Distribution Agreement

In presenting this thesis as a partial fulfillment of the requirements for a degree from Emory University, I hereby grant to Emory University and its agents the non-exclusive license to archive, make accessible, and display my thesis in whole or in part in all forms of media, now or hereafter now, including display on the World Wide Web. I understand that I may select some access restrictions as part of the online submission of this thesis. I retain all ownership rights to the copyright of the thesis. I also retain the right to use in future works (such as articles or books) all or part of this thesis.

Keya Jacoby April 12, 2020

Vaccination and Vacci-notions: Understanding the Barriers and Facilitators of Seasonal Influenza and COVID-19 Vaccine Uptake during the 2020-21 COVID-19 Pandemic

by

Keya Jacoby

Dr. Matthew Collins
Adviser

Center for the Study of Human Health

Dr. Matthew Collins

Adviser

Dr. Rachel Hall-Clifford

Committee Member

Dr. Cynthia Whitney

Committee Member

Dr. Ruth Link-Gelles

Committee Member

2021

Vaccination and Vacci-notions: Understanding the Barriers and Facilitators of Seasonal Influenza and COVID-19 Vaccine Uptake during the 2020-21 COVID-19 Pandemic

By

Keya Jacoby

Dr. Matthew Collins

Adviser

An abstract of
a thesis submitted to the Faculty of Emory College of Arts and Sciences
of Emory University in partial fulfillment
of the requirements of the degree of
Bachelor of Arts with Honors

Center for the Study of Human Health

2021

Abstract

Vaccination and Vacci-notions: Understanding the Barriers and Facilitators of Seasonal Influenza and COVID-19 Vaccine Uptake during the 2020-21 COVID-19 Pandemic

By Keya Jacoby

Vaccination strategies to mitigate the public health burden of the pandemic respiratory virus COVID-19 resemble those for other respiratory viruses that circulate annually, such as seasonal influenza, yet seasonal influenza vaccine uptake is typically low due to factors including vaccine hesitancy. This study examined the demographic characteristics, experiences, and disease- and vaccine-related risk perceptions that influence an individual's decision to adhere to current vaccine recommendations for seasonal influenza and evolving vaccine recommendations for COVID-19. The study utilized a mixed-methods telephone survey to collect quantitative and qualitative responses from 57 participants about their seasonal influenza and COVID-19 vaccine intentions. The results of this study revealed that the primary facilitators of uptake for both vaccines were personal protection, protecting others, preserving public health, and general vaccine confidence. Concerns about vaccine side effects, misinformation about vaccination, personal aversions to the vaccines, general distrust in vaccination, complacency, and distrust in government were the primary barriers to vaccine uptake. Profession, prior vaccination habits, and trust in healthcare providers also played an important role in seasonal influenza vaccine intentions, while race, trust in government health officials, and concerns about the COVID-19 vaccine trials impacted COVID-19 vaccine intentions. The results of this research can inform public health officials on how to best target COVID-19 vaccine communications to optimize future vaccine uptake.

Vaccination and Vacci-notions: Understanding the Barriers and Facilitators of Seasonal Influenza and COVID-19 Vaccine Uptake during the 2020-21 COVID-19 Pandemic

By

Keya Jacoby

Dr. Matthew Collins

Adviser

A thesis submitted to the Faculty of Emory College of Arts and Sciences
of Emory University in partial fulfillment
of the requirements of the degree of
Bachelor of Arts with Honors

Center for the Study of Human Health

2021

Acknowledgements

This thesis would not have been possible without the help and support of a number of people. I would like to thank my adviser, Dr. Matthew Collins, for his continuous encouragement and guidance throughout this project. I am so grateful for your mentorship over the past two years.

I would like to thank my committee member and professor, Dr. Rachel Hall-Clifford, for her expertise in qualitative research and for her support and encouragement throughout the Honors process. I would like to thank my committee members, Dr. Cynthia Whitney and Dr. Ruth Link-Gelles, for their research expertise, time, and encouragement. I would also like to thank Dr. Amanda Freeman for her guidance in navigating the Human Health Program and for her encouragement throughout the Honors process.

To my friends, thank you for being by my side through every challenge and success over the last four years, your support means the world to me.

And finally, thank you to my parents, Hanan and Benu, and my sister Anya for supporting me endlessly in all of my endeavors. To my dad, especially, thank you for guiding me through the most challenging moments of this project. I could not have completed this thesis without you.

Table of Contents

List of Figures

List of Tables

Chapter 1. Introduction

1.1 Introduction to the COVID-19 Pandemic

The World Health Organization (WHO) categorized COVID-19 as a pandemic on March 11, 2020, after the virus had reached 114 countries and infected over 118,000 individuals worldwide (Ghebreyesus, 2020). Scientists predict that this novel strain of coronavirus evolved between mid-November and early December 2019 (Maxmen, 2021). The first major outbreak was reported in Wuhan, China and the virus later spread throughout the province of Hubei and across the world (Maxmen, 2021; Rothan & Byrareddy, 2020). The world has since battled staggering death tolls, faced shortages in healthcare resources, and invested billions of dollars in order to develop a vaccine that will combat SARS-CoV-2, the virus that causes COVID-19 (AJMC Staff, 2021).

The emergence of novel and pathogenic coronaviruses is unfortunately a familiar theme in recent years. Strains such as the Middle East respiratory syndrome MERS-CoV and the severe acute respiratory syndrome SARS-CoV have been responsible for previous outbreaks. SARS-CoV-2 can cause symptoms that range from fever, cough and fatigue, to potentially fatal pneumonia, acute respiratory distress syndrome, and acute cardiac injury. The physical toll of COVID-19 was exacerbated by the fact that there were no specific treatments for the disease; only one broad-spectrum antiviral with marginal efficacy had been approved by the FDA by the end of 2020 (Rothan & Byrareddy, 2020). As a result, US hospitals became overburdened by the number of COVID-19 Emergency Department visits and admissions. On November 30, 2020 alone, a record of 96,039 patients were hospitalized for COVID-19 in the United States, and hospitalizations were expected to double or even triple through the winter months (Almasy, Yan, Holcombe, & CNN, 2020). As the pandemic progressed, it became clear that developing,

distributing, and ensuring high levels of uptake of an effective vaccine would be the key to ending the COVID-19 pandemic (The Lancet, 2020).

1.2 The Public Health Value of Vaccines

Vaccination is the most powerful public health tool for reducing incidence of disease and reducing the severity of disease symptoms (Houser & Subbarao, 2015). Vaccines have been responsible for eradicating diseases such as smallpox and drastically reducing the transmission rates of infections such as yellow fever, pertussis, polio, influenza, and many other infections (Plotkin & Plotkin, 2011). Vaccination seeks to elicit immunity against a pathogen by various strategies in order to prevent or diminish illness or infection upon a future encounter with that pathogen (Ginglen & Doyle, 2020).

In addition to building up immune protection in vaccinated individuals, vaccines play an important role in protecting unvaccinated members of a community by contributing to population herd immunity. Individuals can build up immunity against a pathogen from natural infection or vaccination. When enough members of a population are immune to a pathogen, transmission of that pathogen is reduced, which thereby reduces the risk that non-immune individuals will be infected (Metcalf, Ferrari, Graham, & Grenfell, 2015). This herd immunity is important for protecting individuals who cannot be vaccinated, or those for whom a vaccine is less effective. The level of vaccine uptake required to achieve herd immunity depends on the efficacy of the vaccine and the R_0 of the disease, meaning the average number of additional people to whom an infected person transmits the infection.

Seasonal influenza vaccine effectiveness typically ranges from 40 to 60%, and median R_0 estimates for seasonal influenza fall around 1.27 (Biggerstaff, Cauchemez, Reed, Gambhir, & Finelli, 2014; Dawood et al., 2020). Public health officials aim to vaccinate 80% of the

population against seasonal influenza annually to minimize disease transmission (Plans-Rubió, 2012). Models suggest that this 80% vaccine coverage is sufficient to achieve herd immunity against seasonal influenza if the vaccine is 50% effective and the R_0 of the circulating influenza strain is equal to or less than 1.5 (Plans-Rubió, 2012). Despite these public health goals, annual vaccine uptake in the United States typically falls much closer to 40% (Plans-Rubió, 2012). The herd immunity threshold for COVID-19 is challenging to identify given the novelty of the virus, and researchers have only been able to estimate that the R_0 is between 2.2 and 4.71. However, it is expected that without vaccination, herd immunity will be reached when approximately 70% of the population has been infected by SARS-CoV-2 (Clemente-Suárez et al., 2020). This threshold will likely be adjusted as vaccine distribution unfolds globally.

1.3 The Status of COVID-19 Vaccine Development and Deployment

The development and emergency use authorization of vaccines to prevent COVID-19 has been achieved in an impressive period of time. As of March 2021, three vaccines have received emergency use authorization (EUA) by the Food and Drug Administration (FDA). On December 11, 2020, the FDA issued an EUA for the Pfizer-BioNTech COVID-19 vaccine, making it the first COVID-19 vaccine to be approved for emergency use in the United States (Oliver et al., 2020). Soon after, on December 18, 2020, the FDA authorized the Moderna COVID-19 vaccine for emergency use (Oliver, Gargano, Marin, et al., 2021). The Pfizer-BioNTech COVID-19 vaccine was found to be 95% effective in preventing symptomatic COVID-19 infection and was recommended by the Centers for Disease Control and Prevention's (CDC) Advisory Committee on Immunization Practices (ACIP) for individuals aged 16 years and older (Oliver et al., 2020). The Moderna COVID-19 vaccine is 94.1% effective at preventing symptomatic COVID-19 infection and is recommended for individuals aged 18 years or older (Oliver, Gargano, Marin, et

al., 2021). Both the Pfizer-BioNTech and the Moderna vaccines are two-dose mRNA vaccines that encode the stabilized prefusion spike glycoprotein of SARS-CoV-2 (Oliver et al., 2020; Oliver, Gargano, Marin, et al., 2021). The Moderna vaccine is feasible to administer within most communities, as the vaccine can be stored in a freezer long term and remain thawed for up to thirty days at refrigerator temperatures (Oliver, Gargano, Marin, et al., 2021). The Pfizer-BioNTech vaccine, on the other hand, requires ultracold-chain storage and therefore may not be feasible to distribute in communities without these storage capabilities (Oliver et al., 2020). Following the vaccines' emergency approvals, the United States reserved 100 million doses of the Pfizer-BioNtech COVID-19 vaccine and 100 million doses of the Moderna COVID-19 vaccine (Burki, 2021).

Since December, a third COVID-19 vaccine, by Janssen (Johnson & Johnson) has been approved by the FDA. Janssen received an EUA on February 27, 2021 for its COVID-19 vaccine. The Janssen vaccine is a recombinant, replication-incompetent adenovirus serotype 26 (Ad26) vector vaccine, which encodes for the spike protein of SARS-CoV-2. The Janssen vaccine is 66.3% effective at protecting against symptomatic COVID-19 and 100% effective at protecting against hospitalization. The vaccine only requires one dose and can be stored at refrigerator temperatures, so it is expected to increase access to COVID-19 vaccines across the United States (Oliver, Gargano, Scobie, et al., 2021).

With three COVID-19 vaccines approved, it is important to ensure that individuals will take the vaccine once it is available to them. As Dr. Ornstein and Dr. Ahmed of Emory University's School of Medicine have previously emphasized in their work on vaccination, "a vaccine that remains in the vial is 0% effective even if it is the best vaccine in the world" (Orenstein & Ahmed, 2017). The CDC has released vaccine rollout recommendations that are

intended to decrease morbidity and mortality, reduce the disease burden in heavily impacted communities, and help society return to normal. As of February 2021, healthcare workers, long-term care facility residents, essential workers, people aged 65 and older, and people aged 16-64 with underlying medical conditions have been prioritized for COVID-19 vaccination (Centers for Disease Control and Prevention, 2021). It is now essential to understand how to best promote COVID-19 vaccine uptake, as more groups become eligible for vaccination.

1.4 Socio-Political Context of the COVID-19 Pandemic

As evidenced by these preliminary vaccine eligibility recommendations, the COVID-19 pandemic has not impacted all members of the US population equally. The pandemic has been marked by racial disparities and political discourse that have significantly impacted how certain subsections of the population have not only experienced the pandemic thus far, but also how these groups may respond to future vaccination efforts to end the pandemic. Minority groups, particularly Black and African American communities, have been disproportionately impacted by the COVID-19 pandemic and face a higher risk of exposure to the disease. Black and African American populations are more likely to live in densely populated areas, use public transportation, and be employed in essential industries than White populations. They also experience higher rates of chronic disease, including hypertension, cancer, cardiovascular disease, and diabetes, all of which are considered risk factors for COVID-19 (Holmes et al., 2020). Despite these risk factors, Black and African American populations are less likely to get screened for COVID-19 due to disparities in healthcare access and health insurance coverage (Hawkins, 2020; Holmes et al., 2020). In a study of the COVID-19 burden in the midwestern United States, Blacks and African Americans made up 34% of COVID-related deaths, despite only accounting for 12.5-13% of the total population (Holmes et al., 2020). Other people of

color, particularly Asians and Hispanics, also face an increased risk of employment-related exposure to COVID-19. Black and Asian adults are more likely than White adults to work as respiratory therapists and nurses and Black and Hispanic adults are more likely to work as personal care aids and medical assistants (Hawkins, 2020).

In addition to racial disparities, political beliefs have guided many people's risk perceptions and social distancing practices surrounding COVID-19. United States counties that voted for Donald Trump in the 2016 presidential election were found to be less likely to socially distance and reduce use of non-essential services during the 2020 COVID-19 pandemic than counties that voted for Hilary Clinton. In fact, partisanship was found to be more strongly associated with social distancing practices than race or socioeconomic status, and this partisan gap in preventative practices has increased throughout the COVID-19 pandemic (Gollwitzer et al., 2020). Political beliefs have also been shown to have a stronger association with perceived COVID-19 threat than actual experiences with the disease (Conway, Woodard, Zubrod, & Chan, 2020). Conway *et al*. (2020) found that conservatives were more likely to perceive COVID-19 as non-threatening, because this perception aligned with conservative ideologies to minimize government restrictions, such as lockdowns and mask mandates. These partisan differences extend to vaccine perceptions as well. According to a September 2020 survey by the Pew Research Center, 58% of Democrats surveyed would probably or definitely get the COVID-19 vaccine, while 44% of Republicans surveyed would probably or definitely get the vaccine (Tyson, Johnson, & Funk, 2020).

A COVID-19 vaccine has been touted by politicians and health experts alike as the solution to ending the pandemic (The Lancet, 2020). President Donald Trump advocated for rapid vaccine development as part of his "Operation Warp Speed," and even pushed to have a

vaccine ready for distribution before the presidential election in November 2020 (Mallapaty & Ledford, 2020). However, in order for the vaccine to successfully curb the spread of the coronavirus, many financial, logistical and scientific processes have to come together (The Lancet, 2020).

1.5 Vaccine Hesitancy

Despite the proven individual and population health benefits associated with vaccination, there are still considerable portions of the population that are wary of getting a vaccine. Vaccine hesitancy—a term that covers the middle ground between pro- and anti-vaccine individuals, has been defined by the World Health Organization's Strategic Advisory Group of Experts (SAGE) on Immunization as "a delay in acceptance or refusal of vaccination despite availability of vaccination services" (Larson, Jarrett, Eckersberger, Smith, & Paterson, 2014; Heidi J. Larson et al., 2015). Vaccine hesitancy is specific to the type of vaccine, the type of immunization program, and the context of the vaccine distribution and administration. Vaccine hesitancy is also more likely to arise towards novel vaccines that are administered via mass immunization campaigns than for older or more routine vaccines (Eskola. et al., 2014). Scientists have categorized vaccine hesitancy using a variety of different metrics, the most common being the Health Belief Model and the 3C's or 4C's Model (Rosenstock, 1974).

The Health Belief Model

The Health Belief Model (HBM) is a tool for understanding preventive health behavior, i.e. behaviors undertaken by healthy individuals to prevent disease. Although there are variations of the model, the Health Belief Model primarily consists of: perceived susceptibility to disease, perceived severity of disease, perceived benefits to action, perceived barriers to action, and cues

to action (Rosenstock, 1966). Perceived susceptibility refers to individuals' perceptions of their own likelihood of contracting a disease, while perceived severity refers to how serious that individual considers the symptoms and potential complications of that disease to be (Cheney & John, 2013). Perceived benefits and barriers to action refer to an individual's evaluation of the mental and physicals costs of a behavior versus the costs of the alternatives to that behavior (Rosenstock, 1966). Cues to action refer to the environmental triggers that bridge the gap between health beliefs and health behaviors and prompt an individual to engage in a health behavior (Cheney & John, 2013).

Although the Health Belief Model is a valuable tool for understanding the personal motivations behind preventive health behaviors, the model does have some limitations in the context of vaccine behaviors. The model does not account for the fact that some preventive health behaviors, such as vaccination, may be done with the goal of protecting other individuals, particularly those who may be vulnerable to severe disease complications. The HBM also does not explicitly account for the dynamic nature of health beliefs. In the case of vaccination, past vaccine behaviors or access to new information about vaccines may affect vaccine behaviors over time (Cheney & John, 2013).

The 3C's Model and 4C's Model of Vaccine Hesitancy

The 3C's model of vaccine hesitancy outlines the three main influences on vaccine hesitancy. The SAGE Working Group on Vaccine Hesitancy defines these 3C's as confidence, complacency, and convenience. Vaccine confidence describes individuals' trust in a vaccine's efficacy and safety, trust in the healthcare system and healthcare professionals, and trust in those responsible for developing vaccine policy. Vaccine complacency describes individuals who do not actively seek out vaccines because they do not consider the disease to pose a serious risk to

their health, or they do not consider vaccination to be urgent enough to detract from their other responsibilities. Vaccine convenience refers to the contextual factors of vaccine delivery, such as costs, geographical access, health literacy, and the cultural context in which immunization programs are implemented (Eskola. et al., 2014). A review on vaccine hesitancy by Schmid *et al.* (2017) added a fourth "C" to this model—calculation. Calculation refers to an individual's evaluation of the benefits and risks of vaccination, compared to the risk of contracting the disease itself (Schmid, Rauber, Betsch, Lidolt, & Denker, 2017).

The WHO SAGE Working Group's Determinants of Vaccine Hesitancy Matrix

Another valuable tool for understanding vaccine hesitancy is The WHO SAGE Working Group's Determinants of Vaccine Hesitancy Matrix, which outlines the contextual influences, individual and group influences, and vaccine or vaccination specific influences on vaccine hesitancy. The individual and group influences in the matrix refer to individuals' personal experiences with and attitudes towards vaccination, their knowledge about vaccination, their personal cost-benefit analyses, their social norms, and their trust in healthcare professionals. The vaccine and vaccination specific influences cover the scientific risks and benefits of vaccination, the modes of administration and distribution, vaccine schedules, and vaccine costs. The contextual influences described by the SAGE Working Group include media communications, influences of leaders and lobbyists, historical, financial, social, and political factors, and geographic barriers (Eskola. et al., 2014). Given the public's reliance on political and scientific leaders for information and guidance throughout the COVID-19 pandemic, contextual factors may be particularly impactful influences on COVID-19 vaccine hesitancy.

Assessing Vaccine Hesitancy

In order to determine if vaccine hesitancy will pose a barrier to uptake of the COVID-19 vaccine, it will first be necessary to understand individuals' perspectives and intentions towards COVID-19 vaccination. Several survey tools have been previously developed to assess vaccine hesitancy in a global context and can be modified to evaluate COVID-19 vaccine hesitancy. The World Health Organization's SAGE Working Group on Vaccine Hesitancy developed a survey tool to facilitate cross-country comparisons of vaccine hesitancy. Using the SAGE Working Group on Immunization's model of vaccine hesitancy as a guide, the SAGE Working Group on Vaccine Hesitancy produced a list of core closed questions, Likert scale questions, and open-ended questions to assess vaccine hesitancy. These questions span issues of geographic and financial access, religious barriers, negative information about vaccination, recommendations from community or healthcare leaders, adverse side effects, and the individual and social benefits of vaccination. The survey has limited generalizability, as vaccine hesitancy is vaccine-specific, however, several researchers have adapted this guide to perform global analyses of vaccine hesitancy (H. J. Larson et al., 2015). Larson *et al*. (2016) adapted the ten Likert scale questions from the SAGE Working Group's survey tool to generate regional and country-specific data on vaccine confidence (Larson et al., 2016). Other studies have used the Health Belief Model as a framework for developing Likert scale surveys that assess individuals' perceived susceptibility to disease, their perceived severity of illness, and any perceived benefits of and barriers to vaccination (Zijtregtop et al., 2009). Given that this study is focused on individual health behaviors, the Health Belief Model was identified as the most fitting survey model to assess this study population's vaccine risk perceptions and vaccine intentions towards the COVID-19 and seasonal influenza vaccines.

Lessons on Vaccine Hesitancy from Influenza Vaccine Uptake.

While slowing COVID-19 transmission has certainly been the primary public health concern during the COVID-19 pandemic, seasonal influenza vaccination has also been a major public health priority. Since seasonal influenza and COVID-19 may both lead to severe disease in a subset of those infected, high rates of seasonal influenza transmission could place increased strain on overwhelmed hospitals (Grohskopf et al., 2020). The seasonal influenza vaccine can help prevent infection and transmission of seasonal influenza and is currently recommended annually for all individuals over six months of age (Grohskopf et al., 2020). In particular, the ACIP prioritizes vaccination for children under 2 years, adults aged 50 years or older, immunocompromised individuals, nursing home residents, pregnant women, obese individuals, and adults with chronic pulmonary, cardiovascular, renal, hepatic, neurologic, hematologic, and metabolic illnesses, as they are considered high risk for severe influenza complications (Grohskopf et al., 2020). The seasonal influenza vaccine is typically between 40% and 60% effective, but it plays an important role in reducing both personal and population-wide transmission (Dawood et al., 2020). Vaccinated individuals have a lower probability of infecting unvaccinated individuals, which can create herd immunity that helps protect the general population (Eichner, Schwehm, Eichner, & Gerlier, 2017).

Seasonal influenza infects between 9.3 million and 45 million people in the United States every year (Maragakis, 2020). Despite the burden of seasonal influenza and the benefits of the vaccine, the CDC estimates that only 43.1% of Georgia residents aged 6 months or older received the flu vaccine in the 2018-2019 flu season. Similarly, only 49.2% of people in the United States received the flu vaccine in the 2018-2019 season (Centers for Disease Control and Prevention & National Center for Immunization and Respiratory Diseases (NCIRD), 2019).

Previous uptake of the seasonal influenza vaccine paints a grim picture for the potential uptake rates of new COVID-19 vaccines; however, existing hesitancies towards the seasonal influenza vaccine may shed light on potential sources of COVID-19 vaccine hesitancy.

The suboptimal uptake of the seasonal influenza vaccine can be understood within the 4C's (calculation, complacency, convenience, and confidence) framework of vaccine hesitancy. Vaccine calculations, such as the perceived benefits and risks of vaccination, the perceived risk of influenza, the personal health risks, the social benefits of reducing transmission, the social pressures and attitudes towards vaccination in general, and previous vaccination or infection experiences, all contribute to seasonal influenza vaccine hesitancy. Vaccine complacency is a barrier to seasonal influenza vaccine uptake among individuals who believe their health status is strong enough to obviate the need for preventive vaccination (Schmid et al., 2017). A review by the ADVANCE consortium found that the primary sources of seasonal influenza vaccine hesitancy stem from calculation and complacency factors—for example, the fear that the seasonal influenza vaccine causes influenza infection or the belief that an individual is healthy enough to fight off infection without assistance from a vaccine (Karafillakis, Larson, & consortium, 2017). Vaccine convenience factors, such as access issues and financial barriers, also contribute to low levels of vaccine uptake. Vaccine confidence is higher among individuals who have higher levels of interaction with the healthcare system, especially when individuals receive a direct recommendation to vaccinate from healthcare professionals (Schmid et al., 2017). However, barriers to vaccine confidence can be caused by a lack of information about the seasonal influenza vaccine, misinformation about the vaccine, and mistrust in healthcare or pharmaceutical companies (Karafillakis et al., 2017).

Sociodemographic characteristics have also been reported as important factors in both seasonal and pandemic influenza vaccine uptake, although these associations are more varied (Schmid et al., 2017). A study on pandemic H1N1 vaccination revealed that young age, female gender, higher education, and living alone are negatively associated with the intention to get vaccinated (Zijtregtop et al., 2009). In a similar study on pandemic H1N1 vaccine uptake in France, male gender, higher levels of education, higher socioeconomic status, previous experience with influenza vaccination, and professions in healthcare and childcare were associated with vaccine acceptance (Raude, Caille-Brillet, & Setbon, 2010).

Doornekamp *et al.* (2020) conducted a review of high-risk individuals to assess the factors that drive seasonal influenza vaccine hesitancy among immunocompromised individuals and healthcare workers. The review found that immunocompromised individuals who had high perceived risks of the vaccine, gathered vaccine information from media sources, doubted the effectiveness of the vaccine, expressed concerns about the vaccine's side effects, and did not express favorable attitudes towards vaccination in general, reported lower levels of vaccine uptake. Among healthcare workers, gathering vaccine-related information from media sources, holding high risk perceptions and low benefit perceptions of vaccination, and facing time-related barriers were associated with lower levels of vaccine uptake (Doornekamp, van Leeuwen, van Gorp, Voeten, & Goeijenbier, 2020).

Hesitancy and Uptake of the COVID-19 Vaccine

While seasonal influenza poses a substantial risk to population health, the case fatality rate for COVID-19 is higher than for seasonal influenza, particularly among older adults. The list of medical conditions that place adults at an increased risk of COVID-19 complications is extensive, including cancer, chronic kidney disease, COPD, cardiovascular conditions,

immunocompromised states, obesity, diabetes, asthma, hypertension, cystic fibrosis, and several others (Centers for Disease Control and Prevention, 2020a). The risk of severe COVID-19 complications also increases with age, so older adults are considered a high risk group (Centers for Disease Control and Prevention, 2020b). COVID-19 infection may also be dangerous among children, due to the development of multisystem inflammatory disease in children (MIS-C), despite the fact that they are not considered a high-risk group (Feldstein et al., 2020). Children that were hospitalized for COVID-19 infections in France were four times more likely to die at the hospital than children hospitalized for influenza. Hospitalized COVID-19 patients were also more likely to need intensive care, develop acute respiratory failure, pulmonary embolism, or septic shock, and more likely to required invasive mechanical ventilation than influenza patients (Piroth et al., 2020).

These risks reinforce the importance of increasing uptake of the seasonal influenza vaccine and ensuring optimal uptake of the COVID-19 vaccine (Grohskopf et al., 2020). As public health officials race to distribute the COVID-19 vaccine, it will be important to promote active demand for the vaccine. Active demand entails vaccine uptake by a scientifically-informed public, rather than passive compliance due to social pressures or recommendations from healthcare workers (Nichter, 1995). This distinction is particularly important for pandemic vaccination, as novel pandemic vaccines might spark greater hesitancy than a routine seasonal vaccine, and therefore drive individuals to seek out vaccine-related information prior to vaccination.

Researchers have already begun to investigate how much of the population will get the COVID-19 vaccine, and what sources of hesitancy might dissuade the remainder of the population from getting vaccinated. A Pew Research Center Survey in September 2020 found

that 51% of US adults said that they would probably or definitely get a COVID-19 vaccine, a number that dropped from the 72% that was measured in May 2020. Head *et al.* (2020) published a study in May 2020 that found that individuals with lower levels of education, conservative political views, or careers in the healthcare field were less likely to report intentions to get the COVID-19 vaccine (Head, Kasting, Sturm, Hartsock, & Zimet, 2020). A global survey by Lazarus *et al.* (2020) found that older individuals are more willing to get the vaccine and younger individuals are more willing to follow employer recommendations to get the vaccine. Trust in government, both for information and for guidance, has also been found to play an important role in guiding decisions about the COVID-19 vaccine (Lazarus et al., 2020).

1.6 Research Objectives

As COVID-19 vaccines continue to become available across the United States, it is important to understand the factors that shape decision making around vaccine uptake in order to identify sources of vaccine hesitancy and target messaging towards subpopulations that are likely to be vaccine hesitant. This study aims to understand the factors that influence an individual's decision to adhere to current vaccine recommendations for seasonal influenza and evolving vaccine recommendations for COVID-19. Specifically, we will investigate associations between individuals' demographic identities and vaccine- and disease-related risk perceptions and their intentions to receive the seasonal influenza and COVID-19 vaccines. Given the deeply personal impact of the COVID-19 pandemic, this study also aims to investigate the impact that a COVID-19 disease encounter, such as disease testing, a positive diagnosis, or the diagnosis of a friend or family member, has on an individual's intention to receive the seasonal influenza and COVID-19 vaccines. Identifying "teachable moments," or situations in which individuals have elevated interest and openness to receive public health guidance is one key strategy for making vaccine-

related messaging more effective. By identifying the relative importance of personal experiences, demographic characteristics, and risk perceptions in defining vaccine intentions, the results of this research can help inform public health officials on how to best target COVID-19 vaccine communications to optimize vaccine uptake.

Objectives

1. **Objective 1.** To investigate the demographic and risk-based factors that influence an individual's intention to adhere to current vaccine recommendations for seasonal influenza and evolving vaccine recommendations for COVID-19.
2. **Objective 2.** To investigate the impact that a COVID-19 disease encounter has on an individual's intention to adhere to vaccine recommendations for seasonal influenza and COVID-19.

Hypothesis

We hypothesize that factors such as awareness and fear, elicited by the COVID-19 pandemic, will increase public concerns about respiratory infections and therefore displace the complacency that may otherwise hinder optimal uptake of the 2020-21 seasonal influenza and new COVID-19 vaccines. Thus:

i. Individuals with a prior COVID-19 or seasonal influenza disease encounter, such as prior vaccination or illness, will have higher risk perceptions of seasonal influenza and will be more willing to adhere to vaccine recommendations for the 2020-21 seasonal influenza vaccine.

ii. Individuals with a prior COVID-19 disease encounter, such as prior COVID-19 diagnostic testing or illness, will have higher risk perceptions of COVID-19 and will be more willing to receive a COVID-19 vaccine when it becomes available to them.

Chapter 2. Methods

2.1 Project Approval

This is a cross-sectional exploratory study that examines the factors associated with vaccine uptake and intention to comply to vaccine recommendations for COVID-19 and seasonal influenza. All consent and data collection procedures took place over the phone. Because of the exploratory nature of this study and the semi-quantitative/qualitative nature of the data, a power and sample size calculation was not performed.

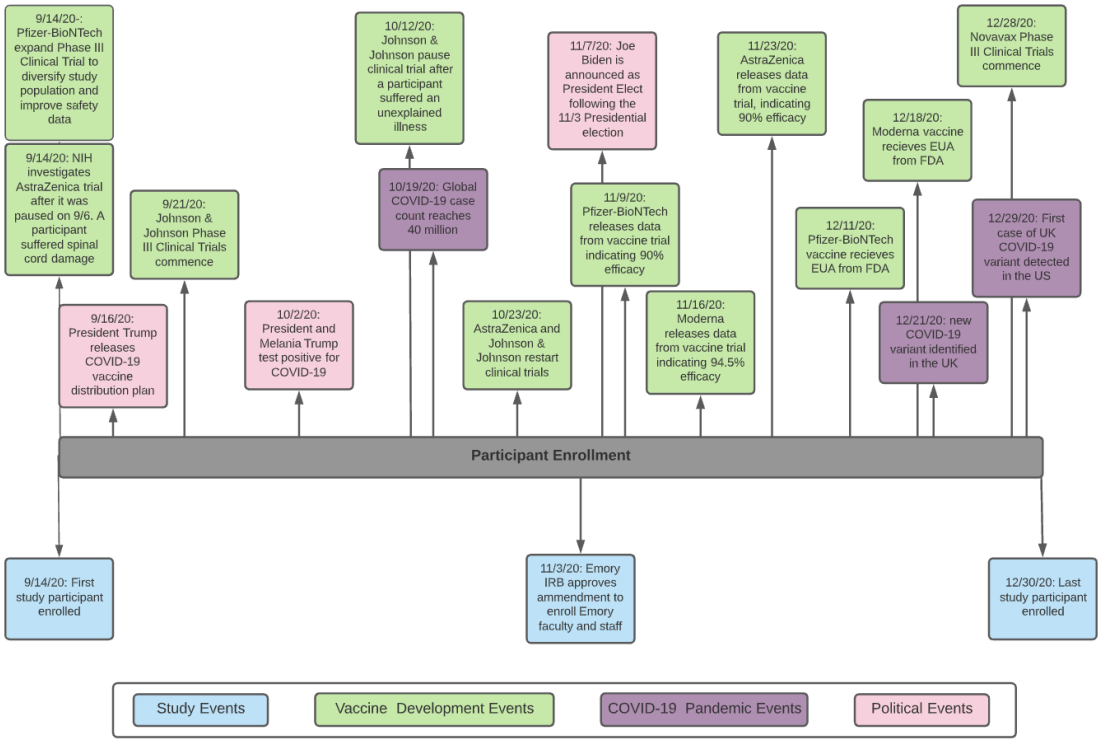
All necessary approvals were applied for and granted by the Emory University Institutional Review Board (IRB) prior to data collection. The Emory IRB determined that this study met the criteria for exemption from further IRB review.

2.2 Participant Recruitment

Participant recruitment took place between September 2020 and December 2020. During this time period, 265 participants were contacted over the phone or via email about participation in this research study, and 57 participants ultimately consented and enrolled in the study. The individuals who were contacted for this study belonged to one of four groups: they had previously consented to participate in the TWS aSx EID study, the AVE Emory Travelers study, or the COPE Study at Emory University and had consented to being contacted for future research studies, or they were a member of the Emory University faculty or staff. Emory faculty and staff were identified by contacting academic department chairs and asking that a research solicitation

email be distributed to department faculty. All academic departments were contacted, and faculty responses were received from the Biology, Psychology, Anthropology, Economics, Environmental Science, and Mathematics departments. The only inclusion criteria for the study was that participants were over the age of 18 and able to give informed consent.

Figure 1: Timeline of study enrollment and major events in the COVID-19 pandemic, vaccine development, and politics from September 14, 2020 to December 30, 2020 (adapted from (AJMC Staff, 2021).



2.3 Data Collection Procedures

Participants were contacted by phone and asked to participate in a phone interview about their beliefs and attitudes towards seasonal influenza and COVID-19 infection and vaccination. If phone numbers were unavailable for participants, they were contacted by email and asked to schedule a time to complete the research study over the phone. Eligible participants were consented for this study over the phone using a verbal consent script that was submitted to and

approved by the Emory IRB prior to the start of this study. The study purpose, data collection procedures, and data management protocols were verbally summarized, and participants were given the opportunity to ask questions prior to giving their consent. Participants did not receive any form of compensation for their participation in this study. All study participation was voluntary, and participants could withdraw from the study at any point, although no participants withdrew.

All consented participants completed the study questionnaire over the phone, and interview lengths ranged from 15 to 35 minutes. Responses to open-ended questions were typed by the interviewer during the phone call. The interview was also recorded using an iPhone and later transcribed to ensure that open-ended responses were accurately captured. All participant responses were entered directly into electronic surveys in RedCap and were stored in a RedCap database. These survey responses did not include any personal identifiers and the responses were associated with an arbitrary study code for future, de-identified data analysis. All personal identifiers, such as the name and telephone number of the study participant, were stored in a password protected Excel file and saved in a secure, password protected computer and cloud storage system maintained by Emory University (EmoryBox). Recordings of the interviews were stored on a password-protected computer and backed-up on a cloud storage system maintained by Emory University (EmoryBox). These recordings will be saved for the duration of the study to ensure that open-ended responses are properly transcribed and backed up. Only the principle investigator and co-investigator have access to these files and both will be responsible for the management of this data.

2.4 Survey instrument for Data Collection

This study utilized a mixed methods survey instrument to collect quantitative and qualitative data on seasonal influenza and COVID-19 disease- and vaccine-related beliefs. The survey was divided into two similar sections to assess vaccine perceptions for each disease independently.

The first section of the survey collected participants' demographic information, including age, gender, race, level of education, profession, political affiliation, religion, medical conditions, and additional household members. The survey also asked whether the participant had been tested for COVID-19, their reason for testing, and their test results.

The second section of the survey assessed participants' disease and vaccine perceptions and intentions using Likert Scale questions. This section of the survey was designed to assess the five components of the Health Belief Model (perceived susceptibility, perceived severity, perceived benefits to action, perceived barriers to action, and cues to action) (Rosenstock, 1966). An additional component, the perceived susceptibility of others, was added to assess the altruistic motivations behind vaccination. Table 1 outlines the statements within the questionnaire that correspond to each component of the Health Belief Model. For each Likert Scale question, participants were asked to rank their level of agreement with the statement provided on a five-point scale that ranged from "Strongly agree" to "Strongly disagree", with a neutral "Do not agree or disagree" option. Participants were also asked to provide information about their primary sources of information on both diseases, as well as how often they consumed information from these sources.

Table 1: Health Belief Model Framework and Corresponding Likert Scale Prompts.

Question Number	Likert Scale Prompt
Perceived Personal Susceptibility	
C7/D5	I think I have a high personal risk of getting [seasonal influenza/COVID-19].
C9/D7	If I were diagnosed with [seasonal influenza/COVID-19], I think it would be dangerous for my health.
Perceived Susceptibility of Others	
C8/D6	I think people close to me have a high risk of getting [seasonal influenza/COVID-19].
C10/D8	If I were diagnosed with [seasonal influenza/COVID-19], I think it is plausible that I would infect people around me.
Perceived Severity of Disease	
C5/D3	I think [seasonal influenza/COVID-19] is a serious illness.
C6/D4	I think the complications associated with [seasonal influenza/COVID-19] are serious.
C17/D15	I am knowledgeable about the symptoms and complications associated with [seasonal influenza/COVID-19] infection.
Perceived Benefits of Vaccination	
C11/D9	I would rather receive a [seasonal influenza/COVID-19] vaccine than get [seasonal influenza/COVID-19].
Perceived Barriers to Vaccination	
C14/D12	I worry about the safety and/or side effects of the [seasonal influenza/COVID-19] vaccine.
Cues to Action	
C12/D10	If my doctor/nurse recommends that I get a [seasonal influenza/COVID-19] vaccine, I will get one.
C13/D11	If a government health authority recommends that I get a [seasonal influenza/COVID-19], I will get one.
C15	My intentions to get vaccinated against seasonal influenza have changed as a result of the COVID-19 pandemic.
D13	My beliefs about vaccination in general have changed as a result of the COVID-19 pandemic.
C18	I am knowledgeable about the CDC recommendations regarding seasonal influenza vaccination.

In the final section of the survey, participants were asked to rate their likelihood of receiving a seasonal influenza or a COVID-19 vaccine in 2020-2021 on a five-point scale from "Very Likely" to "Very Unlikely," with a neutral "Neither likely nor unlikely" option. This section also included three open-ended questions to collect more thorough responses on

participants' vaccine intentions and hesitancies. Participants were asked to elaborate on their reasoning behind their likelihood of future vaccination, as well as to provide general reasoning as to why an individual may or may not choose to get vaccinated against each disease.

2.5 Qualitative Analysis

The qualitative questions in the survey, which included three influenza questions, three COVID-19 questions, and one general concluding question, were transcribed and then coded to identify recurring themes by question. Using the Grounded Theory Approach, qualitative responses were first coded into narrow sub-themes and later combined into broader meta-themes to understand the broad facilitators and barriers to vaccine uptake (Corbin & Strauss, 1990). For this reason, some meta-themes may have a frequency greater than 57, as some participant responses included several sub-themes that fell into the same meta-theme. The data were stratified by vaccine intention to identify the most common themes among participants who intended to vaccinate and those who did not intend to vaccinate.

2.6 Statistical Analysis

For the bivariate and multivariable analysis, the age, race, religion, political affiliation, level of education, profession, living situation, and medical condition variables were recoded into variables with two or three categories. Age was recoded to a categorical variable, with intervals of "18-30 years", "31-59 years", and "60 years or older." Gender remained as a binary "Male" and "Female" variable. An "Other" option was included in the survey to account for non-binary gender identities, but all participants identified as male or female. Race was recoded to "White," "Black," and "NonWhite/NonBlack" because of the small sample of non-Black participants of color. Religion was recoded to "Religious" and "Not Religious," although the

majority of participants who were included in the "Religious" category identified as Christian. Political affiliation was recoded to "Democrat" and "Non Democrat," because of the small number of Republican, Independent, and "Other" political affiliations in the sample. Level of education was recoded to "College level or below" and "Graduate school and beyond." Profession was recoded to "Healthcare Field" and "Non Healthcare Field" to examine the potential role of healthcare expertise in vaccine decision making. Living situation was recoded as "Living alone," "Living with children," and "Living with non-children." Finally, the medical conditions variable was recoded to "1 or more medical conditions" and "No medical conditions." A new binary variable was created to reflect whether participants were enrolled before or after November 9, 2020, the day that the interim results for the first COVID-19 vaccine candidate, the Pfizer-BioNTech vaccine, were released.

The vaccine intention, vaccine hesitancy, and Likert scale variables were recoded to binary variables. For the vaccine intention variable, "Very Likely" and "Likely" were recoded to "Intention to Vaccinate" and "Neither likely nor unlikely," "Unlikely," and "Very Unlikely" were recoded as "No Intention to Vaccinate." For the vaccine hesitancy variable, "Very Likely" was recoded to "No Hesitancy" and the remaining four categories were recoded to "Hesitancy." For Likert Scale questions, "Strongly Agree" and "Agree" were recoded to "Agree" and "Do not agree or disagree," "Disagree," and "Strongly Disagree" were recoded to "Does Not Agree."

A descriptive analysis was performed on the demographic variables and Likert scale variables. Bivariate analyses comparing vaccine intentions and demographic characteristics as well as vaccine intentions and experience variables were performed using a two-tailed Fischer's exact test. A $p<0.1$ was defined as statistically significant, but the statistical analysis identified associations of significance at the $p<0.1$, $p<0.05$, or $p<0.01$ levels.

The multivariable statistical analysis on vaccine intention and vaccine hesitancy was performed using an ordinary least squares (OLS) regression, post-lasso estimator. Holding constant core demographic variables, i.e. demographic data that may be collected with a patient intake form, the analysis used a least absolute shrinkage and selection operator (lasso) regression as a first-step estimator to identify which of the other explanatory variables were most associated with the vaccine intention response variable (Belloni & Chernozhukov, 2013). A lasso regression identifies potential predictor variables by shrinking the regression coefficients of unrelated or weakly related variables to zero (Tibshirani, 1996). In studies such as this one, in which there is a small sample size and many regressors, OLS post-lasso regressions are better suited to identify predictor variables than OLS, stepwise OLS, or lasso regressions alone (Belloni & Chernozhukov, 2013).

The lasso regression included all core demographic variables but retained only the subset of remaining experience and Likert scale variables that were predictive of vaccine intention. All variables selected by the lasso procedure were then included in an OLS regression to determine the fit or R^2 of the model and the statistical significance of each variable's association with vaccine intention. The R^2 of this regression was compared to that of an OLS regression containing only core demographic variables to determine the additional predictive power of the experience and Likert scale variables that were identified by the lasso procedure. The same analysis was repeated using vaccine hesitancy as the response variable. Predictors of seasonal influenza and COVID-19 vaccine intentions and vaccine hesitancy were identified independently. All statistical analysis was performed using STATA statistical software.

Chapter 3. Results

3.1 Overview of Study Population

Table 2 shows the demographic breakdown of the 57 participants enrolled in this research study, of the 265 individuals who were contacted for participation. Approximately 61% of participants identified as Female, while 39% identified as Male. As per the enrollment criteria, all study participants were over the age of 18, and the mean age of study participants was 46 years old. The majority of study participants identified as Christian (37%) or stated that they were Not Religious (39%). The study population was predominantly White (60%) and the majority of participants had obtained a graduate degree (72%). The most common professions among study participants were Professor/Researcher (26%) and Public Health/Healthcare Professional (21%). Only 16% of study participants lived alone, while the remainder lived with roommates (5.3%), a partner (35%), a partner and children (28%), or another household member. Of the study participants who lived with someone else, 60% self-reported that they lived with an individual that had a medical condition that may place them at a higher risk if they were diagnosed with seasonal influenza or COVID-19. The majority of the study population also self-identified as having one or more medical conditions themselves (60%), the most common conditions being hypertension, high cholesterol, and cancer, as shown in Table 3.

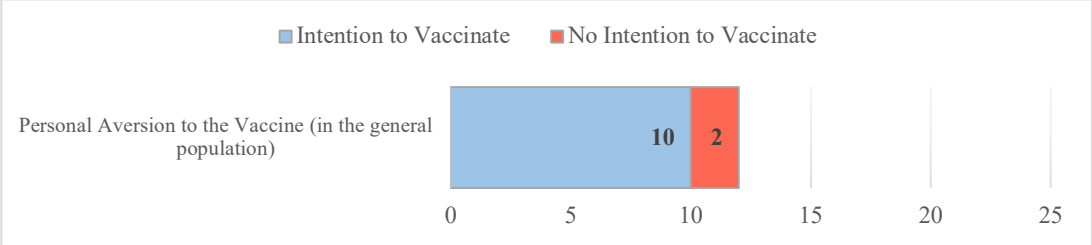
Table 4 outlines participants' vaccine intentions by vaccine type. Of the 57 participants enrolled, 91% intended to receive the 2020-21 seasonal influenza vaccine and 77% intended to receive a COVID-19 vaccine.

3.2 Personal or Demographics-Based Aversions to Vaccination

In order to assess initial associations between demographic characteristics and vaccine intentions, a bivariate analysis was conducted of each of the demographic variables against the

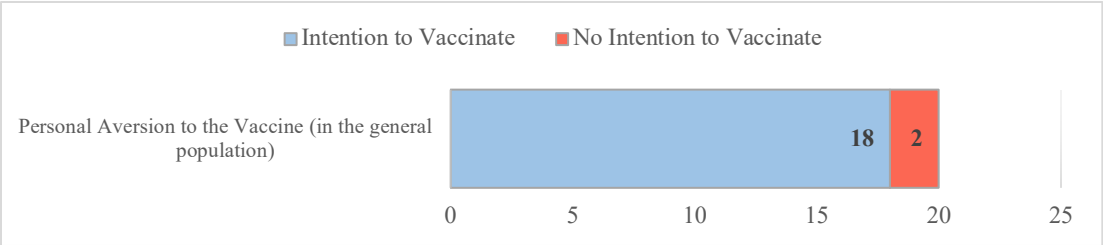
COVID-19 vaccine intention variable and the seasonal influenza vaccine intention variable. Table 5 displays the results of this bivariate analysis. The bivariate analysis indicated that race ($p<0$), religion ($p<0.010$), and level of education ($p<0.004$) were associated with intention to receive the COVID-19 vaccine. Age, gender, political affiliation, profession, living situation, and medical conditions were not found to be associated with COVID-19 vaccine intention. The bivariate analysis of demographic variables and seasonal influenza vaccine intentions found that race ($p<0.091$) was significantly associated with vaccine intentions. Age, gender, religion, political affiliation, level of education, profession, living situation, and medical conditions were not found to be associated with seasonal influenza vaccine intentions.

Figure 2: Frequency of COVID-19 vaccine response meta-themes related to "Personal Aversions to Vaccination."



Sub-themes include "personal health contraindications" (n=3), "political reasons" (n=3), "religious reasons" (n=4), and "African Americans' mistrust of the U.S. medical system" (n=2).

Figure 3: Frequency of seasonal influenza vaccine response meta-themes related to "Personal Aversions to Vaccination."



Sub-themes include "personal health contraindications" (n=11), "political reasons" (n=4), "religious reasons" (n=3), and "African Americans' mistrust of the U.S. medical system" (n=2).

In the qualitative analysis, "Personal Aversion to the Vaccine" emerged as a key theme in response to the questions, "What do you think are reasons why a person might choose not to get

vaccinated against seasonal influenza?" and "What do you think are reasons why a person might choose not to get vaccinated against COVID-19?" (Figures 2 and 3). This meta-theme was used to summarize personal characteristics or personal health conditions that might heighten vaccine hesitancy and reduce an individual's intention to get vaccinated. For both vaccines, participants stated that individuals' political beliefs and religious beliefs may be potential causes of vaccine hesitancy in the general population. However, participants rarely named specific political parties, or religions that may preclude an individual from getting vaccinated, sticking instead to general statements about the role of such affiliations:

> *I think there are certain groups with religious affiliations that discourage vaccinations. I also suspect that there are, well I know there are, political groups that do not regard this virus as serious and I suspect with political motivations, will decide not to get the [COVID-19] vaccine* (female respondent, age 75)

Personal health contraindications, such as egg allergies or immune disorders, were often mentioned as more "legitimate" reasons for hesitancy:

> *…and what I would describe as more legitimate concerns about if they have some condition, immune-related or other, that makes getting vaccines dangerous.* (male respondent, age 38)

Another subtheme that emerged within this category is "African Americans' mistrust of the United States Medical System." In the context of the seasonal influenza vaccine, one participant responded that African Americans may exhibit greater hesitancy because:

> *There are also people who have a bit of skepticism, be it for historical reasons or whatnot. For example, Black people may be hesitant to get vaccinated due to the history of violence against their community by medical professionals and the medical community.* (female respondent, age 30)

Another participant, who identified as African American, blamed shortages in healthcare resources for causing a sense of abandonment within the African American community, particularly during the COVID-19 pandemic:

> *There were a lot of situations when African Americans could not get tested and treated in their communities, because health care services were overwhelmed and testing was not available, so we had to figure out natural remedies to heal ourselves because we were getting told to quarantine at home and get better that way. People had to find natural ways to heal themself or they died. People who think the flu vaccine will protect them from the flu or COVID-19 still have to treat themselves if they get it because there aren't enough tests or places to treat patients. You have to do something to treat yourself in the meantime. When my son and I started feeling COVID symptoms, I ended up doing things I knew naturally to do or things I had heard from a naturalist. By the time I saw a doctor, the remedies had healed me and my son so I felt like I didn't need any medicines. I think people just need to trust what works for them.* (female respondent, age 37)

Study participants cited "Personal Aversion to the Vaccine" 20 times in their responses about seasonal influenza vaccine hesitancy in the general population and 12 times in their responses about COVID-19 vaccine hesitancy in the general population.

3.3 Risk-Based Perceptions on Vaccination

The second section of the study questionnaire was modeled around the Health Belief Model, a framework that assesses perceived susceptibility, perceived benefits to action, perceived severity, perceived barriers to action, and cues to action. The survey was also designed to assess perceived susceptibility of others. These perceptions were assessed through Likert-scale questions, the responses for which can be found in Table 6.

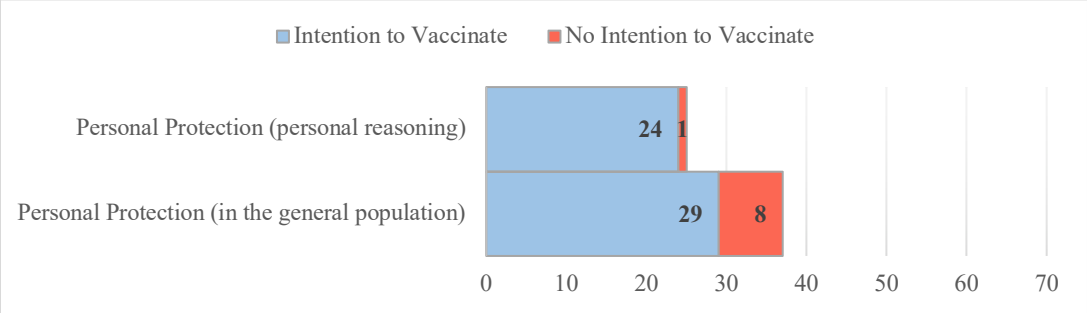
Perceived Personal Susceptibility

Perceived personal susceptibility was assessed using the statements: "I think I have a high personal risk of getting [seasonal influenza/COVID-19]" and "If I were diagnosed with [seasonal influenza/COVID-19], I think it would be dangerous for my health." Respondents who intended to get the COVID-19 vaccine did not report thinking they were at a high risk of contracting COVID-19, with 32% of participants disagreeing with this statement and 25% remaining neutral on the statement. However, a total of 85% of participants who did not intend to

get the COVID-19 vaccine strongly agreed or agreed that they were at high personal risk of contracting COVID-19. For the seasonal influenza vaccine 38% of participants who intended to vaccinate disagreed that they had a high personal risk of contracting seasonal influenza and 25% remained neutral. Among those who did not intend to vaccinate, 60% disagreed with the statement and 40% remained neutral.

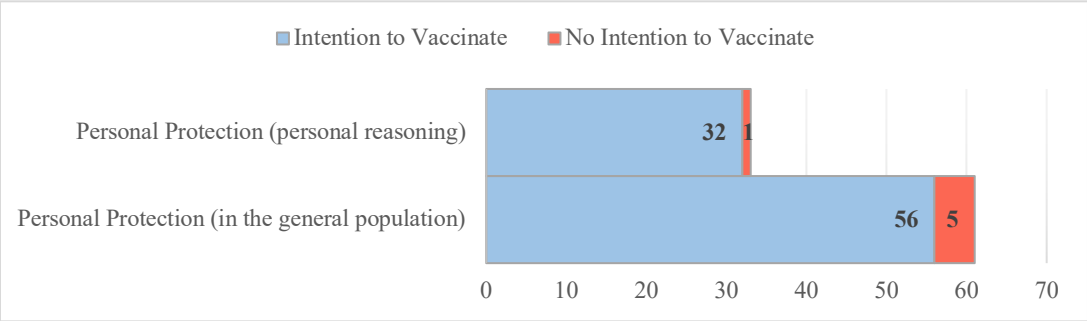
Both those who did and did not intend to receive the COVID-19 vaccine believed that COVID-19 would be dangerous to their health. A total of 87% of individuals who intended to vaccinate and 92% of those who did not intend to vaccinate strongly agreed or agreed that COVID-19 infection would pose dangerous personal health risks. For seasonal influenza, very few participants strongly agreed that seasonal influenza would be dangerous to their personal health, and responses were similarly dispersed across the agree, do not agree or disagree, and disagree categories.

Figure 4: Frequency of COVID-19 vaccine response meta-themes related to "Perceived Personal Susceptibility"



Sub-themes for personal reasoning include "personal protection" (n=20), "reducing symptom severity" (n=2), and "concerns about the danger of infection" (n=3). Sub-themes for the general population's reasoning also include "personal protection" (n=25), "reducing symptom severity" (n=6), and "concerns about the danger of infection" (n=6).

Figure 5: Frequency of seasonal influenza vaccine response meta-themes related to "Perceived Personal Susceptibility."



Sub-themes for personal reasoning include "personal protection" (n=24), "reducing symptom severity" (n=4), "prior experience with influenza infection," (n=3), and "concerns about the danger of infection" (n=2). Sub-themes for the general population's reasoning also include "personal protection" (n=38), "reducing symptom severity" (n=15), "prior experience with influenza infection" (n=1), and "concerns about the danger of infection" (n=7).

In the qualitative analysis, "Personal Protection" emerged as one of the most common reasons why an individual would choose to get vaccinated against COVID-19 and/or seasonal influenza (Figures 4 and 5). In the COVID-19 analysis, "Personal Protection" emerged 25 times as a personal reason for vaccinating and 37 times as a reason for vaccinating within the general population. In the seasonal influenza analysis, the theme emerged 33 times as a personal reason and 61 times as a reason for getting the vaccine within the general population. Within this meta-theme, subthemes such as "Reducing Symptom Severity" and "Concerns about the Danger of Infection" appeared in participants' responses. Qualitative responses related to personal protection were often short and to the point, such as:

> *COVID is potentially a deadly disease so getting the vaccine would protect me and the people I know and the broader community from the spread.* (female respondent, age 54)

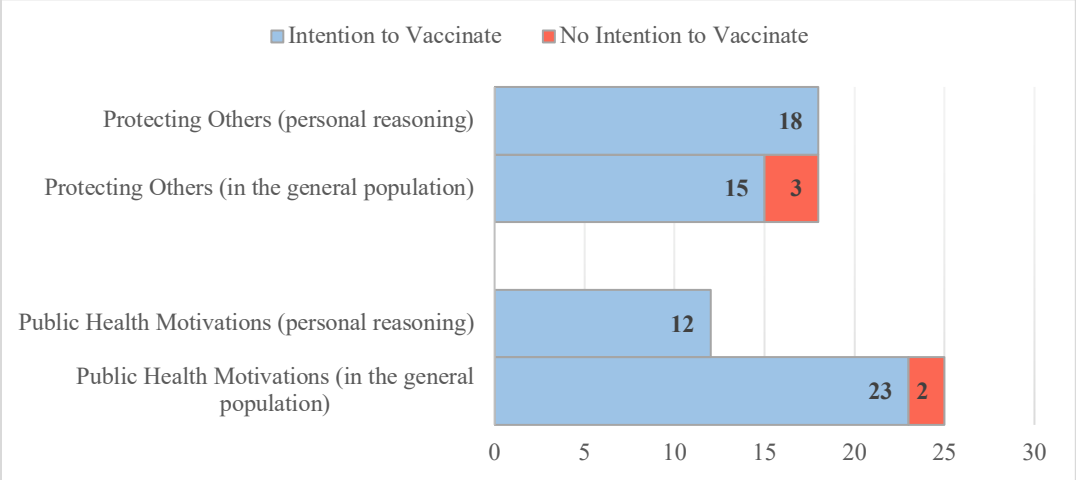
> *I have already received [the flu vaccine] to reduce my own risk of getting and/or transmitting seasonal flu, to increase the potential that even if I were to get it, it would not be as bad as if I had not gotten vaccinated.* (female respondent, age 29)

Perceived Susceptibility of Others

Perceived susceptibility of others was assessed using the statements: “I think people close to me have a high risk of getting [seasonal influenza/COVID-19]” and “If I were diagnosed with [seasonal influenza/COVID-19], I think it is plausible that I would infect people around me.” Despite not intending to get the vaccine, 85% of participants with no intention to vaccinate strongly agreed or agreed that people close to them had a high risk of contracting COVID-19. Reponses to this statement were much more split across categories ranging from “strongly agree” to “disagree” for participants who did intend to get the COVID-19 vaccine. There was a similar split among participants who intended to get the seasonal influenza vaccine, although 43% of this group agreed that those around them were at high risk of contracting seasonal influenza. 60% of those who did not intend to get the seasonal influenza vaccine disagreed that those around them were at high risk of infection.

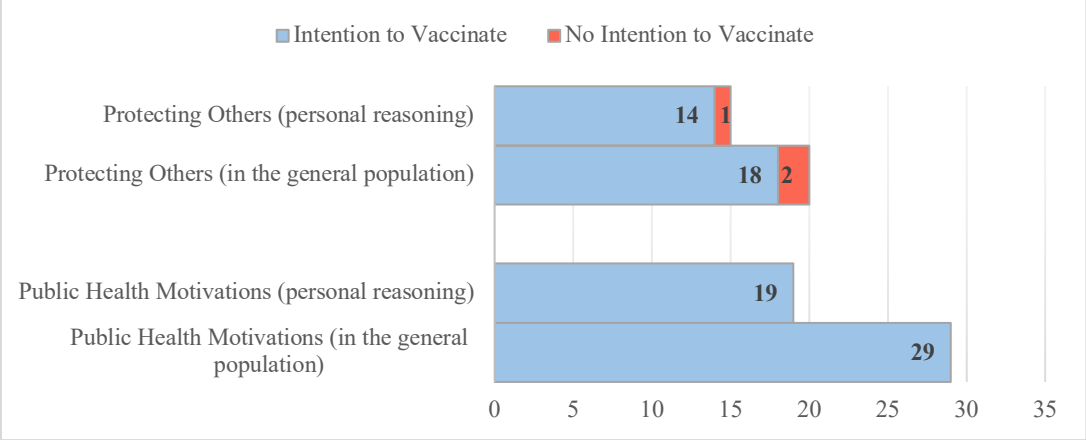
When asked about their perceived likelihood of infecting others, 87% of participants who intended to receive the COVID-19 vaccine strongly agreed or agreed that it was plausible that they would infect people around them. Responses were similar among those who did not intend to receive the COVID-19 vaccine, with 92% strongly agreeing or agreeing with this statement. The majority of participants agreed that they would infect those around them if they were diagnosed with seasonal influenza. Among those who intended to vaccine, 93% agreed or strongly agreed and among those who did not intend to vaccinate, 60% agreed. A substantial 40% of those who did not intend to vaccinate against seasonal influenza disagreed with the statement that they might infect others.

Figure 6: Frequency of COVID-19 vaccine response meta-themes related to "Perceived Susceptibility of Others."



Sub-themes for personal reasoning behind "Public Health Motivations" include "public health/social responsibility" (n=6) and "reducing community spread" (n=6). Sub-themes for the general population's reasoning behind "Public Health Motivations" include "public health/social responsibility" (n=11) and "reducing community spread" (n=14).

Figure 7: Frequency of seasonal influenza vaccine response meta-themes related to "Perceived Susceptibility of Others."



Sub-themes for personal reasoning behind "Public Health Motivations" include "public health" (n=2), "reducing community spread," (n=2) and "important due to COVID-19" (n=15). Sub-themes for the general population's reasoning behind "Public Health Motivations" include "public health" (n=13), "reducing community spread" (n=14), and "important due to COVID-19" (n=2).

In the qualitative analysis, "Protecting Others" was a major theme in participants' personal and general reasoning behind vaccination (Figures 6 and 7). This theme frequently appeared alongside "Personal Protection." "Protecting Others" emerged 18 times in the personal

reasoning question and 18 times in the general reasoning for the COVID-19 vaccine, as well as 15 times in the personal reasoning and 20 times in the general reasoning for the seasonal influenza vaccine. Most commonly, participants cited the need to protect high risk, immunocompromised, and other vulnerable populations from potential infection.

Another important, and related theme, that emerged from this qualitative analysis was "Public Health Motivations," which includes the subthemes of "Reducing Community Spread" and "Social Responsibility." In the seasonal influenza analysis, this theme appears 19 times as a personal reason and 29 times as a general reason for vaccination. The need to build up herd immunity to protect the broader population was expressed by several participants:

> *I really believe in building up our collective immunity and protection, I think it is really important for those of us that can get vaccinated to get vaccinated, to be a buffer for those individuals that might be high risk or can't take it due to allergies or whatever the case may be. I approach it with a collective mentality of protecting not only myself but also the people around me.* (female respondent, age 30)

In the COVID-19 analysis, "Public Health Motivations" appeared 12 times as a personal reason and 25 times as a general reason for getting the vaccine. Participants emphasized that COVID-19 and seasonal influenza vaccination is a matter of social responsibility:

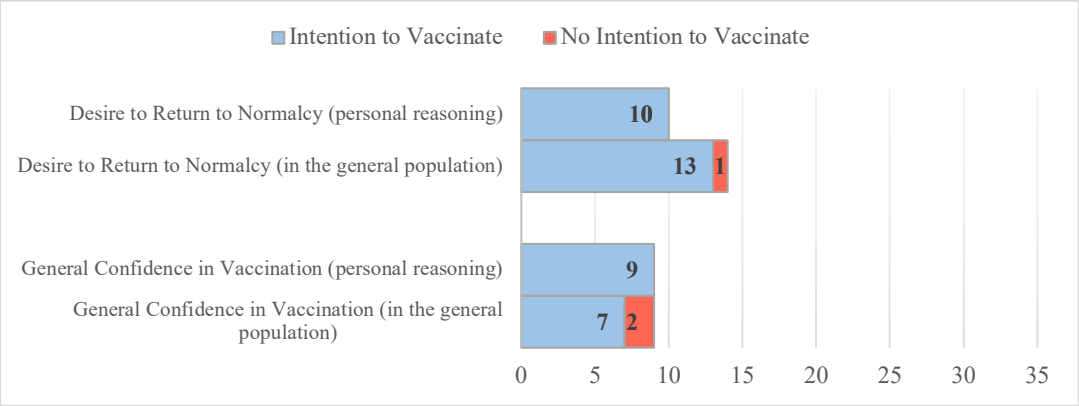
> *I think certainly I want to protect myself. Also, as I mentioned with flu, I think in the case of COVID especially, I think it is really important as a social responsibility to get vaccinated to prevent spread. But I think the difference with COVID for me, is that I am a little more worried about its health implications for my own health than I am about seasonal influenza.* (male respondent, age 38)

> *…You don't want to spread it in a population. Seasonal influenza is a lot more serious than a lot of people realize. I am an economist, so I know that just a couple of years ago 60,000 people died, and then 30,000 people die more or less in normal years. It is not something to be taken lightly. You know? I mean, it is part of being a good citizen, or an enlightened citizen. It's like voting or something, you've got to do it.* (male respondent, age 60)

Perceived Benefits of Vaccination

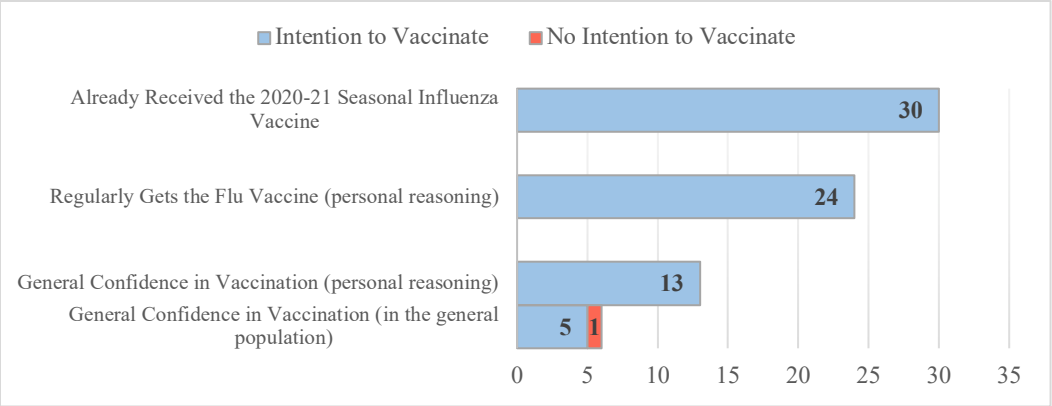
As mentioned by many of the participants, vaccines are advertised as a beneficial public health tool. The statement "I would rather receive a [seasonal influenza/COVID-19] vaccine than get [seasonal influenza/COVID-19]" was used to assess participants' perceptions of the benefits of vaccination as a disease prevention tool. Among those who intended to vaccinate, 98% of participants strongly agreed or agreed that they would prefer the COVID-19 vaccine to COVID-19 infection and 98% strongly agreed or agreed with the statement about seasonal influenza. Responses were much more distributed across the five categories for participants who did not intend to receive these vaccines.

Figure 8: Frequency of COVID-19 vaccine response meta-themes related to "Perceived Benefits of Vaccination."



Sub-themes for the general population's reasoning behind "Desire to Return to Normalcy" include "desire to return to normalcy" (n=10) and "restarting the economy" (n=4).

Figure 9: Frequency of seasonal influenza vaccine response meta-themes related to "Perceived Benefits of Vaccination."



The positive perceptions of vaccination found in the quantitative portion of the survey were echoed in the qualitative responses. Participants cited "General Confidence in Vaccination" as a both personal and general population reason why individuals should get vaccinated (Figures 8 and 9). For seasonal influenza, this theme appeared 13 times in participants' personal responses and 6 times in their reasoning about the general population. In the COVID-19 analysis, this theme appeared 9 times in participants' personal responses and 9 times in their reasoning about the general population. Participants expressed confidence in past vaccines, in scientists' ability to manufacture new vaccines, and in the benefits of vaccine-induced herd immunity:

> *I worked on the Phase III study for the COVID vaccine, so I am excited and confident about the interim efficacy results of 94.5%. We are very good at making vaccines that are very safe and I think that it will help stop the pandemic.* (female respondent, age 29)

Participants also included stipulations about vaccinating during "COVID-19 season" in both their COVID-19 and seasonal influenza-related responses. In their personal responses on seasonal influenza vaccination, participants noted the importance of vaccinating against the flu during 2020 and 2021, given the simultaneous circulation of COVID-19:

> *I got it as early as I did was because I saw that the vaccines are available and I didn't want to risk having a potential complication or co-infection with COVID. The flu vaccine is not perfect but it is better than nothing.* (female respondent, age 53)

> *I usually do not get the flu shot, but this time, any help to help with the pandemic and to lower the burden on the hospitals, I would have absolutely gotten it and the entire family would have gotten it if we had had access to [the flu vaccine].* (female respondent, age 41)

In their personal responses on COVID-19 vaccination, participants admitted to yearning to return to "normal life." "Normal" for some, meant no longer waking up to staggering death tolls. To others, "normal" simply meant being able to hug a loved one:

> *I would like to go outside again, I would like to go to a concert, I would like to go a party, I would like to hug my son. Things like that.* (female respondent, age 54)

> *I mean the 300,000 people dead just in the United States alone, right? I would like to see the world return to some degree of normalcy and this is the one thing that I can do to make this not necessarily a reality, but as a contribution to it. So, I feel it is my civil duty to do it.* (male respondent, age 60)

Perceived Severity of Disease

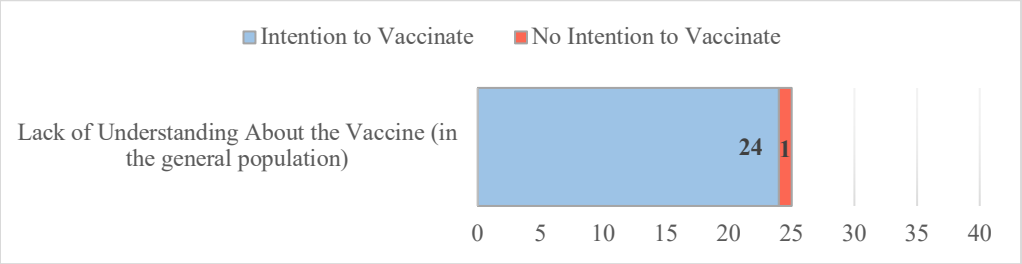
Perceived severity of disease was assessed using three statements: "I think [seasonal influenza/COVID-19] is a serious illness," "I think the complications associated with [seasonal influenza/COVID-19] are serious," and "I am knowledgeable about the symptoms and complications associated with [seasonal influenza/COVID-19] infection." When asked if they considered COVID-19 to be a serious illness, 100% of participants who intended to vaccinate and 92.7% of participants who did not intend to vaccinate strongly agreed or agreed that COVID-19 is a serious illness. Similarly, 98% of participants who intended to receive the seasonal influenza vaccine strongly agreed or agreed that seasonal influenza is serious, and 80% of those who did not intend to receive the vaccine agreed.

All participants who intended to vaccinate against COVID-19 strongly agreed (91%) or agreed (9.1%) that the complications associated with COVID-19 are serious. Similarly, all participants who did not intend to vaccinate against COVID-19 strongly agreed (85%) or agreed

(15%) that the infection can cause serious complications. Among those who intended to receive the seasonal influenza vaccine, 96% agreed or strongly agreed that the complications associated with seasonal influenza were serious and 80% of those who did not intend to vaccinate also agreed.

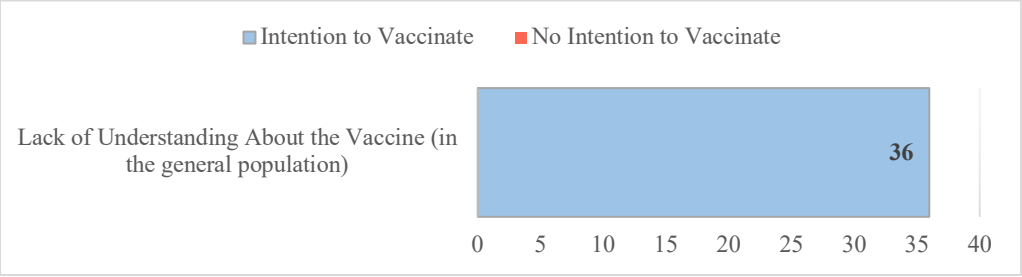
When asked if they were knowledgeable about the symptoms and complications associated with COVID-19 infection, 100% of participants, regardless of vaccine intention, strongly agreed or agreed that they were knowledgeable about COVID-19. When asked about their knowledge of seasonal influenza, 94% of participants who intended to get the flu vaccine strongly agreed or agreed that they were knowledgeable and 100% of participants who did not intend to receive the vaccine strongly agreed or agreed that they were knowledgeable.

Figure 10: Frequency of COVID-19 vaccine response meta-themes related to "Perceived Severity of Disease."



Sub-themes for the general population's reasoning include "access to misinformation" (n=16), "belief in conspiracy theories" (n=7), and "uneducated or ignorant about vaccination" (n=2).

Figure 11: Frequency of seasonal influenza vaccine response meta-themes related to "Perceived Severity of Disease."



Sub-themes for the general population's reasoning include "access to misinformation" (n=10), "belief in conspiracy theories" (n=9), and "uneducated or ignorant about vaccination" (n=17).

Access to Information About Vaccines

Despite participants' high perceptions of their own knowledge of COVID-19 and seasonal influenza, many participants cited misinformation as a reason behind why an individual may choose not to vaccinate. "Lack of understanding about the vaccine" was a key theme that emerged in the qualitative analysis of both COVID-19 responses (n=25) and seasonal influenza responses (n=36) (Figures 10 and 11). Participants only mentioned this theme in their general reasoning behind vaccine hesitancy, and not their personal reasoning, as nearly all participants who mentioned this theme intended to vaccinate. Participants cited "access to misinformation," "belief in conspiracy theories," and "general ignorance or lack of understanding about the vaccine" as more specific subthemes to describe why an individual may choose not to receive the COVID-19 vaccine:

> *Facebook! False media! Propaganda! I think that there are a lot of anti-vax people who decide that they know better than any doctor without any scientific merit and they choose to try to be influencers. I think it is more rooted in personal self-inflation than it is malicious, they just want to be important.* (female respondent, age 53)

One participant called the misinformation surrounding the COVID-19 pandemic unprecedented:

> *How do you overcome the "it's fake" or "it's not real"? That is a public health challenge that I think we have never had to deal with before, because anything you say can always be interpreted as "Oh that is what you would say if it was fake," you know what I mean? So, I don't know what to tell you. The disinformation and misinformation, whatever the source, has caused this to become a nightmare.* (male respondent, age 59)

Although uncommon in the study population, some participants even admitted to believing in some of the circulating conspiracies about the coronavirus:

> *I think many people think that this is all a conspiracy. They feel like the illness, once you get, it is real, but the reason why it is plaguing our country did not start as a real thing. Like they think it was something that was put into the air by a group of people and the result of that is that we are actually getting sick and dying from it. People think that it is not naturally deriving from something; that is not coming from the land or anything natural. People can't trust how it actually got out into the world in the first place and think that the people who released the virus are coming back with their vaccine and*

> *trying to sell them a cure to something that they created, like this is all a money-making gimmick that took people lives, just so they could be saviors of the word. People don't want to give into this money- making scheme that came into to take people's lives. I do believe that in some way.* (female respondent, age 37)

Similar themes emerged regarding misinformation about the seasonal influenza vaccine, with many participants citing "access to misinformation," "belief in conspiracy theories," and "general ignorance or lack of understanding about the vaccine" as causes for hesitancy:

> *There is a whole bunch of them. One is there is misinformation, that is probably the leading cause of people that have easy access [to the flu vaccine], is the disinformation stemming all the way back from the autism, you know the Wakefield stuff with autism, and everything. So disinformation is a major contributing factor.* (male respondent, age 59)

Some participants expressed strong opinions about "anti-vax" individuals, claiming that they are ignorant or uneducated for choosing to forgo vaccination:

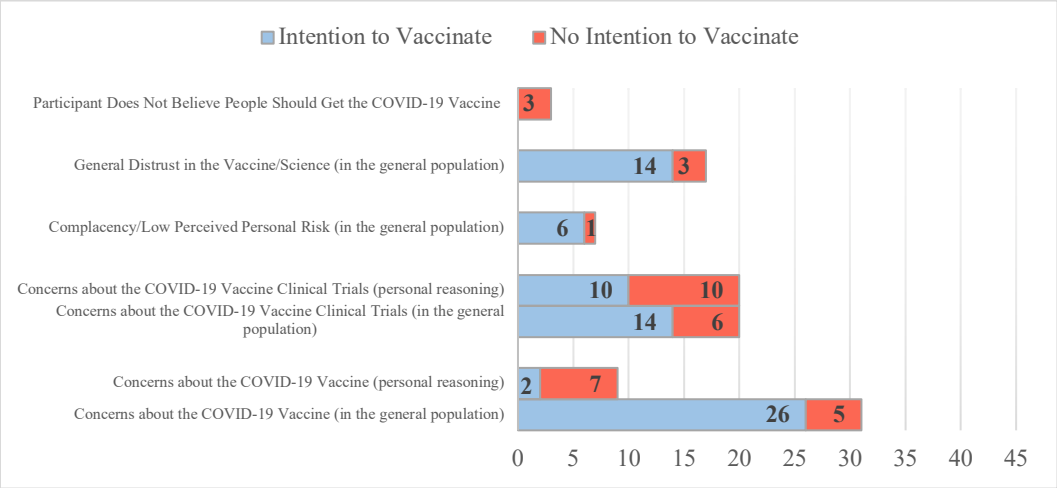
> *They are stupid…lack of education, they are downright dumb.* (female respondent, age 43)

Perceived Barriers to Vaccination

While many participants cited misinformation and conspiracy theories as principle sources of hesitancy in the general population, many admitted to being nervous about the side effects of vaccination themselves. The statement "I worry about the safety and/or side effects of the [seasonal influenza/COVID-19] vaccine" was used to assess the role of side effects as a potential barrier to vaccine uptake. Responses to this statement were divided; the most common response among individuals who intended to vaccinate was "disagree" for both the COVID-19 vaccine (43%) and the seasonal influenza vaccine (44%). Side effects appeared to be a significant deterrent for participants who did not intended to receive the COVID-19 vaccine, with 92% strongly agreeing or agreeing that they worried about the safety or side effects of the vaccine. The fear of side effects was less prominent among individuals who did not intend to

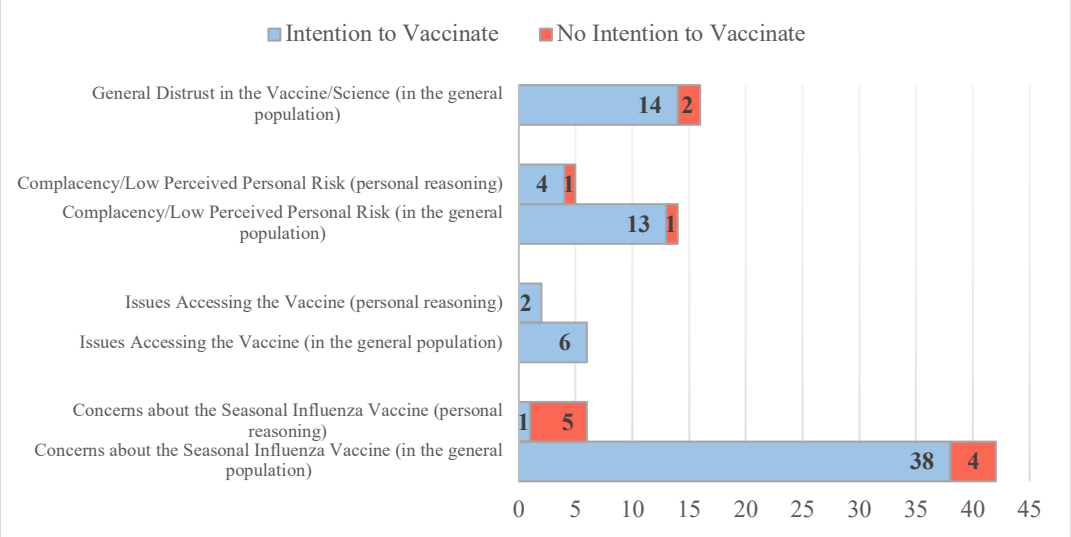
receive the seasonal influenza vaccine, with 60% strongly agreeing or agreeing that this was a concern.

Figure 12: Frequency of COVID-19 Vaccine response meta-themes related to "Perceived Barriers to Vaccination."



Sub-themes for personal reasoning behind "Concerns about the COVID-19 Vaccine Clinical Trials" include "concerns about the safety and efficacy data" (n=12), "concerns about the timing of vaccine development" (n=6), and "lack of minority representation in vaccine trials" (n=2). Sub-themes for the general population's reasoning behind "Concerns about the COVID-19 Vaccine Clinical Trials" include "concerns about the safety and efficacy data" (n=8), "concerns about the timing of vaccine development" (n=10), and "lack of minority representation in vaccine trials" (n=2). Sub-themes for personal reasoning behind "Concerns about the COVID-19 Vaccine" include "concerns about the vaccine side effects" (n=3) and "concerns about the vaccine novelty (n=6). Sub-themes for the general population's reasoning behind "Concerns about the COVID-19 Vaccine" include "distrust in the COVID-19 vaccine" (n=9), "concerns about the vaccine side effects" (n=16), and "concerns about the vaccine novelty (n=6).

Figure 13: Frequency of seasonal influenza vaccine response meta-themes related to "Perceived Barriers to Vaccination."



Sub-themes for personal reasoning behind "Concerns about the Seasonal Influenza Vaccine" include "distrust in the flu vaccine" (n=4) and "fear of getting the flu from the flu vaccine" (n=2). Sub-themes for the general population's reasoning behind "Concerns about the Seasonal Influenza Vaccine" include "concerns about the vaccine side effects" (n=20), "distrust in the flu vaccine" (n=7), and "fear of getting the flu from the flu vaccine" (n=15).

"Concerns about the Vaccine" emerged as a key theme in the qualitative analysis of COVID-19 and seasonal influenza vaccine hesitancy (Figures 12 and 13). When asked generally why an individual may choose not to receive the seasonal influenza vaccine, participants cited subthemes such as "concerns about the vaccine side effects," "distrust in the flu vaccine," and "fear of getting the flu from the flu vaccine." Of these themes, only "distrust in the vaccine" and "fear of getting the flu from the flu vaccine" appeared in participants' personal reasoning behind their vaccine intentions. Many personal concerns about the seasonal influenza vaccine stemmed from the information about its somewhat limited efficacy:

> *The flu vaccine is the only vaccine that I am a little dubious about, and about how helpful it really is at like 50% efficacy being a successful rate. Quite frankly, I worry that people are more likely in our society, if they end up with milder symptoms, they are more likely to schlep themselves to the office and spread the virus more.* (female respondent, age 41)

Another common fear, whether from the participants themselves or the patients that participants treated, is that the seasonal influenza vaccine can cause influenza infection among vaccine recipients:

> *The most common misbeliefs that I see as a nurse are that "the flu shot gives me the flu" because of the body's immune response when they receive the flu vaccine.* (female respondent, age 35)

> *They might be worried about side effects and they also might have known people, and this is the case for me, everyone that I have ever know who got the flu, at least for the past 20 years, also got the vaccine. That doesn't mean that I don't know people who got the vaccine and didn't get the flu, it just means that to me it did not seem effective. You would always hear "Oh this year's flu vaccine, turns out it wasn't very effective because the flu that actually came around was not the one in the vaccine." So for me, I just felt like the risk of side effects was too high given the efficacy that it typically had.* (female respondent, age 54)

Another participant, who expressed strong stances against both the seasonal influenza and COVID-19 vaccines, questioned the contents of the seasonal influenza "cocktail":

> *The side effects that you are putting in your body. You could have rash, swelling, you could even die, nervous system problems that stop your heart, asthma. I have taken the flu cocktail a while ago and I got really sick so I just decided that it was something that wasn't worth me having, I prefer not to be sick. Not everyone knows what is in the seasonal flu vaccination. We just know it is one cocktail after the next. How do you know how this vaccine will affect your body?* (female respondent, age 47)

"Complacency," or the idea that seasonal influenza poses a low risk to participants' own health, emerged as another key theme in both personal reasoning (n=5) and general population reasoning (n=14). Rather than having a strong reason not to get vaccinated, these participants did not feel a strong reason to get vaccinated:

> *Typically I wouldn't, just because I think I am a pretty healthy young adult and historically I just don't get really ill. I don't have any sort of immunodeficiencies or general weakness. I mean, I just don't get it out of convenience, but I don't have any reason not to get it.* (male respondent, age 25)

The potential barriers to COVID-19 vaccination were more extensive. Similar to the seasonal influenza responses, "Concerns about the Vaccine" and "Complacency" emerged as key themes in the COVID-19 qualitative responses. Participants mentioned "concerns about the vaccine side effects," "distrust in the COVID-19 vaccine," and "complacency" in their reasoning why the general population may choose not to receive the COVID-19 vaccine. In their personal reasoning, participants mentioned "concern about the vaccine side effects." "Concerns about the vaccine novelty," was another key subtheme that emerged as both a personal and general population reason for not getting vaccinated. Several participants noted they would prefer to let others get the vaccine first, and felt no rush to be first in line for the vaccine:

> *If other people have taken the vaccine and it showed that it was helpful, then I would get it. But just right now, with no real knowledge from experience of the vaccine, I wouldn't. There is no time frame, but after people I really know, you know, everybody's health is*

> *different, but after they have taken it and have learned their experiences, then maybe I would think about it.* (female respondent, age 63)

Given the novelty of the COVID-19 vaccine, participants also mentioned concerns about the vaccine's development. "Concerns about the COVID-19 Vaccine Clinical Trials" appeared as both personal (n=20) and general population (n=20) reasons why an individual may choose not to get the COVID-19 vaccine. Participants further broke down these concerns as being related to the "safety and efficacy data available," "the timing of the vaccine development," and "the lack of minority representation in the vaccine trials." Many participants who were enrolled prior to the release of the first Pfizer-BioNTech clinical trial results stated that they would only get the vaccine after they had enough data to ensure that the vaccine was effective and it had not been distributed prematurely:

> *The only thing that would give me pause is if I felt like the vaccine came out too quickly, or they had not taken the time to properly research its safety, or I felt like it was being politicized by the federal government. If the CDC says that it is safe, I would go for it. In terms of time frame, I don't have one. As long as the necessary safety procedures that are in clinical trials to test for safety are in place and are being followed, I wouldn't have a specific time frame to wait before getting vaccinated.* (male respondent, age 31)

Two participants were also concerned that they were not represented in the vaccine clinical trials, and the safety and efficacy data could therefore not be generalized to their demographic groups. One of these participants is African American, and was concerned about the lack of diversity in the clinical trials:

> *In trials that they are doing with the vaccines, as an African American, I don't feel like they have had a big enough sample side to test the efficacy and complications of the vaccines on African Americans.* (female respondent, age 43)

The other participant had undergone an organ transplant, and feared that the existing vaccine data would not account for how her body may react to the vaccine:

> *I would have to consult with my provider given my situation as a transplant person to see this vaccine's side effects. I don't know if they had any participants in the study with any transplant, to see how the person will react and what are the side effects and so on. That would be my biggest concern.* (female respondent, age 54)

Participants also credited population-level hesitations about the seasonal influenza and COVID-19 vaccines to a general distrust in both vaccination and the science behind vaccination. "General Distrust in Vaccines/Science" emerged 17 times in the COVID-19 analysis and 16 times in the seasonal influenza analysis. These concerns about vaccines are not tied to a specific vaccine, but rather the concept of vaccination more broadly:

> *They don't trust vaccines and the established medical community or pharma companies.* (female respondent, age 41)

> *I think the anti-vax groups are putting out crazy ideas that vaccinations cause all kinds of crazy things to happen to you. There's that one about there being some kind of transmitter inside the vaccination. I think people believe that stuff, too many, and they are just not accepting the science. I think if you follow the science, it tells you that is the better thing to do.* (male respondent, age 63)

External Cues to Action

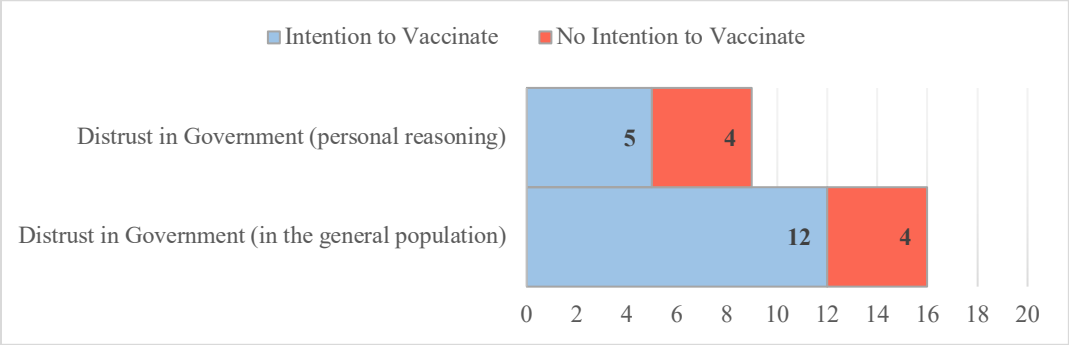
Concerns about the timing of the vaccine development are heavily tied to concerns about which groups are pushing for vaccine uptake, and what their motivations for doing so may be. The impact of external cues to action, such as the recommendations of doctors and government officials, on vaccine uptake were assessed using the statements: "If my doctor/nurse recommends that I get a [seasonal influenza/COVID-19] vaccine, I will get one," "If a government health authority recommends that I get a [seasonal influenza/COVID-19], I will get one," and "I am knowledgeable about the CDC recommendations regarding seasonal influenza vaccination."

Among participants who intended to get vaccinated against seasonal influenza, 98% strongly agreed or agreed that they would get the vaccine following a doctor's recommendation and 83% would get the vaccine following a government recommendation. Among participants

who did not intend to get vaccinated, 80% disagreed or strongly disagreed to getting the vaccine after a doctor's recommendation and 80% responded this way about a government recommendation.

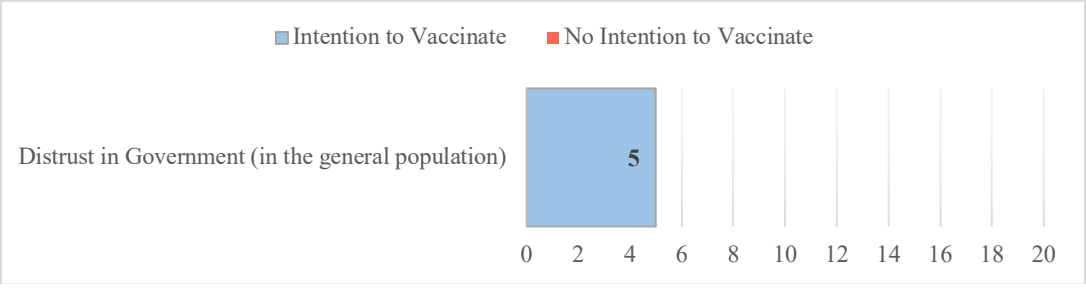
Among participants who intended to receive the COVID-19 vaccine, 95% of participants strongly agreed or agreed that they would get the vaccine if a doctor recommended it and 86% of participants said they would follow a government recommendation to get the vaccine, although participants leaned more towards "strongly agree" in their responses on doctor recommendations than they did for government recommendations. Among participants who did not intend to vaccinate, responses were divided across all five categories with regard to both physician and government recommendations.

Figure 14: Frequency of COVID-19 vaccine response meta-themes related to "External Cues to Action."



Sub-themes for personal reasoning behind "Distrust in Government" include "distrust in government" (n=7) and "distrust in the COVID-19 information" (n=2). Sub-themes for the general population's reasoning behind "Distrust in Government" include "distrust in government" (n=15) and "distrust in the COVID-19 information" (n=1).

Figure 15: Frequency of seasonal influenza vaccine response meta-themes related to "External Cues to Action."



Concerns about the external influences on the COVID-19 vaccine development and distribution process appeared frequently in the qualitative analysis (Figure 14). “Distrust in government,” and fears that the COVID-19 vaccine was being politicized by President Donald Trump, appeared 9 times in participants’ personal reasoning and 16 times in participants’ reasoning behind vaccine hesitancy in the general population. Participants also cited “distrust in government” as a reason behind seasonal influenza vaccine hesitancy in the general population (n=5), although no participants cited it as a personal reason for hesitancy (Figure 15).

Several participants mentioned hesitancy related to the seemingly rushed COVID-19 vaccine development timeline, theorizing that the speed of development may have been politically motivated:

> *I currently am a little distrusting of the level of, well hmm, I understand the urgency but not the circumventing of process and vetting that is happening in government right now to try to push the vaccine out. The Trump administration is trying to push things through right now in a such a way that I am not entirely comfortable saying I would want to take the vaccine right now.* (female respondent, age 30)

> *This particular vaccine seems like it is being rushed. I have participated in studies before, I understand that studies are needed in order to make things better for everybody else. I feel that this particular vaccine has been rushed by our government for political gain and because it seems politicized and sketchy, that would make me wary on whether or not it actually works. They are rushing it, and I have a hard time believing that is for the benefit of the people. My doctors, on the other hand, understand the scientific method and have gone to medical school and I would hope they would not throw me under the bus. I guess medical professionals did throw people under the bus during the opioid crisis, but I think I have forgiven them for that. I don't know, the rush of COVID vaccine just seems nefarious somehow.* (female respondent, age 40)

Others blamed the government for influencing the availability and accuracy of COVID-19 information:

> *I would have to see the data first. There has been a collapse of our institutions and the sanctity of information these days. I would be concerned about interference on behalf of the political party in the White House. It is making it hard to trust those sources now. I would trust the science, but that would have to be published.* (female respondent, age 43)

Participants also noted that the November 2020 election caused the discourse surrounding the COVID-19 vaccine to be highly politicized:

> *I think this time around there is also a lot more government mistrust, so, you know, we have a very politicized environment right now and any given person is bound to either mistrust the current administration or mistrust the incoming administration. So if the government tells you to do something and you mistrust part of the government, then why would you do it. I think that government mistrust plays a much bigger role in the COVID vaccine than in the flu vaccine.* (female respondent, age 36)

> *My beliefs about vaccination have not changed but my beliefs about what people believe about vaccination have changed. I am boggled to see how it has been politicized….this whole, if you look at someone like "Oh they are a Democrat, they are wearing a mask and the Republicans are not." I've never seen anything like it in public health. I mean polio or smallpox, it wasn't like a Democrat Smallpox and a Republican Smallpox, it is just a very unfortunate combination of events.* (male respondent, age 59)

The influence of the COVID-19 pandemic on personal vaccine intentions was assessed using the statements: “My intentions to get vaccinated against seasonal influenza have changed as a result of the COVID-19 pandemic” and “My beliefs about vaccination in general have changed as a result of the COVID-19 pandemic.” The majority of participants, regardless of vaccine intention, disagreed or strongly disagreed with these statements. 100% of those who did not intend to vaccinate against seasonal influenza and 75% of those who did intend to vaccinate disagreed or strongly disagreed that the COVID-19 pandemic had changed their vaccine intentions towards the seasonal influenza vaccine. Similarly, 85% of those who did not intend to vaccinate and 82% of those who did intend to vaccinate disagreed or strongly disagreed that the COVID-19 pandemic had changed their beliefs about vaccination in general.

Those who agreed that their seasonal influenza vaccine intentions had changed as a result of the COVID-19 pandemic claimed that they felt an increased urgency to vaccinate this year, because of the widespread discussion about vaccination and the desire to minimize risks of co-infection with COVID-19:

> *I would have gotten it anyway but we got it extra early, as soon as it became available. We talk more about vaccines now in our house and the importance of vaccines in our community. We talk to our family about getting their flu vaccine.* (female respondent, age 34)

> *I don't remember if I got the vaccine last season, but this season I did. I heard reports that there have been potential benefits in terms of reducing COVID symptoms if you also get the vaccine this year, so I definitely got it this year.* (male respondent, age 25)

When asked about how their general beliefs about vaccination had changed during the pandemic, participants noted that they felt more aware of the importance of vaccination, and found themselves more eager to seek out information about vaccines:

> *I think that maybe before, obviously I wasn't an anti-vaxxer, but I was maybe a little more lax on the idea and the premise and the understanding about the importance of vaccines and now I think that I understand it a lot better.* (female respondent, age 24)

> *I am much more prone to look for more information about vaccines themselves and what they do and whose names are associated with them.* (male respondent, age 63)

3.4 Influence of Personal Experiences on Vaccine Intentions

Another aim of this study was to understand the impact of personal disease encounters on future vaccine intentions. The results of the bivariate analyses of these variables can be found in Tables 7-12. In the seasonal influenza portion of the questionnaire, participants were asked if they had received the seasonal influenza vaccine during the prior flu season (2019-20), whether they had previously been diagnosed with seasonal influenza, and whether someone in their social circle had been diagnosed with seasonal influenza during the 2019-2020 flu season. In the bivariate analysis, 2019-20 seasonal influenza vaccination was found to be significantly associated with participants' seasonal influenza vaccine intentions during the 2020-21 season ($p<0.002$).

In the COVID-19 portion of the survey, participants were asked if they had been tested for COVID-19, if they were tested because they had COVID-19 symptoms, and if someone in

their social circle had been diagnosed with COVID-19. COVID-19 testing status ($p<0.022$), whether an individual was symptomatic ($p<0.033$) and knowing someone who had been diagnosed with COVID-19 ($p<0.013$) were all found to be significantly associated with future COVID-19 vaccine intentions in the bivariate analysis.

In the seasonal influenza qualitative analysis, prior experience with influenza infection did appear as a subtheme in participants' personal reasoning behind their seasonal influenza vaccine intentions (n=3). These participants noted that watching their loved ones go through the symptoms of seasonal influenza infection, or experiencing infection themselves, was a strong motivator to get vaccinated in the future. In the COVID-19 analysis, personal experience with infection did not emerge as a frequent theme.

3.5 Concerns of Participants Who Intend to Receive the Seasonal Influenza Vaccine but Not a New COVID-19 Vaccine

Figure 16: Frequency of sub-themes describing the personal reasoning behind the COVID-19 vaccine intentions of participants who intended to receive the seasonal influenza vaccine, but not the COVID-19 vaccine.

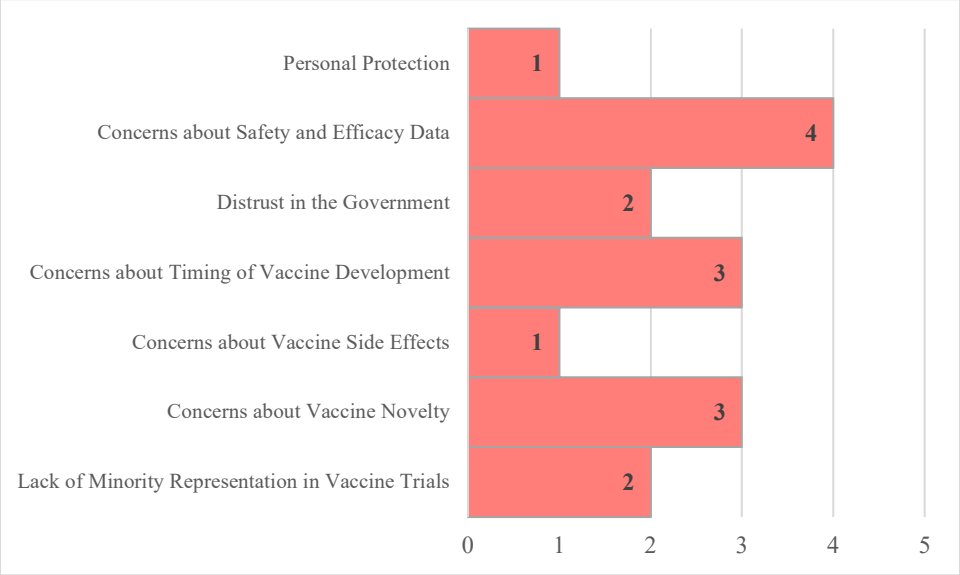
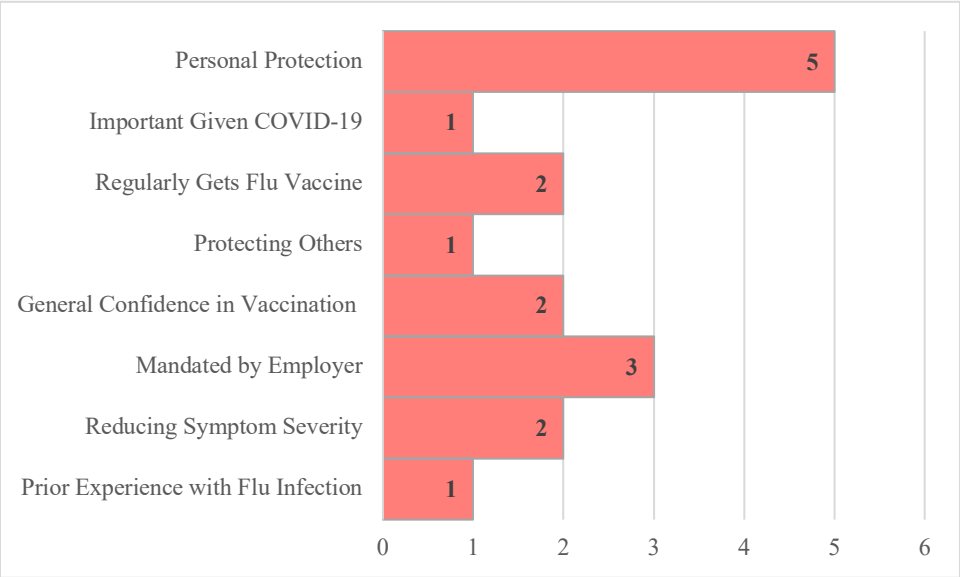


Figure 17: Frequency of sub-themes describing the personal reasoning behind the seasonal influenza vaccine intentions of participants who intended to receive the seasonal influenza vaccine, but not the COVID-19 vaccine.



Nine participants reported intending to receive the seasonal influenza vaccine but not the COVID-19 vaccine. Table 13 shows the demographic breakdown of this subsection of the study population. Seven of these nine participants were enrolled prior to the release of the Pfizer-BioNTech COVID-19 vaccine data on November 9, 2020 and the remaining two participants were enrolled shortly after this date, on November 11, 2020. All of these participants therefore had either no information or access to newly released information about the safety and efficacy of a COVID-19 vaccine. As such, participants' qualitative responses detailing their personal reasoning to not get the COVID-19 vaccine reflected COVID-19-specific vaccine concerns; particularly, fears about the novelty or development timeline of the COVID-19 vaccine, the lack of safety and efficacy data available, the lack of minority representation in clinical trials, the potential government interference in vaccine development, and the potential side effects of the vaccine (Figure 16). In contrast, this group of participants were accepting of the seasonal influenza vaccine and of vaccination more broadly. Participants discussed the personal protective

value of vaccination, their general confidence in vaccination, their desire to reduce flu symptom severity, and their compliance with employer vaccine mandates in their personal reasoning for receiving the seasonal influenza vaccine (Figure 17). The contrast between these two sets of responses indicates that despite being generally accepting of vaccination and science, there were aspects of the development and distribution of an entirely new COVID-19 vaccine that created fears and doubts within a vaccine-accepting population. This group of participants expressed a clear desire to exercise their autonomy in making future vaccine decisions until they felt confident that the new COVID-19 vaccine was safe and effective for them personally, rather than universally complying with government vaccine recommendations or mandates:

> *I am not a huge fan of newer vaccinations, It's not like I don't think a vaccine would be a good thing, but I am concerned about the speed at which vaccinations have become available. I am very distrustful of this administration, their beliefs, their values, how they went about getting a vaccine, and their financial interest. I am not really sure how safe the vaccine would be and I would like to see a bit more research, even if that means that there is a possibility that I could get COVID in the meantime. Me protecting myself is my choice, and I should be able to make that decision, as opposed to just trusting the government. (female respondent, age 26*)

3.6 Perspectives on Vaccine Messaging

In the final portion of the survey, participants were given the opportunity to share any remaining thoughts about their personal vaccine perspectives or their thoughts on vaccination more broadly. Several participants took this as an opportunity to share how they felt vaccine recommendations should, or should not, be messaged to the general public.

Several participants commented on the importance of marketing the COVID-19 vaccine as a duty to others, rather than a means of protecting one's personal health. One participant emphasized that vaccine messaging should focus on the potential for asymptomatic disease spread in unvaccinated individuals:

> *If they want to get uptake of the vaccine, it is going to have to be a different approach. I think the way to do it is "You are not doing it for you." Because the whole thing is "I'm fine, I'm fine," but people don't seem to realize that people that feel fine can give it to other people. I think that needs to be a major focus. Like you are fine, but your grandma that you just visited in the nursing home is going to get sick or someone that you just walked by that you don't know at all in the grocery store is going to get sick.* (male respondent, age 59)

Another participant noted that vaccine messaging should be framed as a patriotic act, one that would help restart the economy and help all Americans. However, they noted that vaccine messaging should be framed as a recommendation, as anything resembling a mandate would be a strong deterrent against vaccination:

> *The more pressure people feel from the government or from their employer to inject something into themselves, I think the less they are going to want to do it, at least that's how I am. I think that it would be best if the government frames this as a recommendation, like something we are going to do for our economy, as Americans, we are going to do our part, rather than "Everybody hold still we are coming after you with a needle!" It should be an effort on the part of people, to protect our country and each other, not a requirement. I guess the difference between signing up in the military and draft, you know what I mean? …I am not an anti-vaxxer, I don't believe that the measles shot causes autism or anything like that, but I do strongly feel that people need to have some autonomy and some agency in making decisions about getting an injection.* (female respondent, age 54)

Other participants discussed the importance of increasing access to vaccine-related information. One participant praised the Q&As that have been available to the public for the COVID-19 vaccine, and argued that extending this practice to other vaccines would help curb vaccine hesitancy towards other vaccinations:

> *I think in general, we see Q&As now and people being able to ask questions that they worry about, I think that would have been useful to have earlier with other vaccines, especially after that MMR thing and after we have had a strong anti-vaxxer movement. I like seeing that now, and I think we could do more of that, where people have someone knowledgeable with a medical degree not from the University of Google that they can ask. That is a nice change.* (female respondent, age 41)

Finally, one participant argued that public health officials should take advantage of social media influencers to increase vaccine uptake in younger age demographics:

> *I think we need to get influencers to take the vaccine early, so that the rest of the population, especially those who are under 25, will take it. If we get our share of YouTube and Instagram and TikTok and Twitter influencers to take the vaccine, I think that is going to be great for our country and the world.* (male respondent, age 63)

3.7 Multivariable Analysis

In the multivariable analysis, the demographic variables of age, gender, race, profession, level of education, living situation, and date of enrollment were controlled for in the lasso procedure. Date of enrollment was held constant to assess the potential impact of the release of the Pfizer-BioNTech vaccine's safety and efficacy data on the vaccine intentions of the study population. The demographic variables were held constant to account for information that might already be accessible to researchers through patient intake data from healthcare facilities. The results of the multivariable analysis are displayed in Tables 14 and 15.

COVID-19 Analysis

Among these demographic variables, race was the only variable that was found to have a statistically significant association with both vaccine intention and vaccine hesitancy for the COVID-19 vaccine. Black race was negatively associated with vaccine intention and positively associated with vaccine hesitancy for the COVID-19 vaccine. Black participants indicated an intention to vaccinate at a rate 33.7 percentage points lower than White participants. Black participants also exhibited vaccine hesitancy at a rate 42.5 percentage points higher than White participants. Other participants of color, i.e. NonWhite/NonBlack participants, exhibited vaccine hesitancy at a rate 30.2 percentage points higher than White participants.

The multivariable analysis of COVID-19 vaccine intentions indicated that including the variables for religion, the reason behind getting a COVID-19 test, preference for getting the vaccine over the disease, a government recommendation, and vaccine safety and side effect

concerns increased the predictive value of the vaccine intentions and vaccine hesitancy models. Of these variables, three were significantly associated with vaccine intention and/or vaccine hesitancy. Individuals who agreed with the statement "I would rather receive a COVID-19 vaccine than get COVID-19" reported intending to vaccinate at rate 33.6 percentage points higher than those who did not agree with the statement. Participants who agreed with the statement "I worry about the safety and/or side effects of the COVID-19 vaccine" intended to vaccinate at a rate 17.7 percentage points lower than those who did not agree with the statement. These individuals also exhibited vaccine hesitancy at a rate 22.7 percentage points higher than individuals who did not agree with the statement. Finally, participants who agreed with the statement "If a government health authority recommends that I get a COVID-19 vaccine, I will get one" exhibited lower rates of vaccine hesitancy, by 39.7 percentage points, than individuals who did not agree with the statement.

Including the predictive variables identified by the initial lasso regression in the final OLS regression did increase the predictive power of both the COVID-19 vaccine intentions and the COVID-19 vaccine hesitancy regressions. The R^2 for the COVID-19 vaccine intentions regression containing only the constant demographic variables was 0.560, while the regression containing the additional predictive variables had an R^2 of 0.760. Similarly, the R^2 for the COVID-19 vaccine hesitancy regression containing only the constant demographic variables was 0.591, while the regression containing the additional predictive variables had an R^2 of 0.809.

Seasonal Influenza Analysis

Race was not statistically significantly associated with vaccine intention or vaccine hesitancy for the seasonal influenza vaccine. However, profession was found to be significantly associated with both variables. Healthcare professionals indicated that they intended to receive

the 2020-21 seasonal influenza vaccine at a rate 14.3 percentage points lower than participants who did not work in the healthcare field. Healthcare professionals also indicated vaccine hesitancy towards the seasonal influenza vaccine at a rate that was 16.8 percentage points higher than non-healthcare professionals. Level of education was also significantly associated with seasonal influenza vaccine hesitancy. Participants with a graduate degree exhibited vaccine hesitancy towards the seasonal influenza vaccine at a rate that was 14.7 percentage points lower than participants with a college degree or below.

The multivariable analysis of seasonal influenza vaccine intentions and vaccine hesitancy indicated that religion, a doctor or nurse recommendation, and a government recommendation were predictive of vaccine intentions and vaccine hesitancy towards the 2020-21 seasonal influenza vaccine. Preference for getting the vaccine over the disease was found to be predictive of vaccine intention, but not of vaccine hesitancy. Seasonal influenza vaccination in the 2019-20 flu season was found to be predictive of vaccine hesitancy, but not of vaccine intentions. All of these associations, with the exception of government recommendation, were statistically significant. As with the COVID-19 vaccine, individuals who agreed with the statement "I would rather receive a seasonal influenza vaccine than get seasonal influenza" reported that they intended to receive the 2020-21 seasonal influenza vaccine at a rate 36.6 percentage points higher than those who disagreed with the statement. Individuals who agreed with the statement "If my doctor or nurse recommends that I get a seasonal influenza vaccine, I will get one" reported an intention to vaccinate at a rate 64.9 percentage point higher than those who did not agree with the statement. These individuals also exhibited hesitancy towards the 2020-21 seasonal influenza vaccine at a rate that was 53.5 percentage points lower than those who did not agree with the statement. Individuals who received the 2019-20 seasonal influenza vaccine

exhibited vaccine hesitancy towards the 2020-21 vaccine at a rate that was 26.0 percentage points lower than those who had not received the vaccine.

Including the predictive variables from the initial lasso regression into the final OLS regression increased the R^2 of both the seasonal influenza vaccine intentions and vaccine hesitancy regressions. The R^2 for the OLS regression for vaccine intentions that included predictive variables was 0.691, compared to 0.183 without these predictive variables. The R^2 for the OLS regression for vaccine hesitancy that included predictive variables was 0.637, compared to 0.267 without these predictive variables.

3.8 Tables of Results

Table 2: Demographic Characteristics of Study Population (n=57)

	Frequency	Percentage (%)
Age		
18-30yrs	11	19
31-40yrs	13	23
41-50yrs	8	14
51-60yrs	13	23
61yrs or older	12	21
Gender		
Male	22	39
Female	35	61
Race		
White	34	60
Hispanic or Latino	3	5.3
Black or African American	14	25
Asian	4	7.0
Middle Eastern or North African	1	1.8
Other (specify)	1	1.8
Religion		
Christian	21	37
Jewish	2	3.5
Muslim	1	1.8
Hindu	1	1.8
Atheist	4	7.0
Agnostic	4	7.0
Not religious	22	39
Other	2	3.5
Political Affiliation		
Democrat	42	74
Republican	3	5.3
Independent	7	12
Other	5	8.8
Level of Education		
High School	2	3.5
Some College	1	1.8
College	13	23
Graduate School and beyond	41	72
Profession		
High Education Administrator/Research Coordinator	6	11

Professor/Researcher	15	26
Public Health/Healthcare Professional	12	21
Engineer	2	3.5
Business/Marketing	6	11
Finance/Accounting/Economics	4	7.0
Nonprofit Fundraising/Grant Manager	2	3.5
Lawyer	1	1.8
Teacher	2	3.5
Graduate Student	2	3.5
Unemployed	3	5.3
Other	2	3.5
Living Situation		
Single and living alone	9	16
Single and living with roommates	3	5.3
Living with a partner	20	35
Living with a partner and children	16	28
Living with children and no partner	3	5.3
Living with family members other than partner or children	3	5.3
Other	3	5.3
Living with High Risk Individual		
Yes	34	60
No	23	40
Has at Least 1 Medical Condition		
1 or more Medical Conditions	34	60
No Medical Conditions	23	40

**Percentages may not add up to 100 due to rounding*

Table 3: Self-Reported Medical Conditions

Medical Condition	**Participant**	**Participant's Household Members**
High Risk for COVID-19 Complications (Total)	**13**	**16**
Cancer	3	2
Cardiovascular Disease	4	1
Organ Transplant	1	0
Diabetes	2	6
Rheumatoid Arthritis	0	1
Respiratory Disease	1	1
Chronic Kidney Disease	1	0
Pregnancy	1	0
Age	0	5
Potentially Increased Risk for COVID-19 Complications (Total)	**8**	**5**
Asthma	1	4
Hypertension	4	1
High Cholesterol	3	0
Other Medical Conditions	**14**	**3**
Sarcoidosis	1	0
Migraines	1	0
Transient Ischemic Attack	1	0
Fibromuscular Dysplasia	1	0
Uterine Fibroids	1	0
Anemia	1	0
Seasonal Allergies	3	0
Hepatitis B	1	0
Polycystic ovary syndrome	1	0
Osteoporosis	1	0
Spinal Stenosis	1	0
Renal Disease	0	1
Psoriasis	0	1
Postural Orthostatic Tachycardia Syndrome	1	1

Table 4: Bivariate Associations between Demographic Characteristics and Intention to Receive the COVID-19 and Seasonal Influenza Vaccines

	COVID-19 VACCINE			SEASONAL INFLUENZA VACCINE		
Study Population Demographics (n=57)	**Intention to Vaccinate**	**No Intention to Vaccinate**	**Total**	**Intention to Vaccinate**	**No Intention to Vaccinate**	**Total**
Age						
18-30yrs	8 (18%)	3 (23%)	11	10 (19%)	1 (20%)	11
31-59yrs	24 (55%)	8 (62%)	32	28 (54%)	4 (80%)	32
60yrs or older	12 (27%)	2 (15%)	14	14 (27%)	0 (0%)	14
Total	44	13	57	52	5	57
			p<0.756			**p<0.471**
Gender						
Male	19 (43%)	3 (23%)	22	21 (40%)	1 (20%)	22
Female	25 (57%)	10 (77%)	35	31 (60%)	4 (80%)	35
Total	44	13	57	52	5	57
			p<0.331			**p<0.639**
Race						
White	33 (75%)	1 (7.7%)	34	33(63%)	1 (20%)	34
Black	4 (9.0%)	10 (77%)	14	11 (21%)	3 (60%)	14
NonWhite/NonBlack	7 (16%)	2 (15%)	9	8 (15%)	1 (20%)	9
Total	44	13	57	52	5	57
			p<0* **			**p<0.091***
Religion						
Not Religious	29 (66%)	3 (23%)	32	31 (60%)	2 (40%)	33
Religious	15 (34%)	10 (77%)	25	21 (40%)	3 (60%)	24
Total	44	13	57	52	5	57
			p<0.010**			**p<0.640**
Political Affiliation						
Non Democrat	10 (23%)	5 (38%)	15	19 (37%)	3 (60%)	22
Democrat	34 (77%)	8 (62%)	42	33 (63%)	2 (40%)	35
Total	44	13	57	52	5	57
			p< 0.294			**p<0.364**
Level of Education						
College Level or Below	8 (18%)	8 (62%)	16	13 (25%)	3 (60%)	16
Graduate School and beyond	36 (82%)	5 (38%)	41	39 (75%)	2 (40%)	41
Total	44	13	57	52	5	57
			p<0.004***			**p<0.129**
Profession						
Non Healthcare Field	36 (82%)	9 (69%)	45	41 (79%)	4 (80%)	45
Healthcare Field	8 (18%)	4 (31%)	12	11 (21%)	1 (20%)	12
Total	44	13	57	52	5	57
			p<0.440			**p<1.000**
Living Situation						

Living Alone	7 (16%)	2 (15%)	9	9 (17%)	0 (0%)	9
Living with Children	13 (30%)	6 (46%)	19	18 (35%)	1 (20%)	19
Living with NonChildren	24 (55%)	5 (38%)	29	25 (48%)	4 (80%)	29
Total	44	13	57	52	5	57
			p<0.526			**p<0.552**
Has at Least One Medical Condition						
1 or more Medical Conditions	16 (36%)	7 (54%)	23	19 (37%)	4 (80%)	23
No Medical Conditions	28 (64%)	6 (46%)	34	33 (63%)	1 (20%)	34
Total	44	13	57	52	5	57
			p<0.339			**p<0.146**

*** p<0.01, ** p<0.05, * p<0.1
Percentages may not add up to 100 due to rounding

Table 5: Vaccine Intentions by Vaccine Type

Vaccine Type	Frequency (n=57)	Percentage (%)
Seasonal Influenza		
Intention to Vaccinate	52	91
No Intention to Vaccinate	5	8.8
COVID-19		
Intention to Vaccinate	44	77
No Intention to Vaccinate	13	23
	**Percentages may not add up to 100 due to rounding*	

Table 6: Likert Scale Responses by Vaccine Intention

	Frequency of Responses: Seasonal Influenza		Frequency of Responses: COVID-19	
	Intention to Vaccinate (n=52)	**No Intention Vaccinate (n=5)**	**Intention to Vaccinate (n=44)**	**No Intention Vaccinate (n=13)**
I think [seasonal influenza/COVID-19] is a serious illness.				
I strongly agree	30 (58%)	0 (0%)	39 (89%)	11 (85%)
I agree	21 (40%)	4 (80%)	5 (11%)	1 (7.7%)
I do not agree or disagree	1 (2%)	0 (0%)	0 (0%)	0 (0%)
I disagree	0 (0%)	1 (20%)	0 (0%)	1 (7.7%)
I strongly disagree	0 (0%)	0 (0%)	0 (0%)	0 (0%)
I think the complications associated with [seasonal influenza/COVID-19] are serious.				
I strongly agree	27 (52%)	0 (0%)	40 (91%)	11 (85%)
I agree	23 (44 %)	4 (80%)	4 (9.1%)	2 (15%)
I do not agree or disagree	2 (3.9%)	0 (0%)	0 (0%)	0 (0%)
I disagree	0 (0%)	1 (20%)	0 (0%)	0 (0%)
I strongly disagree	0 (0%)	0 (0%)	0 (0%)	0 (0%)
I think I have a high personal risk of getting [seasonal influenza/COVID-19].				
I strongly agree	4 (7.7%)	0 (0%)	7 (16%)	4 (31%)
I agree	12 (23%)	0 (0%)	10 (23%)	7 (54%)
I do not agree or disagree	13 (25%)	2 (40%)	11 (25%)	1 (7.7%)
I disagree	20 (38 %)	3 (60%)	14 (32%)	1 (7.7%)
I strongly disagree	3 (5.8%)	0 (0%)	2 (4.6%)	0 (0%)
I think people close to me have a high risk of getting [seasonal influenza/COVID-19].				
I strongly agree	4 (7.8%)	0 (0%)	11 (25%)	4 (31%)
I agree	22 (43%)	1 (20%)	12 (27%)	7 (54%)
I do not agree or disagree	15 (29%)	1 (20%)	11 (25%)	0 (0%)
I disagree	8 (16%)	3 (60%)	10 (23%)	2 (15%)
I strongly disagree	2 (3.9%) **One response left blank*	0 (0%)	0 (0%)	0 (0%)
If I were diagnosed with [seasonal influenza/COVID-19], I think it would be dangerous for my health.				
I strongly agree	4 (7.7%)	0 (0%)	17 (39%)	5 (38%)
I agree	13 (25%)	3 (60%)	21 (48%)	7 (54%)
I do not agree or disagree	17 (33%)	1 (20%)	5 (11%)	1 (7.7%)
I disagree	16 (31%)	1 (20%)	1 (2.3%)	0 (0%)
I strongly disagree	2 (3.9%)	0 (0%)	0 (0%)	0 (0%)

If I were diagnosed with [seasonal influenza/COVID-19], I think it is plausible that I would infect people around me.				
I strongly agree	18 (35%)	0 (0%)	24 (55%)	5 (38%)
I agree	30 (58%)	3 (60%)	14 (32%)	7 (54%)
I do not agree or disagree	1 (1.9%)	0 (0%)	3 (6.8%)	1 (7.7%)
I disagree	3 (5.8%)	2 (40%)	3 (6.8%)	0 (0%)
I strongly disagree	0 (0%)	0 (0%)	0 (0%)	0 (0%)
I would rather receive a [seasonal influenza/COVID-19] vaccine than get [seasonal influenza/COVID-19].				
I strongly agree	39 (75%)	1 (20%)	35 (80%)	1 (7.7%)
I agree	12 (23%)	1 (20%)	8 (18%)	3 (23%)
I do not agree or disagree	1 (1.9%)	0 (0%)	1 (2.3%)	4 (31%)
I disagree	0 (0%)	1 (20%)	0 (0%)	3 (23%)
I strongly disagree	0 (0%)	2 (40%)	0 (0%)	2 (15%)
If my doctor/nurse recommends that I get a [seasonal influenza/COVID-19] vaccine, I will get one.				
I strongly agree	36 (69%)	1 (20%)	34 (77%)	1 (7.7%)
I agree	15 (29%)	0 (0%)	8 (18%)	5 (38%)
I do not agree or disagree	0 (0%)	0 (0%)	2 (4.6%)	2 (15%)
I disagree	1 (1.9%)	3 (60%)	0 (0%)	4 (31%)
I strongly disagree	0 (0%)	1 (20%)	0 (0%)	1 (7.7%)
If a government health authority recommends that I get a [seasonal influenza/COVID-19], I will get one.				
I strongly agree	27 (52%)	0 (0%)	23 (52%)	0 (0%)
I agree	16 (31%)	1 (20%)	15 (34%)	2 (15%)
I do not agree or disagree	5 (9.6%)	0 (0%)	6 (14%)	5 (38%)
I disagree	4 (7.7%)	2 (40%)	0 (0%)	2 (15%)
I strongly disagree	0 (0%)	2 (40%)	0 (0%)	4 (31%)
I worry about the safety and/or side effects of the [seasonal influenza/COVID-19] vaccine.				
I strongly agree	2 (3.9%)	1 (20%)	1 (2.3%)	9 (69%)
I agree	7 (13%)	2 (40%)	13 (30%)	3 (23%)
I do not agree or disagree	8 (15%)	1 (20%)	7 (16%)	1 (7.7%)
I disagree	23 (44%)	1 (20%)	19 (43%)	0 (0%)
I strongly disagree	12 (23%)	0 (0%)	4 (9.1%)	0 (0%)
My intentions to get vaccinated against seasonal influenza have changed as a result of the COVID-19 pandemic.				
I strongly agree	3 (5.8%)	0 (0%)	X	X
I agree	7 (13%)	0 (0%)	X	X
I do not agree or disagree	3 (5.8%)	0 (0%)	X	X

I disagree	21 (40%)	4 (80%)	X	X
I strongly disagree	18 (35%)	1 (20%)	X	X
My beliefs about vaccination in general have changed as a result of the COVID-19 pandemic.				
I strongly agree	X	X	0 (0%)	1 (7.7%)
I agree	X	X	4 (9.1%)	1 (7.7%)
I do not agree or disagree	X	X	4 (9.1%)	0 (0%)
I disagree	X	X	21 (48%)	7 (54%)
I strongly disagree	X	X	15 (34%)	4 (31%)
I am knowledgeable about the symptoms and complications associated with [seasonal influenza/COVID-19] infection.				
I strongly agree	20 (38%)	1 (20%)	22 (50%)	5 (38%)
I agree	29 (56%)	4 (80%)	22 (50%)	8 (62%)
I do not agree or disagree	1 (1.9%)	0 (0%)	0 (0%)	0 (0%)
I disagree	2 (3.9%)	0 (0%)	0 (0%)	0 (0%)
I strongly disagree	0 (0%)	0 (0%)	0 (0%)	0 (0%)
I am knowledgeable about the CDC recommendations regarding seasonal influenza vaccination.				
I strongly agree	17 (33%)	0 (0%)	X	X
I agree	27 (52%)	4 (80%)	X	X
I do not agree or disagree	5 (9.6%)	1 (20%)	X	X
I disagree	3 (5.8%)	0 (0%)	X	X
I strongly disagree	0 (0%)	0 (0%)	X	X

**Percentages may not add up to 100 due to rounding*

Table 7: Association Between 2019-20 Influenza Vaccination and Future Intention to Receive Seasonal Influenza Vaccine

Received 2019-20 Flu Vaccine?	Intention to Vaccinate	No Intention to Vaccinate	Total
No/Unsure	6 (12%)	4 (80%)	10
Yes	46 (88%)	1 (20%)	47
Total	52	5	57
			p<0.002* **

*** p<0.01, ** p<0.05, * p<0.1
Percentages may not add up to 100 due to rounding

Table 8: Association between Influenza Infection and Future Intention to Receive Seasonal Influenza Vaccine

Previous Influenza Infection?	Intention to Vaccinate	No Intention to Vaccinate	Total
No	19 (37%)	3 (60%)	22
Yes/Maybe	33 (63%)	2 (40%)	35
Total	52	5	57
			p<0.364

*** p<0.01, ** p<0.05, * p<0.1
Percentages may not add up to 100 due to rounding

Table 9: Association between Knowing Someone Who Had the Flu in 2019-20 and Future Intention to Receive Seasonal Influenza Vaccine

Someone in Social Circle with 2019-20 Influenza Infection?	Intention to Vaccinate	No Intention to Vaccinate	Total
No	33 (63%)	5 (100%)	38
Yes/Maybe	19 (37%)	0 (0%)	19
Total	52	5	57
			p<0.158

*** p<0.01, ** p<0.05, * p<0.1
Percentages may not add up to 100 due to rounding

Table 10: Association between COVID-19 Testing and Future Intention to Receive COVID-19 Vaccine

Tested for COVID-19?	Intention to Vaccinate	No Intention to Vaccinate	Total
No Test	12 (27%)	1 (7.7%)	13
Tested Negative	30 (68%)	8 (62%)	38
Tested Positive	2 (4.5%)	4 (31%)	6
Total	44	13	57
			p<0.022**
*** p<0.01, ** p<0.05, * p<0.1 *Percentages may not add up to 100 due to rounding*			

Table 11: Association between Reason for COVID-19 Test and Future Intention to Receive COVID-19 Vaccine

Reason for Testing	Intention to Vaccinate	No Intention to Vaccinate	Total
Not Symptomatic	35 (80%)	6 (46%)	41
Symptomatic	9 (20%)	7 (54%)	16
Total	44	13	57
			p<0.033**
*** p<0.01, ** p<0.05, * p<0.1 *Percentages may not add up to 100 due to rounding*			

Table 12: Association between Knowing Someone Who Has Had COVID-19 and Future Intention to Receive COVID-19 Vaccine

Someone in Social Circle with COVID-19?	Intention to Vaccinate	No Intention to Vaccinate	Total
No	15 (34%)	0 (0%)	15
Yes	29 (66%)	13 (100%)	42
Total	44	13	57
			p<0.013**
*** p<0.01, ** p<0.05, * p<0.1 *Percentages may not add up to 100 due to rounding*			

Table 13: Demographic Characteristics of Participants Who Intended to Receive the Seasonal Influenza Vaccine but not the COVID-19 Vaccine

	Frequency	***Percentage (%)***
Age		
18-30yrs	2	22
31-59yrs	5	56
60yrs or older	2	22
Gender		
Male	2	22
Female	7	78
Race		
White	1	11
Black of African American	7	78
NonWhite/NonBlack	1 *(Hispanic or Latino)*	11
Religion		
Religious	7 *(Christian)*	78
Non Religious	2	22
Political Affiliation		
Democrat	6	67
Non Democrat	3	33
Level of Education		
College or Below	5	56
Graduate Degree or Above	4	44
Profession		
Non Healthcare Field	5	56
Healthcare Field	4	44
Living Situation		
Living Alone	2	22
Living with Children	5	56
Living with Non-Children	2	22
Has at least one medical condition		
1 or more Medical Conditions	3	33
No Medical Conditions	6	67

Table 14: OLS Regression Analysis on Vaccine Intentions and Vaccine Hesitancy with Demographic Variables Only

	Intention to Receive the COVID-19 Vaccine	Intention to Receive the Seasonal Influenza Vaccine	Hesitancy to Receive the COVID-19 Vaccine	Hesitancy to Receive the Seasonal Influenza Vaccine
VARIABLES	**REGRESSION COEFFICIENT**			
Age				
vs. 18-30yrs				
31-59yrs	0.095	0.121	0.229*	0.197*
	(0.124)	(0.114)	(0.135)	(0.117)
60yrs or older	0.103	0.0237	0.218	0.0695
	(0.142)	(0.131)	(0.154)	(0.134)
Gender				
vs. Male				
Female	0.097	0.0917	0.0311	0.071
	(0.0893)	(0.082)	(0.0967)	(0.0843)
Race				
vs. White				
Black	0.602***	0.129	0.733***	0.117
	(0.109)	(0.1)	(0.118)	(0.103)
NonWhite/NonBlack	0.149	0.0948	0.427***	0.213*
	(0.134)	(0.123)	(0.145)	(0.126)
Profession				
vs. Non Healthcare Field				
Healthcare Field	0.118	0.021	0.208	-0.0111
	(0.126)	(0.116)	(0.137)	(0.119)
Level of Education				
vs. College Level or Below				
Graduate Level or Beyond	-0.244**	-0.118	-0.184	-0.189*
	(0.108)	(0.0992)	(0.117)	(0.102)
Living Situation				
vs. Living Alone				
Living with Children	0.0424	-0.00703	0.00514	-0.0496
	(0.135)	(0.124)	(0.146)	(0.127)
Living with NonChildren	-0.0688	0.134	-0.00839	0.152
	(0.122)	(0.112)	(0.132)	(0.115)
Observations	57	57	57	57
R-squared	0.56	0.183	0.591	0.267

Note:
Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Constant included in all regressions but not reported

Table 15: OLS Post-Lasso Regression Analysis of Vaccine Intentions and Vaccine Hesitancy

	Intention to Receive the COVID-19 Vaccine	Intention to Receive the Seasonal Influenza Vaccine	Hesitancy to Receive the COVID-19 Vaccine	Hesitancy to Receive the Seasonal Influenza Vaccine
VARIABLES	**REGRESSION COEFFICIENT**			
HELD CONSTANT IN LASSO REGRESSION				
Age				
vs. 18-30yrs				
31-59yrs	0.00617	-0.0561	0.0703	0.136
	(0.116)	(0.0756)	(0.116)	(0.0884)
60yrs or older	-0.00249	-0.0551	0.0555	0.128
	(0.122)	(0.0862)	(0.122)	(0.103)
Gender				
vs. Male				
Female	-0.0543	-0.0162	-0.0562	0.0225
	(0.0774)	(0.0550)	(0.0775)	(0.0642)
Race				
vs. White				
Black	-0.337***	-0.0149	0.425***	-0.0522
	(0.116)	(0.0808)	(0.116)	(0.0958)
NonWhite/NonBlack	-0.0855	0.0364	0.302**	0.0140
	(0.114)	(0.0833)	(0.114)	(0.101)
Profession				
vs. Non Healthcare Field				
Healthcare Field	-0.0671	-0.143*	0.120	0.168*
	(0.127)	(0.0763)	(0.127)	(0.0943)
Level of Education				
vs. College Level or Below				
Graduate Level or Beyond	0.127	0.0917	-0.0956	-0.147*
	(0.101)	(0.0655)	(0.101)	(0.0769)
Living Situation				
vs. Living Alone				
Living with Children	-0.0276	0.0216	0.0431	-0.0516
	(0.120)	(0.0809)	(0.120)	(0.0950)
Living with NonChildren	0.0913	-0.0462	0.00768	0.0597
	(0.103)	(0.0751)	(0.103)	(0.0890)
Enrollment Relative to Pfizer Phase 3 Trial Data Release				
vs. Before Pfizer Phase 3 Results				
After Pfizer Phase 3 Results	-0.0662		0.0936	
	(0.112)		(0.112)	

PREDICTIVE VARIABLES IDENTIFIED BY LASSO REGRESSION				
Religion				
vs. Non Religious				
Religious	0.0821	0.00363	-0.0191	0.0142
	(0.0877)	(0.0608)	(0.0878)	(0.0716)
Reason for COVID-19 Test				
vs. Not Symptomatic				
Symptomatic	-0.137		0.134	
	(0.0910)		(0.0912)	
I would rather receive a COVID-19 vaccine than get COVID-19				
vs. Does Not Agree				
Agree	0.336**		-0.0981	
	(0.137)		(0.137)	
If a government health authority recommends that I get a COVID-19, I will get one.				
vs. Does Not Agree				
Agree	0.176		-0.397***	
	(0.119)		(0.119)	
I worry about the safety and/or side effects of the COVID-19 vaccine.				
vs. Does Not Agree				
Agree	-0.177**		0.227**	
	(0.0863)		(0.0864)	
I would rather receive a seasonal influenza vaccine than get seasonal influenza				
vs. Does Not Agree				
Agree		0.366**		
		(0.132)		
If my doctor/nurse recommends that I get a seasonal influenza vaccine, I will get one.				
vs. Does Not Agree				
Agree		0.649***		-0.535***
		(0.127)		(0.136)
If a government health authority recommends that I get a seasonal influenza, I will				
vs. Does Not Agree				
Agree		-0.0959		-0.0248
		(0.0816)		(0.0950)
Received 2019-20 Seasonal Influenza Vaccine				
vs. No/Unsure				
Yes				-0.260**
				(0.0979)
Observations	57	57	57	57
R-squared	0.760	0.691	0.809	0.637

Note:
Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Constant included in all regressions but not reported

Chapter 4. Discussion

This study examined the role of demographic traits, personal health beliefs, and personal experience in defining individuals' vaccine intentions towards the established seasonal influenza vaccine and the novel COVID-19 vaccine. Given the high prevalence of COVID-19 infection in the United States and the availability of COVID-19 diagnostic testing, we hypothesized that the heightened fear of infection and increased awareness about vaccination would displace the complacency that typically hinders uptake of routine vaccines and increase people's intention to vaccinate in the 2020-21 year. In particular, we hypothesized that individuals who had been tested for or diagnosed with COVID-19 would be more likely to express an intention to receive both the seasonal influenza vaccine and the COVID-19 vaccine. In this analysis, we identified the individual and social influences, the vaccine and vaccination-specific influences, and the contextual influences that serve as significant barriers and facilitators to seasonal influenza and COVID-19 vaccine uptake.

4.1 Individual and Social Influences on Vaccine Hesitancy

Individual Experience

Contrary to our hypothesis, we found that participants' personal experiences with COVID-19 infection and testing were not associated with their intention to receive the COVID-19 vaccine. A personal COVID-19 diagnosis or the diagnosis of someone within a participants' social circle was not significantly associated with their COVID-19 vaccine intentions in the multivariable analysis, which is consistent with a recent study that found that a personal COVID-19 diagnosis or the diagnosis of a close family member or friend is not significantly associated with vaccine intentions (Latkin, Dayton, Yi, Colon, & Kong, 2021). Furthermore, there was not a statistically significant association for the presence of symptoms at the time of diagnostic testing

and vaccine intention in the COVID-19 multivariable analysis, although this variable emerged as predictive in the lasso procedure. Individuals who were symptomatic when tested reported intending to vaccine at a rate that was lower than those who were not symptomatic. This may be due to the fact that individuals who experienced COVID-19 symptoms may consider themselves to have been immune to a second future COVID-19 case or able to experience infection without serious symptoms. However, while individuals who have recovered from COVID-19 are presumed immune for at least 90 days, the CDC has still recommended that these individuals get vaccinated after the symptomatic phase of illness has passed (National Center for Immunization and Respiratory Diseases (NCIRD) & Centers for Disease Control and Prevention (CDC), 2021; Post et al., 2020). While individuals who were symptomatic were not significantly less likely to intend to vaccinate against COVID-19, it will still be important for public health officials to ensure that individuals are aware that they remain a priority for vaccination post-COVID-19 infection.

In the qualitative analysis, the most frequently cited individual and social influences on COVID-19 vaccine intention were the desire for "Personal Protection," "Protecting Others," and "Public Health Motivations," which encompass subthemes such as "Social Responsibility" and "Reducing Community Spread." While these themes all center around a mutual understanding that COVID-19 infection and transmission is dangerous, participants did not explicitly mention a personal experience with COVID-19 as the source of these beliefs. Existing literature evaluating the role of experience in defining COVID-19 vaccine intentions is limited and represents the major knowledge gap we aimed to address with this study. Our qualitative findings are, however, consistent with a recent study by Latkin *et al.* (2021), which has found that individuals who fear

that they or their family will develop COVID-19 are more likely to report an intention to get the vaccine (Latkin et al., 2021).

With regards to public health motivations behind vaccination, participants made an important distinction between the public health value of COVID-19 vaccination and the public health value of seasonal influenza vaccination. In both their COVID-19 and seasonal influenza responses, participants acknowledged that these vaccines are valuable public health tools for curbing community disease spread. However, in their responses for the COVID-19 vaccine, participants further lauded COVID-19 vaccination as a matter of social responsibility and civic duty, a stance which is likely connected to participants' collective mourning of American lives and their expressed desires to "Return to Normalcy." These qualitative responses are not tied to a personal experience with COVID-19 infection, but rather reflect the collective disruption of normalcy and widespread loss of life induced by the COVID-19 pandemic.

In addition to discussing the public health aspects of vaccination in their seasonal influenza qualitative responses, participants frequently cited wanting "Personal Protection" or wanting to "Protect Others" from infection. Some participants did mention that a prior experience with seasonal influenza infection motivates them to get vaccinated to prevent future infection. However, most responses about vaccine-induced protection did not reference a personal experience with the disease. Previous literature on seasonal influenza vaccine hesitancy has shown that prior experience with influenza infection is associated with future vaccine uptake. A review by Schmid *et al.* (2017) found that across nine studies, individuals were less likely to intend to vaccinate in the coming flu season if they had never been previously infected with seasonal influenza. Individuals who do not consider themselves or others in their age group to be

susceptible to the flu are also more likely to be resistant to vaccination, a finding which emerged in the qualitative results of this study (Cheney & John, 2013; Karafillakis et al., 2017).

Prior experience with vaccination likely plays a role in displacing complacency towards the seasonal influenza vaccine. In the multivariable analysis, prior seasonal influenza vaccination was the only personal experience that was significantly associated with participants' intention to vaccinate in the 2020-21 season. Individuals who had received the 2019-20 seasonal influenza vaccine reported intending to receive the 2020-21 seasonal influenza vaccine at a significantly higher rate than those who had not been vaccinated during the previous year's flu season. Many participants said that they planned to get the 2020-21 seasonal influenza vaccine because they get the flu vaccine annually, either due to personal will or employer mandate, which indicates that establishing a vaccination routine helps promote continual uptake. These findings are in line with a review by Schmid *et al.* (2017), which found that high risk individuals who had previously received the flu vaccine were more likely to report an intention to vaccinate in the coming year.

Several participants acknowledged that experiencing the COVID-19 pandemic has increased their urgency to protect themselves against similar respiratory infections. Even participants who admitted to typically being complacent with seasonal influenza vaccination due to a low perceived personal risk of infection, acknowledged the importance of getting the seasonal influenza vaccine during the 2020-21 pandemic year. These themes are evidence of the success of messaging by the CDC and other public figures, who have emphasized the importance of seasonal influenza vaccination in 2020-21 to help alleviate strain on the US healthcare system during the COVID-19 pandemic (Grohskopf et al., 2020). Preliminary reporting by the CDC revealed that seasonal influenza vaccine intentions have increased to 59% in 2020 and 2021, compared to last season's 52.2%. Seasonal influenza vaccine uptake is expected to be higher in

the 2020-21 season than in previous seasons, which may be the result of the pandemic circumstances and widespread messaging about vaccination (Lindley et al., 2020).

Individual Demographic Characteristics

Personal experience with infection is also heavily tied to participants' demographic identifiers, as different demographic groups face differential exposures to disease. Demographic characteristics were found to play a more significant role than personal experience in influencing an individual's vaccine intentions. In the COVID-19 multivariable analysis, race was the only demographic variable associated with COVID-19 vaccine intentions and hesitancy. This association was very strong: Black and African American participants exhibited significantly higher rates of vaccine hesitancy and lower rates of COVID-19 vaccine intentions than White participants. Non-Black participants of color also exhibited significantly higher rates of vaccine hesitancy than White participants. Two participants noted in their qualitative responses that people of color may feel more mistrust towards the medical system because COVID-19 has disproportionately affected African Americans and other communities of color. This subtheme also emerged in the seasonal influenza qualitative analysis, but race was not significantly associated with seasonal influenza vaccine intentions in the multivariable analysis.

These findings are consistent with literature that documents the disproportionate impact of COVID-19 on Black, Hispanic, and Asian populations. Black and Hispanic individuals are more likely to get tested for COVID-19 and test positive for COVID-19 than White individuals (Rentsch et al., 2020). Black, Hispanic, and Asian individuals are also more likely to be employed in essential industries and therefore have greater likelihood of COVID-19 exposure than their White counterparts (Hawkins, 2020). In addition to facing greater exposures to COVID-19, African Americans have also suffered a history of mistreatment by the United States

medical system, which may be a source of medical mistrust within African American populations. Black slaves were exploited as subjects for medical education in the 19th century, African American women were forcibly sterilized under eugenics laws in the early 20th century, and African American men had penicillin withheld from them during the Tuskegee Study on syphilis in the mid-20th century (Nuriddin, Mooney, & White, 2020). The differential risks of COVID-19 and the history of medical experimentation on African American populations likely contributes to African Americans' hesitancy towards the novel COVID-19 vaccine, whereas these hesitancies may not be as strong towards established vaccines like the seasonal influenza vaccine. New research on COVID-19 vaccine hesitancy has found high levels of hesitancy towards the COVID-19 vaccine among Black and Hispanic Americans. Researchers have attributed this hesitancy to factors such as heightened fears of contracting COVID-19 from the vaccine and medical mistrust rooted in systemic racism towards these communities (Bogart et al., 2021; Latkin et al., 2021).

The primary demographic influences on vaccine hesitancy and vaccine intentions towards seasonal influenza were level of education and profession. Individuals with a graduate degree or higher exhibited lower rates of vaccine hesitancy than individuals who had a college degree or below, which aligns with prior research findings that individuals with higher levels of education are more likely to intend to vaccinate than those with lower levels of education (Doornekamp et al., 2020; Lindley et al., 2020; Raude et al., 2010).

Surprising, healthcare professionals in the study reported lower vaccine intentions and exhibited higher rates of vaccine hesitancy than participants who were not employed in the healthcare field. This is likely due to poor sampling of a seasonal influenza vaccine hesitant group, as the sum of available information on this topic indicates that healthcare professionals

are typically accepting of the seasonal influenza vaccine due to feelings of duty, the desire to protect patients and family, high perceived risk of infection, and substantial perceived benefits of vaccination *(Doornekamp et al*., 2020; Lorenc, Marshall, Wright, Sutcliffe, & Sowden, 2017). These reasons for vaccinating were also reported by several healthcare professionals in the qualitative portion of this study. Preliminary reporting by the CDC further draws this statistical finding into question, as a new report found that 74.2% of healthcare professionals intend to receive the seasonal influenza vaccine in 2020-21. Healthcare professionals in this report exhibited the lowest levels of hesitancy among the essential workers surveyed (Lindley et al., 2020).

4.2 Vaccine and Vaccination-specific Influences on Vaccine Hesitancy

Vaccine- and disease-specific risk perceptions were also found to be determinants of vaccine intentions. In the multivariable analysis, participants who indicated a preference for receiving a COVID-19 or seasonal influenza vaccine over contracting the infection itself reported intending to vaccinate at higher rates than participants who did not prefer vaccination to infection. Individuals who intended to receive the seasonal influenza and COVID-19 vaccines also reported a "General Confidence in Vaccination" in their qualitative responses, indicating participants' broader trust in the principles and science behind vaccination. Unsurprisingly, previous literature on seasonal influenza vaccine uptake shows that individuals who perceive substantial benefits to vaccination, are more likely to be accepting of vaccines (Cheney & John, 2013).

While many participants praised the benefits of vaccination, some participants also expressed concerns about the side-effects and efficacy of vaccines. In their seasonal influenza qualitative responses, participants discussed fears that commonly circulated in the general

population about the vaccine's side effects, contracting the flu from the vaccine, and the vaccine's limited efficacy. Fear of side effects did not emerge as a statistically significant factor in the multivariable analysis of seasonal influenza vaccine intentions and hesitancy, but it did emerge as a significant factor in the COVID-19 vaccine analysis. In the multivariable analysis, participants who agreed to being worried about the safety and side effects of the COVID-19 vaccine reported significantly lower vaccine intentions and higher rates of vaccine hesitancy than individuals who did not express these concerns. These differences in seasonal influenza and COVID-19 vaccine hesitancy may indicate that safety and side effect concerns carry a greater weight in decision-making for novel vaccines, which often have less robust safety and efficacy data available.

This trend is further confirmed by the qualitative responses of participants who reported intending to receive the routine seasonal influenza vaccine, but not the novel COVID-19 vaccine. Among this group of nine participants, the most commonly cited causes of personal hesitancy were "Concerns about the COVID-19 vaccine," specifically regarding the novelty of the vaccine, "Concerns about the COVID-19 Vaccine Clinical Trials," specifically the lack of safety and efficacy data, the timing of the vaccine development, and the lack of minority representation in the clinical trials, and finally a "Distrust in government." Participants felt that the COVID-19 vaccine, in particular, was unsafe due to a lack of appropriate, thorough testing and inappropriate government intervention.

Approximately half of the study sample was enrolled before the interim Phase III clinical trial results from the Pfizer-BioNTech vaccine were released. The date of enrollment was included in the multivariable analysis and was not found to be significantly associated with participants' responses, but participants enrolled later in the study did have differential access to

data from these vaccine trials when they provided their responses. All of the participants who belonged to this group were enrolled prior to or within several days of the release of the Pfizer-BioNTech clinical trial data, indicating that the access to more robust scientific data about the vaccine may have helped dispel similar vaccine concerns for participants who were enrolled later in the study. Among participants that are accepting of more established vaccines, it appears that increasing access to safety and efficacy data and providing greater transparency regarding the role of government in the COVID-19 vaccine development process may be the most effective strategies for dispelling hesitancies about the COVID-19 vaccine.

4.3 Contextual Influences on Vaccine Hesitancy

Trust in Institutions

The quantitative and qualitative analysis of both vaccines revealed that contextual influences play a substantial role in defining patients' concepts of risk. In the COVID-19 multivariable analysis, participants who agreed that they would take a COVID-19 vaccine based on the recommendation of a government health authority exhibited significantly lower rates of vaccine hesitancy than those who disagreed. "Distrust in government" was frequently cited as a reason for vaccine hesitancy in the qualitative analysis, indicating that participants' trust in the presidential administration, and the government health entities that the president oversees, played an important role in defining their COVID-19 vaccine intentions. Many participants cited the politicization of the COVID-19 pandemic as the source of their concerns about the vaccine development process. Participants who were enrolled prior to the November 2020 election expressed concerns that the Trump administration was rushing the vaccine development timeline for political gain.

Regardless of participants' personal political affiliations, they generally agreed that the COVID-19 pandemic had become so heavily politicized that decisions about the COVID-19 vaccine were tied to political trust in a way that decisions about routine vaccines were not. These trends are reflected in surveys from the Pew Research Center, which reported in September 2020 that 58% of Democrats would get the COVID-19 vaccine, while only 44% of Republicans would get the vaccine. This partisan gap has since widened, with Democrats now reporting intending to vaccinate at a rate 27 percentage points higher than Republicans (Funk & Tyson, 2021). Government distrust appeared much less frequently in the seasonal influenza qualitative analysis. While agreeing to follow the vaccine recommendation of a government health authority was predictive of seasonal influenza vaccine intentions in the multivariable analysis, this association was not statistically significant.

Doctors' and nurses' recommendations were significantly associated with the intention to receive the seasonal influenza vaccine, but not the COVID-19 vaccine. Participants who agreed that they would take the seasonal influenza vaccine following the recommendation of a doctor or nurse reported intending to vaccinate at higher rates and exhibited vaccine hesitancy at lower rates than participants who did not agree. This is consistent with previous studies on seasonal influenza vaccine uptake, which show that individuals who do not value the recommendations of healthcare providers are more likely to be resistant to vaccination (Cheney & John, 2013).

Many participants noted in their qualitative responses that their vaccine decisions, a health area that is typically driven by scientific data and healthcare professionals' recommendations, had been colored by the political climate of the COVID-19 pandemic. Scientific and political institutions are not, however, inherently connected and this government influence on scientific decision-making is far from the norm. In fact, the CEOs of nine drug

companies leading the COVID-19 vaccine effort issued a joint-statement in September 2020 committing to the scientific process and pledging to keep political considerations out of the vaccine development process (Dyer, 2020). Therefore, while the 2020 political climate played an important role in shaping COVID-19 vaccine decisions, this may not be the prevailing reality in past and future vaccine campaigns.

Misinformation

Participants' willingness to adhere to vaccine recommendations from government officials or healthcare professionals is rooted in their trust in the information that those individuals disseminate. For that reason, many participants blamed misinformation for causing vaccine distrust in the population. In their qualitative responses, participants noted that misinformation about the side effects and efficacy of vaccines is a notable barrier to vaccine uptake. This is particularly true for the seasonal influenza vaccine, as individuals may be hesitant to get the vaccine because of circulating misinformation that the seasonal influenza vaccine will give them seasonal influenza. Existing literature on influenza vaccine hesitancy has found that individuals who are resistant to vaccination tend to believe that influenza vaccination causes influenza and tend to doubt the efficacy of the influenza vaccine in general, both of which serve as barriers to vaccine uptake (Cheney & John, 2013; Karafillakis et al., 2017).

Another source of misinformation are conspiracy theories, which often prey on individuals' lack of understanding about vaccine mechanisms. Participants mentioned several of the circulating conspiracy theories about the COVID-19 vaccine when hypothesizing on sources of vaccine hesitancy in the general population, including the theory that the COVID-19 vaccine will be used to insert tracking chips into Americans and the theory that the COVID-19 vaccine and the pandemic as a whole are hoaxes perpetuated by government officials and pharmaceutical

companies for profit. The Internet has increased the general population's access to both information and misinformation about vaccination in recent years, and also facilitates the communication and reach of individuals with extreme views about vaccines. This, compounded by the media's exposures of dishonesty in government, medicine, academia, and the corporate world, has created a climate of distrust towards vaccine distributers and policy makers and fueled the radical beliefs of conspiracy theorists (Cooper, Larson, & Katz, 2008). A recent study found that between January and April 2020 alone, 2,311 reports of COVID-19 related rumors, conspiracy theories, and stigma were circulating across 87 countries, and over 80% of the information in those reports were false (Islam et al., 2020). This access to COVID-19 misinformation decreases the willingness of the general public to accept COVID-19 vaccines, particularly among communities of color and low-income groups (Loomba, de Figueiredo, Piatek, de Graaf, & Larson, 2021). Misinformation should therefore be a key target to reduce barriers to vaccine uptake.

There are also more general anti-vax theories aimed at discouraging vaccination across the board, such as the theory that vaccines cause autism. One participant blamed Dr. Andrew Wakefield's now-discredited study linking the measles, mumps, rubella (MMR) vaccine to autism for being the root of a now rampant body of anti-vax misinformation promoting vaccine refusal among parents (Koslap-Petraco, 2019). While only one participant admitted to believing in any of these theories, the frequency at which participants mentioned potential conspiracy theories in their responses points to the prevalence of such theories in the media. It is also notable that 100% of participants, even those who expressed full or partial belief in these conspiracy theories, agreed or strongly agreed that they were knowledgeable about seasonal influenza and COVID-19. These results further emphasize the need to increase access to factual

vaccine information, to help counteract the damaging effect of these conspiracy theories on vaccine uptake.

4.4 Overall Determinants of Seasonal Influenza and COVID-19 Vaccine Hesitancy

We found that up to 23% of participants had no intention of receiving an approved COVID-19 vaccination. This is concerning given that the role of vaccination in curbing deaths and ending the pandemic has been made abundantly clear. Furthermore, individuals that would presumably have the best access too, and presumably be most aware and supportive of medical and public health guidance, are overrepresented in our population. Thus, these concerning findings are likely to be amplified in a larger and broader population sample.

The results of the quantitative portion of this study revealed that individuals with no intention to receive the COVID-19 vaccine were predominantly Black, did not strongly prefer COVID-19 vaccination to infection, did not trust the recommendations of government health authorities, and had concerns about the safety and side effects of the COVID-19 vaccine. Participants' religion and whether or not they had COVID-19 symptoms when they were tested for COVID-19 also appears to play a predictive, but not significant, role in their vaccine intentions. If public health officials were to collect data on these non-demographic variables and analyze it in conjunction with demographic data, they could substantially increase their ability to predict COVID-19 vaccine intentions (r^2 change from 0.560 to 0.760) and vaccine hesitancy (r^2 change from 0.591 to 0.809) in this study population.

The results of seasonal influenza analysis revealed that individuals with no intention to receive the seasonal influenza vaccine were predominately employed in the medical field, did not trust the recommendations of healthcare professionals, and were not vaccinated in the previous flu season. Participants' religion and trust in government officials also appeared to potentially

play a predictive role in their vaccine intentions. If public health officials were to collect data on these non-demographic variables and analyze it in conjunction with demographic data, they could substantially increase their ability to predict seasonal influenza vaccine intentions (r^2 change from 0.183 to 0.691) and vaccine hesitancy (r^2 change from 0.297 to 0.637) in this study population.

4.5 Study Limitations

This study had important limitations. The first limitation of this study was the size and representativeness of the sample. Fifty-seven participants were enrolled in this study of the 265 individuals who were contacted to participate. All of the participants were located in or around Atlanta, GA. Due to the small and non-representative sample size, the results of the research cannot be generalized to the broader United States population. The sample size of participants who demonstrated hesitancy towards the seasonal influenza vaccine was particularly small, which makes it challenging to draw actionable conclusions about the determinants of vaccine hesitancy towards the seasonal influenza vaccine. The study population was also highly educated and many participants were closely affiliated with the healthcare system, either through careers in public health, medicine, or research. One might expect this high proportion of educated participants and healthcare professionals to bias our sample to low vaccine hesitancy. However, the diversity of opinions registered in this our study provides valid and valuable insight into the barriers to vaccine uptake among groups that are not traditionally labeled as vaccine refusers.

Another key limitation of this study is the timeline during which participants were enrolled. Participants were enrolled from September 2020 to December 2020. During this time period, the Trump administration released their COVID-19 vaccine distribution plan (September 16, 2020), President Joe Biden was determined to be president elect (November 7, 2020), Pfizer-BioNTech

released data from their COVID-19 vaccine trial (November 9, 2020), Moderna released data from their COVID-19 vaccine trial (November 16, 2020), the FDA granted an EUA for the Pfizer-BioNTech vaccine (December 11, 2020), and the FDA granted an EUA for the Moderna vaccine (December 18, 2020) (AJMC Staff, 2021). Since November 9, 2020 was the first date that COVID-19 vaccine data became available to the public, a variable was included in the multivariable analysis to reflect whether participants were enrolled in the study before or after this date, and date of enrollment was not found to be a significant variable in the analysis. While it is likely that these major events in the pandemic impacted participants' responses in ways that could not be controlled for in this study, the timing of the study enrollment period also creates a valuable snapshot of the impact that major political and scientific developments had on vaccine intentions during this time period.

4.6 Recommendations and Actionable Suggestions

The findings of this study align with much of the emerging literature on COVID-19 vaccine uptake and hesitancy. This study found that 23% (n=13) of participants did not intend to receive the COVID-19 vaccine and 32% (n=18) of participants displayed some hesitancy towards the COVID-19 vaccine. While these numbers are substantially lower than national surveys, likely due to the high proportion of educated participants working in healthcare-adjacent fields, participants' concerns about the vaccines align with the findings of nationally representative surveys. The Pew Research Center released a report in March 2021, which found that 69% of the United States public intends to receive the COVID-19 vaccine, a number which has increased steadily from 60% in November 2020 and 51% in September 2020 (Funk & Tyson, 2021; Tyson et al., 2020). Vaccine hesitancy remains highest among African Americans, but vaccine intentions among African Americans have increased from 42% in November 2020 to

61% in March 2021. Although low income individuals were not well-represented in this study, vaccine intentions appear to be lowest in low-income populations. Only 14% of low-income Americans have been vaccinated against COVID-19, compared to 20% of middle-income and 27% of high-income adults. As of March 2021, Democrats are 27 percentage points more likely to intend to vaccinate than Republicans (Funk & Tyson, 2021). Reports from September 2020 indicated that Democrats were also 50 percentage points more likely than Republicans to believe that President Donald Trump was pressuring the FDA to rush the approval of a COVID-19 vaccine (Hamel et al., 2020). Americans who believe that they are highly susceptible to COVID-19, have positive perceptions of vaccination, and face low barriers to vaccination are more likely to intend to receive an EUA COVID-19 vaccine (Guidry et al., 2021). Americans who regularly get the seasonal influenza vaccine are also more likely to report intending to receive or having already received the COVID-19 vaccine (Funk & Tyson, 2021).

With this data in mind, we offer the following recommended considerations for developing vaccine-related communications and targeting vaccine hesitant populations.

1. **Rely on trusted community health workers, medical professionals, and trusted community leaders who look like their patients to disseminate vaccine-related information.** Vaccine hesitancy is high in Black and African American communities, and the roots of this hesitancy can only be fully understood by other members of the African American community who have faced racism in the medical system. Vaccine messaging may therefore be more effective in these communities if black doctors and community health workers are at the forefront of dissemination, and are able to share why they chose to get vaccinated in spite of these barriers. This recommendation is not limited to racial groups. One participant in this study was a transplant patient and noted

that she would not feel comfortable getting vaccinated before seeing herself represented in vaccine trials. Participants across the study mentioned wanting to postpone vaccination until after they had seen other people in their communities get vaccinated. Individuals' inherent trust in following the guidance and behaviors of people who share the same identities, religious beliefs, or life experiences as they do should be leveraged in vaccine communications.

2. **Focus on the community health benefits of vaccination, even for vaccines with lower efficacies.** Many participants considered COVID-19 vaccination to be a social responsibility, a belief which was not expressed for the seasonal influenza vaccine. However, only participants enrolled after the release of the Pfizer-BioNTech clinical trial results expressed this belief, indicating that it may be easier to understand the population-level health benefits for a vaccine with over 90% efficacy under pandemic conditions than for vaccines with lower efficacies in non-pandemic years. Despite its lower efficacy rates, the seasonal influenza vaccine still has important population health benefits, and vaccine communications should explain how the seasonal influenza vaccine can lower population-wide transmission with only 40-60% efficacy rates. These types of communications will be particularly important as more COVID-19 vaccine candidates, with lower efficacies, receive EUAs from the FDA.
3. **Promote "Vaccinating our way out of the pandemic."** In addition to being a major public health crisis, the COVID-19 pandemic has been a deeply emotional and isolating experience for much of the population. Many participants expressed wanting to return to normal life—wanting to hug their children, travel, gather with friends and family, and feel safe walking outside without a mask. Public health messaging should therefore

emphasize the fact that vaccination is more than just a health measure, it is the gateway to returning to loved ones and loved places that have been inaccessible or unsafe for the past year. These moments of loss have been universally experienced over the past year and may be a powerful way of encouraging vaccine uptake among individuals that do not feel a strong health-based drive to get vaccinated.

4. **Continue to leverage the power of data in vaccine communications.** In highly educated populations, evidence-based recommendations appear to be a strong driver of vaccine related behavior. Nearly 100% of participants who indicated hesitancy towards the COVID-19 vaccine were enrolled prior to the release of the Pfizer-BioNTech clinical trial data. This hesitancy was driven by concerns about the novelty, timing, and safety and efficacy of the COVID-19 vaccine candidates. While a few participants enrolled after the release of the Pfizer-BioNTech data expressed these concerns, the vast majority of these responses came from participants enrolled prior to the public availability of vaccine safety and efficacy data. This trend indicates that the widespread dissemination of clinical trial data and evidence-based recommendations for COVID-19 vaccines may be the key to curbing vaccine hesitancy in populations that are typically accepting of vaccines and of science more generally.
5. **Continue to offer widespread town halls, Q&As, and physician interviews for all new vaccines.** Participants expressed many concerns about vaccine side effects, vaccine efficacies, and the novelty of the COVID-19 vaccine. Throughout the COVID-19 pandemic, town halls and Q&A sessions have given the public an opportunity to have their questions and concerns addressed by healthcare professionals. Continuing to make these professionals accessible to the public when new vaccines are released may help

stop individuals from seeking answers to their questions from less reliable media platforms, which can be full of misinformation.

6. **Promote the establishment of annual vaccine habits.** Employer mandates, annual vaccine habits, and prior influenza vaccination were key drivers of seasonal influenza vaccine uptake in this study population. Prior seasonal influenza vaccination has also been linked to the intention to receive the COVID-19 vaccine (Funk & Tyson, 2021). Helping people establish annual vaccine habits, through methods such as annual employer mandates, yearly text reminders from healthcare clinics, or major communication pushes around fall holidays, may be the key to displacing complacency around vaccination. These strategies will be especially important for curbing COVID-19 transmission if current vaccines are found to require annual boosters to maintain protection.

4.7 Future Directions

This research study evaluated vaccine perceptions and intentions for the seasonal influenza and COVID-19 vaccines from September 2020 to December 2020. However, since the conclusion of study enrollment, there have been significant changes in the United States political climate, the circulation of COVID-19 variants, and the availability of COVID-19 vaccines and vaccine data. Given these developments, future research efforts should include a follow-up with this study population in Spring 2021, six months after initial enrollment, and in Fall 2021, one year after initial enrollment, to understand and evaluate changes in vaccine intentions over time. The results of this research have also shown that vaccine intentions and hesitancies are both vaccine-specific and context-specific. Therefore, future research should focus on expanding this study to more racially, socioeconomically, and geographically representative populations to

better understand seasonal influenza and COVID-19 vaccine intentions and hesitancies across the United States. Understanding the crossover between seasonal influenza disease experiences and COVID-19 vaccine intentions, and COVID-19 disease experiences and seasonal influenza vaccine intentions was an original goal of this study, but was ultimately not analyzed in depth due to sample size constraints. Future research should investigate this interplay between respiratory disease experiences and respiratory vaccine uptake for different viruses. Future studies should also monitor differences in vaccine hesitancies towards seasonal versus pandemic viral strains, in order to prepare for the potential that COVID-19 will resurge or become endemic to some areas of the world (Kissler, Tedijanto, Goldstein, Grad, & Lipsitch, 2020). Finally, as COVID-19 vaccines with different technologies, dose schedules, storage requirements, and efficacies against emerging COVID-19 variants continue to be developed and approved, it will be important to study the public's hesitancies across COVID-19 vaccine types.

4.8 Conclusion

The results of this research reveal that vaccine intentions are far more than a personal health decision. Vaccine intentions are tied to racial identity, political beliefs, altruistic drives to protect loved ones and strangers, and trust in institutions and media. Intentions towards the new COVID-19 vaccines have been heavily impacted by the 2020 public health and political climates, whereas intentions towards the established seasonal influenza vaccine have been impacted by years' worth of hearsay and misinformation about the vaccine's side effects and efficacy. With every new vaccine or pandemic, there is an opportunity to repeat previous mistakes in public health messaging or improve the delivery of action-based public health solutions. The action items presented in this study provide a starting point for dismantling vaccine hesitancies in the populations represented in this study. There remains a need to

understand and address vaccine hesitancy among racial minorities, low-income groups, and populations that may not be overtly anti-science or anti-vaccine, both for future COVID-19 vaccines and for future vaccines more broadly.

Chapter 5. Appendix

5.1 Study Questionnaire

SECTION A: Inclusion Criteria and COVID-19 Testing Information		
INTERVIEWER SAY: I would like to start with a few questions to determine your eligibility for this study.		
	Question	Response
A1	Date of survey completion	DD/MM/YYYY
A2	How old are you?	___ years old
A3	Have you been tested for COVID-19?	1. Yes 2. No
A4	If yes, do you know what type of test you had?	1. PCR or molecular or virus test (usually a nose or mouth/throat swab) 2. Antibody test or serology test (usually a blood draw from the arm; could be by fingerstick or other method)
A5	If yes, what date did you have your COVID-19 test on?	DD/MM/YYYY
A6	If yes, what were the COVID-19 test results?	1. Positive 2. Negative 3. Indeterminate 4. Inconclusive 5. Invalid 6. Intermediate 7. I don't know
A7	If yes, why did you get tested for COVID-19?	1. I had symptoms of COVID-19 2. I was a close contact of a confirmed case 3. I was admitted to the hospital 4. I was tested as part of a school or employer-mandated screening 5. I did not have symptoms but I wanted to know whether I was infected 6. Other, explain: _____

SECTION B: Demographics and Personal Characteristics		
INTERVIEWER SAY: I'm going to continue with some general questions about yourself.		
	Question	Response
B1	What gender do you identify as?	1. Male 2. Female 3. Non-binary 4. Do not wish to answer
B2	How would you describe your race and/or ethnicity?	1. White 2. Hispanic or Latino 3. Black or African American 4. Asian 5. American Indian or Alaskan Indian or Alaskan Native 6. Middle Eastern or North African 7. Native Hawaiian or Pacific Islander 8. Biracial/Multiracial 9. Other 10. Do not wish to answer
B3	What is the highest level of schooling you have completed?	1. None 2. Some High School 3. High School 4. Some College 5. College 6. Graduate School and beyond 7. Other (specify) 8. Do not wish to answer
B4	What is your profession?	_____

B5	How would you describe your political affiliation?	1. Democrat 2. Republican 3. Independent 4. Other 5. Do not wish to answer
B6	What is your religion, if any?	1. Protestant 2. Roman Catholic 3. Greek or Russian Orthodox 4. Jewish 5. Muslim 6. Buddhist 7. Hindu 8. Atheist 9. Agnostic 10. Not religious 11. Other (specify) 12. Do not wish to answer
B7	Which of the following best describes your living situation? (READ OPTIONS)	1. Single and living alone 2. Single and living with roommates 3. Living with a partner 4. Living with a partner and children 5. Living with children and no partner 6. Living with family members other than partner or children (specify) 7. Other (specify) 8. Do not wish to answer
B8	Do you have a history of any medical problems?	1. Cancer 2. Diabetes 3. Lupus 4. Rheumatoid arthritis 5. Autoimmune Disease

		6. Immunodeficiency 7. Organ Transplant 8. Cardiovascular disease 9. High cholesterol 10. Hypertension 11. Asthma 12. COPD / chronic lung disease 13. Other Respiratory disease 14. Other (specify) 15. Do not wish to answer
B9	Does anyone living in your household have a medical condition that might place them at a higher risk if they are diagnosed with seasonal influenza or COVID-19?	1. Yes (specify) 2. No 3. Unsure 4. Living alone 5. Do not wish to answer

SECTION C: Seasonal Influenza Questions		
INTERVIEWER SAY: The following set of questions relate to seasonal influenza.		
C1	Did you receive the 2019-2020 seasonal flu vaccine?	1. Yes 2. No 3. Unsure 4. Do not wish to answer
C2	Have you ever had the seasonal flu?	1. Yes, once 2. Yes, more than once 3. No 4. Unsure 5. Do not wish to answer
C3	If yes, when did you have the seasonal flu?	MM/YYYY
C4	Has anyone in your social circle (i.e. family, friends, partner, classmates, colleagues) been diagnosed with seasonal influenza during the 2019-2020 flu season?	1. Yes (specify) 2. No 3. Unsure 4. Do not wish to answer

INTERVIEWER SAY: In the next section of this survey, I will list some propositions about seasonal influenza. We would like to know your opinion on these propositions. Please respond with "I strongly agree," "I agree," "I do not agree or disagree," "I disagree," or "I strongly disagree." There are no right or wrong answers.		
C5	I think seasonal influenza is a serious illness.	1. I strongly agree 2. I agree 3. I do not agree or disagree 4. I disagree 5. I strongly disagree
C6	I think the complications associated with seasonal influenza are serious.	1. I strongly agree 2. I agree 3. I do not agree or disagree 4. I disagree 5. I strongly disagree
C7	I think I have a high personal risk of getting seasonal influenza.	1. I strongly agree 2. I agree 3. I do not agree or disagree 4. I disagree 5. I strongly disagree
C8	I think people close to me have a high risk of getting seasonal influenza.	1. I strongly agree 2. I agree 3. I do not agree or disagree 4. I disagree 5. I strongly disagree
C9	If I were diagnosed with seasonal influenza, I think it would be dangerous for my health.	1. I strongly agree 2. I agree 3. I do not agree or disagree 4. I disagree 5. I strongly disagree
C10	If I were diagnosed with seasonal influenza, I think it is plausible that I would infect people around me.	1. I strongly agree 2. I agree 3. I do not agree or disagree 4. I disagree 5. I strongly disagree

C11	I would rather receive a seasonal influenza vaccine than get seasonal influenza.	1. I strongly agree 2. I agree 3. I do not agree or disagree 4. I disagree 5. I strongly disagree
C12	If my doctor/nurse recommends that I get a seasonal influenza vaccine, I will get one.	1. I strongly agree 2. I agree 3. I do not agree or disagree 4. I disagree 5. I strongly disagree
C13	If a government health authority recommends that I get a seasonal influenza vaccine, I will get one.	1. I strongly agree 2. I agree 3. I do not agree or disagree 4. I disagree 5. I strongly disagree
C14	I worry about the safety and/or side effects of the seasonal influenza vaccine.	1. I strongly agree 2. I agree 3. I do not agree or disagree 4. I disagree 5. I strongly disagree
C15	My intentions to get vaccinated against seasonal influenza have changed as a result of the COVID-19 pandemic.	1. I strongly agree 2. I agree 3. I do not agree or disagree 4. I disagree 5. I strongly disagree
C16	If “I strongly agree” or “I agree”, how have your intentions changed?	
C17	I am knowledgeable about the symptoms and complications associated with seasonal influenza infection.	1. I strongly agree 2. I agree 3. I do not agree or disagree 4. I disagree 5. I strongly disagree
C18	I am knowledgeable about the CDC recommendations regarding seasonal influenza vaccination.	1. I strongly agree 2. I agree 3. I do not agree or disagree 4. I disagree 5. I strongly disagree

C19	What are your primary sources of information on seasonal influenza?	
C20	How often do you consume information from this source? INTERVIEWER: Ask this question for each source listed by respondent.	1. Several times a day 2. Once a day 3. Several times a week 4. Once a week 5. Several times a month 6. Once a month
C21	The CDC recommends annual influenza vaccination for anyone 6 months of age or older. With this information in mind, how likely are you to get the 2020-2021 seasonal influenza vaccine? PLEASE RESPOND ON A SCALE OF 1-5, 1 BEING "VERY LIKELY" AND 5 BEING "VERY UNLIKELY"	1. Very likely 2. Likely 3. Neither likely nor unlikely 4. Unlikely 5. Very unlikely
C22	Could you please tell me more about your reasoning for this decision?	
C23	What do you think are reasons why a person should get vaccinated against seasonal influenza? INTERVIEWER PROMPT: Tell me more about that. Why do you think this is an important reason?	
C24	What do you think are reasons why a person might choose not to get vaccinated against seasonal influenza? INTERVIEWER PROMPT: Tell me more about that. Why do you think this is an important reason?	

SECTION D: COVID-19 Questions		
INTERVIEWER SAY: The following set of questions relate to COVID-19.		
D1	Has anyone in your social circle (i.e. family, friends, partner, classmates, colleagues) been diagnosed with COVID-19?	1. Yes 2. No 3. Unsure 4. Do not wish to answer

D2	If yes, when were they diagnosed?	MM/YYYY
INTERVIEWER SAY: In the next section of this survey, I will list some propositions about COVID-19. We would like to know your opinion on these propositions. Please respond with "I strongly agree," "I agree," "I do not agree or disagree," "I disagree," or "I strongly disagree." There are no right or wrong answers.		
D3	I think COVID-19 is a serious illness.	1. I strongly agree 2. I agree 3. I do not agree or disagree 4. I disagree 5. I strongly disagree
D4	I think the complications associated with COVID-19 are serious.	1. I strongly agree 2. I agree 3. I do not agree or disagree 4. I disagree 5. I strongly disagree
D5	I think I have a high personal risk of getting COVID-19.	1. I strongly agree 2. I agree 3. I do not agree or disagree 4. I disagree 5. I strongly disagree
D6	I think people close to me have a high risk of getting COVID-19.	1. I strongly agree 2. I agree 3. I do not agree or disagree 4. I disagree 5. I strongly disagree
D7	If I were diagnosed with COVID-19, I think it would be dangerous for my health.	1. I strongly agree 2. I agree 3. I do not agree or disagree 4. I disagree 5. I strongly disagree
D8	If I were diagnosed with COVID-19, I think it is plausible that I would infect people around me.	1. I strongly agree 2. I agree 3. I do not agree or disagree 4. I disagree 5. I strongly disagree

D9	I would rather receive a COVID-19 vaccine than get COVID-19.	1. I strongly agree 2. I agree 3. I do not agree or disagree 4. I disagree 5. I strongly disagree
D10	If a COVID-19 vaccine becomes available and my doctor/nurse recommends that I get the vaccine, I will get one.	1. I strongly agree 2. I agree 3. I do not agree or disagree 4. I disagree 5. I strongly disagree
D11	If a COVID-19 vaccine becomes available and a government health authority recommends that I get the vaccine, I will get one.	1. I strongly agree 2. I agree 3. I do not agree or disagree 4. I disagree 5. I strongly disagree
D12	I worry about the safety and/or side effects of a potential future COVID-19 vaccine.	1. I strongly agree 2. I agree 3. I do not agree or disagree 4. I disagree 5. I strongly disagree
D13	My beliefs about vaccination in general have changed as a result of the COVID-19 pandemic.	1. I strongly agree 2. I agree 3. I do not agree or disagree 4. I disagree 5. I strongly disagree
D14	If “I strongly agree” or “I agree,” how have your beliefs about vaccination changed?	
D15	I am knowledgeable about the symptoms and complications associated with COVID-19 infection.	1. I strongly agree 2. I agree 3. I do not agree or disagree 4. I disagree 5. I strongly disagree
D16	What are your primary sources of information on COVID-19?	

D17	How often do you consume information from these sources? INTERVIEWER: Ask this question for each source listed by respondent.	1. Several times a day 2. Once a day 3. Several times a week 4. Once a week 5. Several times a month Once a month
D18	If a COVID-19 vaccine becomes available, how likely are you to get vaccinated? PLEASE RESPOND ON A SCALE OF 1-5, 1 BEING "VERY LIKELY" AND 5 BEING "VERY UNLIKELY"	1. Very likely 2. Likely 3. Neither likely nor unlikely 4. Unlikely 5. Very unlikely
D19	Could you please tell me more about your reasoning for this decision?	
D20	What do you think are reasons why a person should get vaccinated against COVID-19 when a vaccine becomes available? INTERVIEWER PROMPT: Tell me more about that. Why do you think this is an important reason?	
D21	What do you think are reasons why a person might choose not to get vaccinated against COVID-19 when a vaccine becomes available? INTERVIEWER PROMPT: Tell me more about that. Why do you think this is an important reason?	
D22	Is there anything else you would like to tell me about your thoughts and perspectives regarding vaccination, seasonal influenza, or COVID-19?	

5.2 Detailed Tables from Multivariable Analysis

Table 16: Predicted Rate of Intention to Receive COVID-19 Vaccine by Group

	Predicted Rate of Intention to Receive COVID-19 Vaccine	Std. Err.	[95% Conf.	Interval]
Age				
18-30yrs	0.7690763	0.0951273	0.5769628	0.9611898
31-59yrs	0.7752484	0.0473791	0.6795644	0.8709323
60yrs +	0.7665866	0.0692249	0.6267841	0.9063892
Gender				
Male	0.8052831	0.0573613	0.6894396	0.9211266
Female	0.7509649	0.04387	0.6623676	0.8395622
Race				
White	0.8681787	0.0499287	0.7673457	0.9690117
Black	0.5312409	0.0896521	0.3501849	0.7122969
NonWhite/ NonBlack	0.7827279	0.0963114	0.5882231	0.9772327
Profession				
Non Healthcare	0.786054	0.041774	0.7016896	0.8704184
Healthcare	0.7189641	0.1051321	0.5066456	0.9312827
Level of Education				
College Level or Below	0.6806883	0.0791709	0.5207994	0.8405773
Graduate Level or Above	0.8075363	0.0427766	0.7211471	0.8939254
Living Situation				
Living Alone	0.7346805	0.0903956	0.5521229	0.9172382
Living with Children	0.7070849	0.0675003	0.5707653	0.8434046
Living with NonChildren	0.8259745	0.0496977	0.725608	0.9263411
Enrollment Relative to Pfizer Phase 3 Trial Data Release				
Before Pfizer Phase 3 Results	0.8044579	0.0636815	0.6758505	0.9330653
After Pfizer Phase 3 Results	0.7382401	0.0653843	0.6061938	0.8702863
Religion				
Non Religious	0.7359038	0.0501074	0.6347098	0.8370978
Religious	0.8180431	0.0587746	0.6993454	0.9367409

Reason for COVID-19 Test				
Not Symptomatic	0.8102682	0.0410524	0.7273611	0.8931753
Symptomatic	0.6736877	0.0729312	0.5264002	0.8209752
I would rather receive a COVID-19 vaccine than get COVID-19				
Does Not Agree	0.4944765	0.1173171	0.2575498	0.7314032
Agree	0.8309624	0.0401103	0.7499581	0.9119668
If a government health authority recommends that I get a COVID-19, I will get one.				
Does Not Agree	0.6487152	0.0894649	0.4680371	0.8293933
Agree	0.824296	0.0478721	0.7276164	0.9209757
I worry about the safety and/or side effects of the COVID-19 vaccine.				
vs. Does Not Agree	0.8527108	0.0508036	0.7501108	0.9553108
Agree	0.675614	0.0568669	0.5607689	0.7904592

Table 17: Predicted Rate of Intention to Receive Seasonal Influenza Vaccine by Group

	Predicted Rate of Intention to Receive Seasonal Influenza Vaccine	Std. Err.	[95% Conf.	Interval]
Age				
18-30yrs	0.9572945	0.0641206	0.827983	1.086606
31-59yrs	0.9012362	0.0334106	0.8338573	0.9686152
60yrs +	0.9021572	0.0514331	0.7984324	1.005882
Gender				
Male	0.9222554	0.0414318	0.8387003	1.00581
Female	0.9060109	0.0320353	0.8414056	0.9706162
Race				
White	0.9101905	0.0366277	0.8363236	0.9840573
Black	0.8952799	0.0620307	0.7701831	1.020377
NonWhite/ NonBlack	0.9466228	0.0694458	0.8065721	1.086674
Profession				
Non Healthcare	0.9424059	0.0288736	0.8841766	1.000635
Healthcare	0.7993112	0.0648703	0.6684878	0.9301347
Level of Education				
College Level or Below	0.8463071	0.0528618	0.7397012	0.952913
Graduate Level or Above	0.9380265	0.0302207	0.8770807	0.9989723
Living Situation				
Living Alone	0.9285704	0.0643958	0.7987039	1.058437
Living with Children	0.9501709	0.0465948	0.8562035	1.044138
Living with NonChildren	0.8824006	0.0364094	0.8089741	0.9558272
Religion				
Non Religious	0.9106894	0.0358766	0.8383373	0.9830416
Religious	0.9143175	0.0417317	0.8301576	0.9984774
I would rather receive a seasonal influenza vaccine than get seasonal influenza.				
Does Not Agree	0.6094337	0.1248941	0.3575607	0.8613068
Agree	0.9351371	0.0257085	0.883291	0.9869832
If my doctor/nurse recommends that I get a seasonal influenza vaccine, I will get one.				
Does Not Agree	0.3200683	0.1181493	0.0817975	0.5583391

Agree	0.9692242	0.0264404	0.915902	1.022546
If a government health authority recommends that I get a seasonal influenza, I will.				
Does Not Agree	0.9862829	0.0673734	0.8504116	1.122154
Agree	0.8904164	0.0303541	0.8292016	0.9516312

Table 18: Predicted Rate of COVID-19 Vaccine Hesitancy by Group

	Predicted Rate of Hesitancy for COVID-19 Vaccine	Std. Err.	[95% Conf.	Interval]
Age				
18-30yrs	0.2802726	0.095276	0.0878588	0.4726864
31-59yrs	0.3505252	0.0474531	0.2546917	0.4463587
60yrs +	0.3357283	0.0693331	0.1957072	0.4757494
Gender				
Male	0.3678533	0.0574509	0.2518288	0.4838778
Female	0.3116351	0.0439386	0.2228993	0.4003709
Race				
White	0.1812422	0.0500067	0.0802516	0.2822329
Black	0.6060737	0.0897922	0.4247347	0.7874127
NonWhite/ NonBlack	0.4836369	0.0964619	0.2888281	0.6784457
Profession				
Non Healthcare	0.3080391	0.0418393	0.2235428	0.3925353
Healthcare	0.4281868	0.1052964	0.2155364	0.6408372
Level of Education				
College Level or Below	0.4021334	0.0792947	0.2419945	0.5622722
Graduate Level or Above	0.3064845	0.0428435	0.2199604	0.3930087
Living Situation				
Living Alone	0.3150468	0.0905369	0.1322038	0.4978898
Living with Children	0.3581858	0.0676058	0.2216531	0.4947186
Living with NonChildren	0.3227258	0.0497754	0.2222024	0.4232492
Enrollment Relative to Pfizer Phase 3 Trial Data Release				
Before Pfizer Phase 3 Results	0.2873459	0.063781	0.1585375	0.4161544
After Pfizer Phase 3 Results	0.3809631	0.0654865	0.2487105	0.5132158
Religion				
Non Religious	0.341718	0.0501857	0.2403659	0.4430702
Religious	0.3226009	0.0588665	0.2037176	0.4414842
Reason for COVID-19 Test				
Not Symptomatic	0.2957439	0.0411166	0.2127072	0.3787805
Symptomatic	0.4296563	0.0730452	0.2821386	0.577174
I would rather receive a COVID-19 vaccine than get COVID-19				

Does Not Agree	0.414199	0.1175005	0.1769021	0.651496
Agree	0.3161279	0.040173	0.2349969	0.3972588
If a government health authority recommends that I get a COVID-19, I will get one.				
Does Not Agree	0.6116265	0.0896047	0.4306661	0.792587
Agree	0.2150587	0.0479469	0.1182279	0.3118895
I worry about the safety and/or side effects of the COVID-19 vaccine.				
Does Not Agree	0.2298485	0.050883	0.1270881	0.3326089
Agree	0.4567191	0.0569558		

Table 19: Predicted Rate of Seasonal Influenza Vaccine Hesitancy by Group

	Predicted Rate of Hesitancy for Seasonal Influenza Vaccine	Std. Err.	[95% Conf.	Interval]
Age				
18-30yrs	-0.0022454	0.0752928	-0.1540878	0.1495969
31-59yrs	0.1333577	0.0394041	0.0538917	0.2128237
60yrs +	0.1255181	0.0618784	0.0007284	0.2503078
Gender				
Male	0.0914478	0.0484658	-0.0062929	0.1891885
Female	0.1139471	0.0375405	0.0382395	0.1896546
Race				
White	0.1158654	0.0436833	0.0277695	0.2039612
Black	0.0637085	0.0730987	-0.083709	0.2111261
NonWhite/ NonBlack	0.129851	0.0838124	-0.0391728	0.2988747
Profession				
Non Healthcare	0.0698392	0.0344886	0.0002864	0.1393921
Healthcare	0.2381029	0.0795938	0.0775867	0.3986191
Level of Education				
College Level or Below	0.2108086	0.0620734	0.0856256	0.3359916
Graduate Level or Above	0.0640747	0.035513	-0.007544	0.1356934
Living Situation				
Living Alone	0.0921165	0.0760987	-0.0613511	0.2455842
Living with Children	0.0405098	0.0544792	-0.069358	0.1503776
Living with NonChildren	0.1517678	0.0428168	0.0654194	0.2381161
Religion				
Non Religious	0.0990421	0.0422012	0.0139353	0.1841489
Religious	0.1132261	0.049092	0.0142227	0.2122295
Received 2019-20 Seasonal Influenza Vaccine				
No/Unsure	0.3198613	0.0855267	0.1473802	0.4923423
Yes	0.059604	0.0330251	-0.0069974	0.1262054
If my doctor/nurse recommends that I get a seasonal influenza vaccine, I will get one.				
Does Not Agree	0.5930387	0.1271657	0.3365846	0.8494928
Agree	0.0583617	0.0306217	-0.0033929	0.1201162
If a government health authority recommends that I get a seasonal influenza, I will				
Does Not Agree	0.1244443	0.0785626	-0.0339923	0.2828809

Agree	0.099596	0.035565	0.0278723	0.1713197

Chapter 6. References

AJMC Staff. (2021). A Timeline of COVID-19 Developments in 2020. Retrieved from https://www.ajmc.com/view/a-timeline-of-covid19-developments-in-2020

Almasy, S., Yan, H., Holcombe, M., & CNN. (2020). Officials worry about hospital capacity as US hits record number of Covid-19 patients hospitalized. *CNN*. Retrieved from https://www.cnn.com/2020/11/30/health/us-coronavirus-monday/index.html

Belloni, A., & Chernozhukov, V. (2013). Least squares after model selection in high-dimensional sparse models. *Bernoulli, 19*(2), 521-547. doi:10.3150/11-BEJ410

Biggerstaff, M., Cauchemez, S., Reed, C., Gambhir, M., & Finelli, L. (2014). Estimates of the reproduction number for seasonal, pandemic, and zoonotic influenza: a systematic review of the literature. *BMC Infectious Diseases, 14*(1), 480. doi:10.1186/1471-2334-14-480

Bogart, L. M., Ojikutu, B. O., Tyagi, K., Klein, D. J., Mutchler, M. G., Dong, L., . . . Kellman, S. (2021). COVID-19 Related Medical Mistrust, Health Impacts, and Potential Vaccine Hesitancy Among Black Americans Living With HIV. *Journal of Acquired Immune Deficiency Syndromes, 86*(2), 200-207. doi:10.1097/qai.0000000000002570

Burki, T. (2021). Equitable distribution of COVID-19 vaccines. *The Lancet Infectious Diseases, 21*(1), 33-34. doi:https://doi.org/10.1016/S1473-3099(20)30949-X

Centers for Disease Control and Prevention. (2020a). Certain Medical Conditions and Risk for Severe COVID-19 Illness. Retrieved from https://www.cdc.gov/coronavirus/2019-ncov/need-extra-precautions/people-with-medical-conditions.html

Centers for Disease Control and Prevention. (2020b). Older Adults and COVID-19. Retrieved from https://www.cdc.gov/coronavirus/2019-ncov/need-extra-precautions/older-adults.html

Centers for Disease Control and Prevention. (2021). CDC's COVID-19 Vaccine Rollout Recommendations. Retrieved from https://www.cdc.gov/coronavirus/2019-ncov/vaccines/recommendations.html

Centers for Disease Control and Prevention, & National Center for Immunization and Respiratory Diseases (NCIRD). (2019). *Cumulative monthly influenza vaccination coverage estimates for persons 6 months and older by state, HHS region, and the United States, National Immunization Survey-Flu (NIS-Flu) and Behavioral Risk Factor Surveillance System (BRFSS), 2018-19 influenza season*. Retrieved from: https://www.cdc.gov/flu/fluvaxview/reportshtml/reporti1819/reporti/index.html

Cheney, M. K., & John, R. (2013). Underutilization of Influenza Vaccine: A Test of the Health Belief Model. *SAGE Journals, 3*(2). doi:https://doi.org/10.1177/2158244013484732

Clemente-Suárez, V. J., Hormeño-Holgado, A., Jiménez, M., Benitez-Agudelo, J. C., Navarro-Jiménez, E., Perez-Palencia, N., . . . Tornero-Aguilera, J. F. (2020). Dynamics of Population Immunity Due to the Herd Effect in the COVID-19 Pandemic. *Vaccines, 8*(2), 236. doi:10.3390/vaccines8020236

Conway, L. G., III, , Woodard, S. R., Zubrod, A., & Chan, L. (2020). *Why are Conservatives Less Concerned about the Coronavirus (COVID-19) than Liberals? Comparing Political, Experiential, and Partisan Messaging Explanations.* Working Paper.

Cooper, L. Z., Larson, H. J., & Katz, S. L. (2008). Protecting public trust in immunization. *Pediatrics, 122*(1), 149-153. doi:10.1542/peds.2008-0987

Corbin, J. M., & Strauss, A. (1990). Grounded theory research: Procedures, canons, and evaluative criteria. *Qualitative Sociology, 13*(1), 3-21. doi:10.1007/BF00988593

Dawood, F. S., Chung, J. R., Kim, S. S., Zimmerman, R. K., Nowalk, M. P., Jackson, M. L., . . . Flannery, B. (2020). Interim Estimates of 2019-20 Seasonal Influenza Vaccine Effectiveness - United States, February 2020. *MMWR: Morbidity and Mortality Weekly Report, 69*(7), 177-182. doi:10.15585/mmwr.mm6907a1

Doornekamp, L., van Leeuwen, L., van Gorp, E., Voeten, H., & Goeijenbier, M. (2020). Determinants of Vaccination Uptake in Risk Populations: A Comprehensive Literature Review. *Vaccines (Basel), 8*(3). doi:10.3390/vaccines8030480

Dyer, O. (2020). Covid-19: Pharma companies promise not to bow to political pressure to rush vaccine production. *BMJ, 370*, m3512. doi:10.1136/bmj.m3512

Eichner, M., Schwehm, M., Eichner, L., & Gerlier, L. (2017). Direct and indirect effects of influenza vaccination. *BMC Infectious Diseases, 17*(1), 308. doi:10.1186/s12879-017-2399-4

Eskola., J., Liang., X., Reingold., A., Chaudhuri., M., Dubé., E., Gellin., B., . . . Zhou., Y. (2014). *Report of the SAGE Working Group on Vaccine Hesitancy*. Retrieved from

Feldstein, L. R., Rose, E. B., Horwitz, S. M., Collins, J. P., Newhams, M. M., Son, M. B. F., . . . Randolph, A. G. (2020). Multisystem Inflammatory Syndrome in U.S. Children and Adolescents. *New England Journal of Medicine, 383*(4), 334-346. doi:10.1056/NEJMoa2021680

Funk, C., & Tyson, A. (2021). Growing Share of Americans Say They Plan To Get a COVID-19 Vaccine – or Already Have. Retrieved from https://www.pewresearch.org/science/2021/03/05/growing-share-of-americans-say-they-plan-to-get-a-covid-19-vaccine--or-already-have/

Ghebreyesus, T. A. (2020). WHO Director-General's opening remarks at the media briefing on COVID-19 - 11 March 2020 [Press release]. Retrieved from https://www.who.int/director-general/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-on-covid-19---11-march-2020

Ginglen, J. G., & Doyle, M. Q. (2020). Immunization. In *StatPearls [Internet]*. Retrieved from https://www.ncbi.nlm.nih.gov/books/NBK459331/

Gollwitzer, A., Martel, C., Brady, W. J., Pärnamets, P., Freedman, I. G., Knowles, E. D., & Van Bavel, J. J. (2020). Partisan differences in physical distancing are linked to health outcomes during the COVID-19 pandemic. *Nature Human Behaviour, 4*(11), 1186-1197. doi:10.1038/s41562-020-00977-7

Grohskopf, L. A., Alyanak, E., Broder, K. R., Blanton, L. H., Fry, A. M., Jernigan, D. B., & Atmar, R. L. (2020). *Prevention and Control of Seasonal Influenza with Vaccines: Recommendations of the Advisory Committee on Immunization Practices — United States, 2020–21 Influenza Season.* Retrieved from https://www.cdc.gov/mmwr/volumes/69/rr/rr6908a1.htm#

Guidry, J. P. D., Laestadius, L. I., Vraga, E. K., Miller, C. A., Perrin, P. B., Burton, C. W., . . . Carlyle, K. E. (2021). Willingness to get the COVID-19 vaccine with and without emergency use authorization. *American Journal of Infection Control, 49*(2), 137-142. doi:10.1016/j.ajic.2020.11.018

Hamel, L., Kearney, A., Kirzinger, A., Lopes, L., Muñana, C., & Brodie, M. (2020). *KFF Health Tracking Poll - September 2020: Top Issues in 2020 Election, The Role of Misinformation, and Views on A Potential Coronavirus Vaccine*. Retrieved from https://www.kff.org/coronavirus-covid-19/report/kff-health-tracking-poll-september-2020/

Hawkins, D. (2020). Differential occupational risk for COVID-19 and other infection exposure according to race and ethnicity. *American Journal of Industrial Medicine, 63*(9), 817-820. doi:10.1002/ajim.23145

Head, K. J., Kasting, M. L., Sturm, L. A., Hartsock, J. A., & Zimet, G. D. (2020). A National Survey Assessing SARS-CoV-2 Vaccination Intentions: Implications for Future Public Health Communication Efforts. *Science Communication, 42*(5), 698-723. doi:10.1177/1075547020960463

Holmes, L., Jr., Enwere, M., Williams, J., Ogundele, B., Chavan, P., Piccoli, T., . . . Dabney, K. W. (2020). Black-White Risk Differentials in COVID-19 (SARS-COV2) Transmission, Mortality and Case Fatality in the United States: Translational Epidemiologic Perspective and Challenges. *International Journal of Environmental Research and Public Health, 17*(12), 4322. doi:10.3390/ijerph17124322

Houser, K., & Subbarao, K. (2015). Influenza vaccines: challenges and solutions. *Cell Host & Microbe, 17*(3), 295-300. doi:10.1016/j.chom.2015.02.012

Islam, M. S., Sarkar, T., Khan, S. H., Mostofa Kamal, A.-H., Hasan, S. M. M., Kabir, A., . . . Seale, H. (2020). COVID-19–Related Infodemic and Its Impact on Public Health: A Global Social Media Analysis. *The American Journal of Tropical Medicine and Hygiene, 103*(4), 1621-1629. doi:10.4269/ajtmh.20-0812

Karafillakis, E., Larson, H. J., & consortium, A. (2017). The benefit of the doubt or doubts over benefits? A systematic literature review of perceived risks of vaccines in European populations. *Vaccine, 35*(37), 4840-4850. doi:10.1016/j.vaccine.2017.07.061

Kissler, S. M., Tedijanto, C., Goldstein, E., Grad, Y. H., & Lipsitch, M. (2020). Projecting the transmission dynamics of SARS-CoV-2 through the postpandemic period. *Science, 368*(6493), 860-868. doi:10.1126/science.abb5793

Koslap-Petraco, M. (2019). Vaccine hesitancy: Not a new phenomenon, but a new threat. *Journal of the American Association of Nurse Practitioners, 31*(11), 624-626. doi:10.1097/jxx.0000000000000342

Larson, H. J., de Figueiredo, A., Xiahong, Z., Schulz, W. S., Verger, P., Johnston, I. G., . . . Jones, N. S. (2016). The State of Vaccine Confidence 2016: Global Insights Through a 67-Country Survey. *EBioMedicine, 12*, 295-301. doi:10.1016/j.ebiom.2016.08.042

Larson, H. J., Jarrett, C., Eckersberger, E., Smith, D. M., & Paterson, P. (2014). Understanding vaccine hesitancy around vaccines and vaccination from a global perspective: a systematic review of published literature, 2007-2012. *Vaccine, 32*(19), 2150-2159. doi:10.1016/j.vaccine.2014.01.081

Larson, H. J., Jarrett, C., Schulz, W. S., Chaudhuri, M., Zhou, Y., Dube, E., . . . Wilson, R. (2015). Measuring vaccine hesitancy: The development of a survey tool. *Vaccine, 33*(34), 4165-4175. doi:10.1016/j.vaccine.2015.04.037

Larson, H. J., Jarrett, C., Schulz, W. S., Chaudhuri, M., Zhou, Y., Dube, E., . . . Wilson, R. (2015). Measuring vaccine hesitancy: The development of a survey tool. *Vaccine, 33*(34), 4165-4175. doi:10.1016/j.vaccine.2015.04.037

Latkin, C. A., Dayton, L., Yi, G., Colon, B., & Kong, X. (2021). Mask usage, social distancing, racial, and gender correlates of COVID-19 vaccine intentions among adults in the US. *PloS One, 16*(2), e0246970. doi:10.1371/journal.pone.0246970

Lazarus, J. V., Ratzan, S. C., Palayew, A., Gostin, L. O., Larson, H. J., Rabin, K., . . . El-Mohandes, A. (2020). A global survey of potential acceptance of a COVID-19 vaccine. *Nature Medicine*. doi:10.1038/s41591-020-1124-9

Lindley, M. C., Srivastav, A., Hendrich, M., Fisun, H., Nguyen, K., Pedraza, O., . . . Williams, W. W. (2020). Early-Season Influenza Vaccine Uptake and Intent Among Adults. Retrieved from https://www.cdc.gov/flu/fluvaxview/nifs-estimates-sept2020.htm

Loomba, S., de Figueiredo, A., Piatek, S. J., de Graaf, K., & Larson, H. J. (2021). Measuring the impact of COVID-19 vaccine misinformation on vaccination intent in the UK and USA. *Nature Human Behaviour*. doi:10.1038/s41562-021-01056-1

Lorenc, T., Marshall, D., Wright, K., Sutcliffe, K., & Sowden, A. (2017). Seasonal influenza vaccination of healthcare workers: systematic review of qualitative evidence. *BMC Health Services Research, 17*(1), 732. doi:10.1186/s12913-017-2703-4

Mallapaty, S., & Ledford, H. (2020). COVID-vaccine results are on the way — and scientists' concerns are growing. *Nature, 586*, 16-17. doi:https://doi.org/10.1038/d41586-020-02706-6

Maragakis, L. L. (2020). Coronavirus Disease 2019 vs. the Flu. Coronavirus Disease 2019 vs. the Flu. . *Health.*

Maxmen, A. (2021). WHO report into COVID pandemic origins zeroes in on animal markets, not labs. *Nature, 592*, 173-174. doi:https://doi.org/10.1038/d41586-021-00865-8

Metcalf, C. J. E., Ferrari, M., Graham, A. L., & Grenfell, B. T. (2015). Understanding Herd Immunity. *Trends in Immunology, 36*(12), 753-755. doi:10.1016/j.it.2015.10.004

National Center for Immunization and Respiratory Diseases (NCIRD), & Centers for Disease Control and Prevention (CDC). (2021, March 3, 2021). Interim Clinical Considerations for Use of COVID-19 Vaccines Currently Authorized in the United States.

Nichter, M. (1995). Vaccinations in the third world: A consideration of community demand. *Social Science and Medicine, 41*(5), 617-632. doi:https://doi.org/10.1016/0277-9536(95)00034-5

Nuriddin, A., Mooney, G., & White, A. I. R. (2020). Reckoning with histories of medical racism and violence in the USA. *The Lancet, 396*(10256), 949-951. doi:10.1016/S0140-6736(20)32032-8

Oliver, S. E., Gargano, J. W., Marin, M., Wallace, M., Curran, K. G., Chamberland, M., . . . Dooling, K. (2020). The Advisory Committee on Immunization Practices' Interim Recommendation for Use of Pfizer-BioNTech COVID-19 Vaccine - United States, December 2020. *MMWR: Morbidity and Mortality Weekly Report, 69*(50), 1922-1924. doi:10.15585/mmwr.mm6950e2

Oliver, S. E., Gargano, J. W., Marin, M., Wallace, M., Curran, K. G., Chamberland, M., . . . Dooling, K. (2021). The Advisory Committee on Immunization Practices' Interim Recommendation for Use of Moderna COVID-19 Vaccine - United States, December 2020. *MMWR: Morbidity and Mortality Weekly Report, 69*(5152), 1653-1656. doi:10.15585/mmwr.mm695152e1

Oliver, S. E., Gargano, J. W., Scobie, H., Wallace, M., Hadler, S. C., Leung, J., . . . Dooling, K. (2021). The Advisory Committee on Immunization Practices' Interim Recommendation for Use of Janssen COVID-19 Vaccine — United States, February 2021. *MMWR Morb Mortal Wkly Rep 2021*(70), 329–332. doi:http://dx.doi.org/10.15585/mmwr.mm7009e4

Orenstein, W. A., & Ahmed, R. (2017). Simply put: Vaccination saves lives. *Proceedings of the National Academy of Sciences, 114*(16), 4031-4033. doi:10.1073/pnas.1704507114

Piroth, L., Cottenet, J., Mariet, A.-S., Bonniaud, P., Blot, M., Tubert-Bitter, P., & Quantin, C. (2020). Comparison of the characteristics, morbidity, and mortality of COVID-19 and

seasonal influenza: a nationwide, population-based retrospective cohort study. *The Lancet Respiratory Medicine*. doi:https://doi.org/10.1016/S2213-2600(20)30527-0

Plans-Rubió, P. (2012). The vaccination coverage required to establish herd immunity against influenza viruses. *Preventive Medicine, 55*(1), 72-77. doi:https://doi.org/10.1016/j.ypmed.2012.02.015

Plotkin, S. A., & Plotkin, S. L. (2011). The development of vaccines: how the past led to the future. *Nature Reviews Microbiology, 9*(12), 889-893. doi:10.1038/nrmicro2668

Post, N., Eddy, D., Huntley, C., van Schalkwyk, M. C. I., Shrotri, M., Leeman, D., . . . Ismail, S. A. (2020). Antibody response to SARS-CoV-2 infection in humans: A systematic review. *PloS One, 15*(12), e0244126. doi:10.1371/journal.pone.0244126

Raude, J., Caille-Brillet, A. L., & Setbon, M. (2010). The 2009 pandemic H1N1 influenza vaccination in France: who accepted to receive the vaccine and why? *PLoS Curr, 2*, Rrn1188. doi:10.1371/currents.RRN1188

Rentsch, C. T., Kidwai-Khan, F., Tate, J. P., Park, L. S., King, J. T., Skanderson, M., . . . Justice, A. C. (2020). Covid-19 by Race and Ethnicity: A National Cohort Study of 6 Million United States Veterans. *medRxiv*. doi:10.1101/2020.05.12.20099135

Rosenstock, I. M. (1966). Why People Use Health Services. *The Milbank Memorial Fund Quarterly, 44*(3), 94-127. doi:10.2307/3348967

Rosenstock, I. M. (1974). The Health Belief Model and Preventive Health Behavior. *Health Education Monographs, 2*(4), 354-386. doi:10.1177/109019817400200405

Rothan, H. A., & Byrareddy, S. N. (2020). The epidemiology and pathogenesis of coronavirus disease (COVID-19) outbreak. *Journal of Autoimmunity, 109*, 102433-102433. doi:10.1016/j.jaut.2020.102433

Schmid, P., Rauber, D., Betsch, C., Lidolt, G., & Denker, M. L. (2017). Barriers of Influenza Vaccination Intention and Behavior - A Systematic Review of Influenza Vaccine Hesitancy, 2005 - 2016. *PloS One, 12*(1), e0170550. doi:10.1371/journal.pone.0170550

The Lancet, M. (2020). COVID-19 vaccines: the pandemic will not end overnight. *The Lancet Microbe*. doi:https://doi.org/10.1016/S2666-5247(20)30226-3

Tibshirani, R. (1996). Regression Shrinkage and Selection via the Lasso. *Journal of the Royal Statistical Society. Series B (Methodological), 58*(1), 267-288. Retrieved from http://www.jstor.org/stable/2346178

Tyson, A., Johnson, C., & Funk, C. (2020). *U.S. Public Now Divided Over Whether To Get COVID-19 Vaccine* Retrieved from https://www.pewresearch.org/science/2020/09/17/u-s-public-now-divided-over-whether-to-get-covid-19-vaccine/

Zijtregtop, E. A., Wilschut, J., Koelma, N., Van Delden, J. J., Stolk, R. P., Van Steenbergen, J., . . . Hak, E. (2009). Which factors are important in adults' uptake of a (pre)pandemic influenza vaccine? *Vaccine, 28*(1), 207-227. doi:10.1016/j.vaccine.2009.09.099