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Public Perceptions of Current COVID-19 Vaccinations. Results of a Pilot Survey

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Abstract

Introduction: We conducted a cross-sectional survey as a part of an educational program in collaboration with the Global Thrombosis Forum (GTF), an affiliate of North American Thrombosis Forum (NATF), and Loyola University about public perceptions of COVID-19 and COVID-19 vaccinations in the US. In this study, we are reporting the results of this survey.
Materials and Methods: The survey, in the form of a questionnaire, has been developed by GTF and faculty members. A prepared questionnaire was sent to the members of the Georgia and Illinois communities.
Results: In our current study, the COVID-19 vaccine willingness rate was 94.5% and vaccination rate was 90.9%. In multivariate analysis believing to have enough information about the safety and efficacy of COVID-19 vaccines (OR: 3.730, 95% CI: 1.199–11.603, p: 0.023) and gender (OR: 0.123, 95% CI: 0.016–0.967, p: 0.046) were significant predictors for vaccine willingness. Previous COVID-19 infection (OR: 0.215, 95% CI: 0.061–0.758, p: 0.017), moderate and severe effects of COVID-19 pandemic on participant's life (OR: 4.631, 95% CI 1.681–12.760, p: 0.003) and believing to have enough information about the safety and efficacy of COVID-19 vaccines (OR: 4.119, 95% CI: 1.508–11.253, p: 0.006) were significant predictors for final vaccination status.
Conclusion: In conclusion, currently vaccination remains one of the most effective tools in the fight against the COVID-19 pandemic. The vaccine hesitancy is a complex phenomenon that is driven by individuals' perceptions of safety, and efficiency of the vaccines. We must continue to educate the public and communities that vaccines are safe, that they are effective and that they are still required even after a COVID-19 infection.

Keywords

COVID-19, vaccination, public perception, vaccine hesitancy

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Introduction

Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), first reported in China, has subsequently spread around the world and coronavirus disease 2019 (COVID-19) was declared a pandemic by the World Health Organization in March 2020.[1,2] After its first appearance in late December of 2019, almost two years have elapsed, and the catastrophe that it created paralyzed healthcare systems, disrupted the global economy, led to cessation of educational systems and changed all of our lives. Simple prevention measures such as using masks, physical distancing or hygiene can slow down the pandemic, but no definitive treatment has yet been developed for COVID-19.[3] The effectiveness of vaccines has been scientifically proven, and they are the most powerful tools to fight against COVID-19.[4]

The publication of the virus genome in January 2020 accelerated the development of the vaccines against COVID-19.[5] Several different vaccines were deployed by late December

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2020, under emergency use authorization, and mass vaccination campaigns have commenced all around the world. However, the discovery of vaccines did not completely solve the COVID-19 related problems. Additionally, the control of the pandemic requires greater than 80% vaccination of the global population.[6] Furthermore, uniformity in the vaccination programs in various regions of the world is equally important. Regarding this, the supply, logistics, and monitoring of vaccine distribution and administration cannot be underestimated. The difficulties of supply-chain management require a high level of strategy and proper tactical execution that spans the globe.

According to WHO, more than 6 billion doses of COVID-19 vaccines have been administered globally.[7] However, vaccination rates are far less than would be necessary to control the pandemic, especially in Africa and Southeast Asian countries. Vaccination programs widely differ due to financial and logistics constraints throughout the world with a direct impact on the prevalence of COVID-19 infections. Additionally, public acceptance of vaccines and vaccine hesitancy have become growing concerns for the success of vaccination programs. The information on vaccine effectiveness and safety or adverse effects are important factors for public acceptance of vaccines. The duration of protection of COVID-19 vaccines or requirement of a booster dose are also areas of uncertainty affecting vaccine hesitancy.

The vaccination challenges have gained enormous public interest during COVID-19 pandemic. In general, vaccination programs help protect communities from many infectious diseases based on two main principles: 1) direct protection of an individual by gaining the immune response against a specific disease and 2) indirect protection by providing "herd immunity" for those who cannot be vaccinated.[8] However, vaccination rates against many preventable diseases are lower than expected. Even if the most effective vaccine is administered, it would have a limited impact on the spread of a disease if people refuse to take it.[9,10] This has been proved in various disease states including seasonal influenza and measles vaccinations which caused outbreaks in the US and other countries.[11,12] In order to achieve herd immunity, the vaccination rates must be at high levels. However, vaccine hesitancy has become an increasing problem in recent years globally.

The Strategic Advisory Group of Experts on Immunization (SAGE) described vaccine hesitancy as "delay in acceptance or refusal of vaccination despite availability of vaccination services".[13] WHO enlisted vaccine hesitancy among top ten threats to global health in 2019.[14] Vaccination hesitancy causes significantly decreased rates of vaccination among communities and presents a great challenge in the fight against infectious diseases. Vaccine hesitancy is a multifactorial phenomenon which is caused by many different factors including cognitive, psychologic, socio-demographic, political and cultural factors across different populations.[15] Analysis of these factors is critically important to correctly address COVID-19 vaccine hesitancy, for the assessment of the scope and magnitude of this public health threat.

Recently we conducted a cross-sectional survey as a part of an educational program in collaboration with the Global Thrombosis Forum (GTF), an affiliate of North American Thrombosis Forum (NATF), and Loyola University about public perceptions of COVID-19 and COVID-19 vaccinations in the US. In this study, we are reporting the results of this questionnaire.

Materials and Methods

We conducted a cross-sectional survey as a part of an educational program about public perceptions of COVID-19 and COVID-19 vaccinations in the US between June 15- July 31, 2021. The study was organized as a vaccine awareness project in collaboration with GTF and the faculty of the Health Science Division at Loyola University Chicago, Illinois. The survey, in the form of a questionnaire, has been developed by GTF and faculty members. The items in the questionnaire were designed to identify the community's perception to COVID-19 by considering the public agenda. The first part of the questionnaire was prepared to collect data regarding baseline characteristics of the participants while the second part was used to measure the perceptions about COVID-19. The third part was designed to measure the perceptions about COVID-19 vaccines. The fourth part was prepared to collect data of vaccination experiences among participants. The final part was prepared to understand future perspectives of participants about the COVID-19 pandemic and vaccinations. An introductory mission and confidentiality statement added to the questionnaire enabled us to get a good response. We recruited all participants from an online survey panel accessed through a free, web-based survey administration software (Google Forms). The survey has been distributed by a high school student as well as faculty members who were involved in this project. A prepared questionnaire was sent to the members of the Georgia and Illinois community. Our population consisted of high school students, health care professionals, families, friends, and volunteers. Prior permission from school authorities was obtained. All the prospective respondents were contacted through electronic mail accounts.

Statistical Analysis

Basic descriptive statistics were used to characterize the sample and study variables. Univariate analysis of continuous variables assessed by Mann Whitney U test. Categorical variables assessed by Chi-Square and Fisher exacts tests. Multivariate analysis performed by logistic regression analysis to determine significant independent predictors. A p-value of less than 0.05 was considered to indicate statistical significance; all tests were 2-tailed.

Results

Participant Demographics

A total of 253 participants responded to the survey, including 95 (38%) male and 155 (62%) female participants. Median age of the participants was 22 years old (IQR: 17–43 years). Vaccination willingness rates were, 90.9% for females and

Table 1. Baseline characteristics and univariate analysis of COVID-19 vaccine willingness and vaccination status of the participants. (n:253).

		Vaccination Willingness	Vaccination Status
Age (Median, IQR)	Median 22 yrs (IQR: 17- 43 yrs) Age ≥ 65 n (%): 8 (3.2%) Age ≤ 18 n (%): 115 (45.5%)	p: 0.4	p: 0.7
Gender n (%)	Male: 97 (38.3%) Female: 156 (61.7%)	**p: 0.01**	**p: 0.03**
Educational Status n (%)	Primary/Secondary: 16 (6.3%) Highschool/College: 121 (47.8%) University or higher: 116 (45.8%)	p: 0.40	p: 0.66
Occupation n (%)	Healthcare Professional: 27 (10.7%) Non-Healthcare Professional: 66 (26.1%) Student: 129 (51.0%) Unemployed: 20 (7.9%) Retired: 11 (4.3%)	p: 0.45	p: 0.16
Marrital Status n (%)	Single: 154 (60.9%) Married: 99 (39.1%)	p: 0.40	p: 0.65
Having Child/Children n (%)	Yes: 161 (63.6%) No: 92 (36.4%)	p: 0.53	p: 0.86
Living with an elderly or an individual with weak immune system n (%)	No: 200 (79.1%) Yes: 53 (20.9%)	p: 0.10	p: ns
Previous COVID-19 infection n (%)	Yes: 22 (8.7%) No: 231 (91.3%)	p: 0.08	**p: 0.02**

ns: not significant.

98.9% for males. Vaccination rates were 86.1% for females and 95.7% for males. Vaccination rate in individuals that were previously infected with COVID-19 was 77.3% and it was 92.3% for participants who were never infected with COVID-19. Participant cohort baseline characteristics are shown with the results of univariate analysis in Table 1.

COVID-19 Perceptions

Among the 253 participants,157 (62.1%) were worried about experiencing the COVID-19 infection. 96 (37.9%) participants answered that they were not worried. 194 (76.7%) participants responded that their life was moderate to severely affected by COVID-19 pandemic. 195 (77.1%) participants were aware that COVID-19 infection itself can cause thrombotic events. 123 (48.6%) participants were at least moderately-to-severely concerned about COVID-19 delta variant.

The vaccination rates were 93.3% in participants whose life was moderately-to-severely affected by the COVID-19 pandemic and it was 83.05% in participants with no or mild effects. Similarly, the vaccination rates were 100% in participants who have severe concerns about the delta variant, and it was 88.1% in remaining participants who have less than severe concerns.

Results of the survey data regarding COVID-19 perceptions of the participants and univariate analysis are shown in Table 2.

Table 2. COVID-19 perceptions and univariate analysis of COVID-19 vaccine willingness and vaccination status of the participants (n:253).

		Vaccination Willingness	Vaccination Status
Are you worried about experiencing COVID-19?	Yes: 157 (62.1%) No: 96 (37.9%)	p: 0.33	p: 0.14
How did the COVID-19 pandemic affect your life?	Not: 5 (2.0%) Mild: 54 (21.3%) Moderate: 152 (60.1%) Severe: 42 (16.6%)	p: 0.30	**p: 0.016**
Do you believe that COVID-19 infection can cause blood clots?	Yes: 195 (77.1%) No: 58 (22.9%)	p: 0.60	p: 0.052
How concerned are you about the delta variant?	Not concerned: 13 (5.1%) Mild: 117 (46.2%) Moderate: 79 (31.2%) Severe: 44 (17.4%)	p: 0.63	**p: 0.021**

Table 3. COVID-19 Vaccine Perceptions and univariate analysis of COVID-19 vaccine willingness and vaccination status of the participants. (n:253).

		Vaccine Willingness	Vaccination Status
Do you believe that you have enough information about the safety and efficacy of COVID-19 vaccines?	Yes: 210 (83.0%) No: 43 (17.0%)	**p: 0.008**	**p: 0.003**
Do you believe the importance of having the COVID-19 vaccine to protect yourself?	Yes: 246 (97.2%) No: 7 (2.8%)	p: 0.30	p: 0.06
Do you believe the importance of having COVID-19 vaccine to protect others?	Yes: 250 (98.8%) No: 3 (1.2%)	p: ns	p: ns
Did you hear any news about the side effects after COVID-19 vaccinations?	Yes: 234 (92.5%) No: 19 (7.5%)	p: 0.95	p: 0.29

ns: not significant.

COVID-19 Vaccination Perceptions

Among all participants, 210 (83.0%) responded that they have enough information about the safety and efficacy of COVID-19 vaccines. While 246 (97.2%) participants responded that having vaccinations are important for self-protection from COVID-19 infections, 250 (98.8%) participants responded that having vaccinations are important for protection of others as well. 92.5% of all participants (n: 234) were aware of the news about side effects after COVID-19 vaccinations.

Vaccination willingness rates were 96.2% in participants who believe that they have enough information about the safety and efficacy of COVID-19 vaccines, and it was 76.7% in participants who think conversely. In terms of vaccination rates, 93.3% of participants were vaccinated who believe that they have enough information about the safety and efficacy of COVID-19 vaccines. The vaccination rate was 79.1% in participants who think conversely.

Results of survey data regarding COVID-19 vaccination perceptions of the participants and univariate analysis are shown in Table 3.

Vaccine Willingness and Vaccination Experience

Among the entire cohort, 239 participants responded as they are willing/recommend vaccinations against COVID-19, giving a vaccination willingness rate of 94.5%. However, 230 (90.9%) participants were actually vaccinated with at least one dose of COVID-19 vaccine. 160 (69.6%) participants were vaccinated with BNT162b2 vaccine, 65 (28.3%) participants were vaccinated with mRNA1273 vaccine and only 2 participants were vaccinated with Ad26.COV2.S vaccine. Additionally, 3 (1.3%) participants were vaccinated with Coronavac and BBIBP-CorV vaccines. 214 (93.0%) of the vaccine recipients completed their 2 dose vaccination schedules.

Among 230 participants who had COVID-19 vaccinations, 171 (74.3%) had at least one allergic, local or systemic adverse effect. 59 (25.7%) participants had no adverse events. These adverse events were mild in most of the participants and resolved spontaneously. Only 1 participant (0.4%) needed to be admitted to the hospital due to high grade fever which resolved <24 h.

Results of survey data regarding vaccine willingness and vaccination status are shown in Table 4.

Future Concerns of the Participants

Among 230 vaccinated participants, 191 (83.0%) participants preferred to continue using masks in public places after COVID-19 vaccinations. 162 (70.4%) participants were concerned about having COVID-19 infection even after vaccinations and 220 (95.7%) participants were ready to take a third booster dose of the vaccine if available. Results of survey data regarding perceptions of the participants after COVID-19 vaccinations are shown in Table 5.

Univariate and Multivariate Analysis of Factors Influence Vaccine Willingness And Vaccination Status

In univariate analysis, factors including believing to have enough information about the safety and efficacy of COVID-19 vaccines (β: 4.095, 95% CI: 1.343–12.487, p: 0.008), and gender (β: 0.115, 95% CI: 0.015–0.890, p: 0.01), were statistically significant for vaccine willingness. In multivariate analysis both factors [believing to have enough information about the safety and efficacy of COVID-19 vaccines (OR: 3.730, 95% CI: 1.199–11.603, p: 0.023) and gender (OR: 0.123, 95% CI: 0.016–0.967, p: 0.046)] remained significant for vaccine willingness.

For the final vaccination status of the participants, factors including gender (β: 0.310, 95%CI: 0.102–0.941, p: 0.03), previous COVID-19 infection (β: 0.287, 95% CI: 0.095–0.869, p: 0.02), moderate and severe effects of COVID-19 pandemic on participant's life (β: 2.841, 95% CI 1.175–6.869, p: 0.016), having severe concerns about delta variants (β: 1.237, 95% CI: 1.161–1.317, p: 0.021) and believing to have enough information about the safety and efficacy of COVID-19 vaccines (β: 3.706, 95% CI: 1.487–9.235, p: 0.003), were significant. In

Table 4. Vaccine Willingness and Vaccinations (n:253).

Are you willing/recommend to vaccinate against COVID-19? (n: 253)	Yes: 239 (94.5%) No: 14 (5.5%)
Have you ever received any vaccination against COVID-19? (n:253)	Yes: 230 (90.9%) No: 23 (9.1%)
Which vaccine did you receive? (n:230)	BNT162b2 : 160 (69.6%) mRNA1273: 65 (28.3%) Ad26.COV2.S: 2 (0.9%) Others: 3 (1.3%)
How many doses of vaccine did you receive? (n: 230)	1 dose: 16 (7.0%) 2 doses: 214 (93.0%)
Did you have any side effects after vaccination? (n: 230)	Only Allergic Reaction: 1 (0.4%) Only Local Reactions: 58 (25.2%) Only Systemic Reaction: 42 (18.3%) Local & Systemic Reactions: 70 (30.4%) No Reaction: 59 (25.7%)
How long did your symptoms last? (n: 171)	< 24 h: 74 (43.3%) 24 to 72 h: 85 (49.7%) >72 h: 12 (7.0%)

multivariate analysis, only previous COVID-19 infection (OR: 0.215, 95% CI: 0.061–0.758, p: 0.017), moderate and severe effects of COVID-19 pandemic on participant's life (OR: 4.631, 95% CI 1.681–12.760, p: 0.003) and believing to have enough information about the safety and efficacy of COVID-19 vaccines (OR: 4.119, 95% CI: 1.508–11.253, p: 0.006) remained significant for final vaccination status.

Results of multivariate logistic regression analysis for factors influencing vaccine willingness and final vaccination status are shown in Table 6.

Discussion

In previous survey studies across individual (or multiple) US states, different rates of vaccine willingness ranging between 55% to 75% have been reported.[16] In these studies, vaccine willingness rates differed in the time periods according to when they were conducted and which populations were surveyed. However, these studies were mainly focusing on the rates of the COVID-19 vaccine willingness and studies reporting both the vaccine willingness and actual vaccination rates are scarce. In our current study, the COVID-19 vaccine willingness rate was 94.5% and vaccination rate was 90.9%, which was considerably higher than these reports. The fact that our current survey reports both of these rates are especially important. The difference between vaccine willingness and vaccination rate in our study shows that willingness alone is not sufficient for vaccinations. This difference may either be the result of vaccine availability to different populations or may also be related with the complex pathways of vaccine hesitancy. Additionally, previous COVID-19 infections may also be a reason in our study group which have led to this difference. According to data from CDC, the current vaccination rate in the state of Illinois reported as 63.2%, while this rate is given as 54.9% in the state of Georgia.[17,18] The vaccination rates show prominent differences in different counties of these states. Vaccination rates are between 28.9% to 75.9% in different counties of Illinois, while in Georgia these rates vary between 8.3% to 99%.[17–20] These rates show the importance of availability, adherence and uniformity of the vaccination programs in different regions. Since it is not possible to explain the extremely low vaccination rates in different regions with vaccine hesitancy alone. This is best evident in the vaccination rates of the African continent.[7]

Table 5. Perceptions after COVID-19 Vaccination (n: 230).

After vaccination and CDC directives regarding masks, do you still prefer using masks in public places?	Yes: 191 (83.0%) No: 39 (17.0%)
Are you concerned about exposure to COVID-19 even after vaccination?	Yes: 162 (70.4%) No: 68 (29.6%)
If there is a third booster dose of the vaccine available will you consider taking it?	Yes: 220 (95.7%) No: 10 (4.3%)

In previous studies, many different factors have been reported for vaccine hesitancy. In summary, these factors can be enlisted as: age, gender, the level of education, occupation (eg healthcare workers, students, etc), marital status, having child/children, living with individuals in the risk group of COVID-19 infection (eg >65 years old, chronic diseases, immunocompromised individuals), race/ethnicity, perception about COVID-19 infections, perception of vaccine safety and efficacy, availability, affordability and delivery of vaccines in a comfortable context, public health policies, social factors and the messages spread by the media, level of income, political factors and religious concerns.[21–23] In our pilot study, we were able to evaluate most of these factors. Our results have shown that while female gender and believing to have enough information about the safety and

Table 6. Multivariate Logistic Regression Analysis for factors influencing vaccine willingness and final vaccination status.

Variable	Coefficient	Standard Error	Odds Ratio	P value	95% Confidence Interval
Vaccine Willingness					
Believing to have enough information about the safety and efficacy of COVID-19 vaccines	1.317	0.579	3.730	**0.023**	1.199–11.603
Gender	-2.092	1.050	0123	**0.046**	0.016–0.967
Final Vaccination Status					
Gender	-1.023	0.596	0359	0.086	0.112–1.156
Previous COVID-19 infection	-1.537	0.643	0215	**0.017**	0.061–0.758
Moderate and severe effects of COVID-19 pandemic on participant's life	1.533	0.517	4.631	**0.003**	1.681–12.760
Having severe concerns about delta variants	19.273	5559.910	234439649.2	0.997	0 -.
Believing to have enough information about the safety and efficacy of COVID-19 vaccines	1.416	0513	4.119	**0.006**	1.508–11.253

efficacy of COVID-19 vaccines were independent predictors for vaccine willingness, and only previous COVID-19 infection, moderate and severe effects of COVID-19 pandemic on participant's life and believing to have enough information about the safety and efficacy of COVID-19 vaccines remained independent predictors for vaccination status.

Similar to prior studies, in our current study, females were more represented than males.[16,24] Additionally, women were less likely to be willing to take the COVID-19 vaccines compared to men.[16,24] Here, rare thrombotic events that are predominantly observed in women after AstraZeneca vaccinations in Europe and Johnson & Johnson vaccinations in the US may have a negative impact on increased hesitancy in female gender.[4] It is important to note that over 90% of participants in our study group were aware of the news about the side effects after COVID-19 vaccinations. In this regard, previous studies have shown that lack of trust is an important driver of vaccine hesitancy.[25] However, the trust in safety and efficacy of COVID-19 vaccines together with effects of COVID-19 pandemic in personal lives should be stronger motivators for vaccination decisions. We observe that while female gender was a factor in vaccine willingness, it no longer remained a significant factor for vaccination status in multivariate analysis. This finding reminds us that, level of knowledge increases awareness and affects decision-making in vaccine hesitancy.

Our results have also shown that previous COVID-19 infection was a significant factor for vaccination status in multivariate analysis. This may be because people who already had the infection might think that vaccination is unnecessary. This may be problematic since there is a large number of previous COVID-19 infections. Approximately 45 million people have been infected with COVID-19 infection in the US, and 240 million in the world since the beginning of the pandemic.[7,17] Unvaccinated individuals who were previously infected with SARS-CoV-2 have significantly higher likelihood of reinfection.[26] The CDC and WHO websites recommend that persons previously infected with SARS-CoV-2 still get the vaccine.[27,28] For this reason, taking measures to encourage these individuals to be vaccinated is very important.

Lastly, our results across vaccinated participants have shown that side effects after vaccinations were similar with the published literature, generally mild and self-resolving. 70.4% of the vaccinated participants were still concerned about exposure to COVID-19, and 83.0% of them were still using masks in public places even after vaccinations. Interestingly, 95.7% of our vaccinated participants were willing to consider taking a third booster dose if available. These results may be important to understand the thoughts and future expectations of vaccinated individuals following vaccinations.

Strengths and Limitations

This study provides a high level of evidence regarding the factors that contribute to decreased COVID-19 vaccine willingness and vaccination status, to better understand the underlying reasons and setting of correct intervention measures and policy-making. Our cross-sectional survey was carried out as a part of an educational program in collaboration with the members of two highly respected institutions in the US, GTF and Loyola University Chicago. This design concept, which incorporates educational elements, allowed us to execute our study not only as a simple survey study but also as a vaccine awareness project to help increase the vaccine willingness in our local community. We were able to examine a wide range of information in our study population including socio-demographic factors, COVID-19 and COVID-19 vaccine perceptions. We were also able to examine vaccination status, vaccination experience and post-vaccine perceptions and expectations. For this reason, we think that our results are of great importance.

It is important to note that this study is not without limitations. Firstly, this study is a cross-sectional survey study. Due to their nature, cross-sectional studies can collect data at a given snapshot of time and their results may change after data collection period. Secondly, survey studies generally utilize self-reported responses to a questionnaire as their main data collection method.[29–31] But self-reported surveys have a number of limitations including social desirability bias and recall bias. Moreover, the survey studies are also subject to volunteer

bias, where participants who actively decide to participate in the research may systematically differ from the general population. Additionally, the contact and recruitment of participants were held through the use of electronic mail accounts and web-based survey administration software which may be responsible for a selection bias for the population who have difficulties in using this kind of technology. Although we examined a wide range of information in our study population, personal information such as race/ethnicity, political/religious views and some risk factors for COVID-19 infections (eg, having a chronic disease, immunocompromised status of the participant) were not included in our questionnaire to protect the confidentiality of the participants. Lastly, the study was not gender balanced and more females participated than males in our study.

Conclusion

In conclusion, currently vaccination remains one of the most effective tools in the fight against the COVID-19 pandemic. Yet, there remain populations who still show unwillingness to participate in the vaccination efforts. This vaccine hesitancy is a complex phenomenon that is driven by individuals' perceptions of safety, and efficiency of the vaccines. Therefore, it is critical to ensure that the perception of safety and efficiency is tied to reality and evidence, rather than other factors such as fear and social pressures. We must continue to educate the public and communities that vaccines are safe, that they are effective and that they are still required even after a COVID-19 infection.

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