

## COVID-19 Vaccines: Clinical Relevance, Adverse Effects and the Need for Further Research

Domina Petric\*

\*University Hospital Center Split, Croatia.

Published July 07, 2022

### ABSTRACT

COVID-19 vaccines are important both on individual (reduction of the risk for severe illness, permanent consequences and death) and population level (reduction of the virus transmission) with individual interests and welfare being above the sole interest of society or science (primacy of the human being, Oviedo Convention). Available vaccines are based on the Wuhan strain spike protein (vector, mRNA, protein vaccines) or inactivated virus. In the up-to-date available literature, there are more than thousand published papers on serious adverse effects (myopericarditis, coagulation dyscrasias, autoimmunity) related to spike protein-based COVID-19 vaccines. In addition to that, *in vitro* and *in silico* studies showed that spike protein can inhibit DNA damage repair by impeding key DNA repair protein BRCA1 and 53BP1 recruitment to the damage site; and that S2 subunit of SARS-CoV-2 strongly interacts with p53 and BRCA-1/2 proteins. Another study showed that there is a fast uptake (6 h upon exposure) of BNT162b2 (Pfizer/BioNTech) into human liver cell line Huh7, leading to changes in LINE-1 expression and distribution (reverse transcription). In the context of waning efficacy, above mentioned *in vitro* studies and increasing number of reported serious adverse effects, there is a need for the discussion about more focused approach in COVID-19 vaccination programs, as well as for the open debate on whether are animal studies of genotoxicity and carcinogenicity of the spike protein necessary before proceeding with endless spike-booster shots. Potential clinical relevance of second generation of COVID-19 vaccines designed as a non-spike multi-epitope ORF1-N-(E)-(M)-vaccine should be taken into account and further studied. And finally, in the context of the rising epidemiological relevance of COVID-19-vaccinated individuals, the strategy of compulsory COVID-19 vaccination and obligatory COVID-19 passports should be critically and openly discussed.

**Keywords:** COVID-19, Vaccines, Research, Adverse effects, Clinical relevance

**Corresponding author:** Domina Petric, University Hospital Center Split, Croatia, Email: domina.petric@gmail.com

**Citation:** Petric D. (2022) COVID-19 Vaccines: Clinical Relevance, Adverse Effects and the Need for Further Research. J Infect Dis Res, 5(S1): 03.

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