



Review Paper

Changing views toward mRNA based covid vaccines in the scientific literature: 2020–2024

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ABSTRACT

Introduction: Before the global Covid-19 pandemic caused by the SARS-CoV-2 virus, mRNA based vaccines had never been administered to the public outside of a single clinical trial that was not completed at the time. However, within the space of 9 months these experimental vaccines were administered to millions through an emergency use authorization (EUA).

Aim: The aim of this article is to raise awareness that medical science can be biased due to social and economic influences, especially during high stress epochs in history. Scientists should be conscious of always being objective and skeptical regardless of what is happening in the wider world.

Material and methods: A literature survey was performed examining the reporting of severe adverse events (SAEs) in articles published between 2020 and 2024.

Results and discussion: From 2020 to 2024, the literature has gone from claiming there are absolutely no SAEs from mRNA based vaccines (2020/2021) to an acknowledgment of a significant number of various SAEs (2023/2024); including but not limited to neurological complications, myocarditis, pericarditis and thrombosis.

Conclusions: The early scientific literature was biased, so as not to report SAEs, due to social and political concerns and overwhelming corporate greed. Only in the last year have scientists been able to publish articles that acknowledge a high number of SAEs linked to mRNA based vaccines. This should act as a warning that science should be completely objective when evaluating health risks, but can often be influenced by social and economic considerations.

1. INTRODUCTION

COVID-19 is caused by the SARS-CoV-2 virus and was first observed in Wuhan, China in late 2019. It rapidly spread worldwide, and the World Health Organization (WHO) declared it a global pandemic on March 11, 2020.¹ Almost immediately, the search for an inoculation was accelerated to the point of vaccines being authorized for emergency use within less than a year of initial development.² Unfortunately, international competition between the United States, Russia and China led to a race to see which super-power could produce the first vaccine; with all three countries claiming their vaccine was the most effective and the safest.³ The vaccine technology most favored by the United States was imported into the European Union.

Across the world, there are three types of underlying technologies used in Covid vaccinations. The safest and least controversial is the protein based vaccine, which uses a protein based subunit, usually combined with an adjuvant, to strengthen the immune response. This stimulates the immune system to create memory cells that can be mobilized in the future to quickly ward off a Covid infection. This technology is used in many vaccines, is not considered controversial and is sometimes referred to as an adjuvant vaccine.⁴ The Novavax Covid vaccination is an example of this technology. A slightly more controversial technology is used in vector vaccines, which use a viral vector (usually an adenovirus) to inject DNA into cells, which then produce mRNA, which then produce the desired protein in large amounts; thus eliciting a strong immune response.⁴ Some of these vaccines have been linked with thrombosis. The Sinopharm (China), Sputnik (Russia) and Covaxin (India) inoculations are all vector vaccines that are still in use. However, the most controversial type of vaccine, with the greatest discrepancy in the scientific literature, is the mRNA based vaccine. There are only two mRNA vaccines that are currently approved. They are the Pfizer-BioNTech vaccine and the Moderna vaccine. The Pfizer-BioNTech inoculation is often referred to as BNT162b2 in the literature and the Moderna vaccination is often referred to as mRNA-1273 or CX-024414 in the literature. Both mRNA vaccines use modified mRNA that encodes the SARS-CoV-2 spike protein encapsulated within a lipid nanoparticle.⁴ Unlike the adjuvant and vector vaccines, mRNA vaccines were never used in humans before the Covid pandemic, except for one uncompleted clinical trial of an mRNA based influenza vaccine.⁵

For unknown reasons, the United States chose to invest heavily into mRNA based vaccines, as opposed to other types of vaccines with stronger research supporting the underlying technology. Due to competition between the world's three super-powers, no country wanted to admit there were any problems with their nation's vaccination program. Unfortunately, these toxic politics entered into the scientific literature en force.

In this short review article, the literature will be examined concerning the safety of mRNA vaccines from 2020 until April 2024. This time period can roughly be divided into

three intervals. In the period from 2020 to the end of 2021, the scientific literature claimed there were absolutely no serious adverse events (SAEs) whatsoever; in the period from January to August 2022 the scientific literature claimed there were some SAEs, but they were very rare and that mRNA vaccines were a miracle drug; the final time period from September 2022 to April 2024 is characterized as being highly skeptical of mRNA based vaccines. How did the medical literature, which should be completely objective, progress from mRNA is a wonder drug with absolutely no serious side effects to the view that all mRNA vaccines should be banned until they are more fully tested? In the following sections, these three time periods will be examined by reviewing some selected articles that represent each era.

2. AIM

The main aim of this work is to evaluate how the medical literature with regards to the safety of Covid mRNA vaccines changed drastically within the space of only 3 years from the vaccine having no SAEs to an acknowledgment that the mRNA vaccine may carry serious and significant risks.

3. MATERIAL AND METHODS

A search of the PubMed database was performed using the search terms: 'adverse events,' 'Covid vaccination.' There were 4,130 results in total ranging from 2020 to 2024. The breakdown of search results by year was: 75 articles in 2020; 799 articles in 2021; 1718 articles in 2022; 1188 articles in 2023 and 350 articles from January to April 2024. Articles were then filtered by year and abstracts were examined for general trends. Pertinent articles were then selected for further exploration. Three general trends became apparent that were: early Covid safety publications, median Covid safety publications and later Covid safety publications. Early Covid safety publications ranged from November 2020 to November 2021; median Covid safety publications ranged from January 2022 to August 2022 and the later Covid safety publications ranged from September 2022 until April 2024. April 2024 is the time when this research was conducted. Eight representative articles from each period listed above were analyzed more deeply and the results are discussed below in order of the later period first and early period last.

4. RESULTS AND DISCUSSION

4.1. Later Covid safety publications: September 2022 to April 2024

One of the most recent articles concerning mRNA based vaccines is from April 2024. They used a database covering 8 countries to do an observational cohort study that compared observed with expected rates (OE rates) of several SAEs. It was a very large study of over 99 million vaccinated individu-

als. Significant OE ratios were found for Guillain–Barré syndrome, cerebral venous sinus thrombosis, acute disseminated encephalomyelitis, myocarditis and pericarditis.⁶ Another study from March 2024 also used a database from the WHO and examined the rate of SAEs in adolescents. This is quite relevant, since adolescents have the lowest risk of Covid morbidity. There were over 99 thousand reports of adverse events with 76.1% of them being SAEs. Myocarditis and pericarditis were especially prevalent.⁷ Other articles have reported that between the two mRNA vaccines, the Pfizer vaccine seems to have a significantly higher rate of SAEs than Moderna;⁸ however, SAEs after one dose of Moderna were still higher than vaccination with a viral vector vaccine.⁹ Curiously, even scientists who work for Moderna have published articles admitting ‘mRNA drug and vaccine toxicity’.¹⁰ However, they still claim mRNA vaccines are a wonderful technology that just needs to be improved. Moderna employees weren’t the only ones to still have hope for mRNA technology even while observing large numbers of SAEs. One very large study from 2023 looked at 12 different SAEs individually. They concluded that Pfizer had significantly more SAEs than Moderna, but they made no clear statements linking SAEs with mRNA vaccines, even though that is what the results showed.¹¹ On the other hand, there were some brave souls who managed to publish about vaccine injuries as early as August of 2021. The authors were from Asia and had to publish in an ocular journal and claim the vaccine could cause ‘ocular damage’.¹² The most forceful article recently to come out is associated with MIT and calls for ‘a complete global moratorium’ on all mRNA based vaccines until they are properly tested.¹³ According to these authors, we should all collectively be ashamed of ourselves for letting these experimental drugs be used on the public. The reasoning behind such a forceful statement comes from the statistics that showed that SAEs are not ‘rare’ with mRNA drugs; they are very common when compared to other types of vaccination.¹⁴ Table 1 summarizes the results of this time period.

4.2. Median Covid Safety Publications: January 2022 to August 2022

This time period is perhaps the most embarrassing to anyone who believes in the honesty and integrity of medical science. For most of 2022, the literature acknowledges the existence of SAEs, but universally claims they are ‘rare’ and

that the only relevant issue is ‘vaccine hesitancy.’ During this time, the overall mentality was that mRNA vaccines are wonder drugs and that only irrational conspiracy theorists would be against the mRNA Covid vaccine. This cultural stereotype definitely made its way into the scientific literature. Some articles from this time acknowledge the SAEs, but claim that a connection between mRNA vaccines may be coincidental and not causal.^{15,16,17} As of 2024, causality has been proven. Nearly every article examined during this time, especially in the abstract, is very keen to emphasize that the occurrence of SAEs from mRNA vaccines are ‘miniscule,’¹⁶ ‘very rare’¹⁸ or simply ‘rare’^{19,20} During the first eight months of 2022, even if proper statistical research was performed that showed very high rates of SAEs occurring after mRNA vaccination, the recommendation was always that ‘the benefits outweigh the risks.’²¹ We know this is not true and mRNA vaccinations carry far more risk for healthy persons under 65 than the actual SARS-CoV-2 virus. This was confirmed in 2020 by research from Stanford University.^{22,23} Therefore, almost 2 years after research showing that Covid morbidity is very rare among the young and healthy, why does nearly every research article endorse the vaccine for most of 2022? Most of the articles promote the mRNA vaccine so enthusiastically that it is embarrassing. For example, one article from July 2022 opens with the line, ‘Despite their proven efficacy and huge contribution to the health of humankind,’²⁴ and another article claimed SAEs of 3.5 per 1,000,000 for myocarditis (these are now known to be well over 10,000 per 1,000,000) and then quotes the price per dose in USD; as if to say ‘see how reasonably priced it is?’²⁵ These are some examples, but the vast majority of the articles on this subject during this time are similar. Table 2 summarizes the results of this time period.

4.3. Early Covid Safety Publications: November 2020 to November 2021

While literature from the first eight months of 2022 was embarrassing due to researchers writing what they believed was expected of them regardless of the data, late 2020 and nearly all of 2021 was frightening. In many cases, it seems as if data was intentionally skewed in order to bias the results and show that mRNA was the safest vaccine in human history. For example, a very large study of over 20,000 nursing home patients concluded that adverse events were not statistically

Table 1. A summation of the literature regarding later Covid vaccine safety.

Publication date	Incidence of SAEs reported in the study	Overall Attitude toward the mRNA Vaccine	References
April 2024	Very high OE ratios for several SAEs	Very critical view of mRNA vaccines	Faksova et al., 2024
March 2024	High incidence of SAEs in adolescents	Critical view of mRNA vaccines in general	Kim et al., 2024
March 2023	High number of SAEs, especially with Pfizer	Especially negative toward Pfizer vaccine	Yasmin et al., 2023
April 2024	Moderna has higher SAEs than viral vector	Critical view of mRNA vaccines in general	Tsang et al., 2024
January 2024	Admit SAEs are a problem, although they work for Moderna	Promote mRNA vaccines while admitting SAEs are a problem	Bitounis et al., 2024
August 2023	High number of SAEs, especially with Pfizer	No clear statement of their attitude	Harris et al., 2023
August 2021	High number of SAEs, especially ocular SAEs	Critical view of mRNA vaccines in general	Ng et al., 2021
February 2024	So many SAEs that the authors are angry	mRNA vaccines be totally banned globally	Mead et al., 2024

Table 2. A summation of the literature regarding median Covid vaccine safety.

Publication date	Incidence of SAEs reported in the study	Overall attitude toward the mRNA vaccine	References
April 2022	SAEs are only coincidental not causal	Very positive	Chen et al., 2022
January 2022	Rate of SAEs are ‘minuscule’	Very positive	Garg et al., 2022
March 2022	Rate of SAEs are ‘very rare’	Very positive	Hana et al., 2022
July 2022	Rate of SAEs are ‘rare’	Overall positive	Hadj Hassine, 2022
February 2022	Rate of SAEs are ‘rare’	Overall positive	Iba, Levy, 2022
May 2022	Abnormally high rate of SAEs	Vaccine benefits outweigh the risks	Kouhpayeh, Ansari, 2022
July 2022	Ignore SAEs, claim ‘vaccine hesitancy’ is the only problem	So positive and flattering that it is embarrassing	Mahroum et al., 2022
February 2022	Unrealistically low number of SAEs	So positive that it quotes the cost of vaccines	Fiolet et al., 2022

significant and although they did report a suspiciously low number of venous thromboembolism cases, the article normalizes the findings. The most deceptive part of the study though is that all statistics were collected only after the first vaccination.²⁶ Since most SAEs occur after the second inoculation, this article seriously under-reports the incidence of SAEs. One very questionable 2021 article was published in the *New England Journal of Medicine*, which is one of the top medical journals in the world. The study included over 30,000 individuals and followed up with them 14 days after the second vaccination. The authors claim there were no SAEs linked to the mRNA vaccine at all. ‘Serious adverse events were rare, and the incidence was similar in the two groups’ (placebo and control). The article also says that ‘Aside from transient local and systemic reactions, no safety concerns were identified.’²⁷ With over 15,000 subjects in each group, why didn’t they see a higher rate of SAEs in the experimental group? Other studies from this time also give very low numbers of SAEs compared to what we know today. One study claimed to do a thorough analysis of SAEs caused by mRNA vaccines and concluded the number was 0.4 per 10,000, we now know the number is as high as 18 per 10,000.²⁸ Some early studies actually report seemingly accurate statistics, but then simply claim there were no safety concerns. For example, one of the earliest studies from 2020 used a very small sample size of 45 adults and divided them into placebo vs. experimental groups. One of the experimental groups had ‘one or more SAEs’ at a rate of 21%, but yet the conclusion of the report says that, ‘no trial-limiting

safety concerns were identified. These findings support further development of this vaccine.²⁹ In a similar vein, again from the *New England Journal of Medicine*, this article lists many SAEs, then claim ‘the BNT162b2 vaccine (Pfizer) was not associated with an elevated risk of most of the adverse events examined.’³⁰ They do list myocarditis as an issue, but claim that the patients must have already had Covid before the vaccine; therefore, the Pfizer vaccine does not cause myocarditis. We now know that the Pfizer vaccine absolutely does have a high rate of causing myocarditis. Another problem is obvious corporate greed coupled with political considerations. Two articles were funded by Pfizer, who earned billions per year in profit during the pandemic, and local government agencies who wanted to appear responsible for stopping the pandemic; mainly for political reasons. The first was from December of 2020, which claimed ‘The incidence of serious adverse events was low and was similar in the vaccine and placebo groups.’³¹ In other words, there were no SAEs caused by the Pfizer vaccine. In a similar vein, an article written exclusively by Pfizer scientists published in November 2021 claims that ‘BNT162b2 continued to be safe and have an acceptable adverse-event profile.’ In other words, the Pfizer vaccine is just as safe as every other vaccine. Furthermore, the paper goes on to claim that vaccine efficiency drops every 6 months. Therefore, twice a year everyone must purchase a ‘booster’ vaccine, which is conveniently sold by Pfizer corporation.³² Even though these articles were funded by Pfizer who had a very obvious profit motive, both were published in the prestigious *New Eng-*

Table 3: A summation of the literature regarding early Covid vaccine safety.

Publication date	Incidence of SAEs reported in the study	Overall attitude toward the mRNA Vaccine	References
November 2021	SAEs generally ignored, problematic methodology	Very positive, but still sounds deceptively professional	Bardenheier et al., 2021
February 2021	No SAEs reported whatsoever	Very positive	Baden et al., 2021
November 2021	Abnormally low SAEs at 0.4 per 10 000	Very positive	Liu et al., 2021
July 2020	Report high number of SAEs	So positive that they recommend the vaccine	Jackson et al., 2020
September 2021	Report SAEs, but claim they were coincidental	Very positive	Barda et al., 2021
December 2020	SAE rate the same as placebo group	Very positive and written by Pfizer	Polack et al., 2020
November 2021	SAE rate the same as all other vaccines	Very positive and written by Pfizer	Thomas et al., 2021
October 2020	Risk of SAEs high compared to Covid mortality	Very negative according to title, but never published	Victor, Neville, 2020

land *Journal of Medicine*. In fact, the only article found from 2020 or 2021 that seemed to be critical of the mRNA vaccine was withdrawn. This was a study from the government of Malta that seemed to compare the risk of SAEs from mRNA vaccines with actual Covid mortality. Unfortunately the study was withdrawn and the article (not even the abstract) is available. This was the closest article found prior to late 2022 that seems to have questioned the mRNA vaccine; but it was not published 33. Table 3 summarizes the results of this time period.

5. CONCLUSIONS

- (1) A drastic shift in the medical literature occurred concerning mRNA based vaccines between 2020 and 2024.
- (2) The early literature seems to have been heavily biased in favor of promoting an experimental vaccine, without any previously completed human clinical trials, for both monetary and political purposes.
- (3) Even as reports of SAEs became too numerous to dismiss in 2022, the literature at the time simply downplayed SAEs as extremely rare.
- (4) Even though there were blatantly obvious conflicts of interest, such as vaccine producers publishing manuscripts promoting their own vaccine, articles were published in very prestigious journals.
- (5) It wasn't until late 2022 that the first criticisms of mRNA vaccines began to appear and, as time goes by, more articles are becoming more vocal about completely banning all mRNA vaccines until they can be thoroughly tested for safety concerns.
- (6) The drastic shift in attitude towards mRNA vaccines in only about three years shows serious vulnerabilities in Western medical research.

Conflict of interest

The author has no conflicts of interest to declare.

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References

- 1 Lin Y, Hu Z, Zhao Q, Alias H, Danaee M, Wong LP. Understanding COVID-19 vaccine demand and hesitancy: A nationwide online survey in China. *PLoS Negl Trop Dis*. 2020;14(12):e0008961. <https://doi.org/10.1371/journal.pntd.0008961>.
- 2 Bok K, Sitar S, Graham BS, Mascola JR. Accelerated COVID-19 vaccine development: milestones, lessons, and prospects. *Immunity*. 2021;54(8):1636–1651. <https://doi.org/10.1016/j.immuni.2021.07.017>.
- 3 Heaton PM. The Covid-19 Vaccine-Development Multiverse. *N Engl J Med*. 2020;383(20):1986–1988. <https://doi.org/10.1056/NEJMe2025111>.
- 4 Pokharkar D, Sawale G, Bandarkar A, Galande R, Patil K. A review on vaccines against various diseases. *World J Pharm Res*. 2021;10(10):291–306. doi: 10.20959/wjpps202110-21179
- 5 Dolgin E. mRNA flu shots move into trials. *Nat Rev Drug Discov*. 2021;20(11):801–803. <https://doi.org/10.1038/d41573-021-00176-7>.
- 6 Faksova K, Walsh D, Jiang Y, et al. COVID-19 vaccines and adverse events of special interest: A multinational Global Vaccine Data Network (GVDN) cohort study of 99 million vaccinated individuals. *Vaccine*. 2024;42(9):2200–2211. <https://doi.org/10.1016/j.vaccine.2024.01.100>.
- 7 Kim DH, Kim JH, Oh IS, Choe YJ, Choe SA, Shin JY. Adverse Events Following COVID-19 Vaccination in Adolescents: Insights From Pharmacovigilance Study of VigiBase. *J Korean Med Sci*. 2024;39(8):e76. <https://doi.org/10.3346/jkms.2024.39.e76>.
- 8 Yasmin F, Najeeb H, Naeem U, et al. Adverse events following COVID-19 mRNA vaccines: A systematic review of cardiovascular complication, thrombosis, and thrombocytopenia. *Immun Inflamm Dis*. 2023;11(3):e807. <https://doi.org/10.1002/iid3.807>.
- 9 Tsang RS, Agrawal U, Joy M, et al. Adverse events after first and second doses of COVID-19 vaccination in England: a national vaccine surveillance platform self-controlled case series study. *J R Soc Med*. 2024;117(4):134–148. <https://doi.org/10.1177/01410768231205430>.
- 10 Bitounis D, Jacquinet E, Rogers MA, Amiji MM. Strategies to reduce the risks of mRNA drug and vaccine toxicity. *Nat Rev Drug Discov*. 2024;23(4):281–300. <https://doi.org/10.1038/s41573-023-00859-3>.
- 11 Harris DA, Hayes KN, Zullo AR, et al. Comparative Risks of Potential Adverse Events Following COVID-19 mRNA Vaccination Among Older US Adults. *JAMA Netw Open*. 2023;6(8):e2326852. <https://doi.org/10.1001/jamanetworkopen.2023.26852>.
- 12 Ng XL, Betzler BK, Testi I, et al. Ocular Adverse Events After COVID-19 Vaccination. *Ocul Immunol Inflamm*. 2021;29(6):1216–1224. <https://doi.org/10.1080/09273948.2021.1976221>.
- 13 Mead MN, Seneff S, Wolfinger R, et al. COVID-19 mRNA Vaccines: Lessons Learned from the Registrational Trials and Global Vaccination Campaign. *Cureus*. 2024;16(1):e52876. <https://doi.org/10.7759/cureus.52876>.
- 14 Fraiman J, Erviti J, Jones M, et al. Serious adverse events of special interest following mRNA COVID-19 vaccination in randomized trials in adults. *Vaccine*. 2022;40(40):5798–5805. <https://doi.org/10.1016/j.vaccine.2022.08.036>.
- 15 Chen Y, Xu Z, Wang P, et al. New-onset autoimmune phenomena post-COVID-19 vaccination. *Immunology*. 2022;165(4):386–401. <https://doi.org/10.1111/imm.13443>.
- 16 Garg RK, Paliwal VK. Spectrum of neurological complications following COVID-19 vaccination. *Neurol Sci*. 2022;43(1):3–40. <https://doi.org/10.1007/s10072-021-05662-9>.
- 17 Shafiq A, Salameh MA, Laswi I, et al. Neurological Immune-Related Adverse Events After COVID-19 Vaccination: A Systematic Review. *J Clin Pharmacol*. 2022;62(3):291–303. <https://doi.org/10.1002/jcph.2017>.
- 18 Hana D, Patel K, Roman S, Gattas B, Sofka S. Clinical Cardiovascular Adverse Events Reported Post-COVID-19 Vaccination: Are They a Real Risk? *Curr Probl Cardiol*. 2022;47(3):101077. <https://doi.org/10.1016/j.cpcardi.2021.101077>.

- ¹⁹ Hadj Hassine I. Covid-19 vaccines and variants of concern: A review. *Rev Med Virol.* 2022;32(4):e2313. <https://doi.org/10.1002/rmv.2313>.
- ²⁰ Iba T, Levy JH. Thrombosis and thrombocytopenia in COVID-19 and after COVID-19 vaccination. *Trends Cardiovasc Med.* 2022;32(5):249–256. <https://doi.org/10.1016/j.tcm.2022.02.008>.
- ²¹ Kouhpayeh H, Ansari H. Adverse events following COVID-19 vaccination: A systematic review and meta-analysis. *Int Immunopharmacol.* 2022;109:108906. <https://doi.org/10.1016/j.intimp.2022.108906>.
- ²² Ioannidis JPA, Axfors C, Contopoulos-Ioannidis DG. Population-level COVID-19 mortality risk for non-elderly individuals overall and for non-elderly individuals without underlying diseases in pandemic epicenters. *Environ Res.* 2020;188:109890. <https://doi.org/10.1016/j.envres.2020.109890>.
- ²³ Roy S, Mukhopadhyay S, Mukherjee S, Samajdar SS, Tripathi SK. In search of protective antibody for coronavirus disease 2019: A retrospective study. *Pol Ann Med.* 2022;29(2):189–195. <https://doi.org/10.29089/paom/146894>.
- ²⁴ Mahroum N, Lavine N, Ohayon A, et al. COVID-19 Vaccination and the Rate of Immune and Autoimmune Adverse Events Following Immunization: Insights From a Narrative Literature Review. *Front Immunol.* 2022;13:872683. <https://doi.org/10.3389/fimmu.2022.872683>.
- ²⁵ Fiolet T, Kherabi Y, MacDonald CJ, Ghosn J, Peiffer-Smadja N. Comparing COVID-19 vaccines for their characteristics, efficacy and effectiveness against SARS-CoV-2 and variants of concern: a narrative review. *Clin Microbiol Infect.* 2022;28(2):202–221. <https://doi.org/10.1016/j.cmi.2021.10.005>.
- ²⁶ Bardenheier BH, Gravenstein S, Blackman C, et al. Adverse Events Following One Dose of mRNA COVID-19 Vaccination Among US Nursing Home Residents With and Without a Previous SARS-CoV-2 Infection. *J Am Med Dir Assoc.* 2021;22(11):2228–2232. <https://doi.org/10.1016/j.jamda.2021.08.024>.
- ²⁷ Baden LR, El Sahly HM, Essink B, et al. Efficacy and Safety of the mRNA-1273 SARS-CoV-2 Vaccine. *N Engl J Med.* 2021;384(5):403–416. <https://doi.org/10.1056/NEJMoa2035389>.
- ²⁸ Liu Q, Qin C, Liu M, Liu J. Effectiveness and safety of SARS-CoV-2 vaccine in real-world studies: a systematic review and meta-analysis. *Infect Dis Poverty.* 2021;10(1):132. <https://doi.org/10.1186/s40249-021-00915-3>.
- ²⁹ Jackson LA, Anderson EJ, Rouphael NG, et al. An mRNA Vaccine against SARS-CoV-2 - Preliminary Report. *N Engl J Med.* 2020;383(20):1920–1931. <https://doi.org/10.1056/NEJMoa2022483>.
- ³⁰ Barda N, Dagan N, Ben-Shlomo Y, et al. Safety of the BNT162b2 mRNA Covid-19 Vaccine in a Nationwide Setting. *N Engl J Med.* 2021; 385(12):1078–1090. <https://doi.org/10.1056/NEJMoa2110475>.
- ³¹ Polack FP, Thomas SJ, Kitchin N, et al. Safety and Efficacy of the BNT162b2 mRNA Covid-19 Vaccine. *N Engl J Med.* 2020; 383(27):2603–2615. <https://doi.org/10.1056/NEJMoa2034577>.
- ³² Thomas SJ, Moreira ED Jr, Kitchin N, et al. Safety and Efficacy of the BNT162b2 mRNA Covid-19 Vaccine through 6 Months. *N Engl J Med.* 2021;385(19):1761–1773. <https://doi.org/10.1056/NEJMoa2110345>.