An Analysis of COVID-19 Vaccines and the Need for Post-Vaccination Risk Mitigation Protocols

Understanding the impact of vaccine adoption

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Introduction

This white paper describes and compares the COVID-19 vaccines that are currently available in the US. Our goal is to empower individuals to make decisions around vaccine adoption and to allow organizations to understand the impact of vaccine adoption.

At this time, Pfizer, Moderna, and Johnson & Johnson have vaccines available in the US. Both Pfizer and Moderna vaccines use a newer mechanism of action, but that mechanism has been studied and researched for over 20 years across the globe. The paper will describe that mechanism of action and explain each vaccine's unique characteristics and known limitations.

How to Protect Against Viral Pathogens

There are two ways to protect against a viral pathogen, such as COVID-19: active immunity and passive immunity. Active immunity happens when the body is exposed to a pathogen either naturally or through a vaccine causing the body's immune system to react by generating immune cells and antibodies that directly attack and eliminate that pathogen. Passive immunity describes when antibodies from an individual who has been exposed to a pathogen are transferred to another individual. Passive immunity provides immediate protection, but it fades more quickly than active immunity as the donated antibodies are eliminated from the body. Active immunity on the other hand can take two or more weeks to become effective, but the body's self-produced antibodies can last months to several years.

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Traditional Vaccines

There are three general types of traditional vaccines, live attenuated vaccines, inactivated vaccines, and subunit vaccines. Live attenuated vaccines deliver a weakened pathogen, inactivated vaccines deliver a neutralized and non-viable pathogen, and subunit vaccines deliver a large piece of a pathogen but not the whole pathogen. In all cases, these vaccines cause the immune system to detect that something does not belong in the body and respond. Typically, live attenuated vaccines provide the longest lasting and strongest protection for the individual.

COVID-19 mRNA Vaccine Actions

The COVID-19 mRNA vaccines are different from traditional vaccinations because they deliver a much smaller part of the pathogen, called mRNA, into the body.

mRNA from the pathogen spurs a natural process within the body's cells. The mRNA holds "instructions" that tell the cells to make proteins from the pathogen.

So in the case of the COVID-19 mRNA vaccine, mRNA from COVID-19 enters a person's cells and signals the body's cells to produce COVID-19 virus antigens - small, harmless proteins that are found on the surface of the COVID-19 viral particle. These antigens stimulate an immune response and antibody formation to the COVID-19 virus. After these antigen proteins are made and expressed on the cell surface, the vaccine mRNA is broken down into sub-parts and recycled or excreted.

As the proteins are expressed on the cell surface, the immune response is activated. The individual's body can identify that protein, and active immunity is developed. Vaccine mRNA is broken down no differently than naturally occurring mRNA within the cell, with a half-life of a few hours to a few days. When the mRNA has been broken down completely, it can no longer be synthesized in the cell, and the cell will return to "normal".

Limitations to Efficacy from mRNA COVID-19 Vaccine Trials

Pfizer and Moderna COVID-19 vaccines have been reported to be highly effective at reducing the number of people that will develop symptoms after exposure and the number of people that would otherwise require hospitalization. Based on these results, it is recommended that people get vaccinated.

The efficacy of both vaccines, however, was determined in clinical trials with two important limitations. First, while it is widely known that people without symptoms can be infected with COVID-19 and spread the virus (i.e. asymptomatic rates of infection), the trials did not study this. They studied only whether vaccinated individuals developed symptoms and investigated whether those individuals were COVID-19 positive through laboratory testing (i.e., symptomatic, lab-confirmed COVID-19 infection rates). , A second limitation of the trials was that they did not determine whether infected individuals that receive the vaccine and are asymptomatic can shed the virus significantly enough to infect someone else.

These two limitations do not change the recommendation to get vaccinated, but they are important because they leave open the possibility that vaccinated people who are asymptomatic could still spread the virus. As a result, we conclude that vaccination alone does not reduce the requirement for distance, mask use, hand hygiene or other health protocols, especially when around non-vaccinated individuals.

Differences Between the mRNA and Johnson & Johnson Approaches

Both the Pfizer and Moderna vaccine, as mentioned above, deliver single stranded mRNA into a cell. This causes the creation of the COVID-19 spike protein on a normal cell.

Johnson and Johnson uses an adenovirus as the vehicle for delivery. The adenovirus is absorbed by a cell. The adenovirus cannot replicate or make an individual sick. It delivers a small piece of DNA into a cell. This DNA causes the creation of mRNA and translation of spike proteins.

Johnson and Johnson did show promise in being protective against asymptomatic transmission. This study showed that a small portion of the trial group had been infected with COVID-19 at the 71-day mark when compared to the placebo group. mRNA vaccines did not capture this data, so the claim cannot be made for asymptomatic transmission reduction. This subset of transmission needs to be studied further.

In both cases, mRNA and ribosomes are used to create sand express spike protein. Moderna and Pfizer deliver the mRNA directly. Johnson and Johnson deliver small pieces of DNA that is translated into mRNA within the cell.

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Susceptible Populations

Susceptible individuals and populations are the people in a community that do not have immunity to a particular pathogen. Immunity, in this sense, is defined as active immunity from either vaccination or recovery of a previous infection. The susceptible proportion is the number of susceptible individuals divided by the total number of susceptible individuals plus total number of immune individuals.

For COVID-19, natural immunity is thought to provide protection for 90 days after symptom onset. It is not currently known how long vaccination protection will last.

It is noted that the World Health Organization has definitively indicated "attempts to reach 'herd immunity' through exposing people to a virus are scientifically problematic and unethical. Letting COVID-19 spread through populations, of any age or health status will lead to unnecessary infections, suffering and death". All organizations should encourage healthy behaviors and not encourage COVID-seeking behaviors.

Conclusion

All three vaccines have shown great promise in helping to combat COVID-19 infections. The mRNA vaccines incorporate a new mechanism of action that is different from traditional vaccines; that mechanism of action, introducing mRNA into a host cell, has been studied for over twenty years. It is important to note that information is still being collected on transmission rates after vaccination, as well as the length of protection from the vaccine.

Organizations should still mandate or encourage physical distance, masks, and hand hygiene in their populations for most interactions. Contact tracing and testing are still important in breaking the chain of infection. The impact of vaccination rates of individuals in an organization, along with efficacy adjustments, may allow some interactions that are less conservative. It is highly encouraged that organizations seek help from local, state, or national public health and medical professionals before taking a less conservative approach.

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About Fusion Cell

Fusion Cell's team of board-certified public health epidemiologists and logistics experts are helping numerous schools adapt to the risks of COVID-19. Our consultants are all current and former US military specialists with decades of experience managing pandemics and disease outbreaks in U.S. military bases around the world. We bring the experience and expertise that schools lack and apply a science-based approach that helps schools reduce transmission risk.

Our experts partner with your COVID-19 planning team to help you keep students, faculty, and staff on the campus at the highest possible safety, academic, and quality-of-life levels.

For assistance in creating health and safety plans for your school, contact Fusion Cell at **contact@fusioncell.com**.

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