Special Article

COVID-19 Vaccines

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The main objective in combating pandemics is to develop vaccines to create specific immunity in order to stop disease transmission

In former times, vaccines were traditionally a type of medication prescribed primarily for prevention the development of infectious diseases or treating them. Early products contained dead or inactivated causative organisms to specifically boost the host immune mechanism in order to conquer the disease-producing intruders. Currently, with advancement of molecular medicine, there are vaccine inventions that can do the same by stimulating an immune response to an antigen, a molecule found on the infectious agent. For instance, in the case of the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), which causes "coronavirus disease 2019" (COVID-19), the antigen is typically the characteristic spike protein found on the surface of the SARS-Cov-2, which helps it to invade living cells.[1-3] In this regard, the role of precision medicine would offer an excellent solution based on the knowledge of coronavirus genome structure and its replication, which is mandatory as a guide for developing both protective vaccines and targeted therapies.[4]

Varieties of COVID-19 Vaccines

More vaccine candidates are simultaneously in the pipeline for preventing COVID-19 than ever before for an infectious disease. All developers are trying to create vaccines to achieve immunity to the coronavirus and the ability to stop its transmission. They do so by stimulating an immune response to an antigen molecule found on the coronavirus, typically the characteristic spike protein on its surface, which the coronavirus uses for invading host cells. Currently, there are four categories of COVID-19 vaccines[2] in use or in clinical trials, namely whole coronavirus, protein subunit, viral vector and nucleic acid (RNA and DNA).[5]

Three highly notable vaccines, which were developed by **Pfizer/NioNTech, Moderna, and Oxford/AstraZeneca**[1, 3], are RNA vaccines containing a tiny fragment of the coronavirus's genetic code. When injected into the body, they start producing part of the coronavirus and thus stimulate the body to mount a defense against it.[1, 3]

Of note, the Oxford/AstraZeneca vaccine is subtly different as it uses a harmless virus to carry the same genetic material into the body. It is the easiest of the three to use as it can be stored in a normal refrigerator and does not require specialized freezers to produce extremely cold temperatures. All three vaccines are supposed to be given as two doses; however, the United Kingdom is prioritizing giving as many people as possible the first dose and is delaying the second dose.[6-9]

A fourth vaccine, named **Novovax**, has been developed by Janssen of Johnson & Johnson. It uses the same technique as Oxford/AstraZeneca, but is to be given as a single injection.

Other vaccines, include **Sinovac, CanSino,** and **Sinofarms,** were developed in China. These vaccines contain inactivated Sars-CoV-2. Although they have been used only in a few countries in Asia and South America, they are not used in Europe and the United States.

Lastly, the **Sputnik** V vaccine, developed by Russia's Gamaleya Research Centre, is effective, according to trial results reported in *The Lancet.* The vaccine works in a similar way to the Oxford/AstraZeneca and Janssen vaccines, and has been deemed to be safe and offer complete protection against hospitalization and death.

One further note - the development of two **"Made in Thailand"** vaccines has been announced. On December 30, 2020, *CU in the News* published an article stating that the Faculty of Medicine of Chulalongkorn University is expected to start the human phase of candidate ChulaCOV-19 vaccine trials by April 2021. On February 18, 2021 a television news program announced that ChulaCOV-19 vaccine would be tested on human by May 2021.[10] Another Thai-made vaccine, the product of joint collaboration between the Government Pharmaceutical Organization and the Faculty of Tropical Medicine, Mahidol University, was announced by Thailand's Minister of Public Health. He said that the first stage of human trials of the locally-produced vaccine will get underway in March 2021 (Thaiger. Com, February 14, 2021).[11-14]

Annotations:

(1) It seems that all vaccines will have a large and beneficial impact on public health by eliminating the need for hospital treatment of the disease and preventing death from COVID-19. However, the exact results of their benefits will be available only from challenge trials, in which volunteers will be deliberately infected with the virus.

(2) Knowledge on whether the vaccines are able to stop transmission of the coronavirus between people remains unknown.

(3) Regarding protection against symptomatic cases, the vaccine appeared to be less effective in South Africa, where nearly all cases of COVID-19 were due to infection with the dominant variant there, known as B.1.351. However, Janssen and Novovax produced the first data of astonishing result on the new variants spreading in South Africa, i.e., that their vaccine actually had 89 percent efficacy (The Harvard Gazette, February 1, 2021).

(4) On the whole, the results of vaccination have been good and better than no vaccine at all. Nevertheless, it must be cautioned that the coronavirus is a moving target.

(5) Further research should be conducted to answer the following questions:

- How long does protection last?
- What types of effects does vaccination have on the spread of the coronavirus?
-Are there other ways to treat COVID-19?

(6) At this point, it is not yet known whether vaccination protects against virus transmission. Newly vaccinated people may be carriers who could infect others. Therefore, until a much higher level of community vaccination is reached, some degree of masking and physical distancing is still needed.

(7) There has been unexpected news that we might not eradicate COVID-19 by late 2021, even if a large majority of the population could be vaccinated and protected against the coronavirus's severe effects. It is hoped that COVID-19 would be rendered no more dangerous than the common cold at best and influenza at worst. We would then have to work to avoid infection through annual vaccinations and regular testing. The current fear and isolation could be over - if we all get vaccinated and stay safe until that happens.

(8) Other unknowns could still complicate the matters. For instance, emerging variants could be more contagious and more lethal than existing strains. They could evade existing vaccines, and we might have to keep playing catch-up to develop boosters that target the mutations.

(9) As previously mentioned, with existing vaccines, we might be able to turn COVID-19 into an illness akin to the seasonal flu. The coronavirus might still be around and infect people, and some might still end up ill. However, the disease would no longer overwhelm hospitals and result in terrifying death tolls. Universal vaccination would mean that people may not become severely ill to the point that they require hospitalization.

References

1. AstraZeneca's Vaccine Does Not Work Well Against Virus Variant in South Africa. The New York Times. https://www.nytimes.com/livw/2021/02/07/world/covid-19-coronavirus. Published 2021. Accessed February 15, 2021.
2. Different COVID-19 Vaccine.CDC. https://www.cdc.gov/coronavirus/2019-ncov/vaccines/different-vaccines.html. Accessed February 15, 2021.
3. Gallagher J. COVID vaccine update: Those that work - and the others on the way. BBC News. https://www.bbc.com/news/health-51665497. Accessed February 15, 2021.

4. How Coronavirus Variants Could Outsmart Vaccines. Pittwire, University of Pittsburgh. https://www.pittwire.pitt.edu/news/how-sars-cov-2-mutates-escape-antibody-binding. Accessed February 15, 2021.
5. Johnson CY, Wan W. Mutated virus may reinfect people already stricken once with covid-19, sparking debate and concerns. *The Washington Post*. February 6, 2021.
6. Langreth R. Big Pharma Is Racing to Bolster Its Vaccines Against Variants. *The Coronavirus Daily.* February 4, 2021.
7. Made in Thailand Vaccine to start trials. The Thaiger. https://thethaiger.com. Accessed February 11, 2021.
8. Newest vaccine emerges amid a 'more complicated pandemic'. By Powell A. HMS and Beth Israel's Barouch talks about John & Johnson entry. https://news.harvard.edu/gazette/story/2021/02/dan-barouch-discusses-new-coronavirus-variants. Accessed February 15, 2021.
9. Ritchie H, Ortiz-Ospina E, Beltekian D, et al. Coronavirus (COVID-19) Vaccinations- Statistics and Research - Our World in Data. https://ourworldindata.org/covid-vaccinations#attitudes-to-covid-19-vaccinations. Accessed February 12, 2021
10. Thailand could manufacture COVID-19 vaccine by the end of 2021. *CU in the News.* December 30, 2020.
11. There are four types of COVID-19 vaccines: here's how they work. https://www.gavi.org/vaccineswork/there-are-four-types-covid-19-vaccines-heres-how-they-work. Accessed February 15, 2021.
12. Tracey KJ. Vaccines Alone Are Not Enough to Beat COVID. *Scientific American.* https://www.scientificamerican.com/article/vaccines-alone-are-notenough-to-beat-covid/. Accessed February 15, 2021.
13. Winter L. New Sars-CoV-2 Variant Could Evade Antibodies. *The Scientist Mgazine.* Jan 22, 2021. https://www.the-scientist.com/news-opinion/new-sars-cov-2-varient-could-evade-antibodies-68375. Accessed February 15, 2021.
14. COVID-19 vaccines. World Health Organization. https://www.who.int/emeergencies/diseases/novel-coronavirus-2019/covid-19- vaccines. Accessed February 15, 2021.