

Overview: COVID-19 and COVID Vaccines

¹Kurhade Rupesh R., ²Zaware Shailesh.K., ³Momin Aman.R., ⁴Gadge Vinayak.D.,

⁵Phapale Rohit. H., ⁶Gadge Shubham. C.

Samarth Institute of Pharmacy, Belhe, Maharashtra., India ^{1,2,3,4,5}

⁶Student of Department of Pharmacology

Dr. Vitthalrao Vikhe Patil's Foundation College of Pharmacy, Ahemadnagar, Maharashtra, India

Abstract: Covid-19 is caused by SARS COV-2. To remain unaffected from covid-19 become easy by maintaining a 1 m distance, washing hand with an alcohol-based sanitizer, and vaccination. Vaccination is the best resource that can be effective up to 90% from coronavirus. But some delusions about vaccination therefore people rebuff the vaccine. Even if vaccination is 50, 70 to 90% effective; three things impact taking the vaccine.

- Protection against coronavirus,
- Minor Side Effects like illness Sore arm fever,
- Major side effects like permanent or temporary paralysis or blood clots. With significant effect. Which 1 out of 1 lakh, therefore, is more likely to discourage the people.

According to our research article 1998, about common vaccination is vaccination after the birth of 28 days may induce Type 1 Diabetes mellitus which is an autoimmune disease that thing rumors in people's minds.

Research also shows that mRNA is more effective than other attenuated vaccines. Even some major and minor side effects of vaccination. Vaccination is one of the best ways to slow down the spread or get mutates of the coronavirus. To encourage people and increased their knowledge they should firstly full filled with the knowledge of vaccination by making Awareness of the aftereffect of vaccination..

Keywords: SARS COV 2, COVID- 19, vaccination, Type 1 Diabetes mellitus, mRNA vaccine, adverse effects and efficacy, awareness

I. INTRODUCTION

Corona virus has greater history than we think. To understand SARS COV-2 need to know when, where, and how? the pandemic started. According to the World Health Organisation, when they visited China from where the covid starts to spread had provided information about SARS COV 2. They are also summarise that likely to very likely virus first spread from bats to humans. The history of coronavirus is a simple virus that causes the common cold. After that scientists found seven subclasses of coronavirus that can affect humans as well as animals. In 2002 new variant was found in China, and scientists give the name it- SARS COV. After that in 2012, another variant of the coronavirus was founded in Saudi Arabia, Scientists give the name it- MERS COV. And later, in 2019 new variant founded in Wuhan of China named is SARS cov-2. After the founding million the cases, WHO suggested that vaccination will recover 50 to 90% efficiently. Many vaccination programs are organized and a new record of 2 crore vaccines in One Day- India has been created. But some challenges in front of the government remain the same the myths in people's minds about vaccination. People get panicked & stricken with side effects and adverse effects of medicines and some organizations started awareness about its myths and clarified it. Here we also award and improve knowledge about its common & serious side effects, adverse effects most important its benefits after vaccination.

Background

What is the meaning of covid-19?

In the last two decades, there have been two cases of animal beta coronaviruses crossing into humans, both of which have resulted in serious sickness. The first time this happened occurred in the Guangdong province of China in 2002–2003, when a novel coronavirus of the genera and with origins in bats moved over to humans via the intermediary host of palm civet cats. In 2012, the Middle East respiratory syndrome coronavirus (MERS-CoV), which was likewise of bat origin, emerged

in Saudi Arabia with dromedary camels as the intermediate host, infecting 2494 people and killing 858. (fatality rate 34 percent). While adapting to their new human hosts, SARS-CoV-2, like other RNA viruses, is susceptible to genetic evolution with the formation of mutations over time, resulting in mutant variations with different features than their ancestral strains.

WHO's Variants of Concern (VOCs)

- Alpha (B.1.1.7): In late December 2020, the United Kingdom (UK) reported the first version of concern.
- Beta (B.1.351): first recorded in December 2020 in South Africa.
- Gamma(P.1): first detected in early January 2021 in Brazil.
- Delta (B.1.617.2): first recorded in December 2020 in India. [1]

With the introduction and spread of the 2019 novel coronavirus (2019nCoV), also known as the severe acute respiratory syndrome coronavirus 2, a new public health disaster is threatening the world (SARSCoV2). Year China, over 96,000 instances of coronavirus disease were reported in 2019 (COVID2019), with 3300 deaths documented to date (05/03/2020).

Covid-19 infection is generally known as respiratory tract infection which having 2 to 14 day incubation period. Fever, cough, sore throat, shortness of breath, lethargy, and malaise are common symptoms.

like appearance under the electron microscope, hence the name coronavirus. HKU1, NL63, 229E, and OC43 are four coronaviruses that have been found in humans and cause moderate respiratory illness.

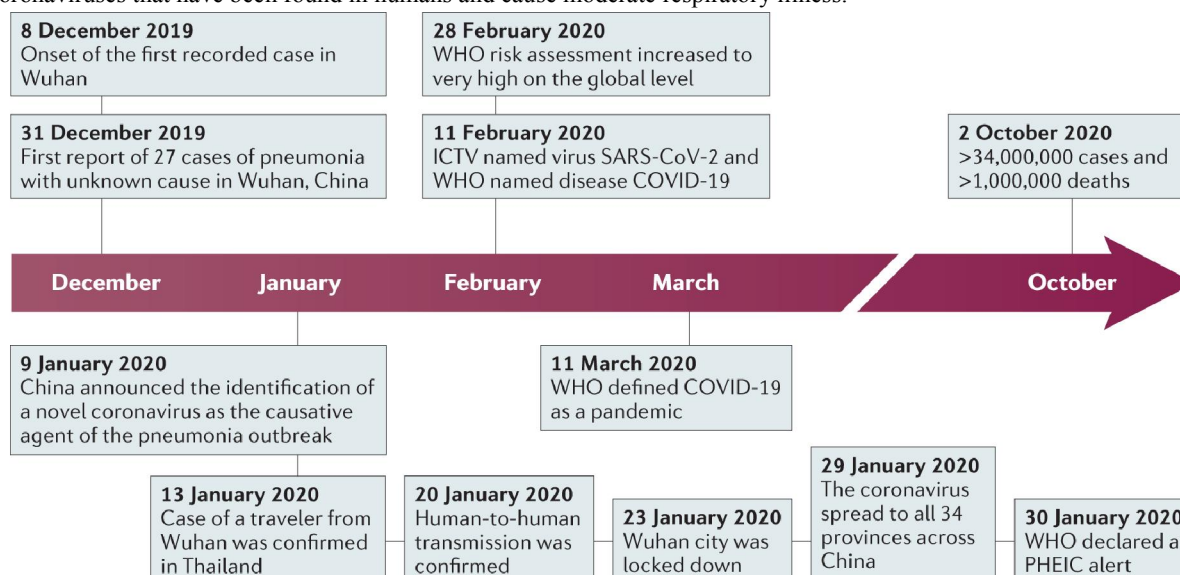


Fig: spreading of covid-19 cases

Etiology

The BetaCoV genus is further subdivided into five lineages or subgenera. Bats and rodents are the most likely gene sources for alpha and beta CoVs, according to genomic analysis. Avian species, on the other hand, appear to be the gene sources for delta coves and gammaCoVs. CoVs have emerged as the most common pathogens in new respiratory illness outbreaks. Camels, cattle, cats, and bats are all susceptible to members of this huge virus family, which can cause respiratory, intestinal, hepatic, and neurological disorders. These viruses can cross species barriers for unknown causes, causing infections in humans ranging from the common cold to more serious diseases like MERS and SARS. Seven human CoVs (HCoVs) capable of infecting humans have been discovered so far. Some of the CoVs were identified in the mid-1960s.

COVID-19 prevalence according Age, Gender and Diseased states:

People of all ages are at risk of developing this infection, which can lead to serious illness. Patients over the age of 60, as well as those with underlying medical comorbidities (obesity, cardiovascular disease, chronic kidney disease, diabetes, chronic lung disease, smoking, cancer, solid organ or hematopoietic stem cell transplant recipients), are at a higher risk of developing severe COVID-19 infection. According to an investigation by Stokes et al. of confirmed cases reported to the

CDC from January 22 to May 30, 2020, the percentage of COVID-19 patients requiring hospitalization was six times greater in individuals with prior medical issues (45.4 percent vs. 7.6 percent). The study also found that the percentage of individuals who died from this illness was 12 times greater in those who had diabetes preexisting medical conditions than those without medical conditions (19.5% vs. 1.6%).

Racial and Ethnic Disparities in COVID-19

The degree of infection and death associated with COVID-19 differs by ethnic group. According to a recent CDC analysis of hospitalizations from a large administrative database that included approximately 300,000 COVID-19 patients hospitalised from March 2020 to December 2020, racial and ethnic minority groups had a higher percentage of COVID-19 related hospitalizations than White patients. A higher risk of exposure to SARS-CoV-2 and a higher chance of acquiring severe COVID-19 disease drove the high percentage of COVID-19-related hospitalizations among racial and ethnic groups. People of Black, Hispanic, and Asian ethnic minority groups are at an elevated risk of getting and dying from COVID-19, according to the findings of a meta-analysis of 50 studies conducted by US and UK experts. COVID-19 related death rates were the highest among Hispanic persons[2]

ABO blood group and infection relation

The skewness and kurtosis of continuous variables were used to assess their normalcy. For categorical data, the Chi-square test was employed, and for comparing demographics, comorbidities, and medications among blood types, the ANOVA or Kruskal-Wallis test was used, as applicable.

Factor	Blood type A	Blood type B	Blood type AB	Blood type O	P value
N	440	201	61	587	
Age, mean (SD)	56.9 (18.6)	57.6 (18.1)	57.1 (19.9)	54.8 (18.1)	0.14
BMI, mean (SD)	30.8 (6.5)	30.6 (6.7)	29.4 (5.4)	32.0 (14.9)	0.32
Rhesus positive	392 (89.1%)	183 (91.0%)	53 (86.9%)	533 (90.8%)	0.63
Female sex	299 (68.0%)	136 (67.7%)	33 (54.1%)	404 (68.8%)	0.14
Spanish	88 (20.0%)	36 (17.9%)	04 (6.6%)	180 (30.7%)	-
Race White	221 (50.2%)	80 (39.8%)	28 (45.9%)	224 (38.2%)	0.008
Black	84 (19.1%)	49 (24.4%)	15 (24.6%)	114 (19.4%)	-
Hispanic	52 (11.8%)	25 (12.4%)	04 (6.6%)	103 (17.5%)	-
Hypertension	256 (58.2%)	124 (61.7%)	42 (68.9%)	341 (58.1%)	0.34
Smoker	97 (22.0%)	39 (19.4%)	15 (24.6%)	117 (19.9%)	0.69
Hyperlipidemia	251 (57.0%)	105 (52.2%)	35 (57.4%)	323 (55.0%)	0.70
COPD	55 (12.5%)	26 (12.9%)	9 (14.8%)	72 (12.3%)	0.95
Diabetes mellitus	150 (34.1%)	66 (32.8%)	25 (41.0%)	197 (33.6%)	0.68
Cancer diagnosis	131 (29.8%)	57 (28.4%)	19 (31.1%)	161 (27.4%)	0.83
Cirrhosis	14 (3.2%)	09 (4.5%)	01 (1.6%)	21 (3.6%)	0.72
Asthma	124 (28.2%)	46 (22.9%)	14 (23.0%)	163 (27.8%)	0.44
History of stroke	50 (11.4%)	30 (14.9%)	10 (16.4%)	71 (12.1%)	0.47
ESRD	17 (3.9%)	13 (6.5%)	5 (8.2%)	30 (5.1%)	0.33
Dysrhythmia	199 (45.2%)	95 (47.3%)	34 (55.7%)	274 (46.7%)	0.49
CCF	71 (16.1%)	41 (20.4%)	13 (21.3%)	107 (18.2%)	0.51
Aspirin	66 (15.0%)	45 (22.4%)	16 (26.2%)	96 (16.4%)	0.029
Warfarin	14 (3.2%)	7 (3.5%)	1 (1.6%)	20 (3.4%)	0.90
Statin use	132 (30.0%)	64 (31.8%)	25 (41.0%)	141 (24.0%)	0.007
CCB Drugs	56 (12.7%)	29 (14.4%)	5 (8.2%)	76 (12.9%)	0.65
Thiazide diuretic	36 (8.2%)	14 (7.0%)	4 (6.6%)	46 (7.8%)	0.94

ACE inhibitor	59 (13.4%)	32 (15.9%)	7 (11.5%)	81 (13.8%)	0.78
ARB	32 (7.3%)	19 (9.5%)	6 (9.8%)	50 (8.5%)	0.76
Beta blocker	97 (22.0%)	51 (25.4%)	14 (23.0%)	124 (21.1%)	0.66

Table no. 1 shows the various parameters that influence ABO blood group in covid-19 infection.

7648 symptomatic individuals were tested for COVID-19 over the study period at the five participating institutions. Twelve hundred and ninety-nine tests were positive, and their blood groups were noted, therefore they were included in the analysis. 484 (37.5%) were admitted to the hospital, 123 (9.5%) were admitted to the intensive care unit, 108 (8.4%) were intubated, 3 (0.2%) required ECMO, and 89 (6.9%) died. 440 (34.2%) of the 1289 individuals who tested positive were of blood type A, 201 (15.6%) were of blood type B, 61 (4.7%) were of blood type AB, and 587 (45.5%) were of blood type O. Patients with blood types B and AB who received a test were more likely to test positive as were those who are Rh+ positive, and blood type O was less likely to test positive.[3]

According to US studies, immunisation beyond 28 days of birth is connected to tragic infant death syndrome, new born asthma, autism, and lifelong brain damage. Vaccination after 28 days of birth may trigger Type 1 Diabetes mellitus, which is an autoimmune disease. [4]

In SARS Cov 2, the world began to manufacture an effective and efficacious vaccine. Scientists engage on a race to develop vaccines for emergency use, with some currently in clinical trials. Vaccination is only 50, 70, or 90 percent effective. Some people will not accept it. According to the survey, 21% of the population refuses vaccination under any circumstances, and 36% believe it is completely hazardous. This data implies that establishing immunity to SARS COV 2 will be difficult unless we have a better understanding of why. [5]

COVID-19 Vaccine: Many efforts have been made to produce COVID-19 vaccines in order to prevent a pandemic, and most of the vaccine candidates in development have used the S-protein of SARS-CoV-2.

Vaccines based on attenuated SARS cov-2 viruses:

Vaccines are weak live microbes that have a proclivity for replication but do not cause disease. The adverse effects of the attenuated vaccine are uncommon but severe. Three institutes are attempting to involve and commercialise this vaccine, but so far they have not been successful. Spikes of virus DNA, RNA, and proteins were used to create an inactivated vaccine. Fast Track vaccine evolution carries a risk.

- New vaccines must be safe and thoroughly researched.
- Virus vaccines have exacerbated the condition and induced T-helper-2 type immunopathology.[6]

Sr.No.	Vaccine Platform	Advantages	Limitations
1	Live Attenuated Vaccine (LAV) /the whole virus	<ul style="list-style-type: none"> • It has the intrinsic ability to stimulate the immune system by inducing the toll-like receptors (TLRs) namely: TLR 3, TLR 7/8, and TLR 9 of the innate immune system that involves B cells, CD4 and CD8 T cells. • It can be derived from 'cold adapted' virus strains, reassortants, and reverse genetics. 	<ul style="list-style-type: none"> • LAV requires an extensive accessory testing to establish safety and efficacy. • There is a probability of nucleotide substitution during viral replication, resulting in the creation of recombinants post-vaccination.
2	Inactivated Virus Vaccine	<ul style="list-style-type: none"> • Stable and safer as compared to the LAVs. • It has the pre-existing technology and infrastructure required for its development. • Has already been tested for SARS-CoV and various other diseases. • Increase their immunogenicity. 	<ul style="list-style-type: none"> • Require the booster shots to maintain the immunity. • Furthermore, large amounts of viruses need to be handled and the integrity of the immunogenic particles must be maintained.

3	Sub-unit Vaccine	<ul style="list-style-type: none"> • Do not have any live component of the viral particle. • Thus, it is safe with fewer side-effects. 	<ul style="list-style-type: none"> • Induce an immune response. • Memory for future responses is doubtful.
4	Viral vector-based vaccine	<ul style="list-style-type: none"> • Show a highly specific gene delivery into the host cell with a vigorous immune response. • Avoids handling of any infectious particle and it has been used widely for MERS-CoV with positive results from the trials. 	<ul style="list-style-type: none"> • The host may possess immunity against the vector due to prior exposure, reducing the efficacy. • May lead to cancer due to the integration of the viral genome into the host genome.
5	DNA Vaccines	<ul style="list-style-type: none"> • The synthetic DNA is temperature stable and cold-chain free • It can be developed at an accelerated pace. • It does not require the handling of the infectious viral particle. 	<ul style="list-style-type: none"> • Though it elicits both Cytotoxic and humoral immunity, the titers remain low. • Insertion of foreign DNA into the host genome may cause abnormalities in the cell. • May induce the antibody production against itself.
6	RNA Vaccines	<ul style="list-style-type: none"> • The translation of mRNA occurs in the cytosol of the host cell averting the risk of any sort of integration into the host genome. 	<ul style="list-style-type: none"> • Safety issues with reactogenicity have been reported for various RNA based vaccines.

Serum Institute of India, ZydusCadila, Biological E, Indian Immunologicals, Bharat Biotech, and Mynvax are six biotech enterprises in India alone that are collaborating with multinational vaccine producers. DNA vaccines, live attenuated recombinant measles vaccines, inactivated viral vaccines, subunit vaccinations, and vaccines created by codon optimization are among the projects they are working on. [7]

Let's check adverse effect with vaccine

Sputnik V

Sputnik V was created from frozen and lyophilized forms. Experiment conducted in Russia with two distinct Recombinant adenovirus Types 5 and 26, in which Phase 1 76 participants were given both adenovirus types, however in the Phase 2 trial, type 26 was given on day zero and type 5 was given on day 21. The most prevalent adverse reaction reported by 58 percent of applicants was injection site pain, followed by 50 percent heat, 28 percent asthenia, 24 percent joint pain, and 24 percent muscle discomfort.

Covaxin

A clinical trial of covaxin was undertaken in India with 375 participants ranging in age from 18 to 55 years old. A number of adverse reactions were observed within 2 hours, 7 days, 14 days, and 28 days following immunisation in phase 1. Five patients out of a hundred had a systemic adverse reaction, while 3% had headaches, 3% lethargy, 2% fever, and 2% nausea and vomiting.

Moderna vaccine

It is mRNA type of vaccine. Clinical trial conducted on 45 volunteer of age group between 18 to 55. The gap between two doses is 28 days. It also shows mild to moderate adverse reaction 35% volunteer with systemic adverse reaction like chill, headache, fatigue and 67% with local reaction like injection site pain. [8] Safety and efficacy of mRNA vaccine for 6 month.

Reactogenicity:

In that trial, the placebo group reported mild-to-moderate pain at the injection site. At both the first and second doses, several participants report weariness and 12% report fever. Adverse outcomes Participants aged 16 and up who did not show reactogenicity had an adverse event reported. Reduced appetite, lethargy, asthenia, malaise, elevated sweat, and hyperhidrosis are some of the side effects.

Efficacy:

Data demonstrates that 91.3 percent efficacy and 91.1 percent efficacy in participants aged 12 and up who have never had a previous SARS cov 2 infection. [9]After 6 months, a dynamic response to the BNT162b2 vaccine was observed. mRNA vaccines, such as those developed by Pfizer – BioNTech, have demonstrated excellent efficacy in clinical studies. The Phase 3 trial has shown a 95 percent effectiveness rate. In that trial, the placebo group reported mild-to-moderate pain at the injection site. At both the first and second doses, several participants report weariness and 12% report fever. Adverse outcomes Participants aged 16 and up who did not show reactogenicity had an adverse event reported. Reduced appetite, lethargy, asthenia, malaise, elevated sweat, and hyperhidrosis are some of the side effects. Efficacy Data demonstrates that 91.3 percent efficacy and 91.1 percent efficacy in participants aged 12 and up who have never had a previous SARS cov 2 infection. [10]After 6 months, a dynamic response to the BNT162b2 vaccine was observed. mRNA vaccines, such as those developed by Pfizer – BioNTech, have demonstrated excellent efficacy in clinical studies. The Phase 3 trial has shown a 95 percent effectiveness rate.

According to the efficacy research, two doses of m RNA vaccine provide 92 to 95 percent protection against COVID 19. In addition, those with shoulder injury, right auxiliary lymph adenopathy, paroxysmal ventricular arrhythmia, and right leg paraesthesia exhibit some major side effects in elderly patients, with mild erythema lasting 5 to 7 days. [11]According to a study conducted in the United Kingdom, vaccination has undesirable effects and increases the likelihood of infection. They discovered that systemic side effects such as headache and fatigue are less common than predicted in clinical trials, with 71 to 83 percent of candidates experiencing injection site pain, 34 to 47 percent experiencing weariness, and 25 to 42 percent experiencing headache. However, in a community trial, 30% of those who had injection site pain and less than 25% of those who had fatigue complaints after the first dose. Women, children, and people over the age of 55 have been found to have more common side effects than adult men when given the initial dose. After the second dosage, the frequency of side effects decreased. It was also discovered that after vaccination, immunologicity increased in persons who had previously been infected and had a high antibody titer compared to those who had not previously been infected. The researchers also discovered that after 14 days following vaccination, the chance of infection is lowered by 90%. [12]

Hair loss problem after covid infection

Acute Telogen effluvium is the name given to this type of hair loss. Hair shedding can be linked to covid-19 after three to six months. Acute Telogen effluvium symptoms were reported by 15 patients with mild symptoms and 24 patients with moderate symptoms in a study of 39 patients with post-covid-19 infection. After 2-3 months of infection, they all complained of severe hair loss. [13]

Rate of SARS cov 2 transmission and vaccination in impact the fate of vaccine resistant strain

Even though the majority of people are vaccinated, the new vaccine resistant strain infects a large number of people, and the rate of transmission is uncontrollable. The sluggish vaccination rate has generated resistance in the new strain.

If a single person in the community becomes infected with a vaccination resistant strain, there is a very good likelihood that he will not infect anyone else. One simple option is to maintain tight social distance for a set length of time. Additionally, a high vaccination rate may aid in reducing transmission. [14]

How vaccine induced immunity remain in body?

'Things diminish, but not all at the same time,' explains Nicole Doria Rose, an immunologist at the National Institute of Allergy and Infectious Diseases in the United States. That implies the amount of antibodies will decrease, but they will be able to respond again if a virus infection occurs in the future.

Can you mean memory cells gives durable protection?

According to Theodora Hatziiounnou, a virologist at New York's Rockefeller University, the memory cell should provide long-term protection against future virus attacks. According to study, elderly people should take a third dose to increase their effectiveness.

Is memory B cell getting stronger?

The experiment is explained by immunologist Ali Ellebedy of Washington University School of Medicine in St. Louis. Using a sample of lymph from a vaccinated candidate, researchers discovered that the memory B cell had been genetically engineered to produce a complete antibody against the SARS cov 2 virus. [15]

II. CONCLUSION

Even though some people refuse vaccination owing to a misunderstanding, we discovered that a high vaccination rate can reduce the rate of covid transmission. Moderna, an mRNA vaccine, appears to be more successful than conventional attenuated vaccines. In addition, the study found that taking any sort of vaccine can result in the development of antibodies. Even after that, antibody memory cells have the ability to re-generate the complete antibody. So there's no need to wonder if this vaccine is effective or if the effect is only for three or one month. According to certain studies, old people require a third dosage of vaccine, although adults only need two doses to combat SARS cov 2. Even some Other Side Effects after vaccination, vaccination is key of success to debate with SARS cov 2 and its evolutionary variant. So take vaccine stay safe.

REFERENCES

- [1]. A Review of Coronavirus Disease-2019 (COVID-19), Tanu Singhal , 25 feb 2020 <https://doi.org/10.1007/s12098-020-03263-6>.
- [2]. Features, Evaluation, and Treatment of Coronavirus (COVID-19) Marco Cascella; Michael Rajnik; Abdul Aleem; Scott C. Dulebohn; Raffaella Di Napoli. September 2, 2021. <https://www.ncbi.nlm.nih.gov/books/NBK554776/>
- [3]. Blood type and outcomes in patients with COVID-19 Christopher A. Latz & Charles DeCarlo & Laura Boitano & C. Y. Maximilian Png & Rushad Patell & Mark F. Conrad & Matthew Eagleton & Anahita Dua. 6 July 2020. <https://doi.org/10.1007/s00277-020-04169-1>.
- [4]. Vaccination and its adverse effects: real or perceived, Tom Jefferson, Coordinator 18 July 1998. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1113535/>
- [5]. Influence of a COVID-19 vaccine's effectiveness and safety profile on vaccination acceptance, Robert M. Kaplan and Arnold Milstein. January 21, 2021. <https://www.pnas.org/content/118/10/e2021726118>.
- [6]. COVID-19 vaccines: where we stand and challenges ahead, Guido Forni & Alberto Mantovani on behalf of the COVID-19 Commission of Accademia Nazionale dei Lincei, Rome <https://www.nature.com/articles/s41418-020-00720-9>.
- [7]. COVID-19 Vaccine: A comprehensive status report Simran Preet Kaur and Vandana Gupta. 2020 Oct 15 <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7423510/>
- [8]. Adverse Events Reported From COVID-19 Vaccine Trials: A Systematic Review, Rimple Jeet Kaur et al. Indian J Clin Biochem. 27 March 2021. <https://pubmed.ncbi.nlm.nih.gov/33814753/>
- [9]. Safety and Efficacy of the BNT162b2 mRNA Covid19 Vaccine through 6 Months. Stephen J. Thomas, M.D., Edson D. Moreira, Jr., M.D., Nicholas Kitchin, M.D., Judith Absalon, M.D., et al., September 15, 2021. <https://www.nejm.org/doi/10.1056/NEJMoa2110345>.
- [10]. Dynamics of antibody response to BNT162b2 vaccine after six months: a longitudinal prospective study, Paul Naaber^{ab} Pärt Peterson^c, 6 September 2021. <https://www.sciencedirect.com/science/article/pii/S266677622100185X?via%3Dihub>
- [11]. The safety of Covid-19 mRNA vaccines: a review, Pratibha Anand & Vincent P. Stahel 01 May 2019. <https://pssjournal.biomedcentral.com/articles/10.1186/s13037-021-00291-9>.
- [12]. Vaccine side-effects and SARS-CoV-2 infection after vaccination in users of the COVID Symptom Study app in the UK: a prospective observational study, Cristina Menni, PhD, Kerstin Klaser, MSc, and Tim D Spector, Prof, MD, 21 July 2021. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8078878/>
- [13]. COVID-19 infection is a major cause of acute telogen effluvium, Khalifa E Sharquie et al. Ir J Med Sci. 2021. <https://pubmed.ncbi.nlm.nih.gov/34467470/>

- [14]. Rates of SARS-CoV-2 transmission and vaccination impact the fate of vaccine-resistant strains, Simon A. Rella, Yuliya A. Kulikova, Fyodor A. Kondrashov 30 July 2021. <https://www.nature.com/articles/s41598-021-95025-3>.
- [15]. News article ; COVID vaccine immunity is waning — how much does that matter?, Elie Dolgin, 17 September 2021. <https://www.nature.com/articles/d41586-021-02532-4>.