critical component
TO REACH THE BLACK & HISPANIC COMMUNITY AS WELL
AGENCY PARTNER:
VALUES PARTNERSHIPS
STRATEGIC PLAN
UNDERSTAND
faith community needs and concerns
Custom research underway
CONVENE
faith leaders and formally engage them and their organizations
Establishing National Steering Committee
EMPOWER
those leaders, their networks, and other faith leaders with impactful messaging and resources
Custom toolkit
HOST
national and local events to get that messaging in the hands of people of faith


“Alone we can do so little;
together we can do so much.”
- HELEN KELLER

COVID Collaborative
THANK YOU

BEHAVIOURAL CONSIDERATIONS FOR

ACCEPTANCE AND UPTAKE OF COVID-19 VACCINES

WHO TECHNICAL ADVISORY GROUP ON BEHAVIOURAL INSIGHTS AND SCIENCES FOR HEALTH

Meeting Report
15 October 2020

World Health Organization

BEHAVIOURAL CONSIDERATIONS FOR

ACCEPTANCE AND UPTAKE OF COVID-19 VACCINES

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CONTENTS

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1. BACKGROUND

On 15 October 2020, the WHO Technical Advisory Group (TAG) on Behavioural Insights and Sciences for Health held a special meeting with the WHO Department of Immunization, Vaccines and Biologicals to discuss behavioural considerations in relation to COVID-19 vaccine acceptance and uptake. The discussion focused on a series of key questions around achieving high and equitable uptake of vaccines through evidence-based and behaviourally informed strategies.

This meeting report is the product of the discussion held by WHO TAG members during the meeting. It covers only the topics that were addressed at the meeting. Following the meeting, the considerations and recommendations made by the members were refined through an iterative process that involved drafting by a core group, literature review and rounds of feedback from all the members. The considerations made by the TAG members during the meeting that were not supported by published evidence were removed with the consensus of the members. The review process was finalized on 15 November 2020.

The TAG members serve in their personal capacity and have completed a declaration of interest form that was subject to evaluation and approval prior to their nomination in July 2020.

This meeting report represents exclusively the views and opinions of the TAG members and does not represent the decisions or policies of WHO.

2. INTRODUCTION

In recent years, there has been a great deal of research on vaccination uptake and its behavioural drivers. While the evidence is still evolving, these efforts have resulted in a better understanding of the barriers and enablers to vaccination – especially, but not only, for child vaccination. Research efforts have also generated potentially effective strategies to improve vaccine acceptance and uptake, which go beyond traditional information campaigns aspiring to change behaviours by improving knowledge. Information on its own has shown a limited impact on facilitating vaccination uptake,

but adding other strategies – such as reducing barriers *(1)*, using reminders *(2)* and planning prompts *(3)*, and training and building confidence in health workers *(4, 5)* – has been shown to be effective.

While evidence on promoting vaccination in general is useful in the context of the current pandemic, the acceptance and uptake of COVID-19 vaccines present an unprecedented challenge. In addition to the sheer magnitude of the coming vaccination effort, the vaccines will be new and are likely to be only partially effective for a yet unknown period of time. There may be so-called adverse events rightly or incorrectly attributed to the new vaccines, and countries will set different safety thresholds before offering the vaccines to their populations. Given the limited supply in the short to medium term, vaccines are likely to be prioritized for health workers at high risk of acquiring or transmitting infection and older adults based on the framework developed by the WHO Strategic Advisory Group of Experts on Immunization *(6)*. Eventually vaccination efforts will expand to target diverse populations not typically reached with immunization programmes, both across and within countries. This will require targeted and tailored strategies, as well as management of expectations.

While the behavioural goal is uptake of COVID-19 vaccine by the general population, achieving that goal will depend on the behaviours of other "actors" in the system – those offering the vaccination, those planning how and where to offer the vaccination, and those tasked with maximizing uptake using strategies such as persuasion and the use of trusted endorsers (or "validators").

To achieve high and equitable vaccine uptake, the use of existing scientific knowledge is essential, as is acquisition of new information, and learning in real time about what works and what does not. Learning can be increased by engaging with target populations in local communities to listen and respond to their perspectives, concerns and expectations in relation to vaccination *(7)*. These efforts can play a role in building the trust of the community in health systems, and in informing the design and delivery of policies and services that are responsive and respectful to local needs.

Behavioural research identifies three categories of drivers of vaccine uptake, in addition to people having the necessary knowledge: 1) an enabling environment; 2) social influences; and 3) motivation. The three drivers interact and overlap, depending on contexts; however, for the purpose of understanding the problem and identifying strategies, it is helpful to keep the categories separate. An appreciation of each driver leads to its own set of insights and interventions, or mix of interventions, which will often vary across communities.

3. DRIVERS OF VACCINE UPTAKE

3.1 AN ENABLING ENVIRONMENT

Multiple groups influence uptake of vaccination, including political decision-makers, immunization programme managers, community and religious leaders, health workers, civil society organizations, media outlets and digital platforms *(1)*. These actors can facilitate or discourage vaccination by creating more or less enabling environments. It is, therefore, important to consider how the behaviours of actors in the system (for example, those responsible for planning locations offering vaccination or setting clinic opening times) might influence the behaviours of the general population.

Evidence has shown that reducing barriers and making it easy to get vaccinated will increase vaccine uptake, especially for the large proportion of people who are not deliberately avoiding vaccination *(8)*. What might seem to be reluctance or resistance, or even opposition, might actually be a response to the burdens or inconvenience of getting vaccinated.

Environmental factors might involve:

- **Location:** Is the vaccination being given in a close by, convenient place?
- **Cost:** Are any costs involved (for the vaccine itself, travelling, or opportunity costs of missing work), either monetary or non-monetary?
- **Time:** Is it time-consuming to be vaccinated? Is booking easy and accessible? Are vaccines delivered at a time of day that is convenient?
- **The quality of the experience of being vaccinated:** Do people feel that they are treated with kindness, understanding and respect? Are health workers well informed and able to answer questions about COVID-19 and vaccination?
- **Information:** Have people been given timely, easy to understand and relevant information about what they are supposed to do, how they are supposed to do it, and how they might benefit? Are the benefits and side-effects of the vaccine explained in plain terms?
- **The default:** Is the default in workplaces to vaccinate all employees, with provision for those who do not want to be vaccinated to opt out? Do health care providers present the opportunity to be vaccinated as the default option?
- **Health regulations or mandates:** Is vaccination mandatory to engage in certain activities, such as employment, education, travelling abroad or enrolling in day care?

In light of these factors, there are several ways to create enabling environments for encouraging widespread vaccination. Strategies include removing barriers in the environment and designing services and policies to support people's intended behaviours and circumstances. For instance, if the default in schools is to vaccinate all students, with the provision of allowing those who object to opt out, then vaccination rates will likely be higher than if the default is to provide vaccination only to those who opt in *(9)*. Making vaccines easily accessible in safe, familiar and convenient locations, such as "drop-in" clinics that are near where people often go, can also encourage uptake *(10)*. In the current pandemic where people have indicated concerns about seeking health services due to fear of contracting COVID-19 in health facilities *(11)*, ensuring that proper safety measures are visibly in place can encourage vaccination. Such measures include facilitating hand hygiene, physical distancing and mask wearing, ensuring rooms are properly ventilated and preventing crowds *(12)*.

An enabling environment is necessary and likely to increase acceptance and uptake of vaccination, but it is unlikely to be sufficient on its own. It should be accompanied by targeted, credible and clear communication from trusted sources demonstrating that getting vaccinated is important, beneficial, easy, quick and affordable. Of course, how easy, quick and affordable it is will vary from place to place, and health systems must be prepared to reduce barriers to supply, service delivery and quality of services, in addition to ensuring that health care and community workers are well trained and well supported *(13)*. Guidance, training, and other tools to support health systems prepare for the introduction of COVID-19 vaccines are currently being developed and made available for adaptation by countries *(14)*.

3.2 SOCIAL INFLUENCES

Sometimes, barriers to vaccine acceptance and uptake are the product of unfavourable social influences and/or insufficiently favourable ones. Such influences can include beliefs about what others in one's social group do, or what they approve and disapprove of ("social norms") *(15)*. For example, if most people in a community are wary of vaccination and believe that the vaccine does not work or that the side-effects will be very bad, they will give a negative signal to others who might otherwise be in favour of, or neutral towards, vaccination *(16)*. On the other hand, if most people in a community support vaccination, they will give a positive signal to others who might otherwise be reluctant to get vaccinated.

Predominant narratives in the media can also skew people's perception of what the majority believe and do *(17)*. For example, anti-vaccine sentiments expressed by relatively small but vocal groups may be promoted, so that they are erroneously seen as capturing a widespread or even majority view. During a pandemic in which people may be confined to their homes, perceptions of other people's behaviours (regarding, for example, mask wearing and physical distancing) are more likely to be inferred from mainstream

and social media and via information online, and less likely to result from direct interactions *(18)*. It is essential to educate the media on the importance of providing context when reporting on anti-vaccine sentiment, to make sure that people do not form an erroneous impression that this is the dominant viewpoint.

Vaccination decision-making is also influenced by people's social networks, which include family members, friends, health professionals and others with whom they interact, as well as the sources of information they consult. The likelihood of vaccine uptake was found to be reduced when a large proportion of people in one's social network did not recommend vaccination *(19)*. On the other hand, encouragement and social pressure from people that an individual respects and trusts have been found to increase vaccine uptake *(20)*. A willingness to get vaccinated, or an unwillingness to do so, can spread through a social cascade as one group of individuals influences another, and then the two influence a third, and so on. Targeting people who are centrally located in the network, such as health professionals who have more opportunities to influence vaccination behaviour, can lead to greater impact of behaviour change efforts *(21)*.

Social influences can be used to promote favourable behaviours of both health professionals and the general population. Five strategies to harness social influences are outlined below.

- **Making social norms in favour of vaccination more salient:** If the majority of people are getting vaccinated, or intend to get vaccinated, that fact can be publicized to good effect. Communication efforts to promote the perception that "most people are getting vaccinated" – if credible and true – are likely to increase vaccination acceptance *(22)*. Making vaccine uptake "visible" to others, through clinics in prominent public places or by enabling ways for people to signal that they have received the vaccine, either on social media, in news media or in person, can contribute to making the social norm more salient *(23)*.
- **Highlighting new and emerging norms in favour of vaccination:** If people learn that others are "increasingly" engaging in certain behaviours, they may be more likely to do so as well *(24)*. Communication efforts to highlight the development of new norms are especially relevant given that the COVID-19 vaccine will be targeting new groups where vaccination may not be the common or the expected behaviour.
- **Leveraging the role of health professionals:** Early priority groups for COVID-19 vaccines include health professionals, who are often the most trusted source of advice on vaccination *(25)*. Studies have shown that health professionals are more likely to recommend vaccination if they themselves have been vaccinated *(26)*. Hence, targeting efforts to facilitate the vaccination of health professionals can in turn lead to greater acceptance and uptake by the general population. These efforts can include improving health professionals' knowledge about the vaccine and increasing their co-workers' support for the vaccine *(26)*.

- **Supporting health professionals to promote vaccination:** Health professionals, including those who are already champions of vaccination, can be equipped with tools to effectively guide communication to encourage people to get vaccinated against COVID-19 *(27)*. Conversations guided by motivational interviewing, a collaborative method of interaction aimed at exploring people's real reasons for hesitancy and strengthening their own motivation for change, can facilitate vaccination *(5)*. Recommendations from providers have also been shown to be more effective when the opportunity to get vaccinated is presented as an expectation (the default) rather than an option – i.e., presuming that people will want vaccination *(28)*.
- **Amplifying endorsements from trusted community members:** An important role can be played by members of the community who are well respected, and who can connect with the group's identity and self-understanding. If endorsers share similar values and characteristics with the relevant group (such as religious or ethnic identity), they are more likely to be influential *(29)*. Endorsement of a COVID-19 vaccine by prominent scientists has also been found to increase trust in the vaccine *(30)*.

3.3 MOTIVATION

Motivation to get vaccinated is usually the result of a combination of factors, such as perceived risk and severity of infection *(31)*, confidence in vaccines *(32)*, values and emotions *(33)*. While motivation to get vaccinated can also be influenced by environmental and social contexts, the focus of this section is on motivational factors themselves.

If people perceive that they are at low risk of contracting COVID-19, or that the consequences of becoming infected will not be severe, they will be less willing to get vaccinated *(34)*. Some people may try to compare the risk of getting infected with that of taking a new vaccine, and determine that between the two, the risk of COVID-19 is lower *(32)*. As it is difficult for most people to understand and assess risks, these risk perceptions are often formed using mental shortcuts *(35)*. For instance, people often judge the likelihood of events by how readily they come to mind ("availability heuristic") *(36)*. As a result, they may downplay some risks (e.g. the likelihood and consequences of getting infected), while exaggerating others (e.g. the likelihood of adverse events following vaccination) based on personal experience or rumours.

Judging events or situations to be risky can also lead to fear, worry and anticipated regret, all of which have been shown to be associated with the intention to accept the offer of vaccination *(20, 37)*. Among these, anticipated regret – when people expect that an unpleasant future outcome would lead them to wish they had made a different decision – shows promise as predictor of intentions and behaviour *(31)*. How anticipated regret is used will determine the direction of its effect: anticipated regret for *inaction* (i.e., not having a vaccination and getting infected and/or infecting loved ones) has

been shown to be associated with a *greater* likelihood of vaccination, and anticipated regret for *action* (i.e., having a vaccination and suffering side-effects) has been shown to be associated with a *lower* likelihood of vaccination *(38, 39)*.

Low levels of vaccine acceptance can follow from low confidence in vaccines, as a result of, for example, the belief that the vaccine will not be effective or that the potential side effects will be severe *(40, 41)*. These concerns may be heightened in the current pandemic, where accelerated timelines may give people the impression that the vaccine was rushed and not tested thoroughly *(42)*. People may also have low confidence in the system that delivers vaccines, including the competence of health workers and motives of other actors *(43, 44)*. For example, confidence may be lowered by scepticism about the profit motives of pharmaceutical companies or the politicization of vaccination *(45)*. In the rapidly evolving situation with multiple uncertainties about COVID-19 vaccines, there is also danger of incorrect information filling the knowledge gap *(46)*. With the overabundance of information circulating around COVID-19 – also known as the "infodemic" – people are inevitably exposed to misinformation, rumours and false conspiracy theories, which may erode their confidence in vaccination. Developing trusted sources, fact-checking and responding to misinformation through dedicated dashboards are some of the strategies suggested to manage infodemics *(47)*.

Vaccine acceptance and uptake may also be undermined by COVID-19 vaccines being not fully effective, meaning that people will have to continue to engage in preventive behaviour (e.g. mask-wearing and physical distancing) even if and after they have been vaccinated. It will be important to manage expectations and ensure that those who have been vaccinated do not stop adhering to protective behaviours and expose themselves and others to risk *(48)*.

As shown above, there are individual and group differences: some may be hesitant toward vaccination due to beliefs that they have a low risk of infection, others may have concerns about the safety of vaccines, while others may be hesitant because of religious values or lack of trust in the health system *(25, 49)*. Engaging in dialogue with communities from the very beginning to understand their different motivations can be a good starting point for designing strategies to tackle specific barriers. Lessons learned from other outbreaks (e.g. Ebola) also highlight the need to actively monitor changes in community sentiments and needs through regular feedback mechanisms and to adapt strategies accordingly *(29)*.

Below are some strategies to tackle motivational barriers to vaccine acceptance and uptake.

- **Building timely trust in vaccines:** Evidence suggests that strategies which aim to change people's thoughts and feelings towards vaccination have not always been successful in increasing uptake *(1)*. It is therefore important to focus on building trust in COVID-19 vaccines *before* people form an opinion against them. This should involve using trusted messengers to help navigate the COVID-19 information landscape and building confidence in the vaccine development process through transparency and managing expectations. Adverse events are often inevitable when large numbers of people get vaccinated in a short period of time, and communities should be engaged early on to listen to concerns, respond to questions and address misinformation *(29)*. Experience suggests that widely rolling out a vaccine followed by announcements of adverse risks can lead to long-lasting damage in confidence in the vaccine *(46)*. Communicating consistently, transparently, empathetically and proactively about uncertainty, risks and vaccine availability will contribute to building trust.

- **Leveraging anticipated regret in communications:** Anticipated regret has been shown to be a strong predictor of vaccination, and there is potential promise in evoking it to encourage vaccination *(39)*. For example, highlighting the consequences of inaction (i.e., by asking people how they would feel if they do not get vaccinated and end up contracting COVID-19 or transmitting it to loved ones) during consultations with health professionals may encourage vaccination.

- **Emphasizing the social benefits of vaccination:** Vaccination not only benefits individuals who receive the vaccine, but also protects others in the community – family members and friends, and eventually the whole of society through "population immunity" if there is a high level of uptake. Communicating the social benefits of vaccination has been found to increase vaccination intention, particularly when the risk associated with vaccination is low and getting vaccinated involves little effort *(50)*. In the specific context of COVID-19, where there can be prolonged duration of illness, putting emphasis on the economic benefits, such as being able to stay in the workforce and provide for one's family, might also encourage vaccination.

4. CONCLUSION

Behavioural research has shown that vaccine acceptance and uptake can be increased by adopting the three strategies below.

- **Creating an enabling environment –** making vaccination easy, quick and affordable, in all relevant respects.
- **Harnessing social influences –** especially from people who are particularly trusted by and identified with members of relevant communities.
- **Increasing motivation –** through open and transparent dialogue and communication about uncertainty and risks, including around the safety and benefits of vaccination.

A common theme is engagement with local communities in developing and implementing tailored strategies to support vaccination uptake. Working in partnership with communities, building trust and ensuring that messages come from trusted endorsers are key to successful strategies. As local circumstances change over time, drivers of people's behaviour will shift as well; it is important to monitor and respond to these changes in as timely a manner as possible.

It is essential to consider local contexts when judging the relevance of research findings. While this report has sought to extract evidence-based principles that can be considered relevant across a wide range of populations and settings, the evidence available is overrepresented from high-income countries; these behavioural considerations should be further researched locally, including in underrepresented low- and middle-income settings, to inform targeted and context-specific interventions.

New evidence relevant to increasing COVID-19 vaccine acceptance and uptake will emerge over time, which means that obtaining and using up-to-date evidence is critical. This report is designed to provide a framework within which to consider new knowledge as it emerges and to help to shape forthcoming policies.

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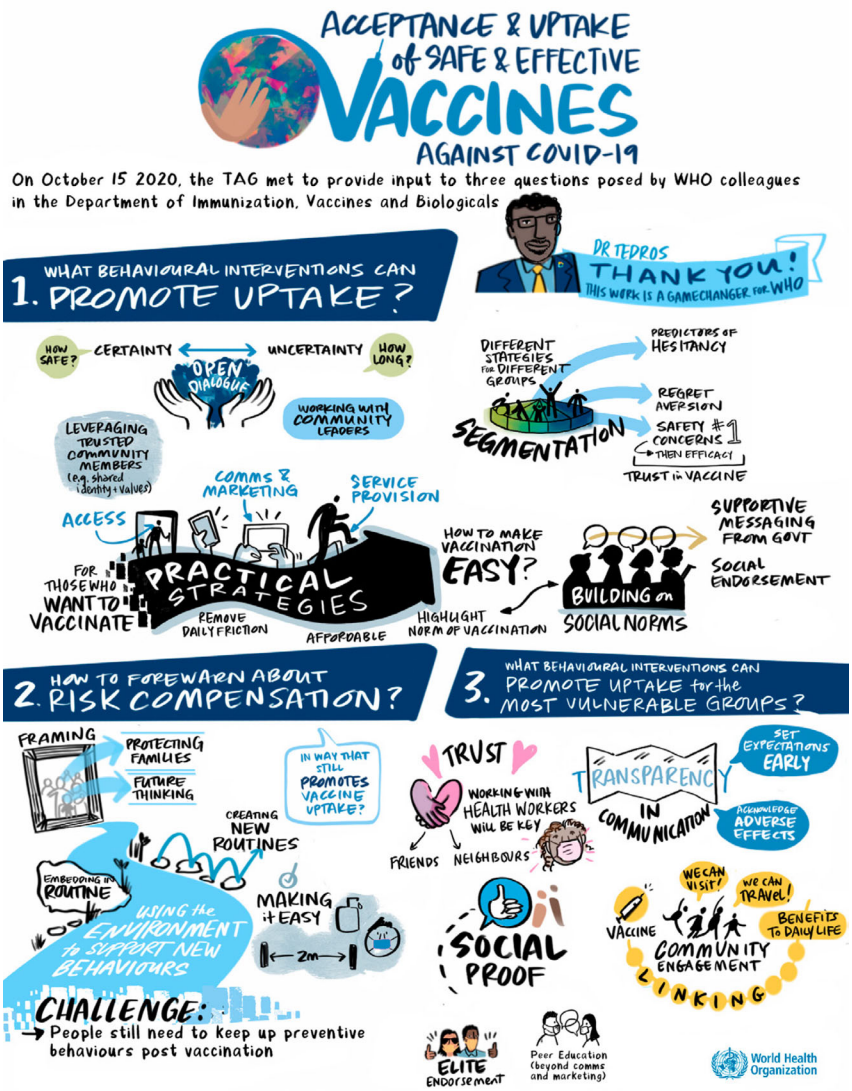

The image above is a visual narration that captures highlights of the meeting on 15 October 2020, during which the TAG on Behavioural Insights and Sciences for Health discussed behavioural considerations in relation to COVID-19 vaccine acceptance and uptake. The discussion was structured around three key questions.


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STRATEGIES FOR BUILDING CONFIDENCE IN THE COVID-19 VACCINES

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This rapid expert consultation was produced through the Societal Experts Action Network (SEAN), an activity of the National Academies of Sciences, Engineering, and Medicine that is sponsored by the Alfred P. Sloan Foundation and the National Science Foundation. SEAN links researchers in the social, behavioral, and economic sciences with decision makers to respond to policy questions arising from the COVID-19 pandemic. This project is affiliated with the National Academies' Standing Committee on Emerging Infectious Diseases and 21st Century Health Threats.

SEAN is interested in your feedback. Was this rapid expert consultation useful? For further inquiries regarding this rapid expert consultation or to send comments, contact sean@nas.edu or (202) 334-3440.

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The National Academies of SCIENCES ENGINEERING MEDICINE

EXECUTIVE SUMMARY

Public engagement and effective communication through clear, transparent messaging will play a central role in building confidence in the COVID-19 vaccines. This rapid expert consultation describes a variety of public engagement and communication strategies that can be implemented at the national, state, and local levels to change patterns of interaction with the public, address hesitancy about the vaccines, and build trust.

In general, given the prevalence of local concerns and information needs, it is important to support local communities with the resources needed to engage people and reinforce information coming from the federal and state levels. Strong community engagement aimed at identifying and understanding local concerns will help determine what messaging, delivered by whom, will be most effective. Moreover, it will be essential to provide people who are hesitant, reluctant, distrusting, or otherwise unmotivated with respect to the COVID-19 vaccines with the resources, information, and support they need to make the vaccination decision that is right for them. This rapid expert consultation highlights overall strategies for engaging the public and building community trust (Box 1), as well as strategies focused specifically on communicating effectively to ensure demand for and promote acceptance of the vaccines (Box 2). These strategies are informed by five principles for effective risk communication:

1. Do not wait.
2. Be credible.
3. Be clear.
4. Express empathy and show respect.
5. Acknowledge uncertainty and manage expectations.

This rapid expert consultation also presents current data about people's motivations, which are informed by perceptions and social norms. These motivations, combined with pragmatic considerations, will determine the uptake of the COVID-19 vaccines. Given that any issues in the early stages of the vaccination program may affect motivation and confidence in the vaccines, distribution, allocation, and patient experience at vaccination sites are important to achieving herd immunity.

BOX 1
Six Strategies for Engaging Communities to Combat Mistrust and Build Public Confidence in COVID-19 Vaccines

1. Form Partnerships with Community Organizations
2. Engage with and Center the Voices and Perspectives of Trusted Messengers Who Have Roots in the Community
3. Engage across Multiple, Accessible Channels
4. Begin or Continue Working toward Racial Equity
5. Allow and Encourage Public Ownership of COVID-19 Vaccination
6. Measure and Communicate Inequities in Vaccine Distribution

BOX 2
Nine Communication Strategies for Ensuring Demand for and Promoting Acceptance of COVID-19 Vaccines

1. Meet People Where They Are, and Don't Try to Persuade Everyone
2. Avoid Repeating False Claims
3. Tailor Messages to Specific Audiences
4. Adapt Messaging as Circumstances Change
5. Respond to Adverse Events in a Transparent, Timely Manner
6. Identify Trusted Messengers to Deliver Messages
7. Emphasize Support for Vaccination Instead of Focusing on Naysayers
8. Leverage Trusted Vaccine Endorsers
9. Pay Attention to Delivery Details That Also Convey Information

INTRODUCTION

Ensuring strong demand for and promoting acceptance of the COVID-19 vaccines is critical to achieving herd immunity, protecting the most vulnerable populations, and reopening social and economic life (NASEM, 2020a). To this end, two distinct challenges must be overcome. First, people who are willing and eager to be vaccinated must be able to do so easily, with minimal friction and hassle; second, people who are hesitant, reluctant, distrusting, or otherwise not motivated with respect to being vaccinated need resources, information, and support for making the vaccination decision that is right for them. Each of these challenges requires different strategies. This rapid expert consultation provides guidance on meeting the second challenge. It is intended to assist decision makers in building public confidence in the COVID-19 vaccines and in communicating with the public about the vaccination process and rollout by highlighting strategies for public engagement and message delivery to ensure demand and promote acceptance.[1,2] While it does not outline a national vaccine marketing strategy, the principles and strategies outlined herein will be critical in the design of such a campaign.

[1]The full statement of task for this rapid expert consultation is as follows: "The National Academies of Sciences, Engineering, and Medicine will produce a rapid expert consultation to assist decision makers in building public confidence in SARS-CoV-2 vaccines, with special attention to communities at higher risk of contracting and dying from the disease, including underserved and vulnerable communities. Drawing from research on decision making, changing beliefs and attitudes, community engagement, and how to reach and engage diverse audiences, this document will identify strategies of communication that are likely to promote uptake of FDA-approved vaccines to prevent COVID-19. This rapid expert consultation will be designed to be of practical use to decision makers, but will not recommend specific actions or include other recommendations. It will be reviewed in accordance with institutional guidelines."

[2]A number of other organizations and agencies have produced guidance on this issue, and those references may also be of use to state and local decision makers. See, for example, "Language That Works to Improve Vaccine Acceptance Communications Cheat Sheet" (www.changingthecovidconversation.org) (accessed January 19, 2021); "COVID-19 Vaccination Communications Toolkit" (https://www.cdc.gov/vaccines/covid-19/health-systems-communication-toolkit.html) (accessed January 19, 2021); and "A Communicator's Tip Sheet for COVID-19

Evidence from the behavioral, psychological, and social sciences demonstrates that people's motivations—their readiness, willingness, intention, or hesitancy—are informed by the information they process; by how they think and feel (their perceived risk, worry, confidence, trust, and safety concerns); and by social processes (recommendations from health care providers, social norms, gender norms, equity, and information processing and sharing). Evidence from anthropology indicates that individuals' motivations are further influenced by cultural understandings of the body, disease, and appropriate types of health care. Motivations can also be influenced by perceptions and beliefs about equitable allocation, distribution, and delivery of services as early vaccination programs roll out. Research from New Jersey's and Rhode Island's COVID-19 testing programs, for example, showed that customer experience challenges at point-of-care testing sites deterred some individuals intending to receive a COVID-19 diagnostic test and discouraged others from repeat testing (Policy Lab et al., 2020). Motivations thus formed interact with practical considerations (e.g., vaccine availability, costs, service quality) to determine vaccination uptake (Brewer et al., 2017).

Of course, context is also important. In particular, it is critical that the efforts of trusted messengers be coordinated. The public has already been receiving information about the COVID-19 vaccines and vaccination efforts from multiple sources, including state and local government entities, local news and community channels, physicians, and employers, among others. The messaging from these sources can be conflicting, which helps to undermine vaccine confidence and trust in public health authorities. Therefore, efforts to influence the shape of public discussion of vaccine issues may be as important as any direct persuasive communication.

Moreover, the pandemic conditions are dynamic and will continue to change as distribution of the COVID-19 vaccines continues and evolves, and ongoing monitoring of beliefs and attitudes will be needed so that messaging can be adjusted as the vaccines become widely available. The ways in which the principles described herein are operationalized will vary based on local context, so that ongoing testing of messages to learn which work best may be needed to optimize communication efforts. Dedicating more resources and technical assistance to local efforts in conjunction with national campaigns could support rapid learning and ultimately increase vaccine acceptance at the community level.

UNDERSTANDING COVID-19 VACCINE HESITANCY

The public's opinions on vaccination fall along a continuum, ranging from those who fully accept vaccines, to those who are vaccine hesitant (two groups that collectively represent the majority of the population), to those strongly or unequivocally opposed to vaccination (a very small minority of the population). It is the middle group that is most likely to respond positively to intervention (Gust et al., 2008a, 2008b). Previous research has found that communications focused on reaching those who are hesitant rather than those firmly opposed to vaccination will be most effective at increasing uptake (NASEM, 2020b), while focusing on those firmly opposed to vaccination will exaggerate and may contribute to the problem.

Since the first COVID-19 vaccine was authorized in December 2020 in the United States, public confidence in COVID-19 vaccines has risen relative to reported attitudes regarding a hypothetical vaccine in early 2020 (Hamel et al., 2020). Relevant details from recent polling are

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Vaccination" (https://obssr.od.nih.gov/wp-content/uploads/2020/12/COVIDTipSheet_Final.pdf) (accessed January 19, 2021).

included in Box 3. As these data reveal, hesitant individuals are not a monolithic group, and hesitancy is not static. As summarized in Box 3, much of the existing hesitancy regarding COVID-19 vaccination revolves around a desire to wait and see how others will respond physically to being vaccinated, as well as technical questions related to the vaccine's safety and efficacy (e.g., "Should I get the vaccine if I'm pregnant?"), which in some cases are accompanied by mistrust of medicine, public health, and government. The desire to "wait and see" is not unique to the COVID-19 vaccination experience. Research on H1N1 vaccine uptake in 2009–2010 shows that, at least in some populations, concerns about the new vaccine affected confidence in the vaccine (Hausman et al., 2020). Although the H1N1 vaccine was approved through the standard FDA process, there were initial concerns that it could have been released under the Emergency Use Authorization mechanism. Quinn and colleagues (2009) found that in that case, intent to take such a vaccine was extremely low, with African Americans being the most reluctant. The phased rollout of available COVID-19 vaccines, all authorized under the EUA mechanism, may provide an opportunity for responding to hesitancy in this respect: officials can make safety and effectiveness data transparent and accessible, especially as additional vaccines are authorized. Acknowledging people's uncertainty and their desire for more data becomes possible as vaccination programs continue.

Specific concerns among those who are vaccine hesitant vary widely, although they tend to cluster geographically and/or culturally. Mistrust of a vaccine in communities of color is of particular concern given that ethnic and racial minority groups in the United States have been disproportionately harmed by the pandemic: individuals from Black, Hispanic, and American Indian/Alaska Native communities all have experienced COVID-19 mortality rates nearly three times higher than the rate among White individuals, as well as higher rates of hospitalization due to the disease. These groups are also more likely to have underlying conditions that place them at higher risk for severe outcomes and complications related to the virus (CDC, 2020a, 2020b).

Mistrust of a vaccine in communities of color is grounded in current experience with structural inequities that permeate public health, medicine, and social services in the United States. Beyond a system that is not reliably trustworthy for many populations, a painful legacy of health care discrimination, medical research exploitation, and unconsented experimentation on Black, American Indian/Alaska Native, Latinx, and other communities that have experienced racism has contributed to justified distrust of government-sponsored medical research and resultant reluctance to become vaccinated (Frakt, 2020; Gamble, 1997; Hoffman, 2020; NASEM, 2020a).[3] This distrust will not be easy to overcome, but the glaring racial and ethnic disparities in the impact of the pandemic will only worsen if decision makers fail to address it.

[3]"Examples include the infamous Tuskegee study—in which hundreds of Black men in Alabama were lied to about being treated for syphilis while the disease was allowed to run its course; the Edmonston-Zagreb vaccine trial, during which parents of immunized infants (mostly Black and Latinx) were not informed that the vaccine used was an unapproved experimental vaccine; and less well known but equally abhorrent instances of unconsented sterilization of Latinx and American Indian and Alaska Native women (Carpio, 2004; Gamble, 1997; University of Wisconsin, 2018). This legacy leaves many communities of color wary of participation in medical research, suspicious of initiatives to engage them in health promotion or surveillance efforts, and, in many cases, reluctant to become vaccinated (Hoffman, 2020)" (NASEM, 2020a, p. 190).

BOX 3
Highlights from the Kaiser Family Foundation's COVID-19 Vaccine Monitor Project, January 2021

Attitudes about the COVID-19 vaccination are changing rapidly. Reported here are the most recent data available at the time of publication. Current data are available from the SEAN Survey Archive at https://covid-19.parc.us.com/client/index.html?mc_cid=a543a1dc66&mc_eid=656554d0a6#/.

Among respondents to a public opinion survey conducted by the Kaiser Family Foundation's (KFF's) COVID-19 Vaccine Monitor project between January 11 and 18, 2021, 41 percent said they would get the vaccine "as soon as possible," and 39 percent said they would "wait and see" (6% said they had already received the vaccine). Compared to results from KFF's December Vaccine Monitor update, the share of adults willing to get the vaccine "as soon as possible" increased, including among Black and Hispanic individuals. However, Black and Hispanic respondents and those aged 18–29 were demographically overrepresented in the "wait and see" group, while "Democrats," those aged 65 and older, Whites, health care workers, and those with someone with a chronic health issue in their household were overrepresented in the "already vaccinated" and "as soon as possible" groups (Hamel et al., 2021).

Although the sentiment reflected in these findings is promising, 13 percent of respondents said they would "definitely not" get the COVID-19 vaccine and 7 percent said they would get it "only if required" (Hamel et al., 2021). These figures are concerning given the anticipated high level of vaccination coverage needed to achieve herd immunity in the United States, previously estimated at 60–70 percent of the population but now expected to be higher (likely closer to 90%, although the exact figure remains unknown) (CDC, 2020; McNeil, 2020; Omer et al., 2020). Thirty-three percent of "Republicans" said they would either "definitely not" get the COVID-19 vaccine or only get it if required, as did 29 percent of rural residents, 21 percent of Black respondents, 28 percent of essential workers, and 21 percent of "independents" (Hamel et al., 2021).

Among those who said they would "definitely not" get the COVID-19 vaccine, the primary concerns included the possibility that the vaccines are not as safe as they are said to be (81%); the unknown long-term effects of the vaccines (77%); the possibility of serious side effects (73%); and the possibility that the vaccines are not as effective as they are said to be (66%). Black and Hispanic respondents who had not yet been vaccinated reported higher levels of concern across these same four factors compared to White respondents (Hamel et al., 2021).

STRATEGIES FOR PUBLIC ENGAGEMENT TO COMBAT MISTRUST AND BUILD CONFIDENCE IN THE COVID-19 VACCINES

Public engagement is critical to overcoming mistrust and building confidence in the COVID-19 vaccines. Public engagement is more likely to be impactful (and build trust beyond COVID-19 vaccination programs) if the process is established and designed so that public values (ascertained through engagement) can be translated into practice and policy. Public health practitioners—if given the necessary resources—can create a strong infrastructure that helps earn community trust by building relationships that encompass organizing for policy change,

providing accessible COVID-19 testing and treatment, listening to the needs of communities, addressing the structural factors that create greater exposure to and poorer treatment for COVID-19, and ensuring the equitable allocation of vaccines. This section summarizes six public engagement strategies designed to combat mistrust and build confidence in the COVID-19 vaccines.

1. *Form Partnerships with Community Organizations*

Partnerships with community organizations that have strong existing community relationships are critical. These organizations are close to their audiences; know how to tailor information to those audiences effectively; and, most important, have trusted leaders who can be effective spokespersons. Research shows that credible partnerships require early two-way dialogue to establish trust and build a shared vision for addressing a problem, citizen involvement in the decision-making process, and sharing of information in a way that is understandable and responsive to local needs (NASEM, 2020a; Quinn et al., 2020). A good example is a communication planning strategy for building partnerships at a New Jersey environmental agency, which included the following steps: identify the issue; set goals; know the issue, audience, and constraints; assess audiences; identify messages and methods; implement a communication strategy; and evaluate, debrief, and follow up (Pflugh et al., 1992). Local governments thus could utilize or leverage existing relationships, social capital, and resources to build vaccine confidence. Potential partners might include faith-based networks, existing community health worker programs, or local advocacy and activism groups (e.g., organizers of get-out-the-vote efforts or the census, or neighborhood coalitions formed to improve walkability or green spaces).

2. *Engage with and Center the Voices and Perspectives of Trusted Messengers Who Have Roots in the Community*

Evidence suggests that efforts to counter vaccine hesitancy and promote vaccination need to emphasize putting "people at the center" of those efforts (Schoch-Spana et al., 2020). Research has highlighted the potential effectiveness of dialogue-based interventions, including social mobilization and engagement with community leaders and trusted community representatives, as well as the importance of community involvement in creating, adjusting, and implementing these solutions to ensure adequate buy-in and trust (Dubé et al., 2015; Jarrett et al., 2015; NASEM, 2020a). Social media or advertising campaigns encouraging community members to share why they choose to get vaccinated—such as the "whatsyourwhy" factor and "blackwhysmatter" social media hashtags—can be persuasive.

Central to this strategy is developing long-term relationships with trusted community members—a process that takes time but is essential. If such relationships are not already in place, local health departments can begin by listening to community members' concerns and providing support and resources to ensure that they have culturally appropriate information about the vaccines and, most critically, equitable access to vaccination.

3. *Engage across Multiple, Accessible Channels*

Community engagement will need to occur across a variety of channels well suited to reaching vulnerable populations, including people who cannot attend public meetings (e.g., because they work, live remotely, are incarcerated, or are undocumented), who have limited broadband service, who speak languages other than English, or who cannot use written text

(NASEM, 2020a). Determining which channels are most appropriate for particular populations is essential. State and local leaders can choose to communicate through town hall meetings, special community events, or faith-based gatherings.

4. *Begin or Continue Working toward Racial Equity*

Public engagement around vaccination, particularly with communities of color, needs to begin with acknowledgment of existing inequities. A health department could, for example, garner supporters and allies—and elevate racial equity—by recognizing how systemic racism has disadvantaged these communities and explaining how the department is working to create health for all communities.

Talking about vaccines in isolation risks reinforcing deeply held beliefs that health (or ill health) is purely a matter of individual behaviors (such as choosing to get vaccinated) and obscuring the broader structural factors—such as housing, jobs, and health care access—that also impact health. It is critical for authorities to acknowledge these broader shortcomings in health equity, to frame the COVID-19 vaccines as one of several tools that can help advance equity in communities most affected by the pandemic, and to reassure those communities that this type of work will continue beyond the pandemic. The pandemic has exposed myriad health disparities, and public health policies and action, including vaccination, need to reflect a deeper commitment to equity (Berkowitz et al., 2020).

An example of such an effort is the Bay Area Regional Health Inequities Initiative, a coalition of health departments and community partners in California's Bay Area focused explicitly on the advancement of health equity, racial justice, and economic opportunity. The group works across nine counties and has recently focused its efforts on COVID-19 response while continuing to highlight the importance of broader social determinants of health in shaping community health outcomes, particularly among communities of color (Bay Area Regional Health Inequities Initiative, 2020; Kritz, 2020).

5. *Allow and Encourage Public Ownership of COVID-19 Vaccination*

As noted earlier, while trust is critical to vaccine acceptance, trust in public health is low within some populations, including many communities of color. Public ownership of COVID-19 vaccination through public oversight and community engagement can inspire greater confidence in COVID-19 vaccination. Best practices for public ownership include actively seeking engagement with the public, listening to feedback and adapting accordingly, establishing local public oversight committees, and implementing bottom-up approaches with community members leading solutions. Research has also highlighted the benefits of public ownership of vaccination through governance structures that involve community members, noting the potential for those mechanisms to drive trust and improve access (Schoch-Spana et al., 2020). Also beneficial is emphasizing vaccination as a public good (e.g., "I am doing this because my vaccination helps the community at large, and I care about my fellow citizens").

6. *Measure and Communicate Inequities in Vaccine Distribution*

Real-time measurement of inequities in vaccine distribution and communication of those findings to the public is critical to building trust. Communities could disaggregate vaccine distribution across the 15 factors that make up the Centers for Disease Control and Prevention's (CDC's) Social Vulnerability Index and publish that information on public dashboards, for

example. Decision makers will need to monitor this information and work with community leaders to implement solutions as inequities arise.

EFFECTIVE COMMUNICATION TO BUILD CONFIDENCE IN THE COVID-19 VACCINES

Principles for Effective Communication

This section highlights five principles of effective risk communication, adapted from guidance issued by the CDC: (1) do not wait; (2) be credible; (3) be clear; (4) express empathy and show respect; and (5) acknowledge uncertainty and manage expectations. These principles can inform communication efforts and the development of strategies and tactics for building confidence in the COVID-19 vaccines and promoting uptake.

Do Not Wait

Begin Communicating Immediately. Once formed, attitudes are difficult to change (Weber and Johnson, 2006). Therefore, COVID-19 vaccination programs will need to develop their communication strategy as soon as possible. Because most people form judgments about new ideas based on narratives they have developed from past experiences, communication approaches could cue or activate people's existing mental models to recognize the COVID-19 vaccine as something with which they are already familiar (i.e., the prototypical childhood vaccines, which are widely accepted in the United States).

Be Credible

Be Consistent and Transparent. Transparency is key, particularly as new data become available. Any vaccine will likely have some side effects and risks associated with its use, and these need to be communicated clearly in ways appropriate for and accessible to target audiences. Likewise, unknowns about the vaccines (e.g., whether they will prevent transmission of the virus as well as symptoms; when the general public will be vaccinated) need to be acknowledged as such. Greater transparency about the vaccine authorization and distribution process, for example, could potentially address concerns about the politicization of the process (Quinn et al., 2020).

Be Clear

Use Accessible, Jargon-free Messages. Accessible communications that avoid jargon and are tailored to the literacy level of the target audience are important. Avoiding jargon is not a matter of merely removing difficult chemical or biological terms from messages, but also entails examining seemingly simple terms for overlooked problems (e.g., whether "significant" refers to statistical or substantive significance). Tailoring messages to the health literacy and numeracy levels of the target audience will also foster greater understanding.

Express Empathy and Show Respect

Avoid Dismissing Concerns. Ensuring that people feel heard—not dismissing their concerns—is important because if people do not feel heard, they are unlikely to listen. Instead, effective communications require listening to people's concerns, rephrasing and restating those

concerns, and presenting relevant new information with empathy. For example, responses to misinformation could begin with, "I see that you have concerns about X. There's a lot of information out there, and some of it is true, and some of it is not true. Let me tell you what I know...."

Acknowledge Uncertainty and Manage Expectations

Acknowledge Uncertainty. During a pandemic, what is and is not known changes constantly, and policy and programs change accordingly. Even now, as the vaccine rollout continues, some people interpret the changes in dose availability and allocation and priority groups as signs of incompetence or mistakes on the part of government or scientists. According to Quinn and colleagues (2013), preparation for uncertainty contributes to the public's acceptance of such change and trust in associated communication. With respect to COVID-19 vaccination, the public could be prepared with such statements as, "While we'd like this to move faster, we cannot always predict how many doses we will have each week, and our limited doses mean it will take longer to vaccinate people."

Don't Overreassure. The vaccine rollout will take significant time and effort. Honestly sharing realistic projections of the timeline could help manage people's expectations. Conversely, overpromising how quickly the process will proceed could undermine trust. Also crucial in ensuring that reasonable expectations are set is clear guidance on how to sign up for vaccination appointments and the various avenues for doing so. Sharing this planning information proactively and widely will help manage expectations and reduce frustration, and ideally will encourage fair coverage of the process as it unfolds.

Communication Strategies for Promoting Acceptance of the COVID-19 Vaccines

There is no single solution to vaccine hesitancy. Rather, multiple nuanced approaches are key to ensuring that those who are hesitant do not evolve to outright vaccine refusal and that existing health inequities are addressed. This section summarizes nine best practices for communication strategies designed to build confidence in the COVID-19 vaccines.

1. *Meet People Where They Are, and Don't Try to Persuade Everyone*

Models identifying stages of behavior change suggest that information and resource needs differ for people who are "considering" a particular self-protective action, such as vaccination (Why should I adopt it?) versus those who have decided to take the action (How do I go about doing it?). Thus, it is important to develop different messages for those who are willing to be vaccinated and need information on how to do so and those who are hesitant but open to learning more. Moreover, trying to persuade those who are completely opposed to vaccination is not a wise use of resources (Public Health Institute, 2020), especially given that, as noted earlier, most people who are unwilling to get vaccinated immediately can be considered hesitant or skeptical, with just a small portion of the population being absolutely opposed to vaccination (Bruine de Bruin et al., 2019).

Research on COVID-19 vaccination, and routine vaccination more broadly, emphasizes the importance of empathy as key to interacting with those who may be vaccine hesitant or skeptical, including through such techniques as motivational interviewing between providers and patients (Ferreri, 2020; Gagneur, 2020; Martin, 2021; Maurici et al., 2019). For these exchanges,

it is important to use such phrasing as, "I understand that you might have questions about the vaccine, and I'm here to answer them as best I can…."

2. *Avoid Repeating False Claims*

Correcting information that is inconsistent with scientific evidence is difficult under most circumstances (Cook and Lewandowsky, 2011; Lewandowsky et al., 2012; NASEM, 2017). It should be noted, moreover, that repeating false claims and misinformation risks inadvertently amplifying and strengthening that information. Occasionally, however, public health practitioners may have to address false claims (Ecker et al., 2017). In these situations, it is important to warn recipients before confronting them with the false information (e.g., "The following claim is misleading…") and to emphasize the facts over the misinformation (MacFarlane and Rocha, 2020). Practitioners can also use a pivot approach to avoid addressing and correcting false claims and misinformation directly, instead diverting the listener to consider concerns about the risk of disease (Omer et al., 2017). According to MacFarlane and Rocha (2020), additional strategies for debunking misinformation and overcoming its effects include preemptively explaining flawed arguments, using visual representations to increase data comprehension (Dixon et al., 2015), and providing alternative explanations of the debunked phenomenon (e.g., that purveyors of misinformation are interested in selling different remedies or support a political ideology) (Ecker et al., 2010).

The nation's polarized media environment also means that people are receiving very different messaging about the pandemic, and at the same time, the spread of information has become more "bottom-up" than "top-down." Evidence indicates that, instead of treating skeptics as the "other" and adopting a "those people" attitude toward vaccine-hesitant individuals, it is best to adopt an approach that encourages empathy (Hausman, 2020).

3. *Tailor Messages to Specific Audiences*

Messages will be received differently by different groups. To be effective, communication about the COVID-19 vaccines needs to reflect an understanding of the targeted audience, including their concerns and motivations and whom they trust. It is essential to recognize that the information needs of diverse audiences may or may not match communicators' assumptions about those needs. If the audience does not deem the information provided to be relevant or responsive to their information needs, they will ignore it.

Successful communication strategies therefore emphasize population segmentation, recognizing the need to develop different strategies for different subgroups, as characterized by epidemiological, psychographic, and demographic variables. Effective communication will use appropriate approaches to reach vaccine-hesitant audiences that differ by age, gender identity, marriage status, education level, refugee and immigration status, health behaviors/norms, and race and ethnicity, as well as the socially marginalized. Survey data can provide information relevant to target audiences, such as existing beliefs and content to avoid, which can inform development of the messages they receive (see, e.g., Amin et al., 2017; Parvanta et al., 2013; Rutjens et al., 2018). Data from qualitative studies that rely on first-hand explanations can also be used to develop messages that will resonate with particular audiences.

It is important as well to consider tailored messaging needs down to the individual level, including through such strategies as the aforementioned motivational interviewing (Gagneur, 2020), despite the anticipated difficulty of widespread scale-up of such strategies. For example, messaging that explains why the COVID-19 vaccines cannot alter DNA might cause more harm

than good if disseminated widely to an audience not already concerned about this misconception. However, particular individuals may benefit from hearing this message or others like it. This example highlights the importance of tailored individual conversations rather than broadly disseminated communications in certain contexts.

4. *Adapt Messaging as Circumstances Change*

Adaptive messaging is a core tenet of communication during the response to an infectious disease outbreak (Tumpey et al., 2018). Accordingly, what influences people's decisions is likely to shift as vaccine distribution goes forward, reflecting both individual experiences and months of media coverage. Ultimately, communication themes being emphasized today may be inappropriate or incomplete in several months as circumstances change, and campaigns will be forced to adapt accordingly. Recognition of the dynamism of COVID-19 vaccine hesitancy is key to the construction of effective communication strategies, which must mirror the dynamism of beliefs. Therefore, constant research to monitor and understand the addressable influences on vaccine confidence over time will be essential, as will feedback mechanisms to ensure that this information is used to inform planning processes. Rapid research methods will be needed to identify relevant priorities, appropriate message formats, trusted messengers, and appropriate message frequency, along with funding to support this research (Schoch-Spana et al., 2020).

5. *Respond to Adverse Events in a Transparent, Timely Manner*

As vaccination becomes more common, people's experiences with the COVID-19 vaccines will become known. While the vaccines often cause mild and transitory side effects, serious adverse reactions are exceedingly rare (CDC, 2021; n.d.). The rarity of adverse events is not always appreciated, however, as such events are often disproportionately reported in the news media and spread widely on social media. Moreover, serious medical events may occur coincidentally soon after vaccination and be perceived as related to the vaccine (Salmon, 2020). It is important to communicate information about adverse events in a timely and transparent manner and to help people understand what is known, what is unknown, and what should be done. In addition, postvaccination surveillance is essential to identify rare adverse outcomes that may be vaccine related. Taking this approach will help mitigate concerns about safety, side effects, and adverse events moving forward.

6. *Identify Trusted Messengers to Deliver Messages*

Messages about a new COVID-19 vaccine will be novel to all target audiences. Trust in the person or institution that delivers a message, built over previous years, will boost its credibility. Different groups may have different trusted messengers and preferred mediums and channels. Decision makers can identify groups that represent trust gaps in their community and trusted sources within and outside their organization who can convey public health messages to those groups.

7. *Emphasize Support for Vaccination Instead of Focusing on Naysayers*

Research shows that people look to their peers for cues about how to behave in a wide range of areas, from voting to savings (Brunson, 2013; Schultz et al., 2007). Accordingly, making vaccine uptake visible will encourage a social norming of COVID-19 vaccine acceptance. Early on, one approach is to emphasize *increasing* support for vaccination as uptake increases, thus initiating a virtuous cycle. Just as voters receive "I voted" stickers after casting

their ballots, vaccine distribution sites could provide "I got vaccinated" stickers, or encourage people to text their friends and family or post on social media that they received the vaccine (Milkman, 2020). Likewise, state and local jurisdictions could create publicly available dashboards with real-time data about the doses of vaccine administered in their communities or highlight evidence of community demand for vaccination (e.g., through news stories about people seeking vaccination).

8. *Leverage Trusted Vaccine Endorsers*

The immunization of thought leaders, community champions, and celebrities could help encourage members of the public to be vaccinated (Freed et al., 2011; Hoffman et al., 2017; Najera, 2019). Such vaccine promotion messengers should be relatable, trusted, and credible, and their messages should be consistent (Tumpey et al., 2018). This strategy could be paired with strategy 1 above.

A particularly effective way to implement this strategy could be to partner with people who have strong existing popular or community relationships with experts, adapting messages as needed. Examples of this approach include NBA star Stephen Curry's hosting Dr. Anthony Fauci on his video series and national vaccine experts participating in local town hall meetings. Likewise, in Baltimore, public health experts and researchers have partnered with faith leaders in the Black community to reach out to and educate community members about both COVID-19 and influenza (Sokolow, 2020), an approach that could be adapted elsewhere. And in Prince George's County, Maryland, a long-time partnership involving the Maryland Center for Health Equity has focused on having local health care providers talk about the vaccine with barbers and stylists to shift them toward vaccine acceptance, the idea being that these individuals can help clarify misinformation and set social norms in their community.

9. *Pay Attention to Delivery Details That Also Convey Information*

Trust in a vaccination program may be undermined if the user experience with enrolling and getting vaccinated is poor. If exposed to reports of online sign-up portals crashing, dirty clinic sites, or long wait times, for example, people may infer that the vaccine itself is also faulty.

CONCLUSION

Public engagement and messaging are critical to addressing the issues discussed herein to promote public confidence and trust in the COVID-19 vaccines. Given the prevalence of local concerns and information needs, it is important to support local communities by providing the resources they need to engage community members and reinforce accurate, clear information. Accessible, consistent, and transparent communication is crucial to converting hesitancy about vaccination to acceptance. Strong community engagement to identify and understand concerns will help in determining what messaging, delivered by whom, will be most effective.

Everyone—employers, health care providers, faith leaders, elected leaders, and public health officials—has a role to play. All strategies for increasing vaccine confidence need to take into account that vaccine decision making is part of a nuanced ecological model in which individual beliefs and behaviors are influenced by experiences at the community, organizational, and policy levels. As the COVID-19 vaccination campaign continues, it will be important to employ a coordinated approach that is supported at the federal and state levels and invests in

Strategies for Building Confidence in the COVID-19 Vaccines

local resources, expertise, and involvement. A variety of strategies at the national, state, and local levels will be required to change the pattern of interactions with the public, address vaccine hesitancy, build trust, and ultimately ensure a successful COVID-19 vaccination campaign.

SEAN is interested in your feedback. Was this rapid expert consultation useful? Send comments to sean@nas.edu or (202) 334-3440.

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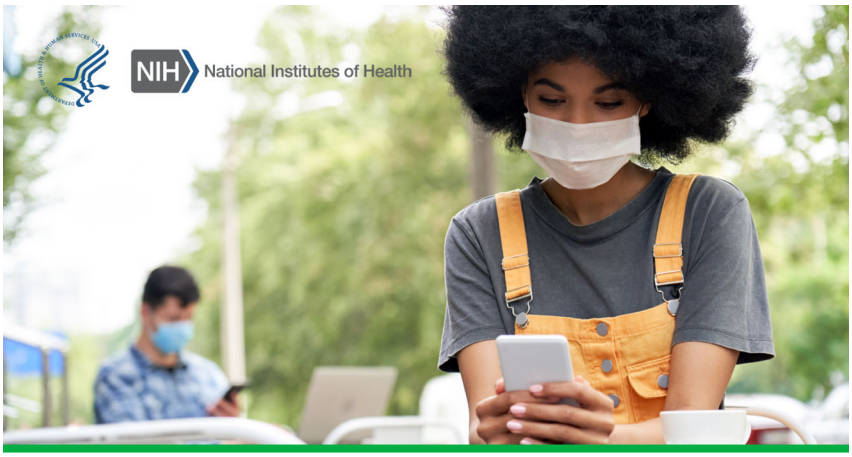

COVID-19 Vaccination* Communication:

Applying Behavioral and Social Science to Address Vaccine Hesitancy and Foster Vaccine Confidence**

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* Although technically these are SARS-CoV-2 vaccines, we refer to them as COVID-19 vaccines to be consistent with how most lay people describe them.

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Executive Summary

Although newly developed COVID-19 vaccines are poised to be a powerful tool in the control of the devastating COVID-19 pandemic, the public's confidence in and willingness to receive the vaccines will determine the outcome of this mass-scale public health intervention. This report, which was developed in consultation with leading experts in social and behavioral sciences and public health, outlines **evidence-informed communication strategies in support of national COVID-19 vaccine distribution efforts** across federal agencies and their state and local partners. The recommendations put forth are actionable and responsive to the unique challenges faced by the United States in responding to the COVID-19 pandemic. The report relies on a few foundational practices of effective health communication, namely **coordinated communication and consistent messaging, trust building through partnerships, consideration of different health literacy levels** in the population, and importantly, **prioritizing equity** in all aspects of communication. We build on these foundational principles to outline three intersecting considerations for communication efforts (*What* is being communicated, *Who* is the target of the message, and *How* the message is communicated), along with concrete recommendations for targeted and tailored communication that responds to the needs and perspectives of the intended audience.

WHAT

Define the goals of vaccination communication

Identification of specific communication goals is necessary to inform the development of message content and format. In addition to provision of top-line information regarding the vaccines, it is important to consider and address underlying reasons for vaccine hesitancy to instill trust. Doing so in an empathic way is crucial to avoid alienating those who have concerns about the development and deployment of these vaccines. Monitoring the spread of both general and COVID-19-specific vaccine misinformation, and taking steps to mitigate its impact, will be critical for successfully addressing vaccine hesitancy. It is important that the goals of communication efforts—whether they focus on the delivery of top-line messages or on addressing vaccine hesitancy and misinformation—continue to evolve in response to emerging pandemic- and vaccine-related information and shifts in public sentiment to sustainably reinforce vaccine confidence.

WHO

Identify the needs and perspectives of the intended audience

The COVID-19 pandemic is having a disproportionate impact on communities already experiencing health and social disadvantages by virtue of their race, ethnicity, health status, age, access to health care, occupation, and socioeconomic conditions. To develop the most effective, trustworthy, and equitable communication strategies, the perspectives of the intended audience—including concerns, motivations, values, and information needs—must be considered. These factors should dictate vaccination communication priorities, including understanding and responding to different reasons for vaccine hesitancy in diverse communities. This document highlights some of the unique challenges and factors associated with vaccine hesitancy in specific communities and describes methods that may help increase vaccine confidence in these populations.

HOW

Create and disseminate messages tailored to the intended audience

Given the diversity of factors that drive vaccine hesitancy in different groups, communication efforts cannot take a "one size fits all" approach. Effective communication goes beyond the provision of accurate content; it must also be tailored to the community's values and priorities and come from trusted messengers. The only way to truly "listen" to the community is to co-develop and co-disseminate COVID-19 vaccination messages through meaningful partnerships with trusted information sources. In addition to partnering with trusted entities and leaders during message development, certain communication tactics may prove effective across a variety of communication campaigns. For example, it may be helpful to frame COVID-19 vaccination as a social norm that is collectively beneficial and acceptable and to reinforce the idea that vaccination is an apolitical, nonpartisan health care decision. Promotional materials, such as "I got the shot" stickers, may help establish vaccination as a socially supported behavior and enhance vaccine confidence by making vaccination behavior more visible.

Furthermore, modifying the choice architecture in ways that make vaccination the easy and convenient action (for example, by asking people to opt out of rather than opt into vaccination at health care appointments) could increase the likelihood of vaccination uptake, while still preserving autonomy in decision making. However, efforts to promote the vaccines must also take care to ensure that all messages are accurate, transparent, and truthful and neither exaggerate nor minimize the vaccine benefits or risks. Similarly, overactivation of fear and overly directive message framing should be avoided, because these approaches are likely to be counterproductive and heighten vaccine hesitancy. Ensuring value-concordant messaging and eliciting positive emotions, whenever possible, will enhance trustworthiness and increase the impact of the message. Finally, several creative communication strategies, such as the use of personal narratives (e.g., from celebrity spokespeople) and short videos (e.g., "edutainment"), may help effectively convey key messages in an accessible way.

Introduction

The historic public health crisis resulting from the SARS-CoV-2 (hereafter COVID-19) pandemic has resulted in tremendous mortality and morbidity, as well as unprecedented economic loss and disruption to daily life in the United States and across the world. Long-term control of the COVID-19 pandemic hinges on the development, distribution, and uptake of vaccines. Although highly effective COVID-19 vaccines have been developed rapidly and a phased plan for national vaccine distribution has been established, ensuring the success of national vaccination efforts will require a communication plan to address vaccine hesitancy and foster vaccine confidence. To enhance acceptance and trust in COVID-19 vaccines among the diverse populations in the United States, communication activities should be informed by insights from behavioral and social sciences and continuously adapt to a complex and dynamic vaccination landscape across all phases of vaccine distribution and administration.

Despite the considerable suffering and disruption caused by the COVID-19 pandemic, polls suggest that a sizable proportion of the U.S. population either does not plan to receive a COVID-19 vaccine or is unsure about receiving a vaccine.[1,2] Furthermore, a recent report found that despite the disproportionate impact the pandemic is having on minority communities in the United States, only 48 percent of Black Americans and 66 percent of Latinx individuals surveyed would receive the vaccine even if it was available for free.[3] The hesitancy observed regarding COVID-19 vaccines is, in many ways, understandable given the novelty of the virus, mixed messages about the severity of the disease, concerns about the rapid vaccine development timeline, and perceived politicization of the process.[4] These COVID-19-specific concerns may be exacerbated by factors that reduce vaccine confidence in general, including distrust in traditional sources of health information (e.g., government agencies, scientists, the medical system), the rapid and extensive spread of misinformation online, and disinformation campaigns that take advantage of the divisive public discourse around vaccines.[3,5,6]

In addition to vaccine hesitancy, the fact that most candidate vaccines require a two-dose regimen administered several weeks apart[7] creates additional challenges for full vaccine uptake. Communication efforts will need to make it clear that individuals will not only need to initiate the vaccine, but also to return to receive another shot at the right time to be fully vaccinated. In addition to logistical complexities, the two-dose regimen could add to communication challenges if individuals experience unpleasant side effects in response to the first dose, making them reluctant to complete the series.[8,9] Experience with other multiple-dose vaccines, like the shingles vaccine, suggests that educational efforts that highlight the efficacy of the vaccine and set appropriate expectations about any initial side effects will be crucial to overcoming this barrier.[8,9]

It is clear that public health entities charged with communicating about COVID-19 vaccines face notable challenges, including a compressed timeline for developing communication strategies to educate the public about the vaccine and address vaccine hesitancy ahead of rollout. Moreover, vaccination communication must be connected to the broader context of COVID-19 pandemic control, including critical preventive behaviors, such as mask wearing, hand washing, and social distancing. Consequently, the rapid, coordinated dissemination of effective messages will be an essential element in addressing one of the most significant public health challenges in decades. Although ensuring successful vaccine uptake across the nation will require addressing demanding logistical and structural challenges, strategic and evidence-informed communication regarding vaccine safety, efficacy, distribution, and access will also play a key role in the complex national COVID-19 vaccination process. Drawing on behavioral and social science research, in addition to establishing collaborative partnerships with trusted community organizations, can increase the likelihood that COVID-19 vaccine communication endeavors will be successful.

To identify evidence-informed strategies for communicating about COVID-19 vaccines, the NIH Behavioral and Social Sciences Research Coordinating Committee formed a COVID-19 vaccine communication working group in September 2020 and convened an expert panel on November 5, 2020. The panel, which comprised 15 leading experts in public health and social sciences (e.g., communication, psychology, behavioral economics, health disparities, anthropology), focused on identifying evidence-informed communication approaches that could guide government entities in communicating COVID-19 vaccine-related information to a variety of constituents. The panel also made recommendations about how these communication strategies could be optimized, tailored, targeted, and delivered to address the unique needs and perspectives of diverse populations. The panel discussion formed the basis of this report, which is designed to summarize evidence from behavioral and social science to inform COVID-19 vaccine communication efforts across U.S. federal agencies and partners at the state and local levels. This report begins by outlining foundational considerations for any public health communication effort and then delves into more specific evidence-informed communication strategies for reducing hesitancy and enhancing confidence in COVID-19 vaccination.

Foundational Communication Considerations

Effective health communication relies on foundational best practices. Although these are not the primary focus of this report, some of the COVID-19 vaccine communication recommendations highlighted in subsequent sections will build on these general best practices:

- **Ensure coordinated communication and consistent messaging:** Although a national strategy is important, sustained partnerships with state, local, and community organizations are critical, because most communication ultimately must be locally implemented and coordinated. Message framing may differ depending on the specific community of focus, but it is important to minimize conflicting or distracting messages by keeping message content as consistent as possible.

- **Foster transparency and build trust through partnerships:** Presenting clear and accurate information that does not exaggrate or minimize the benefits or potential risks is vital. In addition, leveraging trusted sources to disseminate the messages is as essential as the content itself, and it can be accomplished through sustainable partnerships between federal agencies and trusted entities or individuals who reflect the diversity and views of the intended audience.

- **Consider the range of health literacy:** Plain language and visual representations should be used where possible. Additionally, communication strategies should be developed to accommodate different levels of health literacy (e.g., the capacity to understand health information), digital literacy (e.g., the capacity to discern the credibility of online sources), and science literacy (e.g., understanding of the evolving nature of science). Furthermore, language preferences for those with limited English proficiency must also be taken into account. It is important that translations into other languages be done in a culturally sensitive way so that the information is conveyed in an accurate, nuanced, and accessible manner.

- **Prioritize equity:** Suboptimal communication has the potential to exacerbate health disparities and undermine the goals of fostering equity and trust. Communicators should make additional efforts to engage with and address the needs of vulnerable, underserved, and traditionally marginalized populations during communication development and dissemination to avoid exacerbating disparities. Communication efforts should be sensitive to the fact that people may have to balance competing priorities.

Specific Objectives

This report highlights recommended practices drawn from behavioral and social science research that can be used to inform COVID-19 vaccine communication efforts. The intended users of this report are those charged with COVID-19 vaccine communication across federal health agencies and their partners at the state and local levels. The recommendations put forth in this report are evidence-informed, actionable, and responsive to the unique circumstances and challenges facing the United States with regard to the COVID-19 pandemic.

The recommended strategies are organized around three critical and interrelated strategic considerations that should guide the planning and implementation of COVID-19 vaccine communication:

1. **Define the goals of vaccine communication (What)**
2. **Identify the needs and perspectives of the intended audience (Who)**
3. **Create and disseminate messages tailored to the intended audience (How)**

The following sections provide details and examples for each of the strategic considerations. For any communication planning and implementation effort, all three considerations are important and may intersect in unique ways depending on the goals, target audience, resources, and time available for message tailoring and dissemination, among other practical factors.

1. Define the goals of vaccination communication

The first step in any communication effort should be to identify communication goals, because these goals will inform message content, format, mode of delivery, and required partnerships. Within the complex landscape of COVID-19 control and risk mitigation are a number of distinct and high-priority communication goals—such as conveying information about vaccine efficacy and safety, addressing vaccine hesitancy, or mitigating the impact of misinformation—each of which may necessitate a different approach. On the next page, we outline critical considerations for establishing goals in COVID-19 vaccination communication efforts.

1.1 Establish top-line messages regarding COVID-19 vaccination

Key goals of COVID-19 vaccination communication

- Provide assurance of vaccine safety and efficacy.
- Highlight the collective and individual benefits of vaccination.
- Explain the vaccine development, FDA approval, monitoring, and distribution process.
- Address vaccine hesitancy and respond to dominant concerns without judgment or overly directive language.
- Monitor misinformation and develop counter messages.

Developing a core set of messages, along with harmonized themes, images, and branding can help ensure consistency of vaccine information across different entities and sources. Top-line messages should provide accurate vaccine information, acknowledge people's concerns where appropriate, and increase vaccine confidence and acceptance. Currently (as of December 2020), critical content for COVID-19 vaccination messages should include **assurance of vaccine safety and efficacy, evidence that the benefits of vaccination** (i.e., protection from the virus) **outweigh the risks,** and **a focus on the collective benefits of high vaccination coverage.** Emphasizing the importance of completing the two-dose vaccine series will also be critical to ensure adherence. In addition, messages should establish social norms for vaccination—for example, by increasing the perception that members of one's social group plan to or have already been vaccinated[10]—and emphasize how herd immunity resulting from high vaccine uptake can protect the health and well-being of others.[11,12] Finally, vaccination messages cannot be divorced from overall pandemic control efforts and the need for continued preventative behaviors, including social distancing and mask wearing, until COVID-19 community transmission is halted. Messages should therefore clearly explain why vaccination alone, although beneficial, will not offer a quick end to the pandemic, at least in the early stages of rollout.

This core content then can be adapted to fit a given community's context, concerns, and preferred communication channels and developed into a tailored message (detailed in Section 3 below). Moreover, in crafting top-line messages, it will be critical to acknowledge and respond to the evolving scientific knowledge about various COVID-19 vaccines, which is an expected part of the vaccination administration process. Top-line message content may need to be adjusted to account for any documented differences in the various vaccines, who will receive them, and when they will receive them, so that this information can be quickly and consistently communicated to the public.

1.2 Address vaccine hesitancy before and during rollout to reinforce COVID-19 vaccine confidence

Hesitancy or resistance to vaccination is multifaceted and requires different approaches based on the level of hesitancy and the specific concerns driving hesitancy in the targeted community. For example, for some, vaccine hesitancy may stem from deep distrust of certain institutions, such as the media, government agencies, or pharmaceutical companies.[13,14] For this group, communication from more trusted sources will be

essential to reducing vaccine hesitancy. For others, hesitancy may be driven by concerns over the accelerated development timeline for COVID-19 vaccines. These individuals may be eager to gain knowledge from trusted experts about the steps taken to develop and evaluate the vaccine to support them in making an informed decision about vaccination. Hesitancy arising from the false, but understandable, perception that the development and approval of COVID-19 vaccines has not been as stringent as the process for other vaccines could be addressed by transparently **explaining the vaccine development processes** from clinical trials to reviews by U.S. Food and Drug Administration (FDA) panels to authorize use to subsequent monitoring for safety and effectiveness. It is important to note, however, that as knowledge about vaccines and rollout evolves, new concerns and questions about particular vaccines may emerge, requiring government agencies and their partners to adjust and respond quickly.

In addition to unique concerns driving vaccine hesitancy, individuals' personal values and beliefs, such as those related to self-determination vs. fatalism or individualism vs. collectivism, are likely to influence uptake of preventative health measures, including vaccination.[15-18] Understanding a community's dominant values and beliefs can help inform the development of effective messages to build vaccine confidence in the community.

Furthermore, a distinction exists between those who may be hesitant about COVID-19 vaccines and those who have complete mistrust in vaccines. A poll conducted in November 2020 found that 42 percent of Americans are hesitant about receiving a vaccine, with 12 percent reporting not trusting vaccines in general.[2] Communicators should avoid grouping those who are only hesitant to vaccinate, but not entirely opposed, with people who are actively opposed to all vaccination. Research on childhood vaccines suggests that there is a **window of opportunity for influencing people who are initially vaccine hesitant** before their views become ingrained.[19] Therefore, hesitancy should be addressed early in the vaccine rollout process, because the longer people stay uncertain and their concerns go unaddressed, the less likely they are to get vaccinated.

For those who have expressed a deeper general mistrust in vaccines, communication should still be **balanced, empathetic, and compassionate.** Even if this approach does not immediately lead to vaccine acceptance, it could help build relationships and trust, which may lead to greater willingness to consider vaccination in the future.[20] Furthermore, attempting to directly contradict their anti-vaccine stance could lead to defensiveness and psychological reactance and further reduce their willingness to vaccinate.[21] Messages targeting this group might include acknowledgement of some of the dominant concerns about vaccines but emphasize the evidence for the vaccine's safety and efficacy.

More generally, communication efforts targeting any group should **avoid judgment, shaming, or excessive directiveness,** because messages with these characteristics have been found to be counterproductive in previous public health campaigns.[22,23] Avoidance of judgment allows people to feel that their concerns and values are respected and indeed "heard" by public health officials. Dismissing or leaving these vaccine concerns unaddressed creates an opportunity for anti-vaccine groups to further sow doubt in vaccines and gain credibility for their own misinformation by effectively aligning their anti-vaccine messages with their target groups' core concerns and values.[24]

1.3 Mitigate the impact of COVID-19-related misinformation

The spread of health-related misinformation was a significant public health concern well before the COVID-19 pandemic. During the last decade, vaccine-related discourse online and in the media has been plagued

by misinformation.[25,26] Anti-vaccine groups have leveraged political and social divisions to diminish trust in vaccines, pushed false narratives questioning the safety and effectiveness of vaccines, spread false claims about adverse outcomes, and downplayed the risks of the diseases vaccines protect against.[24,27-30] In the case of the current pandemic response, a recent joint statement from global public health organizations asserted the extent to which misinformation and disinformation have undermined public health response.[31] Social media has facilitated the rapid and widespread sharing of inaccurate information and outright falsehoods about many aspects of the COVID-19 pandemic,[32] from denying or downplaying the severity of the virus to casting doubt on public health guidance to spreading vaccine conspiracy theories. COVID-19 vaccine communication efforts cannot ignore misinformation and must take actions, informed by behavioral and communication research, to identify emerging rumors and respond in a way that is informed by behavioral science.

Real-time, agile, and scalable monitoring of discourse concerning COVID 19 vaccination—including conspiracy theories, rumors, and myths—can support a swiftly developed and implemented response. "Misinformation surveillance" efforts should identify the most prominent sources of misinformation, the tactics being used, and the groups most at risk of being exposed to and influenced by the rumors. This information, in addition to data regarding the dynamics and patterns of misinformation spread, could help inform the appropriate response and best targets for intervention efforts. Understanding the emerging themes, values, logic, or concerns underlying the false claims or conspiracy theories can also inform the **development of effective counter-messages.** Developing competing messages that address the same concerns or beliefs held by those who might be vulnerable to misinformation could be important to countering the effects of misinformation exposure, especially if these counter-messages can penetrate online information silos where misinformation circulates.[33] Research suggests that exposure to detailed messages debunking misinformation can be effective[34,35] and that exposure to multiple sources of information outside an individual's siloed communication circle can result in a more accurate credibility assessment.[36] Therefore, broad exposure to multiple sources of factual counterarguments that have been developed according to best-practice recommendations could be an effective way to induce misinformed individuals to update their beliefs.

It is important to recognize that not every piece of misinformation requires an immediate counter-response. Public health organizations do not typically have the resources or capacity to address every piece of misinformation. When a rumor seems to be gaining widespread traction and has the potential to either cause harm or undermine critical health promotion efforts, however, intervention will be required. Correcting the false claim contained in the message, exposing the tactics used by disinformation agents, and inducing skepticism by highlighting the ulterior motives of these actors are all potentially effective strategies for mitigating the impact of misinformation.[37-39] Communication research also points to a few general actions to *avoid* when responding to misinformation: (1) **Do not repeat the falsehood,** because such repetition can have a priming effect. (2) Do not assume that those who are generally well informed about health information are immune to being influenced by falsehoods. (3) Do not assume a one-time effort will be sufficient, because **communication effects are often incremental and require persistence and consistency.**[39]

Finally, although research suggests that certain tactics can effectively mitigate the impact of misinformation and that debunking can work in certain situations, preemptive measures that either prevent people from being exposed to misinformation in the first place or allow them to identify and dismiss misinformation when they encounter it could be the more effective approach. For example, communication science indicates that inoculating people against misinformation by warning them about potential misinformation exposure

and preemptively refuting a "weak" version of the misinformation could make people more psychologically resistant to misinformation.[40]

2. Identify the needs and perspectives of the intended audience

To develop the most effective and equitable communication strategies, efforts must be made to first identify and understand the perspectives of the intended audience. Indeed, **audience segmentation** is a critical step in message development.[41] Once the target audience is defined, **population-specific concerns, motivations, and information needs must be considered.** Vaccination decisions will, in part, depend on perceptions about individual and community risk. For example, young adults may be less concerned about their own health but more motivated to prevent infection in older family members. For some, a motivating factor may be returning to work or resuming social gatherings, whereas older adults and those with co-morbid health conditions may be more motivated to reduce their own risk for severe illness or death.[42] It is also important for public health communicators to understand that their audiences are not "blank slates," and previous experiences and mental models of disease, vaccines, and risk will influence response to messages and recommendations.[43] Furthermore, it is important to recognize that getting vaccinated against COVID-19 may not be the highest priority for some people, who may perceive other risks (unemployment, food insecurity, deportation) to be a much greater threat to their well-being.

Importantly, the COVID-19 pandemic is having a disproportionate impact on people who already experience disadvantage by virtue of their race, ethnicity, and socioeconomic conditions. Research shows that racial and ethnic minorities, in addition to having less access to health care, are more likely to be infected and have poor outcomes after infection with COVID-19, such as being four to five times more likely to be hospitalized.[44,45] Some communities of color also have historically justified distrust of the medical system, which requires careful attention and understanding. Transparent and effective communication must acknowledge and address this interplay between population-specific needs and motivations, vaccine allocation and distribution, and the current and historical context driving hesitancy in various high-risk populations.

Another key consideration in audience segmentation, given that the initial availability of vaccines is likely to be limited, is alignment with the vaccine rollout process developed by the federal, state and local governments.[46,47] Certain factors—such as risk for acquiring infection, risk for severe morbidity and mortality if infected, and potential to transmit infection to others—will determine an individual's vaccine access over time. When limited doses of the vaccine are available, individuals working in health care settings will be the first to be eligible for vaccination, followed by those at highest risk for poor outcomes, such as those with high-risk comorbidities and individuals 65 years of age or older. Other populations of focus include those who perform the essential functions of society other than health care (e.g., public safety, food supply chain, school and daycare personnel); those at increased risk of acquiring COVID-19, such as those living or working in congregate settings; and those with limited access to health care, such as rural communities and individuals experiencing homelessness. The initial response to vaccine rollout (e.g., rate of uptake, expressed hesitancies and concerns, any purported serious adverse events) will have a substantial impact on subsequent vaccination in later groups. Therefore, it is imperative that vaccination communication efforts that can rapidly address emerging concerns are in place for the first groups who are allocated to receive the vaccines.

Important population-specific considerations and concerns could contribute to lower vaccine confidence, and communication strategies must be mindful of these issues to be effective. The sections below highlight a sample of specific populations to consider. Note that this is not a comprehensive list but is intended to illustrate a range of communication considerations based on unique population attributes and contexts. Additionally, communication efforts must account for intersectionality across age, health status, race, and other sociodemographic factors.

2.1 Health care professionals

Frontline health care personnel, as well as ancillary staff who work in health care settings, will be prioritized for initial vaccine access.[48] Concerningly, vaccine hesitancy has been reported in this group, with recent reports suggesting that only about two-thirds of health care workers are willing to be inoculated with COVID-19 vaccines.[49] Hesitancy among health care workers seems to be less about overall distrust in vaccines or in the institutions developing the vaccines and more connected to specific concerns about the lack of longer term data on efficacy and potential side effects of the new vaccines.[49] For this group, **clarity and transparency of information** concerning the rigor of the clinical trial process, ongoing safety data from clinical trials, and the FDA approval process (including Emergency Use Authorization) is likely to increase vaccine confidence and uptake. Ensuring accurate and transparent vaccine messaging and increasing vaccine confidence among health care workers is foundational to successfully instilling vaccine acceptance in other populations. When health care professionals are vaccine confident and commit to vaccinate themselves, they are more likely to discuss and recommend vaccination to their patients, serving as vaccine champions and hence contributing to broader vaccine acceptance across communities.

2.2 Older adults and individuals with underlying medical conditions

Older adults (65+ years of age) and individuals with high-risk medical conditions (e.g., diabetes, heart disease, chronic obstructive pulmonary disease, cancer) or risk factors for severe COVID-19 illness (e.g., smoking, obesity)[50] will be another priority group for vaccination due to their increased risk for infection and related complications.[46] Older adults living in long-term care facilities are recognized to be especially vulnerable, and additional considerations relevant for this population are discussed below (see Section 2.6). Many older adults are justifiably worried about getting severely ill from the COVID-19 virus, and many are ready to be "first in line" to get inoculated.[51] A substantial proportion of this highly heterogeneous group, however, still may be hesitant about receiving the vaccines.[51] This hesitancy may be further exacerbated by social media misinformation, with some research suggesting that older individuals might be particularly vulnerable to being misled in the digital environment.[52] Note that whereas older age and health risk factors affect all segments of society, many high-risk medical conditions are more prevalent in some racial and ethnic minority groups, as well as underserved low-income and rural populations. For instance, people in communities of color are more likely to develop serious illness following COVID-19 infection, in part due to higher rates of underlying health conditions.[44] Many individuals at the highest risk for the poor health outcomes may also have the most limited access to health care and reliable health information. As such, **facilitating access to vaccine information at the appropriate health literacy level** will be particularly important when developing messaging for these groups.

2.3 Non-health-care essential workers

Those playing a critical role in keeping society's essential functions running and who cannot effectively socially distance in the workplace are likely to be among the groups that receive priority vaccine allocation. These essential workers include emergency and public safety personnel, food packaging and distribution workers, teachers and school staff, and childcare providers. It is important to note that many essential workers are also from groups that have been historically marginalized in society. Many service-industry jobs, for example, are low wage and filled by people of color or new immigrants. Compassionately addressing their concerns and priorities in communication about the vaccines will require an assessment of unique and critical factors contributing to essential workers' vaccine hesitancy, such as fear about being used as vaccine "guinea pigs" resulting from distrust in the government or pharmaceutical companies. Although the reasons for early vaccine allocation to this group are scientifically sound and well justified from a public health perspective, there is the potential for widening disparities and suboptimal uptake if the perception is that low-paid and often historically undervalued workers are being asked to take the risks of early vaccination. Therefore, communication strategies should address this groups' information needs to foster vaccine confidence while **preserving their decisionmaking autonomy.**

2.4 Racial and ethnic minority populations

The COVID-19 pandemic has amplified the social and economic factors that contribute to higher infection rates and poor health outcomes among many communities of color. In addition to the higher prevalence of underlying medical conditions discussed above that are related to social and economic disparities, Black, Indigenous, and people of color (BIPOC) are more likely to be essential workers or live in housing arrangements that make it more difficult to avoid exposure to COVID-19.[44,53] Importantly, long-standing systemic racism and historic scientific misconduct make many BIPOC individuals more reluctant to trust the medical establishment and thereby accept vaccines.[3,14,54] To address distrust and vaccine hesitancy among racial and ethnic minorities, health information should be developed and delivered by **sustained partnerships with community organizations trusted and respected by the target audience** to support vaccine decisionmaking. In addition, extra efforts need to be made to respect this population's autonomy and their ability to make informed decisions about vaccination. Messages need to balance inspiring trust through messengers embedded in the community and providing vaccine information in a transparent and inclusive way that supports autonomy. In addition, providing culturally appropriate, multilingual vaccine communication materials in the online spaces and physical locations (e.g., grocery stores, community centers) that are commonly accessed by racial and ethnic minority populations is vital to ensuring that information reaches these communities.

2.5 Vulnerable communities with limited access to routine vaccination services

Underserved rural residents, homeless populations, and migrant communities (including those without legal residency) are critical populations to prioritize for vaccination communication. In addition to perpetuating existing disparities, if these populations are not addressed in communication outreach plans, the vaccines will not reach their full effectiveness potential because of insufficient population-level uptake. Some of these groups may have to overcome significant logistical barriers (e.g., poor access to regular health care or lack of

insurance, long distances from vaccine administration sites, lack of childcare to allow them to take the time to get vaccinated) while also lacking access to accurate information regarding COVID-19 vaccines (e.g., due to limited Wi-Fi access or literacy challenges). Messages targeting these populations need to directly **address actual and perceived barriers, facilitate information access, and foster self-efficacy** to take the actions needed to get vaccinated.

2.6 Individuals living in congregate settings

Residents in congregate setting—such as long-term care facilities, group homes, prisons, and detention centers—are at increased risk of acquiring and transmitting COVID-19.[55] Residents of long-term care facilities are being prioritized for initial vaccine access,[48] so communication that addresses their unique concerns and the concerns of their families should be a priority early in the rollout. Also, some people living in confined settings, such as prisons and detention centers, fear contracting the virus and being unable to receive adequate care. Acknowledging their vulnerable situation and unique concerns in vaccination communication will be critical. A one-size-fits-all communication strategy in these congregate settings, however, is unlikely to be successful because vaccine uptake will require addressing the needs and concerns of multiple stakeholders within the system. For example, administrators may worry about liability, front-line workers may have concerns about safety, and individuals living in the congregate setting may have concerns related to the perception of medical experimentation and loss of self-determination and decision autonomy. Messaging should be **sensitive to the unique needs of each stakeholder in congregate settings.**

2.7 Children and pregnant women

Although clinical trials are underway, the safety and efficacy of COVID-19 vaccines is not currently known for children and has not yet been tested in pregnant women. Messages that address the unique considerations in these groups, however, still should be developed preemptively. Although children have lower risk of severe outcomes or death from COVID-19, infection still poses a risk to the child and the adults in the child's social orbit.[56] Once vaccines are approved for children, communication efforts will need to help caregivers weigh the benefits and risks of vaccination to the child and their social network by **addressing valid concerns about side effects or adverse outcomes** while also **responding to misinformation about other childhood vaccines.** Concerns may also vary by the child's age, with potentially greater safety concern in infants or very young children, and desires for older children to return to school. Moreover, early evidence indicated more severe illness and hospitalization in pregnant women due to COVID-19,[57] although recent studies suggest otherwise.[58] Considering the conflicting information, communication should incorporate the latest knowledge while also portraying transparency behind the uncertainty of higher risk. For this group, communication will need to consider messages that encourage protecting one's own health and the health of the community, in addition to **clear messaging about issues of safety, benefits, and risk to both the pregnant woman and her unborn child.**[59]

3. Create and disseminate targeted and tailored messages for the intended audience

For any identified goal and target audience, effective message development should align with the community's values and preferences and come from **trusted sources,** which **might not include government agencies.** Because communication needs to persist over time, vaccination communication strategies must also adapt to evolving information about the vaccines (e.g., newly published trial results) and guard against information fatigue. The following evidence-informed strategies have demonstrated success in other health behavior domains and can inform the development and dissemination of COVID-19 vaccine messages.

3.1 Identify and partner with trusted COVID-19 vaccine messengers

Successful partnerships between governmental agencies and trusted community entities and leaders as "messengers" can facilitate tailored communication and enhance message acceptance in different communities. The partnerships should be sustained throughout the communication planning process, rather than simply asking messengers to "lend their microphones." In fact, **co-creation and co-dissemination of key messages** and delivery formats between public health agencies and these trusted messengers is more likely to ensure that the communication strategies align with the values and priorities of the communities of focus. Moreover, while rapidly activating existing and new partnerships are required by the urgency of the pandemic crisis, public health communication needs will continue into the future, well past the current pandemic. It would be a significant lost opportunity if current COVID-19-related efforts do not **expand the base of public health messengers** and build **stronger and more sustainable partnerships**—that

Targeted and tailored vaccination messages

- Partner with a wide range of trusted information sources: Co-design and co-disseminate messages with community partners.
- Establish COVID-19 vaccination as an accepted social norm (e.g., through "I got the shot" stickers or sharing vaccine intention through social media).
- Consider behavioral nudges for vaccination (e.g., favoring opt-out vs. opt-in, making receiving vaccination convenient) while respecting decision autonomy.
- Avoid language of requirement and mandate.
- Convey a message of unity and bipartisanship in vaccination, and avoid language that sows divisions or conveys judgment.
- Ensure that all messages are accurate, transparent, and truthful; avoid exaggerating the benefits or minimizing the risks of vaccination; be clear that the vaccine is not an instant fix or a "silver bullet."
- Incorporate the values and beliefs of the target audience, such as protecting one's community or caring for those at higher risk.
- Induce positive emotions and avoid communication (including nonverbal) that heightens negative emotions, such as fear or shame.
- Use simple graphics, images, personal experience narratives, "edutainment", or short videos to creatively distill vaccine information.

endure beyond the current health crisis—between governmental agencies and communities hit hardest by the pandemic. The following strategies can inform effective partnerships with trusted messengers.

First, it is critical to **identify the most trusted sources of information for the population of focus,** including individuals, organizations, and media outlets/platforms (e.g., online influencers, journalists, religious leaders, community organizations, and celebrities and other public figures). Building partnerships with entities that have established trusted relationships with communities can help rapidly activate and mobilize a community and dispel concerns or distrust. Examples of potential messengers include tribal leaders, historically Black colleges and university (HBCU) leaders, sororities and fraternities, the U.S. Department of Agriculture's Cooperative Extension Service, and multidenominational religious leaders and organizations. Relationships with these entities need to be bi-directional, and public health agencies must proactively listen to community concerns.

Even when partnering with trusted brokers of information, careful consideration of how activities might be perceived by the target community is important. As an example, some HBCU leaders recently volunteered in COVID-19 vaccine clinical trials to counteract the distrust that they worried was putting communities of color in greater risks for COVID-19. They received opposition from their communities for their involvement in the trials, however, because of the ingrained hesitancy to trust medical systems based on the history of unethical medical experimentation on African Americans.[60] This situation demonstrates that building partnerships with trusted sources, such as HBCU leaders, may not be sufficient as a standalone strategy to overcome distrust. Moreover, one group's trusted source may, in fact, be considered very untrustworthy by another group (e.g., scientists, political leaders), therefore partnership efforts should be carefully considered to ensure that attempts to increase trust in one community do not undermine trust in another.

Vaccine communication partnerships should include diverse sectors and stakeholders. **Collaborations with health care organizations and pharmacies** are critical, and these partnerships must go beyond front-line caregivers, such as doctors and nurses, and include organizations like Federally Qualified Health Centers and state and local public health departments and jurisdictions, as well as health care extenders, such as pharmacists and community health workers. Moreover, **partnerships across different government communicators, scientists, and journalists** will inform how the science of vaccines is conveyed. Broadening the links between journalists and the scientific, pharmaceutical, and public health communities will ensure that as the situation evolves, new information is communicated in a truthful manner that avoids inflaming divisions or furthering mistrust and distrust in the health sciences. In addition to organizations, **public figures and online influencers** will also be important partners in communicating to audiences who are less likely to attend to information disseminated by government, traditional media, or scientists. Examples include celebrities, such as actors, musicians, athletes, and social media influencers. These types of communicators can improve vaccine attitudes and acceptance by conveying messages that resonate with the target audience in both style and substance.[61]

As part of the partnership-building process, it is important to acknowledge that although COVID-19 efforts in the United States have been hampered by politicization, vaccine confidence could be enhanced through **unified, bipartisan communication of consistent messages** across diverse communities and information

silos. Indeed, COVID-19 vaccine messages should aim to **promote unity and apolitical decisionmaking** regarding vaccination. Prior politicization may need to be acknowledged and addressed in some cases, but moving forward, ideological divisions should be de-emphasized in all communication efforts to create a **message focused on unity and collective benefit.** An example of promoting unity around vaccination might include having politicians from across the political spectrum jointly signal their vaccine confidence in a public health campaign.

3.2 Create accurate, transparent, and truthful vaccine messages

In addition to considering and leveraging trusted messengers, vaccination messages themselves need to be trustworthy. Emphasis on creating messages that are **accurate, transparent, and truthful** will help ensure trustworthiness. Messages need to present clear and accurate information and avoid either exaggerating the benefits or minimizing the potential risks of vaccination. Acknowledging uncertainty, as well as emphasizing that changes in what is known are expected and appropriate as scientific knowledge evolves, could help preempt skepticism when messages are updated.

As part of societal reinforcement for getting vaccinated, communication must acknowledge that herd immunity will not be reached until a sizeable majority of the population is vaccinated, with estimates that anywhere between 75 and 90 percent coverage likely will be needed, depending on vaccine efficacy.[62,63] Communication may stress that the sooner most people complete their vaccinations, the sooner we will be able to return to normal social and economic activities. Messages, however, should also emphasize that, at least during initial phases of the rollout, a COVID-19 vaccine is not a "magic bullet" that will immediately allow a full return to social functioning. Instead, it is important that messaging emphasize that until society is widely vaccinated, the need continues for both preventive behaviors—such as mask wearing, hand washing, and social distancing—and public health measures, such as contact tracing and widely accessible testing.

3.3 Frame vaccine acceptance as a social norm

Vaccine communication efforts should also include approaches that **establish getting the vaccination as a social norm.** Social norms, defined as the standards against which the appropriateness of a certain behavior is assessed, are a powerful form of contextual influence over human behavior.[64] Social norms are more heavily influenced by the views and behaviors of a network of peers than by expert advice. Intervention strategies aimed at modifying social norms could positively influence the decision to vaccinate. Such intervention strategies could include **promotional materials that induce peer pressure** to vaccinate (e.g., "I got the shot" stickers akin to "I voted" stickers or "share your vaccination experience" campaigns). This type of strategy not only communicates pride in the behavior, affirms pro-health values, and supports self-concept as a contributing citizen, but also serves a "norming" function that capitalizes on regret avoidance (engaging in a behavior to avoid anticipated regret). The goal of this type of communication is to convey that getting vaccinated is widely accepted and widely practiced, and not engaging in the behavior might result in social sanctions.[65]

Another example of a communication strategy to influence social norms would be a campaign that encourages individuals who chose to get vaccinated to share their vaccination experience with others in their social network (e.g., verbally, through text messages, on social media) and encourage their networks to get vaccinated if

they have not done so already. Visual aids—such as thermometers, heatmaps, or dashboards—can also be used to reinforce social norms by tracking increasing vaccination uptake at the state or local levels. Finally, publicizing the vaccination of celebrities and public figures, including bipartisan political leaders, could have a powerful impact on normalizing vaccination across diverse segments of society.

3.4 Use behavioral nudges

In addition to establishing norms around vaccination, behavioral economics research demonstrates the **potential of using choice architecture to "nudge" people to engage in particular health behaviors,** such as vaccination, while retaining and respecting decisional autonomy.[66] Making vaccination an easy and convenient choice is key to increasing uptake. For example, making vaccination the default choice, so that people need to actively opt-out of receiving a vaccine if they don't want one, could be a very effective way to increase uptake while still respecting people's self-determination in health-related decisions.[67] Similarly, medical providers could use more of a presumptive approach during health care encounters and offer the vaccination to all eligible patients, as this would signal that getting vaccinated is the accepted "norm" while still allowing the patient to ultimately make their own decision.

Similarly, providers, health care systems, and pharmacies may also leverage electronic patient portals (e.g., by sending messages to patients prior to a medical appointment or prior to a prescription refill) to encourage individuals to vaccinate. These messages could provide information on the vaccine's availability, logistics of where and how to receive the vaccine, and electronic reminders about receiving the second shot. Social media platforms could also be used to nudge people toward vaccination against COVID-19; in addition to providing information on where and how to receive a vaccine, these sites could be used to offer opportunities for individuals to publicly commit to vaccinate. Such public commitment increases the chances that a person will follow through with the desired behavior[68] and could encourage others in their social networks to do the same.

Additional strategies to encourage vaccine uptake could include competition, gamification, and incentives related to vaccination behaviors. Incentives, particularly, are increasingly seen as an important tool for health behavior change, and research suggests that appropriately designed incentives can be effective for some behaviors.[69] It is important to consider carefully how to message incentives, however, so that they promote autonomy and motivation for getting vaccinated.[70] Otherwise, incentives might encourage some to get vaccinated, while for others, an incentive may inadvertently signal a risk (e.g., "if they are paying me to receive a vaccine, there must be something wrong with it"), which could undermine their motivation to be vaccinated.

3.5 Enact value-concordant messaging that is sensitive to the emotional state of the audience

When choosing the spokesperson who will deliver the message, a degree of surface-level concordance (e.g., communicators who look like members of the target population) can enhance message receptivity and acceptance.[71] Having popular celebrities, such as artists and athletes, speak to their fan base is an example of superficial-level targeting and may be very effective. In contrast, messaging based on deep structures would involve addressing the core values that may be unique or particularly salient to a target group, which may further enhance communication effectiveness.[72] This begins with assessing the **dominant values of a**

target audience group and then embedding such values into vaccination messages. For example, some messages might **invoke a personal leadership role as a protector of the community** (be a hero/shero), whereas other messages might **build on desires to resume certain activities** (get back to work/school) or frame vaccination as a way to **enact social justice, equity, or altruism** (protect vulnerable people or those at higher risk). Messaging such as "Protect your family, if not yourself" can help reframe the motivation for getting vaccinated from decreasing personal risk to helping others (e.g., older parents, teachers, those who are immunocompromised), thus preventing message reactance (resulting from the perception that choices are being taken away).

Vaccination communication should also **avoid language such as "requirement" or "mandate"** as this type of directive and authoritative language can generate further resistance and be perceived as restricting individual choice. Relatedly, vaccination messaging should **consider emotional valence.** Messages and images that **heighten negative emotions, such as fear or shame, may induce avoidance behavior,** and such emotional over-amplification should generally be avoided.[73] Conversely, messages that **evoke positive emotions**—such as happiness, hope, and a sense of self-worth for engaging in the vaccination behavior—may effectively promote vaccine confidence. Considering emotions, neither the message text nor the accompanying imagery should elicit fear or dread, but they should instead convey hope and well-being associated with getting vaccinated, including taking action to protect one's loved ones.

3.6 Creative strategies: Going beyond didactic vaccine messages

Communication messages should be as concise as possible and clearly convey the action-oriented "bottom line." **Simple graphics, numbers, images/visuals, or short videos** can be effective in distilling complicated statistical and scientific information into digestible messages.[74] Other communication strategies, such as entertainment-education ("edutainment") and the **sharing of personal experience narratives or storytelling,** particularly by popular and trusted spokespersons, may be more motivating than facts and statistics.[75,76] Research has shown that narratives can effectively influence beliefs, attitudes, intentions, and behaviors,[77] and stories have been adopted to great effect by anti-vaccine advocates, whose sharing of emotional personal stories about injuries they perceive to stem from vaccination has influenced the public's vaccine perceptions. Conversely, **authentic narratives from relatable spokespeople** about how they were positively affected by receiving the COVID-19 vaccination could be equally compelling and persuasive. These personal stories could also help allay fears, address hesitancy, and encourage uptake.

Conclusion

This report outlines foundational considerations for health communication activities and expands on those considerations with evidence-informed strategic communication recommendations specific to fostering COVID-19 vaccine confidence across diverse audience segments. To achieve herd immunity, a high rate of COVID-19 vaccine uptake in the population is crucial, and this will require timely and effective communication to address the public's concerns. Evidence-informed communication is a critical component of the complex puzzle that will help end the COVID-19 pandemic. In this way, communication about COVID-19 vaccines can benefit from drawing on the extant social and behavioral science literature about successful strategies to influence health decisions and behaviors. Communication strategies, however, would also benefit from ongoing evaluation so that they can efficiently adapt to real-time changes in COVID-19 vaccine research, as well as the evolving public health communication context. No single communication approach or message can address all COVID-19 information needs, perspectives, and concerns over time, but careful consideration and continuous reevaluation of communication efforts will help reduce vaccine hesitancy, enhance vaccine confidence, and bolster uptake.

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Communicating about the COVID-19 vaccines: Guidance and sample messages for public health practitioners

The science is clear: Vaccines save lives. But despite overwhelming evidence of their effectiveness, vaccines remain a contentious issue, with municipalities across the country often receiving vocal pushback in response to their efforts to implement immunization programs. With the onset of the global COVID-19 pandemic, and the race to develop vaccines, the debate has taken on a new importance.

The first COVID-19 vaccines will soon be available in the United States. Residents will have many questions about the rollout of the vaccine, and policymakers, the media, and the public are turning to public health practitioners for accurate, timely information. Public health practitioners can communicate effectively even in this chaotic time. Other public health issues — like practicing safer sex — have shown us that widespread shifts in individuals' behavior to support health actions is possible, even though it can be challenging.
There is no one easy communication solution, but here we provide some quick tips for:

- communicating effectively about the COVID-19 vaccines, or vaccines in general, and
- bringing equity forward in your communication.

At the end of this resource we also include general tips for good communication.

When you communicate about the COVID-19 vaccines, or vaccines in general, remember…

Meet people where they are.

Most people's willingness to vaccinate falls on a continuum from acceptance, to questioning, to doubt, to outright rejection. Diverse groups across that continuum — even people who intend to get the vaccine — will have questions about vaccine safety that need to be answered, especially regarding the COVID-19 vaccine. Vaccine opponents are very visible and vocal in political debates on vaccines in general and the COVID-19 vaccine in particular, which can increase doubt.

Some who are considering, but have questions about, the vaccine may fear or resent being cast as “anti-vax” or having their concerns dismissed as ridiculous. Recognize where your audience may be on the spectrum of vaccine support and avoid stereotyping people who ask questions or express reluctance as “anti-vax.” Instead, use language like “vaccine hesitant” or “vaccine questioning,” acknowledge that people are seeking to stay healthy and safe, and assure them that having questions is an important part of the process.

Since your audience will be confronted with a barrage of information about the COVID-19 pandemic, make sure to acknowledge that, beyond questions, your audience may have legitimate, deep-seated fears about the vaccine and the pandemic itself. Research has shown that acknowledging an audience’s fears and doubts about difficult subjects can help assuage those fears, build trust in messengers, and circumvent shame and frustration. When you acknowledge your audience’s stance about vaccinations — and the complex emotions they may be feeling — it helps them remain open to what you have to say.

Putting it into practice:
Meeting people where they are

Sample message that helps people understand the research process: We understand that some people may be nervous about the COVID-19 vaccines — this is totally reasonable. Fortunately, researchers have been working on vaccines for the coronavirus family for years, so they did not have to start from scratch. As researchers have been working intensely to develop and test the vaccine, they have been transparent in sharing data, holding live hearings, and pausing trials when it’s been important to slow down. Vaccine makers have also pledged that they would not seek FDA approval until phase 3 testing is done. All of this has given us trust and confidence in vaccination — a critical tool in our toolbox in slowing the spread of COVID-19 and helping our communities move forward. *We have sacrificed so much this year to keep our loved ones and community safe. **While we know getting vaccinated isn’t always comfortable, you can play a big role to support our county by keeping yourself and your family up-to-date on vaccinations — including the seasonal flu shot and the COVID-19 vaccine once it is available. By staying updated on immunizations, we can make sure our sacrifice and efforts to fight COVID-19 keep everyone safe.

**Conveys health department identity and values*
***Acknowledges that vaccination can be uncomfortable and notes sacrifice of community*
(Adapted from Dr. Theresa Chapple’s Twitter thread)

Clearly explain the COVID-19 immunization process.

Between the news and social media, there are multiple sources demanding your audience's attention with conflicting and confusing messages. Public health practitioners are an especially important source for providing credible and consistent information to the public because they can explain what will happen locally. Materials should make it easy for residents to understand the process of the vaccine rollout and specific technical questions. Prepare materials that use clear, plain language to answer questions like:

- Where and when can people get the vaccine?
- What will people feel like after they receive the vaccine? Are there side effects? What does it mean if I don't feel good after I get the shots?
- Why do people need to receive two vaccinations from the same manufacturer? How can people know which one they are receiving?
- Are there costs associated with the vaccine? If so, will my insurance pay?
- Who determines which groups get the vaccine first? Why are some groups prioritized?
- Do we still need to wear masks and keep social distancing while we roll out vaccinations?
- Where can people get more information?

To bring racial equity forward in communicating about COVID-19 vaccines…

Prepare for discomfort and distrust.

Multiple articles and advocates have noted that there are good reasons for people, especially Black, Indigenous, Latinx, Asian, Pacific Islander, and other people of color, to distrust the medical and public health fields. This distrust extends to recommendations about the COVID-19 vaccine.
There are no magic words that can build trust and erase centuries of medical and public health neglect and abuse. Much racial equity work extends beyond communication to transforming organizations, engaging with communities who have been most harmed to help support their power-building efforts, and doing the long-term work it takes to earn the trust of communities that have been harmed by medicine and public health. By building relationships that encompass organizing for policy change, providing COVID testing and treatment,

listening to the needs of communities, and addressing the structural factors that create greater exposure to and poorer treatment for COVID, public health practitioners can build a strong communication infrastructure that helps earn community trust.

Build relationships with trusted messengers from diverse organizations and community groups.

While using clear messaging to align the voices of elected officials, health officers, public health advocates, and medical professionals is essential, these messengers may not be the most trusted entities within parts of our communities. Health departments should engage with and center the voices and perspectives of trusted messengers who have roots in the community; they should also embrace and acknowledge those who may be justifiably distrustful of government and medicine. Trusted messengers could include Black, Indigenous, Latinx, Asian Pacific Islander communities, and other health care practitioners of color, as well as people from community organizations, faith communities, youth organizations, parent and caregiver groups, or unions. Developing long-term relationships with these and other trusted community members takes time — but it is essential. Local health departments can listen to these groups' concerns and provide support and resources to ensure they have timely, accurate, and concise information to tailor to their communities.

Name racial equity explicitly.

While public health practitioners engage in the long-term work of trust-building to support equity, in the short-term they also need to address racial equity proactively when they communicate about COVID-19. BMSG's research shows that vaccine opponents regularly invoke historical instances of racially motivated medical oppression to undermine trust in the medical system and government overall. If vaccine supporters stay silent on racial equity, they are conceding the issue to vaccine opponents. A health department could, for example, engage strong supporters and allies — and elevate racial equity — by saying how racism has been used as a tool used to divide us and showing how the department is working to create a healthy community for all residents.

Putting it into practice:
Sample language for centering racial equity

Our health department believes that everyone in our county should have the opportunity to be as safe and healthy as possible. This means we must pay particular attention to the communities who are most at risk for COVID-19 and have less access to the supports they need to stay healthy. We know that Black, Indigenous, Latinx, Asian and Pacific Islander communities, and other communities of color are most at risk for exposure to COVID — and suffer poorer health outcomes if they get it — because they are often locked out of affordable homes, safe transportation, quality health care, and jobs that offer paid sick leave and options to work from home. Many of our essential workers who keep our country running — our bus drivers, our farmworkers, our grocery store workers — are from these same communities. This is why they will be among the first to have the option to be vaccinated. And it is why the national recommendations are prioritizing essential workers, in addition to health care workers. The COVID-19 vaccines offer an important opportunity to support and protect those who have been and stand to be most harmed by COVID-19. We know this is only part of the solution, and we must also commit to addressing the social factors that affect our health and that will reduce inequities in health outcomes, like universal basic income, equitable school funding, eviction moratoriums and rent cancellation, and releasing people who are in prison.

Show how the COVID-19 vaccine fits into a larger public health strategy.

Dr. Camara Jones notes that it is important to avoid framing the "vaccine as the cure": If we talk about vaccines in isolation, we risk reinforcing deeply held beliefs that health (or ill health) is purely a matter of individual behaviors (like choosing to get the vaccine) and obscuring the broader structural factors — like housing, jobs, or health care access — that also impact health and must be taken into account. To integrate equity into our vaccine messages, we need to describe, even briefly, some of the structural factors that affect health in the "landscape" that surrounds us. Evoking the landscape acknowledges the reality that for many communities, a vaccine isn't going to solve some of the most pressing problems of hunger, job loss, looming rents, crowded prisons, and underfunded schools. Recognizing these realities is one part of building trust and shows that our public health organizations are committed to the full spectrum of needed interventions.

Name what your health department is doing that illustrates public health's commitment to the hard work it will take to achieve equity, justice, and health for all.

Connect communication about vaccines to these other necessary interventions as a way to build momentum for the systemic changes we need to support racial and health equity. For example, a health department could name immunization as one of a number of strategies to promote community health, in concert with a universal basic income, equitable school funding, eviction and rent moratoriums, and releasing people who are in prison. These strategies might not be the centerpiece of all vaccine messages, especially shorter messages, but they can be part of our communication with the communities we serve.

For good communication, remember …

Always have a clear goal.

Even if the goal seems obvious — like encouraging residents to get vaccinated and ensuring they have all the information they need to do so — be sure all staff developing communication materials understand the goal, audience, key messages, and next steps for each communication opportunity. Review the Layers of Strategy to help set goals and target audiences for short-term and long-term communication. This tool, and the goal you set, will guide the decisions you will make, including what messages to develop.

Keep values front and center.

Messages that lead with values are effective because they move us and motivate us to act. Values like unity, interconnectedness, justice, or pride of place reinforce a vision of what we create together by getting vaccinated: For example, a health department representative could describe how the COVID-19 vaccine keeps the entire community safe, secure, and protected — from teachers to hospital workers and small business owners. You can do this simply by using titles and subtitles that include values (such as "Vaccinating makes everyone safer"). Values are also importing in keeping the focus on equity and equity-focused solutions that emphasize unity, interconnectedness, and inclusion.

Putting it into practice:
Sample message from a local health department that leads with values

Our health department's goal has always been to keep everyone in our county safe and healthy, and that is especially true in this challenging time. We know our residents care about the health of our communities, too. Our hospital beds are filling up, and our doctors, nurses, and health care staff are going above and beyond to take care of our communities. Our small businesses and the people who work there are struggling to stay afloat. One way we can keep each other healthy, support our health care workers, and get California back on its feet is to get vaccinated against COVID-19. When we get vaccinated, we can slow the surge to help our nurses, doctors, schools, fellow community members, and businesses.

Name your solution.

In public health, we often talk more about the problem than the solution — aim to reverse that. The solution could be a policy, like an eviction moratorium or paid sick leave, or an action like people getting vaccinated to prevent community spread of COVID.

Avoid repeating false claims.

Doing so risks inadvertently amplifying and strengthening inaccurate information. Occasionally, public health practitioners may not be able to avoid addressing false claims. In these situations, create messages that sandwich misinformation about vaccinations between the facts about safety and widely shared values about protecting communities. When combined with shared values like trust and protection, this approach, known as a "truth sandwich," may be an effective tool. Cognitive linguist George Lakoff and journalists are using this technique. Lakoff's recipe is:

1. Start with the truth. The first frame gets the advantage.
2. Indicate the lie. Avoid amplifying the specific language if possible, and don't repeat what's not true.
3. Return to the truth. Always repeat truths more than lies.

Putting it into practice:
Sample language for a "truth sandwich"

1. Start with the truth: Our health department's goal has always been to keep the people in our county safe and healthy, and that is especially true in this challenging time. The COVID-19 vaccines, in addition to ongoing handwashing, distancing, and mask-wearing, offer us a new opportunity to protect ourselves and those around us, from our friends and family to the people ringing up our groceries. We know you want to stay safe and keep your family safe, and part of that involves ensuring you have the information you need about the vaccines to make an informed decision.

2. Indicate, but don't repeat, the lie: We know many people have questions about the vaccine, and some people who are opposed to it have frightened people with misinformation about the vaccine.

3. Return to the truth: At the same time, there are many people who want to get the vaccine or are considering it because it can mean that we keep our loved ones safe, our schools open, get our local businesses back on their feet, and move our communities forward. As more people are vaccinated, we can protect health care and essential workers, people who are at highest risk, and our broader community. Our focus is on listening to your questions, providing clear, accurate, science-based information, and keeping our community's health front and center.

For good communication, AVOID traps like…

Trying to say everything.

You can't be strategic and comprehensive at the same time. Stay focused on the top communication priorities that stem from your goal. This may feel at odds with including details about the broader "landscape" that surrounds us, but if our overarching goal centers equity, we can be strategic about how to talk about the landscape.

Trying to persuade everyone.

Many residents are already eager to get the COVID-19 vaccine. Others aren't so sure but are open to learning more. And some people will not change their stance, regardless of evidence and strong messages. There's no one message that will move everyone to be vaccinated, especially those who have politicized the issue. Focus your time and energy on developing messages for those who are willing and need information and for those who are hesitant but open to learning more, rather than trying to persuade those who are completely opposed to vaccination.

Engaging in fruitless arguments.

Responding to social media agitators can be emotionally and cognitively exhausting, and it takes up precious time and resources. Sometimes the best response is no response — often agitators are trying to elicit a reaction and redirect the conversation. Engaging with them pulls more eyes to their accounts and comments. If you decide to respond, create two or three rotating messages that lead with values. Use those messages to respond quickly and move on. Advanced preparation will also reduce the risk of your messaging being reactive. Agitators are not likely to let things go — your goal should be to neutralize their misinformation.

Shaming people.

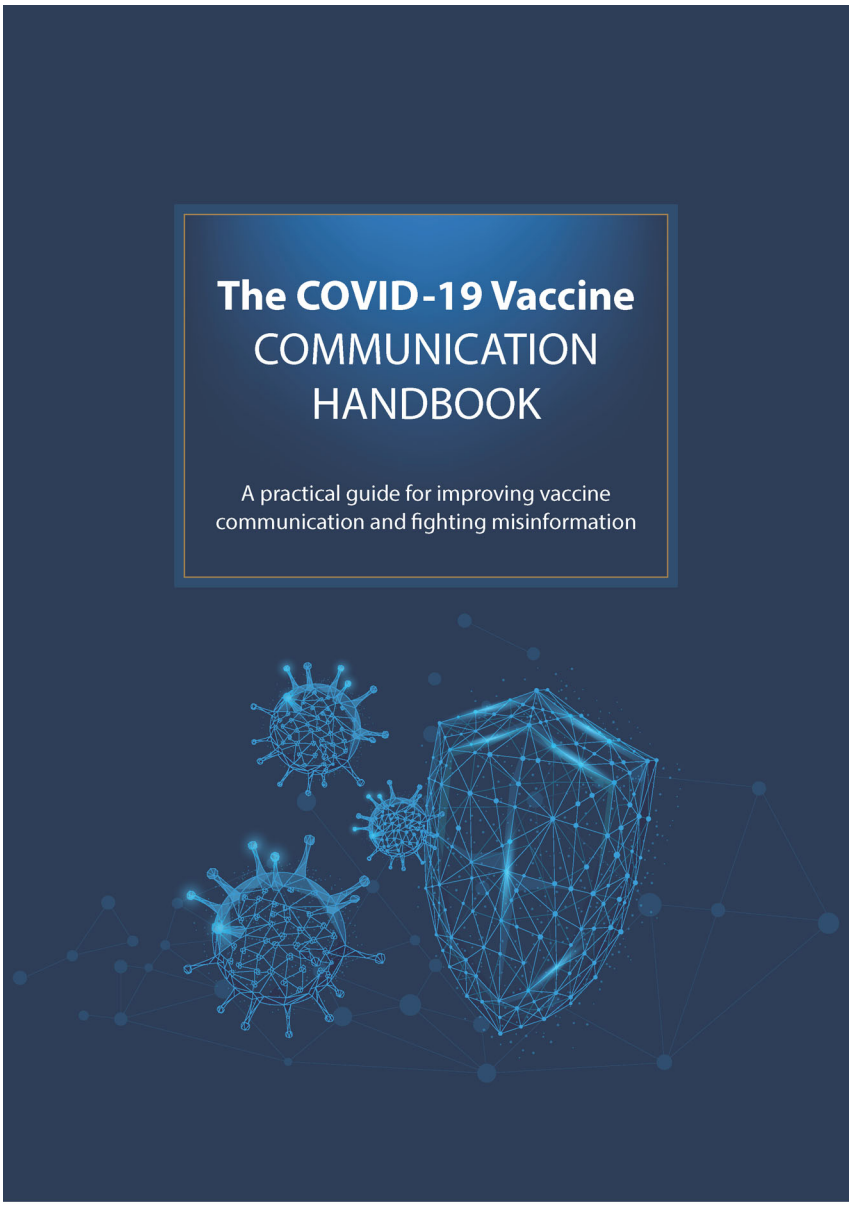
Public health has been successful in shaming industries like Big Tobacco, but shaming individuals rarely works in public health campaigns. And from an equity perspective, people of color have good reason to be cautious about the COVID-19 vaccine. Don't shame or scold people — instead, meet them where they are by recognizing that these are challenging times, and acknowledge their concerns and questions.

Using jargon.

Plain and simple language can make even complex ideas accessible and comprehensible to a broad range of audiences. Whenever possible, have people outside of your immunization program, and ideally outside of public health, review your materials for words and phrases they do not understand. Create a list of alternatives to jargon that your whole team can add to and use.

Putting it into practice:
Sample language for a social media response to misinformation

Thanks for commenting. To keep everyone in [county name] safe and healthy, we're using the best science available to address COVID's threat to our health and economic well-being, including providing the COVID-19 vaccines. We know people have many questions about the vaccine — you can find the most accurate and up-to-date information here: [add website].


The COVID-19 Vaccine
COMMUNICATION
HANDBOOK
A practical guide for improving vaccine
communication and fighting misinformation

This handbook is for journalists, doctors, nurses, policy makers, researchers, teachers, students, parents – in short, it's for everyone who wants to know more:

- about the COVID-19 vaccines,
- how to talk to others about them,
- how to challenge misinformation about the vaccines.

This handbook is self-contained but additionally provides access to a "wiki" of more detailed information.

Wherever you see this button  a click will take you to in-depth information that is updated by our team as new knowledge becomes available.

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They are available here: 

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Available at: https://sks.to/c19vax

Why vaccinations?

Vaccines help people survive. Vaccines save 5 lives every minute. The eradication of smallpox—a serious disease that left even survivors scarred for life—alone saves an estimated 5 million lives every year. If a vaccine had not eradicated smallpox, someone would now die from the disease every 6 seconds of every day. Prior to the introduction of a vaccine, as recently as 1980, measles caused more than 2.6 million deaths globally.

SUCCESS OF VACCINES

Vaccines can only save lives if people are vaccinated. Fortunately, most people get vaccinated. For example, 85% of children worldwide are vaccinated against diphtheria, tetanus, and pertussis (whooping cough), and in 125 countries that figure exceeds 90%.

The vast majority of people in most countries vaccinate their children, thereby making an important contribution to public health and people's lives.

Why COVID-19 vaccinations?

COVID-19 is a serious disease. In only 10 months the SARS-CoV-2 virus infected over 78 million people across the world, killing 1.7 million [1]. COVID-19 patients require intensive care in hospital at a rate more than 6 times greater than during the influenza pandemic in 2009 [2]. Many survivors are faced with sometimes severe long-term health impacts [3,4].

> ***COVID-19 is not like the flu. It is more contagious, more deadly, and is spreading across a world where no-one was immune.*** [2]

FACTS ABOUT COVID-19

While behavioral measures such as isolating while symptomatic, mask-wearing and physical distancing have slowed the spread of the virus, vaccines provide a better path out of the COVID-19 pandemic, and scientists have now developed several highly effective vaccines against COVID-19.

BEHAVIORS TO CONTROL COVID-19

Because of the risk from COVID-19 and its prevalence, it was possible to expedite the clinical trials without compromising safety:

COVID-19 VACCINE DEVELOPMENT PROCESS

- Funding was no obstacle and thousands of scientists contributed to the effort.
- Many tens of thousands of people signed up rapidly to participate in COVID-19 vaccine trials in 2020, compared to the 12-18 months it often takes to recruit far fewer participants for such trials[5].
- These vaccines have been tested with more participants than many earlier vaccines for other diseases.
- Because of the high prevalence of COVID-19 in the population, observing the efficacy of the vaccines based on naturally-occurring infections was more rapid than it would be with other, rarer diseases.
- Pharmaceutical companies took financial risks and started investing in manufacturing early on, so there was no delay between completion of testing and rollout.

FACTS ABOUT COVID-19 VACCINES

As with all medicines, side effects can occur after getting a COVID-19 vaccine. However, these side effects are transient (24-48 hours), and serious side effects (allergic reactions) are exceedingly rare. The fact is: The risk of the disease by far outweighs the risks of the COVID-19 vaccines.

POTENTIAL SIDE-EFFECTS OF COVID-19 VACCINES

> ***A safe vaccine against COVID-19 protects us against a serious illness and is our ticket to freedom. We now have vaccines that have been tested on tens of thousands of people, and more than 10,000,000 people were already vaccinated by the end of 2020. The risk of COVID-19 far outweighs the risks of the vaccine.***

Studies in several countries have shown that most of the public recognize the importance of the COVID-19 vaccine and are keen to be vaccinated. For example, in a U.K. sample of more than 5,000 respondents, 72% were willing to be vaccinated in October 2020[6]. In Finland, up to 75% of respondents were willing to be vaccinated[7]. In Australia, the rate was 86%[8], and similarly high levels have been found in Malaysia[9]. In the United States the rate was 66% in a national sample of 19,058 respondents in August 2020. Because attitudes can shift, we keep an inventory of public opinion in the wiki.

PUBLIC ATTITUDES TOWARDS COVID-19 VACCINE

> ***Trust in scientists increases:***
>
> ***Surveys in several countries have shown trust in scientists to increase. In Germany, the share of people who completely trust scientists doubled between 2019 and November 2020, and around 70% of the public trust scientists. In the U.K., 64% of respondents indicated in April 2020 that the pandemic had made them more likely to listen to scientists and researchers.***
>
> TRUST IN SCIENTISTS

What facilitates vaccine uptake?

Although most people and their children get vaccinated against common diseases, there is variability between countries, cultures, demographic, and ethnic groups.

CULTURAL DIFFERENCES IN VACCINE ACCEPTANCE

People are more likely to vaccinate when [10]:

- It is convenient, free, and easy.
- They have confidence in the safety of the vaccine and trust the system that delivers it [11].
- Their healthcare professionals recommend it.

IMPORTANCE OF HEALTHCARE PROFESSIONALS

- Role models, friends and family, or others "like them" have already been vaccinated [12].
- People are reminded that their actions can foster community immunity and help others [13].
- People recognize the risk from the disease, and understand vaccination is an effective solution to that risk [14].

Some countries also have mandates for certain vaccinations.

THE ROLE OF VACCINATION MANDATES

Thus, aspects related to thinking and feeling, social processes, and practical issues determine vaccine uptake. The same determinants have been identified for COVID-19 vaccines.

DETERMINANTS OF COVID-19 VACCINE UPTAKE

What variables increase hesitancy about COVID-19 vaccines?

Research has also considered the flipside, by examining the factors that may lead to hesitancy towards the COVID-19 vaccine.

- Some people oppose the vaccine for ideological reasons because COVID-19 and the response to it have become politicized in some countries. When this occurs, opposition is generally greater on the political right and among populists [15,16].

POLITICS OF COVID-19 VACCINATION

- About a third of people who are not intending to be vaccinated against COVID-19 are committed vaccination opponents [16] and often believe in conspiracy theories.

VACCINE DENIERS CONSPIRACY THEORIES

- Some people understand the need for a COVID-19 vaccine but have safety concerns.

FACTS ABOUT COVID-19 VACCINES COVID-19 VACCINE DEVELOPMENT PROCESS

- People of color, immigrants, LGBTQ individuals, homeless or low-income people, people with disabilities and other marginalized populations traditionally face obstacles and inequalities in healthcare and this situation has been exacerbated by the COVID-19 pandemic. They may also have collective histories of experience with medical malpractice that affect current trust.

CULTURAL DIFFERENCES IN VACCINE ACCEPTANCE

- Some people intend to become free-riders, letting others have the vaccine while they receive the benefits of herd immunity without getting the vaccine.

COVID-19: WHY FREERIDING MIGHT BE A DISASTROUS STRATEGY

- Some young and healthy individuals believe they are not at risk from COVID-19. Unfortunately this belief is misplaced, because even survivors of COVID-19 may suffer long-term health consequences [3,4].

I AM NOT IN DANGER OF COVID-19, OR AM I?

Fortunately, vaccine hesitancy does not necessarily lead to rejection of a vaccine [17], as many individuals who are skeptical about a vaccine nonetheless take it.

Setting the communication agenda for the COVID-19 vaccines

Several health organizations, such as UNICEF and the WHO (World Health Organization) have provided excellent detailed resources for positive communication.

FURTHER RESOURCES

Keep on Your Mask:

Despite the vaccine being rolled out now, health-protective behaviors remain critical for the foreseeable future. Even though the available COVID-19 vaccines are highly effective, the intensity of the pandemic (e.g., in the U.S.) means that it will take months before the impact of the vaccine fully kicks in [18].

So keep your mask on, practice hand hygiene, and maintain physical distance—if possible, stay home to stay safe.

BEHAVIORS TO CONTROL COVID-19

Communicating risk.

It is common for new vaccines to be met with initial hesitancy which later resolves as the program becomes established. Transparent and effective risk communication can assist with this process. Communicators must be aware of cultural and emotional differences but must also recognize that some people are adversarial or misinformed—we explain how to deal with misinformation and conspiracy theories below.

CULTURAL DIFFERENCES IN VACCINE ACCEPTANCE

Risk communication should acknowledge that the COVID-19 vaccines have transient but discomforting side effects such as fever and muscle pain [19]. Ironically, those side effects show that the vaccine is working because they prepare the body to fight the disease.

POTENTIAL SIDE-EFFECTS OF COVID-19 VACCINES

It is also crucial to prepare the public—and the media in particular—that "misattributed side effects" will occur, especially when lots of elderly people are getting vaccinated first [20]. For example, if we vaccinate 10 million people *and the vaccine had no side effects whatsoever*, then over the following two months we can nonetheless expect that:

- 4,025 of those vaccinated will have a heart attack.
- 3,975 will have a stroke.
- 9,500 will have a new diagnosis of cancer.
- 14,000 will, unfortunately, die. [21]

Life is risky, and some tragic events will happen after a vaccination, even when the vaccine has nothing to do with it. It is important not to jump to the conclusion that there is a connection between the vaccination and those events.

The only way to determine if vaccines have serious side effects is by scientific means, by looking at the data from many vaccinated people, and by comparing them to what would be expected in that age group by chance alone. When this is done, scientists find clear evidence that vaccinations do not cause the vast majority of the serious diseases and conditions that have been attributed to them in the media or by activists [22].

During the trial for one of the COVID-19 vaccines, involving nearly 40,000 participants, some side effects such as headaches and fatigue were more frequent in the vaccine group than the control group whereas others (such as diarrhea) were equal across groups [23].

Scientists will continue to monitor the COVID-19 vaccines meticulously to detect any potentially serious side effects that are biologically plausible. For example, the WHO has published a detailed manual about surveilling the safety of the COVID-19 vaccines: COVID-19 Vaccines: Safety Surveillance Manual. The Centers for Disease Control and Prevention in the U.S. maintains a real-time reporting system that can be interrogated for adverse effects: The Vaccine Adverse Event Reporting System (VAERS).

Engaging communities.

Community leaders can play a crucial role: Ingroup norms and habits have a big influence on group members, so mentioning positive norms towards vaccination by community leaders is helpful [24]. Community leaders should engage with empathy, transparency, and honesty to develop and maintain public trust and communicate effectively. A diversity of community groups should be included in engagement activities [25].

Let the public do the talking.

Getting the public involved in spreading the message can be helpful *(see box below)*. Social media can be an asset, too. YouTube has some excellent videos, for example: The Side Effects of Vaccines - How High is the Risk? and Inside the Lab That Invented the COVID-19 Vaccine.

F*ck It Won't Cut It:

Boston University successfully held classes on campus during the fall of 2020 in part because of an edgy, student-led campaign to enforce physical distancing and other health-protective behaviors. Called "F*ck It Won't Cut It," the campaign was created by students, for students. Although the university was already planning a campaign, students needed a voice they could trust: Generation Z is less likely to trust institutions and people in power and more likely to trust their peers.

Designed to remind students that saying "F*ck It" to small rules can lead to big consequences, the campaign aimed to modify the way students conducted themselves on and off campus, backed with factual statements that quoted reliable sources. A Bullsh*t Meter was used to debunk misinformation about COVID-19 and tips were offered on processing COVID-19 vaccine news. Across the semester, 2,063,415 users were reached via Instagram, Twitter, and TikTok. The campaign attracted the attention of the Centers for Disease Control and Prevention, and students presented their campaign to the CDC's COVID-19 Response Team.

How should healthcare professionals talk with people about the vaccines?

Healthcare professionals are the most trusted advisors and influencers of vaccination decisions [26], and the public generally also trusts public health bodies when it comes to COVID-19 vaccine information.

A recommendation from a healthcare provider is one of the strongest determinants of vaccine acceptance [10]. However, providers often underestimate the importance of their recommendations. A strong recommendation to get vaccinated, that assumes the person is willing to be vaccinated, has been shown to increase uptake [27,28]. For example:

- *'I can see that you need your COVID vaccine today'*
- *'You are due for your second COVID vaccine'*

Such announcements signal the healthcare professional's confidence in the vaccine and help establish vaccination as the norm. They are more effective at increasing uptake than more hesitant language (such as *'What do you think about getting the COVID vaccine today?'*) [27].

Where someone expresses hesitance or ambivalence after an announcement of vaccination, the healthcare professional should switch rapidly to acknowledging and empathizing with the person's concerns. The objective of any vaccination conversation should then be as much to build trust and rapport as to secure vaccination. Active listening fosters receptivity [26,29]. The table below shows how this can be done.

Traditional approach
(based on education and directing)

Healthcare professional (HCP): It's important to have your COVID-19 vaccine. If not, you're putting yourself and others in danger. ***[Confrontational, making client defensive.]*** Do you know there are still lots of cases of COVID-19 around and the illness can be very dangerous? Even if it doesn't kill you or land you in hospital, you can end up with long-term health problems if you catch it. You should get your vaccine as you are now due it according to the guidelines. We could do it now if you want. ***[One-way communication, no eliciting.]***

Client: I don't see the urgency. And the unknown effects of this new vaccine might be worse than COVID! I heard some people don't even know they've had COVID, or it's just like a flu. It's completely unbelievable to know that the vaccine is safe given it's been rushed out so quickly!

HCP: Studies have demonstrated no significant adverse effects. The vaccine is safe, I assure you. ***[Dismissive, not providing explanation of why we're confident the vaccine is safe.]*** You should be wary of the information that you could find on the Internet.

Client: I've heard something else and not only on the Internet. I've read a lot, and vaccination is not mandatory, I can do what I want.

HCP: Yes, you're right, it's not mandatory, but you're putting yourself and others in danger. The risks of COVID-19 are much higher than the risks of the vaccine. If I take this time to speak with you, it's because it's very important.

Client: But what if I have an adverse reaction? I would prefer to rely on my natural immune system if I can rather than put unknown chemicals in my body. I'm worried about the risks of this new vaccine that we don't fully understand and you don't seem to be interested in the possible implications for my future health.

HCP: Of course I am! And I'm worried about the fact that you could get COVID-19 when it could be prevented by this vaccine. ***[Fails to address client concerns about vaccine chemicals and other risks.]***

Client: I think we do not understand each other. Let's talk about this another time.

- Summary -
The healthcare professional adopted the role of the expert and used a directive intervention approach based on argumentation and righting reflex. This type of intervention led to resistance.

Active listening approach
(after presumption to vaccinate has not been successful)

HCP: What do you see as the advantages of having the COVID-19 vaccine? ***[Open-ended question.]***

Client: Well, I know that it's to protect against the virus and help us get back to normal. My dad received his, but I'm worried that it was rushed out too quickly and I can't be sure that it's safe. For other vaccines, I don't have the same doubts because they are more tried and tested, but this one makes me nervous.

HCP: As you said, it's to protect against the virus and to help us all get back to normal. If I understood you correctly, other vaccines seem safe to you, but you're a bit hesitant about this because it's new and was developed quickly. ***[Reflection, acknowledging concerns.]***

Client: Yes, I know it's good to protect against COVID and I do want to get back to normal but I'm conflicted. You know, I've read a lot of articles and online comments. Lots of people are worried about the vaccine being rushed out, and we just don't know the long-term effects and whether it's really safe.

HCP: So, you feel that it's important to protect yourself when the vaccines are safe, but you're worried about what you've read about possible unknown effects of the COVID-19 one. ***[Summarize position.]*** I hear that you've done a lot of research and thinking about the subject. ***[Affirmation]*** I have an information sheet here about studies on the safety of the vaccine. Shall we go through that briefly? ***[Elicit positive response.]***

Client: Sure! I want to know exactly what I'm risking.

HCP: Yes! You should definitely be aware of that. ***[Affirmation]*** In one trial alone, more than 40,000 people ***[Specific statistics are more credible.]*** took this vaccine under test conditions with very strict monitoring and follow-up over several months. Although many recipients reported mild reactions like pain at the injection site, tiredness and headache, only 4 people had more serious side effects. You might expect to have a sore arm and feel a bit off-color for a day. ***[Acknowledge side-effects but emphasise their mild nature.]*** But you will also have protection against COVID-19 and this means you can be more confident in going to the family event you mentioned. ***[Share]*** What do you think? ***[Elicit]***

Client: Well, it does help to know more about the safety checks.

HCP: You're right to want to keep yourself safe. ***[Affirmation]***

Client: Thank you for taking the time to understand my concerns. I think it's a bit clearer now.

HCP: I'm glad. There's a choice to be made here. I'd like to see you have the vaccine. Would you be willing to have it now?

- Summary -
Active listening allowed the client, in a non-judgmental way, to express concerns and ambivalence. Using an Elicit–Share–Elicit method allowed the healthcare professional to give solicited information that could be accepted by the client.

It should also be noted that healthcare professionals themselves may feel ambivalent or hesitant about vaccines [30]; this may need to be addressed in a separate intervention.

Addressing COVID-19 vaccine misinformation

Notwithstanding broad public acceptance of vaccinations, anti-vaccination activists have sought to undermine vaccinations since their invention more than 200 years ago. Although they rarely prevail, when anti-vaccination activists find temporary traction in a society, vaccination rates can decline, and preventable illnesses increase [31,32]. Anti-vaccination misinformation is characterized by reasoning flaws and fallacies [33,34,35] and, often, by belief in conspiracy theories [36,37].

COMMON ANTI-VACCINATION MISINFORMATION

During the COVID-19 pandemic, misinformation disseminated by an American cable TV channel was causally linked to increasing numbers of COVID-19 cases and deaths in the U.S. [38]. In the United Kingdom, the baseless conspiracy theory that blamed COVID-19 on the 5G mobile network engendered vandalism against telecommunications installations [39]. Numerous studies around the world have shown that belief in COVID-19 misinformation or conspiracy theories is associated with reduced intention to vaccinate [6,40,41,42,43].

FALLOUT FROM COVID-19 MISINFORMATION

It is therefore important to protect the public against anti-vaccination misinformation and propaganda.

Voices from the frontline:

Public-health professionals' experiences with anti-vaccination activist strategies [44]:

> ***"There might only be 20 people actually actively commenting, but they're just making lots and lots of comments."***
>
> ***"They feed people lies and try and convince people that not vaccinating is really, really safe."***
>
> ***"They will put up link after link after link after link after link after link so that you had to shut the conversation down."***

Here are some key steps to consider when confronted with misinformation:

1. Determining whether misinformation is gaining traction

Before spending time and resources on addressing specific misinformation, it's important to know whether it is really having an impact or is likely to have an impact. Remember that every time you address misinformation, you are talking about someone else's agenda not your own.

For policy makers it is particularly important to monitor media, and to know which media to monitor. There is evidence that reliance on social media for information about COVID-19 is associated with reduced health-protective behaviors and increased belief in conspiracy theories [45]. By contrast, reliance on broadcast media is associated with increased health-protective behaviors.

SUCCESSFUL STRATEGIC COMMUNICATION MEASURES

The health risks from social-media consumption are also manifest in other analyses. Greater prevalence of misinformation and conspiracy theories about the HPV vaccine on Twitter is associated with reduced vaccine uptake across U.S. states [46]. Similar effects have been found in a global analysis [47].

> ***The Platforms Can Help:***
>
> ***On December 10, 2020, Google launched a tool in its search feature to address misinformation about vaccinations and vaccine hesitancy claims, as well as where and how to get vaccinated in the United Kingdom.***

If misinformation demonstrably gains traction, then there are several possible responses.

2. Protecting against misinformation: "Prebunking" or inoculation

Because misinformation can spread fast and far [48], it's best if people are ready for it. This can be achieved by explaining misleading or manipulative argumentation strategies to people—a technique known as "inoculation" or "prebunking" that makes people resilient to subsequent manipulation attempts.

The process of inoculation includes a warning that people may be misled, followed by a preemptive refutation of the misleading argument. Inoculation thus follows the biomedical analogy [49]: By exposing people to a weakened dose of the techniques used in misinformation and pre-emptively refuting them, "cognitive antibodies" can be stimulated.

For example, one can explain to people how the tobacco industry rolled out "fake experts" in the 1960s to create a chimerical scientific "debate" about the harms from smoking. Doing so makes people more resistant to subsequent persuasion attempts using the same misleading argumentation technique, for example in the context of climate change [50].

The effectiveness of inoculation has been shown repeatedly and across many different topics [50,51,52]. During a mumps epidemic in Iowa in 2006, the Department of Public Health posted a primer, directed at the media, that anticipated and prebunked potential contrarian arguments [33]. This helped journalists resist being misled by bad argumentation.

The power of inoculation derives from understanding the general techniques of misinformation that are used to mislead the public [50,53]. A framework for the five techniques of science denial is known by the acronym FLICC [53,54,55]:

Examples of misleading FLICC arguments together with counterarguments to defang them are available on our wiki. This will be updated as misinformation emerges.

MYTHS ABOUT COVID-19 VACCINATION

Illustrating misleading techniques

Fake experts

People are more likely to rely upon and endorse ideas offered by expert sources [56]. However, people often lack the resources, knowledge, or time to resolve whether someone is an expert or not, affording "fake" experts (i.e., people who represent themselves as possessing relevant knowledge and expertise when they have none) the opportunity to mislead the public.

False balance

News sources can sow confusion and undermine scientific facts in an effort to provide "balanced" views. When a scientific issue is settled, presenting sources from "both sides" as if the scientific community were split on the issue, is misleading the public. Research shows that false-balance reporting can quickly erode public support for scientifically well-supported positions [57,58].

In the context of COVID-19, a political pressure group with a history of climate denial recently presented a "declaration" that dangerously proposed letting the pandemic run free to achieve "herd immunity" as a solution to the pandemic. This strategy was presented as an alternative scientific approach, despite being rejected as "scientifically and ethically problematic" by the WHO. In reality, the scientific consensus endorses mask wearing, physical distancing, and widespread administration of a COVID-19 vaccine as strategies to combat the pandemic [59].

THE POLITICS OF MISINFORMATION RELATING TO COVID-19

A simple and helpful prevention measure is to forewarn people about the false-balance effect. This could be implemented in media libraries or on television before broadcasting potentially misleading debates [60]. Here is a hypothetical example:

In the following program, opposing standpoints may be presented equally, although there is only scientific evidence for one standpoint. Since journalists are anxious to report as fairly as possible, in some cases this so-called false balance occurs. By implementing false balance, journalists aim to equally weigh opposing perspectives on a topic. Thus, pro- and contra- arguments are presented to express different opinions. In debates about opinions, this serves to increase fairness and is widely regarded as good journalism.

However, this becomes problematic in science reporting – because science is about facts and not opinions. In most cases, an advocate for science is invited and, in addition, someone who represents an unscientific standpoint. This may make the debate more exciting, but it also creates the false impression that both positions are of equal value. The most common example is climate change: about 97 percent of scientists agree that climate change is caused by humans. However, people who deny human-caused climate change are still being invited on television. The scientific facts are distorted by these falsely balanced reports.

Impossible expectations

One misinformation strategy exploits the ambiguity of words that are understood differently by scientists and non-scientists. For example, to a scientist, "uncertainty" is a word used to quantify how precisely we know things (e.g., by providing confidence intervals around estimates). Knowing the uncertainty of estimates actually enables scientists to have greater confidence in the results of a vaccine test, for example. People who seek to discredit vaccines, however, often use uncertainty as a reason to dismiss solid knowledge.

More examples here: MYTHS ABOUT COVID-19 VACCINATION

3. Correcting misinformation: How to debunk

If misinformation has already found traction, then your next option is debunking. Debunking can be challenging because even though corrections may seem to reduce people's beliefs in false information, the misinformation often continues to influence people's thinking[61].

> ***Once experienced, even corrected misinformation can linger in memory but we can often undo its influence if we follow best practices.***

The structure of an effective debunking involves the following components:

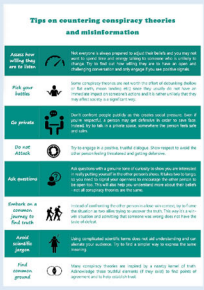
FACT	It is important to provide a factual alternative to the misinformation. If you have a clear, pithy, and sticky fact (e.g., "The vaccine is safe"), lead with it. It is also fine to lead with the warning/myth when the focus is on explaining why it is misleading. Avoid scientific jargon or complex, technical language[62]. Well-designed graphs, videos, photos, and other semantic aids can be helpful to convey corrections involving complex or statistical information clearly and concisely[63,64,65].
WARN ABOUT THE MYTH	Repeat the misinformation, only once, directly prior to the correction. One repetition of the myth is beneficial to belief updating because then people know what memory they should revise[66,67].
EXPLAIN FALLACY	Rather than only stating that the misinformation is false, provide details as to why. This is crucial. Explain (1) why the mistaken information was thought to be correct in the first place and (2) why it is now clear it is wrong and (3) why the alternative is correct[68,69]. It is important for people to see the inconsistency between misinformation and correct information in order to resolve it[67,70].
FACT	Finish by reinforcing the fact—multiple times if possible. Make sure it provides an alternative causal explanation whenever possible.

> ***Social Media Messaging about COVID-19:***
>
> ***One study in Zimbabwe showed that targeting misinformation via WhatsApp has considerable promise. Exposure to corrective messages circulated via a newsletter significantly increased respondents' knowledge about the virus. The messages also reduced potentially harmful violations of social-distancing measures by 30%[71].***

Debunking based on best-practice recommendations has been shown to be effective in combating vaccine related misinformation[72], notwithstanding the fact that vaccine misinformation might be expected to be resistant to corrections that may conflict with people's emotions and moral values[73]. Ideally, corrections of vaccine and COVID-19 misconceptions should be adapted to connect with the morality of recipients (e.g., do they value individual well-being or individual freedom more?) to mitigate negative emotional and cognitive reactions[73].

It can also be helpful to instruct people to attend to the source of the misinformation and its credibility[74].

Click on the thumbnails for two succinct guides about how to counter conspiracy theories and misinformation:



General vaccine myths [WHO, 2016]		
Fact	**Myth**	**Fallacy**
	SAFETY	
Many large studies have found that vaccines do not cause autism. The imaginary link between autism and vaccinations was based on fraudulent conduct[75]. Current research suggests that autism cannot be explained by a single cause, but is probably due to a combination of developmental, genetic, and environmental factors.	Children have developed autism after receiving the MMR vaccination.	**Correlation is not causation:** Just because two events happen close to each other in some cases doesn't mean one event caused the other.
Vaccines are generally a safe way to prevent vaccine-preventable diseases.	I am not against vaccination, but it needs to be 100% safe.	**Impossible expectations:** It is unrealistic to expect that any medical treatment is 100% free of side-effects.

Fact	Myth	Fallacy
EFFECTIVENESS		
Vaccines have shown to be effective in protecting people from vaccine-preventable diseases. SUCCESS OF VACCINES	My uncle got vaccinated and still developed the disease!	**Impossible expectations:** Vaccines aren't 100% effective, but they greatly reduce the likelihood of infection. **Anecdote:** Focuses on single cases while ignoring the larger picture of the vast majority of vaccinated people not getting infected.
THREAT OF DISEASE		
There is an overwhelming scientific consensus among medical experts that vaccines are the best way to fight preventable infectious diseases.	A group of experts who sell lots of books about the healing power of the human soul state there are no such things as diseases.	**Fake experts:** Relies on a small number of non-experts while ignoring the consensus of the expert community.
ALTERNATIVES		
Vaccines are one of the most important inventions in human history. They save more than 5 lives every minute.	Natural prevention is so much better than artificial inventions.	**Appeal to nature:** Just because something is natural doesn't make it good or effective, just as being 'unnatural' (e.g., scientifically developed medicine) doesn't make it bad.
TRUST		
Vaccine development is conducted by different pharmaceutical companies and independent research teams all over the world.	We know they are all systematically hiding the real data because we never see real data!	**Conspiracy theory:** Arguing that all the world's medical scientists are deceiving the public is an implausible conspiracy theory, given so many independent scientific teams find consistent results and check each others' work.

COMMON ANTI-VACCINATION MISINFORMATION

COVID-19 vaccine myths		
Fact	**Myth**	**Fallacy**
	SAFETY	
There is negligible risk of any vaccine giving you the disease—and in the case of COVID-19, none of the vaccines currently being rolled out use the live virus at all, not even in a weakened form.	The COVID-19 vaccine may give you COVID-19!	**Misrepresentation:** this myth is based on the misconception that the vaccines contain a live version of the virus.
Even though COVID-19 vaccine development was accelerated, vaccine testing was still required to proceed through a rigorous series of steps to establish the vaccines' safety and efficacy. The vaccines' safety will continue to be closely monitored as they are rolled out, to ensure they don't have serious side effects at unacceptable rates.	We can't know the COVID-19 vaccine is safe if it's only been around for a few months.	**Impossible expectations:** There are already many stringent tests to ensure the vaccines' safety. To delay vaccination means many more deaths due to COVID-19.
		COVID-19 VACCINE DEVELOPMENT PROCESS
mRNA vaccines are synthetic and do not contain a weakened form of the actual virus. Instead, mRNA vaccines deliver instructions that allow your body to make a protective response. This is just as unlikely to change your genome as eating fish will make you grow gills.	mRNA vaccines change the human genome!	**Misrepresentation:** mRNA vaccines affect proteins specific to the virus and don't change human DNA.
Because of the risk from COVID-19 and its prevalence, the trials have proceeded faster than has been possible with other vaccines: Many tens of thousands of people signed up rapidly to participate in vaccine trials, compared to the more usual year or 18 months it takes to recruit a fraction of that for other vaccines.	COVID-19 vaccines were developed too fast. They simply cannot have a good safety profile.	**Straw man:** Paints a misleading picture of COVID-19 vaccine development which was so fast not because corners were cut but because so many resources were thrown at the problem.
		COVID-19 VACCINE DEVELOPMENT PROCESS
The COVID-19 vaccines are highly effective but transient side effects such as headaches, pain at the injection site, or fatigue have been reported by a significant number of people.	The COVID-19 vaccine has terrible side effects.	**Impossible expectations:** The side effects of the vaccine pale in comparison to possible death from COVID-19.
		POTENTIAL SIDE-EFFECTS OF COVID-19 VACCINES

Fact	Myth	Fallacy
	THREAT OF DISEASE	
COVID-19 is a highly infectious and deadly disease. By the end of 2020, it had caused over 1.7 million deaths globally. FACTS ABOUT COVID-19	COVID-19 is just another flu!	**Slothful induction:** Ignores that COVID-19 is far deadlier than the flu (e.g., by a factor of 3 among hospitalized patients overall and by a factor of 10 among adolescents[76]).
	TRUST	
Our understanding of COVID-19 is based on scientific research conducted by teams all over the world, as well as practical experience by the entire global medical community.	COVID-19 is a hoax.	**Conspiracy theory:** If COVID-19 were a hoax, it would have to involve millions of "insiders" who pretend to care for the ill and bury the deceased, or pretend to have lost loved ones. CONSPIRACY THEORIES
It is true that COVID-19 is more deadly in older people and those with underlying health problems. However, COVID-19 has caused many additional deaths beyond what would normally be expected in an average year.	Those dying of COVID-19 would have died of other causes anyway.	**Hasty generalization:** Assumes that because some older people die of other causes, they are all going to imminently die of other causes. **Slothful induction:** Younger people also die from COVID-19, and generally people suffer other long-term injuries from COVID-19 besides death.

More examples here: MYTHS ABOUT COVID-19 VACCINATION

Find out more about poor arguments and fallacies here: ARGUMENT QUALITY AND FALLACIES

4. Flattening the curve of the "infodemic": Nudging

If misinformation cannot be eliminated, the goal should be to "flatten the curve of the infodemic, so that bad information can't spread as far and as fast"[77]. Debunking and inoculation can help flatten the curve.

Another way to flatten the curve involves "nudges": Nudges are ways to alter the context in which decisions take place to improve the quality of those decisions. One approach involves subtly prompting people to consider accuracy before sharing content on social media—thereby increasing the salience of truth. This approach has been shown to increase the quality of news content that people intend to share on social media about COVID-19[78].

NUDGING: FLATTENING THE CURVE OF THE INFODEMIC

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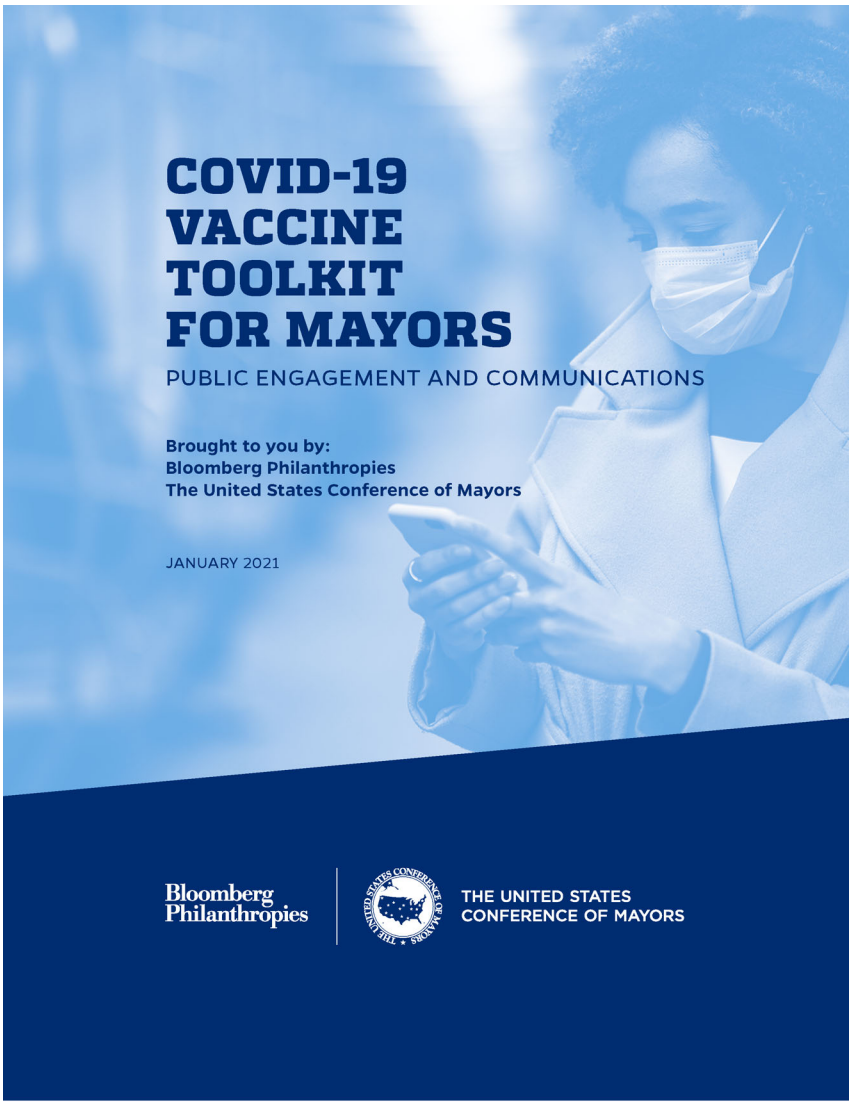
COVID-19
VACCINE
TOOLKIT
FOR MAYORS
PUBLIC ENGAGEMENT AND COMMUNICATIONS
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COVID-19 VACCINE TOOLKIT FOR MAYORS

Context

The COVID-19 vaccine, developed in record time, is the path forward for ending the current pandemic and reopening cities around the world. However, effective and equitable vaccination is an unprecedented logistical and public education challenge. Mayors and city leadership play a critical role in responding to this challenge, given their strong connection to residents and deep understanding of local context.

Purpose

The COVID-19 Vaccine Toolkit provides Mayors and their teams the guidance and resources they need to help facilitate the largest vaccination program ever seen in the United States. This toolkit is grounded in extensive research and interviews with leading experts and city leaders across the country with significant experience in public health, municipal emergency management, and crisis response.

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THE BEHAVIORAL INSIGHTS TEAM

JOHNS HOPKINS UNIVERSITY

Delivery Associates

For **more information** please visit bloombergcities.jhu.edu/vaccine.

For any **questions or feedback**, please email coronavirusresponse@bloomberg.org.

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INTRODUCTION: PUBLIC ENGAGEMENT AND COMMUNICATIONS

To achieve an effective and equitable vaccination rollout, Mayors will play a critical role in communicating with their communities about the vaccine. Effective public engagement on the COVID-19 vaccine is not an easy task. While the majority of U.S. residents intend to get the COVID-19 vaccine, one in four U.S. residents say they wouldn't get the vaccine if it were free, determined safe by scientists, and available today (as of January 2021). Even for those who want the vaccine, in the early phases it is not always easy for residents to determine whether they're eligible, and if so, to navigate how to receive the vaccine.

If not already underway, Mayors need to begin engaging residents about the COVID-19 vaccine distribution process and the importance of receiving the vaccine. Effective local engagement requires staying abreast of a rapidly evolving vaccine distribution process, monitoring emerging concerns of residents, understanding evidence-based messages that can build public trust, identifying trusted messengers, and investing in community-specific communications campaigns.

The federal government is preparing to play a larger role in mounting a "safe, effective, comprehensive vaccination campaign," as the Biden administration details in its new "National Strategy for the COVID-19 Response and Pandemic Preparedness." The federal government's efforts will include guidance and tools related to engaging the American people, including communications "toolkits for local leaders" and a national vaccinations public education campaign, with the goal of increasing public trust in the COVID-19 vaccine. Cities should keep abreast of new federal resources as they are developed and shared. The evidence-based best practices in this guide are aligned with the general engagement plans set out by the Biden administration and provide detailed guidance for Mayors on urgently needed public engagement.

How to Use this Module

This module provides evidence-based public engagement and communications guidance for Mayors and their staff. Mayors may feel comfortable with some elements of vaccine engagement and communications, but not others. Accordingly, this module is designed to be useful its entirety or in separate parts. Each section contains a set of stand-alone and actionable recommendations that can be used to get started right away.

The brief guide on the next page outlines the content found in each section to allow the reader to find the topics most relevant to their needs.

INTRODUCTION: PUBLIC ENGAGEMENT AND COMMUNICATIONS

Understanding Messaging Challenges: Why are People Hesitant?	This section presents the groups most hesitant about the COVID-19 vaccine and summarizes the underlying drivers of vaccine hesitancy.
The Mayoral Role in COVID-19 Vaccine Messaging	This section provides concise guidance on the optimal messaging role for Mayors related to the COVID-19 vaccine and distribution process in a crowded messaging context.
Best Practices for COVID-19 Vaccine Communications from City Hall	This section contains evidence-based tips and best practices for developing effective digital, print, and verbal COVID-19 vaccine messages to be distributed by Mayors and their staff.
How to Reach At-Risk Communities	Vaccination is particularly important for disproportionately affected communities. However, as a result of current inequities, historical treatment, and other community-specific injustices, many of these communities have lower trust in the vaccine. This section shares best practices for engaging these communities.
How to Engage and Deploy Trusted Community Messengers	Disseminating information through trusted messengers is key to increasing vaccination uptake. People give more weight to information when it comes from someone who is seen as trustworthy and credible in their community. This section shares best practices around engaging trusted local messengers about the COVID-19 vaccine, including healthcare workers.
Best Practices and Tools for Countering Misinformation	Misinformation about the vaccine and distribution process threatens public trust. This section shares evidence-based guidelines and resources for Mayors for getting ahead of, crowding out, and debunking vaccine-related misinformation.
The Importance of Rigorously Testing Vaccine Messaging	Messages intended to increase engagement with vaccine-related materials or drive people to make vaccination appointments can be rigorously tested for effectiveness. This section links to an e-learning resource detailing how to use rapid A/B testing to test the effectiveness of Mayoral vaccine messaging.

UNDERSTANDING MESSAGING CHALLENGES: WHY ARE PEOPLE HESITANT?

While the majority of U.S. residents intend to get the COVID-19 vaccine, one in four U.S. residents say they wouldn't get the vaccine if it were free, determined safe by scientists, and available today.[1] Thankfully, approximately half of that group say they may change their mind and U.S. residents' overall intent to get vaccinated is slowly increasing.

While national survey data is informative, the reasons for hesitancy can be nuanced and community-specific. With strong knowledge of their communities, Mayors are well-positioned to use national trends as a starting point for understanding local reasons for hesitancy and deploying relevant messages and messengers to address these concerns.

We present the common drivers of COVID-19 vaccine hesitancy below. We draw on:

- Nationwide surveys, like the Kaiser Family Foundation Vaccine Monitor
- Academic research
- Original survey and focus group research conducted by BIT

Why are People Hesitant to get the COVID-19 Vaccine?

COVID-19 vaccine hesitant individuals cite a wide variety of reasons, most of which are understandable. Some of the most common drivers of hesitancy include:

Safety concerns, including fear of short and long term side effects:

In recent polling by KFF, "among those who are hesitant to get a COVID-19 vaccine," the main reason is concern about possible side effects (cited by 59%).[1] In BIT focus groups, participants cited uncertainty about possible long term side effects.[i]

> *"They tested it, I trust Pfizer and all those places, but no one really knows what's gonna happen in one year or two years, ... I don't know if I'd risk that yet."*
> - Latino focus group participant[i]
>
> *"I'm not worried about a sore arm or a headache, I'm worried about a neurological disorder ten years down the road."*
> - White female focus group participant[i]

[1] BIT conducted 9 focus groups from December 28 2020 - January 5, 2021 with people who had not yet decided to get the COVID-19 vaccine.

UNDERSTANDING MESSAGING CHALLENGES: WHY ARE PEOPLE HESITANT?

Lack of trust in institutions and the vaccine development process.

Just behind side effects, hesitant individuals cite "a lack of trust in the government to ensure the vaccines' safety and effectiveness (55%)" and "concerns over the role of politics in the development process (51%)."[1]

Historical and current racial inequities and injustice in science and medicine.

For example, stemming from historical and present inequity in access to quality healthcare and notorious examples of abuse such as the Tuskegee Study, Black Americans are justifiably less likely to trust COVID-19 vaccines and less likely to volunteer for medical research.

Perceptions of risk.

COVID-19 has a high degree of symptom-free cases. This can lead to miscalculations about the risk of infection and the benefits of vaccination. Additionally, the risks associated with the COVID-19 vaccine seem novel and salient, which may make them more memorable or compelling.

Vaccine denialism.

About one third of people who do not intend to get the COVID-19 vaccine are vaccination opponents. Many in this group believe in vaccine-related conspiracy theories.[2] Note: messaging can influence people who haven't made up their mind about whether to be vaccinated, but is not likely to persuade vaccine opponents. When considering vaccine opponents, the primary goal should be to limit them from spreading vaccine opposition and related conspiracy theories to others (see "Best Practices and Tools for Countering Misinformation on page 27).

Which groups are more hesitant?

Broad patterns on the most hesitant groups have emerged across public polling conducted by KFF, Pew Research Center, Gallup, other research groups. We share the most consistent patterns below:

- **Race:** Black adults, a group that has suffered disproportionately, are more hesitant than adults of other races.[3] [4] 35% say they definitely or probably would not get vaccinated.[1]
- **Political party:** In the U.S., 45% of Republicans say they would get the COVID-19 vaccine, compared to 83% of Democrats.[3] Previous surveys suggest that hesitancy among Independents is similar to (or exceeding) Republicans.[1]
- **Age groups:** Individuals in the age group 30-49 are more likely to be hesitant than other age groups. 36% say they would probably or definitely not get the COVID-19 vaccine.[1] [4]
- **Rural vs urban groups:** Rural residents are among the most vaccine hesitant groups, even controlling for age, political ideology, and race.[5]

To review updated information on hesitancy and national attitudes towards COVID-19 vaccination, we recommend The Kaiser Family Foundation's Vaccine Monitor.

THE MAYORAL ROLE IN COVID-19 VACCINE MESSAGING

In order to be effective in a crowded COVID-19 vaccine messaging context, Mayors need to understand their vaccine messaging role. What topics should they speak to and when should they draw on federal, state, and local public health officials? How can they best use their public platform and relationships to encourage vaccine uptake?

The Mayoral messaging role laid out below — Understand, Amplify, Direct, Reassure, Role-Model, Activate, and Advocate — is based on expert interviews with national public health leaders and city leaders. In this framework and the subsequent resources in this guide, we apply best practices from public health communications experts, the behavioral science literature, and original survey and focus group research conducted by The Behavioral Insights Team to help Mayors and city leaders operate effectively in their messaging role.

Understand community concerns that drive COVID-19 vaccine hesitancy and local barriers to vaccine access.

At a high-level, seek to understand what factors drive vaccine hesitancy in your city. Use existing COVID-19 and other community stakeholder groups to listen to residents' concerns about the vaccine, the distribution process, and the barriers they face to accessing the vaccine.

Amplify health department messaging and guidance.

Repeat and reinforce messages from the health departments interacting with your residents (e.g., city, county, state, Centers for Disease Control and Prevention (CDC)) — from very high-level messages (e.g., the vaccines are safe and effective) to logistical details (e.g., location of vaccination sites and eligibility). Repetition will build confidence and participation.[i] Surveys show that Mayors are familiar, trusted sources who often reach residents that health departments can't reach on their own.

- Create a standard recommendation on where people can get vaccine information and repeat it over and over again. Being able to say "go to chicago.gov/COVIDvax or call 311 to find out everything you need to know about getting vaccinated" is powerful.

Direct residents to the right experts and resources.

The Mayor's office should make it clear to residents who the relevant COVID-19 vaccine authorities are and where to find updates that are meaningful for them. Use verbal addresses and online presence to direct residents to reliable sources of information for health questions (e.g., CDC on side effects) and logistical updates (e.g., county health department website on vaccination sites and how to sign up, who is currently eligible to get the vaccine). This can also help combat misinformation, see the "Best Practices and Tools for Countering Misinformation" module on page 27.

[i] Experimental evidence suggests that repetition increases the perceived credibility of messages.[6]

THE MAYORAL ROLE IN COVID-19 VACCINE MESSAGING

Reassure.

Residents are more likely to participate in a vaccination process that they believe is fair and trustworthy[7] [8], but we already know that there are challenges. Residents may be critical of the speed or organization of the rollout and have questions about fairness as some populations are prioritized for vaccination first.[i] As a moral authority in their community, the Mayor's opinions on fairness will matter to residents. Use the Mayor's platform to provide a vote of confidence in the process to encourage patience and build acceptance of the sequence for the rollout as fair and just. In event that the city is subject to a flawed distribution process, reassure residents that the Mayor is advocating for their interests.

Mayors should regularly and transparently share data-driven updates on the status of vaccine distribution in their city. For more guidance on vaccine distribution metrics, see the "COVID-19 Vaccine Toolkit: Data and Monitoring Strategies".

Mayors are also well positioned to quickly respond to emerging concerns about the vaccine. For more information on responding to emerging concerns, see "Responding to Emerging COVID-19 Vaccine Concerns" on page 16.

Role-model.

Demonstrate that the Mayor and city staff are confident in the vaccine, will get it as soon as it is available to them, and are following all of the relevant COVID-19 safety protocols to prevent the spread. Capture and share photo and/or video of mayors and other leaders receiving vaccinations as much as possible.

> *"I feel like if ... the Mayor, did get the vaccine and did it publicly it would influence a lot of people outside of the religious organizations, especially those who keep up with other community as well, different pillars of the community."*
> - Black female focus group participant[ii]
>
> *"They have to be an example. [...] They have to show themselves, they have to receive the vaccine. And make the vaccine available to everybody. They say that is available, they have to be very clear the way it's going to be to the people to feel secure. But I think the example."*
> - Mexican Consulate Health Team focus group participant [ii]

[i] This may be particularly true for communities (e.g., communities of color, people with disabilities, transgender, non-binary, and LGBQA+ populations) that have experienced historical medical abuses (e.g., Tuskegee study) as well as ongoing health disparities and discrimination. Here, the role of trusted, in-group messengers will be important to increase uptake.
[ii] BIT conducted 9 focus groups from December 28, 2020 - January 5, 2021 with people who had not yet decided to get the COVID-19 vaccine.

THE MAYORAL ROLE IN COVID-19 VACCINE MESSAGING

Activate other leaders as messengers, especially in at-risk communities.

Use the city's network and influence to ensure that other community leaders are similarly role-modeling and spreading the word. This includes empowering them with the right information and ability to ask questions — and have them answered. This will help reach communities who may be disconnected from the city's typical channels — many of whom have already disproportionally carried the burden of this virus. Trusted messengers can also reinforce critical messages via repetition and ensuring residents are equipped with good information. For example, encouraging and equipping faith and other community leaders outside of the healthcare profession to speak about vaccination will help build trust. Similarly, support from the Mayor may help motivate healthcare workers to have impact as messengers in their daily lives outside of work.

As part of this outreach, Mayors should connect trusted messengers with experts and provide a platform for resident engagement (e.g., public panels, radio broadcasts). For more on how to activate community messengers, see page 22 on mobilizing trusted community messengers, including healthcare professionals in particular.

Advocate for residents with a focus on equity.

As you convey messages to your residents, listen to the concerns that they raise and relay these to the responsible stakeholders (county and state government, local health department, pharmacies, hospitals, and more), including responses to their messaging. If, for example, residents from a particular community do not have clear, actionable guidance on where and when to get vaccinated due to language barriers or lack of internet access, advocate and work with health departments to translate and adapt to other channels. Consider leveraging lessons learned from COVID-19 testing, the Census, and other community engagement efforts.

This advocacy is especially important on behalf of at-risk communities who suffer worse COVID-19 outcomes and reduced access to healthcare. For more on reaching these communities, see the "How to Reach At-Risk Communities" section on page 18.

As part of the "National Strategy for the COVID-19 Response and Pandemic Preparedness" the federal government and CDC will be conducting outreach and education campaigns with local governments around the vaccine. The CDC will be producing toolkits to help local governments give trusted messengers and leaders the information and tools they need to talk about vaccination with others in the community. Mayors should monitor for these new resources as they become available.

BEST PRACTICES FOR COVID-19 VACCINE COMMUNICATIONS FROM CITY HALL

Throughout this pandemic Mayors nationwide have stepped up to the challenge of communicating public health guidance to residents. As they add the responsibility of communicating about the COVID-19 vaccine to their public engagement, Mayors should use these best practices to be confident they are addressing this complex topic effectively. These practices have yielded measurable improvements for cities' COVID-19 communications. Specifically, these practices have been rigorously shown to improve people's ability to recall and understand the main message, their intent to undertake the recommended action, and their sentiment towards the message.[i]

Best Practices

Keep messages simple, clear, and actionable.

When it comes to public health, people understand and remember messages better when they are simple and short. Research on communicating COVID-19 guidelines and public health information (e.g., proper handwashing technique) finds that "less is more" and striking a balance between telling people what they need to know without overloading them with detail leads to higher retention.[10] Try to focus on one main point at a time and use as few words as possible.

Make it easy for people to understand what to do.

Avoid complex language. Be simple and precise with your messages. This will help your message spread equitably to populations that are more at-risk and those that are likely more vaccine-hesitant.

If the communication is trying to encourage a specific action, give people the information they need to take that action clearly and simply as possible:

- **Explicitly state the recommended action or behavior.** For instance, "Call the Vaccination Information Line to book an appointment" is more explicit and helpful than "Get the COVID-19 vaccine."
- **Give people the information they need in order to perform the behavior.** For instance, if a communication encourages people to talk to a doctor about the vaccine, provide a toll-free number that people can call.
- **Break complicated behaviors down into clear steps.** Consider using visual aids, such as

[i] BIT has conducted dozens of online studies around the world to develop COVID-19 guidance. For examples, see a Harvard Data-Smart City Solutions write-up of BIT's work with 12 U.S. cities.

a checklist or picture for each step. For example, if information on vaccine availability is changing regularly, you could break down instructions for how to stay up to date: "1. Check this website for the current status, today. 2. Sign up for email or SMS notifications that will tell you when you will become eligible 3. When you become eligible, click on the link in your email or SMS to learn what vaccination site you can use."

Use local facts, tell stories, and evoke constructive emotions.

People often find personal stories and examples more compelling than factual statements, particularly abstract ones, and health communication scholars recommend these approaches to increase vaccination.[11] Telling an anecdote or making an emotional appeal that evokes constructive emotions like pride, hope, and parental love (rather than fear or shame) can increase the persuasiveness and recall of pro-vaccination messages.[12] [13]

> Example: Talk about a local family's experience with COVID-19 or a healthcare worker's endorsement of the vaccine.

Use local facts and figures whenever possible as these can make information more relevant to residents (see the "COVID 19 Vaccine Toolkit: Data & Monitoring Strategies" module).

> Example: Stating the total number of vaccines given in the U.S. is less impactful than telling people that almost 1,000 healthcare workers and seniors in their county have been safely vaccinated.

> *"Information is good. Maybe percentages. Thirty percent of people get a headache, 12% of people have experiences but 98% people will be immune to COVID. Something like that, where it's very clear that even though the percentages, 20% get this, at the end you're going to be immune or protective."*
>
> - Latina focus group participant[i]

Provide a rationale for recommended actions.

Provide a rationale for recommended actions, giving people a "why" they should do what you are saying, while still keeping it simple. Explanations that highlight helping others or "prosocial" motivations, such as protecting elders in their family or community, are often particularly effective.[14] [15] [16]

[i] BIT conducted 9 focus groups from December 28, 2020 - January 5, 2021 with people who had not yet decided to get the COVID-19 vaccine.

BEST PRACTICES FOR COVID-19 VACCINE COMMUNICATIONS FROM CITY HALL

> *"So, you know, like tugging on those heart strings and making me think about protecting my dad or whatever and maybe having to worry that I bring anything over there. That kind of makes me feel like, OK, yes, I guess that's a reason to do it."*
>
> *- Latino focus group participant*[i]

Repeat key messages.

Repetition helps people remember communications and build trust over time.[6] This is important as people will be exposed to a lot of information about the vaccine, some of which will be conflicting or confusing. Therefore it is essential that accurate, actionable information reach your residents and be absorbed. As people are repeatedly exposed to a message, they may see it as more credible and be more likely to remember it.

Example: Use your communications to amplify messages from county, state, and federal public health agencies, such as state vaccination task forces and the CDC.

Highlight social norms in favor of vaccination.

People look to others - what they think and do - as a source of information about what they themselves should do. When social norms are in favor of vaccination (i.e., people have begun receiving the vaccine and/or have stated their willingness to do so), highlighting these can increase uptake. If you have access to this information (e.g., local survey data or service use statistics), sharing it can increase uptake in the community.

Example: "A recent poll we did showed that 84% of people in our city plan to get the vaccine."

Do not reinforce social norms about behaviors or beliefs that you do not want to encourage. (E.g., "I know there is widespread concern about side effects..." or "one in four say they wouldn't get the vaccine.") This can end up increasing that behavior.

Center equity and make messages accessible to all residents.

This includes considerations such as:

- Provide written materials in all commonly spoken languages
- Use multiple media platforms and formats, including those that will reach people without

[i] BIT conducted 9 focus groups from December 28, 2021 - January 5, 2021 with people who had not yet decided to get the COVID-19 vaccine.

internet access, such as posters/flyers, television ads, or radio content

- Use culturally appropriate messaging specific to the intended audience and use trusted messengers
- Use a sign language interpreter for all briefings and appearances
- Have an interpreter for commonly spoken languages present at briefings and appearances
- Include captions for all briefings and appearances, as well as for clips that will be distributed
- Use bolding or underlining to highlight or differentiate information instead of relying on color
- Ensure that written documents are compatible with screen reading technology and use alternative text for images when possible, including for online resources

Activate trusted messengers and community leaders.

Activate trusted messengers and community leaders to reinforce your messages and better reach communities that may be disconnected from official city or the Mayoral channels. See guidance on engaging and deploying trusted messengers on page 22.

Use vaccine-related language that resonates with the public.

The Ad Council and COVID Collaborative have produced a list of recommended terms and language based on research with focus groups.

Exhibit 1

CONSUMER LANGUAGE DO'S & DON'TS

DO SAY	DON'T SAY
COVID Vaccination	COVID injection or shot
A safe and effective vaccine	A vaccine developed quickly
Authorized by FDA based on clinical testing	Operation Warp Speed; Emergency Use Authorization
Get the latest information	There are things we still don't know
Keep your family safe; keep those most vulnerable safe	Keep your country safe
Public Health	Government
Medical experts and doctors	Scientists
People who have questions	People who are hesitant, skeptical, resistant, or "Anti-vaxxers"

Additional Tips for Print and Digital Communications

As they have throughout COVID-19, cities will produce print and digital content to equip residents with the information they need to keep themselves healthy. This guidance will help maximize their effectiveness in communicating key vaccines guidance.

1. Put the key action or message at the top

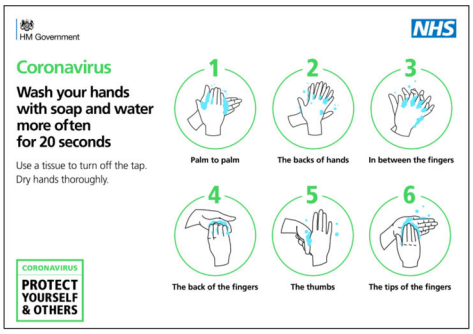
Place lower on the page all other types of content, including city name, logo, greetings (e.g., Attention Residents), titles or subject lines that are not action-oriented (e.g., Vaccine Availability Update). While we are used to putting titles, headers, or preambles in emails, reports, and other written documents, these are counter-productive when encouraging a behavioral change. Many readers will only read the top line, and so it must contain the action you would like them to take (e.g., "Make a COVID-19 vaccination plan today").

2. Use images and graphics

Whenever possible, use images, symbols, and pictures to support and reinforce the message. This is particularly important when communicating about numerical concepts, such as the risk of contracting COVID-19, to give your statement an emotional or visceral appeal as well. When using photos, representation matters, and you should depict people who your target audience will identify with in terms of their race, gender, and age.

For example, the following poster employs minimal text and attention-getting images to provide hand washing directions. A recent study showed that people remembered it better, liked it more, and were more likely to say they would wash their hands after seeing it than text heavy alternatives.[8]

Exhibit 2



3. **Group related items and separate text into chunks**

When information is presented in discrete sections, it is easier to process and understand. For instance, organizing information into bullets and lists is more efficient and clear than presenting people with large blocks of text.

4. **Test what works**

These tips are derived from data-driven research work on COVID-19 communications, but you can further refine this guidance for your city with commonly used evaluation tools like A/B testing. Testing the performance of alternate messages on a behavior or outcome is recommended and additional detail is found in the "The Importance of Rigorously Testing Vaccine Messaging" section on page 31.

Responding to Emerging COVID-19 Vaccine Concerns

Mayors are used to rapidly responding to crises. Evidence-based tactics can help Mayors respond to emerging COVID-19 vaccine concerns effectively in-the-moment, even on technical topics where they are not likely to be the expert (e.g., concerns about rare side effects). Use these questions to guide formulating a response to vaccine concerns as they emerge:

1. **What is the primary issue being raised?**

- **Gather information** about the specific issue related to vaccines that is being raised. Find out more about what people in your community are saying.

2. **What is the underlying concern?**

- **Seek to understand the motivation or underlying vaccine concern** that people are raising. For instance, when people talk about allergic reactions, the underlying concern is about vaccine safety.
- Understanding what motivates people can help establish common ground. While you may not have a concrete answer, this opens the door for acknowledging their concerns and building common ground.[17]

3. **How can I address underlying concerns?**

- **Acknowledge the concerns and make people feel heard.** When people feel their concerns are being ignored or minimized, it can damage trust and undermine communication about the vaccine.[i]

[i] For example, when people are told that vaccines have no risk and feel that their concerns are not being heard or addressed, this can decrease willingness to be vaccinated.[16] [17] French et al. (2020) suggest appealing to values, active listening, and encouraging dialogue can facilitate vaccine uptake by increasing trust. [8]

- **Seek to establish common ground.** Even if you are unsure about or disagree with the claim, acknowledging the underlying concern can facilitate common ground and help to maintain trust. Build on this common ground by making appeals to the shared underlying concern (e.g., the desire to protect the community) and framing the vaccine as a way to mitigate these concerns may help encourage uptake.[16]

4. What do I already know?

- **Are there existing resources?** Involve additional messengers to help (e.g., public health leads, medical professionals) when needed. If there are resources that address the underlying concern, adapt or use these to craft Mayoral responses.
- Refer to the CDCs Crisis & Emergency Risk Communication principles for additional information: https://emergency.cdc.gov/cerc/
- Monitor the CDC website for updated public health guidance

5. What do I not know?

- **Be transparent.** You do not have to know everything. State what you do not know and acknowledge when there is uncertainty. Although it may seem counterintuitive, being transparent is crucial to building trust.[i]
- **Outline what you will do** to learn more or address the concern and give people information about what they can do to stay safe in the meantime.
- **Refer to the relevant Department(s) of Health and local experts,** particularly when the issues are medical or scientific.
- **Refer to the relevant federal experts,** such as the federal COVID-19 Response Team briefings and updated guidance from the CDC and National Institutes of Health.

[i] Best practices for communicating science to lay audiences emphasizes transparent open communication, especially when facts are unknown, and flexibility in face of changing conditions/information. For issues where the answer is not known, trust and efficacy is enhanced when paired with actionable steps that will be taken to find out the answers.[18]

HOW TO REACH AT-RISK COMMUNITIES

African Americans, Latinx Americans, and Native Americans suffer disproportionately high COVID-19 infections and deaths (e.g., the mortality rate for Black Americans is 2.1 times higher than that of whites).[21] Systemic inequalities have shaped the nature of COVID-19 responses and the provision of services in ways that have failed to adequately support these communities (e.g., many communities of color have reduced access to testing sites and longer wait times for test results).[22]

Vaccination is particularly important for disproportionately affected communities and they must be prioritized when planning for distribution. However, as a result of current inequities, historical treatment, and other community-specific concerns (e.g., memory of the Tuskegee experiment; fear of immigration officials), many of these communities have lower trust and confidence in the COVID-19 vaccine. Messaging content and approaches must be tailored to these communities, contextualized within this history, and delivered by trusted messengers in order to reach them effectively. This guidance is informed by new research that considers health inequities in historical responses to pandemics to inform responses to COVID-19.[i]

Best Practices

Invite a representative group of community leaders to COVID-19 vaccine stakeholder group.

Invite a representative group of community leaders to COVID-19 Vaccine stakeholder group (or use an existing COVID-focused stakeholder group). You know your city. Use your understanding of city stakeholders to determine which community leaders to activate and learn from. These community leaders should be representative of the population and should be well positioned to share information within key social networks in your city. Some or all of these actors may already be involved in the city's COVID-19 response. Continue to activate and empower existing leaders. Be intentional about activating and empowering additional leaders who are not currently involved in the City's response.

- Groups to consider: faith leaders, small business owners, healthcare workers, organizers, trade associations, and non-profit and community-based organization leaders. Faith leaders are particularly important for older age groups and vaccine hesitant minority communities.

[i] This guidance, reframed to be actionable for Mayors, is primarily adopted from "Historical Insights on Coronavirus Disease 2019 (COVID-19), the 1918 Influenza Pandemic, and Racial Disparities: Illuminating a Path Forward," by Dr. Lakshmi Krishnan, Dr. S. Michelle Ogunwole, and Dr. Lisa A. Cooper. (2020) *Annals of Internal Medicine, 173(6),* 474-481

HOW TO REACH AT-RISK COMMUNITIES

Situate efforts to vaccinate within the historical arc, contextualizing current disparities in vulnerable communities and acknowledge past harms.

Vaccination can't be the only goal. This effort has to be a part of addressing structural inequities and a long-term commitment to communities of color using a restorative justice framework.[23] Larger social inequities need to be considered in tandem with the COVID-19 crisis. Mayors should acknowledge national and local past harms caused by government, scientific, and healthcare institutions, such as the "Tuskegee Study." Being clear and transparent will help build trust both during this vaccination effort and over the long term.

Seek to understand communities' COVID-19 vaccine concerns.

National data is helpful, but may not always map to specific cities and communities. Beyond the community stakeholder group, Mayors should work with the county or city public health department to set up a COVID vaccination hotline, email address, virtual events, and open dialogue with community leaders to field and speak to residents' questions and concerns.

Recognize the contributions and inherent strength in these communities.

In conversation with community leaders and residents more generally, it is crucial to acknowledge the contributions of frontline workers in communities of color as well as in the communities themselves. Focus on the strengths, both in verbal statements (e.g., examples of resilience and generosity) and - just as importantly - when creating community-specific vaccination plans (e.g., build on existing networks, such as communities of faith). Do not focus on perceived weaknesses, which can reinforce negative outcomes and behaviors, and justifiably generate resentment given the historical and current experiences of these communities.

Use participatory governance best practices.

Be sure that stakeholder group members are in the driver's seat using participatory governance best practices.[i] [24] The task force should solicit early and consistent involvement from community participants - instead of telling them what to do, Mayors should include them in the decision making process (they know their communities best, so they will know what will work on the ground and what won't). This will help Mayors build trust and create strategies and messaging that are culturally sensitive and relevant. Early insights from our focus group with community-based organizations indicate that they have a pulse on the concerns of their communities, they are viewed as trusted messengers, and they have ideas about how to effectively communicate with hard-to-reach groups.

[i] For more information, the World Health Organization provides a series of webinars and resources on participatory governance, https://www.who.int/activities/promoting-participatory-governance-social-participation-and-accountability, and Effing & Groot (2017) outline strategies for e-participation that Mayors may adopt during the pandemic, https://hal.inria.fr/hal-01636462/document

HOW TO REACH AT-RISK COMMUNITIES

Show your commitment and be consistent.

Use a restorative justice framework to acknowledge and make amends for the structures contributing to disadvantages in these communities, as they contribute to disparities in COVID-19 outcomes. Take a broader lens towards protecting communities of color against racism and structural inequality, and narrowing the gap between those most and least privileged. Mayors should have and communicate a genuine commitment to these issues, and raise public awareness around the need for equity.

Solicit ongoing feedback, regularly surface barriers to vaccine access, and co-create solutions.

Your community leaders will be best positioned to notice barriers to vaccine uptake in their communities. For example:

- Does a certain neighborhood have a long drive to a local distribution site?
- Are the locations optimized to match the transportation modes of community members (near public transit, sufficient parking, not drive-up only, etc.)?
- Are there long wait times or fewer vaccine administrations at certain distribution sites?
- Do the hours of operation match the community needs?
- Are there sufficient resources in all needed languages (flyers, translators, signs, etc.)?

Ensure barrier identification is a standing agenda item for all meetings of your local vaccine task force to surface barriers throughout the rollout process. For each barrier that comes up, examine and discuss why the barrier exists.

In addition to surfacing barriers, brainstorm and co-create solutions with community stakeholders. For many community-specific issues, community members themselves will be best-placed to offer effective fixes that may not immediately occur to city staff. In some cases, bringing about a solution may involve the Mayor advocating for resident needs to other government entities, such as the county health department, the state, and the CDC. For more on addressing practical barriers to access, see the “The Mayoral Role in COVID-19 Vaccine Messaging” on page 8.

Recognize your own limitations as a messenger.

There will be communities that do not trust political leaders. In these cases, it will be important to consider other messengers. See guidance on “How to Engage and Deploy Trusted Community Messengers” in the following section.

Look for other ways to engage community groups about the vaccine.

There is no one-size-fits-all approach that will work for every community.

- **Host information sessions** to provide communities with information and solicit feedback on plans to distribute the vaccine. In BIT’s focus groups with community-

based organizations (CBOs), CBOs leaders suggested Mayors and public health officials hold webinars or listening sessions with them to relay up to date, specific information and answer questions. Ideally, these information sessions should include medical professionals with a similar background as the community members who can answer questions.

> *"We've had panels at the church with representation from the health department locally that helped answer questions, offered some opinions so that helped a lot."*
> - Black female focus group participant[i]

- **Solicit initial and ongoing feedback** from community groups about vaccine distribution. Establish channels for regular, two-way communication throughout the distribution process. For example, Dayton, OH has weekly hour-long question and answer sessions with local faith leaders where they ask questions reflecting what they're hearing from their community and city staff respond with answers in a timely fashion.
- **Encourage social sharing by vaccine recipients** and gather testimonials for distribution by trusted community channels.

> *"They'll definitely trust someone in their family if they've gotten it, and they'll definitely reach out and trust them."*
> - Healthcare provider in community-based center[i]

[i] BIT conducted 9 focus groups from December 28, 2020 - January 5, 2021 with people who had not yet decided to get the COVID-19 vaccine.

HOW TO ENGAGE AND DEPLOY TRUSTED COMMUNITY MESSENGERS

Disseminating information through trusted messengers is a key part of increasing vaccination uptake.[8] People give different weight to information depending on who is communicating it to them. For example, people are more receptive to messengers that come from sources who are similar to them, such as someone who is seen as trustworthy and credible in their community, and are more influenced by people who are perceived as experts. This may not always be the mayor. Empowering trusted local messengers will be key to fostering confidence in the safety and efficacy of the vaccine and increasing residents' motivation to get vaccinated.

In general, representatives from the medical and scientific communities are highly trusted messengers[25] [26] [27] [28] [i], as are community leaders (e.g., faith leaders)[29], perceived experts[30], in-group members and people who are demographically similar (to the recipient).[31] Employing more than one trusted messenger can strengthen communications.[8] This is particularly important for communities that mistrust and / or have poor relationships with the government and medical institutions, particularly marginalized people (e.g., homeless) and communities of color (e.g., African American, Latinx) as they are disproportionately impacted by COVID-19[32] and have high levels of vaccine hesitancy.[33] [34]

However, it is important that messengers are matched to the audience (e.g., members of the same community), are equipped with the best facts and resources the Mayor and others can provide them, and that messengers who have been inconsistent in their position on the vaccine / in their past messages are not used, as this can create confusion and undermine the message.[35]

Best Practices

1. **Leverage your COVID-19 or vaccine-focused community stakeholder group.** Important messengers should be part of that group.
2. **Co-create a communications plan,** including campaigns, that leverage community messengers: Develop a plan to share communications about the safety and efficacy of vaccines with your communities. Be sure that stakeholder group members are in the driver's seat using participatory governance best practices.

The Biden administration is launching a National COVID-19 Vaccination Ambassadors Program, which will promote the experiences of people who have received the vaccine, and which Mayors can amplify and point residents to. The CDC is also producing a toolkit with

[i] Note: This may not be equally true for all people. For instance, communities of color and marginalized populations such as homeless people, may have higher levels of mistrust and less access to healthcare providers, meaning that alternate messengers may be more important for these individuals.

guidance on how to develop local ambassador programs, which Mayors can employ.

3. **Answer trusted messengers' questions and solicit ongoing feedback on vaccine distribution.** When activating messengers, provide access to public health or medical experts so that messengers can have their own questions addressed and learn how to communicate vaccine-related information to others.
4. **Ensure trusted messengers have talking points, printed, and digital materials.** Engage with your stakeholder group to disseminate positive, factual messages about the vaccine. Provide messengers with accurate information and materials (e.g., flyers/graphics, videos, logistical information, links to official sources for in-depth information) to ensure they are equipped to support the community.
    - As the rollout goes on, some messages may prove to be more effective than others for specific groups. The Abdul Latif Jameel Poverty Action Lab (J-PAL), alongside the Center for Diversity and Inclusion of Massachusetts General Hospital and over 40 physicians from MGH and the Lynn Community Health Center evaluated video health messages targeting the specific concerns of Black and Latinx communities. J-PAL's findings and messages can be found here.
    - US Digital Response conducted in-depth research with trusted messengers to see what types of information they find helpful and produced a set of recommendations, which can be found here.
5. **Empower community messengers to respond to misinformation** or the spread of rumors in their communities (see "Best Practices and Tools for Countering Misinformation" on page 27).
6. **Provide a platform for community messengers.** Create opportunities for trusted messengers and experts to engage with the public through various channels. For example, the Mayor and a trusted messenger could go on local radio or participate in panels at cultural or religious centers. Some communities may not be gathering in person or may be more likely to get their information online (e.g., younger demographics), so online and social media outreach is important. For example, host a Facebook live or Reddit AMA ("Ask Me Anything") session where the Mayor brings together trusted messengers and/or experts to answer questions from the community.
7. **Messengers should publicly model getting vaccinated.** Community leaders should:
    - Be willing to take the vaccine and recommend it to their family and friends
    - Be public about their experience
    - Display trust in the vaccine and in healthcare professionals administering the vaccine (e.g. "I am in touch with Dr. ___ and we are all in this together")
    - Highlight people from their specific communities who have participated in vaccine trials (and activate them as messengers, if there are local examples). This is especially important for at-risk communities

Special Considerations about Healthcare Workers as Messengers

It is essential that local healthcare workers are active messengers. In surveys about COVID-19, healthcare workers, scientists, and researchers are consistently the most trusted messengers across political parties, race, and other demographics. Healthcare workers and providers play a key role in persuading individuals who are undecided about vaccination, both in their official roles and as members of their social networks. Mayors should therefore work to activate healthcare workers of all types in their communities to serve as messengers about the vaccine, if they are not already active.

Activating healthcare providers as messengers about the COVID-19 vaccine is important as medical professionals, particularly those with existing relationships to an individual or community, are among the most trusted sources of vaccine information.[26] Recommendations from health care providers are a critical predictor of vaccine uptake[36] and provide a channel to facilitate discussions about vaccination.[i]

However, Mayors shouldn't take for granted that all healthcare workers intend to receive the vaccine. **While this may surprise some, a sizable minority of healthcare workers (between 16% and 36%) do not intend to get the COVID-19 vaccine.** [37] [38] Education about vaccine hesitancy, including opportunities to ask questions, should specifically target healthcare workers and providers. Changing their perspective is important not only for their own health, but also for the broader community that they interact with, as healthcare provider attitudes and outcome expectations impact likelihood of recommending vaccination to patients.[39] [40] As a part of reaching out to healthcare workers and asking them to serve as messengers and advocates for the vaccine, Mayors should also educate and influence any healthcare workers who might be hesitant themselves in the process.

Develop strategies to mobilize healthcare workers in collaboration with healthcare professionals that are adapted to meet the needs of your community. Mayors should:

Reach out to a broad array of local healthcare organizations

Reach out to a broad array of local healthcare organizations to reach a diverse set of healthcare workers. In addition to doctors and nurses, involve other types of healthcare workers, as well as those who work in settings outside of hospitals and medical practices (e.g., outreach and community mental health workers, personal support workers, social workers, home care providers). This will increase the number of workers who can talk to people about vaccination and is particularly important to reach people who do not have a family doctor or access to healthcare resources.

[i] Multimedia outreach involving education, adverts, social media, events, and the distribution of a Handbook to providers successfully vaccination knowledge, perceived importance, and rates to over 90% in Australia.[40]

HOW TO ENGAGE AND DEPLOY TRUSTED COMMUNITY MESSENGERS

Solicit initial and ongoing feedback from healthcare workers

Solicit initial and ongoing feedback from healthcare workers about vaccine distribution — for example, including a representative in your task force or in your community stakeholder group. Involving healthcare workers in the planning stage of your messaging efforts can increase buy-in.[i] Establish channels for regular, two-way communication throughout the distribution process.

Address healthcare workers questions and concerns.

The Ad Council and the COVID Collaborative developed resources designed to address healthcare professionals' questions about COVID-19 vaccination. Organized in the form of a toolkit, the resource includes videos (featuring Dr. Anthony Fauci and other leading healthcare experts), a press release, FAQs, talking points, social media posts, and many customizable materials. Topics addressed include safety, availability, cost, side effects, vaccine administration, answering patients' questions, and more. Mayors can provide local healthcare organizations these materials, and encourage them to send the videos to their employees to address their concerns and deploy other educational programming.

Provide messaging materials specific to healthcare workers.

This could include both materials that Mayors develop and external resources, such as posters, pamphlets, and digital content that providers can post in their offices and share with patients. These materials should cover basic information about the vaccine and information about how to talk to patients about the vaccine (e.g., Ad Council's resources and CDC's Building Confidence in COVID-19 Vaccines Among Your Patients). Healthcare organizations may already have some of these materials, but Mayors are connected to multiple channels of valuable information — particularly from trusted messengers and the community — and are well positioned to ensure that materials are widely distributed, including through healthcare organizations. Healthcare organizations can provide information on outreach efforts or sessions that trusted messengers may be hosting, as well as send representatives with clinical expertise to field questions from the community.

Healthcare providers themselves are exposed to many sources of information, which may include inaccurate or misleading information about the vaccine. When possible, Mayors should amplify messages from local, state, and federal health agencies (e.g., CDC) and connect healthcare providers to reliable resources so they can promote the vaccine to others.

[i] Healthcare providers may need support to manage the quickly evolving vaccine environment as well as changing public, especially those who are reluctant or refuse vaccination. Some recommended strategies included strengthening trust between healthcare providers, health authorities and policymakers, through more shared involvement in the establishment of vaccine recommendations.

HOW TO ENGAGE AND DEPLOY TRUSTED COMMUNITY MESSENGERS

Encourage healthcare workers to advocate for the vaccine.

Encourage healthcare workers to advocate for the vaccine outside of their official roles, reaching out to friends and neighbors who are vaccine hesitant in an unofficial capacity. This will broaden the reach of healthcare messengers beyond those who regularly receive healthcare, or who may be hesitant about medical settings.

> *"I know a lot of people in the healthcare industry. Seeing them get it made me feel a little more comfortable."*
>
> - Black female focus group participant[i]

Plan outreach efforts or campaigns.

Plan outreach efforts or campaigns, such as Vaccine Awareness days, that involve healthcare workers and organizations as messengers. Encourage healthcare providers to proactively reach out to their patients to have conversations about the vaccine. If events are organized by healthcare organizations, lead by example and publicize Mayoral attendance and support.

> *"The doctor is not recommending it to us. My primary care physician hasn't reached out to me and said, you should get the vaccine."*
>
> - Latina focus group participant[i]

[i] BIT conducted 9 focus groups from December 28, 2020 - January 5, 2021 with people who had not yet decided to get the COVID-19 vaccine.

BEST PRACTICES AND TOOLS FOR COUNTERING MISINFORMATION

Misinformation can decrease individuals' willingness to get vaccinated and undermine confidence in the safety and efficacy of the vaccine. Surveys show that belief in vaccine and COVID-related misinformation is higher in at-risk communities. Mayors can use evidence-based methods to "prebunk" misinformation to prevent its spread, work with public health officials to debunk misinformation that is spreading, and foster resilience against the negative effects of misinformation. The Biden administration's COVID-19 Response Office plans to monitor misinformation campaigns and deploy science-based information in response (see "National Strategy for the COVID-19 Response and Pandemic Preparedness").

COVID-19 Vaccine Misinformation is Widespread and Damaging

Definition: "Misinformation is false information that is spread either by mistake or with intent to mislead."[42]

Misinformation about COVID-19 is widespread and harmful to vaccine uptake and other protective measures (e.g., mask wearing).[43] From a vaccine equity standpoint, surveys show that belief in vaccine and COVID-related misinformation is higher in at-risk communities.[44] Belief in misinformation can distort perceptions of risk and undermine public health advice, so proactively and reactively addressing misinformation is crucial for maintaining support for key public health behaviors.

The Mayoral Role in Countering Misinformation

Mayors, local public health officials, and community-based stakeholders are all well-placed to detect and address misinformation circulating in their communities.

Public health officials, rather than Mayors, should take on the primary role in debunking misinformation, getting into details of particular myths and explaining why they are not true. Many COVID-19 vaccine myths rely on misunderstandings of vaccine technology and public health officials have the necessary expertise and credibility to explain how vaccines work. Additionally, we know from survey data that U.S. residents place the most trust in their own healthcare providers and in national and local public health officials on medical topics.

The Mayor's role in combating vaccine misinformation is therefore primarily:

1. Warning residents that misinformation is coming, preparing them to detect it, and amplifying messages that are true ("pre-bunking" and "inoculating", described in more depth below).
2. Monitoring what misinformation is spreading locally and working to combat it with public health officials.

Best Practices and Tools for Combating Misinformation

Mayors and public health officials should use the following practices to mitigate the negative effects of misinformation:

1. Pre-bunk and "Inoculate"

Pre-bunking, or pre-emptively debunking misinformation, is easier than dealing with it after it has spread. It involves:

- Warning people that misinformation is coming and individuals may expose them to misinformation for personal gain or due to legitimate worries about vaccine safety. Note: Mayors should avoid describing vaccine opponents or vaccine hesitant individuals spreading misinformation with pejoratives, as many spread misinformation as a consequence of legitimate concerns about vaccine safety and pejoratives can be polarizing.
- Providing information about the techniques that are used to spread vaccine misinformation to help "inoculate" residents[1]:
    - **Impersonating experts or citing "fake experts"** to create the illusion of a lack of consensus about the safety of the vaccine.
    - **Using emotional language** that plays into basic emotions such as fear, anger, or empathy, in order to gain attention or frame an issue in a particular way.
    - **Group polarization**, amplifying existing grievances and tensions between different groups in society, like political differences, in order to garner support for or against partisan viewpoints and policies.
- Providing counter-arguments and strategies to refute misinformation in advance.[45] For example, much of vaccine misinformation is on the topic of side effects, and so Mayors could repeat information that is true from clinical trials and direct the public to credible sources to learn about side effects.
    - The authors of the COVID-19 Communication Handbook have a wiki with COVID-19 specific vaccine-related misinformation paired with counter-arguments.

Mayors should also promote the GoViral! online game. Developed through a collaboration between the University of Cambridge, Drog, Gusmanson, and the UK Cabinet Office, GoViral! is a 5-minute game shown to protect users against COVID-19 misinformation.[46] It teaches users about the common strategies used to spread false and misleading information about the virus and helps them resist them the next time they encounter them online.

[1] Techniques adopted from: Roozenbeek, J., & van der Linden, S. (2019). Fake news game confers psychological resistance against online misinformation. *Palgrave Communications*, 5, 1-10.

2. Consistently amplify fact-based information

Consistently amplify fact-based information in partnership with local public health officials to crowd out misinformation. Once it takes hold, misinformation is hard to dislodge. Communicating consistently about the vaccine will reduce the amount of misinformation that sticks.

- Mayors should make sure that city websites link to local or county health department or CDC vaccine information resources.
- Mayors should encourage healthcare providers to proactively communicate with patients about the safety and efficacy of COVID-19 vaccines.
- Mayors, public health officials, and community messengers should proactively provide accurate information via multiple channels that is tailored for specific communities, especially those with higher rates of belief in COVID-19 misinformation. See "How to Engage and Deploy Trusted Community Messengers" on page 22.

3. Monitor

Monitor for misinformation that is spreading locally. Gather information from your COVID-19 or COVID Vaccine community stakeholder group, as well as from community leaders, particularly those who are connected to vulnerable or at-risk populations.

- Your stakeholder group agenda should feature a discussion of emerging reasons for vaccine hesitancy as a regular item and specifically probe for myths, misconceptions, and rumors.
- Provide feedback and updates on local misinformation to local public health officials and strategize how to respond.
- As of late January 2021, there is no online CDC resource for tracking COVID vaccine misinformation. However, the CDC does maintain a "Facts about COVID-19 Vaccines" page to counter known myths. The authors of the COVID-19 Communication Handbook also have a wiki with COVID-19 specific vaccine-related misinformation paired with counter-arguments.

4. Debunk regularly

For misinformation with a substantial scientific dimension, which is likely to be most COVID vaccine misinformation, Mayors should rely on local public health officials to debunk in their official capacity, in addition to amplifying trusted national officials such as Dr. Anthony Fauci, CDC, the National Institute of Allergy and Infectious Diseases, the Surgeon General, and President Biden's COVID-19 task force. Mayors should make sure local public health officials are communicating with local healthcare providers about the need for addressing misinformation.

Ensure that debunking happens over multiple channels, such as press conferences, digital and print materials, and community outreach (e.g., conversations with stakeholders and representatives from at-risk communities). Mayors and public health officials should also prepare community messengers to debunk effectively when they encounter common misinformation.

In order to debunk a specific piece of misinformation:

- Start with the facts so as not to reinforce the misinformation
- Warn about the myth (but mention it only once)
- Explain in detail why the misinformation is false or misleading. Avoid scientific jargon and complex, technical language
- Reinforce the facts
- Provide the correct information and direct people to credible sources, such as public health officials.

Additional Resources for Combating Misinformation

1. **The Debunking Handbook 2020.** For an in-depth treatment of how to properly debunk misinformation, The Debunking Handbook 2020 is an in-depth guide to combating misinformation written by experts who specialize in debunking. This can be used by city staff and shared with community stakeholders.
2. **The Conspiracy Theory Handbook** explains why conspiracy theories are so popular, shows how to identify the traits of conspiratorial thinking, and lists effective debunking strategies. A condensed summary of tips for countering conspiracy theories based on the handbook lives here.
3. **GoViral! online game.** Developed through a collaboration between the Social Decision Making Lab at the University of Cambridge, Drog, Gusmanson, and the UK Cabinet Office, GoViral! is a 5-minute game shown to protect users against COVID-19 misinformation.[46] It teaches users about the common strategies used to spread false and misleading information about the virus and helps them resist them the next time they encounter them online.

THE IMPORTANCE OF RIGOROUSLY TESTING VACCINE MESSAGING

Messages intended to increase engagement with vaccine-related materials or drive people to make vaccination appointments, such as emails, social media posts, or SMS reminders, can be rigorously tested for effectiveness. Utilizing rapid A/B tests, or randomized controlled experiments, can yield meaningful improvements in key behavioral outcomes.

For example, early in the COVID-19 pandemic, **BIT partnered with 12 cities to test COVID-19 public health messages** encouraging behaviors such as staying home, wearing face masks, and keeping six feet apart from each other. Testing allowed cities to select message variants that performed best on measures of reader comprehension and intent to comply with the suggested behavior.

BIT has worked with over 55 U.S. cities to launch over 100 rigorous evaluations, many in support of communications strategies. From this experience, we can say with confidence that testing your message is valuable even if you believe that it is already effective. This is for several reasons:

- **Even a little improvement could be a big impact:** On a topic like COVID-19 vaccination that will impact all residents in your city, even a small improvement in your messaging can make a big impact. A message that results in just 3% more people choosing to get vaccinated could result in thousands or tens of thousands of additional people being protected, depending upon the size of your population.
- **Context matters:** We have found that what works in one city may not always work in another.
- **Equity matters:** Cities are diverse, and different populations might react differently to the same message. Testing with specific populations can ensure you are communicating equitably, and in ways that work for each population.
- **Results can be surprising:** Even the best experts cannot accurately predict which message will work best in tough situations, because of all the different contextual and population-specific factors at play. We frequently work with cities who believe they know which messaging option will work best, only to be surprised by the outcome.

Message testing is also low-cost, and not difficult to learn. We have synthesized and packaged our experience testing messages as a free online course which walks participants through the process of designing and implementing a simple email communications trial step-by-step.

Cities are welcome to sign up for this course and use course materials to design their own vaccine-related message testing by signing up through this **Google form**.

Please contact Kelsey Gohn with questions (kelsey.gohn@bi.team).

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Appendix II

Additional Material for the Record

DOCUMENTS SUBMITTED BY REPRESENTATIVE GWEN MOORE

MATERNAL IMMUNIZATION — TASK FORCE —

ACOG · American Academy of Family Physicians · American College of Nurse-Midwives "With women, for a lifetime" · AWHONN Promoting the Health of Women and Newborns

JOINED BY

AAPA · American Academy of Pediatrics Dedicated to the Health of All Children · ACP American College of Physicians Leading Internal Medicine, Improving Lives · AMA · APhA American Pharmacists Association · APHA American Public Health Association

AIM Association of Immunization Managers · IAC immunize.org · IDSA Infectious Diseases Society of America · NACDS National Association of Chain Drug Stores · NACCHO

National Foundation for Infectious Diseases · National Medical Association · NPWH Nurse Practitioners in Women's Health Caring for Women · Society for Maternal-Fetal Medicine · VACCINATE YOUR FAMILY

Maternal Immunization Task Force and Partners Urge That COVID-19 Vaccine be Available to Pregnant Individuals

All pregnant individuals who choose to receive the COVID-19 vaccine must be allowed to do so in alignment with their state and local vaccination allocation plan. This includes the estimated 330,000 health care workers who are pregnant and should be allowed to receive the vaccine as part of the first phase of vaccine distribution plans. Reports of pregnant individuals being refused vaccination are concerning.

Pregnant individuals who otherwise meet the criteria for COVID-19 vaccines should not be denied the opportunity to be vaccinated, should they choose to do so. Although a conversation with a clinician may be helpful for patients to aid in their decision-making, it should not be required prior to vaccination.

As the COVID-19 vaccine rollout continues, use must reflect the vaccines' federal regulatory authorization as well as information and recommendations from the Centers for Disease Control and Prevention, the U.S. Food and Drug Administration, and expert healthcare organizations.

Currently, available data demonstrate that pregnant individuals are at increased risk of more severe illness and death due to COVID-19 than their non-pregnant counterparts[1]. Providing pregnant individuals with the opportunity to be vaccinated can be critical to allowing them to protect themselves, particularly if their occupation puts them at increased risk of contracting the virus or they have underlying and comorbid conditions.

When pregnant individuals are excluded from the opportunity to decide whether to be vaccinated, it not only violates their bodily autonomy, it also puts them at risk of severe outcomes and death related to COVID-19 illness. Excluding this critical population at increased risk of severe illness and death related to COVID-19 is unethical.

In the interest of allowing pregnant individuals who would otherwise be considered a priority population for vaccines to make their own decisions regarding their health, our groups strongly recommend pregnant individuals should be free to make their own decision in conjunction with their clinical care team. All pregnant individuals must be supported in their decision about COVID-19 vaccination, whether they choose to receive the vaccine, or they opt to decline.

For more information, please visit ACOG's Practice Advisory on Vaccinating Pregnant and Lactating Patients Against COVID-19 and the CDC's Interim Clinical Considerations for Use of mRNA COVID-19 Vaccines Currently Authorized in the United States.

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ACOG
The American College of Obstetricians and Gynecologists

Vaccinating Pregnant Individuals:
Eight Key Recommendations for COVID-19 Vaccination Sites

The American College of Obstetricians and Gynecologists (ACOG) recommends that pregnant individuals be free to make their own decision regarding COVID-19 vaccination. While pregnant individuals are encouraged to discuss vaccination considerations with their clinical care team when feasible, documentation of such a discussion should not be required prior to receiving a COVID-19 vaccine. Further, pregnant individuals should not be denied COVID-19 vaccine(s) because of their pregnancy-status alone. COVID-19 vaccination sites should consider the recommendations below regarding vaccinating pregnant individuals.

1 COVID-19 vaccines should be available and administered to pregnant individuals who choose to be vaccinated.

2 While pregnant individuals are encouraged to discuss vaccination considerations with their clinical care team when feasible, documentation of such a discussion should not be required prior to receiving a COVID-19 vaccine.

3 Pregnancy testing should not be a requirement prior to receiving any EUA-approved COVID-19 vaccine.

4 Similar to their non-pregnant peers, pregnant individuals can receive a COVID-19 mRNA vaccine in any setting authorized to administer these vaccines. This includes any clinical setting and non-clinical community-based vaccination sites such as schools, community centers, and other mass vaccination locations.

5 Precautions should be discussed with any individual who reports a history of any immediate allergic reaction to any other vaccine or injectable therapy (i.e., intramuscular, intravenous, or subcutaneous vaccines or therapies not related to a component of mRNA COVID-19 vaccines or polysorbate).

6 If anaphylaxis is suspected in a pregnant individual after receiving a COVID-19 vaccination, anaphylaxis should be managed the same as in non-pregnant individuals (CDC).

7 Pregnant individuals who experience fever following vaccination should be counseled to take acetaminophen. Acetaminophen has been proven to be safe for use in pregnancy and does not appear to impact antibody response to COVID-19 vaccines.

8 Pregnant individuals who receive a COVID-19 vaccine should be educated about and encouraged to participate in CDC's V-SAFE program (see below for more information on CDC's V-SAFE program).

For more information, please visit ACOG's Practice Advisory on Vaccinating Pregnant and Lactating Patients Against COVID-19 and CDC's Clinical Considerations.

ACOG | Clinical

Vaccinating Pregnant and Lactating Patients Against COVID-19

Practice Advisory

December 2020

Last updated February 4, 2021

This Practice Advisory was developed by the American College of Obstetricians and Gynecologists' Immunization, Infectious Disease, and Public Health Preparedness Expert Work Group in collaboration with Laura E. Riley, MD; Richard Beigi, MD; Denise J. Jamieson, MD, MPH; Brenna L. Hughes, MD, MSc; Geeta Swamy, MD; Linda O'Neal Eckert, MD; Mark Turrentine, MD; and Sarah Carroll, MPH.

Summary of Key Information and Recommendations

COVID-19 vaccine development and regulatory approval are rapidly progressing. Thus, information and recommendations will evolve as more data are collected about these vaccines and their use in specific populations. This Practice Advisory is intended to be an overview of currently available COVID-19 vaccines and guidance for their use in pregnant and lactating patients.

- The U.S. Food and Drug Administration (FDA) issued an Emergency Use Authorization (EUA) for the following vaccines:
  - Pfizer-BioNtech mRNA vaccine (BNT162b2): for use in individuals age 16 years and older as a 2-dose regimen given 3 weeks (21 days) apart.
  - Moderna mRNA-1273 vaccine: for use in individuals age 18 and older as a 2-dose regimen given 1 month (28 days) apart.
- After an explicit, evidence-based review of all available data, the Advisory Committee on

- After an explicit, evidence-based review of all available data, the Advisory Committee on Immunization Practices (ACIP) issued interim recommendations for use of the Pfizer-BioNTech COVID-19 vaccine in persons aged ≥16 years for the prevention of COVID-19 (CDC 2020) and the use of the Moderna-1273 COVID-19 vaccine in persons aged ≥ 18 years (CDC 2020).
- ACOG recommends that COVID-19 vaccines should not be withheld from pregnant individuals who meet criteria for vaccination based on ACIP-recommended priority groups.
- COVID-19 vaccines should be offered to lactating individuals similar to non-lactating individuals when they meet criteria for receipt of the vaccine based on prioritization groups outlined by the ACIP.
- Individuals considering a COVID-19 vaccine should have access to available information about the safety and efficacy of the vaccine, including information about data that are not available. A conversation between the patient and their clinical team may assist with decisions regarding the use of vaccines approved under EUA for the prevention of COVID-19 by pregnant patients. Important considerations include:
  - the level of activity of the virus in the community
  - the potential efficacy of the vaccine
  - the risk and potential severity of maternal disease, including the effects of disease on the fetus and newborn
  - the safety of the vaccine for the pregnant patient and the fetus.
- While a conversation with a clinician may be helpful, it should not be required prior to vaccination, as this may cause unnecessary barriers to access.
- Vaccines currently available under EUA have not been tested in pregnant women. Therefore, there are no safety data specific to use in pregnancy. See details about the Food and Drug Administration's (FDA) EUA process below.
- Similar to their non-pregnant peers, vaccination of pregnant individuals with a COVID-19 mRNA vaccine may occur in any setting authorized to administer these vaccines. This includes any clinical setting and non-clinical community-based vaccination sites such as schools, community centers, and other mass vaccination locations.
- Pregnancy testing should not be a requirement prior to receiving any EUA-approved COVID-19 vaccine.
- Pregnant patients who decline vaccination should be supported in their decision. Regardless of

their decision to receive or not receive the vaccine, these conversations provide an opportunity to remind patients about the importance of other prevention measures such as hand washing, physical distancing, and wearing a mask.

- Expected side effects should be explained as part of counseling patients, including that they are a normal part of the body's reaction to the vaccine and developing antibodies to protect against COVID-19 illness.
- The mRNA vaccines are not live virus vaccines, nor do they use an adjuvant to enhance vaccine efficacy. These vaccines do not enter the nucleus and do not alter human DNA in vaccine recipients. As a result, mRNA vaccines cannot cause any genetic changes.

COVID-19 Infection Risk in Pregnancy

Available data suggest that symptomatic pregnant patients with COVID-19 are at increased risk of more severe illness compared with nonpregnant peers (Ellington MMWR 2020, Collin 2020, Delahoy MMWR 2020, Panagiotakopoulos MMWR 2020, Zambrano MMWR 2020). Although the absolute risk for severe COVID-19 is low, these data indicate an increased risk of ICU admission, need for mechanical ventilation and ventilatory support (ECMO), and death reported in pregnant women with symptomatic COVID-19 infection, when compared with symptomatic non-pregnant women (Zambrano MMWR 2020). Pregnant patients with comorbidities such as obesity and diabetes may be at an even higher risk of severe illness consistent with the general population with similar comorbidities (Ellington MMWR 2020, Panagiotakopoulos MMWR 2020, Knight 2020, Zambrano MMWR 2020). Given the growing evidence, CDC has included pregnancy as a factor that leads to increased risk for severe COVID-19 illness (CDC). Similar to the general population, Black and Hispanic individuals who are pregnant have disproportionately higher rates of COVID-19 infection and death (Ellington MMWR 2020, Moore MMWR 2020, Zambrano MMWR 2020). Further, risk (Zambrano MMWR 2020) of ICU admission was higher for pregnant Asian and Native Hawaiian/Pacific Islander individuals. These disparities are due to a range of social and structural factors including disparities in socioeconomic status, access to care, rates of chronic conditions, occupational exposure, systemic racism, and historic and continued inequities in the health care system.

COVID-19 Vaccines in Development

It is important to note that COVID-19 vaccine development and regulatory approval is a rapidly changing process, and information and recommendations will evolve as more data are collected about these vaccines and their use in specific populations.

Advisory Committee on Immunization Practices Recommendations

The Advisory Committee on Immunization Practices (ACIP) develops recommendations on how to use vaccines to control disease in the United States. The Committee's recommendations are sent to CDC's Director for approval. Once the ACIP recommendations have been reviewed and approved by the CDC Director and the U.S. Department of Health and Human Services, they are published in CDC's Morbidity and Mortality Weekly Report (MMWR). The MMWR publication represents the final and official CDC recommendations for immunization of the U.S. population (ACIP).

ACOG has representation on the ACIP, including on the ACIP COVID-19 working groups. ACIP has made the following recommendations for prioritization of COVID-19 vaccine allocation:

Phase 1a: Health care workers and long-term care facility residents (CDC 2020)
Phase 1b: Persons aged ≥75 years and frontline essential workers (CDC 2020)
Phase 1c: Persons aged 65-75 years, persons aged 16-64 years with high-risk* medical conditions (including pregnancy), and other essential workers (CDC 2020)

*High-risk medical conditions outlined by the CDC include:

- Pregnancy
- Cancer
- Chronic kidney disease
- COPD (chronic obstructive pulmonary disease)
- Down Syndrome
- Heart conditions, such as heart failure, coronary artery disease, or cardiomyopathies
- Immunocompromised state (weakened immune system) from solid organ transplant
- Obesity (body mass index [BMI] of 30 kg/m2 or higher but < 40 kg/m2)
- Severe Obesity (BMI ≥ 40 kg/m2)
- Sickle cell disease
- Smoking (current or history)
- Type 2 diabetes mellitus

As the availability of vaccine becomes more robust, ACIP will expand these recommendations to include

additional priority populations. Within national guidelines, state and local jurisdictions should have flexibility to administer vaccine based on local epidemiology and demand (ACIP Slides 2020).

After an explicit, evidence-based review of all available data, the Advisory Committee on Immunization Practices (ACIP) issued interim recommendations for use of the Pfizer-BioNTech COVID-19 vaccine in persons aged ≥16 years for the prevention of COVID-19 (CDC 2020) and the use of the Moderna-1273 COVID-19 vaccine in persons aged ≥ 18 years (CDC 2020). Information for pregnant and lactating individuals has been posted on CDC's website under Clinical Considerations. Within these clinical considerations, CDC outlines that a pregnant individual who is part of a group (e.g., healthcare personnel) recommended to receive a COVID-19 vaccine may choose to be vaccinated. A discussion with their healthcare professional can help the patient make an informed decision. Further, CDC states that lactating individuals who are part of a group (e.g., healthcare personnel) recommended to receive a COVID-19 vaccine may choose to be vaccinated.

U.S. FDA Emergency Use Authorization and Approval

The U.S. Food and Drug Administration (FDA) has issued an Emergency Use Authorization (EUA) for the following vaccines:

- **Pfizer-BioNtech mRNA vaccine (BNT162b2)**: for use in individuals age 16 years and older as a 2-dose regimen given 3 weeks (21 days) apart
- **Moderna mRNA-1273 vaccine**: for use in individuals age 18 and older as a 2-dose regimen given 1 month (28 days) apart.

These vaccines have been shown to be about 95% effective at preventing COVID-19 illness after the second dose.

According to the EUA Fact Sheet for Health Care Professionals for both Pfizer-BioNtech and Moderna vaccines available data on COVID-19 vaccine administered to pregnant women are insufficient to inform vaccine-associated risks in pregnancy. The EUA Fact Sheet for Recipients and Caregivers both Pfizer-BioNtech and Moderna vaccines states "If you are pregnant or breastfeeding, discuss your options with your healthcare provider".

The EUA authority allows the FDA to strengthen the nation's public health protections against chemical, biological, radiological, and nuclear (CBRN) threats by facilitating the availability and use of medical countermeasures needed during public health emergencies.

Under section 564 of the Federal Food, Drug, and Cosmetic Act (FD&C Act), the FDA Commissioner may allow unapproved medical products or unapproved uses of approved medical products to be used in an emergency to diagnose, treat, or prevent serious or life-threatening diseases or conditions caused by CBRN threat agents when there are no adequate, approved, and available alternatives (FDA 2017).

Data on the safety and effectiveness of the vaccine(s) continues to be collected during the EUA period. (FDA 2017).

Vaccine Information and Recommendations

At the time of this publication, two vaccines developed for the prevention of COVID-19 have received EUA from the FDA. However, COVID-19 vaccines are rapidly emerging and additional EUAs are likely to materialize. ACOG will strive to update this guidance as quickly as possible while maintaining accurate, evidence-based information.

mRNA COVID-19 Vaccines

The development and use of mRNA vaccines is relatively new. These vaccines consist of messenger RNA (mRNA) encapsulated by a lipid nanoparticle (LNP) for delivery into the host cells. These vaccines utilize the body's own cells to generate the coronavirus spike protein (the relevant antigens), which, similar to all other vaccines, stimulates immune cells to create antibodies against COVID-19. The mRNA vaccines are not live virus vaccines, nor do they use an adjuvant to enhance vaccine efficacy. These vaccines do not enter the nucleus and do not alter human DNA in vaccine recipients. As a result, mRNA vaccines cannot cause any genetic changes (CDC, Zhang 2019, Schlake 2012). Based on the mechanism of action of these vaccines and the demonstrated safety and efficacy in Phase II and Phase III clinical trials, it is expected that the safety and efficacy profile of the vaccine for pregnant individuals would be similar to that observed in non-pregnant individuals. That said, there are no safety data specific to mRNA vaccine use in pregnant or lactating individuals and the potential risks to a pregnant individual and the fetus are unknown.

Side Effects

Expected side effects should be explained as part of counseling patients, including that they are a normal part of the body's reaction to the vaccine and developing antibodies to protect against COVID-19 illness. Most study participants for both the Pfizer-BioNtech and Moderna vaccines experienced mild side effects similar to influenza-like illness symptoms following vaccination (see table below). In the Pfizer-BioNtech study subgroup of persons age 18-55 years fever greater than 38°C occurred in 3.7% after the first dose and 15.8% after the second dose (FDA 2020). In the Moderna vaccine trials, fever greater than 38°C was reported in 0.8% of vaccine recipients after the first dose, and 15.6% of vaccine recipients after the second dose (FDA 2020). Most of these symptoms resolved by day 3 after vaccination for both vaccines. Patients should be counseled about more severe side effects and when to seek medical care. For more information and details on side effects, see Local Reactions, Systemic Reactions, Adverse Events, and Serious Adverse Events: Pfizer-BioNTech COVID-19 Vaccine from the CDC.

Table 1. Mild Side Effects Among All Study Participants*

	Moderna
	91.6%
	68.5%
	43.4%
	59.6%
	44.8%
	63%

	Pfizer-BioNTech
	84.10%
	62.90%
	31.90%
	38.30%
	23.60%
	55.10%

**Fever was the least common side effect reported; see text above for data on frequency of fever*

Allergic Reactions Including Anaphylaxis

Allergic reactions including anaphylaxis have been reported to be rare following COVID-19 vaccination in non-pregnant individuals. For the Pfizer-BioNtech vaccine, through January 18, 2021, nearly 10 million doses were administered and monitoring by the Vaccine Adverse Event Reporting System detected 50 cases (5 cases per million doses administered) of anaphylaxis following vaccination (ACIP Slides). For the Moderna vaccine, through January 18, 2021, over 7.5 million doses were administered, and monitoring by the Vaccine Adverse Event Reporting System detected 21 cases (2.8 cases per million doses administered) of anaphylaxis following vaccination (ACIP Slides).

If anaphylaxis is suspected in a pregnant individual after receiving a COVID-19 vaccination, anaphylaxis should be managed the same as non-pregnant individuals (eg, rapidly assess airway, breathing, circulation, and mental activity; call for emergency medical services; place the patient in a supine position, and administration of epinephrine) (CDC). Similar to non-pregnant individuals, anaphylaxis may recur after the individual begins to recover, and monitoring in a medical facility for at least several hours is advised, even after complete resolution of symptoms and signs.

For more information on the management of anaphylaxis after COVID-19 vaccination, see CDC's website.

Available Safety Information Related to the use of COVID-19 Vaccines in Pregnancy

Despite ACOG's persistent advocacy for the inclusion of pregnant individuals in COVID-19 vaccine trials, none of the COVID-19 vaccines approved under EUA have been tested in pregnant individuals. However, studies in pregnant women are planned.

Data from Developmental and Reproductive Toxicity (DART) studies for the Pfizer-BioNtech COVID-19 vaccine have been reported in Europe. According to the report presented to the European Medicines Agency, animal studies using the Pfizer/BioNtech COVID-19 vaccine do not indicate direct or indirect harmful effects with respect to pregnancy, embryo/fetal development, parturition or post-natal development (EMA).

A combined developmental and perinatal/postnatal reproductive toxicity (DART) study of Moderna's mRNA-1273 in rats was submitted to FDA on December 4, 2020. FDA review of this study concluded that mRNA1273 given prior to mating and during gestation periods at dose of 100 µg did not have any adverse effects on female reproduction, fetal/embryonal development, or postnatal developmental except for skeletal variations which are common and typically resolve postnatally without intervention (FDA).

These DART studies provide the first safety data to help inform the use of the vaccine in pregnancy until there are more data in this population.

Among participants of Phase II/III COVID-19 vaccine clinical studies in non-pregnant adults, a few inadvertent pregnancies that have occurred are being followed to collect safety outcomes.

As of January 20, 2021, there have been over 15,000 pregnancies reported in CDC's V-SAFE post-vaccination health checker and CDC is currently enrolling pregnant individuals in a pregnancy registry. Evidence gathered through these systems will provide clinicians with critically needed data to inform future recommendations related to COVID-19 vaccination during pregnancy (ACIP slides).

ACOG Recommendations

Pregnant Individuals

ACOG recommends that COVID-19 vaccines should not be withheld from pregnant individuals who meet criteria for vaccination based on ACIP-recommended priority groups. While safety data on the use of COVID-19 vaccines in pregnancy are not currently available, there are also no data to indicate that the vaccines should be contraindicated, and no safety signals were generated from DART studies for the Pfizer-BioNtech and Moderna COVID-19 vaccines. Therefore, in the interest of patient autonomy, ACOG recommends that pregnant individuals be free to make their own decision regarding COVID-19 vaccination. While pregnant individuals are encouraged to discuss vaccination considerations with their clinical care team when feasible, documentation of such a discussion should not be required prior to receiving a COVID-19 vaccine.

Individuals considering a COVID-19 vaccine should have access to available information about the safety and efficacy of the vaccine, including information about data that are not available. A conversation between the patient and their clinical team may assist with decisions regarding the use of vaccines approved under EUA for the prevention of COVID-19 by pregnant patients. Important considerations include the level of activity of the pandemic in the community, the potential efficacy of the vaccine, the potential risk and severity of maternal disease, including the effects of disease on the fetus and newborn, and the safety of the vaccine for the pregnant patient and the fetus. While a conversation with a clinician may be helpful, it should not be required prior to vaccination as this may cause unnecessary barriers to access.

Clinicians should review the available data on risks and benefits of vaccination with pregnant patients, including the risks of not getting vaccinated in the context of the individual patient's current health status, and risk of exposure, including the possibility for exposure at work or home and the possibility for

exposing high-risk household members. Conversations about risk should take into account the individual patient's values and perceived risk of various outcomes and should respect and support autonomous decision-making (ACOG 2013).

Vaccination Considerations

- Similar to their non-pregnant peers, vaccination of pregnant individuals with a COVID-19 mRNA vaccine may occur in any setting authorized to administer these vaccines. This includes any clinical setting and non-clinical community-based vaccination sites such as schools, community centers, and other mass vaccination locations. Precautions should be discussed with any individual who reports a history of any immediate allergic reaction to any other vaccine or injectable therapy (i.e., intramuscular, intravenous, or subcutaneous vaccines or therapies not related to a component of mRNA COVID-19 vaccines or polysorbate) (CDC). Locations administering COVID-19 vaccines should adhere to CDC guidance for use of COVID-19 vaccines, including screening recipients for contraindications and precautions, having the necessary supplies available to manage anaphylaxis, implementing the recommended postvaccination observation periods, and immediately treating suspected cases of anaphylaxis with intramuscular injection of epinephrine (CDC)
- Pregnant women who experience fever following vaccination should be counseled to take acetaminophen. Acetaminophen has been proven to be safe for use in pregnancy and does not appear to impact antibody response to COVID-19 vaccines.
- There is currently no preference for the use of one COVID-19 vaccine over another except for 16-17 year olds who are only eligible for the Pfizer-BioNtech vaccine.
- Individuals should complete their 2-dose series with the same vaccine product.
- COVID-19 vaccines should not be administered within 14 days of receipt of another vaccine. For pregnant individuals, vaccines including Tdap and influenza should be deferred for 14 days after the administration of COVID-19 vaccines.
- Anti-D immunoglobulin (i.e. Rhogam) should not be withheld from an individual who is planning or has recently received a COVID-19 vaccine as it will not interfere with the immune response to the vaccine.

Pregnant patients who decline vaccination should be supported in their decision. Regardless of their decision to receive or not receive the vaccine, these conversations provide an opportunity to remind patients about the importance of other prevention measures such as hand washing, physical distancing, and wearing a mask.

Pregnant individuals who receive a COVID-19 vaccine should be educated about and encouraged to participate in CDC's V-SAFE program (see below for more information on CDC's V-SAFE program).

Lactating Individuals

ACOG recommends COVID-19 vaccines be offered to lactating individuals similar to non-lactating individuals when they meet criteria for receipt of the vaccine based on prioritization groups outlined by the ACIP. While lactating individuals were not included in most clinical trials, COVID-19 vaccines should not be withheld from lactating individuals who otherwise meet criteria for vaccination. Theoretical concerns regarding the safety of vaccinating lactating individuals do not outweigh the potential benefits of receiving the vaccine. There is no need to avoid initiation or discontinue breastfeeding in patients who receive a COVID-19 vaccine (ABM 2020).

Individuals Contemplating Pregnancy

Vaccination is strongly encouraged for non-pregnant individuals within the ACIP prioritization group(s). Further, ACOG recommends vaccination of individuals who are actively trying to become pregnant or are contemplating pregnancy and meet the criteria for vaccination based on ACIP prioritization recommendations. Additionally, it is not necessary to delay pregnancy after completing both doses of the COVID-19 vaccine.

Given the mechanism of action and the safety profile of the vaccine in non-pregnant individuals, COVID-19 mRNA vaccines are not thought to cause an increased risk of infertility.

If an individual becomes pregnant after the first dose of the COVID-19 vaccine series, the second dose should be administered as indicated. If an individual receives a COVID-19 vaccine and becomes pregnant within 30 days of receipt of the vaccine, participation in CDC's V-SAFE program should be encouraged (see below for more information on CDC's V-SAFE program).

Importantly, routine pregnancy testing is not recommended prior to receiving any EUA-approved COVID-19 vaccine.

Health Equity Considerations and Communities of Color

Communities of color have been disproportionately affected by the COVID-19 pandemic. Individuals in communities of color are more likely to have severe illness and even die from COVID-19 likely due to a range of social and structural factors including disparities in socioeconomic status, access to care, rates of chronic conditions, and occupational exposure, systemic racism, and historic and continued inequities in the health care system. Access to and confidence in COVID-19 vaccines is of critical importance for all communities, but willingness to consider vaccination varies by patient context, in part due to historic and continued injustices and systemic racism that has eroded trust in some communities of color. According to a recent Kaiser Family Foundation survey, only 50% of Black Americans compared with 65% of White Americans, would definitely or probably get vaccinated against COVID-19 even if the vaccine was free and determined safe by scientists, many citing distrust as a concern (Hamel 2020). When discussing COVID-19 vaccines with an individual who expresses concerns, it is critical to:

- Be aware of historical and current injustices perpetuated on communities of color
- Actively listen to and validate expressed fears and concerns
- Continue to support patients who decide not to be vaccinated, share resources, and encourage the continued use of prevention measures

If the patient is amenable to further discussion:

- Inform about the testing process, existing safety data and continued monitoring of safety and efficacy data on COVID-19 vaccines; there have not been shortcuts with the testing of this vaccine
- Discuss the increased incidence of infection and severe illness from COVID-19 in communities of color
- Note that individuals from communities of color were included in clinical trials (9.8% of Pfizer-BioNtech overall Phase II/III participants were Black and 26.2% were Hispanic/Latinx; 9.7% of Moderna overall Phase II/III participants were Black and 20% were Hispanic/Latinx) and the vaccine was equally effective among different demographics, including race and ethnicity.

Additional Health Equity Resources

- Centers for Disease Control and Prevention. Health Equity Considerations and Racial and Ethnic Minority Groups. Available at: https://www.cdc.gov/coronavirus/2019-ncov/community/health-equity/race-ethnicity.html. Retrieved December 13, 2020.

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Vaccine Confidence

Vaccine hesitancy, particularly around COVID-19 vaccines, exists among all populations. When communicating with patients it is extremely important to underscore the general safety of vaccines and emphasize the fact that no steps were skipped in the development and evaluation of COVID-19 vaccines. This can be done by briefly highlighting the safety requirements of vaccines, and ongoing safety monitoring even after vaccines are made available. The following are some messages to consider using when discussing COVID-19 vaccines with patients:

Vaccines are one of the greatest public health achievements of the 20th century. Before the widespread use of vaccines, people routinely died from infectious diseases, several of which have since been eradicated thanks to robust immunization programs.

- Several vaccines have safely been given to pregnant and lactating individuals for decades.
- The rigor of COVID-19 vaccine clinical trials with regards to monitoring safety and efficacy meet the same high standards and requirements as with a typical vaccine approval process

the same high standards and requirements as with a typical vaccine approval process.

- While there has been a worldwide attempt to develop COVID-19 vaccines rapidly, this does not mean that any safety standards have been relaxed. In fact, there are additional safety monitoring systems to track and monitor these vaccines, including real-time assessment.
- Side effects such as influenza-like-illness can be expected with these vaccines, however this is a normal reaction as the body develops antibodies to protect itself against COVID-19. COVID-19 vaccines cannot cause COVID-19 infection. It is important not to be dissuaded by these side effects, because in order to get the maximum protection against COVID-19, patients need two doses of the vaccine.
- Safety monitoring continues well beyond the EUA administration.
  - CDC's V-SAFE: A new active surveillance smartphone-based after-vaccination health checker for people who receive COVID-19 vaccines. V-SAFE will use text messaging and web surveys from CDC to check in with vaccine recipients for health problems following COVID-19 vaccination. Information on pregnancy status at the time of vaccination and at subsequent follow up time points will also be collected. The system will provide telephone follow up to anyone who reports medically significant (important) adverse events or exposure to COVID-19 vaccines during pregnancy or periconception period. As of January 20, 2021, there have been over 15,000 pregnancies reported in CDC's V-SAFE after-vaccination health checker.
  - Vaccine Adverse Event Reporting System (VAERS): A national early warning system to detect possible safety problems in U.S.-licensed vaccines. VAERS is co-managed by the CDC and the FDA. Healthcare professionals are encouraged to report any clinically significant adverse events following vaccination to VAERS, even if they are not sure if vaccination caused the event. In addition, we are anticipating that the following adverse events will be required to be reported to VAERS for COVID-19 vaccines administered under an Emergency Use Authorization (EUA):
    - Vaccine administration errors (whether associated with an adverse event or not)
    - Serious adverse events (irrespective of attribution to vaccination) (such as death, life-threatening adverse event, inpatient hospitalization)
    - Multisystem inflammatory syndrome (MIS) in children [if vaccine is authorized in children] or adults
    - Cases of COVID-19 that result in hospitalization or death
  - CDC's National Healthcare Safety Network (NHSN): An acute care and long-term care facility

monitoring system with reporting to the Vaccine Adverse Event Reporting System or VAERS

- Vaccines and Medications in Pregnancy Surveillance System (VAMPSS): A national surveillance system designed to monitor the use and safety of vaccines and asthma medications during pregnancy
- FDA is working with large insurer/payer databases on a system of administrative and claims-based data for surveillance and research
- Additional safety monitoring information can be found here: https://www.cdc.gov/coronavirus/2019-ncov/vaccines/safety.html

Additional Resources

- CDC Vaccination Considerations for People who are Pregnant or Breastfeeding https://www.cdc.gov/coronavirus/2019-ncov/vaccines/recommendations/pregnancy.html
- Baystate Health & University of Massachusetts Medical School COVID-19 Vaccine Decision Tool https://foamcast.org/covidvacpregnancy/?fbclid=IwAR35gMR8Tdx-qEC2CBGAfNYiTMeRhw7W-x0eGjABEh8eqODTujv49bkuzwE
- Frequently Asked Questions about COVID-19 Vaccination https://www.cdc.gov/coronavirus/2019-ncov/vaccines/faq.html
- CDC's Talking to Recipients about COVID-19 Vaccines https://www.cdc.gov/vaccines/covid-19/hcp/index.html
- CDC's Interim Considerations: Preparing for the Potential Management of Anaphylaxis at COVID-19 Vaccination Sites https://www.cdc.gov/vaccines/covid-19/info-by-product/pfizer/anaphylaxis-management.html

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Estimation of US Children's Educational Attainment and Years of Life Lost Associated With Primary School Closures During the Coronavirus Disease 2019 Pandemic

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Abstract

IMPORTANCE United States primary school closures during the 2020 coronavirus disease 2019 (COVID-19) pandemic affected millions of children, with little understanding of the potential health outcomes associated with educational disruption.

OBJECTIVE To estimate the potential years of life lost (YLL) associated with the COVID-19 pandemic conditioned on primary schools being closed or remaining open.

DESIGN, SETTING, AND PARTICIPANTS This decision analytical model estimated the association between school closures and reduced educational attainment and the association between reduced educational attainment and life expectancy using publicly available data sources, including data for 2020 from the US Centers for Disease Control and Prevention, the US Social Security Administration, and the US Census Bureau. Published peer-reviewed studies (2 US studies, 5 European studies) were identified that provided estimates of the relative risk (RR) of annual mortality related to educational attainment, which were weighted and applied to the most recent life table data to obtain YLL estimates across the life course. Direct COVID-19 mortality and potential increases in mortality that might have resulted if school opening led to increased transmission of COVID-19 were also estimated.

MAIN OUTCOMES AND MEASURES Years of life lost.

RESULTS A total of 24.2 million children aged 5 to 11 years attended public schools that were closed during the 2020 pandemic, losing a median of 54 (interquartile range, 48-62.5) days of instruction. Missed instruction was associated with a mean loss of 0.15 (95% credible interval [CI], 0.08-0.22) years of final educational attainment for boys and 0.12 (95% CI, 0.06-0.19) years for girls. Summed across the population, based on the RR from US studies, an estimated 13.8 million (95% CI, 2.5-42.1) YLL may be associated with school closures. Summed across the population, based on the RR from the European studies, an estimated 0.8 million (95% CI, 0.1 -2.4) YLL may be associated with school closures. The Centers for Disease Control and Prevention reported a total of 88 241 US deaths from COVID-19 through the end of May 2020, with an estimated 1.50 million (95% CI, 1.23-1.85 million) YLL as a result. Had schools remained open, an estimated 4.4 million (95% CI 2.29-6.41,) YLL could have been expected as a result, based on results of studies associating school closure with decreased pandemic spread. Comparing the full distributions of estimated YLL under both "schools open" and "schools closed" conditions, based on the US studies and the European studies, the analysis observed a 98.9% probability and a 26.3% probability, respectively, that school opening would have been associated with a lower total YLL than school closure.

CONCLUSIONS AND RELEVANCE In this decision analytical model of years of life potentially lost under differing conditions of school closure, based on the US studies, the analysis favored schools remaining open. Future decisions regarding school closures during the pandemic should consider the

(continued)

Key Points

Question Based on the current understanding of the associations between school disruption and decreased educational attainment and between decreased educational attainment and lower life expectancy, is it possible to estimate the association between school closure during the coronavirus disease 2019 pandemic and decreased life expectancy of publicly educated primary school-aged children in the United States?

Findings This decision analytical model found that missed instruction during 2020 could be associated with an estimated 13.8 (95% CI 2.5-42.1) million years of life lost based on data from US studies and an estimated 0.8 (95% CI 0.1-2.4) million years of life lost based on data from European studies. This estimated loss in life expectancy was likely to be greater than would have been observed if leaving primary schools open had led to an expansion of the first wave of the pandemic.

Meaning These findings suggest that the decision to close US public primary schools in the early months of 2020 may be associated with a decrease in life expectancy for US children.

+ Supplemental content

Author affiliations and article information are listed at the end of this article.

Abstract (continued)

association between educational disruption and decreased expected lifespan and give greater weight to the potential outcomes of school closure on children's health.

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Introduction

In early 2020, school closures were widely instituted across the United States as a coronavirus disease 2019 (COVID-19) containment strategy. The rationale for closures was 2-fold. First, at least initially, the risks that the virus posed to children were unclear but worthy of precaution. Second, it was assumed that children might represent important vectors for disease spread even if they were themselves unaffected or asymptomatic. Both of these considerations appeared to justify the harm of missed education in order to minimize the population-level risk of disease. In the ensuing months, data have emerged indicating that COVID-19 infection poses significantly less direct risk to children to adults.[1,2] While the scientific evidence on transmission of SARS-CoV-2 by children remains in flux, recent studies indicate that young children (<10 years) appear less likely to serve as vectors for COVID-19 transmission.[3,4] Although the risks of keeping schools open drove decisions made in the early phases of the pandemic, the probable harm to children associated with school closure were less explicitly discussed.[5] The public debate has pitted "school closures" against "lives saved," or the education of children against the health of the community. Presenting the tradeoffs in this way obscures the very real health consequences of interrupted education.

These consequences are especially dire for young children. There is little reason to believe that virtual learning environments can be effective for primary school–aged children. A meta-analysis[6] of 99 experimental studies included only 5 conducted in school-aged children, and they were primarily in fifth through eighth grade. The meta-analysis concluded that "the mean effect size [for online learning] is not significant for the seven contrasts involving K-12 students."[6(pXV)] That so few studies have even been conducted in this age group is also telling. A recent study comparing Indiana children in grades 3 through 8 who switched from brick-and-mortar to virtual schooling "experienced large, negative effects in math and [English/language arts] that were sustained across time".[7(p170)] Sal Khan, a widely respected innovator in the field of distance learning, reported that distance learning approaches do not work for younger students.[8] Furthermore, it is not clear how much access to remote instruction primary school–aged children actually received during the spring of 2020. For example, in its March 2020 guidelines for districts, the Illinois Department of Education recommended that primary school children have a maximum of 60 to 120 minutes per day in remote learning, representing a fraction of a regular school day.[9] In 2 national surveys, teachers of all grades reported that only 60% of their students were regularly engaging in distance learning at all, and only 27% of teachers took attendance.[10-12] Accordingly, it is reasonable to infer that primary school–aged children received minimal meaningful instruction beyond what is being delivered by their parents or other caregivers at home.[13] It is not surprising, then, that the National Academies of Science, Engineering, and Medicine's report on school openings[13] concluded that districts should make returning primary school children to in-person classes a priority.

Evidence suggests that missing school has adverse effects on eventual educational attainment. A longitudinal study of teacher strikes in Argentina revealed that disrupted schooling lowered graduation rates, total educational attainment, and subsequent income.[14] An educational reform in Belgium differentially affected Flemish-speaking and French-speaking parts of the country and resulted in strikes of approximately 60 days in the French-speaking part of the country against none in the Flemish-speaking part. Using this natural experiment in a difference-in-difference framework, economists estimated the long-term effects of these strikes on educational attainment to be a 5.8% reduction in total years of educational attainment, a somewhat larger effect than that identified in

Argentina.[15] Studies of prolonged strike in the United States and Canada are lacking, but even short-term strikes were found to result in diminished test scores.[16,17] One US report[18] found that the single best predictor of high-school graduation was fourth-grade reading test scores: 23% of children who are not reading at grade level by the end of third grade will not graduate high school, compared with 9% of those who are. The risks are even greater for low-income Black or Hispanic students: 33% of those not reading at grade level will not graduate from high school. These educational impairments are in turn consequential for mortality: the quality and quantity of education received today have considerable effects on life expectancy.[19-22]

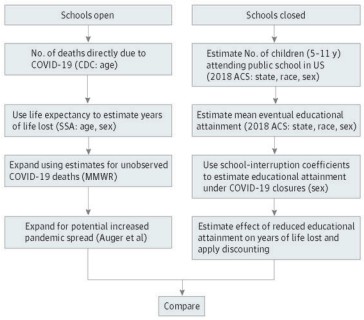
The American Academy of Pediatrics' policy statement on school reopening suggested that science drive decision-making.[23] Doing so requires a better-informed estimate of the tradeoffs being considered. The primary objective of this study was to model the expected years of life lost (YLL) in association with primary school closures in early 2020 and to compare them to potential YLL had schools remained open.

Methods

This decision analytical model consisted of an analysis of publicly available data and an estimate of the relative risk (RR) of annual mortality, derived from the existing literature. Our analysis and report follows the Consolidated Health Economic Evaluation Reporting Standards (CHEERS) reporting guideline.[24] As an analysis of publicly available data, our institutions considered this work exempt from institutional review board review.

Our goal was to compare the number of expected YLL due to COVID-19 in the United States under 2 different scenarios (**Figure 1**). Scenario 1, observed from January 1 to May 30, 2020, consisted of the closing of primary schools during the early phase of the COVID-19 pandemic in the United States, resulting in expected YLL from 2 primary pools: premature deaths from COVID-19 and shortened life expectancy due to decreased educational attainment among children. Scenario 2 was unobserved and was based on a counterfactual decision to allow primary schools to remain open, with a potentially increased number of deaths and years of life directly lost due to COVID-19 if school opening led to increased pandemic spread.

Figure 1. Analysis Overview



ACS indicates US Census Bureau American Community Survey; CDC, US Centers for Disease Control and Prevention; COVID-19, coronavirus disease 2019; MMWR, *Morbidity and Mortality Weekly Report*; and SSA, US Social Security Administration.

Statistical Analysis

Scenario 1 Estimation

To estimate the YLL due to COVID-19 under conditions of school closure, we required an estimate of direct mortality from COVID-19 during the early phase of the pandemic (see Scenario 2 Estimation) and an estimate of the YLL associated with primary school closure. This latter estimate was constructed in 2 stages: we first estimated the association between school closures and educational attainment, and then we estimated the association between reduced educational attainment and mortality risk. For stage 1, we used the results of a carefully constructed econometric analysis of quasi-random school closures due to teachers' strikes in Argentina. These results—which use within-province differences in strike exposure across birth cohorts and within-cohort differences in strike exposure across provinces as sources of exogenous variation—provide a reasonable estimate of the association between missed education during primary school and total years of educational attainment.[14] This analysis suggests that 10 days of missed school is associated with a reduction in final educational attainment of 0.0262 (SE, 0.0064) years for boys and 0.0217 years (SE, 0.0062) years for girls.

To apply this analysis to the US, we used the 2018 1-year estimates from the US Census Bureau American Community Survey (ACS) and counted all children between the ages of 5 and 11 (inclusive) who were enrolled in public school. Because life expectancy varies by race/ethnicity, we categorized children as White, Black, Hispanic, or Other. Children in the Other category were assigned the average life expectancy (nonconditioned on race/ethnicity), whereas other races/ethnicities were assigned specific life expectancies based on life tables for these groups available from the US Centers for Disease Control and Prevention (CDC).[25] State-specific missed days of education were estimated by reviewing published school closure orders and school calendars from school districts in the capital of each state and counting weekdays only. We assumed that final educational attainment reported by respondents aged 25 to 29 years in the 2018 ACS (again stratified by sex, race/ethnicity, and state) would be representative of eventual attainment of children attending primary school in 2020.

Prior research in economics has estimated the association between decreased educational attainment and life expectancy using a variety of causal inference techniques.[21,22,26-30] Using the method described in the eAppendix in the Supplement, we attempted to estimate a weighted average effect of these estimates. However, with this analytic approach of the 7 studies that provided data (2 US studies, 5 non-US studies), a single estimate could not be derived because of high heterogeneity of settings, methods, and data (eAppendix in the Supplement). Therefore, we used 2 estimates in our model, the weighted RR of annual mortality from the 2 US studies[21,22] (RR, 0.541; 95% CI, 0.166-0.916) and from the 5 non-US (all European) studies[26-30] (RR, 0.976; 95% CI, 0.910-1.042). It should be noted that although the RRs between the US studies and the European studies were different, the estimates from different studies within the US and within Europe were similar. These RRs were then applied to the most recent life table published by the CDC[25] to obtain YLL estimates across the life course. Uncertainty estimates were generated by a Monte Carlo simulation, treating the associations between school closure and education and between education and life expectancy as truncated normal and normally distributed variables, respectively.

In cost-benefit analyses, it is customary to apply a discount factor to costs and benefits that occur in the future so that they can reasonably be compared to current values. Although discounting of future costs is reasonable, how and even whether to discount future health benefits is controversial, with no clear consensus in the literature.[24-27] Yet because the association of missed education with YLL of today's children occurs so far in the future, discounting is consequential to the analysis. We therefore summarized the YLL associated with decreased educational attainment under 3 different annual discounting scenarios: no discount, 0.5%, and 3%, with the understanding that the choice of the appropriate discount rate represents a value judgment (see Discussion).[31-34] The simulation results are reported for the nation as a whole in terms of total estimated YLL.

Scenario 2 Estimation

Estimation of YLL under unobserved conditions (ie, US primary schools being left open with a potential for increased spread of COVID-19) necessarily required explicit modeling of a range of potential scenarios. In order to model parameter uncertainty, we again performed a Monte Carlo simulation, this time using a Program Evaluation Research Task (PERT) distribution.[35] The PERT distribution is a modification of the beta distribution with 2 favorable characteristics for this type of analysis. First, it allows for explicit specification of the minimum, maximum, and most likely (modal) values of the parameter. Second, it assigns greater probability weight to the modal value (approximately 4-fold greater) while still incorporating the minimum and maximum values into the resultant distribution. Like all beta distributions, it is positive-bounded.

As a separate calculation, we used CDC data on patient ages and numbers of COVID-19 deaths observed in early 2020 as the source of our mortality estimates and merged these data with sex-specific actuarial life tables published by the US Social Security Administration to estimate the lost years of life expectancy incurred by deaths in each age group, assuming that deaths occurred in the middle of the 10-year span and that 85 was the maximum age of death.[25] There is broad acceptance that CDC mortality estimates for COVID-19 are an underestimate; we corrected for this bias by modeling a multiplicative ratio of YLL using a PERT distribution. We defined the minimum ratio as 1 (excess deaths being unlikely to be negative), used CDC estimates of excess mortality observed in New York state in early 2020 to define a modal ratio of 1.22, and doubled the modal estimate as our maximum.[36] This method provided a distributional estimate of US YLL directly related to COVID-19 observed in 2020.

The next question we considered was how many deaths might have occurred (and how many YLL would have resulted) had primary schools remained open. Again, substantial uncertainty exists regarding the degree to which school closures affect the spread of COVID-19, with some authors[4] suggesting that young children contribute very little to the spread of SARS-CoV-2 and others suggesting that school closures might play a substantial role in the pandemic's spread.[37] Auger and colleagues[37] recently published an estimate that school closures may have prevented 40 600 US deaths during the early phase of the pandemic, with a mortality rate of 19.4 deaths per 100 000 population under school opening and 6.8 per 100 000 under school closure. In contrast, Courtemanche and colleagues[38] estimated a nonsignificant daily decrease in mortality associated with school opening. Using a PERT distribution, we used the Auger mortality ratio (2.85) as our maximum estimate. Given the belief on the part of some investigators that young children do not measurably influence disease spread, we used a mortality ratio of 1 as our minimum estimate. To define a plausible modal estimate, we used the average of the Auger and Courtemanche mortality ratios, using a baseline schools-closed mortality rate in the Courtemanche estimate (which was not provided) equal to that in Auger. This yielded a modal mortality ratio of 1.93.

We summarized our data with 95% credible intervals (95% CIs) drawn from our Monte Carlo estimates, constructed distributional summary plots, and finally estimated the probability that YLL associated with COVID-19 in 2020 were greater under primary school closure than had schools remained open by enumerating the proportion of Monte Carlo draws where this event was observed. All statistical analyses and graphs were constructed using R, version 3.6.2 (R Foundation).

Results

Using the 2018 ACS, we estimated that approximately 24.2 million children aged 5 to 11 years attended public schools that were closed during the 2020 pandemic (11.4 million White, 4.3 million Hispanic, 3.6 million Black, and 4.9 million Other). Across all US states, we estimated that public schools were closed for a median 54.0 days as a result of COVID-19 (IQR, 48-62.5 days). The mean (SD) final years of educational attainment reported by 25- to 29-year-old respondents in the 2018 ACS was 13.7 (2.1).

We estimated that primary school–aged boys could lose, approximately 0.15 (95% credible interval, 0.08-0.22) final years of education as a result of school closure (whereas girls could lose 0.12 (95% CI, 0.05-0.19) years. Based on the 2 US studies of the education-related RR of mortality, these losses in education were associated with a mean loss of life of 0.67 (95% CI, 0.12-2.09) years for boys and 0.45 (95% CI, 0.08-1.52) years for girls. Undiscounted, these estimated losses in life related to missed education summed to a median estimate of 13.8 (95% CI, 2.5-42.1) million YLL. Under conditions of 0.5% annual discounting, YLL were estimated at 10.9 (95% CI, 2.0-33.5) million. Under 3% annual discounting, YLL were estimated at 3.8 (95% CI, 0.7-11.9) million. Based on the 5 European studies of the education-related RR of mortality, losses in education related to school closures were associated with a mean loss of life of 0.38 (95% CI, 0.00-0.12) years for boys and 0.03 (95% CI, 0.00-0.09) years for girls. Undiscounted, these estimated losses in life due to missed education summed to a median estimate of 0.8 (95% CI, 0.1-2.4) million YLL. Under conditions of 0.5% annual discounting, YLL were estimated at 0.6 (95% CI, 0.0-1.9) million. Under 3% annual discounting, YLL were estimated at 0.2 (95% CI, 0.0-0.7) million.

The CDC reported a total of 88 241 US deaths from COVID-19 through May 30, 2020. Using Social Security Administration life tables, we estimated that these deaths resulted in 1 146 136 YLL (**Table**). Adjusting for potential undercounting of COVID-19 deaths led us to estimate that US deaths due to COVID-19 in early 2020 generated 1.50 million (95% CI, 1.23-1.85 million) YLL. Applying the counterfactual procedure described in our methods, we further estimated that had primary schools remained open and, in doing so, permitted the pandemic to spread, an estimated total of 2.97 million (95% credible interval, 1.88-4.30 million) YLL might have been observed, with 1.47 million (95% credible interval, 0.45-2.59 million) YLL associated with schools remaining open.

We also compared the YLL in each scenario: the scenario in which the United States experienced deaths due to COVID-19 as well as decreased predicted life expectancy due to decreased educational attainment associated with school closures (ie, the path followed by the United States in early 2020 of primary schools closed) or an alternate, counterfactual scenario in which the country had left schools open, with a possible increase in transmission of COVID-19. The results of this analysis, including modifications of these estimates by discounting future deaths, using estimates from the US-based studies and the European-based studies for the association between lost education and mortality, are depicted in **Figure 2**. When comparing the distribution of probable YLL under these "primary schools open" and "primary schools closed" scenarios using US-based studies, we estimated a 98.9% probability that nondiscounted YLL would be greater under school closure than had schools remained open (98.4% under 0.5% discounting and 89.6% under 3% discounting). Using European-based studies, the estimated probability was 26.3% (17.9% under 0.5% discounting and 1.6% under 3% discounting).

Table. Years of Life Lost Due to COVID-19 Deaths Through June 3, 2020

	Male				Female			
Age, y	COVID-19 deaths	Death probability	Life expectancy	YLL, thousands	COVID-19 deaths	Death probability	Life expectancy	YLL, thousands
0	3	0.0063	76.0	0.22	2	0.0052	81.0	0.16
1	1	0.0004	75.5	0.08	2	0.0003	80.4	0.16
10	10	0.0001	66.5	0.67	2	0.0001	71.5	0.14
20	68	0.0011	56.9	3.87	38	0.0004	61.6	2.34
30	396	0.0019	47.7	18.87	187	0.0008	52.0	9.71
40	1094	0.0025	38.6	42.18	430	0.0014	42.5	18.26
50	3009	0.0050	29.7	89.28	1229	0.0031	33.2	40.83
60	6988	0.0115	21.6	150.80	3598	0.0069	24.6	88.37
70	11 479	0.0229	14.4	165.18	6881	0.0153	16.5	113.81
80	12 961	0.0582	8.3	107.32	10 650	0.0428	9.7	103.09
85	11 566	0.0979	5.9	68.12	17 647	0.0743	7.0	122.65

Abbreviations: COVID-19, coronavirus disease 2019; YLL, years of life lost.

Discussion

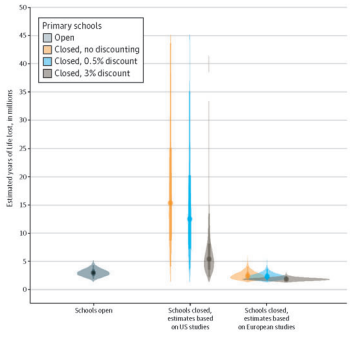
In this decision analytical model, based on estimates of the RR of mortality associated with educational attainment derived from US studies, we estimated that there was a 98.9 % probability that the decisions to close US primary schools in March of 2020 could be associated with more eventual YLL than would be observed if these schools had remained open, even if schools remaining open had led to a substantial increase in the rate of death observed during the early phase of the pandemic. Based on estimates of RR derived from European studies, the probability was 26.3%.

This difference in these estimates provides important insights. More than 95% of the combined sample of the European studies we used in our analysis was from Norway and Sweden. However, the mortality-education association in these 2 countries, both of which have robust social protections, strong vocational programs, meaningful income equality, and universal health care, is unlikely to be a good model for the association between education and mortality in the US, which does not have these structural supports. The Norwegian study,[28] for example, explicitly tested the relationship between education and health care utilization and found no association. While the 2 US studies did not explicitly test this link, there is a well-known association between educational attainment and medical care access in the US.[39]

There are also methodological differences between the US-based and European-based studies. The US-based studies may provide an estimate of the education-mortality link that is too large, especially if, for example, the US does develop better social protections in the future. The Cochrane collaboration recommends thinking qualitatively about the sources of such heterogeneity.[40] Following that advice, the best estimate of YLL may lie somewhere in the middle between the US-based studies and the European-based studies. As a referent, the midpoint between the 2 estimates is 7.3 million YLL.

Our analysis was based on the decreased life expectancy associated with a decrease in the mean years of educational attainment that could be expected to occur as a result of the disruption in schooling during a critical period of educational development. These potential associations of school closure with child health remain hidden at present, as the shortening of lifespans that today's primary school children could experience would not manifest until long after the pandemic is over. The public discourse on reopening schools has focused on lives saved in the present and largely neglected the years of life that may be lost in the future because of decisions made today.

Figure 2. Estimated Years of Life Lost



Center dots indicate medians; thin lines, 91% probability intervals; thick lines, 50% probability intervals; and shaded areas, probability density of the estimated years of life lost under each condition.

We believe that the debates over opening schools have often lacked nuance, portraying schools monolithically—as all opened or all closed—without regard for potential safeguards that could reduce transmission within schools. Furthermore, to our knowledge, very little discussion has considered the very different outcomes and costs associated with school closure for children at different ages and developmental stages. Based on the existing evidence regarding the limited role primary school–aged children play in transmission of COVID-19 and the heavy burden of decreased educational exposure on their health, we believe that restoring access to in-person primary school education should be an immediate national priority, even while the country awaits a vaccine.[4,41]

There are several ways in which our estimates of YLL are conservative. First, we focused only on interruptions to primary school. We did this because distance learning has been demonstrated to be largely ineffective for this age group, and there are well-controlled longitudinal data to model the association between primary school disruption and final educational attainment. Nevertheless, we believe it highly probable that school closures in early 2020 will also ultimately depress high school graduation rates (and therefore may influence lifespan) for older children as well. A recent McKinsey report[42] estimated that 2% to 9% of high school students could drop out of school because of COVID-19–related school absences. These losses in educational attainment and resultant increased mortality are not included in our estimates.

Second, we adjusted the number of COVID-19–related deaths in early 2020 to account for underreporting, thus favoring the schools-closed scenario. Third, we used a well-constructed estimate of increased mortality associated with school opening to inform our estimate of potential increased pandemic spread associated with school opening. In fact, in a recent study, the net contribution of school closures to virus spread was found to be close to zero.[41] Fourth, whereas other models have been criticized for their complexity and opacity, our model is simple and transparent.[43,44] Fifth, our estimates do not consider quality of life or disability associated with decreased educational attainment, which would be difficult to assess. However, it stands to reason that by not graduating high school, children may experience lower wages and the attendant detriments to quality of life for the duration of their lives.

Limitations

Our study has a number of limitations. First, we based our estimates of decreased educational attainment associated with school closures on data from a single study performed in Argentina. The Argentine health and educational context is similar to the US. Life expectancy at birth is currently estimated to be 79.1 years in the US and 77.2 years in Argentina. The expected educational attainment for US children is 16.5 years; in Argentina it is 17.4 years.[45] Although we believe this assumption to be justified, the extent to which these data can be applied to a US population is unknown.

Second, our results are reliant on the assumptions that the disruptions in Argentinian schooling observed during teacher strikes in the 1983 to 2014 mimic those of school closures due to COVID-19 and that these disruptions will have similar effects on eventual educational attainment. In our opinion, these assumptions are reasonable, in part, based on a recent US study that confirms that falling behind in primary school has a significant negative association with rates of high school graduation.[18] In fact, the effects are already being demonstrated among high school students, as higher education enrollment declined by 3.6% in Fall 2020, doubling the decline observed in 2019.[46] Students in the United States also have some access to distance learning (not present in the Argentinian example), and it can be argued that US children received at least some form of education during COVID-19–related closures. The effectiveness of distance learning for primary school–aged children is highly questionable. Moreover, in 28 states representing 48% of children in the United States, distance learning was not mandated, and many children received none.[11,47] As for parental teaching, it is probable that Argentinian parents likewise provided some level of instruction to their children during the prolonged strikes.

Third, the estimates of YLL directly due to COVID-19 in our study are dependent on the population prevalence of SARS-CoV-2 during that time. Since the end of May 2020, some communities have seen increases in disease prevalence, and a few have seen decreases. The association between school opening and population disease prevalence remains uncertain, and school opening could lead to greater transmission of disease among both adults and children. The most recently available data suggests that children younger than 10 years (consistent with the age we used in our model) transmit the virus considerably less readily than adults, suggesting that community prevalence may not be as important a factor in this population.[4] Our analysis, however, presupposes that leaving schools open would be associated with a substantial increase in pandemic spread. Despite this obviously undesirable potential outcome, very likely borne to some extent by teachers and elderly relatives, the net YLL due to COVID-19 (at least during the early pandemic) appears to have favored schools remaining open.

Fourth, our estimates are sensitive to the discount rate applied to future health outcomes. Discounting for conditions that affect young children is a matter of considerable controversy and represents the values that society places on children vs adults. Many argue against discounting of any kind, some authors argue for 0.5% annual discount rates, and others argue for 3% or even greater.[31,33,34] As a matter of pure math, a discount rate of 3% heavily biases against any outcome that will occur in the distant future. In fact, any intervention that affects children over the entirety of their lifespans will be penalized by a high discount rate. Prior studies examining death from H1N1 influenza selected discount rates of zero.[48] We presented 3 different rates to highlight that prior beliefs about future event value will influence policy changes. Our belief is that the future health outcomes of children deserve our full attention and consideration today and that a discount of 0 or 0.5% is most appropriate. However, our findings suggest that even under a 3% discount rate, the probability that life years were saved owing to school closures may essentially be a toss-up.

Fifth, this study used estimates of the relationship between education and mortality derived from a literature that is necessarily imperfect. Even if it were possible or ethical to randomize children to more or less education and observe mortality risk years later, such a study would lack external validity, as this relationship is deeply contextual to the policy, social, and economic environments of the time and place. The studies used to estimate this relationship vary widely. We attempted to address this limitation by providing 2 distinct estimates that likely bracket the range, using weighted estimates from 2 US-based studies and 5 European-based studies.

This study has potentially important implications. The results of this decision analytical model suggest that the attempt to save lives by closing schools may not have resulted in a net savings when considering the potential harms associated with this intervention. This lack of intergenerational health equity is as unjust and deserves careful societal consideration. Another implication is that the losses being experienced among children are unlikely to be equitably distributed across the boundaries of gender, socioeconomic status, and race/ethnicity. Both Argentinian and US data suggest the adverse influence of educational interruption is greater for low-income children and for boys, suggesting that the potential outcomes of school closures may be felt more substantively by vulnerable populations in the United States.[14,18] Those outcomes are compounded by the fact that there was demonstrably less engagement in distance learning among low-income minority children: schools serving predominantly Black and Hispanic students reported that only 60% to 70% were participating in remote education on a regular basis, and only one-third were participating daily.[11,42,47] In addition, to preserve intergenerational equity, the costs of future life-years lost for young children today must be factored into decision-making regarding school openings and potential future closings. During the COVID-19 pandemic, school closures in the US may have contributed to possible adverse future consequences for children to protect the health of older adults. During a pandemic, this may well be an ethically defensible tradeoff, but only if resources are invested to reverse the potential harms to health and education that may be associated with this strategy.

Conclusions

In this decision analytical model of years of life potentially lost under differing conditions of school closure, based on the US studies, the analysis favored schools remaining open. Future decisions regarding school closures during the pandemic should consider the association between school closures and life expectancy of children.

ARTICLE INFORMATION

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SUPPLEMENT.
eAppendix. Notes on Education-Mortality Link
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NBER WORKING PAPER SERIES

WHEN THE GREAT EQUALIZER SHUTS DOWN: SCHOOLS, PEERS, AND PARENTS IN PANDEMIC TIMES

Francesco Agostinelli
Matthias Doepke
Giuseppe Sorrenti
Fabrizio Zilibotti

Working Paper 28264
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Francesco Agostinelli, Matthias Doepke, Giuseppe Sorrenti, and Fabrizio Zilibotti
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ABSTRACT

What are the effects of school closures during the Covid-19 pandemic on children's education? Online education is an imperfect substitute for in-person learning, particularly for children from low-income families. Peer effects also change: schools allow children from different socio-economic backgrounds to mix together, and this effect is lost when schools are closed. Another factor is the response of parents, some of whom compensate for the changed environment through their own efforts, while others are unable to do so. We examine the interaction of these factors with the aid of a structural model of skill formation. We find that school closures have a large and persistent effect on educational outcomes that is highly unequal. High school students from poor neighborhoods suffer a learning loss of 0.4 standard deviations, whereas children from rich neighborhoods remain unscathed. The channels operating through schools, peers, and parents all contribute to growing educational inequality during the pandemic.

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Education, then, beyond all other divides of human origin, is a great equalizer of conditions of men—the balance wheel of the social machinery.

—Horace Mann, 1848

1 Introduction

Of the many facets of the Covid-19 pandemic, the impact on children's education stands out as having particularly long-lasting consequences. Schools were closed for months in most countries, and early evidence suggests that online education that was offered as an alternative is a poor substitute. School closures threaten to widen inequality not only across cohorts but also across socio-economic groups. For example, online education relies on access to technology like computers and fast internet that not all families can afford. Likewise, parents' ability to support their children's learning depends on their own knowledge and on whether they can work from home during the crisis. Because learning is a cumulative process, part of the effects of the disruption will persist until children reach adulthood, thereby affecting their future success in labor markets, family formation, and other dimensions of social life.

How should policy be designed to mitigate learning losses and their effects? The Covid-19 crisis is still ongoing and unlikely to be resolved for a number of months. During this time, policymakers must decide whether to continue school closures, open all schools, or follow a more flexible policy of partial openings. If partial openings are pursued, they must determine how to target openings. Another important question is whether additional programs should be offered after the pandemic subsides and which groups of students deserve special attention. Given that organizing such programs on a large scale requires planning and resources, decisions must be taken soon.

For answering these and other related questions, we need to understand both the size of the problem and the channels through which the crisis affects children. The fact that online learning is less effective than in-school learning is well recognized. But the accumulation of both cognitive and non-cognitive skills does not depend on schools alone. Especially for older children, peer interactions are another crucial ingredient, and school closures and lockdown measures during the

pandemic drastically change children's social interactions and peer environment. The response of parents is no less important: they can complement education in school, replace some of the inputs usually provided by teachers, and influence their children in other ways such as through their choice of a parenting style. Parents' ability to do all of this interacts with their own exposure to the crisis, such as whether they lost their job or could work from home during lockdowns.

In this paper, we provide a first assessment of how these channels interact during a pandemic. We focus on the impact on the education of students in high school, from grades 9 to 12. We organize our analysis with a structural model of skill acquisition based on Agostinelli et al. (2020). The model captures how children's skill acquisition depends on educational inputs such as the quality of schools, parental inputs that include educational investments and parenting style, and on peer groups that are endogenously chosen. We use pre-crisis evidence from the Add Health data set to discipline the time-invariant parameters of the model.

We model the impact of the Covid-19 pandemic through a set of temporary changes in the economic environment. First, the switch to remote learning lowers the overall productivity of the learning technology. The size of the productivity loss is chosen to match evidence on lower test score growth during the current crisis. Second, there are changes to the peer environment: children may lose contact with some peers, and new peer connections are shaped by the peer environment in the neighborhood of residence rather than the school. We discipline this part of the model using evidence from Add Health on the impact of losing peer connections on learning, and on differences in the peer environment at the level of neighborhoods and schools (which draw students from multiple neighborhoods). Third, remote learning makes greater demands on parents, who have to supply some inputs usually provided by teachers and take a greater role on organizing, inciting, and supporting their children's learning. This aspect of the model is matched to empirical evidence on the increase in the time parents spend on helping their children with school during the current crisis. We also take into account that parents' ability to spend time helping their children depends on their own constraints, such as whether the parent is able to work from home during the pandemic. We use evidence on how the ability to work from

home correlates with parental characteristics to quantify these constraints.

Our quantitative model is able to replicate the impact of the Covid-19 crisis on student's educational performance and on parents' time allocation. Our structural model implies that each channel of change to children's skill acquisition contributes to widening educational inequality during the crisis. Beyond the direct impact of the switch from in-person to virtual schooling, children from low-income families are also affected by a decline in positive peer spillovers, and parents in low-income families face greater challenges in supporting their children's learning, in large part because they are less likely to be able to work from home. In our baseline calibration, these effects combine to generate a skill loss relative to a counterfactual of no pandemic of 0.4 standard deviations for children from a census block at the 20th percentile of the income distribution, versus almost no losses at all for children from the richest neighborhoods. Learning gaps are reduced somewhat in subsequent years, but are still large at the end of high school, when less than half of the gap opened during the pandemic is closed.

We can then use the structure of the model to decompose how different channels working through schools, peers, and parents contribute to overall learning losses and to changes in educational inequality. While each channel makes a sizeable contribution, the peer effects channel turns out to be the most important: in a counterfactual that keeps the peer environment constant but introduces all other pandemic-induced changes, the change in educational inequality is reduced by more than 60 percent.

We also discuss policies that may be used to prevent some of the learning losses and widening educational inequality predicted by our structural model. Opening schools would be the obvious solution, but clearly educational benefits must be weighed against repercussions in terms of spreading of the pandemic. Still, the large detrimental effects on overall skill acquisition and inequality implied by our analysis can inform tradeoffs faced by policymakers, such as how much priority to give to opening schools relative to other sectors of the economy. Our results also highlight which groups of students would benefit most from restoring in-person schooling. Beyond students from low-income families in general, this also includes students who are already undergoing a change in the peer en-

vironment, such as those who enter high school after having completed middle school, who are especially vulnerable to the detrimental effects of being separated from peers. Some of the impact of the pandemic on children's education could be mitigated by expanded in-school support once the pandemic is under control, for example by shortening the summer break in 2021 or offering targeted services to disadvantaged groups.

Our paper builds on three strands of the literature. The first is the economic literature on children's skill formation, including the contributions by Cunha, Heckman, and Schennach (2010), Del Boca, Flinn, and Wiswall (2014), Agostinelli and Wiswall (2016), and Attanasio et al. (2020) and recent work considering the role of parenting styles that is summarized by Doepke, Sorrenti, and Zilibotti (2019). The second related literature considers neighborhood effects for children's skill acquisition, such as Chetty, Hendren, and Katz (2016), Chetty and Hendren (2018a, 2018b), Eckert and Kleineberg (2019), and Fogli and Guerrieri (2018).[1] Finally, our work is part of the emerging literature on the consequences of the Covid-19 pandemic for families and children. Our work relates in particular to Fuchs-Schündeln et al. (2020), who also use a structural model to examine the impact of pandemic-induced school closures on educational inequality. Their contribution is complementary to ours; Fuchs-Schündeln et al. (2020) examine on the macroeconomic angle and account for the economic impact of the crisis, government transfers, and different stages of education, whereas we focus on the interaction of influences of schools, peers, and parents at the high school stage and discipline the analysis using data on children's educational performance and parents' behavior during the crisis. Alon et al. (2020) also consider effects of school closures, but with a focus on implications for parents' labor supply rather than children's education. We link our work to additional empirical contributions specifically on the impact of the pandemic on children's education in Section 2 below.

In the next section, we provide descriptive evidence that sheds light on how a

[1]Within this literature, Calvó-Armengol, Patacchini, and Zenou (2009) consider the role of a child's position in her local friendship network (measured by the Katz-Bonacich centrality) on school performance. More recently, List, Momeni, and Zenou (2019) have documented large spillover effects (operating through children's social networks) of programs targeting disadvantaged children.

pandemic changes children's education and peer environment. In Section 3, we present a structural model of skill acquisition, peer formation, and parenting that we will take to the data. In Section 4, we calibrate the model to match evidence on children's skill acquisition and on the changes brought about by the Covid-19 pandemic. In Section 5, we present our main results on how different changes during a pandemic affect children's overall learning and educational inequality. Section 6 discusses policy implications of our analysis, and Section 7 concludes.

2 Empirical Evidence: How School Closures Affect Children's Education

Our analysis focuses on three channels through which school closures affects child development and human capital formation. The first is the direct effect of suspending in-person teaching and replacing it with online instruction. The second is the change in the peer environment when children stop going to school, which includes the psychological impact of losing contact with some friends and a changed pool for making new connections. The third is the parents' response. Parents have to replace some of the inputs usually provided by professional teachers with their own efforts, subject to the constraints imposed by the requirements of their own work. We start our analysis by describing evidence that allows a first assessment of the importance of these channels.

Effect of School Closures in the United States. A benchmark to evaluate the direct effect of the interruption of in-person teaching is what happens during regular summer breaks.[2] A RAND Corporation study from McCombs et al. (2014) uses results for standardized MAP tests to measure the extent of learning losses. They document a 4-point drop in the mathematics score on the RIT scale during each summer break, which compares with an 8-point gains that accrue from sixth to eighth grade during regular school years. In English, students gain five points during the school year and lose two points during summer. These figures suggest that a child who does not engage at all with learning activities during a school closure lasting three months could lose four points in math and two points in

[2]The discussion in this paragraph follows Doepke and Zilibotti (2020). For evidence on summer losses see also Downey, von Hippel, and Broh (2004).

English. In comparison, a child who keeps on learning at the usual speed gains about 2.7 points in math (i.e., a third of the gain during an academic year) and 1.7 points in English during the same period. The achievement gap between these two scenarios is about seven points in math and four points in English. This is larger than the typical learning gain during a school year. Therefore, if some families can fully make up for the lack of in-person teaching while others make no remedy, a gap equivalent of more than an entire year of schooling can arise.[3]

Effect of School Closures: International Evidence. A number of studies provide first assessments of the effects of Covid-induced school closures in different countries. Maldonado and De Witte (2020) compares standardized test scores of Belgian students attending the last year of primary school who were affected by school closures (cohort of 2020) with those of previous cohorts. Students exposed to school closures experience a decrease in mathematics and language scores by 0.19 and 0.29 standard deviations, respectively. These are large effects. Moreover, school closures deepen existing inequality as children from more disadvantaged backgrounds experience larger learning losses. Engzell, Frey, and Verhagen (2020) find similar results in the Netherlands, a country with a relatively short 8-weeks lockdown and high degree of technological preparedness. Their difference-in-differences finds large learning losses, especially for students from less affluent families.[4] In short, a variety of international studies point at large effects on learning of school closures.

Time Diaries. Time diaries for children's activities during the crisis also help us understand why the pandemic has unequal effects across the socio-economic ladder. The analysis of a sample of German parents in Grewenig et al. (2020) suggests that low-achieving students may suffer more from the lack of educator support during school closures. Compared to high achievers, these students appear to disproportionately replace learning time with less productive activities

[3]Kuhfeld et al. (2020a) reach similar conclusions based on the evidence about learning losses because of absenteeism, summer breaks, and weather-related school closures. Kuhfeld et al. (2020b) find smaller effects when comparing a cohort of student assessed in the fall 2019 with that of the cohort of students assessed in the fall 2020. However, the authors acknowledge that their preliminary results might severely underestimate the effect of the pandemic on students' achievements due to selective attrition in the studied sample.

[4]Di Pietro et al. (2020) provide an insightful report covering a few European countries.

such as watching TV or playing computer games. Andrew et al. (2020) reach similar conclusion for a sample of English children.

Losing Contact with Friends. School closure also affects children's socialization with peers. A large literature in economics and developmental psychology documents large peer effects in education.[5] To evaluate the effects of Covid on socialization, we consider the Add Health data set, which focuses on a representative sample of high school students in the United States. One aspect of the peer-interaction channel is that the forced separation from friends can have psychological effects that hinder the learning process. Detachment from close friends can be a source of stress and instability. In particular, we study how separations affect children's learning in normal (non-pandemic) times. In the Add Health data set, parents and children are interviewed twice over two different school years (Wave I and Wave II In-Home). When some children are not in the Wave II sample, although they were active respondents of the Wave I In-Home survey, we infer that they have left the school. We can then study the effect of a child leaving the school on the academic performance of their friends who continue in the school.

Table 1 provides regression results. For children moving from 8th to 9th grade, the loss of one friend is associated with a deterioration of more than 10 percent in growth in the grade point average (GPA).[6] The result is robust to controlling for other determinants of school performance and for school fixed effects, and is larger for boys than for girls (see Table A-1 in the appendix). The negative effect is twice as large for children who lose two or more friends relative to those who lose only one friend. Table 2 shows the result of a specification where separation is interacted with the pre-separation GPA of the child. The negative effects are larger for low achievers. In other words, high achievers appear to be more resilient and cope better with losing contact with friends. Taking stock, there

[5]See, e.g., Durlauf and Ioannides (2010), Sacerdote (2011), and Epple and Romano (2011) for extensive reviews on the role of peer effects in education.

[6]The descriptive analysis in this section ignores important econometric issues in the study of peer effects. For instance, it is possible that a correlated shock hits the families of two friends, inducing one of them to move. This shock (e.g., a job loss) could have direct effects on the performance of the stayer. For this reason, we refrain from a strict causal interpretation. Note that we control for school fixed effects that reduces but does not eliminate these concerns.

is evidence that forced separation from friends negatively affects children's academic performance, and that this impact is particularly large for children who are already struggling in school.

Interestingly, the effect of being separated from friends is small and statistically insignificant in higher grades beyond 9th grade (see Table A-2 in the appendix). One interpretation of this finding is that children may be especially vulnerable to changes in their peer environment when they are changing schools (i.e., entering high school in grade 9 after completing middle school). Older children who continue in the same school may have already established a stable group of friends in their new environment, so that losing one or two peers has less of an impact. This observation suggests that children who switch schools may be especially vulnerable during the pandemic.[7]

Changes in the Peer Environment. Beyond losing existing friends, the pandemic also changes children's ability to form new peer connections. Schoolmates who live far away may no longer be potential friends once children stop attending school in person. Instead, the peer interactions that are still possible happen at the level of the neighborhood. Even if children are able to make new connections, this distinction matters because the peer environment may differ at the level of the school and the neighborhood. To quantify these effects, we suppose here that when schools close down, children's peer environment is restricted to the neighborhood in which they live, which we assume to be the census block of their residence. The Add Health data allows us to infer the characteristics of census blocks where each child lives.[8] While US school districts are characterized by a high degree of social sorting by international standards, the extent of socio-economic segregation is even higher if children's peer interactions get confined to the block level. In other words, schools operate as an equalizer insofar as they mix children from different socio-economic backgrounds.

Figure 1 shows a bin scatter plot displaying the correlation between median fam-

[7] See Appendix Tables A-1 to A-5 for additional regression results on the effects of peer separation.

[8] The contextual data section in Add Health includes information matched from the 1990 US Census. We use median household income at the census block to characterize the neighborhood where children live.

Table 1: Effect of Peer Separation on Child's GPA (Sample of Children in 8th Grade)

	Change in GPA (from Grade 8 to Grade 9)								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
One or More Peers Left	-0.123**	-0.112**	-0.107*						
	(0.051)	(0.051)	(0.054)						
N. of Peers who Left				-0.105**		-0.096**		-0.090**	
				(0.040)		(0.040)		(0.043)	
1 Friend					-0.102*		-0.093*		-0.095
					(0.055)		(0.055)		(0.058)
2 Friends (or More)					-0.218**		-0.196**		-0.172
					(0.093)		(0.092)		(0.104)
N	1235	1235	1235	1235	1235	1235	1235	1235	1235
Controls	No	Yes	Yes	No	No	Yes	Yes	Yes	Yes
School F.E.	No	No	Yes	No	No	No	No	Yes	Yes

The table shows the disruptive effects of losing social ties in the transition from middle school to high school. The outcome is the change in a child's GPA during the transition from middle school to high school. In columns (1)-(3), the independent variable is whether or not a child lost a friend or more during the transition (dummy variable). In columns (4), (6) and (8), the dependent variable is the number of friends that a child lost. In columns (5), (7) and (9), the independent variables are whether a child lost one friend or two (or more) friends during the transition (dummy variables).

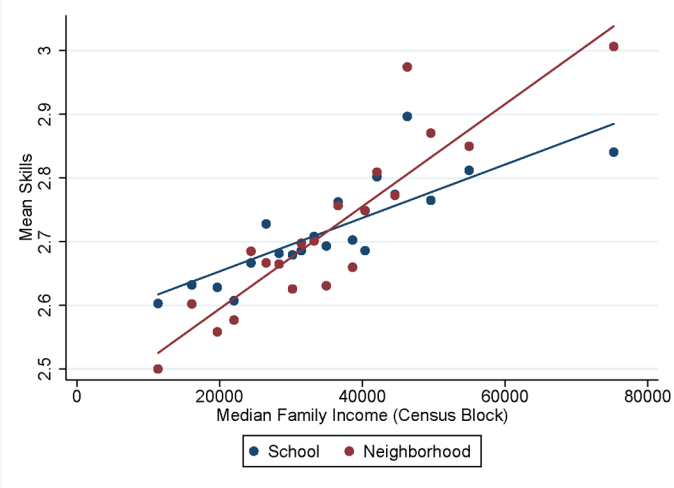
Table 2: Effect of Peer Separation on Child's GPA: Heterogeneity

	Change in GPA (from Grade 8 to Grade 9)			
	(1)	(2)	(3)	(4)
N. of Peers who Left	-0.314**	-0.268**	-0.576**	-0.540*
	(0.135)	(0.131)	(0.287)	(0.296)
N. of Peers who Left × Child's GPA (t-1)	0.086**	0.067*		
	(0.040)	(0.040)		
N. of Peers who Left × Peers' GPA (t-1)			0.166*	0.155
			(0.093)	(0.098)
N	1235	1235	1223	1223
Controls	Yes	Yes	Yes	Yes
School F.E.	No	Yes	No	Yes

The table shows the heterogeneous disruptive effects of losing social ties in the transition from middle school to high school. The outcome is the change in a child's GPA during the transition from middle school to high school. In columns (1)-(2), we interact the number of friends that a child lost with the child's own GPA during 8th grade. In columns (3)-(4), we interact the number of friends that a child lost with the child's peer quality during 8th grade.

ily income at the census block level and the average grade of children attending the same school (blue) or living in the same census block (red). As expected, the correlation is positive, namely, children living in richer blocks are exposed to academically stronger peers. The important observation is that the regression line is substantially steeper as we move from schools to blocks. For the children of poorer families, schools provide an opportunity to socialize with children from more privileged environments (relative to the block where they live). In contrast, the children of richer families meet children from less affluent families. Thus, the evidence on the peer environment channel adds to the overall theme that pandemic restrictions increase inequality in educational opportunities, here through the peer groups that children have access to.

Figure 1: Peer Quality: School vs Neighborhood



The figure shows the relationship (scatter plot) between peer quality and median family income at the census block level. The blue dots represent the predicted peer quality that children are exposed to at school by the median family income of the census block where children live. The red dots represent the peer quality composition of the census blocks where children live. Peer quality is measured by children's GPA.

Changes in Parenting: Knowledge and Time Constraints. Another channel through which a pandemic affects learning is through changes in parents' behavior and parental investment. Virtual schooling places new demands on parents, from making sure that children have access to the technology they need to replacing some of the tutoring, encouragement, and admonishment usually provided by teachers. Not all parents are equally able to provide these inputs. In some cases, knowledge might be a constraint, for example when helping children with homework in advanced high school math. Time constraints are likely to be even more important. Most parents have to earn a living in addition to being substitute teachers, which limits the inputs they can provide. These constraints are especially binding for single parents with limited resources, and single parenthood is more prevalent among parents with less education and lower earnings prospects. For parents who were employed during the crisis, a key issue was

whether they could do their work from home, such as academics and other office workers working from their home office, or had to go to another workplace, such as most workers in manufacturing, supermarkets, and other retail outlets. Once again, the aspect of working from home introduces an element of inequality across the socio-economic ladder. Mongey, Pilossoph, and Weinberg (2020) show that workers with less income and education are more likely to be unable to work from home during the crisis than others. In our analysis below, we use survey evidence from Adams-Prassl et al. (2020a, 2020b) to quantify the extent to which the ability to work from home varies across the income scale.

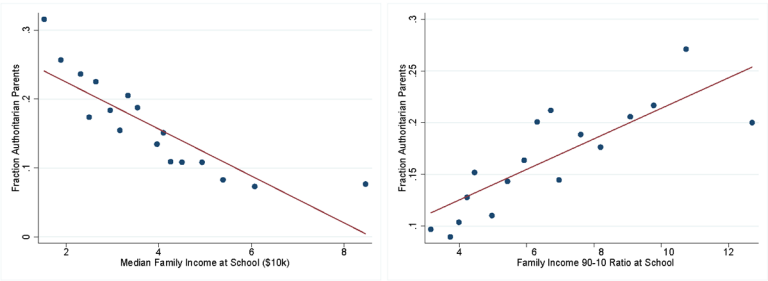
Changes in Parenting Style. Beyond the the impact of knowledge and time constraints, parenting styles tend to adjust to changes in the peer environment. Here a relevant observation—which is the focus of our previous research in Agostinelli et al. (2020)—is that parents become more authoritarian when children are exposed to a more unequal environment. In particular, some parents actively discourage their children from interacting with lower-achieving peers, especially when their children are low achievers themselves. The evidence discussed above suggests that the peer environment deteriorates for poor families during the pandemic. Thus, we expect parents from a lower socio-economic background to turn more authoritarian during school closure periods. This has two effects. First, changes in parenting style makes it even harder for the most disadvantaged children to interact with stronger peers. Second, an authoritarian parenting style (albeit rational from the point of view of parents) has a negative direct effect on the process of skill formation and reduces educational achievement.

Agostinelli et al. (2020) zoom in on a narrower dimension of authoritarian parenting, namely, meddling with the choice of friends.[9] Figure 2 reproduces Figure 1 in Agostinelli et al. (2020). It shows how authoritarian parenting varies across schools with different characteristics. The left panel displays a binned scatter plot of the relationship between median family income and the fraction of authoritarian parents at the school level, whereas the right panel shows the

[9] A parent is considered authoritarian or not depending on how her or his child answers to the question: "Do your parents let you make your own decisions about the people you hang around with?" A parent whose child answers "No" is classified as behaving in an authoritarian fashion; all others are nonauthoritarian.

relationship between income inequality (defined as the 90th–10th percentile ratio of within-school family income) and authoritarian parenting. The figure shows that across schools, the proportion of parents adopting the authoritarian parenting style is decreasing with the median income and increasing with income inequality. Broadly speaking, parents are more likely to meddle in the choice of friends when there are more children from disadvantaged families present. The differences are quantitatively large. The same pattern emerges in multiple regressions where we simultaneously include median income and income inequality and control for parental characteristics.[10] The results are robust to within-school regressions exploiting variations across cohorts.

Figure 2: Authoritarian Parenting and Neighborhood Characteristics



The figure shows how the incidence of the authoritarian parenting style varies with within-school average family income (left panel) and inequality (right panel). Inequality is measured by the 90th–10th percentile ratio of within-school family income.

Taking Stock. The evidence reviewed in this section has established the following points.

1. School closures have a negative impact on children's accumulation of skills,

[10]Similar patterns exist when one considers broader definitions of parenting styles. For instance, we consider the answer parents give to the question: "Of the following, which do you think is the most important thing for a boy/girl to learn? Be well-behaved, work hard, think for himself, help others, be popular." We define authoritarian parents as those who choose "be well-behaved," authoritative parents as those opting for "work hard," and permissive parents as those who choose "think for themselves." When we use these definitions, we continue to find that parents tend to be more permissive in wealthier and more equal neighborhoods, while they tend to be more authoritative and authoritarian in poorer and more unequal neighborhoods.

and learning losses are particularly acute for children from low-income families.

2. Separation from peers reduces children's learning. School closures and social distancing also lead to more segregation in the peer environment for children from rich and poor families.

3. School closures place additional demands on parents, and richer and better-educated parents are better positioned to meet these demands. In addition, parents' responses to their children's environment are likely to lead to more authoritarian parenting in less affluent neighborhoods.

We now construct and structurally estimate a model that allows us to quantify the joint effect of these factors on children's learning. The theory emphasizes potential heterogeneous effects across the socio-economic ladder.

3 A Model of Skill Acquisition with Schools, Peers, and Parents

The model is an extension of Agostinelli et al. (2020). We consider an economy where children live in neighborhood n and attend school s. Human capital accumulation is determined by a technology of skill formation where a child's skills $\theta_{i,t}$ is a state variable whose evolution over time is affected by parental investments and peer effects. The distinctive features of our technology is that it allows for interactions between parents' behavior and peer effects, in the sense that parents can decide to interfere with the process of peer formation. Parental decisions crucially hinge on the social environment at the school and at the neighborhood level. In our empirical application the dynamics of the model corresponds to the four years of high school (grades 9 to 12). We first describe the model setup in normal times, and then discuss below how the Covid-19 pandemic temporarily changes the technologies and constraints faced by parents and children.

During normal times, children meet and interact with friends at school. Even though students live in different neighborhoods n, the neighborhood is not a relevant state variable during normal times because peer interactions take place at the school level. A school s is characterized by a set $\mathcal{X}^s$ of attending children and their initial ($t = 1$) skill distribution.

The timing of events in each period is as follows. At the beginning of the period, the child's current skill level $\theta_{i,t}$ is realized. Next, the child forms friendships with some of the other children of the same age in the same school. The characteristics of these friends (which affect skill formation) are summarized by the variable $\bar{\theta}_{i,t}$. The parent can now make two choices that affect the evolution of the child's skills and peers. First, the parent can undertake (authoritative) parenting investments $I_{i,t}$ that affect the child's skill formation. Second, the parent chooses her parenting style, $P_{i,t} \in \{0, 1\}$, where $P_{i,t} = 1$ means that the parent behaves in an authoritarian fashion by interfering in the child's next round of friendship decisions. At the beginning of the next period, the child's updated skill $\theta_{i,t+1}$ is realized and the new group of friends with the average skill $\bar{\theta}_{i,t+1}$ is formed. These events are repeated until the final year of high school. Then, the child enters adult life with skills $\theta_{i,T+1}$.

3.1 Preferences of Parents and Children

Parents' and children's preferences are as in Agostinelli et al. (2020), where we provide a more detailed discussion of the foundations of the preference structure. We employ the convention that lowercase variables correspond to the child and uppercase variables correspond to the parent. The individual state variables for a family are the child's skills $\theta_{i,t}$ and the characteristics of the child's peers $\bar{\theta}_{i,t}$. An additional aggregate state variable is the distribution of the children $\mathcal{X}^s$ in the school over skills at age t, which matters for friendship formation and peer effects. However, since in our analysis families do not switch schools, the aggregate state is taken as given by each family.

The parent decides on parenting style ($P_{i,t}$ and $I_{i,t}$), and the child chooses peers, i.e., who to be friends with. We express the preferences of parent and child with value functions that summarize utility in a period after the child's current skills and peer group have already been realized so that the decisions concern the evolution of these variables into the next period.

The value function for child i in neighborhood n and school s in period t is given by:

$$v_t^{n,s}(\theta_{i,t}, \bar{\theta}_{i,t}) = \max \left\{ \mathrm{E} \left[u(\mathcal{F}_{i,t+1}) | \theta_{i,t}, \bar{\theta}_{i,t} \right] \right\}. \tag{1}$$

Here $u(\mathcal{F}_{i,t+1})$ captures the utility derived from peer interactions with the set of friends $\mathcal{F}_{i,t+1}$ chosen in period t, where $\mathcal{F}_{i,t+1} \subseteq \mathcal{X}^{n,s}$. The friend set $\mathcal{F}_{i,t+1}$ determines the next period's peer quality $\bar{\theta}_{i,t+1}$. The friendship decisions, in turn, hinge on both the child's and the parent's decisions. The expectation in the value function reflects the presence of taste shocks affecting the process of friendship formation. Current peer quality $\bar{\theta}_{i,t}$ enters the value function because it affects the evolution of the child's skills and the decisions of parents.

The parent's total utility in period t is given by the value function:

$$V_t^{n,s}(\theta_{i,t}, \bar{\theta}_{i,t}) = \max \Big\{ \mathrm{E} \Big[U(I_{i,t}, P_{i,t}, \epsilon_{i,t}) + Z \left[\lambda \tilde{u}(\theta_{i,t}, P_{i,t}) + (1-\lambda) u(\mathcal{F}_{i,t+1}) \right] + B V_{t+1}^{n,s}(\theta_{i,t+1}, \bar{\theta}_{i,t+1}) | \theta_{i,t}, \bar{\theta}_{i,t} \Big] \Big\}. \quad (2)$$

Here $U(I_{i,t}, P_{i,t}, \epsilon_{i,t})$ is the parent's period utility, which depends on parenting style ($P_{i,t}$ and $I_{i,t}$), chosen optimally by the parent. Utility also depends on taste shocks $\epsilon_{i,t}$, which ensure a smooth mapping from state variables into decisions. The parent also cares about the child, where Z is the overall weight attached to the child's welfare. Parental concern about children has an altruistic and a paternalistic component. The altruistic component with weight $1-\lambda$ consists of the child's actual period utility $u(\mathcal{F}_{i,t+1})$. The paternalistic component with weight λ is the parent's own evaluation of the current actions and outcomes of the child. The paternalistic concern is focused on the child's accumulation of skills $\theta_{i,t}$, where we allow for the possibility that the parent's evaluation of the child's skill interacts with parenting style $P_{i,t}$. Hence, paternalistic utility enters as $\tilde{u}(\theta_{i,t}, P_{i,t})$. Note that, at time t, the parent takes the quality of the child's current peers $\bar{\theta}_{i,t}$ as given, but the parent can influence future peer formation (and hence future peer quality $\bar{\theta}_{i,t+1}$) through the choice of parenting style $P_{i,t}$.

The continuation utility at the end of high school is identical to the child's continuation utility, and thus depends on θ_{T+1}:

$$V_{T+1}^{n,s} = v_{T+1}^{n,s}(\theta_{i,T+1}),$$

where the function $v_{T+1}^{n,s}(\theta_{T+1})$ (corresponding to the child's utility as an adult) is taken as given and assumed to be identical across schools.

3.2 The Technology of Skill Formation

The initial distribution of children's skills is drawn from the distribution $F^{n,s}(\theta_{i,1})$. This initial distribution would generally depend on families' socio-economic conditions, neighborhood effects, and earlier actions by parents and children, but is treated as exogenous here.

Subsequently, skills evolve as a function of family inputs and peer influences. For each child i, next period's skill $\theta_{i,t+1}$ depends on the current stock of skills $\theta_{i,t}$, a summary statistic of the quality of peers $\bar{\theta}_{i,t}$ (e.g., the average level of skills), parental investments $I_{i,t}$, and the parent's choice of whether to interfere in the child's choice of peers $P_{i,t} \in \{0, 1\}$. The technology of skill formation is:

$$\theta_{i,t+1} = s(\theta_{i,t}, \bar{\theta}_{i,t}, I_{i,t}, P_{i,t}). \tag{3}$$

The direct effect of parenting style $P_{i,t}$ in Equation (3) captures the impact of the quality of the parent-child relationship on skill accumulation.

3.3 Endogenous Peer Selection

We model the formation of friendships as a random utility model. Every period, each child meets all potential peers $\mathcal{X}^{n,s}$ in the school and can try to be friends with some of them. There is no capacity constraint in the number of friends nor any decreasing marginal utility to the number friendships. The potential utility $f_{i,j,t+1}$ that child i would derive from forming a new friendship with $j \in \mathcal{X}^{n,s}$ is given by:

$$f_{i,j,t+1} = g(\theta_{i,t+1}, \theta_{j,t+1}, P_{i,t}, \eta_{i,j,t+1}). \tag{4}$$

Here $\eta_{i,j,t+1}$ is an independent and identically distributed (i.i.d.) taste shock that guarantees that the probability that a friendship is established is a smooth function of fundamentals. Note that, in general, $\eta_{i,j,t+1} \neq \eta_{j,i,t+1}$, which captures the common situation where, say, child i wants to be friends with j but not vice versa. The utility from forming a friendship depends on both the own skill of child i and the skill of the potential friend j. This specification allows for homophily bias in

terms of skills.[11]

The parenting style $P_{i,t}$ affects how much utility accrues to the child when it forms friendships with children of different skill levels. Since parents want to encourage skill formation, we assume that an authoritarian parenting style ($P_{i,t} = 1$) lowers the utility of befriending a low-skill peer relative to a high-skill one. This could be done by rewarding the child in some way for making "desirable" friends or by meting out punishments for befriending less desirable ones.

Friendships are subject to mutual agreement: a friendship between child i and child j is formed if and only if

$$f_{i,j,t+1} > 0 \;\; \& \;\; f_{j,i,t+1} > 0, \tag{5}$$

where we normalize the value of not forming a friendship to zero. As already mentioned, $\mathcal{F}_{i,t+1} \subseteq \mathcal{X}^{n,s}$ denotes the set of friendships involving child i in period $t+1$, i.e., the set of $j \in \mathcal{X}^{n,s}$ for which Equation (5) is satisfied. The friendship utility $u(\mathcal{F}_{i,t+1})$ that determines the child's utility (1) is then:

$$u(\mathcal{F}_{i,t+1}) = \sum_{j \in \mathcal{F}_{i,t+1}} f_{i,j,t+1}.$$

3.4 Friendship Formation in the First and Last Periods

The value functions (1) and (2) in the first period (corresponding to 9th grade) depend on the initial quality of peers $\bar{\theta}_{i,1}$. Rather than taking this state variable as parametric, we assume that only the initial distribution of skills is given and that friendships are formed through the endogenous process discussed above. Given data limitations, we assume that parents cannot affect the initial choice of friends.[12]

In the last period $T = 4$ (corresponding to 12th grade), the parental decision problem is different because the continuation utility $V^{n,s}_{T+1}$ does not depend on

[11] The homophily bias is a common tendency of people in social networks to be drawn toward others who are similar to them in some significant dimension (see e.g., McPherson, Smith-Lovin, and Cook 2001; Currarini, Jackson, and Pin 2009; Jackson 2010, and, in a context similar to ours, Agostinelli 2018).

[12] Formally, we set $P_{i,t-1} = 0$ when evaluating Equation (4) and Equation (5) at time $t = 1$.

the quality of peers. This reflects that children have to form new peer groups after leaving high school, and at any rate these future peers are not observed in the Add Health data. Setting $P_{i,T} = 1$ does not affect future peers' skills, and parenting style will be optimally chosen solely based only on the parents' taste shocks.

The functional forms for estimating the model in pre-pandemic times are as in Agostinelli et al. (2020) and are described in Appendix A.

3.5 Covid-19 in the Model: School Closures and Social Distancing

In this section, we discuss the effect of the Covid pandemic in the model. We model the Covid shock as affecting parameters in a single period (one year of school). We assume that parents and children correctly anticipate that things will return to normal in the following year. Even though the shock is temporary, its effects will be persistent, through the dynamics of a child's own skill accumulation and further ramifications through peer effects and parental responses.

To show where the pandemic-induced parameter changes appear in the model, we first describe the functional forms for the technology of skill formation and parental utility.

Technology of Skill Formation. The technology of skill formation (3) takes the following form:

$$s(\theta_{i,t}, \bar{\theta}_{i,t}, I_{i,t}, P_{i,t} = p) = A_{p,t} \times H_p(\theta_{i,t}, \bar{\theta}_{i,t}, I_{i,t}),$$

where $A_{p,t}$ is a total factor productivity term such that

$$A_{p,t} = -\nu_t + \kappa_t \cdot (\psi_0 + \psi_1 \cdot t) + \psi_2 \cdot p,$$

and the contributions of peers, initial human capital, and parental time to skill formation enter in a CES functional form:

$$H_p(\theta_{i,t}, \bar{\theta}_{i,t}, I_{i,t}) = \left[\alpha_{1,p}\,\theta_{i,t}^{\alpha_{4,p}} + (1-\alpha_{1,p})\left[\alpha_{2,p}\,\bar{\theta}_{i,t}^{\alpha_{3,p}} + (1-\alpha_{2,p})\left(I_{i,t}-\bar{I}\right)^{\alpha_{3,p}}\right]^{\frac{\alpha_{4,p}}{\alpha_{3,p}}}\right]^{\frac{\alpha_{5,p}}{\alpha_{4,p}}}. \quad (6)$$

Consider, first, the total factor productivity term $A_p(t)$. In normal times, $\nu_t = 0$ and $\kappa_t = 1$. When schools are closed (SC), we have $\nu_t = \nu_t^{SC} \geq 0$ and $\kappa_t = \kappa^{SC} < 1$. Relative to the baseline case, productivity falls across the board by a factor $1 - \kappa^{SC}$. In addition, there is a grade-specific productivity loss ν_t^{SC}.

Consider, next, the term $H_p(\theta_{i,t}, \bar{\theta}_{i,t}, I_{i,t})$. In normal times, $\bar{I} = 0$, while during school closures, $\bar{I} = \bar{I}^{SC} > 0$. The term $\bar{I}^{SC}$ (which is constant across parents) captures a minimum time requirement before their parental investment $I_{i,t}$ becomes productive. This term captures the basic time cost required to manage learning at home during school closures and can be thought of as providing inputs usually coming from teachers.

Parental Utility. Parents' period utility function in Equation (2) takes the form:

$$U(I_{i,t}, P_{i,t}, \epsilon_{i,t}, T) = \delta_1 \ln(T - I_{i,t}) + \delta_2 P_{i,t} + \epsilon_{i,t}(P_{i,t}). \quad (7)$$

In normal times, $T = 1$ for all parents. In pandemic times, the time endowment is given by $T = T^{SC} \in \{\underline{\tau}^{SC}, \bar{\tau}^{SC}\}$, where $\bar{\tau}^{SC} > \underline{\tau}^{SC}$. Heterogeneity in the time endowment during the pandemic captures how the ability to work form home affects parents' ability to support their children's virtual learning.

Effect of School Closures in the Model. We now have all the pieces in place to summarize how the model captures the effects of school closures and social distancing on children's skill acquisition. The following changes are imposed in the pandemic period:

1. The switch to remote learning lowers the total factor productivity in the

technology of skill formation (6). This is captured by two shocks. First, $\kappa_t = \kappa^{SC} < 1$ for all grades. Second, motivated by the evidence of disruptive effects of losing social ties in Section 2, we allow for a grade-specific shock ν_t. In normal times, $\nu_t = 0$ for all grades. During school closures, $\nu_t = \nu_t^{SC} \geq 0$.

2. When schools are closed, peer interactions are confined to the neighborhood n rather than the school s. The relevant state variable becomes the distribution of peer skills in the neighborhood $\mathcal{X}^n$.

3. The switch to remote learning requires parents to spend time on home schooling. We model this as a minimum time requirement $\bar{I}$ in the skill formation technology. The time investment $I_{i,t}$ is productive only as long as $I_{i,t} \geq \bar{I}$. In normal times, $\bar{I} = 0$.

4. Finally, the time constraints faced by parents change during the pandemic. We capture this change by a shock to the time endowment T in the period utility function (7). In particular, we normalize $T = 1$ for every parent in normal times. During pandemic times, we allow the time endowment to be heterogeneous across parents ($T = T_i^{SC}$). This feature captures the different situations of parents who have a flexible work arrangement and are able to work from home during the pandemic (where can they help their children with school) versus those that cannot. Work flexibility status is assumed to be an individual state variable rather than a choice.

4 Model Estimation: Normal and Pandemic Times

We build our analysis on Agostinelli et al. (2020), who estimate the baseline model based on the Add Health data set that follows a set of children through the high school years in the 1990s. We take the estimated model in Agostinelli et al. (2020) to represent skill accumulation in regular times. We then use additional evidence to discipline the shocks occurring during the Covid-19 crisis. For overall learning losses and inequality, we use information on changes in children's test scores during the crisis discussed in Section 2. For changes in the peer environment, we use data on differences in income inequality and peer composition

at the school and neighborhood levels. We also use the reduced-form evidence on the effects of losing peer connections on education from the Add Health data, as described in Section 2. For parental inputs, we use survey evidence from Adams-Prassl et al. (2020a) on parental time use during the pandemic.

By combining these data sources, our model accounts for up-to-date evidence on parental behavior and children's education during the Covid-19 crisis. Doing this in the context of a structural model then allows us to take additional steps. First, we can simulate the model forward to project the impact of current changes on children's education by the time they finish high school, taking endogenous changes in peer effects and parental inputs into account. Second, we can use the structure of the model to decompose the sources of various changes, such as peer influences, parental influences, and changes to the productivity of schooling during school closures. Third, we can use our model for policy analysis.

4.1 Properties of the Estimated Technology of Skill Formation

We start by summarizing the properties of the estimated skill formation technology in normal times, since these are key determinants of the effect of the Covid shock.

The technology of skill formation is allowed to differ across parents adopting an authoritarian ($p = 1$) or nonauthoritarian ($p = 0$) parenting style—formally, all parameters in Equation (3.5) depend on p. Total factor productivity A_p is lower when parents are authoritarian ($A_1 < A_0$), capturing the well-documented disruptive effects of an authoritarian parenting style on the process of skill formation. Moreover, for authoritarian parents the estimated elasticities of substitution in the H_p function (6) are close to unity. Hence, H_p is well-approximated by a Cobb-Douglas production function.

In contrast, the estimated elasticities in (6) are significantly different from unity for nonauthoritarian parents. The estimates imply that:

- Parental investment and peer quality are substitutes: nonauthoritarian parents spend more time with their children when the peer group is weak.

- Parental investment and own child quality are complements: nonauthoritarian parents invest more time when the child has high skill.

These properties of the technology of skill formation imply that when children face a deteriorating peer environment, parents who adopt a nonauthoritarian parenting style will spend more time with their children to offset unfavorable peer effects.

Concerning the choice between being authoritarian or not, parents are prone to turn authoritarian when the peer environment worsens and when their child's own skill goes down.

4.2 Calibration of Covid Effects in the Model

Our calibration focuses on five model features that capture the Covid shock: (i) the Covid-related learning shock κ^{SC}; (ii) the disruptive effect of losing social ties at school ν^{SC}; (iii) the change in peer quality during the school closure; (iv) the basic time cost for parents required to manage learning at home during the pandemic $\bar{I}^{SC}$; and (v) parents' heterogeneous time endowments during the pandemic T_i^{SC}. We assume that the time endowment during COVID can take two values $T_i^{SC} \in \{\bar{\tau}^{SC}, \underline{\tau}^{SC}\}$, where $\bar{\tau}^{SC} > \underline{\tau}^{SC}$, capturing the heterogeneity in work flexibility status among parents.

We divide the calibration exercise into two steps. In the first step, we externally calibrate the first three elements (i)-(iii) by matching the measured changes in learning and social interactions associated with school closures. In the second step of the calibration, we use the simulated method of moments to estimate the parameters in (iv)-(v) by targeting moments related to changes in parents' time allocation during the pandemic.

We carry out our calibration exercise under the assumption that the Covid shock lasts for one school year. This scenario matches the likely outcome in those parts of the United States where schools continue to be closed and are unlikely to reopen before vaccines are widely available in mid-2021. The Covid shock therefore changes model parameters for a single period, and subsequently all parameters return to their previous levels for the remaining periods. The one-time shock

still has persistent effects due to changes in the children's skill accumulation and peer groups.

Calibrating Changes in Learning and Social Interactions during Covid. We first externally calibrate three new model's features capturing Covid-19 in the model.

- Covid learning shock κ^{SC}: we calibrate the learning shock in our model based on the results in Maldonado and De Witte (2020), who use test score data from Belgium to estimate the impact of the Covid crisis on learning. According to their analysis, the 2020 cohort of children leaving primary school (grade 6) experienced a learning loss of approximately 0.2 standard deviations compared to the previous cohort. This Covid-induced learning loss translates into a learning (TFP) shock of κ^{SC}=0.5 in our framework. Given that Maldonado and De Witte (2020) consider the impact of school closures that lasted only a few months, this learning shock is a conservative estimate of the potential impact on learning of the entire pandemic. Still, erring on the conservative side is appropriate given that virtual instruction may have become more effective over time after the initial adjustment.

- Disruptive effect of losing social ties at school ν^{SC}: we use the estimated effects in Table 2 (Column 1) of losing peers in the transition from 8th grade to 9th grade. We divide children's skills during 9th grade into quartiles $Q(\theta) \in \{4, 3, 2, 1\}$ corresponding to GPA grades A, B, C, and D, and then calibrate the disruptive effect as follows: $\nu^{SC} = -0.314 + 0.086 \cdot Q(\theta)$.

- Change peer quality during school closure: we calibrate the change in peer quality based on the evidence in Figure 1. We translate these findings in the following peer quality in the model during the pandemic: $\bar{\theta}^{SC} = 0.1802 + 0.0198 \cdot$ *Income Percentile*.

Calibrating Changes in Time Endowments and Allocations. We use two sources to study the change in parental time inputs due to the outbreak of the pandemic. The Covid Inequality Project described in Adams-Prassl et al. (2020a) provides

information on time spent on active childcare and homeschooling for a representative sample of US parents during the pandemic. As these data do not contain information for the pre-pandemic period, we complement them with data on parental time use drawn from the 2019 American Time Use Survey (2019 ATUS-CPS). For the purpose of comparability, we classify as parental time inputs the following activities in ATUS: physical care of children, homework and other school related activities, homeschooling, reading, playing (including arts, crafts, and sports), other educational activities, talking and listening to children, organization of activities, looking after children, attending events, picking up, dropping off or waiting for/with children, providing medical or other health care to children.[13]

We focus on two data moments to characterize the change in parental time inputs due to the outbreak of the pandemic.[14] First, we consider on the average number of daily hours parents spend with children. Parental time with children has grown by a factor of about four, from an average of 1.26 daily hours in 2019 to 5.15 daily hours during the pandemic in 2020. Second, we focus on the relationship between family income and parental time inputs.[15] Wealthier families report more parental time inputs than their less-affluent counterparts. The positive relation between family income and parental time inputs is apparent both in 2019 and 2020, but it strengthens with the outbreak of the Covid-19 crisis. The income effect on parental time inputs is almost four times larger during the pandemic than in 2019.[16]

[13]The analysis of parental time inputs should be interpreted with caution as it relies on the comparison of two different data sets with time variables that are similar but not identical across the two data sources.

[14]For the sake of comparability across data sets, parental time inputs refer to weekdays and to the sample of working parents.

[15]Due to the role of work flexibility in shaping parental time inputs during the pandemic, we rely on additional information provided by the Covid Inequality Project research team to map parental time with children, family income, and work flexibility. We start with additional evidence of a positive and significant effect of work flexibility on parental time inputs during the pandemic. Then, we combined the information on the effect of work flexibility on parental time inputs with the positive relationship between labor income and work flexibility shown in Adams-Prassl et al. (2020b) (Figure 14-a). Finally, using the Current Population Survey (CPS) for 2019 we convert labor income into family income and estimate the relationship between family income and parental time inputs during the Covid-19 crisis.

[16]For completeness, in 2020 the average effect of a $10,000 change in family income on daily hours spent by a parent in activities with children amounts to 0.06.

Table 3: Calibration Fit for Parental Investments (Ratios of During vs. Before Pandemic)

	Data	Model
Ratio of Mean Investments	4.08	4.04
Ratio of Income Gradient of Investments	3.94	4.04

The table shows both data and simulated target moments for the calibration exercise. The first moment represents the ratio of the mean parental investments after and before Covid (2020 vs. 2019). The second moment is the ratio of the income gradients of parental investments after and before Covid (2020 vs. 2019).

Table 3 shows the two matched moments for this calibration exercise. The calibration recovers two structural parameters associated with the Covid shock: the basic time cost required to manage learning at home $\bar{I}^{SC}$, as well as the time endowment for parents who are able to work from home $\bar{\tau}^{SC}$. We set $\underline{\tau}^{SC} = 1$, that is, parents who cannot work from home have the same time endowment as before the crisis. In contrast, parents who can work from home have a higher endowment, $\bar{\tau}^{SC} > 1$. The underlying assumption is that parents who can work from home have some ability to work and supervise their children's learning at the same time, which increase their effective time endowment (as in Alon et al. 2020).

Table 4: Calibrated Parameters: Time Cost and Time Endowment

	Value
Minimal Time Cost $\bar{I}^{SC}$	0.32
Time Endowment of Work-from-Home Parents $\bar{\tau}^{SC}$	2.42

The table shows the values of the two calibrated parameters: the basic time cost required to manage learning at home ($\bar{I}^{SC}$), as well as the time endowment for parents who are able to work from home ($\bar{\tau}^{SC}$).

Table 4 shows the calibrated parameters. We find that approximately 30 percent of the pre-Covid time endowment needs to be devoted to the child as a basic parental time cost of remote learning. Moreover, we find that the effective time endowment available for childcare for parents who work from home is 2.4 times

higher than the endowments of parents with in-person jobs.

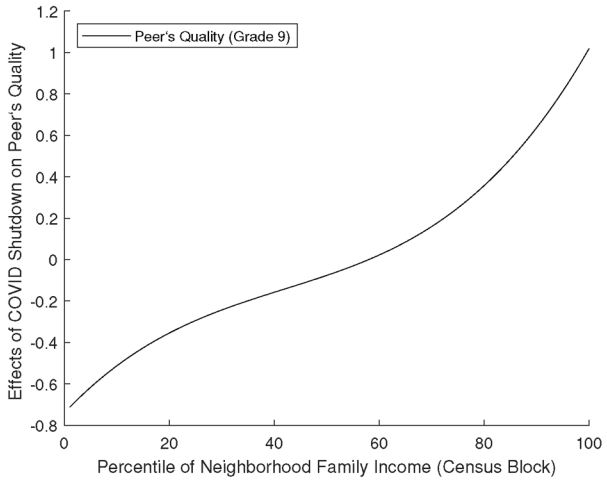
5 The Effect of a Pandemic in the Estimated Model

Our estimated model matches well the evidence on children's skill acquisition, peer formation, and parental behavior during normal times. It also matches well the evidence on average learning losses, changes in the peer environment, and differential time constraints across richer and poorer parents during the Covid-19 crisis. We can then use the estimated model to assess how school, peers, and parents contribute to educational inequality during the pandemic. We can also make forecasts for how human capital accumulation and educational inequality will evolve during the years following the crisis.

Peer Effects. Consider, first, the effect of school closure on peer effects. Figure 3 shows the change in the average GPA of the chosen friends broken down by the percentile of family income at the census block level. The average GPA falls for children from low-income census blocks and increases for children from high-income blocks. This is the result of several forces. First, during the pandemic there is a general decay in the learning process because of the impact of school closures on the productivity of the skill formation technology. Second, the effect varies greatly across the social ladder. Because the peer environment shifts from the school to the neighborhood level, socio-economic segregation increases, causing children living in low-income neighborhoods to have lower-achieving peers than in normal times. Inequality is further exacerbated by the different extent to which rich and poor parents can use their own time to compensate for the lack of in-school instruction. This causes an additional deterioration of the peer environment in low-income neighborhoods, where fewer parents can work from home and hence have less time to help their children.

Overall, peer effects deteriorate far more in low-income neighborhoods. In the richest neighborhoods there is no negative effect at all, partly because interactions move to the neighborhood level where children are more assortatively sorted. In other words, the children from the most affluent families only meet children with a similar background who on average are highly academically proficient.

Figure 3: Simulated Effects of Covid on Endogenous Peer Effects

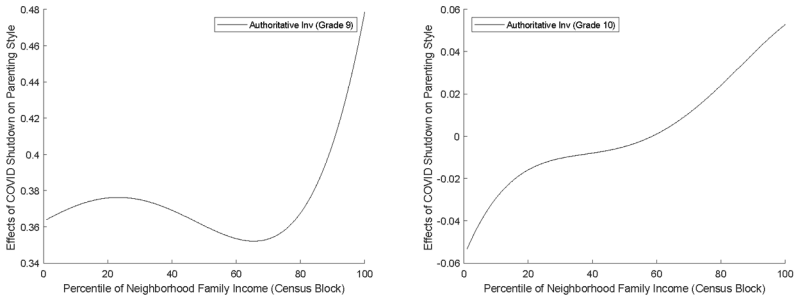


The figure shows the effect of Covid on the endogenous peer quality by neighborhood income. The y-axis displays the change in peer quality after the Covid shock (relative to baseline). The x-axis represents the income percentile of the neighborhood where children live.

Parental Time Investments. Because in our estimated model parental investments are a substitute of peer effects (see Section 4.1), parents in more disadvantaged areas have an incentive to offset a deteriorating peer environment by spending more time on supporting their children's learning. Indeed, Figure A-1 in the Appendix shows that, absent other constraints, it is the parents living in poor neighborhoods who would increase their time investments the most during the pandemic. However, the pandemic has an additional effect: it frees time selectively for parents working from home. The flexibility of work arrangements hinges on a parent's occupation, which in turn is highly correlated with income.

Figure 4 shows the response of time investments for parents of 9th graders, taking into account the different time constraints people face. The time investment increases for all parents, largely because during the pandemic parents must devote a certain number of hours to help their children with school-related tasks.

Figure 4: Simulated Effects of Covid on Parenting: Authoritative Investments



(a) Grade 9 (b) Grade 10

The figure shows the effect of Covid on parental investments by neighborhood income. The y-axis displays the change in parental investments after the Covid shock (relative to baseline). The x-axis represents the income percentile of the neighborhood where children live.

However, the response varies across the socio-economic ladder, with a reverse pattern relative to the case in which parents face uniform constraints. There are no significant differences across the poorest 80 percent of neighborhoods. However, authoritative investments increase steeply in income for the top 20 percent. In the richest neighborhoods, where many parents can work from home, the response of parental investments is 50 percent larger compared to average parents, and 70 percent larger compared to the poorest parents.

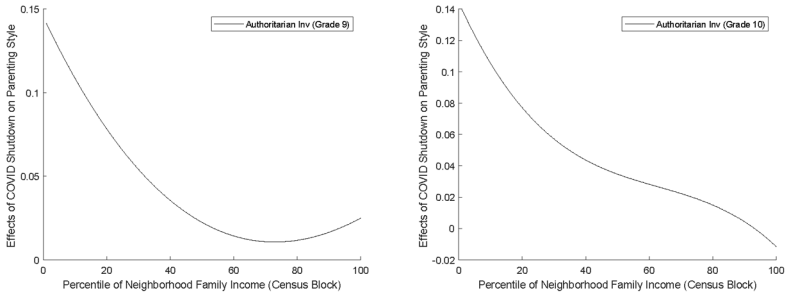
One might have expected poorer parents to make up for the learning gap after the pandemic is over. However, this turns out not to be the case. The right-hand panel of Figure 4 shows the response when the children move to 10th grade after the pandemic is over. Changes in parental investments relative to the pre-pandemic baseline continue being steeply increasing in income. The reason is that in our estimated model authoritative investments are a substitute for peer effects but a complement to children's own skills. For parents living in the poorest neighborhoods, there is a discouragement effect arising from the lower attainment of their own children. In addition, when their children return to school, they are mixed with better peers. Both changes induce parents living in dis-

advantaged neighborhoods to cut the authoritative investments relative to the pre-pandemic baseline. The situation is different for the children of richer parents. The skills of these children did not suffer a comparable setback during the school closure. Moreover, when they return to school these children interact with weaker peers. This induces rich parents living in affluent neighborhoods to increase the authoritative investments relative to the pre-pandemic baseline.

Authoritarian Parenting. Another part of the response generated by the Covid shock is an increase in authoritarian parenting. In the baseline economy, authoritarian parenting is prevalent among poorer families whose children are on average less proficient, while it is almost absent among richer families. Figure 5 shows that the pandemic exacerbates this pattern. In both grade 9 (during Covid) and grade 10 (after Covid), the authoritarian parenting style increases in poor neighborhoods, while remaining unchanged at a low level in richer neighborhoods. The difference in the response is quantitatively large. In the baseline economy, about 18 percent of parents adopt an authoritarian parenting style. For the poorest parents, the model predicts an increase in the prevalence of authoritarian parenting of 14 percentage points. The effect persists beyond the pandemic. To understand why the response is heavily skewed toward poor families, note that authoritarian parenting increases when peer effects deteriorate and when a child's own skills are lower. Both factors apply to poor families during Covid: their children suffer a learning loss and they are more exposed to the influence of low-achieving peers. While adopting the authoritarian parenting style is an individually rational choice in the model, it exerts a negative externality on other disadvantaged children, thereby contributing to wider educational inequality during the pandemic.

Skill Accumulation. Our analysis thus far has highlighted two main channels leading to skewed effects against the poor. The first is an increase in sorting associated with the fact that peer interactions move from the school to the neighborhood level. Because neighborhoods are more segregated than schools, the peer environment deteriorates for children living in poorer neighborhoods and improves for those living in richer neighborhoods. The second concerns parenting style and parental investments. In poor neighborhoods, parents become more

Figure 5: Simulated Effects of Covid on Parenting: Authoritarian Parenting Style



(a) Grade 9 (b) Grade 10

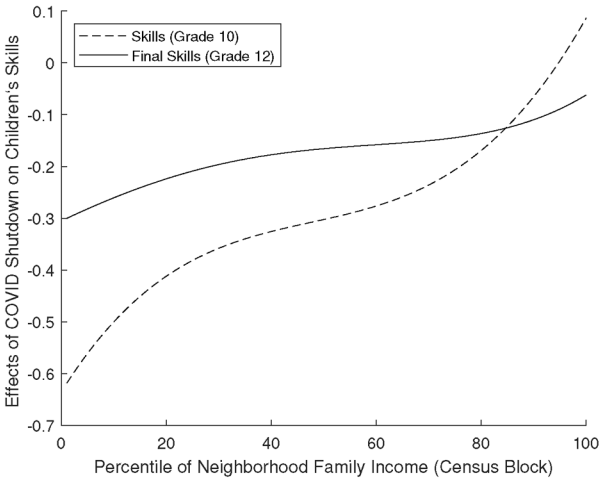
The figure shows the effect of the pandemic on parenting style by neighborhood income. The y-axis displays the change in the fraction of authoritarian parents after the Covid shock (relative to baseline). The x-axis represents the income percentile of the neighborhood where children live.

authoritarian, while in rich neighborhoods parents spend significantly more time with their children. This is the rational response to different time constraints and to the change in the peer environment. The pattern persists after schools reopen.

Figure 6 shows the effect of the Covid shock on the skill accumulation of 9th graders along with the simulated effect for the same children at the end of the high school. The initial impact in 9th grade is large and skewed. There are no significant effects on the skills of children living in the most affluent neighborhoods—for the top decile of neighborhoods we even observe a slight improvement relative to baseline. For children living in rich neighborhoods, the negative effect of school closures is offset by an increase in parental investments along with an improvement in the peer environment. For children living in the poorest neighborhoods, the skill loss when entering 10th grade amounts to 0.6 standard deviations.[17] Many poor working parents cannot respond to the lack of in-class teaching because they cannot work from home. In addition, parents turn more

[17]In terms of the GPA scale (which ranges from 1.0 for a straight-D student to 4.0 for a straight-A student) this change corresponds to a decline of almost half a point; for example, a child who was a straight-B student before would now be getting a C grade in almost half of the subjects.

Figure 6: Simulated Effects of Covid on a Child's Skills



The figure shows the effect of Covid on children's skills by neighborhood income. The y-axis displays the change in children's skills after the Covid shock (relative to baseline). The units are in terms of a standard deviation of skills across children. The x-axis represents the income percentile of the neighborhood where children live.

authoritarian, which imposes a negative externality on the local environment that hits the most disadvantaged children especially hard.

Table 5 shows how each of the three channels (schools, peers, and parents) contributes to rising educational inequality during the pandemic. If we remove the negative learning shock during the pandemic (i.e., the downward shift in the skill accumulation technology that represents the direct effect of switching from in-person to virtual schooling) the income gradient in the impact of the crisis on education would be reduced by about a third. Leaving the learning shock in place but removing inequality in time constraints across parents (as if all parents could work from home, regardless of income), reduces the gradient by slightly more than 20 percent. The change to the peer environment has the largest impact: if we hold peer influences on learning constant at the pre-crisis level, the gradient is reduced by more than 60 percent.

Table 5: Contribution of Covid Effects on Children's Skills by Income

	No Learning Shock	No Peers Shock	No Extra Time Constraints
Inequality of Covid Effects by Income	-32.85%	-61.94%	-22.13%

The table shows the contribution of school, larges, and parents to the income gradient of the effect of the pandemic on skills in 12th grade in Figure 6. Each column shows the reduction in the income gradient when the mechanism is shut down.

We can also use the estimated model to trace out how children's skills evolve over the remaining high school years. Over time, the negative effect turns both smaller and less unequal. The children of richer families suffer some losses because they interact with weaker peers in school. Conversely, as schools reopen the children from disadvantaged backgrounds benefit from returning to school, which offers a less socially segregated environment and better peer effects than does the neighborhood. The long-run losses are about half as large as the short-run losses (in percentage terms). Nevertheless, the outcome continues to be unequal. At the end of high school, the average human capital deficit is about 12 percent, ranging from 5 percent in the most affluent communities to 30 percent in the poorest ones. These are large long-run differences in a society already troubled by dramatic gaps in opportunities.

6 Policy Implications

The severe learning losses already documented during the Covid-19 pandemic and the prospect of widening educational inequality call for well-designed policies that can help offset some of these effects. These policy questions are relevant not just for the ongoing crisis, but also for preparing for the possibility of another pandemic in the near future. In terms of consequences for education, keeping schools open during a pandemic would be desirable, but clearly this has to be weighed against the need to control the pandemic and to stop infections from spreading. Still, policymakers face tradeoffs even during a crisis, and an analysis of the consequences of the pandemic for children's education can help inform these tradeoffs.

A general point about the impact on children's education is that the impacts are hard to undo and can have lifelong consequences for children's future prospects. Unlike a business that can be compensated for pandemic-induced losses, there is no magic trick for making up learning losses incurred during the crisis. This observation suggests that keeping schools open during the crisis should have a higher priority than, say, opening bars and restaurants that can be supported with other means. While this is the approach already taken by a number of countries, other communities, including many US states, have taken the opposite tack of prioritizing keeping businesses open over schools.

Beyond fully opening all schools, another option consists of partial openings, with only a fraction of students attending in-person school to allow for better social distancing. Our analysis can inform which groups would particularly benefit from in-person schooling. One potential criterion is whether a child's parents are able to work from home and support virtual learning. The children of essential workers who cannot work from home during the crisis are especially vulnerable. Some countries have already experimented with providing childcare specifically for the children of essential workers. But the ability to work from home could be used as a more general criterion for who should attend in-person schooling.

In terms of peer effects, our empirical results suggest that children who already have to adjust to a new peer environment because they are switching schools are especially vulnerable to negative repercussions of reduced peer interactions. This channel would suggest that students who enter high school (9th grade) should have a higher priority for in-person schooling compared to 10th or 11th graders who have already established peer networks in high school. The evidence is suggestive that the same would be true for children transitioning from elementary to middle school, although our data does not directly speak to this issue.

Beyond the specific structure of our analysis, it is also worth asking whether additional schooling could be provided at a later time to make up for some of the learning losses during the pandemic. School children in the United States and other countries usually have long summer breaks. It now appears likely that by the summer of 2021 safe, in-person schooling will be possible again. Extending school throughout the summer at least for the more vulnerable groups of chil-

dren might be the last chance to offset at least some of the substantial learning losses that are otherwise likely to have lifelong effects. Investing in such programs would be expensive, but not excessively so relative to support already given to individuals and businesses. Providing a detailed cost-benefit analysis for such programs should be a high priority for researchers in the coming months.

7 Conclusions

The Covid-19 pandemic has brought about the largest disruption to children's learning in many countries in generations. Empirical evidence suggests that learning losses, once accrued, are difficult to fully offset later on, suggesting that the current crisis will affect the economic opportunities of today's children for decades to come. An additional concern is the impact of the pandemic on educational inequality. As Horace Mann famously put it, in regular times schools play a role as a "great equalizer"—they provide a single learning environment and integrated peer groups for children from different backgrounds. The Covid-19 pandemic puts this role of schools at risk.

This paper builds on the observation that children's learning depends not just on schools, but also on inputs provided by their parents and on interactions with their peers. To assess how a pandemic such as the current one affects overall learning and educational inequality, all three channels should be taken into account. We provide such an analysis by using a quantitative model of skill acquisition that explicitly models the behavior of parents, children, and children's peers. We calibrate this model to match evidence from the current crisis, and use the estimated model to shed light on how each factor contributing to children's overall success in education is modified during the pandemic.

The main conclusion from our analysis is that each of the channels we consider contributes to higher educational inequality. Children from poorer families do relatively worse with virtual compared to regular schooling; they are less likely to benefit from positive peer spillovers during the crisis; and their parents are less likely to work from home and hence less likely to be able to provide them with maximum support for virtual schooling. The end result is that learning gaps

grow during the pandemic. Our model also predicts that wider achievement gaps will persist until children finish high school, suggesting that children's long-term prospects are at risk.

Our findings suggest that policy options that could counteract some of these changes, such as extending in-person schooling for at-risk children throughout the summer months, should be considered. Our findings also call for more empirical and structural research on the education crisis brought about by the pandemic. There is now some direct evidence on changes in children's learning during the pandemic, but for other aspects such as changes to peer effects our analysis relies primarily on extrapolation from earlier evidence. More comprehensive evidence on how children's peer environments and parental interactions change during the pandemic will put researchers and policymakers in a better position to evaluate possible countermeasures.

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Appendices

A Functional Forms for Estimation

To estimate the model, we impose functional forms and restrictions that allow us to summarize the model by a list of parameters.

Initial Conditions. The initial distribution of children skills within each school s is drawn from a log-normal distribution. This specification captures the initial (and to us unobserved) sorting of families into different schools characterized by different initial distributions of children's skills. We define the initial conditions for each school s as follows:

$$\ln \theta_{i,1} \sim N(\mu^s, (\sigma^s)^2), \tag{A-1}$$

where μ^s and σ^s represent the school-specific mean and the standard deviation of the log-skills.

Similarly, initial conditions at the neighborhood level (which are relevant during the pandemic are given by:

$$\ln \theta_{i,1} \sim N(\mu^n, (\sigma^n)^2), \tag{A-2}$$

Once the initial heterogeneity of children's skills within the school is realized, children select their initial peer group according to their preferences for friends (Equation (4)). At this stage, the initial vector of state variables $\{\theta_{i,1}, \bar{\theta}_{i,1}\}$ is determined, and the dynamic parent-child interaction starts according to the model described above.

Technology of Skill Formation. We parameterize the technology of skill formation with the following nested CES production function:

$$s(\theta_{i,t}, \bar{\theta}_{i,t}, I_{i,t}, P_{i,t} = p) = A_p(t) \times H_p(\theta_{i,t}, \bar{\theta}_{i,t}, I_{i,t}),$$

where $p \in \{0, 1\}$, $A_p(t) = exp(\psi_0 + \psi_1 \cdot t + \psi_2 \cdot p)$, and

$$H_p(\theta_{i,t}, \bar{\theta}_{i,t}, I_{i,t}) = \left[\alpha_{1,p}\, \theta_{i,t}^{\alpha_{4,p}} + (1 - \alpha_{1,p}) \left[\alpha_{2,p}\, \bar{\theta}_{i,t}^{\alpha_{3,p}} + (1 - \alpha_{2,p})\, I_{i,t}^{\alpha_{3,p}} \right]^{\frac{\alpha_{4,p}}{\alpha_{3,p}}} \right]^{\frac{\alpha_{5,p}}{\alpha_{4,p}}}.$$

Note that all parameters of the skill formation technology depend on p, namely, whether the parent chooses an authoritarian parenting style. First, this affects the total factor pro-

ductivity $A_p(t)$, capturing the potential disruptive effect of authoritarian parenting on the parent-child relationship documented by the developmental psychology literature. Our estimation below indeed finds that $\psi_2 < 0$, i.e., an authoritarian parenting style depresses skill accumulation. Second, parenting style affects the parameters $\alpha_{1,p}$ and $\alpha_{2,p}$, capturing the weights of the different inputs. Our estimation finds that the authoritarian style attenuates the influence of peers. Third, an authoritarian parenting style also affects the elasticity-of-substitution parameters $\alpha_{3,p}$ and $\alpha_{4,p}$ and the returns-to-scale parameter ($\alpha_{5,p}$). Here the data suggest the parenting style determines whether peer effects are a substitute or a complement to other inputs in the production of skills.

Parent's Preferences. We specify the parent's period utility in (2) as follows:

$$U(I_{i,t}, P_{i,t}, \epsilon_{i,t}) = \delta_1 \ln(1 - I_{i,t}) + \delta_2 P_{i,t} + \epsilon_{i,t}(P_{i,t}), \tag{A-3}$$

where δ_1 and δ_2 define the disutility of authoritative investment and of engaging in an authoritarian parenting style, respectively, and $\epsilon_{i,t}(P_{i,t})$ is a taste shock that is conditional on the parenting style. We assume that this shock follows a type-I extreme value distribution. The paternalistic utility of the parent takes the following form:

$$\tilde{u}(\theta_{i,t}, I_{i,t}, P_{i,t}) = \delta_3 \ln(\theta_{i,t}) \cdot (1 + \delta_4 P_{i,t}), \tag{A-4}$$

where δ_3 captures the level of the parent's paternalistic enjoyment of the child's skills, which may depend on the parenting style through parameter δ_4. The utility derived from the child's adult skills $\theta_{i,T+1}$ takes the same form as the period-by-period paternalistic utility from skills:

$$V_{T+1}^{n,s} = \delta_3 \ln(\theta_{i,T+1}).$$

In the empirical model, we set $Z = B = 1$. This is without loss of generality. An increase in either B or Z is equivalent to a proportional decrease in cost parameters δ_1 and δ_2. Changing B and/or Z would affect the numerical estimates of those parameters without altering the model fit or the counterfactual experiments.

Child's Preferences. The (marginal) utility child i earns from being friends with child j relative to not being friends with j is:

$$\begin{aligned} f_{i,j,t+1} = \gamma_0 + \gamma_1 \ln\theta_{i,t+1} + \gamma_2 \ln\theta_{j,t+1} + \gamma_3 (\ln\theta_{i,t+1} - \ln\theta_{j,t+1})^2 \\ + \gamma_4 \mathbb{1}(\theta_{j,t+1} < \theta_{i,t+1}) (\ln\theta_{i,t+1} - \ln\theta_{j,t+1})^2 P_{i,t} + \eta_{i,j,t+1}. \end{aligned} \tag{A-5}$$

Here, $\eta_{i,j,t+1}$ is a random taste shock for being friends with child j, which we assume to be i.i.d. standard logistic distributed. The terms $\gamma_1 \ln \theta_{i,t+1}$ and $\gamma_2 \ln \theta_{j,t+1}$ capture, respectively, the effect of child i's and child j's skills on the utility child i earns from being friends with child j, where γ_1 and γ_2 are parameters that will be estimated. The quadratic term $(\ln \theta_{i,t+1} - \ln \theta_{j,t+1})^2$ captures potential homophily bias in the formation of friends. A negative coefficient $\gamma_3 < 0$ would imply that the higher the difference in skills between the two children, the lower the utility for child i to be friends with child j.

The coefficient γ_4 captures the effect of an authoritarian parenting style on the preferences for child j's skills. In particular, if $\gamma_4 < 0$, authoritarian parenting imposes a penalty whenever the child is friends with a lower-skill peer, where the penalty increases with the GPA gap between the two children. This formulation captures the idea that parental intervention (through, e.g., moral suasion, threat of punishment, or incentives) is designed to improve the quality of the child's peer selection.

We can now characterize the conditional probability that a friendship link between child i and child j is formed as:[18]

$$Pr(j \in \mathcal{X}_{i,t+1} | \theta_{i,t+1}, P_{i,t}, \theta_{j,t+1}, P_{j,t}) = \frac{\exp(\Gamma_{i,j})}{1+\exp(\Gamma_{i,j})} \frac{\exp(\Gamma_{j,i})}{1+\exp(\Gamma_{j,i})}, \tag{A-6}$$

where:

$$\Gamma_{i,j} = \gamma_0 + \gamma_1 \ln \theta_{i,t+1} + \gamma_2 \ln \theta_{j,t+1} + \gamma_3 (\ln \theta_{i,t+1} - \ln \theta_{j,t+1})^2 + \gamma_4 \mathbb{1}(\theta_{j,t+1} < \theta_{i,t+1}) (\ln \theta_{i,t+1} - \ln \theta_{j,t+1})^2 P_{i,t},$$

$$\Gamma_{j,i} = \gamma_0 + \gamma_1 \ln \theta_{j,t+1} + \gamma_2 \ln \theta_{i,t+1} + \gamma_3 (\ln \theta_{j,t+1} - \ln \theta_{i,t+1})^2 + \gamma_4 \mathbb{1}(\theta_{i,t+1} < \theta_{j,t+1}) (\ln \theta_{i,t+1} - \ln \theta_{j,t+1})^2 P_{j,t}.$$

The presentation of the parent's and child's preferences completes the description of the effects of parenting style in our model. To summarize, authoritarian parenting has a direct effect on the technology of skill formation given the current child's skill and peers. In

[18]The conditional probability in Equation (A-6) might suggest a potential strategic interaction between parents when deciding about their own parenting style. However, under our assumptions, only the parent of the higher-skill child can actively affect the probability in Equation (A-6), so there is in fact no strategic interaction among parents. Note that in our model parents have an additional motive to invest in their children's skills, namely, to give them more opportunities to condition their children's choice of peers in the future.

addition, authoritarian parenting affects the process of peer formation by discouraging the child from choosing low-skill friends. Our estimates below imply that, conditional on an existing set of friends, an authoritarian parenting style entails productivity losses in the skill formation technology. The reason some parents still choose to be authoritarian must then lie in the benefits of an improved quality of future peers. It follows from this argument that in wealthy and homogeneous schools, where most potential friends are highly skilled and there is little risk that one's child might associate with low-skill peers, the cost of an authoritarian parenting style is high while the benefit is small. Conversely, parents will tend to be authoritarian in schools where children face a high risk of exposure to low-skill peers.

A Additional Figures and Tables

Table A-1: Effect of Peer Separation on Child's GPA by Gender

	Change in GPA (from Grade 8 to Grade 9)			
	Child is Boy		Child is Girl	
	(1)	(2)	(3)	(4)
N. of Peers who Left	-0.100*	-0.124*	-0.100**	-0.080
	(0.059)	(0.073)	(0.049)	(0.052)
N	559	559	676	676
Controls	Yes	Yes	Yes	Yes
School F.E.	No	Yes	No	Yes

The table shows the disruptive effects by gender of losing social ties in the transition from middle school to high school. The outcome is the change in a child's GPA during the transition from middle school to high school. In all the columns, the independent variable is the number of friends that a child lost. In columns (1)-(2), consider the sample of female students, while in columns (3)-(4) we consider the sample of male students.

Table A-2: Effect of Peer Separation on Child's GPA

	Change in GPA		
	(1)	(2)	(3)
Grade 8 (t-1) × N. of Peers who Left	-0.105***	-0.106***	-0.111***
	(0.040)	(0.040)	(0.039)
Grade 7 (t-1) × N. of Peers who Left	0.001	0.004	-0.021
	(0.052)	(0.052)	(0.049)
Grade 9 (t-1) × N. of Peers who Left	-0.028	-0.030	-0.014
	(0.042)	(0.042)	(0.036)
Grade 10 (t-1) × N. of Peers who Left	-0.033	-0.034	-0.013
	(0.025)	(0.025)	(0.023)
Grade 11 (t-1) × N. of Peers who Left	0.039	0.038	0.055*
	(0.025)	(0.025)	(0.032)
N	7611	7611	7611
Controls	No	Yes	Yes
School F.E.	No	No	Yes

The table shows the disruptive effects by grade of losing social ties in the transition from middle school to high school. The outcome is the change in a child's GPA from Wave I survey to Wave II survey. In all the columns, the independent variable is the number of friends that a child lost, interacted with the grade in which children were enrolled to during Wave I.

Table A-3: Balance Test on Peers who Left

	Peers' GPA (t-1)		
	(1)	(2)	(3)
One or More Peers Left	0.013	0.024	-0.017
	(0.041)	(0.038)	(0.029)
N	1230	1230	1230
Controls	No	Yes	Yes
School F.E.	No	No	Yes
Mean Cohort GPA	2.90		
Mean Peers Left GPA	2.81		
P-value	0.065		

The table shows the balance test for the quality of peers who left. Each column shows a regression coefficient, where the dependent variable is the Peers' GPA during Wave I survey, while the independent variable is whether or not a child lost a friend or more during the transition (dummy variable).

Table A-4: Effect of Peer Separation (with Quality) on Child's GPA

	Change in GPA	
	(1)	(2)
One or More Peers Left	-0.117**	-0.075*
	(0.051)	(0.044)
One or More Peers Left × GPA of Peers who Left	0.049	-0.004
	(0.079)	(0.071)
N	1235	1235
Controls	No	No
GPA (t-1)	No	Yes

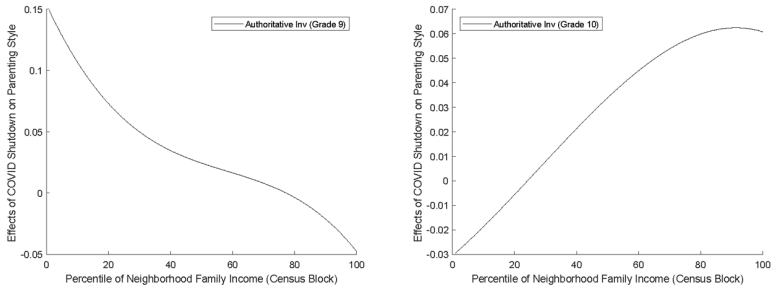
The table shows the heterogeneous disruptive effects of losing social ties in the transition from middle school to high school. The outcome is the change in a child's GPA during the transition from middle school to high school. We interact whether or not a child lost a friend with the baseline GPA of the peers who left.

Table A-5: Effect of Peer Separation on Child's GPA (All grades)

	Change in GPA								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
One or More Peers Left × Grade 8 (t-1)	-0.123**	-0.124**	-0.131**						
	(0.051)	(0.051)	(0.051)						
Grade 8 (t-1) × N. of Peers who Left				-0.105***		-0.106***		-0.111***	
				(0.040)		(0.040)		(0.039)	
1 Friend × Grade 8 (t-1)					-0.102*		-0.103*		-0.113**
					(0.054)		(0.054)		(0.056)
2 Friends (or More) × Grade 8 (t-1)					-0.218**		-0.218**		-0.219**
					(0.093)		(0.091)		(0.087)
One or More Peers Left × Grade 7 (t-1)	0.005	0.008	-0.022						
	(0.058)	(0.057)	(0.054)						
Grade 7 (t-1) × N. of Peers who Left				0.001		0.004		-0.021	
				(0.052)		(0.052)		(0.049)	
1 Friend × Grade 7 (t-1)					0.009		0.012		-0.018
					(0.052)		(0.052)		(0.049)
2 Friends (or More) × Grade 7 (t-1)					-0.015		-0.012		-0.049
					(0.147)		(0.146)		(0.139)
One or More Peers Left × Grade 9 (t-1)	-0.024	-0.025	-0.006						
	(0.055)	(0.055)	(0.047)						
Grade 9 (t-1) × N. of Peers who Left				-0.028		-0.030		-0.014	
				(0.042)		(0.042)		(0.036)	
1 Friend × Grade 9 (t-1)					-0.006		-0.008		0.006
					(0.057)		(0.056)		(0.050)
2 Friends (or More) × Grade 9 (t-1)					-0.093		-0.095		-0.059
					(0.087)		(0.087)		(0.080)
One or More Peers Left × Grade 10 (t-1)	-0.033	-0.034	-0.004						
	(0.031)	(0.031)	(0.032)						
Grade 10 (t-1) × N. of Peers who Left				-0.033		-0.034		-0.013	
				(0.025)		(0.025)		(0.023)	
1 Friend × Grade 10 (t-1)					-0.019		-0.019		0.008
					(0.032)		(0.032)		(0.036)
2 Friends (or More) × Grade 10 (t-1)					-0.085		-0.091		-0.057
					(0.063)		(0.063)		(0.054)
One or More Peers Left × Grade 11 (t-1)	0.087*	0.086*	0.107*						
	(0.045)	(0.046)	(0.058)						
Grade 11 (t-1) × N. of Peers who Left				0.039		0.038		0.055*	
				(0.025)		(0.025)		(0.032)	
1 Friend × Grade 11 (t-1)					0.120*		0.119*		0.128*
					(0.061)		(0.061)		(0.069)
2 Friends (or More) × Grade 11 (t-1)					0.029		0.027		0.065
					(0.044)		(0.045)		(0.056)
N	7611	7611	7611	7611	7611	7611	7611	7611	7611
Controls	No	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes
School F.E.	No	No	Yes	No	No	No	No	Yes	Yes

The table shows the disruptive effects of losing social ties in the transition from one grade to the next one. This table replicates the results in Table 1 for every grade in the sample.The outcome is the change in a child's GPA from Wave I survey to Wave II survey.

Figure A-1: Simulated Effects of Covid on a Parenting Style: Authoritative Investments (Absent Time Constraints)



(a) Grade 9 (b) Grade 10

The figure shows the effect of Covid on the parental investments by neighborhood income. The y-axis displays the change in parental investments after the Covid shock (relative to baseline). The x-axis represents the percentile of neighborhood income where children live.