COVID-19 Weekly Epidemiological Update

Edition 56, published 7 September 2021

In this edition:

- Global overview
- Special focus: Update on SARS-CoV-2 Variants of Interest and Variants of Concern
- WHO regional overviews
- Summary of the COVID-19 Weekly Operational Update

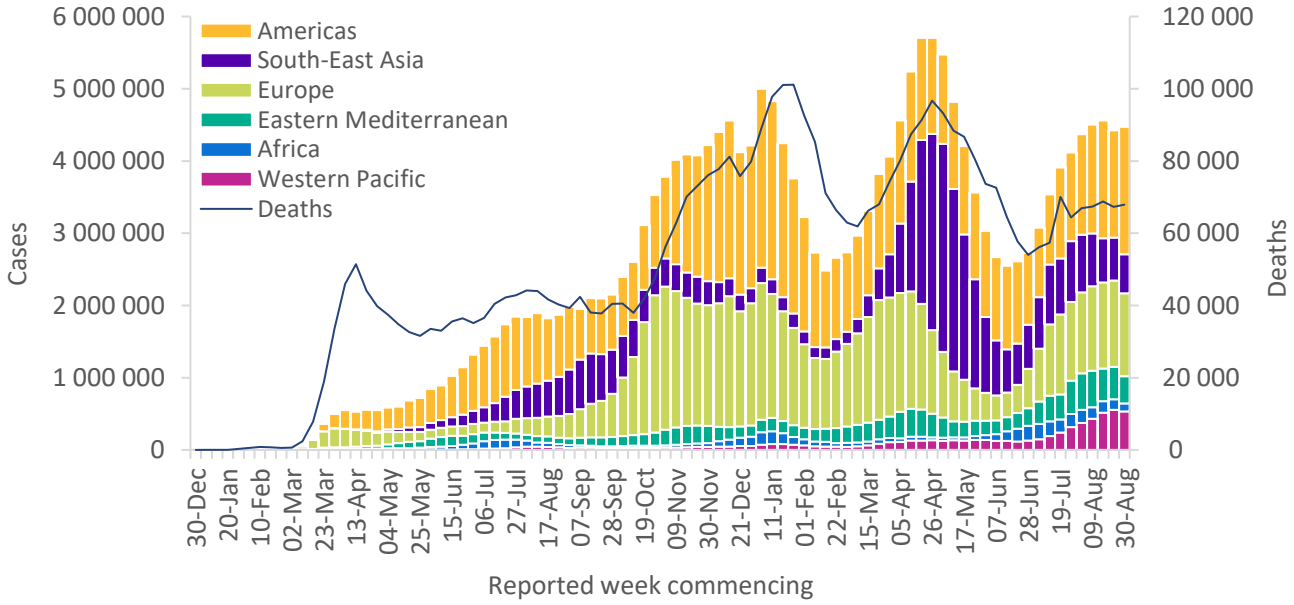
Global overview

Data as of 5 September 2021

Globally, the number of new cases reported this week remained similar to that of the previous week. With over 4.4 million new cases reported this week (30 August-5 September; Figure 1), the global incidence of COVID-19 cases has remained stable over the past month. In the past week, all regions reported either a decline (Regions of Africa, South-East Asia, and the Eastern Mediterranean) or a similar trend in new reported cases, as compared to previous week (Regions of Europe and the Western Pacific); the Region of the Americas reported a 19% increase.

The number of deaths reported globally this week also remained similar to the previous week, with just under 68 000 new deaths reported. The incidence of new deaths declined in all regions apart from the Region of the Americas and Europe where deaths increased by 17% and 20%, respectively. Regionally, the largest proportionate decreases in new deaths this week were observed in the South-East Asia (21% decrease) and African (26% decrease) regions, while the regions of the Western Pacific (8% decrease) and the Eastern Mediterranean (14% decrease) also reported notable declines, as compared to the previous week. The cumulative number of cases reported globally is now just over 220 million and the cumulative number of deaths is over 4.5 million.

Figure 1. COVID-19 cases reported weekly by WHO Region, and global deaths, as of 5 September 2021**



**See *Annex 2: Data, table and figure notes*

The Regions reporting the highest weekly case and deaths incidence rates per 100 000 population remain the same as last week: the Regions of the Americas (172.4 new cases per 100 000 population; 2.5 deaths per 100 000 population) and Europe (122.8 new cases per 100 000 population; 1.6 deaths per 100 000 population).

The highest numbers of new cases were reported from the United States of America (1 297 399 new cases; 38% increase), India (293 643 new cases; 8% increase), the United Kingdom (243 125 new cases; similar to the previous week), the Islamic Republic of Iran (208 089 new cases; 18% decrease), and Brazil (152 154 new cases; 13% decrease).

Globally, cases of the Alpha variant have been reported in 194 countries (one new country since last week), territories or areas (hereafter countries), while 141 countries (no new countries) have reported cases of the Beta variant; 92 countries (one new country) have reported cases of the Gamma variant; and 174 countries (four new countries) have reported cases of the Delta variant.

Table 1. Newly reported and cumulative COVID-19 cases and deaths, by WHO Region, as of 5 September 2021**

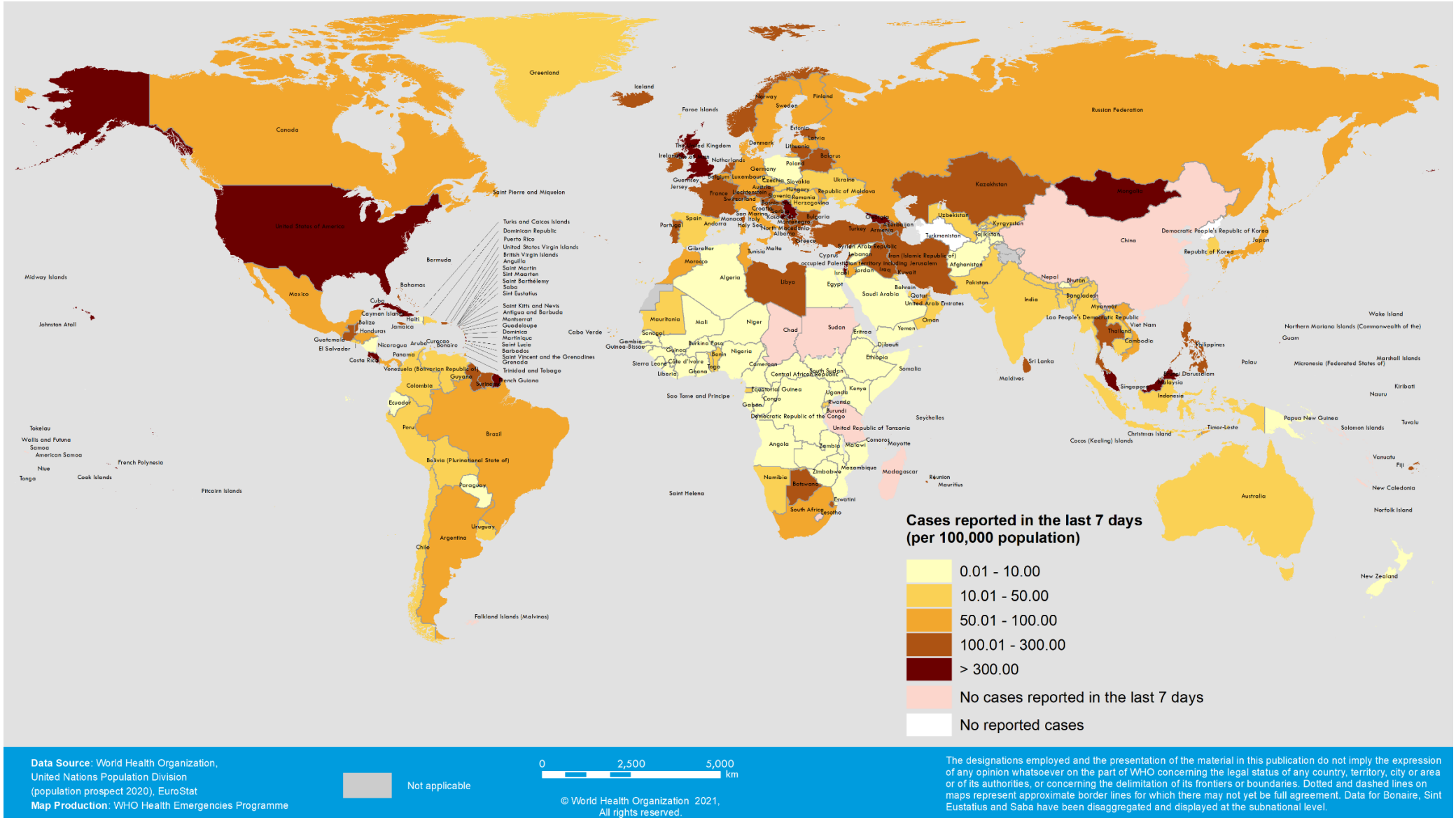
WHO Region	New cases in last 7 days (%)	Change in new cases in last 7 days *	Cumulative cases (%)	New deaths in last 7 days (%)	Change in new deaths in last 7 days *	Cumulative deaths (%)
Americas	1 763 048 (39%)	19%	84 995 058 (39%)	26 028 (38%)	17%	2 120 533 (47%)
Europe	1 146 065 (26%)	-4%	66 029 959 (30%)	14 883 (22%)	20%	1 282 565 (28%)
South-East Asia	543 013 (12%)	-9%	41 662 330 (19%)	11 116 (16%)	-21%	652 990 (14%)
Eastern Mediterranean	377 304 (8%)	-16%	14 879 624 (7%)	6 782 (10%)	-14%	271 279 (6%)
Western Pacific	531 922 (12%)	-4%	6 931 169 (3%)	6 282 (9%)	-8%	94 450 (2%)
Africa	110 594 (2%)	-25%	5 718 668 (3%)	2 826 (4%)	-26%	136 976 (3%)
Global	**4 471 946 (100%)**	**1%**	**220 217 572 (100%)**	**67 917 (100%)**	**1%**	**4 558 806 (100%)**

**Percent change in the number of newly confirmed cases/deaths in past seven days, compared to seven days prior*
***See Annex 2: Data, table and figure notes*

For the latest data and other updates on COVID-19, please see:

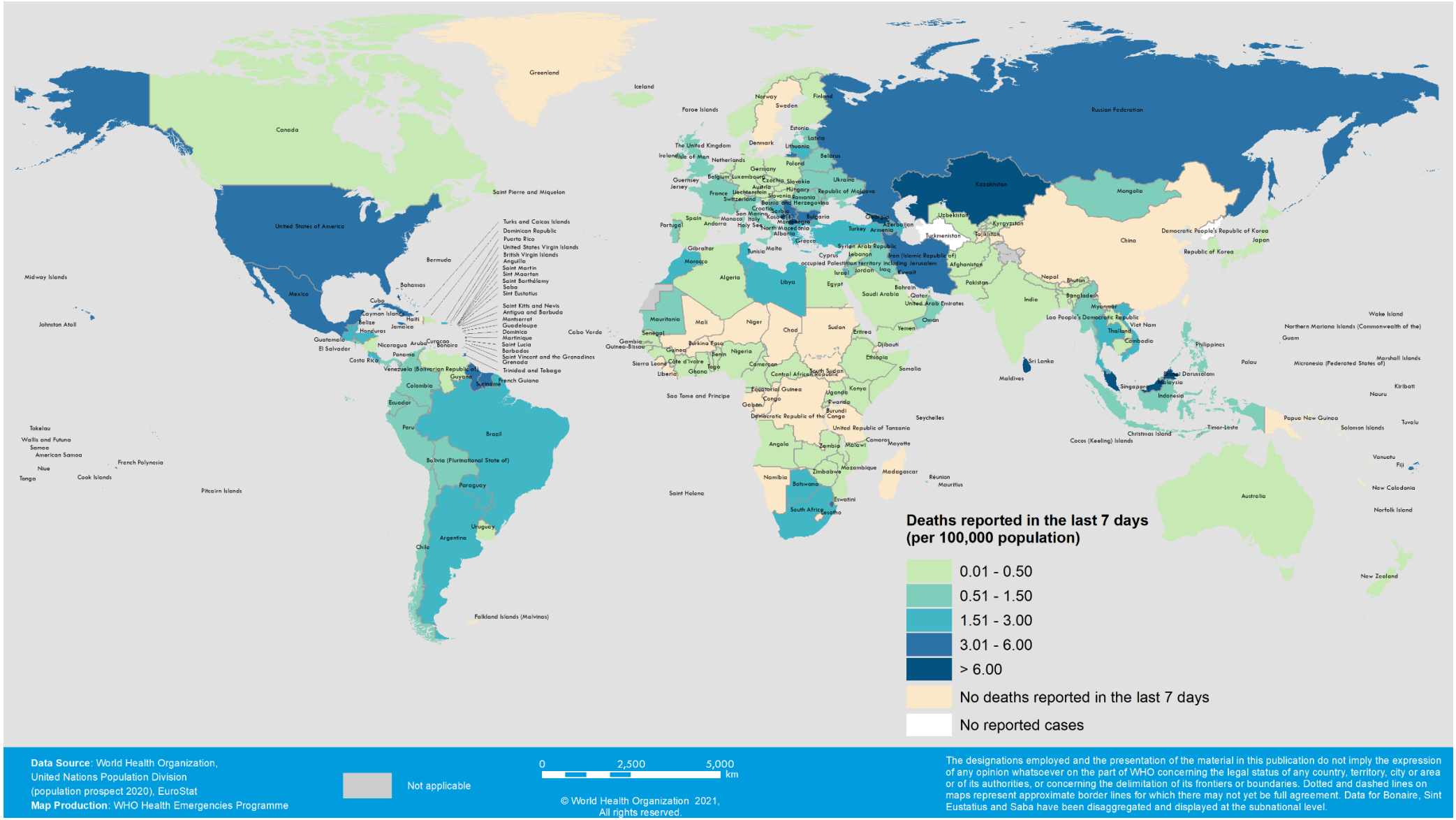
- WHO COVID-19 Dashboard
- WHO COVID-19 Weekly Operational Update and previous editions of the Weekly Epidemiological Update

Figure 2. COVID-19 cases per 100 000 population reported by countries, territories and areas, 30 August – 5 September 2021**



**See *Annex 2: Data, table and figure notes*

Figure 3. COVID-19 deaths per 100 000 population reported by countries, territories and areas, 30 August – 5 September 2021**



**See *Annex 2: Data, table and figure notes*

Special Focus: Update on SARS-CoV-2 Variants of Interest and Variants of Concern

WHO, in collaboration with national authorities, institutions and researchers, routinely assesses if variants of SARS-CoV-2 alter transmission or disease characteristics, or impact vaccine, therapeutics, diagnostics or effectiveness of public health and social measures (PHSM) applied by national authorities to control disease spread. "Signals" of potential Variants of Concern (VOCs) or Variants of Interest (VOIs) are detected and assessed based on the risk posed to global public health. National authorities may choose to designate other variants of local interest/concern and are encouraged to investigate and report on impacts of these variants.

Updates on VOCs and VOIs, and a list of Alerts for Further Monitoring, are available on the WHO Tracking SARS-CoV-2 Variants website.

Geographic distribution

As surveillance activities to detect SARS-CoV-2 variants are strengthened at national and subnational levels, including through the expansion of genomic sequencing capacities, the number of countries/areas/territories (hereafter countries) reporting VOCs continues to increase (Figure 4, Annex 1). This distribution should nonetheless be interpreted with due consideration of surveillance limitations, including differences in sequencing capacities and sampling strategies between countries.

Phenotypic characteristics

Available evidence on phenotypic impacts of VOCs is summarized in Table 2, as well as in previous editions of these COVID-19 Weekly Epidemiological Updates. Since the last detailed update on 24 August, new evidence has been published on the phenotypic characteristics of VOCs.

A retrospective cohort study, available in preprint, of RT-PCR SARS-CoV-2 positive individuals was conducted using healthcare datasets in the provinces of Ontario and Alberta, Canada, which were the most affected provinces during the resurgence of cases in Canada from February to May 2021. During this time, the 30-day outcomes of those infected with VOCs (n=37 902), of which 91% (34 658/37 902) were infected with the Alpha variant, showed a higher risk of death [adjusted Odds Ratio (aOR) of 1.34 (95% Confidence Interval 1.29-1.39) in Ontario and 1.53 (95% CI: 1.41-1.65) in Alberta] and hospitalization [aOR 1.57 (95% CI: 1.47-1.69) in Ontario and aOR 1.88 (95% CI: 1.74-2.02) in Alberta)] as compared to those infected with non-VOCs.[1]

In a prospective clinical cohort study of hospitalized and community cases (n=1475) conducted between 1 November 2020 to 30 January 2021 in Scotland as part of a larger study in the United Kingdom, and published as a preprint, infection with the Alpha variant was associated with increased clinical severity [cumulative OR 1.40 (95% CI: 1.02-1.93)] as compared to non-Alpha SARS-CoV-2 infection. Additionally, the viral load of samples positive for the Alpha variant, as measured by the cycle threshold (Ct) value, was lower than that of non-Alpha samples [mean change in Ct: -2.46 (95% CI -4.22, -0.70)], where lower Ct value indicates higher viral load of specimens.[2]

A recent study from China, published as a preprint, found a higher viral load and higher risk of pre-symptomatic transmission in patients infected with the Delta variant when compared to those infected with non-VOC SARS-CoV-2.[3] The study identified 167 patients infected with the Delta variant in an outbreak in Guangdong. The mean estimates of the latent period and the incubation period were 4.0 and 5.8 days, respectively. A relatively higher viral load was observed in Delta cases than in the 49 non-VOC SARS-CoV-2

infections. The study also found the secondary attack rate among close contacts of Delta cases was 1.4%, and 73.9% (95% CI: 67.2%- 81.3%) of the transmissions occurred before onset of symptoms. Index cases without vaccination (OR: 2.84, 95% CI: 1.19, 8.45) or with a single dose of vaccination (OR: 6.02, 95% confidence interval: 2.45, 18.16) were more likely to transmit infection to their contacts than those who had received two doses of vaccination.[3] Although this study provides insight into differences in the incubation period and secondary transmission of the Delta variant, these are preliminary findings specific to one outbreak and further studies will aid in understanding how these findings can be generalized to other contexts.

A large national cohort study from the United Kingdom found higher risk of admission to hospital or emergency care for COVID-19 patients infected with the Delta variant as compared to those infected with the Alpha variant.[4] In this study, 2.3% (196/8682) patients infected with the Delta variant versus 2.2% (764/34 656) patients infected with the Alpha variant were admitted to hospital within 14 days after the first positive specimen was collected (adjusted hazard ratio [HR] 2.26 [95% CI 1.32–3.89]). Additionally, the HR for hospital admission with the addition of attendance to emergency care was higher in patients infected with the Delta variant within 14 days (5.7%) than those infected with the Alpha variant (4.2%) (adjusted HR 1.45 [1.08–1.95]).[4] Nearly three quarters (74%) of all individuals, across both groups included in the study, were unvaccinated. Overall, these findings suggest that outbreaks of the Delta variant may lead to a greater burden on health-care services than the Alpha variant, a burden which may be even greater in largely unvaccinated populations.

Table 2: Summary of phenotypic impacts* of Variants of Concern

WHO label	Alpha	Beta	Gamma	Delta
Transmissibility	Increased transmissibility[5]	Increased transmissibility[6,7]	Increased transmissibility[7,8]	Increased transmissibility and secondary attack rate[7,9]
Disease severity	Increased risk of hospitalization[10], possible increased risk of severity and mortality[11,2]	Not confirmed, possible increased risk of in-hospital mortality[12]	Not confirmed, possible increased risk of hospitalization[13]	Increased risk of hospitalization[14]
Risk of reinfection	Neutralizing activity retained [15], risk of reinfection remains similar[16]	Reduction in neutralizing activity reported; T cell response elicited by D614G virus remains effective[17]	Moderate reduction in neutralizing activity reported[18]	Reduction in neutralizing activity reported[19–21]
Impacts on diagnostics	Limited impact – S gene target failure (SGTF); no impact on overall result from multiple target RT-PCR, No impact on Ag RDTs observed[22]	No impact on RT-PCR or Ag RDTs observed[21]	None reported to date	None reported to date

**Generalized findings as compared to previously/co-circulating variants. Based on emerging evidence, including non-peer-reviewed preprint articles and reports, all subject to ongoing investigation and revision.*

Table 3. Summary of vaccine performance against Variants of Concern

	Anhui ZL-Recombinant	AstraZeneca-Vaxzevria	Beijing CNBG-BBIBP-CorV	Bharat-Covaxin	Gamaleya-Sputnik V	Janssen-Ad26.COV 2.5	Moderna-mRNA-1273	Moderna-mRNA-1273/ Pfizer BioNTech-Comirnaty	Novavax-Covavax	Pfizer BioNTech-Comirnaty	SII - Covishield	Sinovac-CoronaVac
Alpha[23,24]												
Summary of VE*						Protection retained against all outcomes						
- Severe disease	-	↓$_1$	-	-	-	-	↔$_1$	↔$_1$	-	↔$_4$	-	-
- Symptomatic disease	-	↔to↓$_3$	-	-	-	-	↔$_1$	↔$_1$	↓$_1$	↔$_3$	-	-
- Infection	-	↔to↓$_2$	-	-	-		↔$_1$	-	-	↔$_2$	-	-
Neutralization	↔$_2$	↓$_5$	↔$_1$	↔$_2$	↔$_3$	↔$_3$	↔to↓$_{11}$	↓$_1$	↓$_1$	↔to↓$_{37}$	↔$_1$	↔to↓$_5$
Beta[25–28]												
Summary of VE*						Protection retained against severe disease; reduced protection against symptomatic disease; limited evidence						
- Severe disease	-	-	-	-	-	↔$_1$	-	-	-	↔$_2$	-	-
- Symptomatic disease	-	↓↓↓$_1$	-	-	-	↔$_1$	-	-	↓↓↓$_1$	↔$_1$	-	-
- Infection	-	-	-	-	-	-	↔$_1$	-	-	↓$_1$	-	-
Neutralization	↔to↓$_3$	↔to↓↓$_6$	↔to↓$_2$	↓$_2$	↓to↓↓$_3$	↓to↓↓$_5$	↓to↓↓$_{13}$	↓↓↓$_1$	↓↓↓$_1$	↓to↓↓$_{34}$	↓$_1$	↓to↓↓$_4$
Gamma												
Summary of VE*						Unclear impact; very limited evidence						
- Severe disease	-	-	-	-	-	-	-	-	-	-	-	-
- Symptomatic disease	-	-	-	-	-	-	-	-	-	-	-	-
- Infection	-	-	-	-	-	-	-	-	-	-	-	↔$_1$
Neutralization	↔$_1$	↓$_2$	-	-	↓$_2$	↓$_2$	↓$_6$	-	-	↔to↓$_{18}$	-	↔to↓$_3$
Delta[29]												
Summary of VE*						Protection retained against severe disease; possible reduced protection against symptomatic disease and infection; limited evidence						
- Severe disease	-	↔$_1$	-	-	-	-	↔$_1$	-	-	↔$_4$	-	-
- Symptomatic disease	-	↓↓$_2$	-	↓$_1$	-	-	-	-	-	↔to↓$_3$	-	-
- Infection	-	↓$_1$	-	-	-	-	-	-	-	↓$_1$	-	-
Neutralization	↔to↓$_2$	↓to↓↓$_5$	-	↔to↓$_3$	↓$_2$	↓$_3$	↓$_4$	↓↓$_1$	-	↓to↓↓$_{10}$	↓$_2$	↓to↓↓↓$_2$

VE refers to vaccine effectiveness and vaccine efficacy

Summary of VE*: indicates the general conclusions but only for the vaccines evaluated against the specific variant

Arrows generalize the magnitude of reduction in VE or neutralization: "↔" <10% reduction in VE, or VE >90% with no comparator, or that there was a <2-fold reduction in neutralization; "↓" 10 to <20% reduction in VE, or 2 to <5-fold reduction in neutralization; "↓↓" 20 to <30% reduction in VE, or 5 to <10-fold reduction in neutralization; "↓↓↓" ≥30% reduction in VE, or ≥10-fold reduction in neutralization. When more than one neutralization study is available, the interquartile range (25th and 75th percentiles) of fold-reductions across all studies for specific vaccine/variant was used.

"Moderna-mRNA-1273/Pfizer BioNTech-Comirnaty" indicates that both vaccines were evaluated together in study.

The number of studies is shown as subscripts: vaccine effectiveness and neutralization studies informing this table can be found on the VIEW-hub Resources page (https://view-hub.org/resources). For individual vaccine effectiveness studies, see 'COVID-19 Vaccine Effectiveness Results Summary', reference numbers noted with a '#'. For a list of all neutralization studies, see 'COVID-19 Vaccine Neutralization Studies Table'.

References indicated by superscripts next to VOC name in column 1 are vaccine efficacy results from randomized controlled trials informing this table and are included in the reference section below.

Since the 24 August update, three studies have been published that have assessed vaccine effectiveness against SARS-CoV-2 variants of concern.

A retrospective cohort study (preprint) from the United States of America evaluated the effectiveness of the Pfizer BioNTech-Comirnaty vaccine against documented infection and hospitalization due to the Delta variant seven or more days after receiving the second dose, among persons ≥ 12 years of age in a large healthcare system.[30] VE against Delta infection was lower than that against infection due to non-Delta variants [75%, (95% CI: 71-78%) vs. 91% (95% CI: 88-92%)]. The decreased VE for Delta infection is likely explained by multiple factors including but not limited to confounding effect of waning VE and inherent properties of Delta variants that influence immune escape. Given that the Delta variant became dominant in June, the timing of most Delta infections included in this study likely occurred after longer intervals post-vaccination as compared to that of non-Delta infections. When stratifying by time since vaccination, VE against infection due to Delta was high (93%) one month after full vaccination but dropped to 53% four or more months after full vaccination. While a decrease in VE was also observed for non-Delta variants as the time since full vaccination increased, this decrease was less pronounced (97% at one month vs. 67% at four months post vaccination), which, although not statistically significantly different from the findings for Delta, could suggest that waning may be more pronounced for Delta than other variants. VE against hospitalization due to Delta remained high at 90% (95% CI: 89-92%) and was comparable to the VE against hospitalization due to non-Delta variants of 95% (95% CI: 90-98%).

A second retrospective cohort study (preprint) of over 9 million individuals ≥ 16 years of age in Israel assessed the effectiveness of Pfizer BioNTech-Comirnaty in preventing infection and severe disease during the month of July when Delta was the predominant variant.[31] The study evaluated the VE among persons vaccinated more recently compared to those vaccinated earlier. For persons fully vaccinated two months prior, VE against infection ranged from 73%-80% by age group, whereas VE for persons vaccinated six months prior ranged from 50-58% by age group. For all age groups, VE against infection decreased with increasing age at time of vaccination. However, consistent with the above study from the United States of America, investigators found that VE against severe disease remained high for persons 40 years and older vaccinated six months prior. (VE of 94% for persons 40-59 years and 86% for persons ≥ 60 years of age). Of note, this study did not compare VE for Delta against other variants, so the relative VE by variant was not presented.

A third study (preprint) used a test-negative design to evaluate the effectiveness of Pfizer BioNTech-Comirnaty against infection and severe disease due to Alpha, Beta, and Delta variants, separately, among individuals ≥ 16 years in Qatar.[32] VE against infection due to Alpha, Beta, and Delta five to nine weeks post second dose was 82.2% (95% CI: 72.1-89.0%), 52.7% (95% CI: 40.3-62.7%), and 72.0% (95% CI: 60.5-80.5%), respectively. VE against infection showed a general trend of decreasing VE after five to nine weeks post second dose for all variants through to ≥ 25 weeks post second dose, with 0% VE for the Alpha and Delta variants beyond 20 weeks. VE against infection due to each of the variants was lower than that observed in other studies, although the Qatar study was different in that most infections were asymptomatic. VE against severe, critical and fatal disease at five to nine weeks post second dose was high for all variants: 100.0% (95% CI: 0.0-100%), 94.6% (95% CI: 63.5-99.9%), and 100% (95% CI: 74.3-100%) for the Alpha, Beta, and Delta variants, respectively. VE against hospitalization and at later time points after vaccination remained high, but it is not possible to interpret the waning VE against severe disease because there were very small numbers of subjects and wide confidence intervals for these later time points.

In addition to the above studies, two recent studies from Israel evaluated the short-term relative effectiveness of a third dose of Pfizer BioNTech-Comirnaty in preventing infection and severe disease compared to those who received two doses of vaccine, during the past month when Delta was the dominant circulating strain.[33,34] One study found that a third dose of the vaccine decreased the relative risk of infection

and of severe disease ≥ 12 or more days post vaccination by 11.4- and 15.5-fold, respectively compared to persons receiving two doses of the vaccine. In a second study, 79% (95% CI: 72-84%) of infections 14-20 days post vaccination were estimated to have been prevented by a third dose of the vaccine compared to persons receiving two doses. Of note, neither of these studies provide the absolute VE compared to an unvaccinated group, as was done in the previously mentioned studies of fully vaccinated persons.

Similar to the studies included in the 24 August update, these studies provide additional evidence for continued high VE of Pfizer BioNTech-Comirnaty against severe COVID-19 due to the Delta variant. There is some evidence from multiple studies that VE against SARS-CoV-2 infection and non-severe disease may be reduced with Delta. However, it is challenging to separate the effect of Delta from the effect of potential waning immunity, as Delta circulation in most countries became dominant several months after vaccine introduction. In addition, differential risk of exposure profiles between vaccinated and unvaccinated populations, as well as early versus late vaccines, increasing levels of natural immunity in the unvaccinated population over time, or other potential confounding factors, complicate interpretation of VE estimates over time. Furthermore, the study from Qatar provides additional evidence of reduced Pfizer BioNTech-Comirnaty effectiveness against infection due to Beta, consistent with previous studies. Additional studies, over longer time periods and in different settings are needed to further support these initial findings.

Additional notes on VOC impacts on vaccines

- Studies presenting VOC-specific vaccine efficacy or effectiveness (VE) estimates for full vaccination (≥ 7 days post final dose) are assessed against a comparator VE estimate for that vaccine product to determine level of reduction in VE. For symptomatic disease, VOC VE is compared against phase 3 randomised RCT results from non-VOC settings. For severe disease and infection, VOC VE is compared to non-VOC VE estimates from the same study when available (or to Alpha VE from same study when assessing Beta, Gamma, or Delta); with an exception for AstraZeneca Vaxzevria for severe disease (phase 3 RCT efficacy estimates against severe disease are used as comparator since a within study comparator is unavailable) and for infection (when phase 3 estimate of VE against infection due to non-VOC is available and used as comparator). In some instances, a study may be included for severe disease or infection outcome even without a comparator if a very high VE estimate is reported against a VOC (i.e., >90%).

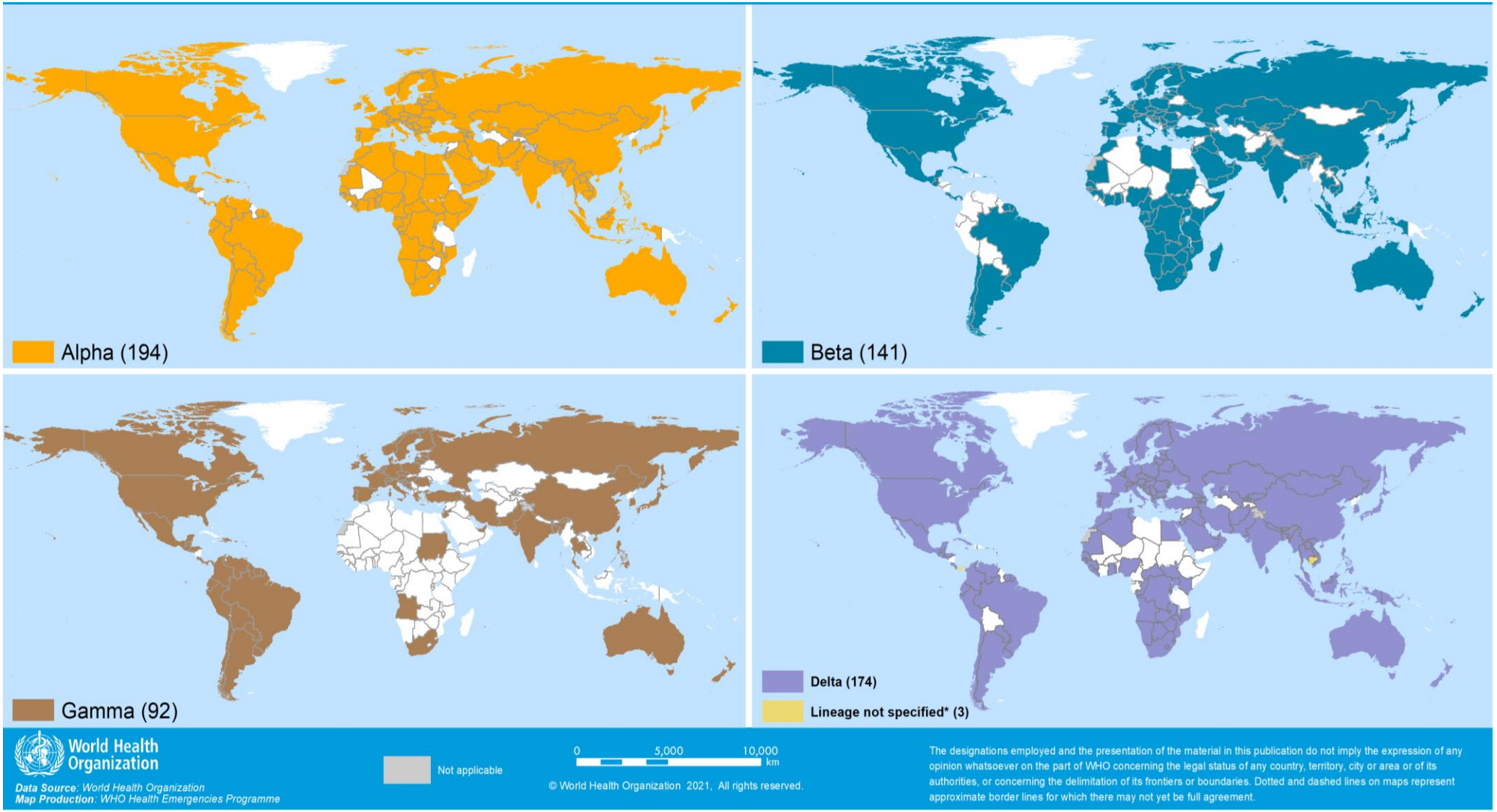
- It is also important to note that studies vary in population, outcome definitions, study design and other methodological considerations, which may in part explain differences when comparing VE estimates for a product between different studies. In addition, the reductions summarized in the table represent VE point estimates and do not represent the uncertainty intervals around these estimates which vary substantially across studies. The reductions in VE noted should be interpreted with these limitations in mind.
- Some VE estimates may not be included in the table above when it is not possible to tease out the effect of waning from the effect of variants on vaccine performance.

Table 3 presents the impact of variants on product specific vaccine efficacy/effectiveness (VE) and quantifies the reduction in VE in the setting of variants compared to VE in non-VOC settings. Of note, reductions in VE do not necessarily mean loss of protection, as indicated by the absolute VE estimate. For example, a 10-percentage point reduction in VE against symptomatic disease for mRNA vaccines would still mean high vaccine effectiveness of ~85%. In addition, vaccines have shown higher VE against severe disease; thus, small reductions in VE against severe disease due to VOCs may still mean substantial protection, as is the case for AstraZeneca-Vaxzevria.

Additional resources

- Tracking SARS-CoV-2 Variants
- COVID-19 new variants: Knowledge gaps and research
- Genomic sequencing of SARS-CoV-2: a guide to implementation for maximum impact on public health
- Considerations for implementing and adjusting public health and social measures in the context of COVID-19

Figure 4. Countries, territories and areas reporting variants Alpha, Beta, Gamma and Delta, as of 7 September 2021**



**Includes countries/territories/areas reporting the detection of B.1.617 without further specification of lineage at this time. These will be reallocated as further details become available.*

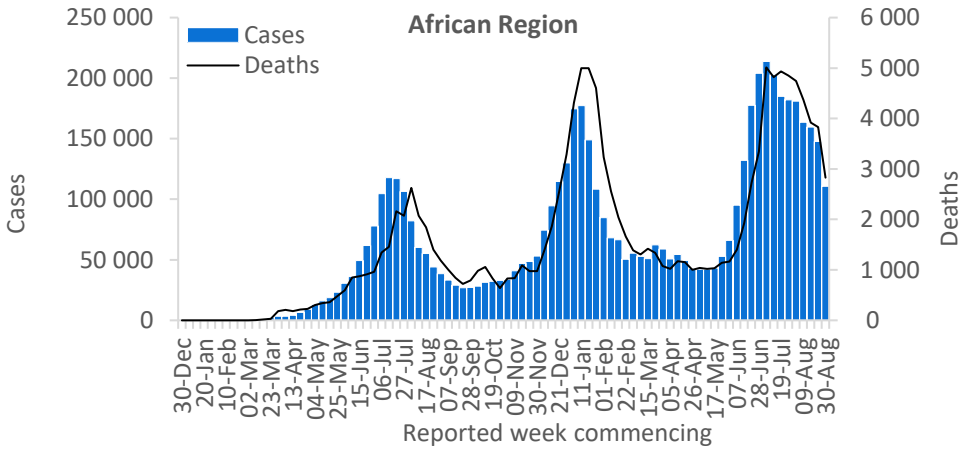
***Countries/territories/areas highlighted include both official and unofficial reports of VOC detections, and do not presently differentiate between detections among travellers (e.g., at Points of Entry) or local community cases. Please see Annex 2 for further details.*

WHO regional overviews – Epidemiological week 30 Aug–5 Sep 2021

African Region

The African Region continued to report substantial declines in incidence of both cases and deaths. This week the Region reported over 110 000 new cases and over 2800 new deaths, decreases of 25% and 26%, respectively, as compared to the previous week. These declining trends for the Region's third wave are encouraging, and largely driven by continued declines in South Africa. Nonetheless, several countries continued to report increasing trends in cases (> 30%) this week while mortality continued to increase, albeit at a lower proportion (>10%) in five countries. The highest numbers of new cases were reported from South Africa (56 823 new cases; 95.8 new cases per 100 000 population; a 26% decrease), Ethiopia (8391 new cases; 7.3 new cases per 100 000; a 17% decrease), and Botswana (5524 new cases; 234.9 new cases per 100 000; a 25% decrease).

The highest numbers of new deaths were reported from South Africa (1700 new deaths; 2.9 new deaths per 100 000 population; a 23% decrease), Algeria (194 new deaths; <1 new death per 100 000; similar to the previous week), and Nigeria (127 new deaths; <1 new death per 100 000; a 26% increase).

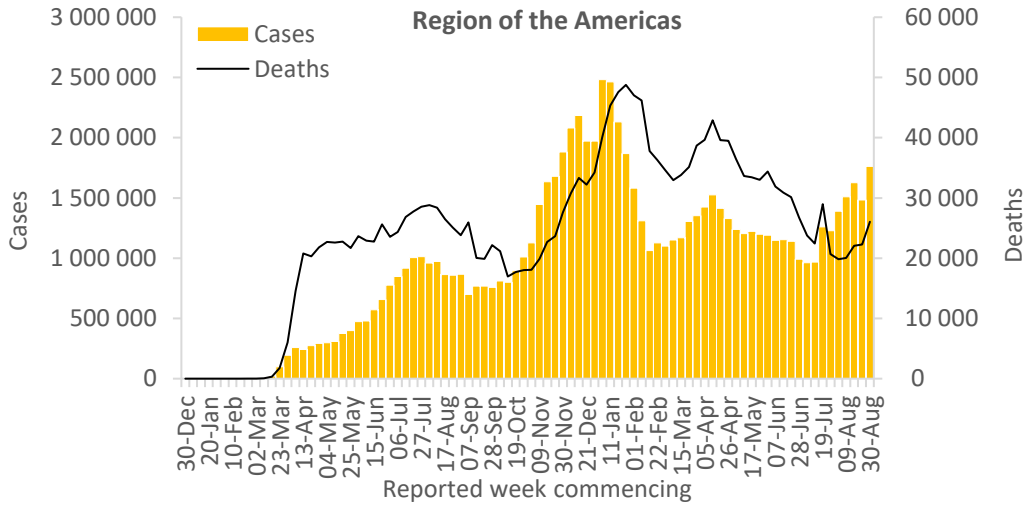


Updates from the African Region

Region of the Americas

The Region of the Americas reported marked increases in the number of cases and deaths in the past week. With over 1.7 million new cases and over 26 000 new deaths, increases of 19% and 17%, respectively. These are the largest regional proportionate increases in cases at the regional level as compared to the previous week. The highest numbers of new cases were reported from the United States of America (1 297 399 new cases; 392.0 new cases per 100 000; a 38% increase), Brazil (152 154 new cases; 71.6 new cases per 100 000; a 13% decrease), and Mexico (93 977 new cases; 72.9 new cases per 100 000; an 18% decrease).

The highest numbers of new deaths were reported from the United States of America (11 946 new deaths; 3.6 new deaths per 100 000; a 63% increase), Mexico (5071 new deaths; 3.9 new deaths per 100 000; similar to the previous week), and Brazil (4344 new deaths; 2.0 new deaths per 100 000; a 10% decrease).

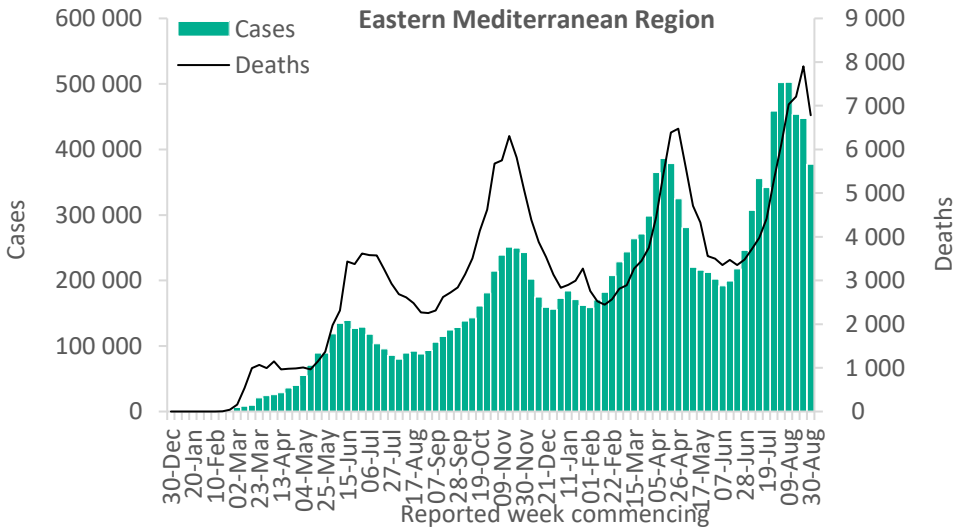


Updates from the Region of the Americas

Eastern Mediterranean Region

The Eastern Mediterranean Region reported over 377 000 new cases and over 6700 new deaths, decreases of 16% and 14%, respectively, as compared to the previous week. The downward trend in the number of new cases reflects the decrease in case incidence from the top three countries reporting the highest numbers in the Region; the Islamic Republic of Iran (208 089 new cases; 247.7 new cases per 100 000; an 18% decrease), Iraq (44 043 new cases; 109.5 new cases per 100 000; a 10% decrease), and Morocco (31 510 new cases; 85.4 new cases per 100 000; a 27% decrease). These three countries accounted for over 75% of all new cases in the Eastern Mediterranean. However, six of 22 countries in the Region, including Djibouti, Egypt, occupied Palestinian territory, Oman, Syrian Arab Republic and Yemen reported increases in case incidence.

The highest numbers of new deaths were reported from the Islamic Republic of Iran (4163 new deaths; 5.0 new deaths per 100 000; an 8% decrease), Morocco (632 new deaths; 1.7 new deaths per 100 000; an 8% decrease), and Pakistan (579 new deaths; 0.3 new deaths per 100 000; a 16% decrease).

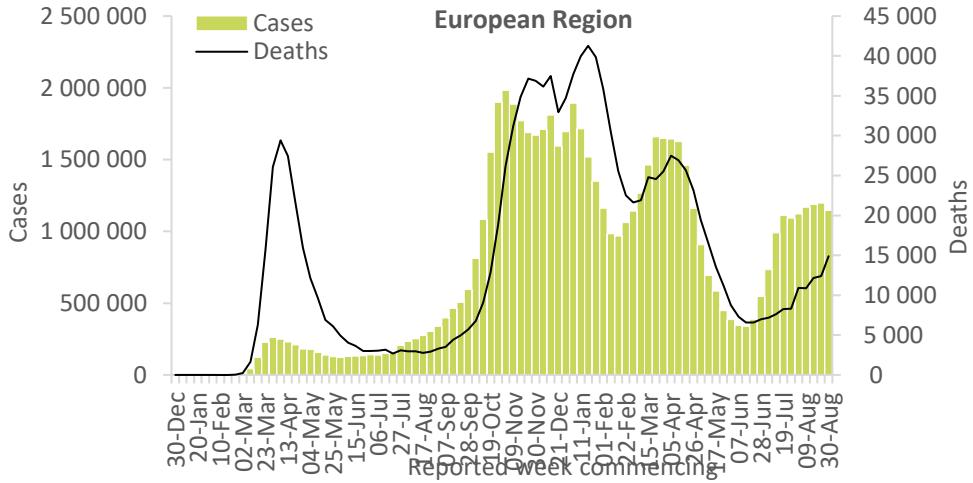


Updates from the Eastern Mediterranean Region

European Region

While the European Region reported a number of new cases similar to that of the past week, with over 1.1 million new cases, the number of deaths increased by 20% with over 14 000 new deaths as compared to the previous week. Almost half (29/61) of the countries reported an increase in death incidence compared to last week. However, in a few countries in the Region where relatively high vaccination coverage and high case incidence were reported, death incidence was relatively low compared to that of countries with low vaccination coverage. The highest numbers of new cases were reported from the United Kingdom (243 125 new cases; 358.1 new cases per 100 000; similar to the previous week), Turkey (149 114 new cases; 176.8 new cases per 100 000; a 13% increase), and the Russian Federation (129 772 new cases; 88.9 new cases per 100 000; similar to the previous week).

The highest numbers of new deaths were reported from the Russian Federation (5563 new deaths; 3.8 new deaths per 100 000; similar to the previous week), Turkey (1879 new deaths; 2.2 new deaths per 100 000; a 15% increase), and Kazakhstan (1768 new deaths; 9.4 new deaths per 100 00).

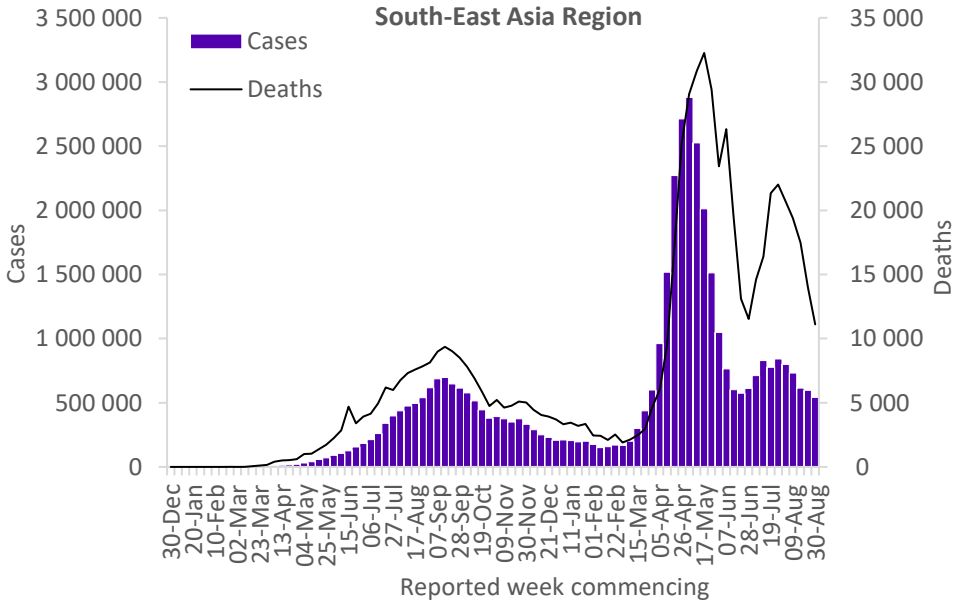


Updates from the European Region

South-East Asia Region

The South-East Asia Region reported over 543 000 new cases and over 11 000 new deaths, decreases of 9% and 21%, respectively, as compared to the previous week. Despite the overall regional decline in case incidence, India, Myanmar and the Maldives reported increases in the number of cases of 8%, 24% and 43%, respectively, as compared to the previous week. The highest numbers of new cases were reported from India (293 643 new cases; 21.3 new cases per 100 000; an 8% increase), Thailand (106 443 new cases; 152.5 new cases per 100 000; a 15% decrease), and Indonesia (55 189 new cases; 20.2 new cases per 100 000; a 42% decrease).

All countries except for Sri Lanka and Timor-Leste reported decreases in weekly mortality by more than 5%. The highest numbers of new deaths were reported from Indonesia (3938 new deaths; 1.4 new deaths per 100 000; a 29% decrease), India (2703 new deaths; <1 new deaths per 100 000; a 22% decrease), and Thailand (1712 new deaths; 2.5 new deaths per 100 000; a 6% decrease).

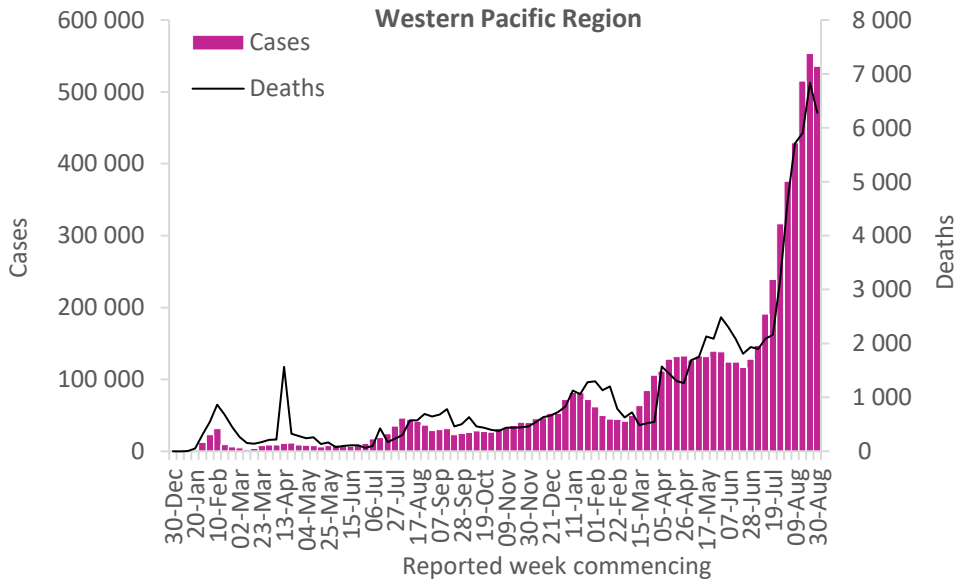


Updates from the South-East Asia Region

Western Pacific Region

The Western Pacific Region reported over 531 000 new cases, a similar number as the previous week, and over 6200 new deaths, an 8% decrease compared to the previous week. Although the absolute numbers of cases and deaths remain very high, this is the first week in over two months in which declining trends in the number of deaths were reported. The highest numbers of new cases were reported from Malaysia (138 929 new cases; 429.2 new cases per 100 000; an 8% decrease), the Philippines (125 470 new cases; 114.5 new cases per 100 000; a 12% increase), and Japan (122 628 new cases; 97.0 new cases per 100 000; a 22% decrease).

The highest numbers of new deaths were reported from Viet Nam (2388 new deaths; 2.5 new deaths per 100 000; a 17% decrease), Malaysia (2081 new deaths; 6.4 new deaths per 100 000; a 12% increase), and the Philippines (1054 new deaths; 1.0 new deaths per 100 000; a 25% decrease).



Updates from the Western Pacific Region

Summary of the COVID-19 Weekly Operational Update

The Weekly Operational Update (WOU) is a report provided by the COVID-19 Strategic preparedness and response plan (SPRP) monitoring and evaluation team which aims to update on the ongoing global progress against the COVID-19 SPRP 2021 framework.

In this week's edition of the COVID-19 Weekly Operational Update, published on 6 September, highlights of country-level actions and WHO support to countries include:

- Shipment of medical supplies to Viet Nam
- Engagement of the African Regional Monitoring of Vaccine Effectiveness (AFRO-MoVE) in 17 countries
- Scale-up capacity for real-time PCR testing for SARS-CoV-2 and biosafety in Montenegro at the subnational level
- Risk Communications and Community Engagement support hotline in Thailand
- Civil Society engagement in North-West Syria
- Updates on WHO's Early AI-Powered Social Listening Tool (EARS) to support country infodemic management
- Inauguration of the WHO Hub for Pandemic and Epidemic Intelligence in Berlin
- Progress on a subset of indicators from the SPRP 2021 Monitoring and Evaluation Framework
- Updates on WHO's financing to support countries in SPRP 2021 implementation and provision of critical supplies.

For more information, see the Weekly operational update on COVID-19

Annex

- COVID-19 confirmed cases and deaths reported in the last seven days by countries, territories and areas, and WHO Region (reported in previous issues) are now available at: https://covid19.who.int/table.

Annex 1. List of countries/territories/areas reporting Variants of Concern as of 7 September 2021**

Country/Territory/Area	Alpha	Beta	Gamma	Delta	Unspecified B.1.617
Afghanistan	●	-	-	●	-
Albania	●	-	-	○	-
Algeria	●	-	-	●	-
Andorra	○	○	-	○	-
Angola	●	●	●	●	-
Anguilla	●	-	-	●	-
Antigua and Barbuda	●	●	●	●	-
Argentina	●	●	●	●	-
Armenia	●	-	-	●	-
Aruba	●	●	●	●	-
Australia	●	●	●	●	-
Austria	●	●	●	●	-
Azerbaijan	●	-	-	○	-
Bahamas	●	-	-	-	-
Bahrain	●	●	●	●	-
Bangladesh	●	●	●	●	-
Barbados	●	-	●	●	-
Belarus	●	-	-	○	-
Belgium	●	●	●	●	-
Belize	●	-	●	●	-
Benin	●	-	-	-	-
Bermuda	●	●	-	●	-
Bhutan	●	●	-	●	-
Bolivia (Plurinational State of)	●	-	●	-	-
Bonaire	●	-	●	●	-
Bosnia and Herzegovina	●	●	●	○	-
Botswana	○	●	-	●	-
Brazil	●	●	●	●	-
British Virgin Islands	●	-	●	●	-
Brunei Darussalam	●	●	-	○	-
Bulgaria	●	●	-	●	-
Burkina Faso	●	-	-	-	-
Burundi	●	●	-	●	-
Cabo Verde	●	-	-	●	-
Cambodia	●	●	-	●	●*
Cameroon	●	●	-	-	-
Canada	●	●	●	●	-
Cayman Islands	●	●	●	●	-
Central African Republic	●	●	-	●	-
Chad	●	-	-	-	-
Chile	●	●	●	●	-
China	●	●	●	○	-
Colombia	●	-	●	●	-
Comoros	●	●	-	-	-
Congo	●	○	-	●	-
Costa Rica	●	●	●	●	-
Croatia	●	●	●	○	-
Cuba	●	●	-	●	-
Curaçao	●	●	●	●	●
Cyprus	●	●	-	○	-
Czechia	●	●	●	●	-
Côte d'Ivoire	●	●	-	-	-
Democratic Republic of the Congo	●	●	-	●	-
Denmark	●	●	●	●	-
Djibouti	●	●	-	-	-
Dominica	●	-	-	●*	-
Dominican Republic	●	-	●	-	-
Ecuador	●	-	●	●	-
Egypt	●	-	-	●	-
El Salvador	●	-	●	●	-
Equatorial Guinea	●	●	-	-	-
Estonia	●	●	○	○	-
Eswatini	●*	●	-	●	-
Ethiopia	●	-	-	-	-
Falkland Islands (Malvinas)	●	●	-	-	-
Faroe Islands	●	-	●	-	-
Fiji	-	-	-	●	-
Finland	●	●	●	●	-

Country/Territory/Area	Alpha	Beta	Gamma	Delta	Unspecified B.1.617
France	●	●	●	●	-
French Guiana	●	●	●	●	-
French Polynesia	●	●	●	●	-
Gabon	●	●	-	-	-
Gambia	●	-	-	●	-
Georgia	●	○	-	●	-
Germany	●	●	●	●	-
Ghana	●	●	-	●	-
Gibraltar	●	-	-	○	-
Greece	●	●	●	●	-
Grenada	●	-	-	●	-
Guadeloupe	●	●	●	●	-
Guam	●	●	●	●	-
Guatemala	●	●	●	●	-
Guinea	●	○	-	●*	-
Guinea-Bissau	●	●	-	●*	-
Guyana	-	-	●	-	-
Haiti	●	-	●	-	-
Honduras	●	-	●*	●*	-
Hungary	●	○	●	○	-
Iceland	●	-	-	-	-
India	●	●	●	●	-
Indonesia	●	●	-	●	-
Iran (Islamic Republic of)	●	●	●	●	-
Iraq	●	●	-	●	-
Ireland	●	●	●	●	-
Israel	●	●	●	●	-
Italy	●	●	●	●	-
Jamaica	●	-	-	●	-
Japan	●	●	●	●	-
Jordan	●	●	●	●	-
Kazakhstan	●	○	-	●	-
Kenya	●	●	-	●	-
Kosovo[1]	●	○	-	○	-
Kuwait	●	●	-	●	-
Kyrgyzstan	●	●	-	●	-
Lao People's Democratic Republic	●	-	-	●	-
Latvia	●	●	●	○	-
Lebanon	●	-	-	●	-
Lesotho	-	●	-	●	-
Liberia	●	-	-	○	-
Libya	●	●	-	-	-
Liechtenstein	●	-	-	○	-
Lithuania	●	●	●	○	-
Luxembourg	●	●	●	●	-
Madagascar	-	●	-	-	-
Malawi	●	●	-	●	-
Malaysia	●	●	-	●	-
Maldives	●	-	-	●	-
Malta	●	○	●	○	-
Martinique	●	●	●	●	-
Mauritania	●	●	-	●	-
Mauritius	●	●	-	●	-
Mayotte	●	●	-	-	-
Mexico	●	●	●	●	-
Monaco	●	●	-	●	-
Mongolia	●	-	-	●	-
Montenegro	●	-	○	○	-
Montserrat	●	-	●	-	-
Morocco	●	●	-	●	-
Mozambique	●	●	-	●	-
Myanmar	●	-	-	●	-
Namibia	●	●	-	●	-
Nepal	●	-	-	●	-
Netherlands	●	●	●	●	-
New Caledonia	●	-	-	-	-
New Zealand	●	●	○	○	-
Niger	●	-	-	-	-
Nigeria	●	●	-	●	-
North Macedonia	●	●	-	○	-
Northern Mariana Islands (Commonwealth of the)	○	-	-	●	-
Norway	●	●	●	●	-
Occupied Palestinian Territory	●	●	-	●	-
Oman	●	●	-	●	-
Pakistan	●	●	●	●	-
Panama	●	●	●	●	●
Papua New Guinea	-	-	-	●	-
Paraguay	●	-	●	●	-
Peru	●	-	●	●	-
Philippines	●	●	●	●	-
Poland	●	○	●	●	-
Portugal	●	●	●	●	-
Puerto Rico	●	●	●	●	-
Qatar	●	●	-	●	-
Republic of Korea	●	●	●	●	-

Country/Territory/Area	Alpha	Beta	Gamma	Delta	Unspecified B.1.617
Republic of Moldova	●	-	-	●	-
Romania	●	●	●	●	-
Russian Federation	●	●	○	●	-
Rwanda	●	●	-	●	-
Réunion	●	●	●	○	-
Saba	-	-	-	●	-
Saint Barthélemy	●	-	-	-	-
Saint Kitts and Nevis	-	-	-	●	-
Saint Lucia	●	-	-	●	-
Saint Martin	●	●	-	-	-
Saint Pierre and Miquelon	-	-	-	●	-
Saint Vincent and the Grenadines	-	-	-	●	-
Sao Tome and Principe	○	-	-	-	-
Saudi Arabia	●	●	-	●	-
Senegal	●	●	-	●	-
Serbia	●	-	-	●	-
Seychelles	●	●	-	●	-
Sierra Leone	-	-	-	○	-
Singapore	●	●	●	●	-
Sint Maarten	●	●	●	●	-
Slovakia	●	●	-	●	-
Slovenia	●	●	●	●	-
Somalia	●	●	-	-	-
South Africa	●	●	○	●	-
South Sudan	●	●	-	●	-
Spain	●	●	●	●	-
Sri Lanka	●	●	-	●	-
Sudan	●	●	●	-	-
Suriname	●	●	●	●	-
Sweden	●	●	●	●	-
Switzerland	●	●	●	●	-
Thailand	●	●	●	●	-
Timor-Leste	●	-	-	●	-
Togo	●	●	-	○	-
Trinidad and Tobago	●	-	●	●	-
Tunisia	●	●	-	●	-
Turkey	●	●	●	●	-
Turks and Caicos Islands	●	-	●	●	-
Uganda	●	●	-	●	-
Ukraine	●	○	-	○	-
United Arab Emirates	●	●	●	●	-
United Kingdom	●	●	●	●	-
United Republic of Tanzania	-	●	-	-	-
United States Virgin Islands	●	●	-	●	-
United States of America	●	●	●	●	-
Uruguay	●	●	●	●	-
Uzbekistan	●	●	-	○	-
Venezuela (Bolivarian Republic of)	●	-	●	●	-
Viet Nam	●	●	-	●	-
Wallis and Futuna	●	-	-	-	-
Yemen	●	●	-	-	-
Zambia	●	●	-	●	-
Zimbabwe	-	●	-	●	-

**Newly reported in this update.*
"Unspecified B.1.617" reflects countries/territories/areas reporting detection of B.1.617 without further specification of lineage at this time. These will be reallocated as further details become available.
"●" indicates that information for this variant was received by WHO from official sources.
"○" indicates that information for this variant was received by WHO from unofficial sources and will be reviewed as more information become available.
****Includes countries/territories/areas reporting the detection of VOCs among travelers (e.g., imported cases detected at points of entry), or local cases (detected in the community). Excludes countries, territories, and areas that have never reported the detection of a variant of concern*

See also Annex 2: Data, table and figure notes.

Annex 2. Data, table and figure notes

Data presented are based on official laboratory-confirmed COVID-19 case and deaths reported to WHO by country/territories/areas, largely based upon WHO case definitions and surveillance guidance. While steps are taken to ensure accuracy and reliability, all data are subject to continuous verification and change, and caution must be taken when interpreting these data as several factors influence the counts presented, with variable underestimation of true case and death incidence, and variable delays to reflecting these data at global level. Case detection, inclusion criteria, testing strategies, reporting practices, and data cut-off and lag times differ between countries/territories/areas. A small number of countries/territories/areas report combined probable and laboratory-confirmed cases. Differences are to be expected between information products published by WHO, national public health authorities, and other sources. Due to public health authorities conducting data reconciliation exercises which remove large numbers of cases or deaths from their total counts, negative numbers may be displayed in the new cases/deaths columns as appropriate. When additional details become available that allow the subtractions to be suitably apportioned to previous days, graphics will be updated accordingly.

A record of historic data adjustment made is available upon request by emailing epi-data-support@who.int. Please specify the country(ies) of interest, time period(s), and purpose of the request/intended usage. Prior situation reports will not be edited; see covid19.who.int for the most up-to-date data.

The designations employed, and the presentation of these materials do not imply the expression of any opinion whatsoever on the part of WHO concerning the legal status of any country, territory or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. Dotted and dashed lines on maps represent approximate border lines for which there may not yet be full agreement. Countries, territories and areas are arranged under the administering WHO region. The mention of specific companies or of certain manufacturers' products does not imply that they are endorsed or recommended by WHO in preference to others of a similar nature that are not mentioned. Errors and omissions except, the names of proprietary products are distinguished by initial capital letters.

[1] All references to Kosovo should be understood to be in the context of the United Nations Security Council resolution 1244 (1999). In the map, number of cases of Serbia and Kosovo (UNSCR 1244, 1999) have been aggregated for visualization purposes.

Technical guidance and other resources

- WHO technical guidance
- WHO COVID-19 Dashboard
- WHO Weekly Operational Updates on COVID-19
- WHO COVID-19 case definitions
- COVID-19 Supply Chain Inter-Agency Coordination Cell Weekly Situational Update
- Research and Development
- OpenWHO courses on COVID-19 in official UN languages and in additional national languages
- WHO Academy COVID-19 mobile learning app
- The Strategic Preparedness and Response Plan (SPRP) outlining the support the international community can provide to all countries to prepare and respond to the virus
- Recommendations and advice for the public:
  - Protect yourself
  - Questions and answers
  - Travel advice
- EPI-WIN: tailored information for individuals, organizations and communities

References

1. McAlister FA, Nabipoor M, Chu A, Lee DS, Saxinger L, Bakal JA. *Lessons from the COVID-19 Third Wave in Canada: The Impact of Variants of Concern and Shifting Demographics*. Infectious Diseases (except HIV/AIDS); 2021. doi:10.1101/2021.08.27.21261857
2. Pascall DJ, Mollett G, Blacow R, Bulteel N, et al. The SARS-CoV-2 Alpha variant causes increased clinical severity of disease. https://www.medrxiv.org/content/10.1101/2021.08.17.21260128v1
3. Kang M, Xin H, Yuan J, et al. Transmission dynamics and epidemiological characteristics of Delta variant infections in China. *medRxiv*. Published online January 1, 2021:2021.08.12.21261991. doi:10.1101/2021.08.12.21261991
4. Twohig KA, Nyberg T, Zaidi A, et al. Hospital admission and emergency care attendance risk for SARS-CoV-2 delta (B.1.617.2) compared with alpha (B.1.1.7) variants of concern: a cohort study. *Lancet Infect Dis*. Published online August 27, 2021:S1473-3099(21)00475-8. doi:10.1016/S1473-3099(21)00475-8
5. Buchan SA, Tibebu S, Daneman N, et al. Increased household secondary attacks rates with Variant of Concern SARS-CoV-2 index cases. *Clinical Infectious Diseases*. 2021;(ciab496). doi:10.1093/cid/ciab496
6. Tegally H, Wilkinson E, Giovanetti M, et al. Emergence of a SARS-CoV-2 variant of concern with mutations in spike glycoprotein. *Nature*. Published online 2021. https://doi.org/10.1038/s41586-021-03402-9
7. Sinha S, Tam B, Wang SM. Altered interaction between RBD and ACE2 receptor contributes towards the increased transmissibility of SARS CoV-2 delta, kappa, beta, and gamma strains with RBD double mutations. *bioRxiv*. Published online January 1, 2021:2021.08.30.458303. doi:10.1101/2021.08.30.458303
8. Curran J, Dol J, Boulos L, et al. Transmission characteristics of SARS-CoV-2 variants of concern Rapid Scoping Review. *medRxiv*. Published online January 1, 2021:2021.04.23.21255515. doi:10.1101/2021.04.23.21255515
9. Campbell F, Archer B, Laurenson-Schafer H, et al. Increased transmissibility and global spread of SARS-CoV-2 variants of concern as at June 2021. *Eurosurveillance*. 2021;26(24):2100509. https://www.eurosurveillance.org/content/10.2807/1560-7917.ES.2021.26.24.2100509
10. Bager P, Wohlfahrt J, Fonager J, Albertsen. Increased Risk of Hospitalisation Associated with Infection with SARS-CoV-2 Lineage B.1.1.7 in Denmark. doi:Bager, Peter and Wohlfahrt, Jan and Fonager, Jannik and Albertsen, Mads and Yssing Michaelsen, Thomas and Holten Møller, Camilla and Ethelberg, Steen and Legarth, Rebecca and Fischer Button, Mia Sara and Gubbels, Sophie Madeleine and Voldstedlund, Marianne and Mølbak, Kåre and Skov, Robert Leo and Fomsgaard, Anders and Grove Krause, Tyra, Increased Risk of Hospitalisation Associated with Infection with SARS-CoV-2 Lineage B.1.1.7 in Denmark. Available at SSRN: https://ssrn.com/abstract=3792894 or http://dx.doi.org/10.2139/ssrn.3792894
11. NERVTAG paper on COVID-19 variant of concern B.1.1.7. *GOVUK*. Published online 2021. https://www.gov.uk/government/publications/nervtag-paper-on-covid-19-variant-of-concern-b117, http://files/64/nervtag-paper-on-covid-19-variant-of-concern-b117.html %[2021/02/08/18:37:19
12. Pearson CA, Eggo. Estimates of severity and transmissibility of novel South Africa SARS-CoV-2 variant 501Y.V2. https://cmmid.github.io/topics/covid19/reports/sa-novel-variant/2021_01_11_Transmissibility_and_severity_of_501Y_V2_in_SA.pdf
13. Funk T, Pharris A, Spiteri G, et al. Characteristics of SARS-CoV-2 variants of concern B.1.1.7, B.1.351 or P.1: data from seven EU/EEA countries, weeks 38/2020 to 10/2021. *Eurosurveillance*. 2021;26(16). doi:https://doi.org/10.2807/1560-7917.ES.2021.26.16.2100348
14. Fisman DN, Tuite AR. Progressive Increase in Virulence of Novel SARS-CoV-2 Variants in Ontario, Canada. *medRxiv*. Published online July 12, 2021:2021.07.05.21260050. doi:10.1101/2021.07.05.21260050
15. Muik A, Wallisch A-K, Sänger B, et al. Neutralization of SARS-CoV-2 lineage B.1.1.7 pseudovirus by BNT162b2 vaccine–elicited human sera. *Science*. Published online 2021:eabg6105. https://science.sciencemag.org/content/sci/early/2021/01/28/science.abg6105.full.pdf
16. Gallais F, Gantner P, Bruel T, et al. Anti-SARS-CoV-2 Antibodies Persist for up to 13 Months and Reduce Risk of Reinfection. *medRxiv*. Published online January 1, 2021:2021.05.07.21256823. doi:10.1101/2021.05.07.21256823
17. Wibmer CK, Ayres F, Hermanus T, et al. SARS-CoV-2 501Y.V2 escapes neutralization by South African COVID-19 donor plasma. *Nat Med*. Published online March 2021. https://www.ncbi.nlm.nih.gov/pubmed/33654292
18. Sabino EC, Buss LF, Carvalho MPS, et al. Resurgence of COVID-19 in Manaus, Brazil, despite high seroprevalence. *The Lancet*. 2021;397(10273):452-455. https://linkinghub.elsevier.com/retrieve/pii/S0140673621001835
19. Planas D, Veyer D, Baidaliuk A, et al. *Reduced Sensitivity of Infectious SARS-CoV-2 Variant B.1.617.2 to Monoclonal Antibodies and Sera from Convalescent and Vaccinated Individuals*. Microbiology; 2021. doi:10.1101/2021.05.26.445838
20. Public Health England (PHE). *SARS-CoV-2 Variants of Concern and Variants under Investigation in England. Technical Briefing 20*. Public Health England; 2021. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1009243/Technical_Briefing_20.pdf
21. Public Health England (PHE). *SARS-CoV-2 Variants of Concern and Variants under Investigation..Technical Briefing 18*.; 2021. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1001358/Variants_of_Concern_VOC_Technical_Briefing_18.pdf
22. Public Health England. SARS-CoV-2 lateral flow antigen tests: evaluation of VOC1 (Kent, UK) and VOC2 (South Africa). GOV.UK. Accessed June 21, 2021. https://www.gov.uk/government/publications/sars-cov-2-lateral-flow-antigen-tests-evaluation-of-voc1-and-voc2/sars-cov-2-lateral-flow-antigen-tests-evaluation-of-voc1-kent-uk-and-voc2-south-africa
23. Emary KRW, Golubchik T, Aley PK, et al. Efficacy of ChAdOx1 nCoV-19 (AZD1222) vaccine against SARS-CoV-2 variant of concern 202012/01 (B.1.1.7): an exploratory analysis of a randomised controlled trial. *The Lancet*. 2021;397(10282):1351-1362. doi:10.1016/S0140-6736(21)00628-0
24. Heath PT, Eva Galiza FP, David Neil Baxter M, et al. Efficacy of the NVX-CoV2373 Covid-19 Vaccine Against the B.1.1.7 Variant. *medRxiv*. Published online May 2021:2021.05.13.21256639-2021.05.13.21256639. doi:10.1101/2021.05.13.21256639
25. Madhi SA, Baillie V, Cutland CL, et al. Efficacy of the ChAdOx1 nCoV-19 Covid-19 Vaccine against the B.1.351 Variant. *New England Journal of Medicine*. Published online March 2021:NEJMoa2102214-NEJMoa2102214. doi:10.1056/NEJMoa2102214
26. Sadoff J, Gray G, Vandebosch A, et al. Safety and Efficacy of Single-Dose Ad26.COV2.S Vaccine against Covid-19. *New England Journal of Medicine*. Published online April 2021:NEJMoa2101544-NEJMoa2101544. doi:10.1056/NEJMoa2101544
27. Shinde V, Bhikha S, Hoosain MZ, et al. Preliminary Efficacy of the NVX-CoV2373 Covid-19 Vaccine Against the B.1.351 Variant [Authors, highest degree, and affiliation/institution]. *medRxiv*. Published online March 2021:2021.02.25.21252477-2021.02.25.21252477. doi:10.1101/2021.02.25.21252477
28. Thomas SJ, Moreira ED, Kitchin N, et al. Six Month Safety and Efficacy of the BNT162b2 mRNA COVID-19 Vaccine. *medRxiv*. Published online July 28, 2021:2021.07.28.21261159. doi:10.1101/2021.07.28.21261159
29. Ella R, Reddy S, Blackwelder W, et al. Efficacy, safety, and lot to lot immunogenicity of an inactivated SARS-CoV-2 vaccine (BBV152): a double-blind, randomised, controlled phase 3 trial. *medRxiv*. Published online July 2, 2021:2021.06.30.21259439. doi:10.1101/2021.06.30.21259439
30. Tartof SY, Slezak JM, Fischer H, et al. *Six-Month Effectiveness of BNT162B2 MRNA COVID-19 Vaccine in a Large US Integrated Health System: A Retrospective Cohort Study*. Social Science Research Network; 2021. doi:10.2139/ssrn.3909743
31. Goldberg Y, Mandel M, Bar-On YM, et al. *Waning Immunity of the BNT162b2 Vaccine: A Nationwide Study from Israel*.; 2021:2021.08.24.21262423. doi:10.1101/2021.08.24.21262423
32. Chemaitelly H, Tang P, Hasan MR, et al. *Waning of BNT162b2 Vaccine Protection against SARS-CoV-2 Infection in Qatar*.; 2021:2021.08.25.21262584. doi:10.1101/2021.08.25.21262584
33. Bar-On YM, Goldberg Y, Mandel M, et al. *BNT162b2 Vaccine Booster Dose Protection: A Nationwide Study from Israel*.; 2021:2021.08.27.21262679. doi:10.1101/2021.08.27.21262679
34. Patalon T, Gazit S, Pitzer VE, Prunas O, Warren JL, Weinberger DM. *Short Term Reduction in the Odds of Testing Positive for SARS-CoV-2; a Comparison Between Two Doses and Three Doses of the BNT162b2 Vaccine*.; 2021:2021.08.29.21262792. doi:10.1101/2021.08.29.21262792