COVID-19 Vaccine Primer for Providers

SARS-CoV-2, the virus that causes COVID-19, is a highly infectious coronavirus. Coronaviruses typically only cause cold like symptoms in humans but over the last decade and a half there have been a handful that cause more severe symptoms, but none with the broad spread nor toll on human life as this one. The challenges with this coronavirus are many including that while spread primarily through respiratory droplets like influenza, it has the potential to trigger such a severe inflammatory response to affect almost every organ system in the young and old, healthy and ill alike. Particularly at high risk are those over 65 years of age, the obese, and those with chronic medical conditions such as heart disease, lung disease, diabetes and cancer.

While preventative measures such as limiting travel and non-essential business, mask wearing and physical distancing, good hand hygiene can help to lesson spread of the infection, only with widespread immunity toward this virus will we be able manage this pandemic. Immunity can be obtained via infection to the disease or through vaccination. Natural immunity beyond the immediate infectious stage has yet to be proven and there is some anecdotal evidence that individuals have become re-infected with same virus. Furthermore, herd immunity where enough healthy individuals have been infected to protect the rest of the population is unlikely to occur. Countries that relied on this approach have already seen a second wave of disease equal to or greater than countries that took a more protective approach toward spread.

Thankfully there have been advances on the vaccination front that are both promising and soon to be available at least in some minor quantity. This is remarkable as the typical timeline for a novel vaccine is three to nine years after initial research. The general principle for all vaccines is to introduce an external material into an individual and stimulate some part of the human immune response against the organism for which the vaccine was designed. For the SARS-CoV-2 virus, the predominate immune response is toward the spike proteins that encapsulate the virus. While there are a large number of methods to accomplish this, we will only discuss the three modalities of the four leading vaccine candidates.

Each vaccine will need initial emergency use authorization from the Food and Drug Administration and then guidance provided by Advisory Committee on Immunization Practices (ACIP). The ACIP has already made recommendation as to a prioritization of individuals to be vaccinated. Phase 1A includes healthcare workers and staff and residents of skilled nursing and long-term care facilities. Limited supplies of vaccine initially will require further prioritization of sub-groups of these recommendations. Currently that has been left to the State for determination. Guidance from the Maine CDC is for hospital systems to determine who should be vaccinated first based on risk and critical need. This will be an evolving situation.

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I. Leading Vaccine Candidates

Messenger RNA (Pfizer, Moderna)

Messenger RNA (mRNA) has been used in other therapeutic modalities before, but this will be the first time they are used as vaccine vectors in human beings. In normal biology, messenger RNA carries genetic information form the DNA in a cell's nuclease into its protoplasm where it becomes the blueprint for protein synthesis. Certain viruses, like SARS2, behave in the same way by infecting cells with mRNA to replicate copies of the virus. For the vaccine, mRNA coded for the virus' spike protein si (?) introduced into the body causing the body's cells to produce the spike protein, and the body's immune system recognizes the foreign entity and responds accordingly. Advances in genetic technology, especially in genomic sequence, allowed this specific mRNA to be coded shortly after the SARS2 virus was identified. The Pfizer product will be the first to market, delivered to hospitals in less than three weeks. Messenger RNA is inherently unstable, and the Pfizer product will require to be kept at a temperature less than minus 70 degrees Celsius until shortly before use. Northern Light Health has four freezers dedicated to this use. Moderna, is the second product expected to be available within the month. It also uses mRNA as the vector to induce an immune response. It is more stable and can be stored in a more conventional freezer. Both vaccines appear to have very high levels of immunogenicity, offer protection against severe illness, and have a high level of safety.

As of this date, the Pfizer vaccine requires two doses separated by 21 days. The Moderna vaccine requires two doses separated by 28 days. Due to limited information, at this time there is a strong recommendation that the second dose be given precisely on this schedule. If an individual misses their scheduled second dose, they should receive it as soon as possible. They do not need to repeat the series, but this may affect the immune response.

Individuals should avoid any other vaccines for 14 days prior to and 14 days after administration of any vaccine against SARS-CoV-2.

See accompanying Frequently Asked Question Sheet for information for populations needing special consideration (prior coronavirus infection, pregnancy, immunocompromised individuals, allergic reactions).

Replication-incompetent Viral Vector (AstraZeneca)

Another vaccine approach is to utilize a virus that does not have the ability to replicate itself as the vector to bring in some protein to elicit an immune response to the targeted pathogen. These types of vaccines have imitations, especially if the virus used as the vector is common in humans and individuals who are to be vaccinated already have an immune response to the vector and therefore do not recognize the protein of the targeted pathogen. AstraZeneca's product, expected to be approved before the end of the year, uses a chimpanzee adenovirus as the vector with a spike protein for the target. As this virus typically only affects chimps, few humans would have immunity to either the vector or the additional protein. These vaccines are more stable than mRNA vaccines. The Astra-Zeneca

vaccine appears to have less of an immune response and there are questions that remain about how it initially conducted its study and reported its data.

Recombinant Protein (Novavax)

Recombinant protein vaccines are more typical of traditional vaccines, directly administering a protein manufactured to appear as one from the targeted pathogen. These are often slower to develop but have the advantages of being used before in humans, stable for transport, and once approved can have an accelerated production. Little is known about the Novavax vaccine candidate except that it is due to request approval early next year. It may have an added benefit of being able to be combined with their influenza vaccine at some point.