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Perspective

Beyond the First Dose — Covid-19 Vaccine Follow-through and Continued Protective Measures

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In December 2020, the United States began an ambitious vaccination program to inoculate Americans against Covid-19. Just a year after the first known Covid case in the United States, more than 40 million Americans had received the first dose of a vaccine developed by Pfizer and BioNTech or one by Moderna. The herculean effort has grappled with immense technological and logistic challenges in developing, producing, and distributing vaccines at unprecedented scale and speed. Its ultimate success, however, hinges on the public's behavior.

Perhaps the greatest barrier to the campaign's success is public hesitancy to be vaccinated, which is the focus of extensive research.[1] Additional hurdles exist, however, including follow-through with a multidose vaccination regimen[2] and adherence to public health guidance about continuing appropriate prophylactic measures. With these challenges in mind, we designed a national sur ngs about the timing of vaccine protection, willingness to continue to wear masks after being vaccinated, and the extent to which vaccinees are informed of Centers for Disease Control and Prevention (CDC) recommendations on postvaccination behaviors. Uncovering the public's beliefs about vaccination and postvaccination behaviors is crucial for informing effective education efforts. Our survey was administered to 1027 U.S. adults between February 11 and 15, 2021, using the National Opinion Research Center's nationally representative, probability-based AmeriSpeak panel. Additional details of the methods are provided in the Supplementary Appendix (available at NEJM.org).

First, we examined public perceptions of the timing of strong protection against Covid-19 offered by the Pfizer/BioNTech and Moderna vaccines, since an important potential barrier to follow-through is the belief that a second dose is unnecessary. Evidence continues to emerge on first-dose effectiveness in real-world conditions, but we based the question on the CDC's guidance at the time of the survey, which explicitly raised the possibility that the vaccines may not protect vaccinees until a week or two after the second dose (see Supplementary Appendix for additional information). Furthermore, although phrasing our question to assess beliefs about the timing of "strong protection" does allow for some subjectivity, it avoids potentially misleading respondents by referring to "full" or "complete" protec-

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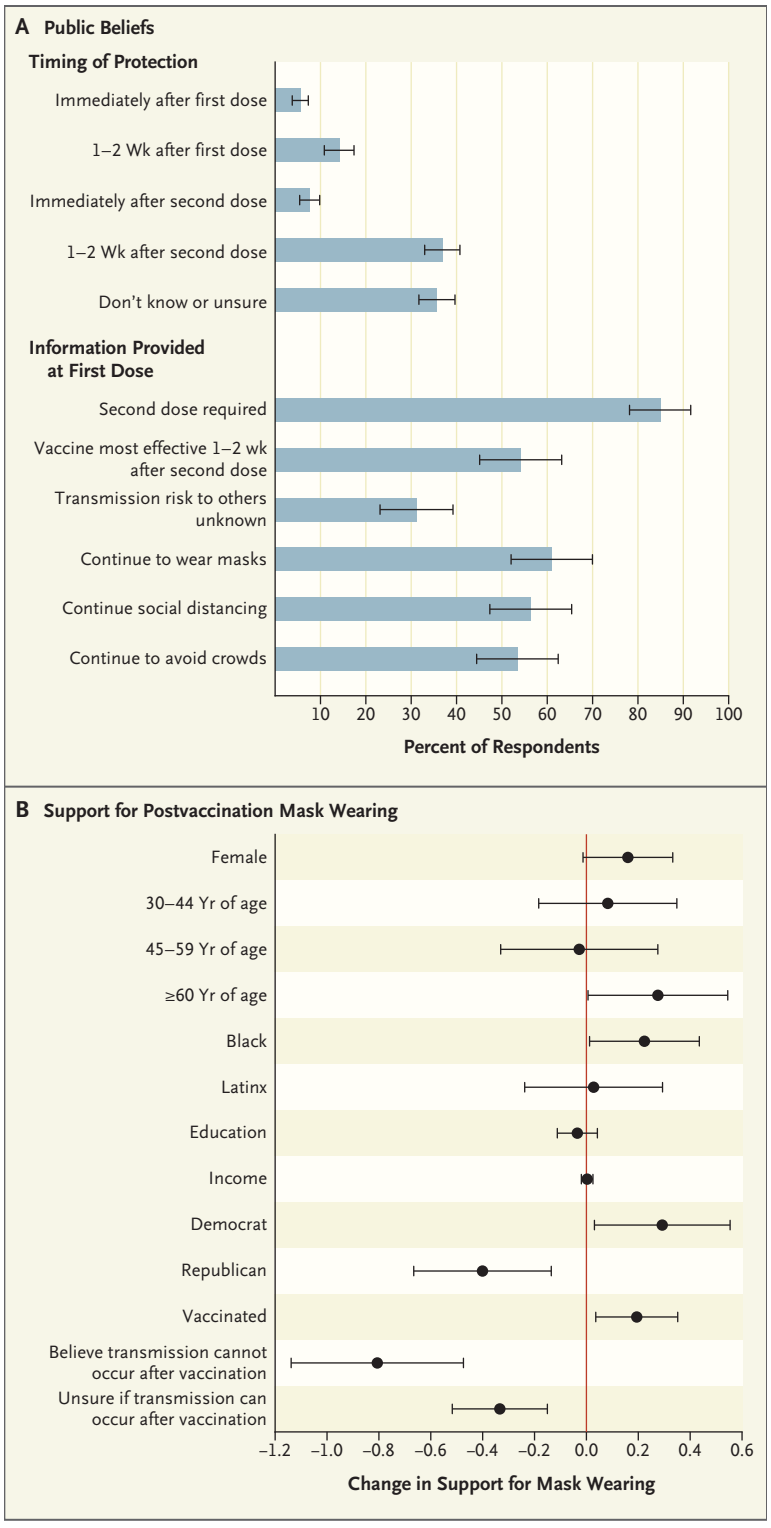

Public Beliefs about Timing of Protection, Information Reported as Having Been Provided at First Dose, and Factors Associated with Support for Postvaccination Mask Wearing.

Panel A shows the percentage of respondents with specific beliefs about the timing of protection along with the information vaccinated persons recalled having received at the time of the first dose. Panel B shows average marginal effects from an ordinary least squares regression (see Supplementary Appendix for full results and robustness checks). Support for mask wearing was measured on a five-point scale. Figure shows predicted change in support produced by changing each indicator variable from 0 to 1 or a 1-unit increase in education or income. I bars represent 95% confidence intervals.

tion, which some could interpret as implying absolute protection against the virus (see Panel A of the figure).

Just over 44% of adults reported that the vaccines provide strong protection against Covid-19 by 1 to 2 weeks after the second dose (in keeping with CDC guidelines), about 20% believed the vaccines provide strong protection before the second dose, and 36% were unsure. The fact that public health officials debated the relative merits of delays in second-dose administration (in order to provide partial protection to a larger percentage of the public more quickly) may have contributed to public confusion over the need for a second dose. Ongoing studies of the effectiveness of the first dose provide varying estimates, some of which are considerably higher than those based on initial studies. In addition, the introduction of new vaccination options, such as Johnson and Johnson's single-dose vaccine, offers consumers a choice that may help combat hesitancy,[3] but this development in combination with the discussion of delaying second doses of the other vaccines may exacerbate public confusion and uncertainty over two-dose regimens, thereby undermining efforts to ensure that as many Americans as possible return to receive their second dose.

This problem could be particularly acute for racial and ethnic

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minority groups who are disproportionately susceptible to attrition with multidose vaccines. In our survey, Black and Latinx respondents (24%) were significantly less likely than White respondents (43%) to believe that the Pfizer/BioNTech and Moderna vaccines offered strong protection by 1 to 2 weeks after the second dose and significantly more likely to report being unsure (45% vs. 33%). Failure to combat second-dose attrition among members of minority groups risks magnifying existing racial disparities in the virus's human toll.

Second, to explore the strengths and limitations of current outreach to vaccinees, we asked respondents who had already received at least one dose of a Covid-19 vaccine (18%) about the information they recalled being provided when they received their first dose. While 85% of vaccinated respondents reported being informed that they needed a second dose, just 54% recalled being told that protection was strongest after the second dose. That nearly half of vaccinated respondents could not recall being informed about the timing of protection may help explain why vaccinated respondents did not differ from unvaccinated respondents in their answers to the preceding question: an identical percentage of each group believed the Pfizer/BioNTech and Moderna vaccines offer strong protection before the second dose.

Crafting guidance is necessarily a balancing act between encouraging vaccinated people to continue practicing prophylactic behaviors to protect themselves and others and ensuring the public that vaccination offers tangible benefits, including a slow but sure return to normalcy.[1] However, a substantial proportion of vaccinated people reported not being informed about core CDC guidance and recommendations for continued protective measures after vaccination. Only 31% of vaccinated respondents reported being told that the risk of transmission from vaccinated people to others is unknown — a key impetus for continuing to practice protective measures in public settings. And only slim majorities reported being told to continue wearing masks (61%), social distancing (56%), and avoiding crowds (53%). These findings suggest that there is a real need — and opportunity — for the medical community to provide fuller guidance and greater contextual explanations to vaccinees about how life can change after vaccination as we gradually return to normalcy.

Finally, we examined the correlates of support for continued postvaccination mask wearing. Aggregate support for this prophylactic measure was high: 21% agreed and 60% agreed strongly that continuing to wear masks is important. But support varied substantially among subgroups. Panel B of the figure presents average marginal effects for each independent variable in a regression analysis on a five-point index of support for mask wearing (see Supplementary Appendix). Older (≥60 years of age), Black, and already-vaccinated respondents were more supportive of mask wearing, all else being equal. In keeping with the current political polarization regarding many aspects of pandemic-response policy, we also found a substantial partisan divide, with Republicans being significantly less supportive of continued mask wearing than Democrats. Finally, respondents who believed that vaccinated people cannot transmit the virus (7% of the sample) were least likely to support continued mask wearing, followed by those who were unsure about transmission risks (39% of the sample).

Despite current efforts, many Americans, including many of those who have already received a first vaccine dose, remain confused about the timing of protection and the necessity of a second dose. Moreover, a large proportion of vaccinees report being uninformed about CDC guidance regarding the need to continue to take prophylactic measures including mask wearing and avoiding crowds. Finally, our results have identified demographic groups who are most reluctant to accept these measures who would benefit from targeted outreach.

Vaccination campaigns must not only address concerns about product safety but must also provide clear guidance about vaccine benefits (e.g., the reduced likelihood of severe disease and death).[4] Historical rejection of past public health strategies may influence attitudes and beliefs regarding Covid-19 vaccination. Though communications that focus on misinformation should be at the core of any strategy, educational strategies must also focus on building trust and informing the public about the science. Such efforts are especially important in light of existing mental models of infectious disease and biases that can affect public acceptance of scientific information and fuel vaccine skepticism.[5] These challenges may be particularly acute when it comes to a novel technology like mRNA vaccines. Augmented educational efforts for vaccinees at the time of the first dose also hold considerable promise for combating second-dose

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attrition, clarifying that the risk of transmission from vaccinated to unvaccinated persons remains uncertain, and bolstering compliance with critical public health guidance that minimizes general health risks and provides the fastest possible transition to normalcy.

Disclosure forms provided by the authors are available at NEJM.org.

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