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Editorial

Disparities in global COVID-19 vaccination rates & allocation of resources to countries in need



A B S T R A C T

As of July 20th, 2021, over 191 million confirmed COVID-related cases and 4.1 million COVID-related deaths have been documented across the globe. Vaccines were initially prioritized in healthcare workers (HCWs) and elderly populations to provide protection to high-risk individuals. However, despite the intra-and-international distribution of COVID-19 vaccines, there is considerable variability in the vaccination rates observed worldwide. For example, the United Arab Emirates reported 166 vaccine doses/100 population, whereas most of the countries in Africa have administered <10 doses/100 population. The inadequate supply of vaccinations in addition to the lack of swift distribution/reallocation of vaccines that arrived likely contribute to the low vaccination rates observed in Africa. The US and many countries in Europe began administering vaccines in December 2020, whereas the majority of countries in Africa began administering vaccines in March 2021. In order to mitigate COVID-related deaths, we recommend that countries join in the efforts of allocating COVID vaccines to countries in need. In addition, we recommend for the partial vaccination of a larger proportion of high-risk population as opposed to fully vaccinating half the amount. However, adequate supply of vaccines may be of limited use if not distributed in a time-sensitive manner. We recommend for the implementation of targeted and cost-effective vaccine allocation and distribution strategies in order to increase vaccination rates, reserve healthcare systems resources and avoid any preventable deaths associated with COVID-19 infections.

As of July 20, 2021, a total of 191, 943, 037 confirmed cases of COVID-19 have been documented worldwide and 4,126,289 deaths and corresponds to a 2.1 % case-fatality ratio (CFR) [1]. As healthcare workers rose to the challenge to meet the demands of their communities, the great amount of exposure proved to be dire for those on the front lines. Some countries (e.g. Italy) put contingencies into place such as mandatory COVID-19 vaccination in healthcare workers in order to mitigate the risk posed to healthcare personnel, as the Moderna, Pfizer, and AstraZeneca vaccines were shown to have reasonable efficacy (Paterlini, 2021; Kakulavarapu et al., 2021) [2,3].

The COVID-19 vaccine was distributed in phases in order to prioritize those with the greatest risk of contracting COVID-19 and/or were at risk for severe complications should they succumb to the disease, as those living in nursing homes represent over 50 % of COVID-19 deaths in the U.S [4,5]. These trends extend down to the zip code level, as CFRs correlate significantly with those aged >65 and demonstrate a large proportion of nursing homes residing in zip codes heavily burdened by COVID-19 [6]. In an effort to match vaccine eligibility with the risk posed, healthcare workers and the elderly were prioritized in the process due to their constant exposure and increased risk of mortality, respectively [4]. However, there was considerable variability in the general acceptance and willingness of healthcare workers (HCWs) to receive the vaccine largely due to concerns surrounding the safety and efficacy of the COVID-19 vaccine [7]. Thus, discrepancies in the decision to receive the vaccine may influence vaccination rates. Although vaccination data is available for the general public, public health officials may consider reporting vaccination rates among HCWs in order to track and ensure proper safety in those at the front lines of the pandemic.

On a global scale, 655, 744, 134 people have been fully vaccinated

and demonstrates the efforts of the nations to subdue the pandemic [8]. Only 11/40 (27.5 %) countries in Africa with available data have administered >1,000,000 vaccine doses (Fig. 1a), and only 4 countries in Africa administered >10 vaccine doses/100 population (Fig. 1ab) [8]. To help alleviate disparities in access, COVID-19 Vaccines Global Access (COVAX) began administering doses in Africa in March 2021. At the time, 11 million COVAX doses were expected to be delivered in the first week of March and AstraZeneca/Oxford vaccine was intended to be distributed among 142 economies by the end of May 2021 [9].

As of July 20, 2021, 58.0/100 persons have been partially vaccinated with at least one vaccine dose (Fig. 2a), whereas 49.2/100 people have been fully vaccinated per 100 population in the United States (Fig. 2b) [8]. In contrast, despite being one of the first countries in Africa to receive the COVID-19 vaccines, only 5.7 and 2.8 persons per 100 population in South Africa have been partially and fully vaccinated, respectively (Fig. 2ab) [8]. WHO regional director for Africa recommended the administration of a single dose to the greatest proportion of high-risk populations in the shortest amount of time as opposed to fully vaccinating half the amount. This strategy may be effective in substantially reducing deaths due to COVID-19 in countries with a limited supply of vaccines [10]. However, there is an approximate 50/50 split between those partially and fully vaccinated per 100 population in South Africa, suggesting that the second dose administered to those who are now fully vaccinated (as much as 1/3rd of administered doses) could have been allocated to additional residents if this had been enforced.

On the other hand, the timing of the first vaccine administration may play a role in the variability in vaccination rates. For example, the majority of countries in Africa began administering vaccines in March 2021, whereas the US and many countries in Europe began

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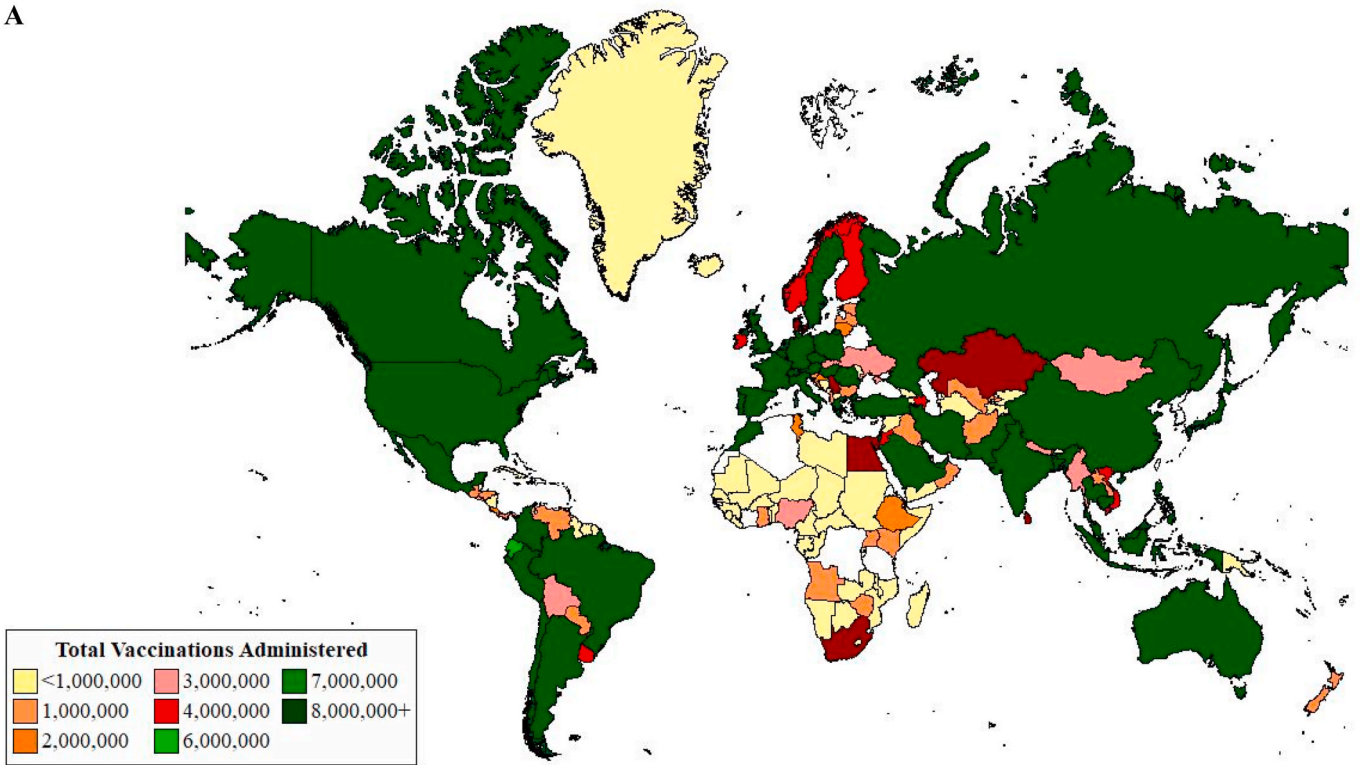
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A



B

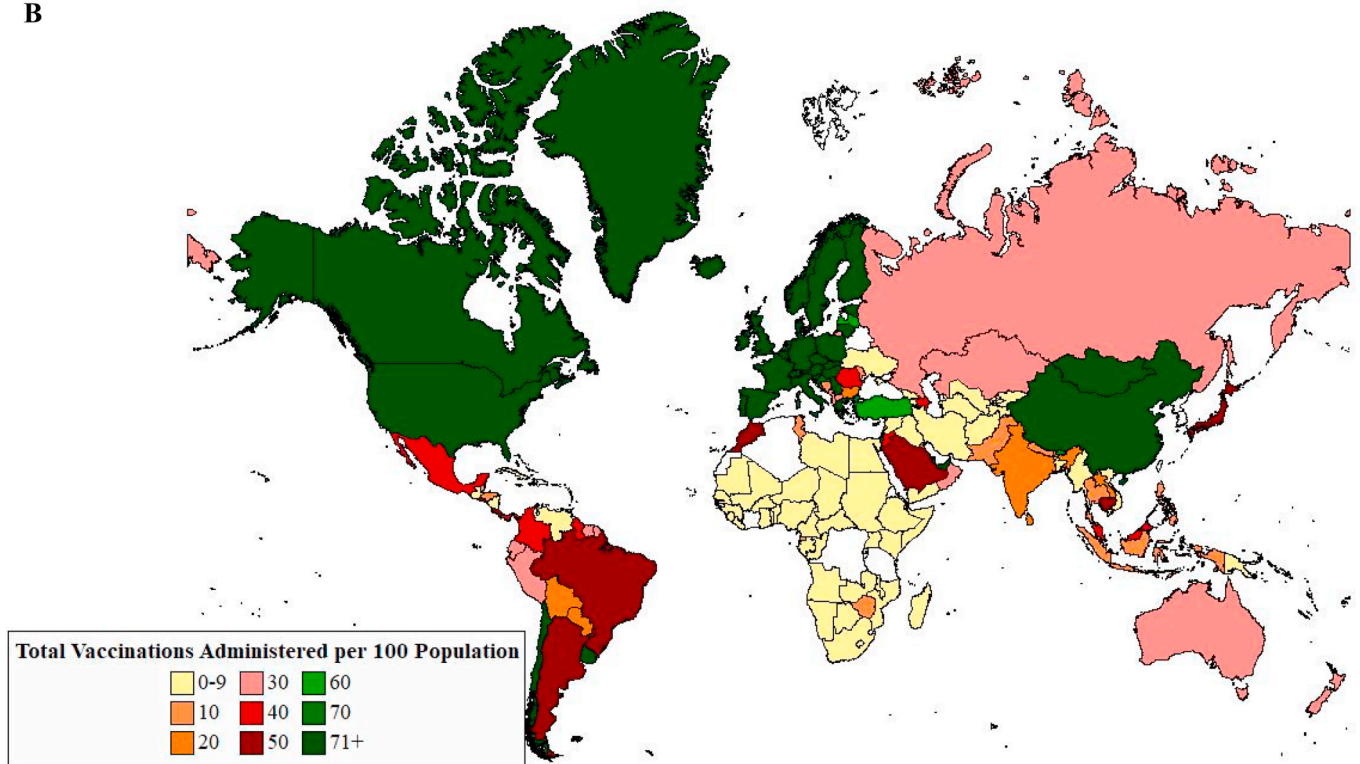
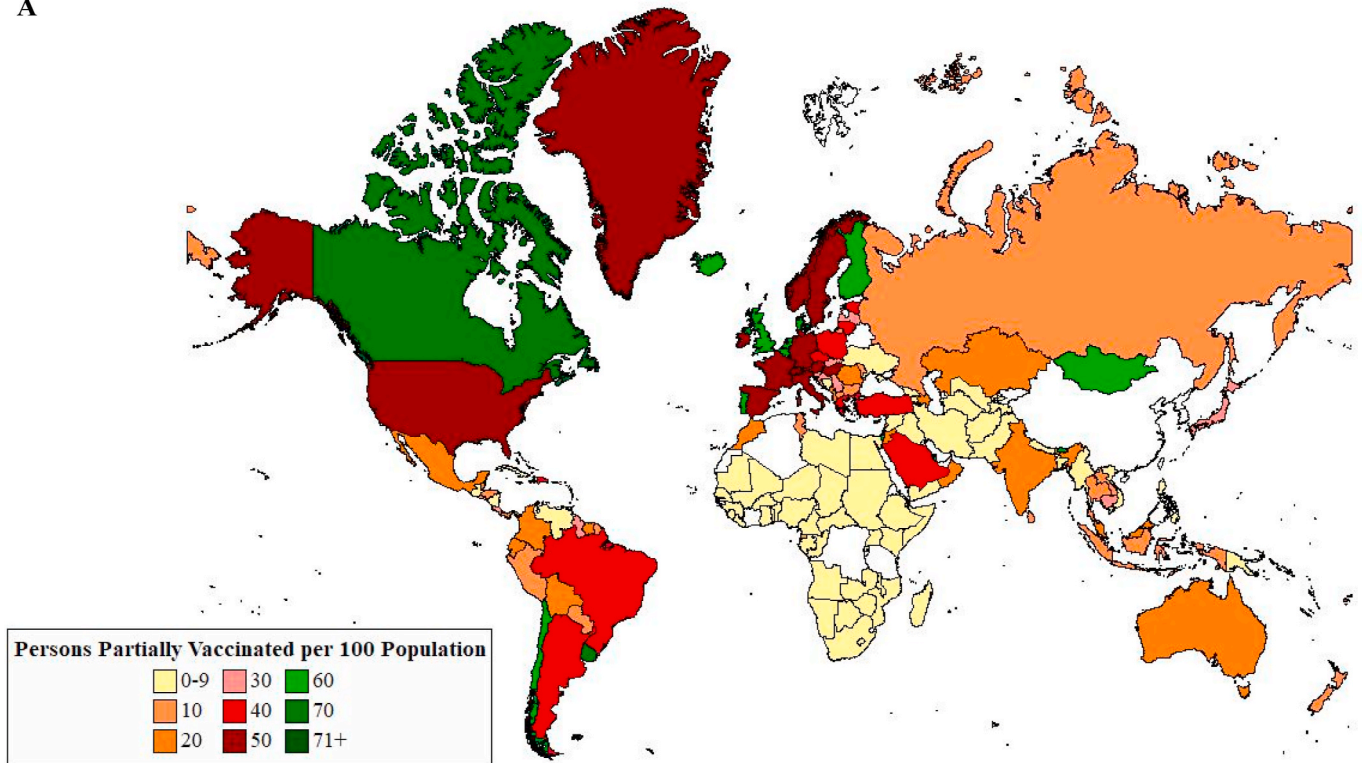


Fig. 1. A. Total vaccine doses administered, by country. *.

administering vaccines in December 2020 (Fig. 3). However, when comparing the persons partially/fully vaccinated per 100 population in Africa to other countries with identical vaccine start dates, the former remains at a considerable deficit, suggesting a lapse in supply and/or time-sensitive administration.

There is inadequate delivery of vaccines to countries in Africa with insufficient numbers of vaccine doses. Officials in South Africa announced that 1 million AstraZeneca vaccines would be delivered in January and another 500,000 doses in February from the Serum Institute of India [10]. However, due to the rising surge of COVID-19 cases,

A



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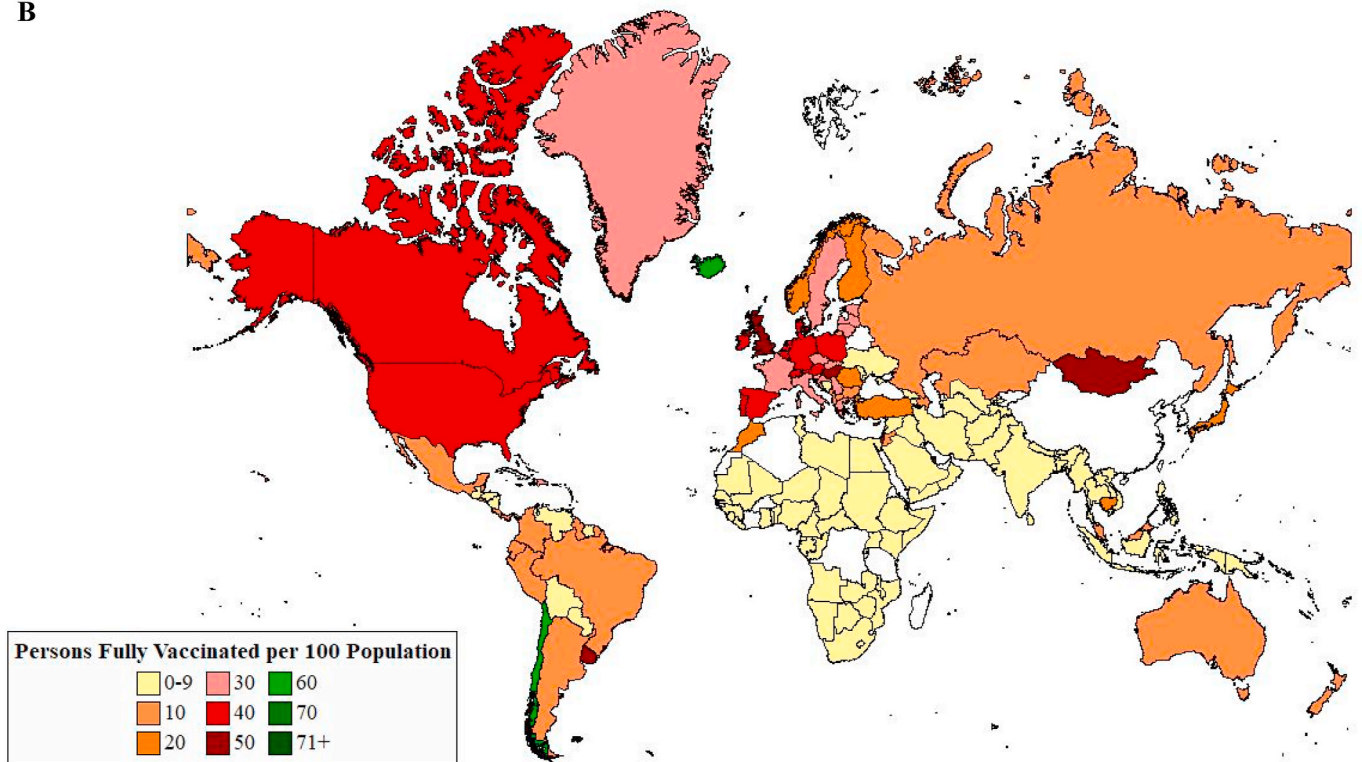


Fig. 2. A. Persons partially vaccinated against COVID-19 per 100 population, by country. *.

India ceased export of Oxford/AstraZeneca COVID-19 vaccines to other countries [11]. Thus, anticipated vaccine orders were largely left un-filled in South Africa and likely contributes to the substantially lower vaccination rates.

Another explanation for the large discrepancy in vaccination rates is

the inadequate administration of doses that had already been delivered to South Africa. One report from the WHO indicates that as of May 6, 2021, only about half of all vaccines received by South Africa were administered [12].

Likewise, halting the distribution of the AstraZeneca vaccine in

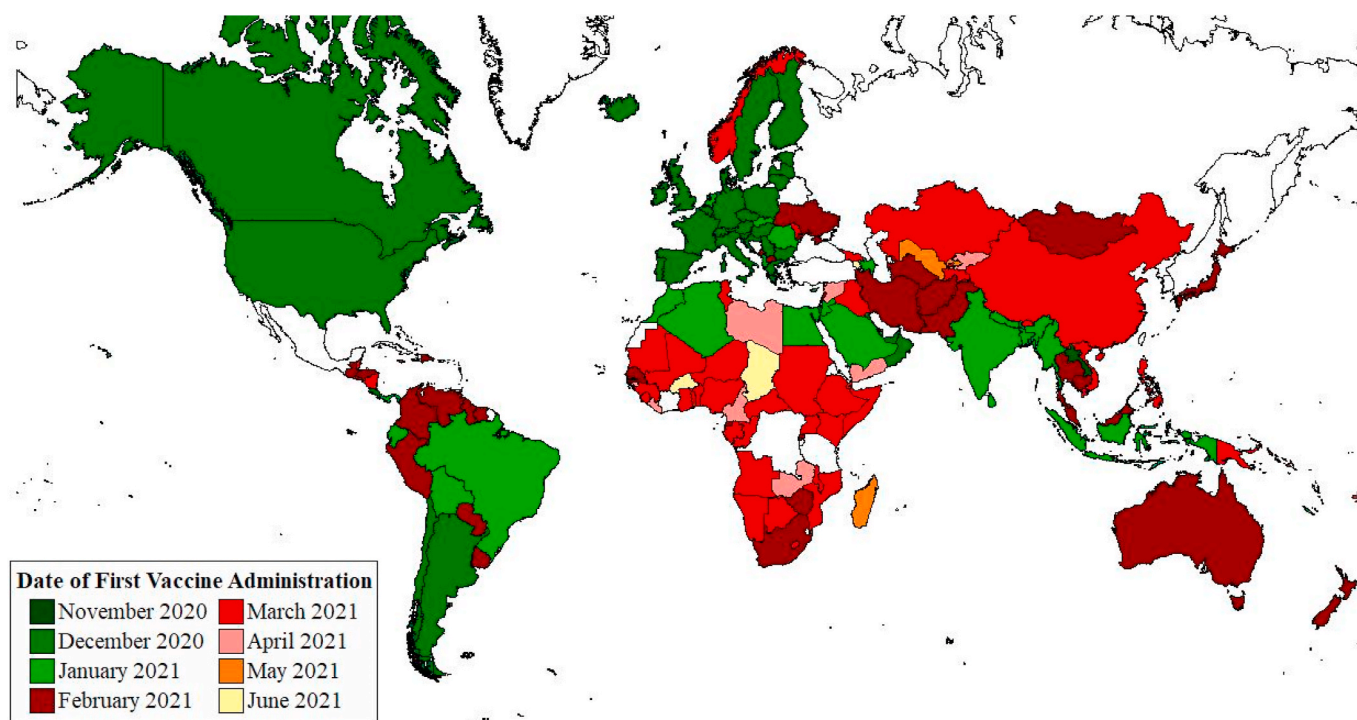


Fig. 3. Date of first COVID-19 vaccine administration, by country. *.

South Africa in February 2021 may also play a role in the low vaccination rates [13]. Officials in South Africa stopped administering doses of AstraZeneca due to the results of a trial in South Africa [13]. Their unpublished trial included 2000 participants that were either given an active vaccine or placebo in HIV-negative individuals and assessed the efficacy of the vaccine against the 501Y-V2 variant of the SARS-CoV-2 virus [13]. The trial demonstrated a low efficacy against mild and moderate cases of COVID-19 [13]. Similarly, a previous analysis determined that the Johnson & Johnson single-dose vaccine demonstrated only 57 % efficacy in the South African population and represents a considerably lower success rate than other countries using this vaccine [13]. These delays in rollout may play into the low vaccination rates seen in South Africa.

In order to mitigate the number of COVID-related deaths, we recommend partial immunization of more high-risk populations as opposed to fully vaccinating half the amount in countries with a limited supply of vaccines. However, allocation of vaccines from other countries will be of limited use without an efficient method of distribution. The implementation and investigation of policies surrounding the swift distribution of vaccines following receipt should be assessed by future studies with the goal of establishing clear protocols that maximize efficiency. Finally, the allocation of vaccines to countries with low vaccination rates is an avenue worth pursuing. For example, despite the growing number of COVID-19 cases and constant burden inflicted on the country, the U.S. is electing to increase the export of COVID-19 vaccines to countries in dire need [14]. The current U.S administration has authorized the export of 80 million COVID-19 vaccines – 60 million of AstraZeneca vaccines and 20 million of other COVID-19 vaccines [14]. Countries with a very high national vaccination rates and vaccines availability should consider providing aid to countries who are struggling to vaccinate even a small percentage of their population. Lastly, countering misinformation related to COVID-19 vaccines and ensuring the credibility and reliability of disseminated COVID-19 vaccines information is crucial for the successful implementation of COVID-19 vaccination program and increase vaccination rates globally [15].

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A total of 222 countries contained available data. The global median number of doses administered amounted to 606,298 (IQR = 4,368,629).

*Data as of July 20, 2021.

*WHO Coronavirus (COVID-19) Dashboard. World Health Organization. <https://covid19.who.int/info/>. Accessed July 20, 2021. Fig. 1B. Vaccine Doses Administered per 100 Population, by Country. *

A total of 222 countries contained available data. The median vaccine doses administered per 100 population amounted to 37.3 (IQR = 87.3). 7 countries in Africa (Morocco, Equatorial Guinea, Tunisia, Sao Tome and Principe, Seychelles, Mauritius, and Zimbabwe) exhibited >10 vaccine doses administered per 100 population.

*Data as of July 20, 2021.

*WHO Coronavirus (COVID-19) Dashboard. World Health Organization. <https://covid19.who.int/info/>. Accessed July 20, 2021.

A total of 217 countries contained available data. The median number of persons partially vaccinated (received at least one vaccine dose) was 24.7 (IQR = 48.8). 6 countries in Africa (Morocco, Tunisia, Sao Tome and Principe, Seychelles, Mauritius, and Equatorial Guinea) exhibited >10 partially vaccinated persons per 100 population.

*Data as of July 20, 2021.

*WHO Coronavirus (COVID-19) Dashboard. World Health Organization. <https://covid19.who.int/info/>. Accessed July 20, 2021. Fig. 2B. Persons Fully Vaccinated against COVID-19 per 100 population, by Country. *

A total of 213 countries contained available data. The median persons fully vaccinated per 100 population was nearly exactly half of those partially vaccinated per 100 population and amounted to 12.4 (IQR = 37.7). 4 countries in Africa (Morocco, Mauritius, and Sao Tome and Principe, and Seychelles) exhibited >10 persons fully vaccinated per 100 population.

*Data as of July 20, 2021.

*WHO Coronavirus (COVID-19) Dashboard. World Health Organization. <https://covid19.who.int/info/>. Accessed July 20, 2021.

A total of 222 countries contained available data. The date of the first vaccine administration varied over an 8-month period: November 2020–June 2021. 2 countries (0.9 %) began administering vaccines in November 2020, followed by a large increase to 42 countries (18.9 %) in

December 2020. In January 2021, 32 countries (14.4 %) administered the first COVID vaccine, followed by an increase 51 countries (23.0 %) in February 2021. Progressively smaller percentages of countries administered their first COVID vaccine in March 2021 (48 countries, 21.6 %), April 2021 (17 countries, 7.7 %), and May & June 2021 (5 countries (2.3 %), respectively).

*Data as of July 20, 2021.

*WHO Coronavirus (COVID-19) Dashboard. World Health Organization. <https://covid19.who.int/info/>. Accessed July 20, 2021.

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