**Vaccine and challenges**

[**Khalid Munir, Hamna Khalid, Isra Munir, M Akram Muneer and Fraaz Mahmood**](https://nation.com.pk/Columnist/khalid-munir-hamna-khalid-isra-munir-m-akram-muneer-and-fraaz-mahmood)

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The severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), the causative agent of coronavirus disease 2019 (Covid-19), has resulted in more than 74 million reported cases and over 1.6 million deaths worldwide since December 2019. The pandemic continues to devastate public health, the global economy and social order.

Safe, efficacious, and effective vaccine are urgently needed to halt the pandemic through the curtailment of SARS-CoV-2 infections, viral shedding, transmission among humans, disease severity, hospitalisations and deaths as well as to minimise post-infection complications and potential virus transmission from humans to certain animal species and vice versa.

The typical outcomes desired of a successful vaccination campaign include statistically significant reduction in infection and severity of consequential clinical disease or the duration of infectivity. The major goal of widespread vaccine deployment is to develop herd immunity, also known as herd protection. Typically, about 65 to 70 percent of the population in a geographic region needs to be immunised to exhibit herd immunity against a pathogen such as SARS-CoV-2.

[Oil down on demand fears from spread of virus variant](https://nation.com.pk/28-Dec-2020/oil-down-on-demand-fears-from-spread-of-virus-variant)

The vaccine development against SARS-CoV-2, like any significant pathogen, is a costly, time-dependent and laborious process that can typically take more than a decade. It consists of the exploratory stage, preclinical stage, clinical stage, review and approval stage, post-licensure manufacturing—initially on a smaller and then on a mass scale—and post-marketing surveillance stage and quality control. The preclinical stage may involve in vitro studies in cell culture and in vivo studies in animal models such as mice, Syrian hamsters, ferrets and rhesus macaques. The clinical stage consists of three phases; Phase I which is safety testing in a small number of individuals, Phase II which is when safety testing is expanded from a few hundred to a few thousand individuals, and Phase III through which the vaccine efficacy testing I carried out usually in many thousand individuals.

Currently, more than 200 Covid-19 vaccines, using multiple platforms, are under development in various research facilities worldwide. It is remarkable that several vaccine candidates have entered or completed Phase III Clinical trials in less than a year. Recent approvals and licensure of Covid-19 vaccines from Pfizer and BioNTech, Moderna, and AstraZeneca-University of Oxford are based on statistically significant efficacy of these vaccines in Phase III Clinical Trials. This is very encouraging but a substantial amount of work is needed to overcome several challenges that lie ahead.

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The most important efficacy endpoint is protection against severe disease and death, which is difficult to assess in Phase III Randomised Clinical Trials. Additionally, vaccine efficacy does not always predict vaccine effectiveness—protection attributable to a vaccine administered non-randomly. Under field conditions, many factors such as age, ethnicity, gender, comorbidities, immuno-competence of individuals, political issues, vaccine hesitancy, differences in infrastructure, quality assurance, control and maintenance, cold chain distribution and storage temperatures, geo-genetics, pre-existing immunity to SARS-CoV-2 and cross-immunity from other coronaviruses’ infection, timely vaccine distribution and inoculation, compatibility of vaccine with the field strain of SARS-CoV-2, affordability and literacy rates. Covid-19 is more common and severe among individuals often underrepresented in clinical trials, including older individuals, people with chronic illnesses, and persons in racial and ethnic minority populations. Different groups of people may not have the same level of immune response to vaccination.

[Chinese journalist jailed over reports on early COVID outbreak in Wuhan](https://nation.com.pk/28-Dec-2020/chinese-journalist-jailed-over-reports-on-early-covid-outbreak-in-wuhan)

Thus, many unanswered questions will require post-vaccination assessment. First, to assess how effective the vaccines in high-risk individuals are. Second, how effectively vaccines protect against severe Covid-19. Third, how effectively vaccines prevent virus transmission from infected individuals to susceptible individuals. Fourth, the magnitude of protection across population subgroups defined by age, race and ethnicity. Fifth, the duration of protection conferred by various vaccine types. Sixth, a more comprehensive understanding of the long-term safety of different Covid-19 vaccines, including rare complications; vaccination may be associated with mild adverse events like soreness at the injection site, fever, fatigue, and myalgias. More serious reactions, such as otherwise unexplained neurologic or inflammatory processes, would raise concerns. Seventh, the duration of naturally occurring immunity to infection with SARS-CoV-2 is not decisively known and may wane with time. Eighth, protective and pathogenic aspects of the immune response to SARS-VoV-2 are not fully understood as scientists’ understanding of this new virus, host immune responses and disease pathogenesis is still evolving. The correlates of protection against SARS-CoV-2 in Covid-19 have not yet been conclusively established—it is yet to be determined whether systemic antibody-mediated (IgG), T-cell mediated or local (IgA or mucosal) immune responses in the upper respiratory tract or a combination of these responses is protective in susceptible individuals. Antibody Dependent Enhancement (ADE) of infection, reported in rare other coronavirus infections, is also a likely concern. There is a possibility that just as seasonal influenza vaccines are updated yearly to match the vaccine virus strains with the field virus strains, Covid-19 vaccine may also need to be updated periodically to match the antigen targeted in the vaccine with the field strain. Since SARS-CoV-2 is an RNA virus, it will continue to evolve genetically and phenotypically. Last but not the least, will Covid-19 vaccines protect against both developing clinical illness and also prevent virus transmission? Different infection routes and the type of immunity that confers the highest protection may also dictate the kind of vaccine development.

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The Covid-19 vaccines alone will not end the pandemic immediately. Due to many variables involved, effective vaccines along with hygiene measures are required to control the current pandemic, which, if successful, may take another year or two. Hence, the public must continue to observe public health measures such social distancing, hand washing, best personal and public hygiene practices, and mask-wearing. The Covid-19 scenario highlights the importance of the One-Health concept, global interconnectivity, global health security, and the need for adequate resources and investment in science and research. In order to end the pandemic and return to life as we know it, interdisciplinary cooperation and efforts on the individual, regional, national, and global levels are of utmost importance.