



## Effectiveness of vaccines against omicron

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**ABSTRACT-** On November 26, 2021 WHO designated the variant B.1.1.529 virus a variant of concern (VOC) and named it omicron. This article discusses the effectiveness alongwith waning of present vaccines and their booster doses against omicron.

**Keywords-** omicron, vaccine, effectiveness, booster, waning, covid-19

**Abbreviations-** VE- vaccine effectiveness  
VOC- variant of concern

### I. INTRODUCTION

Lancet Laboratories in South Africa, observed that routine polymerase chain reaction (PCR) tests for SARS-CoV-2 failed to detect the S gene which is a key target in many virus samples. The genome was heavily mutated to test the missed S gene after sequencing another eight viruses. On November 26, 2021, WHO designated the variant B.1.1.529 virus a “variant of concern” (VOC) and named it the Omicron[1], Omicron raised concerns about reduced vaccine efficacy and risk of reinfection due to mutations in the spike protein (S), which is the antigenic target of vaccine-elicited antibodies [2] infection of omicron is more in people who are immune to other variants of covid-19[3,4,5-7]. Omicron has a higher reinfection risk profile than other variants[8]. PCR tests that include multiple gene targets are not likely to be much affected and should be continued to detect SARS-CoV-2 infection, including the Omicron variant. This has been confirmed by statements issued by United States Food and Drug Administration (US FDA) and the manufacturers [9] based on sequence analysis and preliminary laboratory evidence.

**Animal studies:** Two animal models have been used; mice expressing human ACE2 had significantly less weight loss, had less lung pathology recovered faster and when infected with Omicron compared to Delta or WT [10]. A Syrian hamster (*M. auratus*) model demonstrated poorer capability of Omicron to infect or spread in lung tissue compared to Delta or WT [11]. Additional studies on Syrian hamsters yielded similar results confirming that Omicron-infected animals show fewer clinical signs and have milder disease [12, 13].

**Effect of vaccines:** Current vaccines remain effective against severe disease including the Delta variant and [4]. Partially and fully vaccinated cases are highly protected against hospitalization associated with Alpha or Delta[14]. Greater than 80% protection against hospitalization was shown on analysis of data in Canada[15]. Omicron variant reduces effectiveness of the Pfizer-BioNTech's COVID-19 vaccine, but the vaccine still lowers the risk of hospital admission[16]. The Omicron might evade immunity from previous infections or vaccines and blunt the potency of neutralizing antibodies causing the existing vaccines to be less effective against the Omicron[3,17,5]. The study by Discovery Ltd, the largest private health insurer in South Africa, showed that Omicron reduced vaccine effectiveness against infection to 33% from 80% for Delta. The vaccine's efficacy of Pfizer-BioNTech against severe illness and hospitalization falls to 70% from 93%. Relative risk of contracting the Omicron variant in people infected with the Delta variant is 40%, while there is 60% chance of reinfection with Omicron in those infected with the Beta variant at the beginning of 2020[18]. Serum from 12 people who received the Pfizer-BioNTech vaccine was 40 times less potent against the Omicron than an earlier strain of SARS-CoV-2 as reported by Virologist Alex Sigal and colleagues, in Durban, South Africa[7]. Most breakthrough infections with the Omicron had less severe symptoms than previous variants[19]. The number of patients who needed oxygen support was less than previous waves[19]. As per the preliminary results released in South Africa, Germany, Sweden and the Pfizer-BioNTech collaboration the boosters should strengthen immunity to the Omicron[1]. People infected with SARS-CoV-2 previously prior to vaccination tended to have higher levels of neutralizing antibodies against the Omicron than vaccinated people with no prior infection as per Callaway[1]. The vaccines alone are not strong enough to control the pandemic[20]. The Cov-Boost experiment with seven different vaccines as boosters following two doses of either the AstraZeneca or Pfizer vaccines, including AstraZeneca, Curevac, Johnson & Johnson (Janssen), Moderna, Novavax, Pfizer, and Valneva demonstrated that all vaccinations (except



Curevac, which was discontinued) increased the immunological response; however, the number of antibodies varied greatly depending on the vaccine-combination [21–23]. Zhang and colleagues found that vaccinated sera were suppressed tenfold more by triply vaccinated sera than by doubly vaccinated sera while performing pseudo-virus assays [24]. Pajon and colleagues observed that neutralization antibody titre was 20 times higher with an mRNA booster dose than second dose of the vaccine [25]. A pre-print by researchers in Qatar have shown that protection afforded by prior infection dropped from 90% against reinfection with in Alpha, Beta, or Delta to 56% with Omicron [26].

### Countrywise data on vaccine-effectiveness

#### United Kingdom

- In England, using a test-negative design, VE for symptomatic infection for Pfizer BioNTech-Comirnaty, Moderna mRNA-1273, and AstraZeneca-Vaxzevria dropped to under 20% by 20 weeks after vaccination (completion of the primary series). An mRNA booster dose restored VE to >60%, for all three vaccines following a primary two dose series with waning of VE by 10 weeks post-booster [27].

- In Scotland [28], a third/booster mRNA vaccine dose was associated with a 57% (95% CI 55, 60) reduction in symptomatic infection relative to  $\geq 25$  weeks post second dose (Pfizer BioNTech-Comirnaty, Moderna mRNA-1273, and AstraZeneca-Vaxzevria), as compared to a relative VE of 88% (95% CI 86,89) for presumed Delta infection. [29].

The SIREN cohort study among health care workers found VE against any infection for the two mRNA vaccines and AstraZeneca-Vaxzevria combined was 60% among those with previous infection and 32% after two doses among those without previous infection and, increasing to 62% and 71%, respectively after a booster dose [30].

#### Denmark

- A nationwide cohort estimated a VE against infection of 55% (95% CI 24-74%) and 37% (95% CI -70-76%) for Pfizer BioNTech-Comirnaty and Moderna- mRNA 1273, respectively, in the month after vaccination, with evidence of waning VE to negligible VE by two to three months. A booster dose among those who received a primary series of Pfizer BioNTech-Comirnaty was found to restore the VE to 55% in the first month post-booster.

#### Canada

- In Ontario, there was negligible VE against infection among recipients of a primary series that included at least one mRNA vaccine. The VE increased to >40% after an mRNA booster [31].

#### U.S.A.

- In a study in California, the VE was 30% (5%-49%) within three months of full vaccination for two doses of the Moderna mRNA-1273 vaccine and dropped to 0% by 6 months [32]. The VE increased to 64% (58-90%) within six weeks after a third dose among immunocompetent persons and was negligible in immunocompromised persons South Africa

- VE of the Pfizer BioNTech-Comirnaty vaccine was 50-70% against [33] hospitalization as reported by an insurance company study

- As shown by The Sisonke trial of health care workers a second dose of the Janssen-Ad26.COV2.S vaccine had 85% (54-95) VE against hospitalization through two months post-vaccination [34].

#### United Kingdom

- Combined data from England/Wales for three vaccines (Pfizer BioNTech-Comirnaty, Moderna mRNA-1273, and AstraZeneca-Vaxzevria) showed that the VE against hospital admission fell to 44% (95% CI 30-54) by 25 weeks post-full vaccination, and increased to >80% through 10 weeks after booster vaccination [35].

### Waning of vaccine-effectiveness

Large evidence of waning vaccine effectiveness overtime is provided by systematic review and meta-regression by Daniel R Feikin and colleagues [36] in The Lancet. The authors identified 18 studies matching their inclusion criteria, of which three were randomised controlled trials (RCTs). Meta regression studies suggested a decrease in protection against SARS-CoV-2 infection by 21.0% (95% CI 13.9–29.8; on the basis of evidence from six studies) over a 6-month period from full vaccination across all ages and for all investigated vaccine types (Pfizer–BioNTech Comirnaty, Moderna-mRNA-1273, Janssen-Ad26.COV2.S, and AstraZeneca-Vaxzevria) while vaccine effectiveness against severe disease decreased by 10.0% (95% CI 6.1–15.4; on the basis of evidence from five studies); however, vaccine effectiveness remained higher than 70% for 6 months against severe disease. The findings of Feikin and colleagues [36] relate to the effect of waning immunity after full vaccination, without booster doses. In addition their findings are restricted to evidence before the emergence of omicron. [36] A report on population-based surveillance data from the UK, illustrated waning of protection against symptomatic disease after two-dose and three-dose vaccination schedules. [37] The protective effect against hospitalisation after omicron infection could be restored up to 90% with



an mRNA vaccine booster; a decrease to 75% 3–4 months after the booster was noted [37]. US data from a test negative study design support high vaccine effectiveness against omicron-related hospital admission after three doses (89%, 95% CI 84–92).[38]Preliminary data from Israel suggest an increased protective effect against infection (risk reduced by a factor of 2•0, 95% CI 2•0–2•1) and severe illness (risk reduced by a factor of 4•3, 2•4–7•6) 12 or more days after dose four when compared with people who received three doses.[39]; however the magnitude of effect vaccination has on transmission rates changed in the light of arising VOCs.[40] a vaccine-induced reduction of transmission was observed for omicron (but to a lesser extent), the findings underline that the continuing emergence of new VOCs will pose a threat to reduce the spread of SARS-CoV-2.[41]

## II. CONCLUSION

The variant of concerns for SARS-COVID-19 will continue to pose a threat to existing vaccine programmes against SARS-COVID-19.

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