Editorial

Current ideas in COVID vaccines

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Different forms of vaccines have been developed to prevent the SARS-CoV-2 virus infection and subsequent COVID-19 disease. The first COVID-19 vaccine outside a clinical trial setting was administered on Dec 8, 2020. Several COVID-19 vaccines are in widespread use globally and provide strong protection against serious illness, hospitalization and death by producing immunity via humoral and cellular immune responses.

As the virus evolves, the original strain of SARS-CoV-2, called the Wuhan-1 or ancestral strain is soon replaced by a series of variants of COVID-19. Many of these variants spread rapidly and constantly replace the resident variants. In particular, the emergence of omicron and its subvariants have triggered waves of the COVID pandemic. The intrinsically increased transmissibility and evasion of immunity play a key role in contributing to the spreading of SARS-CoV-2.

Asymptomatic and mild infections are the main source of SARS-CoV-2 transmission. Successful prevention of these is important for containing the pandemic. However, the efficacy of vaccination in preventing asymptomatic and mild infections is suboptimal. In real-world observational studies, the effectiveness of vaccines against asymptomatic and mild infections is 10-30% and tends to decrease over time.[1,2] Given the moderate and variable efficacy of vaccines in preventing asymptomatic and mild infections, the primary goal of SARs-CoV-2 vaccination strategies is crucial as it can prevent about 90% of severe COVID-19 illness and deaths[3]

In 2022, the SARS-CoV-2 omicron BA.1 sublineage accounted for most of the sequenced viral genomes worldwide and then was replaced by BA.4, BA.5, BQ.1, BQ.1.1, BF.7, XBB, and XBB.1. respectively. The omicron variant still causes severe COVID-19 and death. Monovalent booster vaccine effectiveness against omicron is lower than other SARS-CoV-2 variants, which substantially declines at 3-4 months after vaccination. Therefore, the next generation of COVID-19 messenger RNA (mRNA) vaccine has been developed and contains different variants of SARS-CoV-2, which induces broader immune responses and provides enhanced protection against severe outcomes. The advantages of mRNA vaccine over other platforms include fast manufacturing, simple production process, flexibility to respond to new variants, and the capacity to stimulate immune response.

Currently, Moderna and Pfizer–BioNTech have developed bivalent COVID-19 vaccines, each containing equal amounts of mRNA encoding the spike protein from the ancestral strain and the spike protein from the omicron variant. The current spike protein, which is contained in the bivalent vaccine, is from BA.4 and BA.5 lineage. It is used as a single booster dose at least 2 months after primary or booster vaccination. Bivalent COVID-19 vaccination is recommended for ages 6 months and older. The number of bivalent doses varies by age, previous COVID-19 infection, vaccine type, previous COVID-19 vaccines received, and the presence of moderate to severe immunocompromised status.

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Most of the current studies show high effectiveness against hospitalization and death due to COVID-19 for bivalent mRNA vaccine booster doses when compared with a monovalent booster dose. Despite the extensively vaccinated population, cases and reinfections are continuously rising across the world. In a real-world effectiveness data, bivalent vaccination provides some protection against BA.4/5 strains (29%, 95%CI 21 to 37), less protection against BQ strains (20%, 95%CI 6 to 31), and non-protection against XBB strains infection (4%, 95%CI -12 to -18)[4].

The effectiveness of a bivalent booster dose against severe infection resulting in hospitalization and hospitalization or death with omicron are 58.7% (95%CI 43.7 to 69.8) and 61.8% (95%CI 48.2 to 71.8), respectively.[5] In addition, the number needed to vaccinate to prevent COVID-19-related hospitalization and COVID-19-related death are high in adults aged 65 years or older (1:1118, 95% CI 993 to 1,341 and 1:3722, 95% CI= 3,086 to 6,026)[6]. These findings support the importance of bivalent booster vaccination in populations at high risk of severe COVID-19 and the necessity to increase efforts to encourage eligible people to be vaccinated.

The latest study data from the United States during September 13, 2022-April 21, 2023, indicates that vaccine effectiveness for receipt of a bivalent vaccine dose in adults aged ≥18 years was 62% (95%CI 57 to 67) among adults without immunocompromising conditions and 28% (95%CI 10 to 42) among adults with immunocompromising conditions during the first 2 months after vaccination. Among adults without immunocompromising conditions, vaccine effectiveness declined to 24% (95%CI 12 to 33) among those aged ≥18 years by 4 to 6 months after vaccination. Vaccine effectiveness was generally lower for adults with immunocompromising conditions. A bivalent booster dose provided the highest protection, and protection was sustained through at least 6 months against critical outcomes, including in-hospital death or intensive care unit (ICU) admission. These data support updated recommendations allowing additional optional bivalent COVID-19 vaccine doses for certain high-risk populations. All eligible persons should stay up to date with recommended COVID-19 vaccines.[7]

The United States Centers for Disease Control and Prevention (U.S. CDC) currently has no recommendation for an annual COVID-19 vaccination schedule. The concern primarily revolves around the long-term durability of immunity and the efficacy of vaccines against new strains of viruses, particularly in populations at high risk of severe COVID-19.

On the other hand, the Department of Disease Control of Thailand publishes an annual COVID-19 vaccine guideline. High-risk groups, individuals at risk of exposure and transmission, as well as healthcare personnel should be considered to receive COVID-19 vaccine annually, the same as influenza vaccine. The annual COVID-19 vaccine is planned to begin in August 2023.

Regarding the advantages of COVID-19 vaccination, each country should engage in a comprehensive assessment to determine the appropriateness of COVID-19 booster vaccine (annual vs. periodic). The following key considerations include national disease burden, cost effectiveness and opportunity cost.

As new variants of SARS-CoV-2 continue to appear, continued vaccine effectiveness monitoring is important. Many of the next-generation mutant or bivalent vaccines will continue to be developed against the current dominant variant as booster shots. Scientists and vaccine manufacturers will endeavor to develop other types of new vaccines, such as polyvalent, pan-coronavirus, combined COVID-flu vaccine, and combined COVID-flu-RSV vaccine in the near future. These will likely attempt to achieve comprehensive protection that includes future strains of SARS-CoV-2 and other future virus pandemics.

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