Editorial

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Rapid evolution of the COVID-19 pandemic calls for a unified public health response

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SUMMARY The globe has witnessed the rapid evolution of SARS-CoV-2 mutations and emerging variants of concern (VOCs) and variants of interest (VOIs) that have broadly impacted the transmissibility, antigenicity, morbidity, and mortality of the virus. Although around 2.5 billion vaccine doses have been administered worldwide, vaccine coverage remains far behind the minimum threshold needed to achieve herd immunity overall and it varies substantially by country. Many countries, and especially low- and middle-income countries (LMICs), are struggling with access to COVID-19 vaccines and a lack of personnel to perform mass vaccination. Effective nonpharmaceutical interventions (NPIs) are also not unanimously accepted and strictly complied with by the public and local communities. Moreover, the global fight against COVID-19 is and continues to face geopolitical, social, economic, and human rights concerns. Taken together, these circumstances call for a unified public health response with well-organized individual, local, national, and global efforts and actions to achieve success in controlling the COVID-19 pandemic and achieving sustainable health and development goals.

Keywords SARS-CoV-2; evolution; vaccine; NPIs; unified public health response

As of 5:44 PM CEST on June 22, 2021, there have been 178,503,429 confirmed cases of COVID-19 globally, including 3,872,457 deaths, reported to the WHO (*1*). The global number of weekly confirmed cases has been decreasing since April 26 (Figure 1A, 1B), but such declines have not been observed universally (*2*). In the week of June 14-20, a marked increase in the number of weekly cases compared to the previous week was recorded in the African Region and some countries such as Brazil (505,344 new cases, representing an 11% increase), Colombia (193,907 new cases, representing a 10% increase), and the Russian Federation (108,139 new cases, representing a 31% increase) (*2*). The number of new deaths weekly has also been decreasing across all regions except for the African, the South-East Asia, and the Eastern Mediterranean Regions. Nevertheless, the global mortality remains high, with around 70,000 deaths reported each week (Figure 1C, 1D).

Rapid evolution of SARS-CoV-2

Over two million SARS- CoV-2 sequences have been submitted and shared *via* the Global Initiative on Sharing All Influenza Data (GISAID) (*https://www.gisaid.org*). Since late 2020, after 11 months of relative evolutionary stasis following the emergence of SARS-CoV-2 in late 2019, the virus has been identified as having mutations, in the context of 'variants of concern (VOCs)', that impact its characteristics, including transmissibility and antigenicity (*3*). As of June 22, 2021, the WHO has designated four SARS-CoV-2 VOCs: Alpha (B.1.1.7, first documented in the UK), Beta (B.1.351, first documented in South Africa), Gamma (P.1, first documented in Brazil), and Delta (B.1.617.2, first documented in India) (*2*). The WHO has also designated seven variants of interest (VOIs): Epsilon (B.1.427/B.1.429, first documented in the US), Zeta (P.2, first documented in Brazil), Eta (B.1.525, first documented in multiple countries), Theta (P.3, first documented in the Philippines), Iota (B.1.526, first documented in the US), Kappa (B.1.617.1, first documented in India) and Lambda (C.37, first documented in Peru).

Figure 2 shows the timeline for a total of eleven VOCs or VOIs from earliest documentation to designation as VOCs or VOIs. The Delta variant, first documented in October 2020 in India, was designated as a VOI on April 4 and as a VOC on May 11 (Figure 2). Globally, the Alpha variant has been reported in 170 countries (seven new countries in the week of June 14-

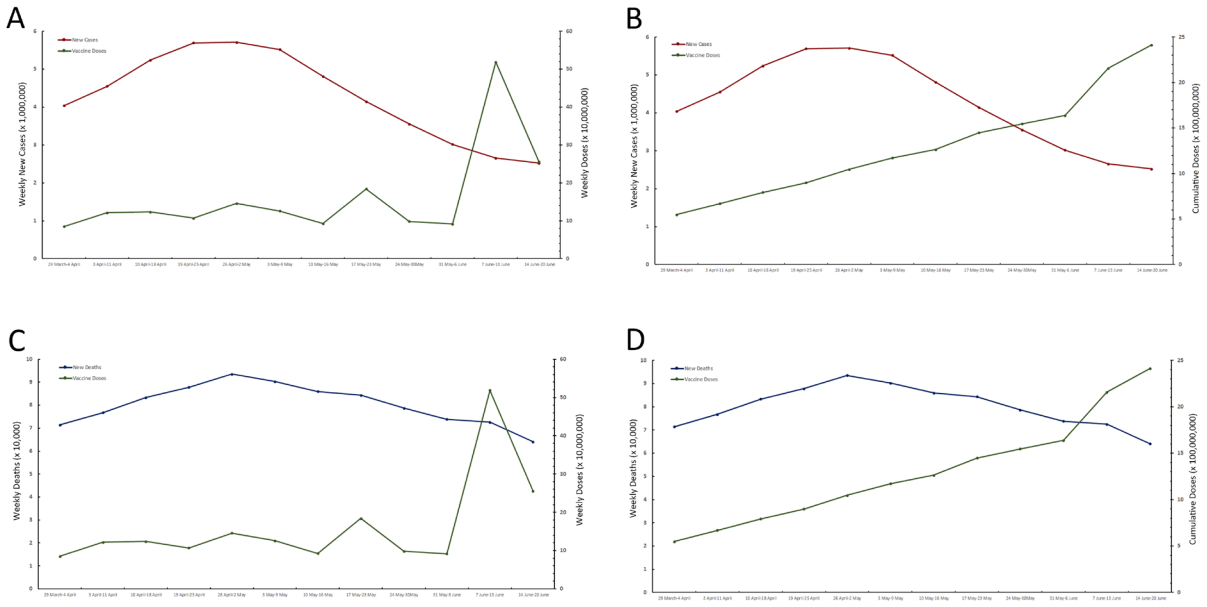

Figure 1. Weekly new confirmed cases or deaths versus vaccine doses administered weekly or cumulatively since April 2021.

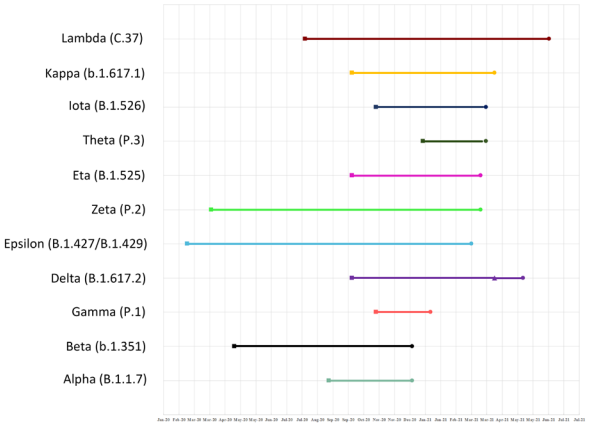

Figure 2. Timelines of SARS-CoV-2 variants of concern (VOCs) and variants of interest (VOIs) from the date of the earliest documentation in samples to the date of designation as VOCs or VOIs, as of June 22, 2021.

20), the Beta variant has been reported in 119 (four new countries), the Gamma variant has been reported in 71 (three new countries), and the Delta variant has been reported in 85 countries (six new countries) (*2*). The Delta variant has a much higher transmissibility and shorter incubation period than other variants (*4*).

Mass vaccination campaigns

Successful control of the current COVID-19 pandemic relies to a large extent on herd immunity achieved as early as possible. By 22 June 2021, a total of 2,414,347,324 vaccine doses have been administered globally (*1*). The vaccine doses administered weekly have not risen over the past two and a half months (Figure 1A, 1C), and vaccine coverage remains far behind the minimum threshold needed to achieve herd immunity. Vaccination coverage of 60-75% would be necessary to achieve this goal (*5,6*). However, the size of populations for COVID-19 vaccination varies markedly by geographical region (*7*). Moreover, many countries are still struggling to provide access to vaccines.

Addressing the scope of COVID-19 vaccine hesitancy in various countries is recommended as an initial step to building trust in COVID-19 vaccination efforts (*8-10*). Various individual and organizational factors, social networks, and media shape public attitudes towards COVID-19 vaccines (*10*). There are increasing global concerns about vaccine effectiveness and how it may be affected by the rapidly emerging VOCs and VOIs. Limited clinical trials have indicated that some vaccines protect against certain variants (*11,12*), but emerging evidence indicates that vaccinated serum is less capable of neutralizing some SARS-CoV-2 variants and that vaccines are less effectiveness against emerging variants (*13-15*). As shown in Figure 1B and 1D, the increase in the cumulative number of vaccine doses crisscrosses the decreases in the weekly reported numbers of new cases and new deaths, and the decrease in the number of new deaths is marked.

Non-pharmaceutical interventions

Stringent non-pharmaceutical interventions (NPIs) including facemasks, individual hygiene, restrictions on public and community activities, regional lockdowns, and international quarantines have played a critical role in curbing the pandemic and will continue to be crucial aspects of the discussion and debate among the general public, governments, and the international community

regarding mandatory self-isolation, limiting sizes of gathering, and business closures (*16-18*), which should all be addressed (*17,19*).

Discussion

There is no doubt that the evolution of SARS-CoV-2 is inevitable and will continue as the pandemic continues to rage worldwide. The more the virus circulates, the greater the risk that the virus evolves into variants that have higher infectivity, transmissibility, and virulence. Established and proven public health measures including mass vaccination and various NPIs such as individual hygiene, social distancing, travel restrictions, and international quarantine as well as public health surveillance of and screening for COVID-19 are all crucial aspects of the global strategy to reduce viral transmission and the occurrence of mutations that negatively impact disease control (*20,21*). Nevertheless, the key to successful global control of the COVID-19 pandemic is the planning and implementation of a unified public health response among all countries, territories, areas, communities, families, and citizens; in this era of globalization, no person or entity can avoid the pandemic (*2,22,23*).

A *Unified Public Health Response* to rapidly evolving SARS-CoV-2 involves the integration of efforts at four levels linked by trust, respect, rights, and obligations: personal or individual, community or local, national, and global. At the personal or individual level, keeping individual hygienic behaviors, complying with preventive measures and interventions continue to be essential for halting viral transmission (*24*). Vaccine hesitancy should be closely examined and addressed as COVID-19 vaccine acceptance depends on personal beliefs and attitudes, as well as the characteristics of new vaccines, vaccination strategy and various other factors.

At the community or local level, understanding various personal and population needs and the factors shaping public attitudes towards access to, acceptance of, and the effectiveness of vaccines would facilitate the planning of multiple evidence-based interventions in order to promote vaccine acceptance. Public concerns about public activities and social interaction as well as the need for healthcare unrelated to COVID-19 also need to be carefully addressed. A supportive and trusting community is critical and conducive in terms of promoting the public response to COVID-19.

At the national level, the government should foster public trust, create multi-sectorial consortia, and devise strategic response plans including greater political commitment, collection and allocation of various resources, more precise and timely public health surveillance, rapid large-scale contact tracing and screening, public education to promote NPIs, and the roll out of mass vaccination (*22,25*). Governments should evaluate different strategies and allocation schemes based on local epidemiological characteristics, the general health of the population, projections of the number of available vaccine doses, and vaccination strategies that offer direct or indirect benefits (*7*).

At the global level, the UN and WHO should continue to work closely with national governments and authorities, regional organizations, non-government organization (NGOs), donors, and vaccine manufacturers to improve access to and distribution of vaccines, and especially in low- and middle-income countries (LMICs) (*25*). More importantly, international organizations under the UN should play a constructive role as platforms in coordinating COVID-19 control efforts among countries, territories, and areas, *e.g.*, creating mechanisms for more effective global allocation of vaccines and mutual acceptance of vaccination certificates between countries using different vaccines, as well as instituting quarantines for international travel and trade (*23,26*).

One hundred years ago, C.E.A. Winslow, the first chairman of the Department of Public Health at the Yale University School of Medicine, set forth a new definition of public health that has widely served as a guide for public health efforts over the past century: *Public health is the science and the art of preventing disease, prolonging life, and promoting physical health and efficiency through organized community efforts for the sanitation of the environment, the control of community infections, the education of the individual in principles of personal hygiene, the organization of medical and nursing services for the early diagnosis and preventive treatment of disease, and the development of the social machinery which will ensure to every individual a standard of living adequate for the maintenance of health; organizing these benefits in such a fashion as to enable every citizen to realize his birthright of health and longevity* (*27*). According to this concept, the core elements of a successful public health response are organized and unified individual, local, national, and global efforts and actions to achieve sustainable health goals and longevity. This has been proven in the global fight against the COVID-19 pandemic (*2,16,28,29*) and is particularly relevant at this moment in time. Given the accelerated emergence of viral mutations and variants, vaccination programs need to be rapidly rolled out and NPIs need to continue to be implemented under the rubric of a *Unified Public Health Response* (*3,30-32*).

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