Chapter

Introductory Chapter: Lessons from SARS-CoV-2/COVID-19 after Two Years of Pandemic

Alfonso J. Rodriguez-Morales and D. Katterine Bonilla-Aldana

1. Introduction

In December 2019, the apparent emergence of a new disease, the Coronavirus Disease 2019 (COVID-19), in Wuhan, Hubei, China, caused by a new coronavirus, the Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2), occurred [1–4]. This viral emerging zoonotic disease was initially linked to a fresh seafood market in Wuhan city, with the secondary human-to-human transmission, initially considered by droplets and later confirmed in an aerosolized way, among other potential and alternate routes of transmission [5–11], even including transmission from human-to-animals, particularly to dogs, different felines (cats, lions, and tigers) and minks, among others [12, 13]. Initially affecting China [14–16], the SARS-CoV-2 spread rapidly in a few days to other countries in Asia, as well as later to Europe [17–20], North America [21–23], Africa, and Latin America [9, 24–27]. On January 30, 2020, after the assessments of the Emergency Committee, under the International Health Regulations (IHR), the World Health Organization (WHO) Director General declared that the SARS-CoV-2 outbreak constitutes a Public Health Emergency of International Concern (PHEIC). On March 11, 2020, the WHO declared the SARS-CoV-2 outbreak as a pandemic. Two years later, the pandemic continues, summarizing a total of 628,184,448 cases up to October 25, 2022, with 6,580,107 deaths (**Figure 1**).

Over this time, the initial impact of the outbreak lead globally to generalized lockdowns and quarantine [28–30], a collapse of the health systems, especially in low- and middle-income countries [31], as well as devastating impacts on travel, tourism, economy, education, and multiple other societal sectors [32, 33]. Fortunately, only a low proportion of infected individuals develop mild or severe diseases that required hospitalization and admittance to an intensive care unit, but still, given the magnitude of the pandemic, imply a collapse in countries with limited resources and facilities. During 2020, no effective treatments and vaccines were available, only non-pharmacological interventions (NPI), including the massive use of face masks (including personal protection equipments [PPE], such as N95 filters, especially for healthcare workers), and after December 2021, some treatments, including the use dexamethasone [34–38], and RNA and viral vector vaccines, such as BNT162b2 vaccine (Pfizer/BioNTech®), the ChAdOx1 nCoV-19 vaccine (AstraZeneca/Oxford®), mRNA-1273 (Moderna®), among others, were available and widely used [39–45].

One of the major issues after 2021 was the emergence of the mutations of the SARS-CoV-2 leading to variants of different nature, particularly the variants of

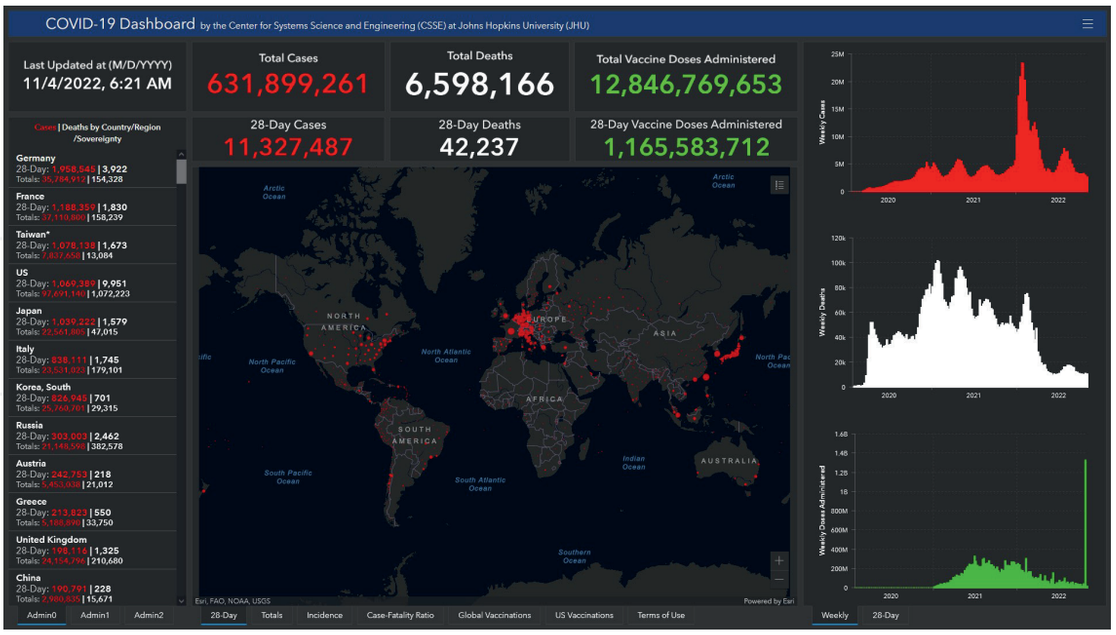

Figure 1.
COVID-19 dashboard showing the cumulated incidence, mortality, and vaccination, as well as their total during the last 28 days, evolution since 2020, and the top of countries in such indicators; up to October 25, 2022. (https://gisanddata.maps.arcgis.com/apps/dashboards/bda7594740fd40299423467b48e9ecf6).

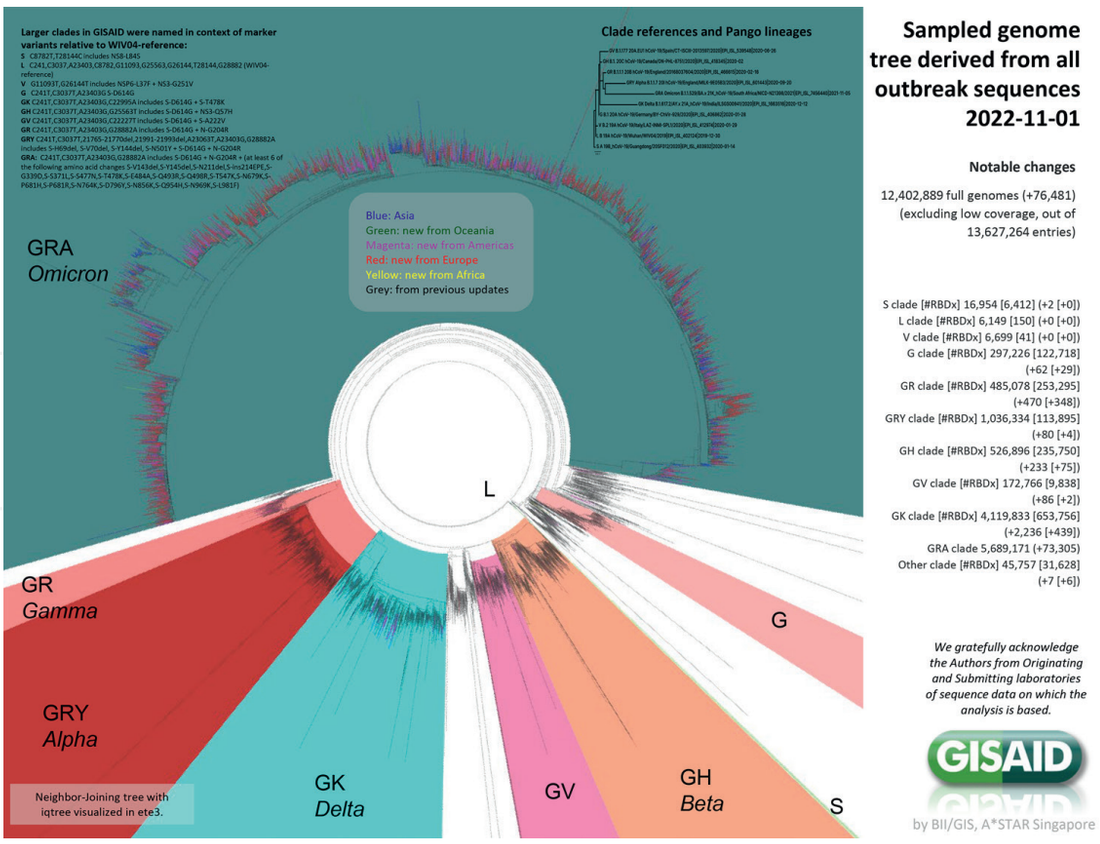

Figure 2.
SARS-CoV-2 variants and genomes were sequenced and collected at the GISAID database up to October 25, 2022. (https://www.gisaid.org/).

interest (VOI), and the variants of concern (VOC), which decrease the protection capacity of used vaccines [40, 44, 46, 47]. The emergence of the VOCs, Alpha, Beta, Gamma, Delta, and Omicron (**Figure 2**), as well as the Omicron's sublineage during those months, have been a real challenge for prevention and control of the pandemic.

2. Vaccines impact on the course of pandemic

Despite all the issues and difficulties, the humankind succeeds enough against the SARS-CoV-2/COVID-19, returning to a new "normal" life, after a successfully deployed and globally aggressive plan of vaccination against SARS-CoV-2/COVID-19 with multiple vaccine types. Up to October 25, 2022, a total of 12,822,482,039 vaccine doses have been administered in the world, representing the largest historical effort in vaccination [44, 47–49]. Over these months, multiple studies on vaccine impacts, preclinical, phase 1, phase 2, phase 3 (efficacy), and phase 4 (effectiveness, real-world impact), as well as their corresponding side effects assessment, have been developed showing the high efficacy, effectiveness, and safety of the used anti-COVID-19 vaccines (**Figure 3**) [41, 50–53].

Using vaccines with 50% of efficacy, or more, some of them above 75–80%, together with other measures, transmission was affected, but particularly mortality. Additionally to the published studies (**Figure 3**), multiple countries (e.g., the United States of America) monitor data regarding incidence and mortality among non-vaccinated and vaccinated people.

Case fatality rate among those not-vaccinated according to some analyses in the United States of America reached up to 12 times higher than compared with

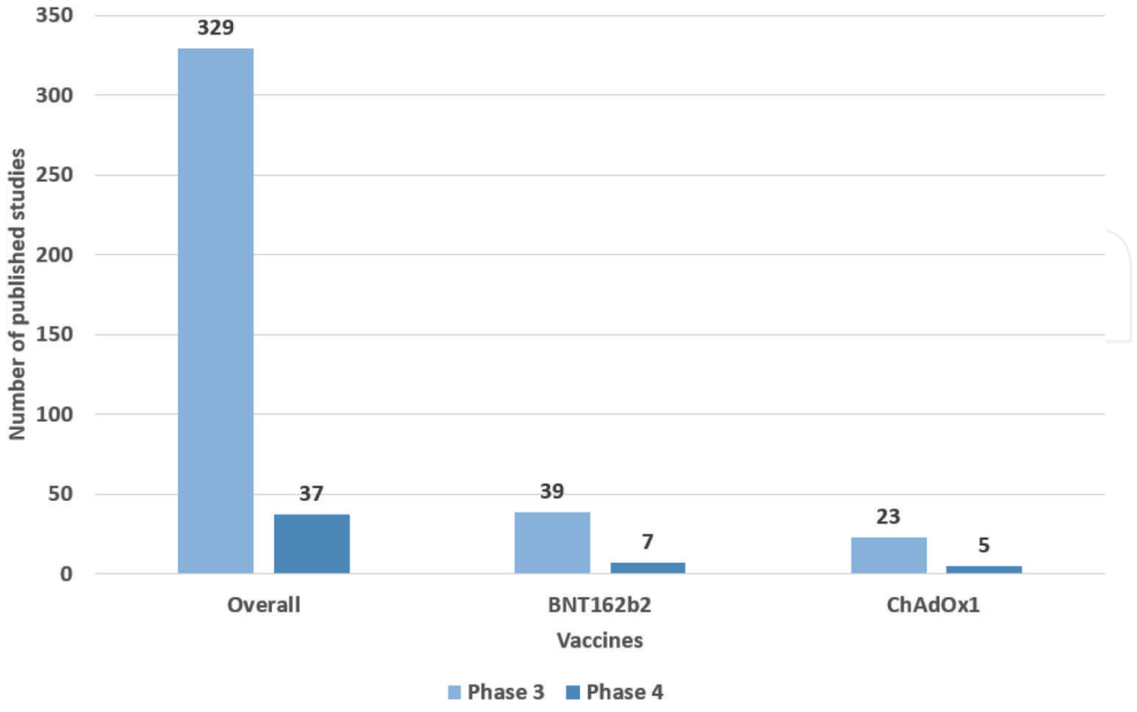

Figure 3.
Phase 3 and phase 4 COVID-19 vaccine studies published in PubMed-indexed journals up to October 25, 2022.

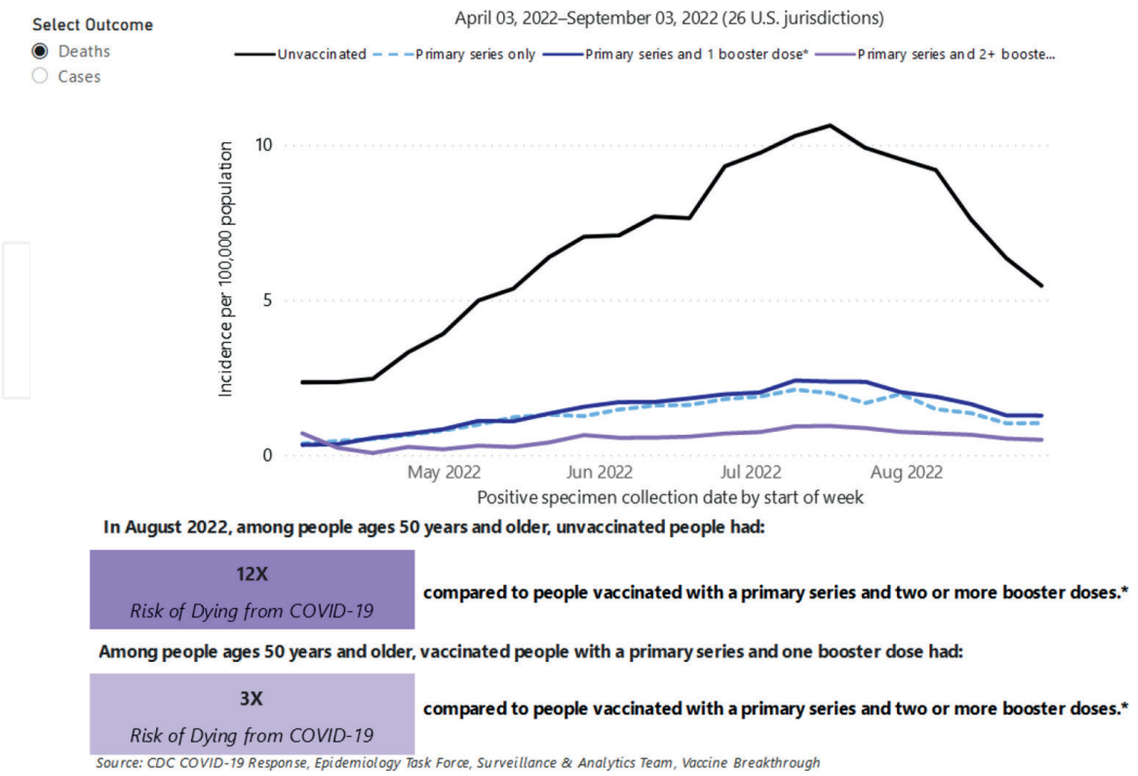

Figure 4.
Rates of COVID-19 deaths by vaccination status and two or more (2+) booster doses in ages 50+ years. (https://covid.cdc.gov/covid-data-tracker/#rates-by-vaccine-status).*

people with boosters, especially in elderly people (**Figure 4**). Anti-COVID-19 vaccines save lives.

For October 2022, multiple countries have applied a fourth dose or second booster in their populations. Obviously, the coverage at primary and booster schemes is highly variable among countries. Prioritizing vaccination coverage must remain as one of the key factors driving vaccine uptake [54]. Also, vaccine hesitancy is important and should be prevented with comprehensive population education [55].

It is now clear that none of the available COVID-19 vaccines provides robust, lasting protection against infection, particularly in the Omicron era, and likely due to inadequate and/or short-lived mucosal immunity [56, 57]. However, booster doses of all widely used vaccines offer very high levels of protection against severe outcomes [54]. With this consistency of protection against severe disease across different variants, the case for developing variant-specific vaccines becomes less urgent, particularly if heterologous schedules can potentially circumvent some of the challenges homologous schedules may encounter in the face of new variants [58–60].

3. Conclusions

COVID-19 pandemic has not been over. Although the evolution during the last months, especially in 2022, has been significantly positive, still SARS-CoV-2 and its variants, particularly the sublineages of Omicron (**Figure 5**), continue changing and circulating. That means preparedness, vaccination, assessment, and research, considering this evolving scenario, should be considered and continuously applied.

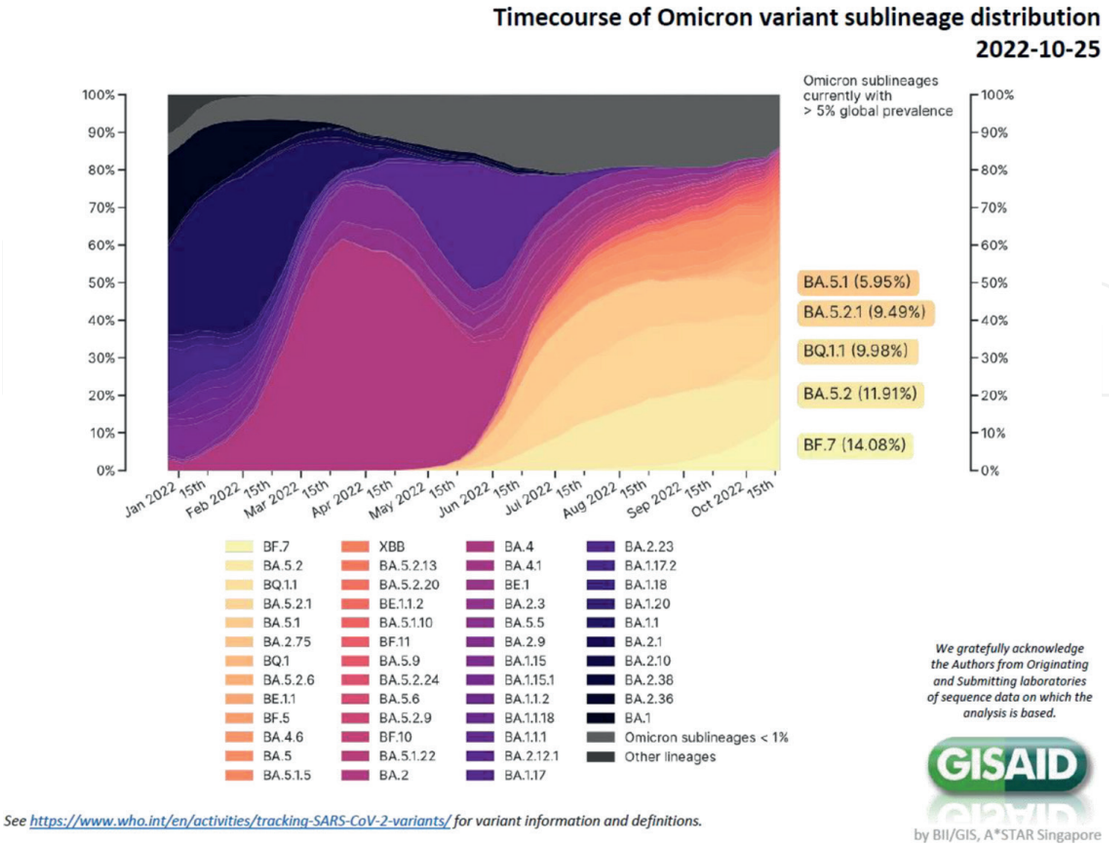

Figure 5.
Omicron sublineages over time, up to October 25, 2022. (https://www.gisaid.org/).

Prevention is key in general, continued education, surveillance, and monitoring, has been essential, and still will be up to the time SARS-CoV-2 became endemic or disappear. Many lessons have been learnt at differential levels [61, 62], but is essential to be highly, and even, better prepared for the next pandemic, to be caused by a coronavirus, another zoonotic virus making a spillover [3, 62] (e.g., zoonotic Influenza or monkey pox) [63, 64], or in general by another emerging or remerging pathogen. In the future outbreaks, we cannot fall into some of the mistakes done during the COVID-19 pandemic [65]. We have to work on the impacts of COVID-19 on other infectious diseases, such as the decrease of vaccine coverages against other vaccine-preventable diseases [66], as well as to deal with long-COVID-19 syndrome [67], among others.

We need to be better prepared for viral threats, monitor risks, and increase our preparedness and effective responsiveness against outbreaks, epidemics, and pandemics, to promote a safer and healthier world.

Author details

Alfonso J. Rodriguez-Morales[1,2,3,4,5*] and D. Katterine Bonilla-Aldana[3,4]

1 Faculty of Medicine, Grupo de Investigación Biomedicina, Fundación Universitaria Autónoma de las Américas, Pereira, Colombia

2 Universidad Cientifica del Sur, Lima, Peru

3 Latin American Network on COVID-19 Research (LANCOVID), Pereira, Colombia

4 Research Unit, Universidad Continental, Huancayo, Peru

5 Gilbert and Rose-Marie Chagoury School of Medicine, Lebanese American University, Beirut, Lebanon

*Address all correspondence to: alfonso.rodriguez@uam.edu.co; arodriguezmo@cientifica.edu.pe

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