COVID-19 Real-Time Learning Network

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# Emerging SARS-CoV-2 Variants of Concern

***Selected CDC/World Health Organization Designees with Published Clinical Data***

*Version 12/25/21*

| Variant (WHO label/ Pango lineage) | Treatment efficacy (*in vitro*)** | mRNA vaccine clinical effectiveness | Viral vector vaccine clinical effectiveness | Nanoparticle/subunit vaccine clinical effectiveness |
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| **Omicron**<br>**B.1.1.529**<br><br>Southern Africa 2021 | Bamlanivimab + etesevimab: **No neutralization efficacy** (CDC; Gruell, December 2021 – preprint, not peer-reviewed)<br><br>REGEN-COV (casirivimab + imdevimab): **No neutralization efficacy** (Wilhelm, December 2021 – preprint, not peer-reviewed)<br><br>Sotrovimab: Retains neutralization efficacy<br><br>Convalescent sera: **Severely reduced neutralization efficacy** (from patients recovering from Alpha and some Delta infections) (Ikemura, December 2021 – preprint, not peer-reviewed)<br><br>Evusheld: Retains neutralization efficacy (NIH OpenData, December 2021) | Pfizer-BioNTech vaccine: **Significantly reduced effectiveness against infection** in the UK (Andrews, December 2021 – preprint, not peer-reviewed) | Oxford-AstraZeneca vaccine: **Significantly reduced effectiveness against infection** in the UK (Andrews, December 2021 – preprint, not peer-reviewed) | *No data* |

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| **Delta B.1.617.2**<br><br>India 2020 | Bamlanivimab + etesevimab:<br>Retains neutralization efficacy (FDA EUA)<br>***Bamlanivimab alone inefficacious***<br><br>REGEN-COV (casirivimab + imdevimab):<br>Retains neutralization efficacy (FDA EUA; Planas, May 2021)<br><br>Sotrovimab:<br>Retains neutralization efficacy (FDA EUA)<br><br>Convalescent sera:<br>**Potential moderately reduced neutralization** (Planas, May 2021) | Pfizer-BioNTech vaccine:<br>Slightly reduced effectiveness against infection but **preserved effectiveness*** against severe COVID-19** after 2 doses in the U.S. (Tartof, October 2021), U.K. (Bernal, July 2021; Stowe, May 2021 - preprint, not peer-reviewed; Sheikh, June 2021; Sheikh, December 2021), Canada (Chung, August 2021), and Qatar (Tang, November 2021)<br><br>Moderna vaccine:<br>Slightly reduced effectiveness against infection but **preserved effectiveness against severe COVID-19** in the U.S. (Baden, November 2021; Chin, December 2021), Canada (Chung, August 2021), and Qatar (Tang, November 2021) | Oxford-AstraZeneca vaccine:<br>Slightly reduced effectiveness against infection but **preserved effectiveness*** against severe COVID-19** after 2 doses in the U.K. (Bernal, July 2021; Stowe, May 2021 - preprint, not peer-reviewed; Sheikh, June 2021; Sheikh, December 2021) and Canada (Chung, August 2021) | *No data* |

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| **Gamma P.1**<br><br>Brazil 2020 | Bamlanivimab + etesevimab: **Markedly reduced neutralization** (FDA EUA)<br><br>REGEN-COV (casirivimab + imdevimab): Retains neutralization efficacy (FDA EUA)<br><br>Sotrovimab: Retains neutralization efficacy (FDA EUA)<br><br>Convalescent sera: **Moderately reduced neutralization (**Wang, June 2021) | *No data*<br><br>(Presumed to be similar to Beta variant based on relevant mutations) | Oxford-AstraZeneca vaccine: Preserved effectiveness against COVID-19 after 2 doses in Brazil (Hitchings, October 2021)<br><br>(Presumed to be similar to Beta variant based on relevant mutations) | *No data*<br><br>(Presumed to be similar to Beta variant based on relevant mutations) |
| **Beta B.1.351**<br><br>South Africa 2020 | Bamlanivimab + etesevimab: **Markedly reduced efficacy** (FDA EUA; Chen, June 2021)<br><br>REGEN-COV (casirivimab + imdevimab): Retains neutralization efficacy (FDA EUA; Wang, March 2021)<br>***Markedly reduced neutralization with casirivimab alone***<br><br>Sotrovimab: Retains neutralization efficacy (FDA EUA) | Pfizer-BioNTech vaccine: Slightly reduced effectiveness against infection but **preserved effectiveness against severe COVID-19** in Qatar (Abu-Raddad, May 2021)<br><br>Moderna vaccine: Slightly reduced effectiveness against infection but **preserved effectiveness against severe COVID-19** in Canada (Chung, August 2021) | Oxford-AstraZeneca vaccine: **No effectiveness against infection** in South Africa (Madhi, May 2021) Reduced effectiveness against infection but **preserved effectiveness against severe COVID-19** in Canada (Chung, August 2021)<br><br>Johnson & Johnson vaccine: Reduced effectiveness against infection but **preserved effectiveness against severe COVID-19** in South Africa (Sadoff, May 2021) | Novavax vaccine: **Reduced effectiveness** against infection (Shinde, May 2021) |

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| | Convalescent sera: **Moderately reduced neutralization** (Planas, May 2021) | | | |
| **Alpha B.1.1.7**<br><br>U.K. 2020 | Bamlanivimab + etesevimab: Retains neutralization efficacy (FDA EUA)<br><br>REGEN-COV (casirivimab + imdevimab): Retains neutralization efficacy (FDA EUA)<br><br>Sotrovimab: Retains neutralization efficacy (FDA EUA)<br><br>Convalescent sera: Retains neutralization efficacy (Planas, May 2021) | Pfizer-BioNTech vaccine: **Preserved effectiveness** against infection and severe COVID-19 in the U.K. (Hall, May 2021), Israel (Haas, May 2021), Qatar (Abu-Raddad, May 2021) and Canada (Chung, August 2021)<br><br>Moderna vaccine: **Preserved effectiveness** against infection and severe COVID-19 in Canada (Chung, August 2021) | Oxford-AstraZeneca vaccine: Slightly reduced effectiveness against infection but **preserved effectiveness against severe COVID-19** in the U.K. (Emary, April 2021) and Canada (Chung, August 2021) | Novavax vaccine: **Preserved effectiveness** against infection and severe COVID-19 in the U.K. (Heath, June 2021) |

*As compared with vaccine efficacy/effectiveness against wildtype or D614G variant SARS-CoV-2.

**The susceptibility results refer, as a default, to in vitro testing of sotrovimab against both pseudotyped virus-like particles and authentic SARS-CoV-2 virus. Where results are discordant, both pseudotyped and authentic virus susceptibility is presented. Where only one type of virus was tested, it was in all cases pseudotyped virus. In the case of the Delta variant, binding of the monoclonal antibodies to variant strain was tested with the S-Fuse binding assay. **The extent of correlation of neutralizing activity in in vitro cell culture experiments with clinical outcomes is as yet unknown.**

*** As compared with vaccine efficacy/effectiveness against Alpha/B.1.1.7 variant.