Overcoming the Covid-19 The Vaccine Dilemma

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UNIMAS
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What is a Dilemma?

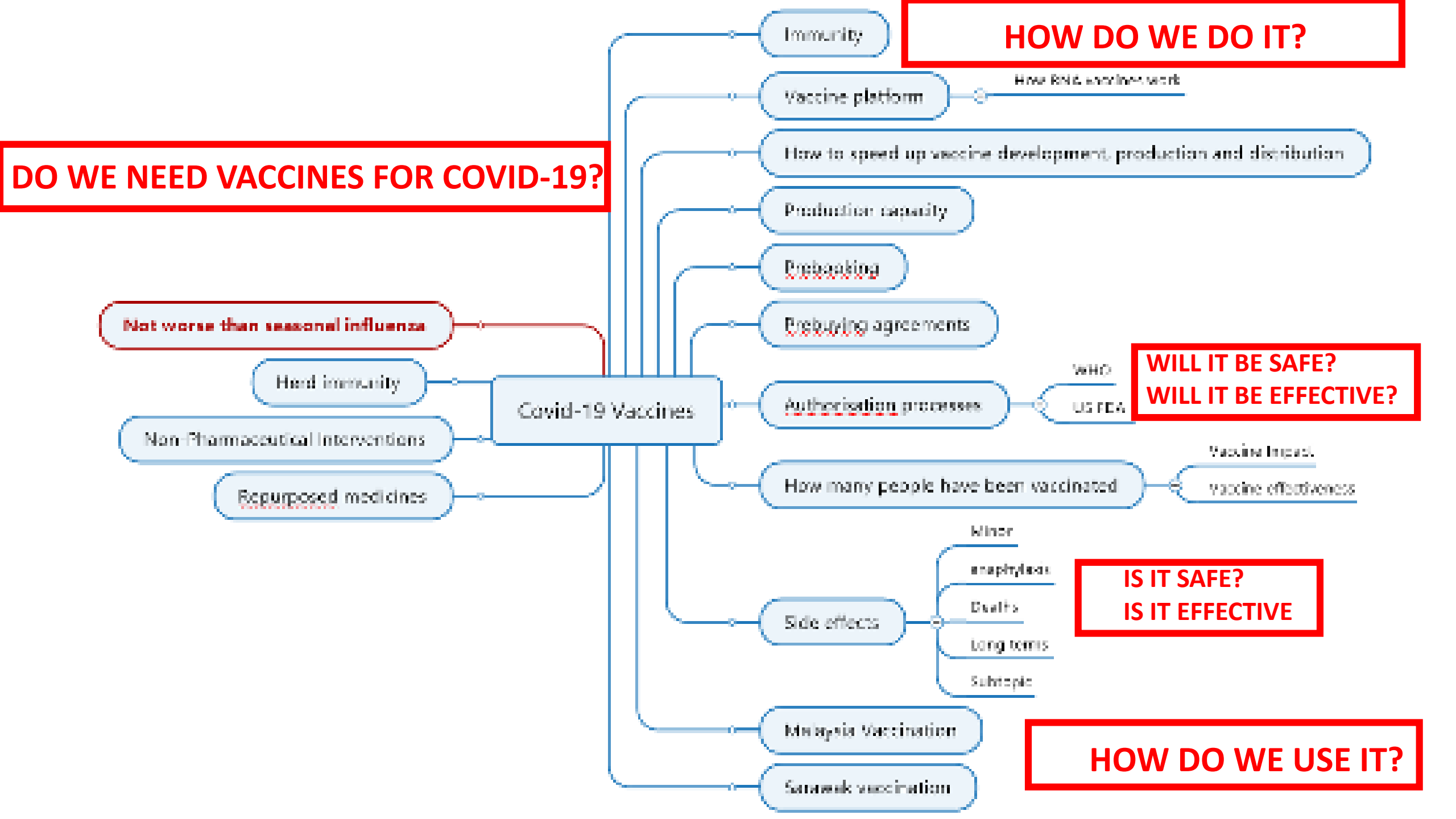
- A **dilemma** is a problem with at least two solutions or possibilities.
- None of the solutions are practically acceptable;
- a person in this position has been traditionally described as being **impaled on the horns of a dilemma**, neither horn being comfortable.

https://en.wikipedia.org/wiki/Dilemma

How do We Overcome a Dilemma

- According to Robert Pirsig (1974) in his book '*Zen and the Art of Motorcycle Maintenance*'
- The classical responses are to
  - either choose one of the two horns and refute the other or alternatively to
  - refute both horns by showing that there are additional choices.
- Other rhetorical responses.
  - One can "**throw sand in the bull's eyes**" by, for example, questioning the competence of the questioner.
  - One can "**sing the bull to sleep**" by, for example, stating that the answer to the question is beyond one's own humble powers and asking the questioner for help.
  - Finally one can "**refuse to enter the arena**" by, for example, stating that the question is unanswerable.

https://simple.wikipedia.org/wiki/Dilemma


DO WE NEED VACCINES FOR COVID-19?
Not worse than seasonal influenza
Herd immunity
Non Pharmaceutical Interventions
Repurposed medicines
Covid-19 Vaccines
Immunity
Vaccine platform
How to speed up vaccine development, production and distribution
Production capacity
Prebooking
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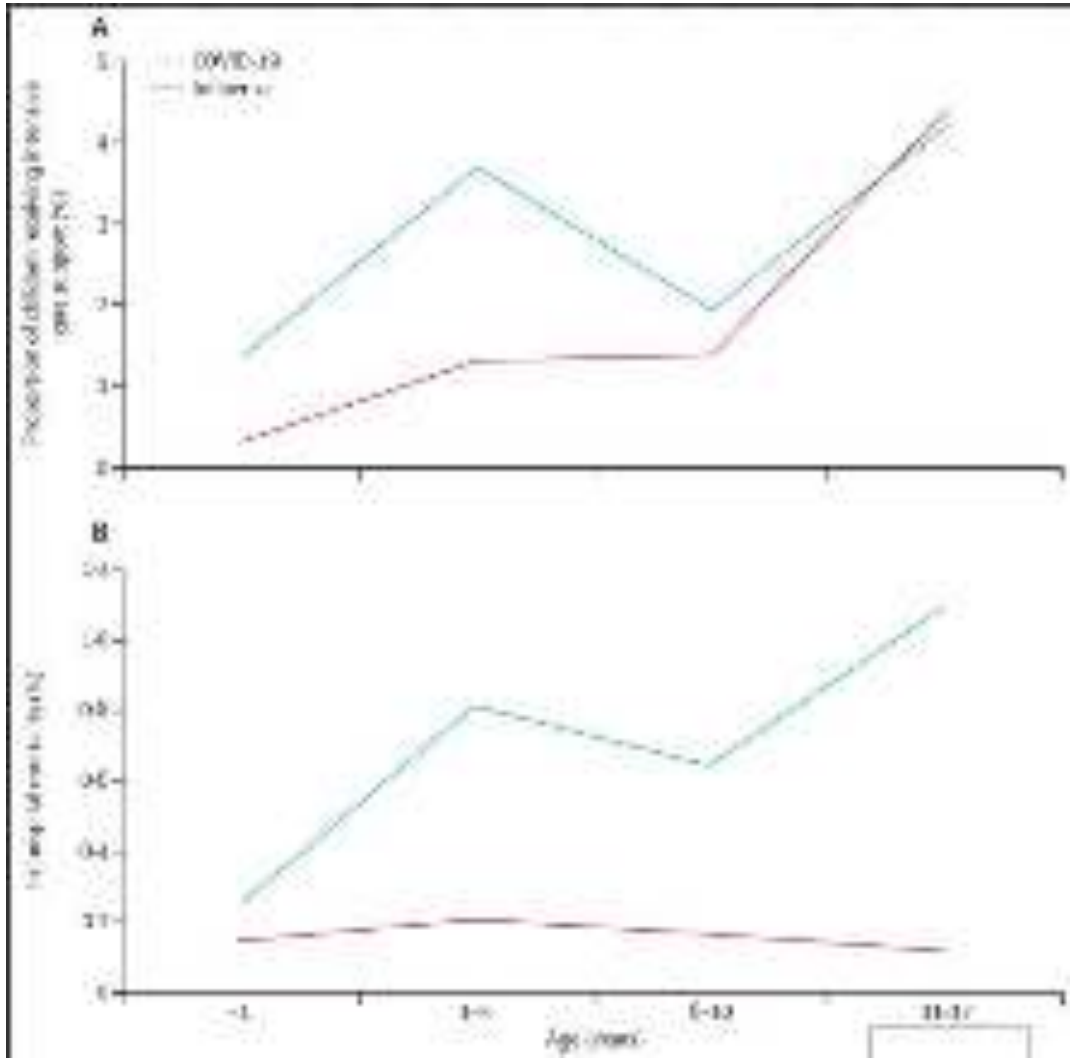
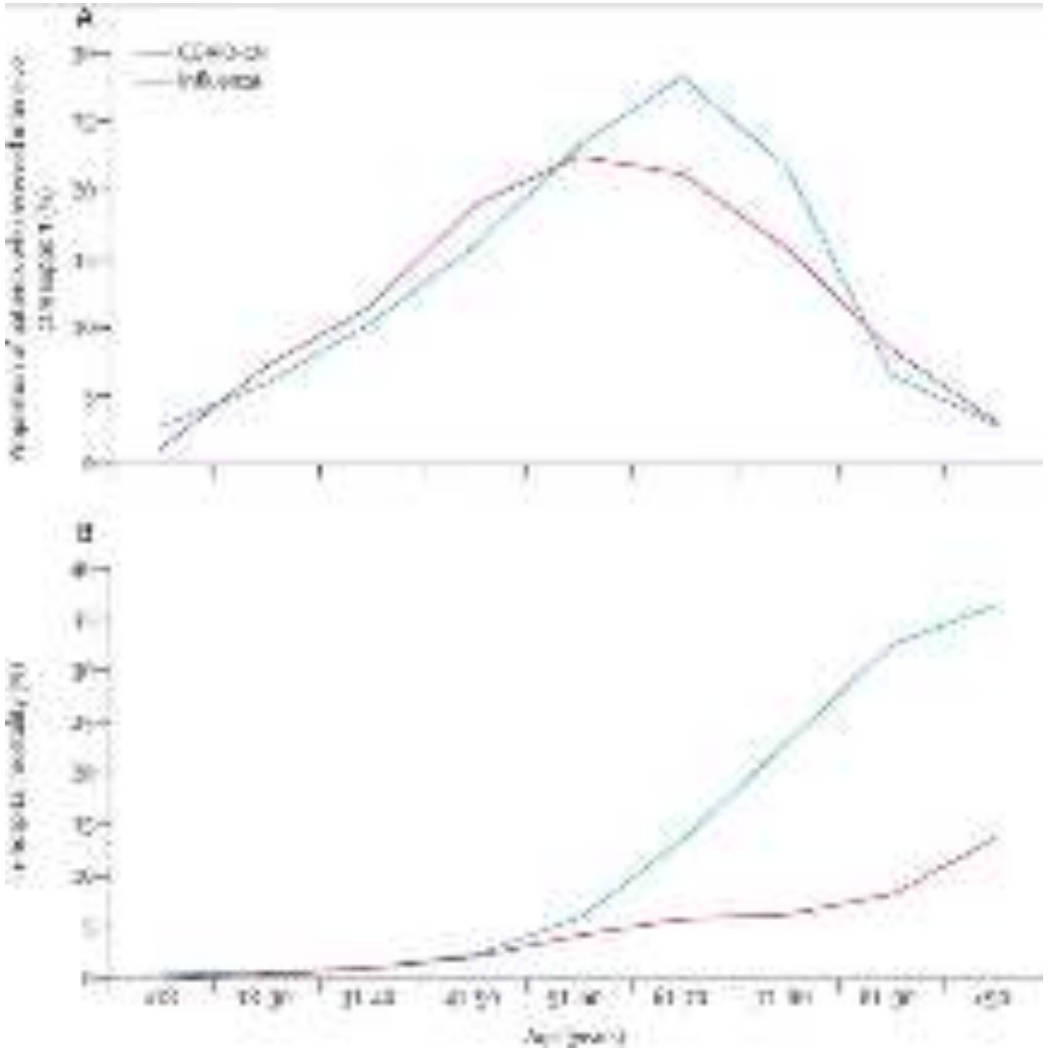
Authorisation processes
WHO
US FDA
WILL IT BE SAFE?
WILL IT BE EFFECTIVE?
How many people have been vaccinated
Vaccine effectiveness
Side effects
Minor
Deaths
Long terms
IS IT SAFE?
IS IT EFFECTIVE
Malaysia Vaccination
Sarawak vaccination
HOW DO WE DO IT?
HOW DO WE USE IT?

Why Bother Since Covid-19 is No Worse Than Seasonal Flu?

Intensive care support and mortality of children younger than 18 years hospitalised in France for COVID-19 or seasonal influenza, by age at admission

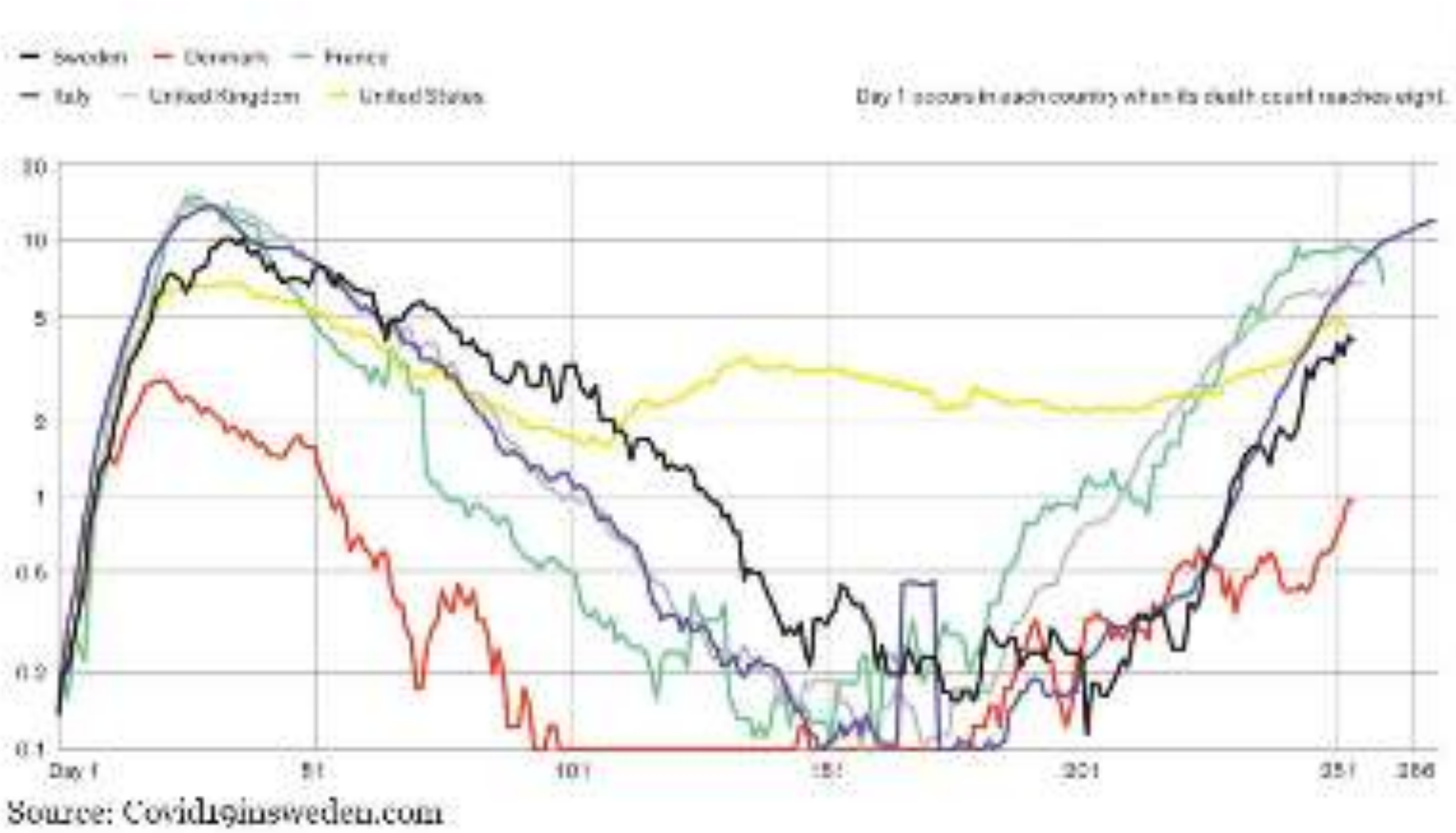


Intensive care support and mortality of patients hospitalised in France for COVID-19 or seasonal influenza, by age at admission



Lionel Piroth, et al. (2020.12.17). Comparison of the characteristics, morbidity, and mortality of COVID-19 and seasonal influenza: a nationwide, population-based retrospective cohort study. The Lancet. (Online First). DOI:https://doi.org/10.1016/S2213-2600(20)30527-0

Daily COVID-19 Deaths per Million Inhabitants



Vaclav Smil (2020.12.29) **Don't be Too Quick to Judge Sweden's Covid-19 Policy. https://spectrum.ieee.org/biomedical/ethics/dont-be-too-quick-to-judge-swedens-covid19-policy**

Excess Deaths in 2020

FMT

US reports nearly 300,000 more deaths in 2020 than in typical year

A Covid-19 patient is moved by healthcare workers at a medical centre in New York in May. (AP pic)

https://www.freemalaysiatoday.com/category/world/2020/10/21/us-reports-nearly-300000-excess-deaths-in-2020-than-in-typical-year/

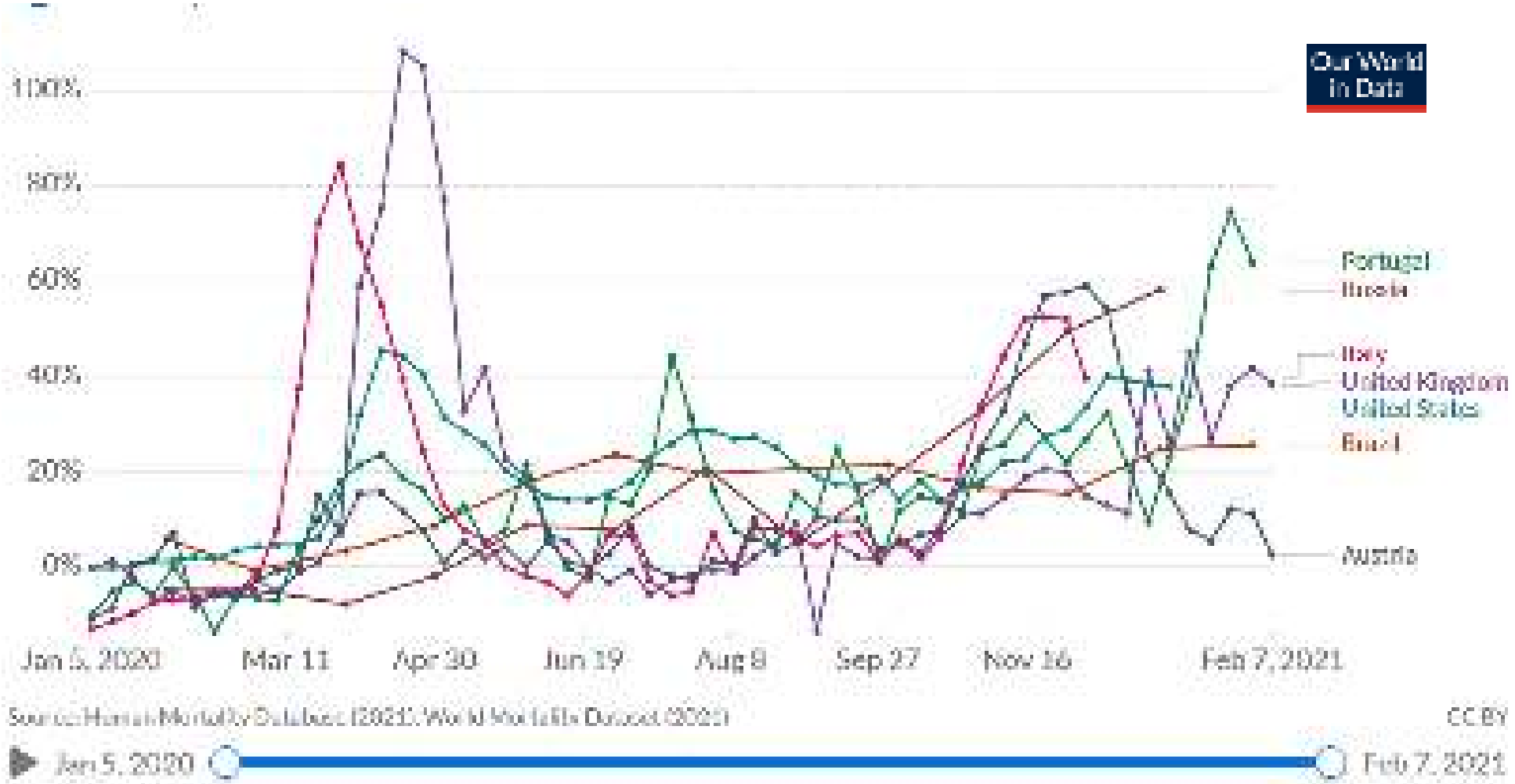
malay mail

EU reports nearly 300,000 excess deaths in eight months of 2020

Statistics from Eurostat showed that across the bloc, excess mortality peaked during the early rise of Covid-19 in April 2020. — Reuters pic

https://www.malaymail.com/news/world/2021/01/20/eu-reports-nearly-300000-excess-deaths-in-eight-months-of-2020/1942421

Excess mortality during COVID-19: Deaths from all causes compared to previous years, all ages

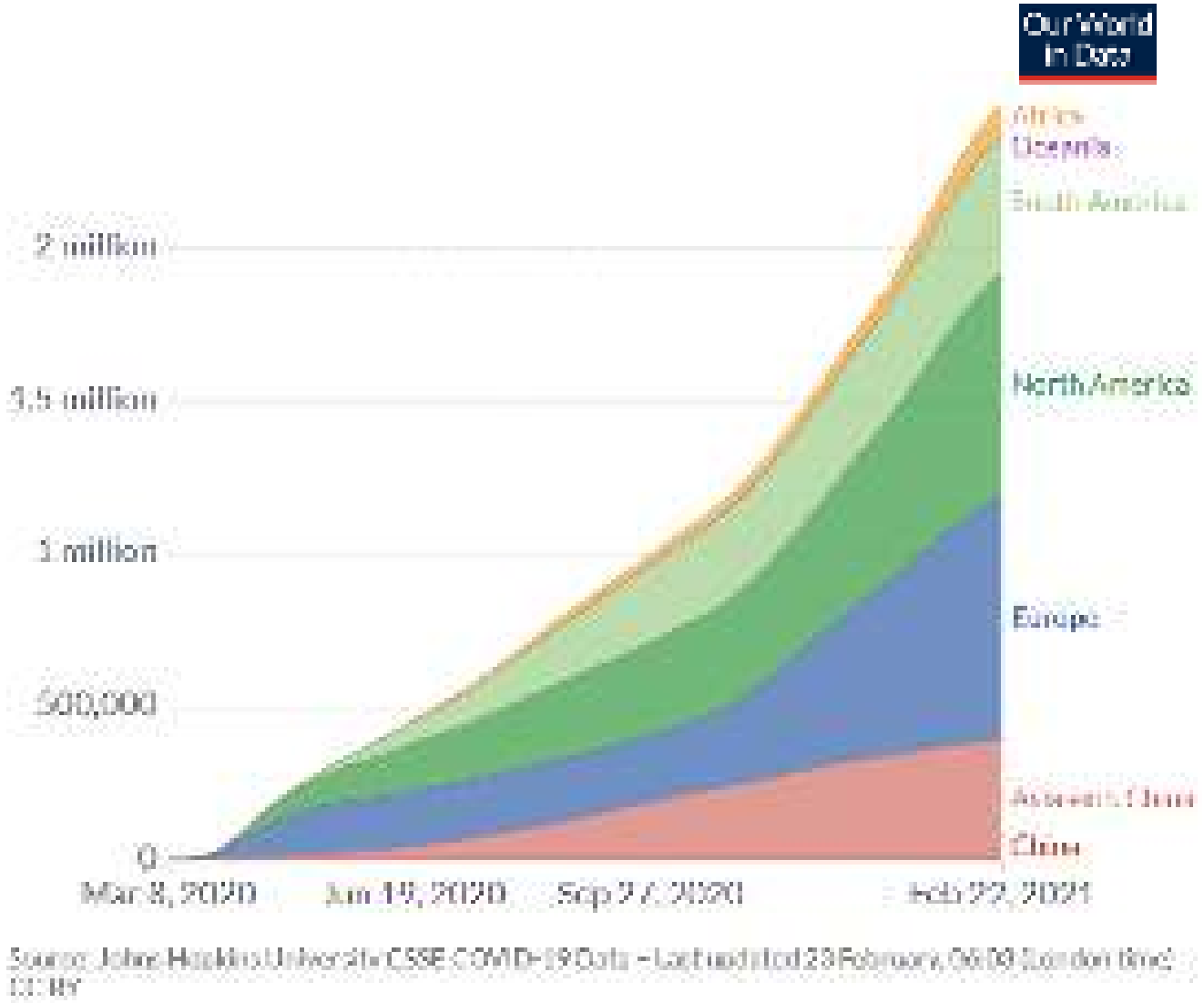


Shown is how the number of weekly or monthly deaths in 2020–2021 differs as a percentage from the average number of deaths in the same period over the years 2015–2019. This metric is called the P-score. The reported number of deaths might not count all deaths that occurred due to incomplete coverage and delays in death reporting.

https://ourworldindata.org/excess-mortality-covid

Cumulative confirmed COVID-19 deaths

Limited testing and challenges in the attribution of the cause of death means that the number of confirmed deaths may not be an accurate count of the actual number of deaths from COVID-19.

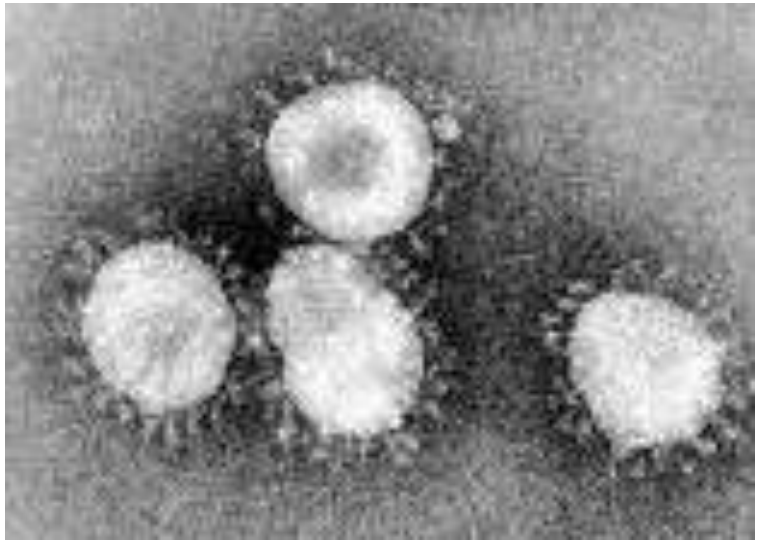


https://ourworldindata.org/search?q=cumulative+deaths+due+to+covid+19

Dilemma 1: Why Bother?

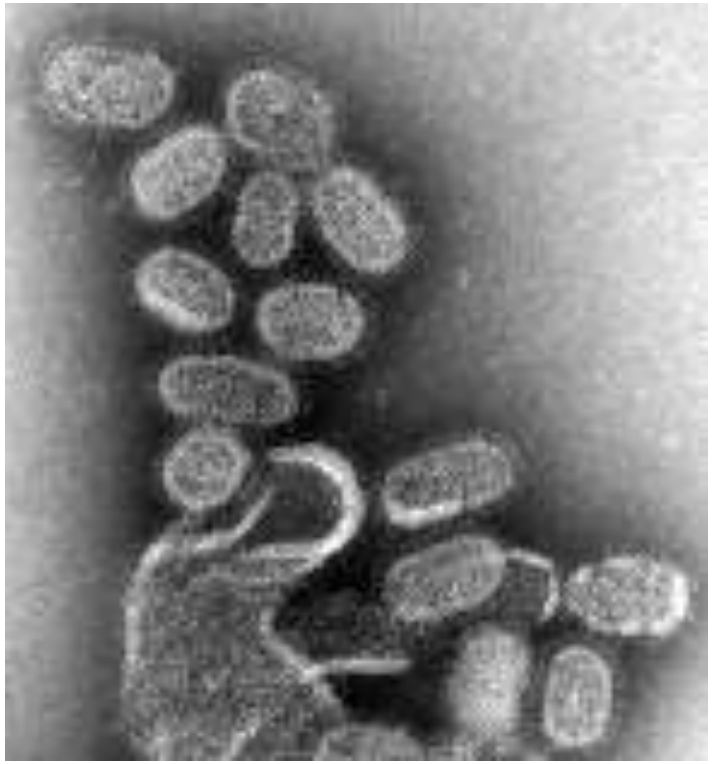
- Covid-19 is definitely many times worse than seasonal influenza, based on deaths alone

SARS-CoV-2

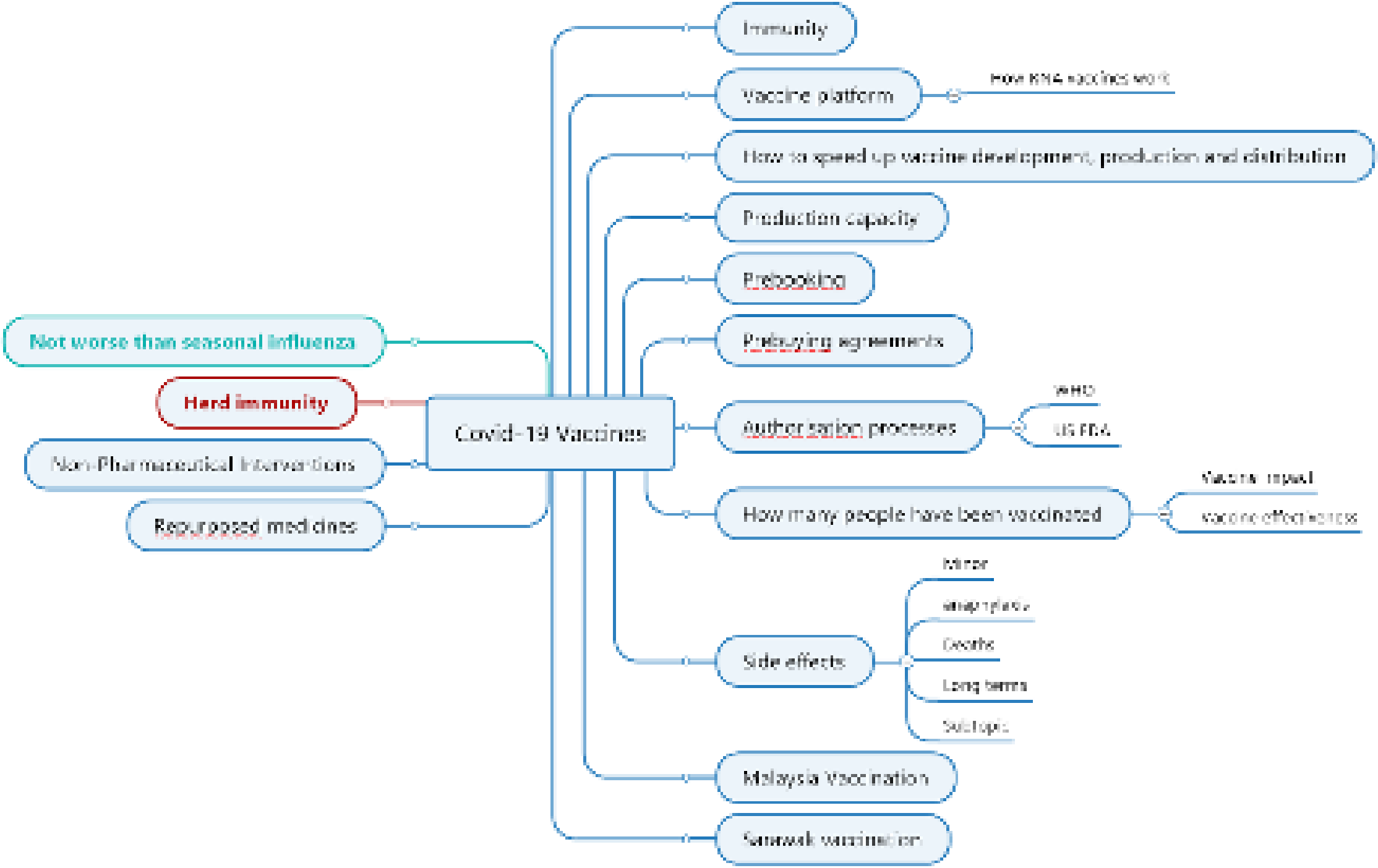


The S (spike) proteins of coronaviruses © CDC/Dr Fred Murphy https://cehjournal.org/wp-content/uploads/Coronaviruses.jpg

Influenza virus



negative stained transmission electron micrograph (TEM) shows recreated 1918 influenza virions https://en.wikipedia.org/wiki/Influenza#/media/File:EM_of_influenza_virus.jpg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How mRNA vaccines work
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Deaths
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Subtypes
Malaysia Vaccination
Sarawak vaccination

https://intermountainhealthcare.org/blogs/topics/covid-19/2020/11/debunking-the-myth-of-non-vaccine-herd-immunity-in-covid-19/

Why Don’t we just let everyone get infected so that we can achieve population (Herd) Immunity

What is herd immunity?

- Herd immunity, also known as “population immunity,”
- refers to the situation when enough members of a population, or “herd,” develop immunity to a pathogen to prevent further outbreaks.
- But not all infectious diseases can be controlled through herd immunity. Success depends on two factors:
- The percentage of the population that must develop immunity before the disease is controlled

https://intermountainhealthcare.org/blogs/topics/covid-19/2020/11/debunking-the-myth-of-non-vaccine-herd-immunity-in-covid-19/

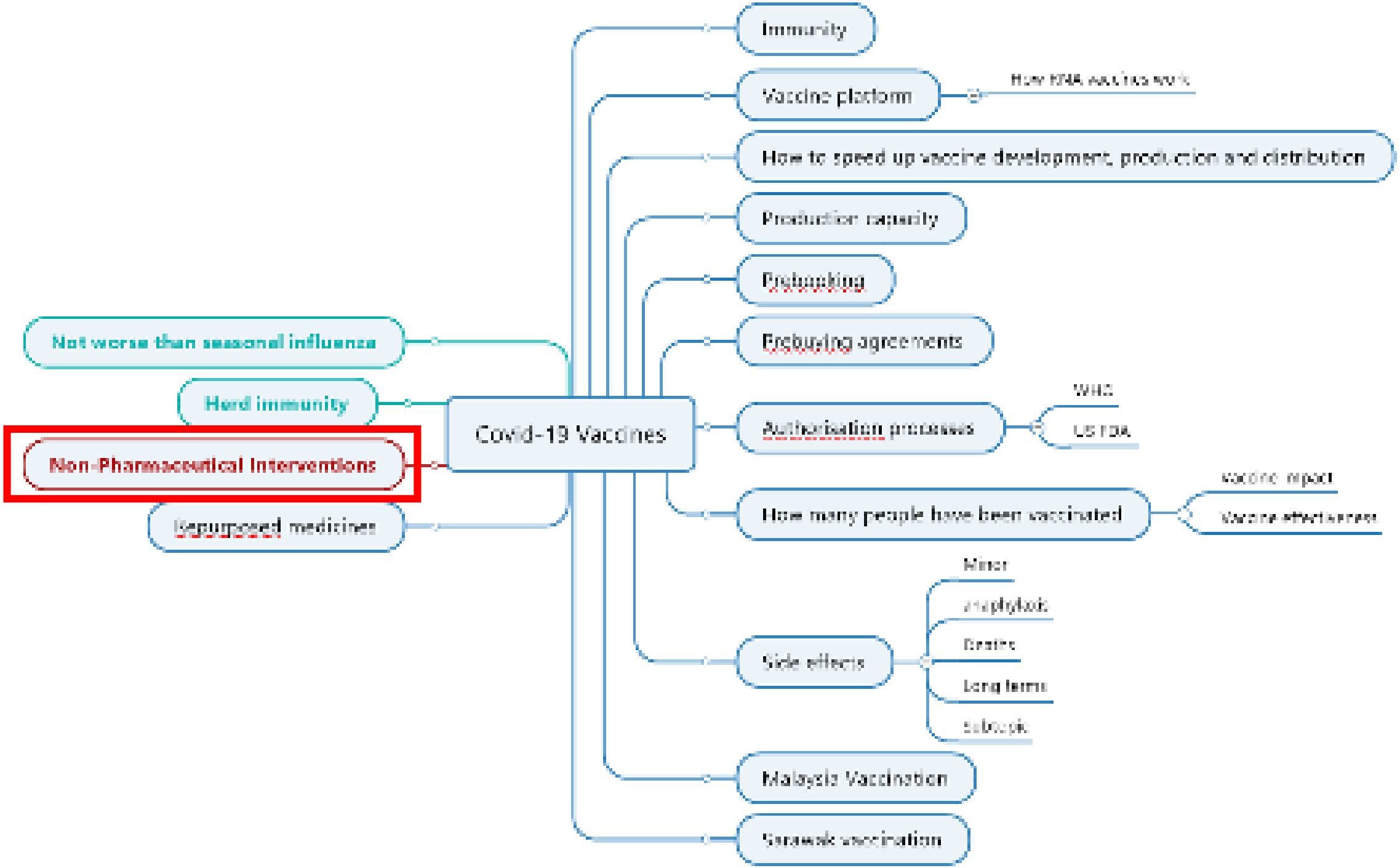
70% of the Population Have to Get the Infection to Achieve Population Immunity

- Chickenpox never killed more than 150 Americans in a year.
- To reach herd immunity for COVID-19, likely 70% or more of the population would need to be immune.
- Without a vaccine, over 200 million Americans would have to get infected before we reach this threshold.
- Put another way, even if the current pace of the COVID-19 pandemic continues in the United States, we won't reach herd immunity in 2021.
- If current daily death rates continue, over half a million Americans would be dead from COVID-19 by that time.

Dowdy D, D'Souza G. (2020). Early herd immunity against COVID-19: a dangerous misconception. Johns Hopkins Coronavirus Resource Center. URL: https://coronavirus.jhu.edu/from-our-experts/early-herd-immunity-against-covid-19-a-dangerous-misconception (Accessed 12 December 2020).

Implications of Achieving Population Immunity Through Natural Infection in Sarawak

- Sarawak's population in 2020: 2,471,140
  - (https://sarawak.gov.my/web/home/article_view/240/175/)
- 70% of the population = 1,729,789
- Based on the Covid-19 case fatality rate among those infected = 1%
- The expected number of deaths due to Covid-19 from among the 1.7 million infected persons ~ 17,300
- This is unacceptable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Why Bother when We Can Use the Non-Pharmaceutical Interventions

Nonpharmaceutical Interventions

- **Nonpharmaceutical Interventions (NPIs)** are actions, apart from getting vaccinated and taking medicine, that people and communities can take to help slow the spread of illnesses like pandemic influenza (flu).
- NPIs are also known as community mitigation strategies.

https://www.weforum.org/agenda/2020/04/covid-19-in-pictures-this-is-what-social-distancing-looks-like/

https://www.usatoday.com/story/news/nation/2020/03/17/coronavirus-social-distancing-creates-sad-reality-window-visits/5066758002/

CDC (2017). **Nonpharmaceutical Interventions (NPIs).** https://www.cdc.gov/nonpharmaceutical-interventions/tools-resources/faq-pandemic-flu.html

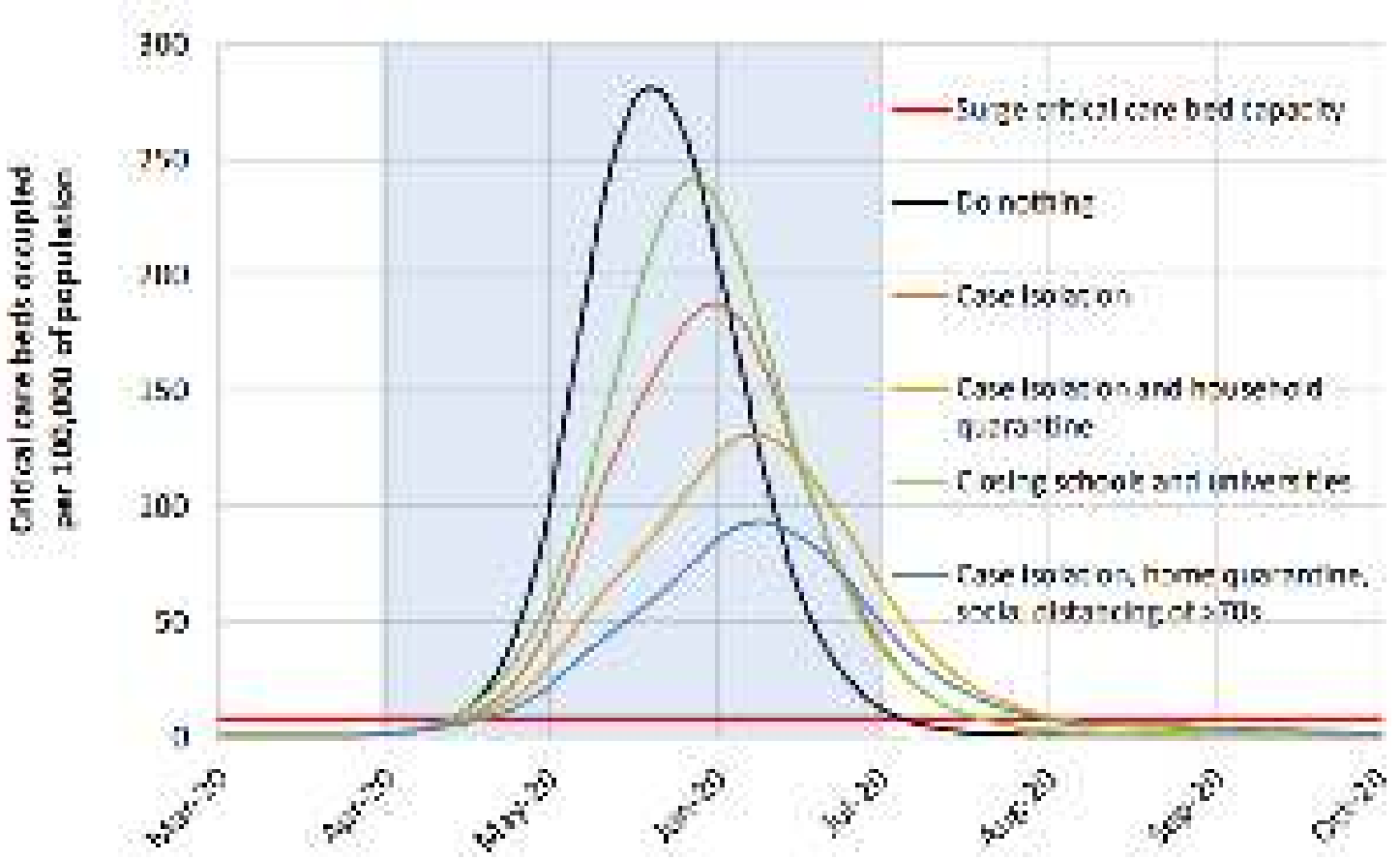
Purpose of Non-pharmaceutical Interventions

- Non-pharmaceutical interventions outside of healthcare settings focus on measures to:

1. limit international spread of the virus
   - (e.g., travel screening and restrictions);
2. reduce spread within national and local populations
   - (e.g., isolation and treatment of ill persons; monitoring and possible quarantine of exposed persons; social distancing measures, such as cancellation of mass gatherings and closure of schools);
3. reduce an individual person's risk for infection
   - (e.g., hand hygiene); and
4. communicate risk to the public.

World Health Organization Writing Group (2006). Nonpharmaceutical Interventions for Pandemic Influenza, International Measures. Emerging Infectious Diseases • www.cdc.gov/eid • Vol. 12, No. 1, January 2006 81. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3291414/pdf/05-1370.pdf

Modeling the Impact of Various Mitigation Strategies on the Need for Critical Beds (UK)



Neil M Ferguson, Daniel Laydon, Gemma Nedjati-Gilani et al. (2020.03.16). Impact of non-pharmaceutical interventions (NPIs) to reduce COVID-19 mortality and healthcare demand. Imperial College London (16-03-2020),doi:https://doi.org/10.25561/77482.

Effectiveness of Government Interventions for Covid-10

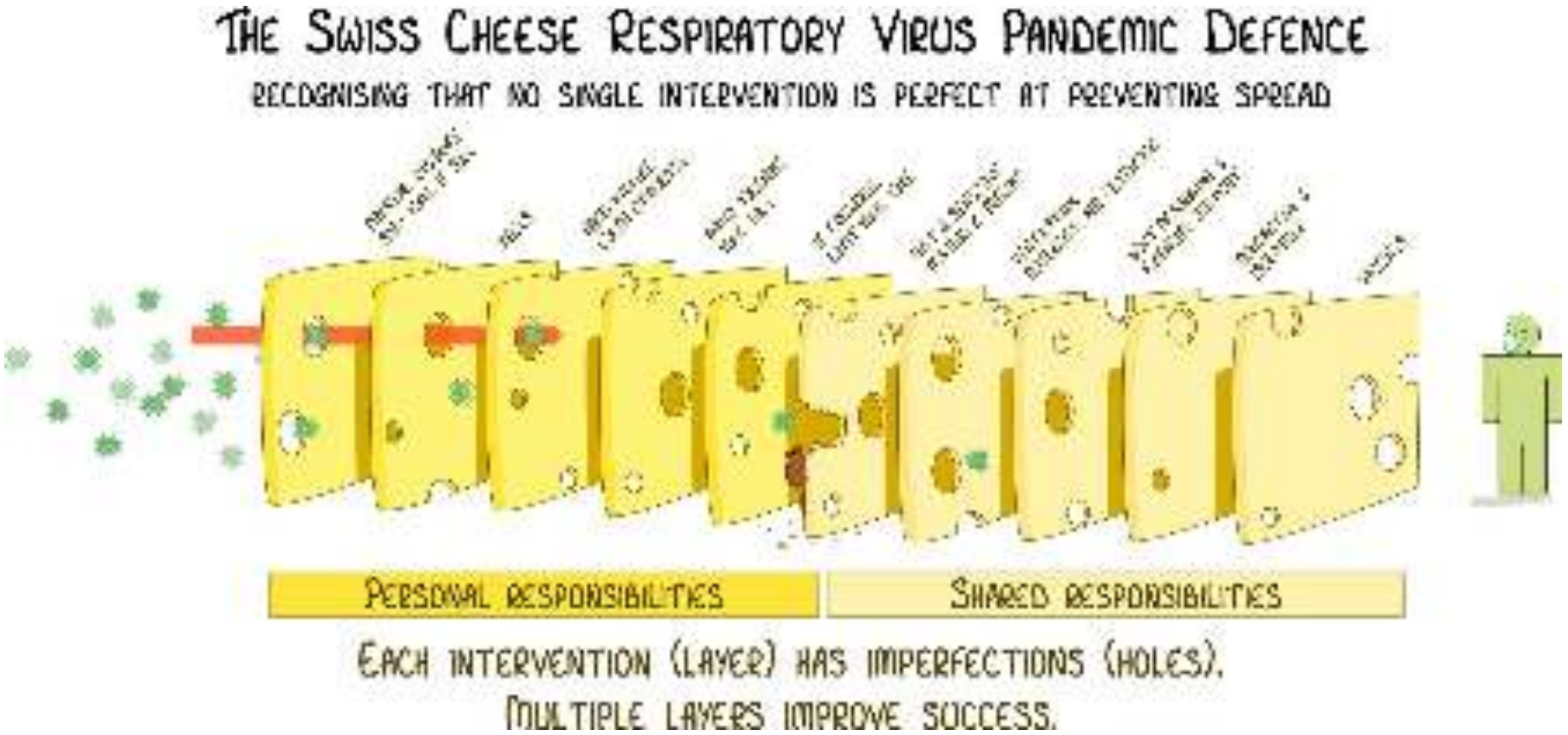
L2 category	Score (%)	Consensus	ΔR_i^{OC}	ΔR_i^{LASSO}	Importance (RF)	ΔR_i^{TF}
Small gathering cancellation	83	4	−0.35 (2)	−0.22 (5)	0.020 (2)	−0.327 (3)
Closure of educational institutions	73	4	−0.16 (2)	−0.21 (4)	0.028 (2)	−0.146 (2)
Border restriction	56	4	−0.23 (2)	−0.12 (2)	0.017 (2)	−0.057 (2)
Increased availability of PPE	51	4	−0.11 (2)	−0.13 (2)	0.012 (1)	−0.062 (2)
Individual movement restrictions	42	4	−0.13 (2)	−0.08 (3)	0.017 (2)	−0.121 (2)
National lockdown	25	4	−0.14 (3)	−0.09 (2)	0.0020 (9)	−0.008 (3)
Mass gathering cancellation	53	3	−0.33 (2)	0	0.012 (1)	−0.127 (2)
Educate and actively communicate with the public	48	3	−0.18 (4)	0	0.018 (2)	−0.276 (2)
The government provides assistance to vulnerable populations	41	3	−0.17 (3)	−0.18 (4)	0.009 (1)	0.090 (3)
Actively communicate with managers	40	3	−0.15 (2)	−0.20 (4)	0.004 (2)	−0.050 (2)
Measures for special populations	37	3	−0.19 (2)	0	0.008 (1)	−0.100 (2)

Haug, N., Geyrhofer, L., Londei, A. *et al. (2020.11.16)* Ranking the effectiveness of worldwide COVID-19 government interventions. *Nat Hum Behav* **4,** 1303–1312 (2020). https://doi.org/10.1038/s41562-020-01009

Effectiveness of Government Interventions for Covid-10

L2 category	Score (%)	Consensus	ΔR_t^{OC}	ΔR_t^{LASSO}	Importance (RF)	ΔR_t^{TF}
Increase healthcare workforce	35	3	−0.17 (20)	−0.13 (3)	0.030 (8)	0.011 (2)
Quarantine	30	3	−0.28 (2)	−0.2 (1)	0.0023 (9)	0.023 (2)
Activate or establish emergency response	29	3	−0.13 (2)	0	0.0037 (9)	−0.121 (2)
Enhance detection system	25	3	−0.19 (3)	0	0.0032 (9)	−0.106 (2)
Increase in medical supplies and equipment	25	3	−0.13 (3)	−0.004 (3)	0.003 (2)	−0.200 (3)
Police and army interventions	23	3	−0.16 (2)	0	0.003 (2)	−0.091 (2)
Travel alert and warning	20	3	−0.13 (3)	0.0 (1)	0.002 (1)	−0.159 (3)
Public transport restriction	13	3	00.20 (4)	−0.01 (7)	0.004 (1)	−0.023 (3)
Actively communicate with healthcare professionals	11	3	0	−0.08 (4)	0.003 (1)	−0.003 (2)

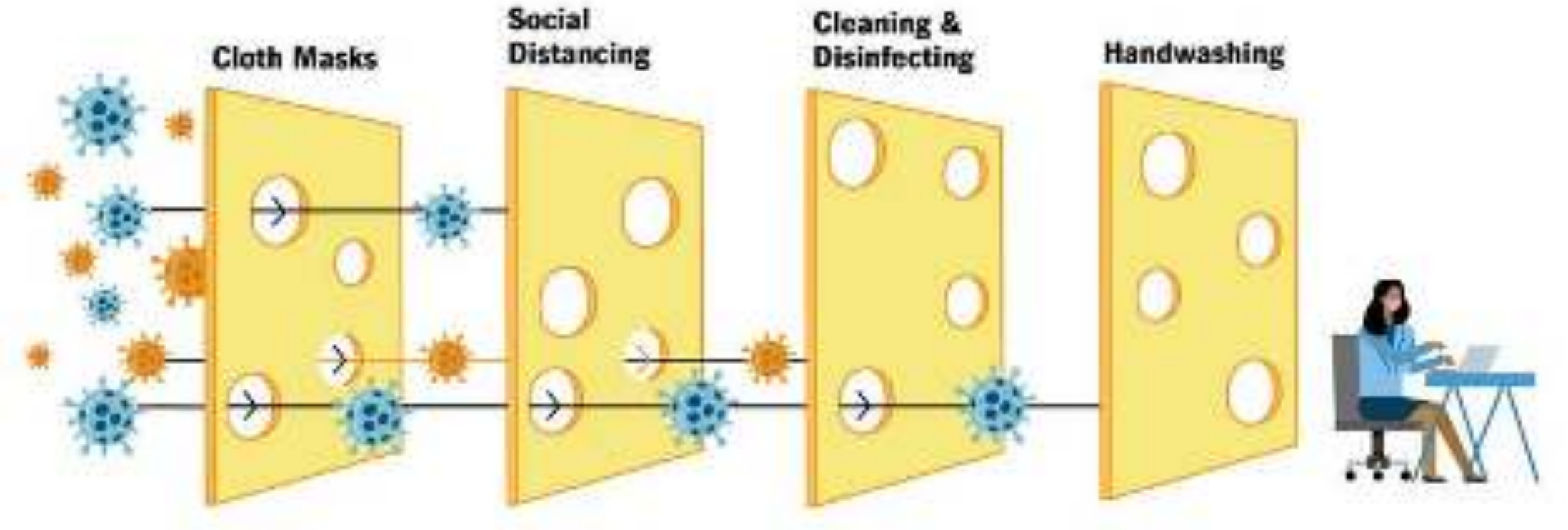
Haug, N., Geyrhofer, L., Londei, A. *et al. (2020.11.16)* Ranking the effectiveness of worldwide COVID-19 government interventions. *Nat Hum Behav* **4,** 1303–1312 (2020). https://doi.org/10.1038/s41562-020-01



It was created in 1990 by James Reason, a professor at Manchester University, who wanted to shed light on human error and how mishaps could be prevented by “a series of barriers.” It’s now used extensively in health care, risk management, aviation and engineering.
The coronavirus version of the Swiss Cheese Model was adapted by Ian M. Mackay, a virologist in Australia.

Ian M Mackay (2020.12.26). The **Swiss cheese infographic that went viral.** https://virologydownunder.com/wp-content/uploads/2020/12/SwissCheese-ver3.0_MUG-version.png#main

Swiss Cheese Model of NPI for Covid-19



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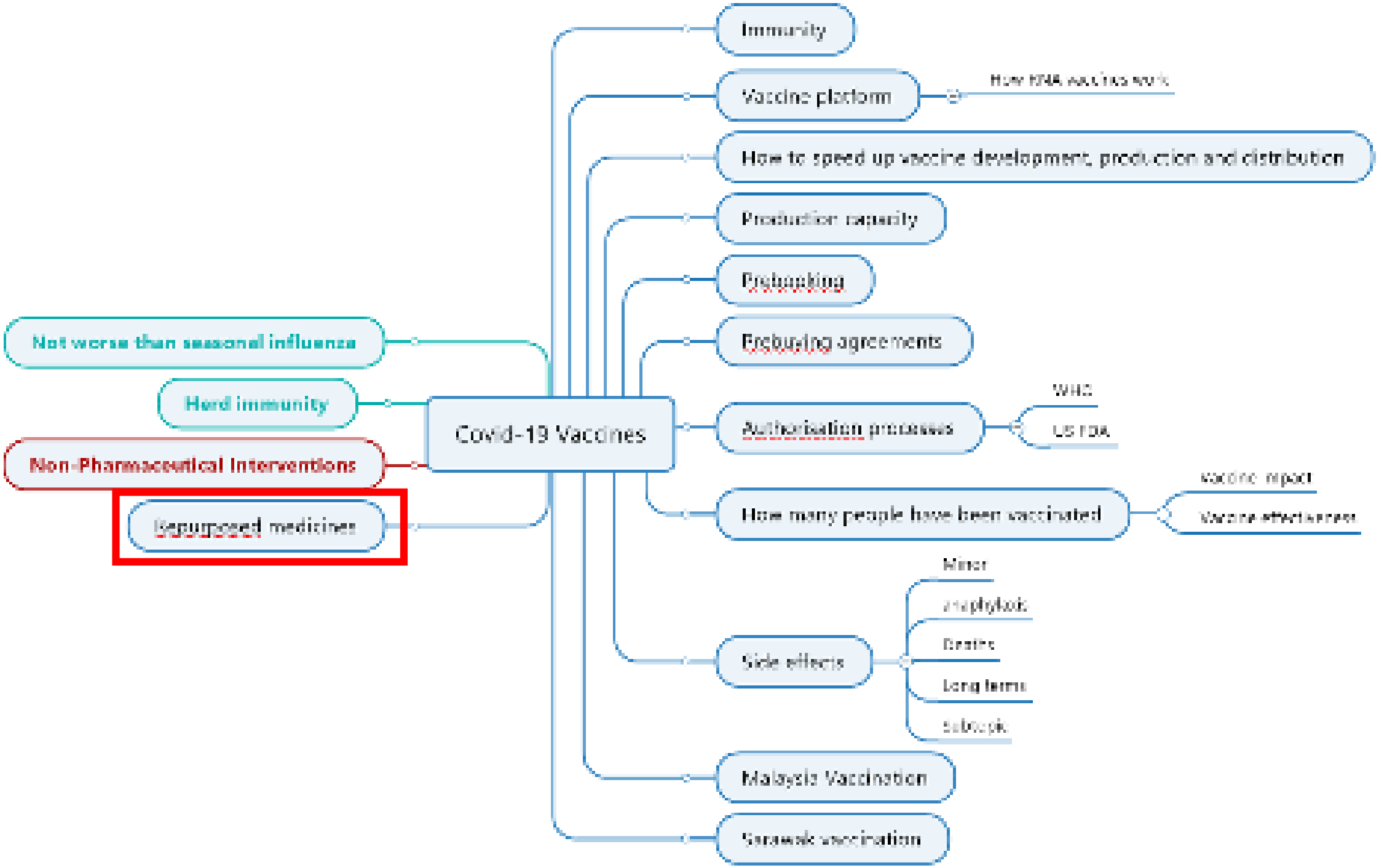
https://consultqd.clevelandclinic.org/how-to-talk-to-your-patients-about-covid-19-precautions/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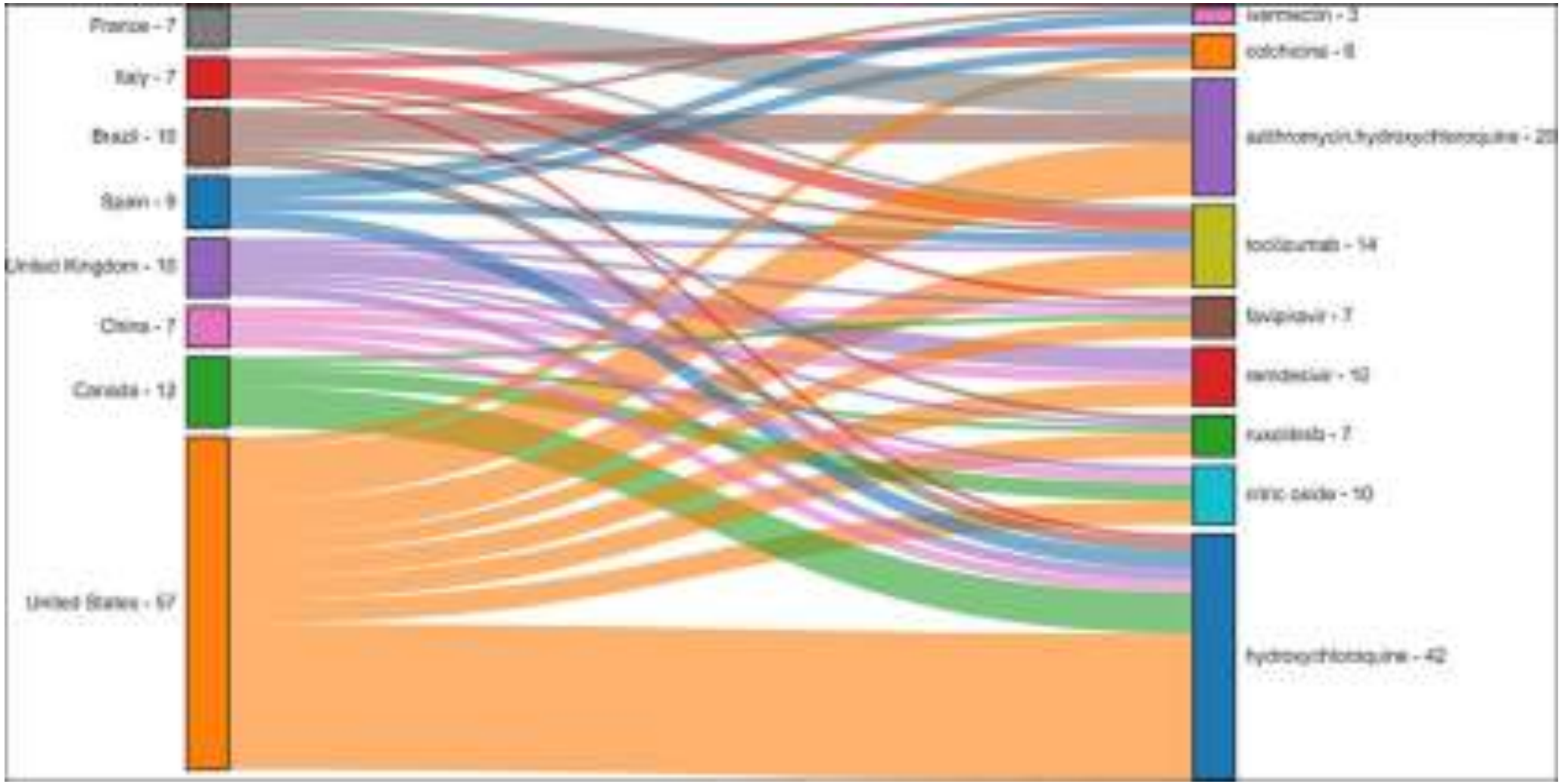
Seroweek vaccination

Why Bother When Cheap and Well-Known Medicines are Effective Against Covid-19?

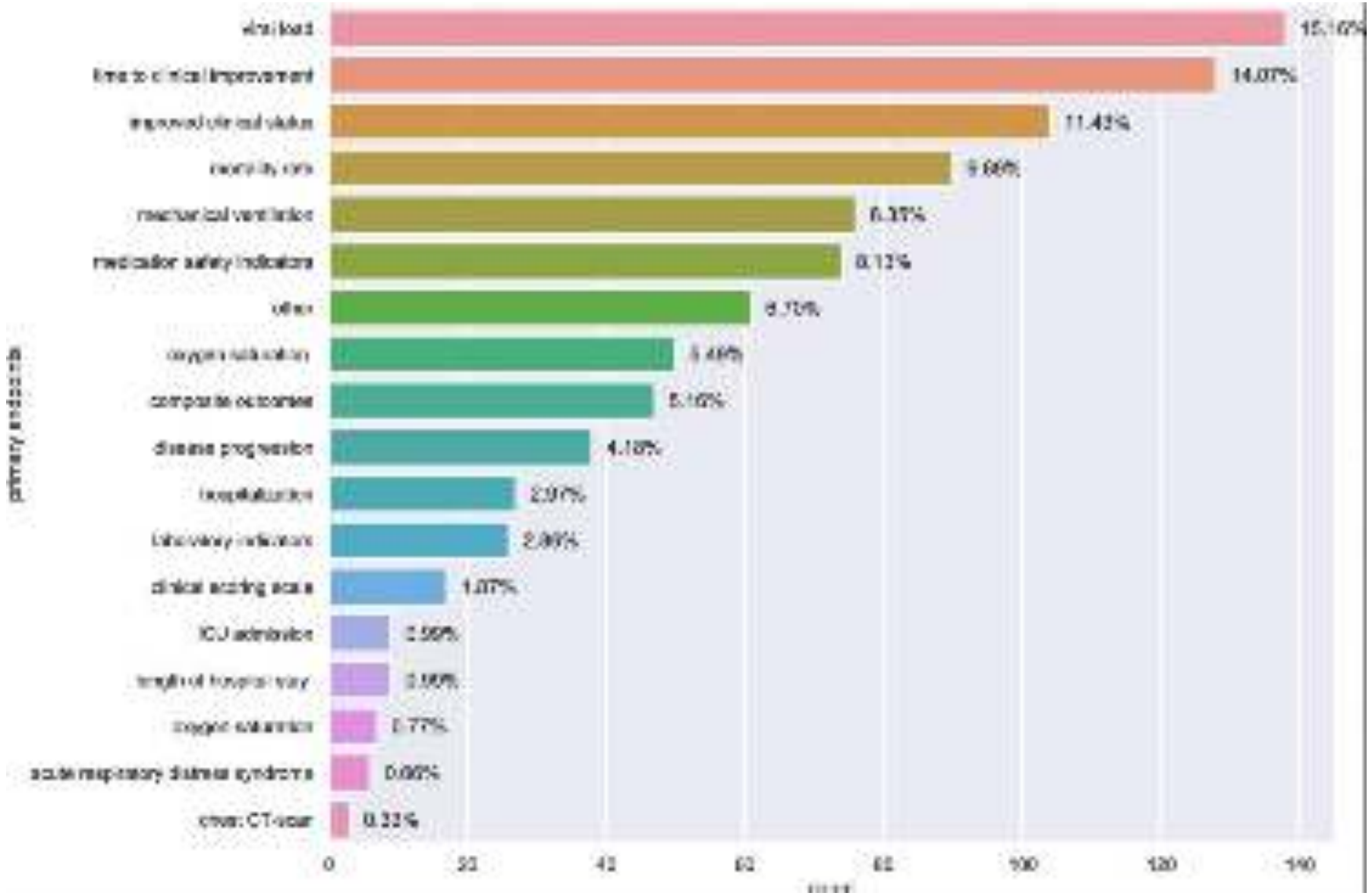
Sankey diagram from countries to drugs.



To avoid creating an excessively complex Sankey diagram and increase readability, we controlled the number of drug and country nodes.

Wang B, et al. (2020.11.19). **COVID-19 Clinical Trials Registered Worldwide for Drug Intervention: An Overview and Characteristic Analysis** Drug Design, Development and Therapy . 2020 Volume 2020:14 Pages 5097—5108. **DOI** https://doi.org/10.2147/DDDT.S281700

Number of registered trials by primary outcome indicator.



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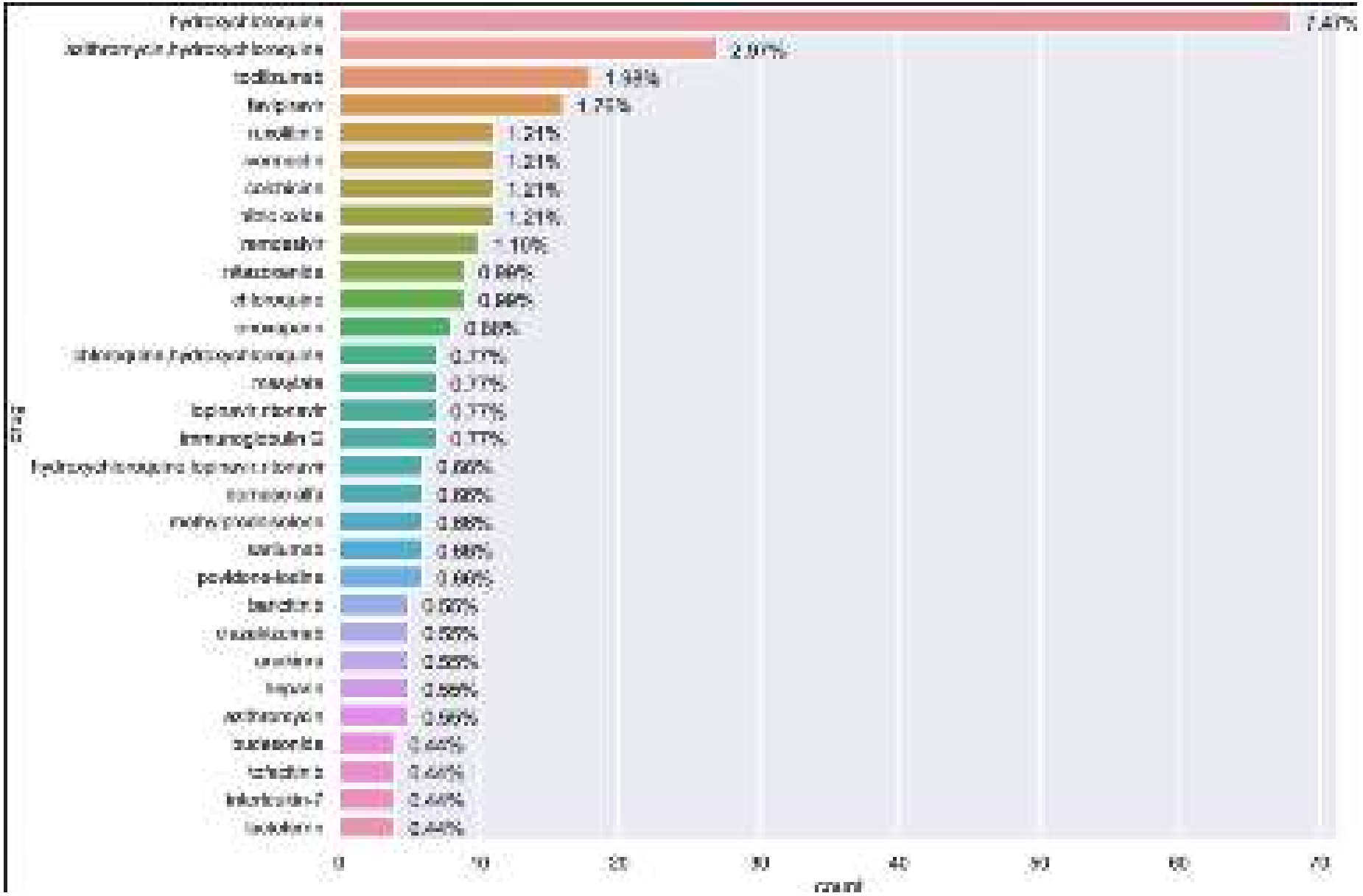
Number of registered trials by mapped drug name.



Only the top 30 drugs are shown. The percentage on the bar graph indicates the proportion of trials for the drug out of the total trials. Note: if a trial contains multiple drugs, it will be counted once for each of the drugs. Standardized drug names automatically assigned by the National Library of Medicine based on drug names provided by the responsible party.

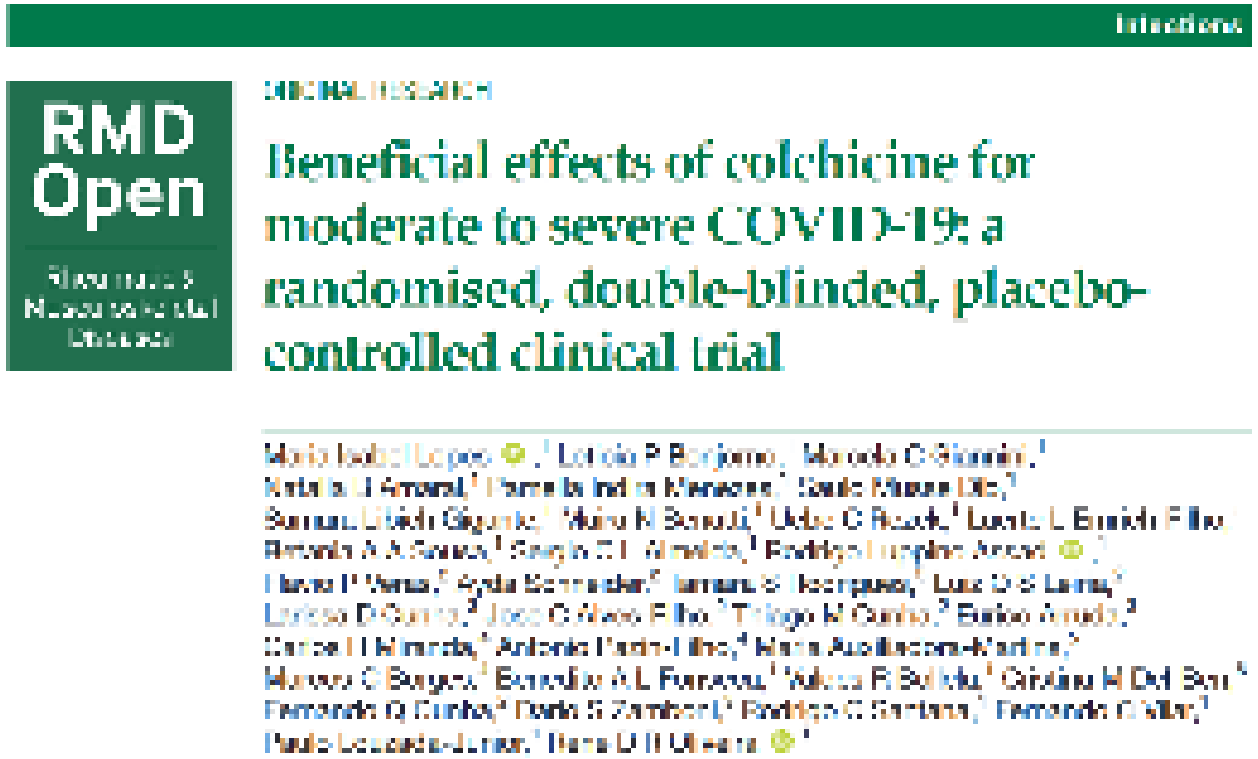
Wang B, et al. (2020.11.19). **COVID-19 Clinical Trials Registered Worldwide for Drug Intervention: An Overview and Characteristic Analysis**
Drug Design, Development and Therapy . 2020 Volume 2020:14 Pages 5097—5108. **DOI** https://doi.org/10.2147/DDDT.S281700

Clinical Take Home Point For Ivermectin

- Evidence for the use of Ivermectin is based on in vitro, prophylaxis, clinical, safety, and large-scale epidemiologic studies (heterogenous populations in multiple different settings) BUT…
- Many of the trials thus far are methodologically flawed without enough information about baseline demographics, multiple primary outcomes, soft/subjective outcomes, convenience samples, and unclear definitions, just to name a few
- Additionally, a valid concern in evaluating the literature is that many of the trials have not yet passed the peer review process and are in pre-print format
- Although Ivermectin is cheap, readily available, with a fairly safe side effect profile, based on the evaluation of the literature above, at this time, Ivermectin should not be recommended outside of a clinical trial to ensure we get a true answer of effect
- Ivermectin is interesting, there is certainly signal to evaluate further, but in our desire to want a treatment option, let's not continue to do the same thing over and over again, as we saw play out with Hydroxychloroquine

Salim Rezaie (2020.12.16). **COVID-19 Update: Ivermectin. https://rebelem.com/covid-19-update-ivermectin/**

Colchichine

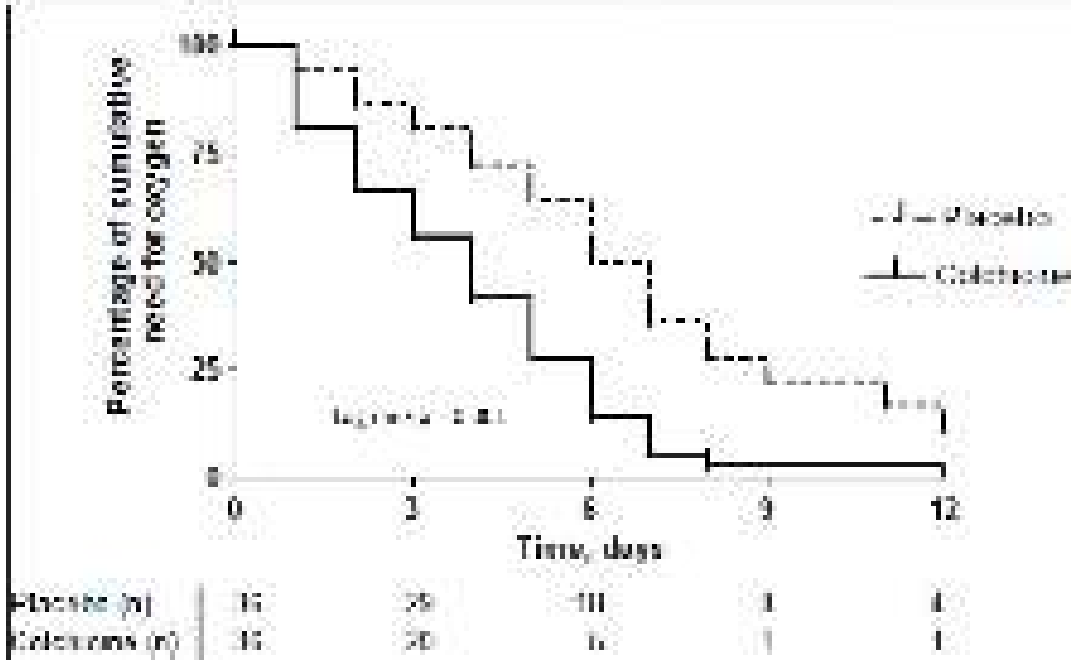


- The small study involving 72 patients (36 for placebo and 36 for colchicine) by Lopes on <u>hospitalized patients</u> shows nice results, with regard to:
  - need for mechanical ventilation
  - discharge from hospital, and decrease of CRP,
  - without apparent side effects.

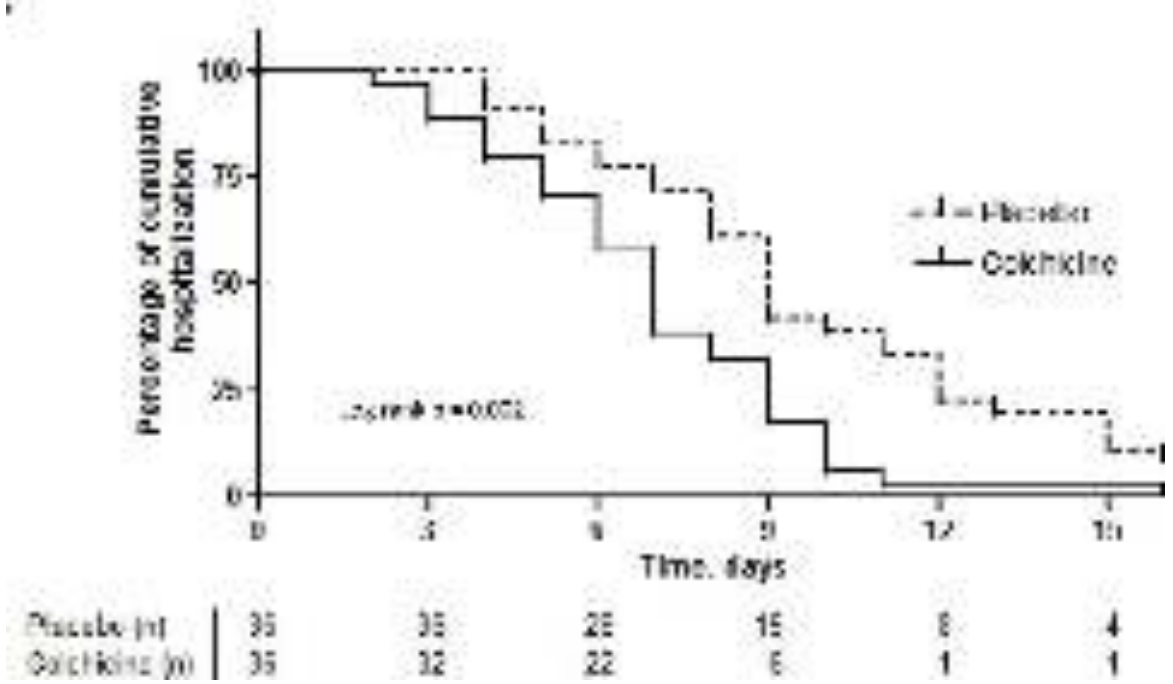
Lopes MI, Bonjorno LP, Giannini MC, et al (2021). Beneficial effects of colchicine for moderate to severe COVID-19: a randomised, double-blinded, placebo-controlled clinical trial RMD Open 2021;7:e001455. doi: 10.1136/rmdopen-2020-001455

The small study on effects of colchicine on Covid-19 involving 72 patients

Kaplan-Meier curves of time to the end of need for supplemental oxygen for both groups. Kaplan-Meier curves of time to the end of need for supplemental oxygen for both groups.



Kaplan-Meier curves of time to clinical improvement and discharge for both groups.



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JAMA Network Open.

Original Investigation | Public Health

Effect of High-Dose Zinc and Ascorbic Acid Supplementation vs Usual Care on Symptom Length and Reduction Among Ambulatory Patients With SARS-CoV-2 Infection

The COVID A to Z Randomized Clinical Trial 2021.02.12

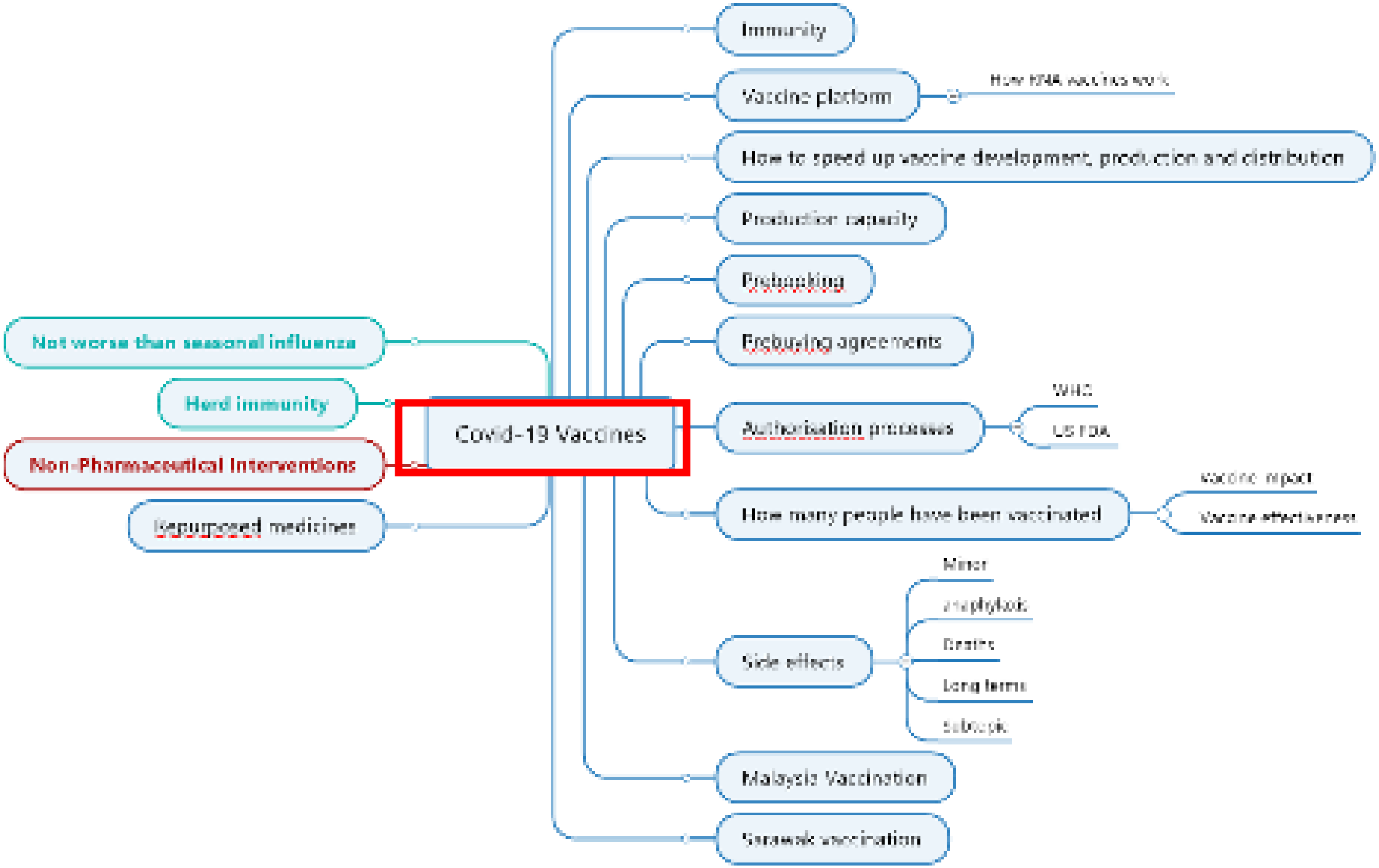
Suma Thomas, MD, MBA; Divyang Patel, MD, MS; Barbara Bittel, BSN, RN; Kathy Wolfe, MPH; Cluqing Wang, MS; Anirudh Kumar, MD, MS; Zachary J. Ilg Levine, MD; Reena Mehra, MD, MS; Carla McWilliams, MD; Steve E. Nissen, MD; Milind Y. Desai, MD, MBA

Findings In this randomized clinical trial of 214 patients with confirmed SARS-CoV-2 infection receiving outpatient care,

there was no significant difference in the duration of symptoms among the 4 groups.

Meaning These findings suggest that treatment with zinc, ascorbic acid, or both does not affect SARS-CoV-2 symptoms.

https://jamanetwork.com/journals/jamanetworkopen/fullarticle/2776305


Immunity
Vaccine platform
How to speed up vaccine development, production and distribution
Production capacity
Prebunking
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Herd immunity
Covid-19 Vaccines
Non-Pharmaceutical Interventions
Repurposed medicines
Authorisation processes
WHO
US FDA
How many people have been vaccinated
Vaccine impact
Side effects
Minor
Anaphylaxis
Deaths
Long term
Malaysia Vaccination
Seroweek vaccination

The Need for Covid-19 Vaccines

SARS-CoV-2 Sequencing and the Search for Vaccines

- In the current context of the pandemic triggered by SARS-COV-2,
  - the immunization of the population through vaccination is recognized as a public health priority.
- In the case of SARS-COV-2, the genetic sequencing was done quickly, in one month (Dec 2019).
- Since then, worldwide research has focused on obtaining a vaccine.

- Daniela Calina, et al. (2020.05.06). **Towards effective COVID-19 vaccines: Updates, perspectives and challenges (Review)**
- https://www.spandidos-publications.com/10.3892/ijmm.2020.4596
- https://www.who.int/bulletin/volumes/98/7/20-253591/en/
- Severe acute respiratory syndrome coronavirus 2 isolate Wuhan-Hu-1, complete genome. NCBI Reference Sequence: NC_045512.2. Bethesda: National Center for Biotechnology Information; 2020. Available from: https://www.ncbi.nlm.nih.gov/nuccore/1798174254

SARS-CoV-2 Sequencing and the Search for Vaccines

- This has a major economic impact because
  - new technological platforms and
  - advanced genetic engineering procedures are required to obtain a COVID-19 vaccine.
- The most difficult scientific challenge for this future vaccine obtained in the laboratory is
  - the proof of clinical safety and efficacy.
- The biggest challenge of manufacturing is
  - the construction and validation of production platforms capable of making the vaccine on a large scale.

- Daniela Calina, et al. (2020.05.06). **Towards effective COVID-19 vaccines: Updates, perspectives and challenges (Review)**
- https://www.spandidos-publications.com/10.3892/ijmm.2020.4596
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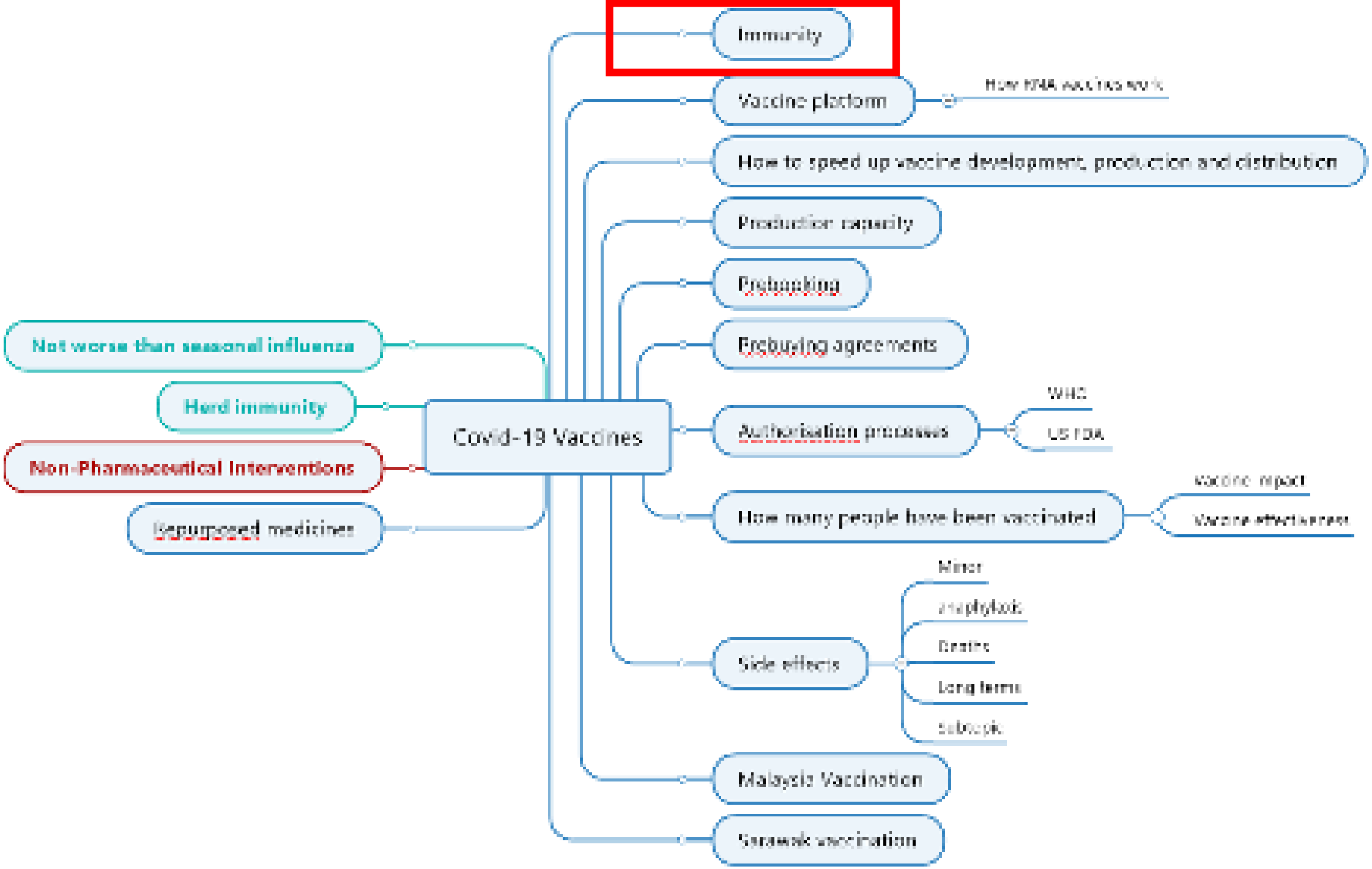
Barriers to Vaccine Design and Development

- At the outset of a disease outbreak,
  - gaps in knowledge of identity,
  - pathogenesis,
  - epidemiology of the new emerging pathogen
  - time required to study the immune responses correlating with the outcome of the viral infection
  - lack of appropriate preclinical models susceptible to infection for testing a vaccine candidate
- pose several barriers and impediments to expedite vaccine design and development, and thus to ensure global vaccination coverage in time.

Maria Trovato, et al (2020.09.03). Viral Emerging Diseases: Challenges in Developing Vaccination Strategies. Frontiers in Immunology; vol. 11: p2130. https://www.frontiersin.org/article/10.3389/fimmu.2020.02130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Non-Pharmaceutical Interventions
Repurposed medicines
Covid-19 Vaccines
Authorisation processes
WHO
US FDA
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Let’s Talk About Immunity First

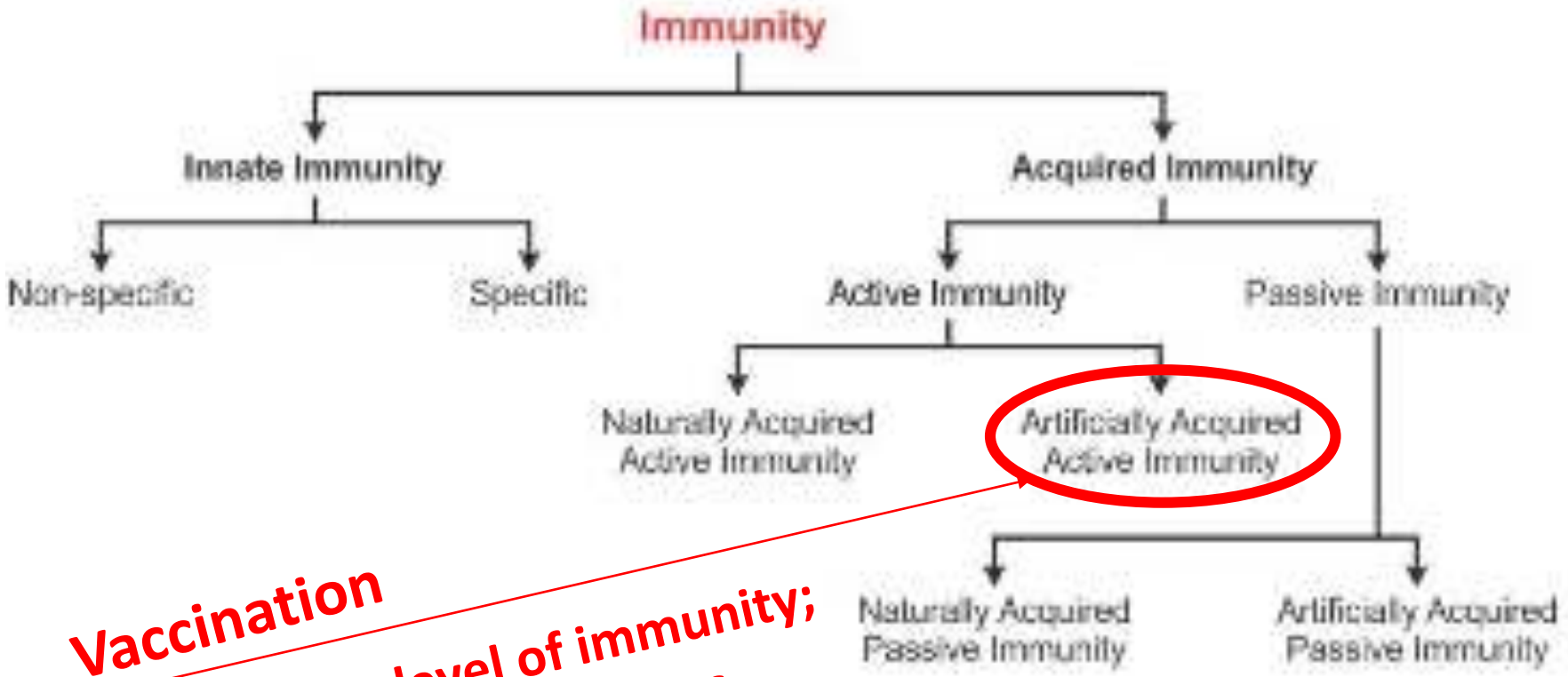
Innate Versus Acquired Immunity

Innate Immunity

- It is by the virtue of genetic constitution of organism i.e. it is inherited from parents.
- Innate immunity is independent of external stimulus or previous infection.

Acquired or Adaptive Immunity

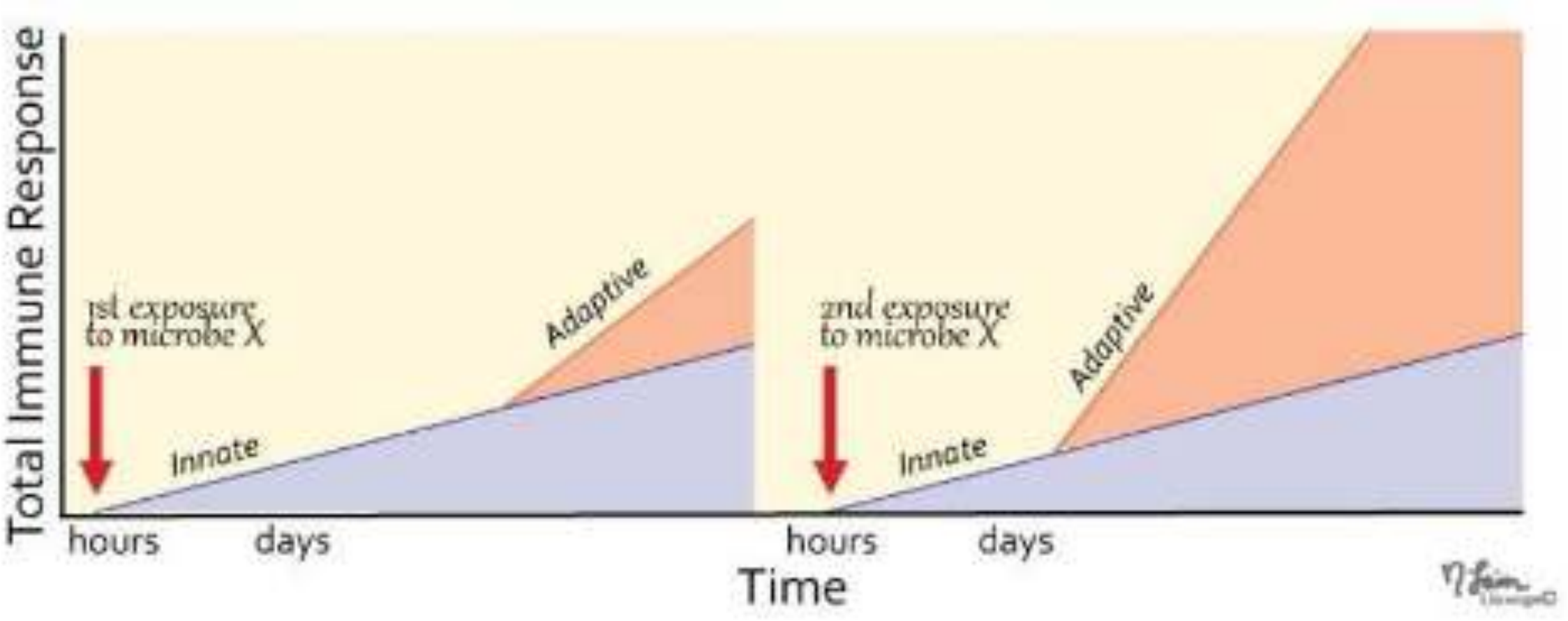
- Resistance to a disease is acquired during the life time of an organism.
- It is developed due to previous infection or antibodies provided from an outside source.



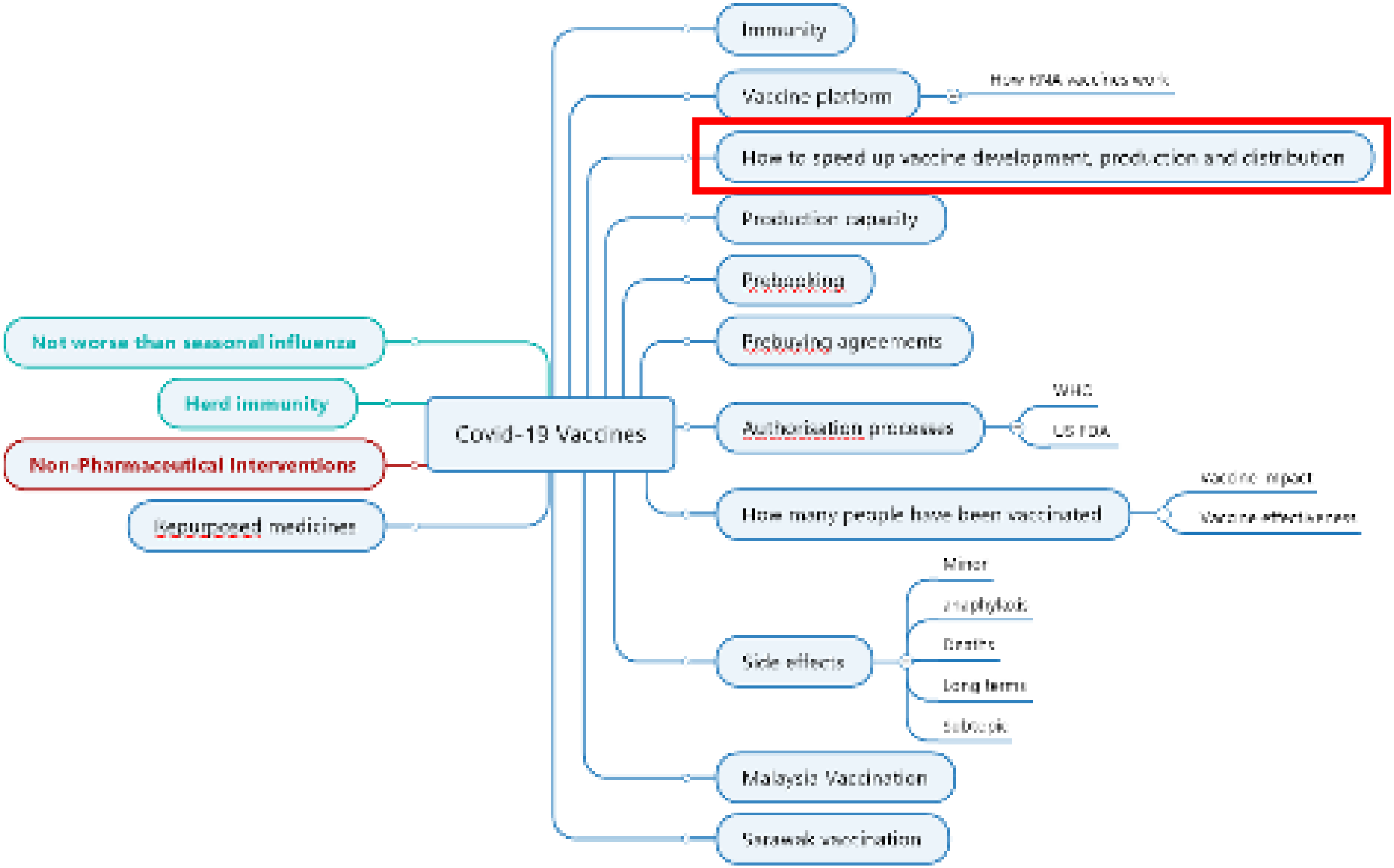
Vaccination

Leads to some level of immunity; Dependant the effectiveness of the vaccine

Innate versus Adaptive Immune Response to Microbial Exposure



Don Li (2017.05.20) **Innate vs. Adaptive Immunity. https://step1.medbullets.com/immunology/105041/innate-vs-adaptive-immunity**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Can we Trust Vaccines That Were Developed So Fast?

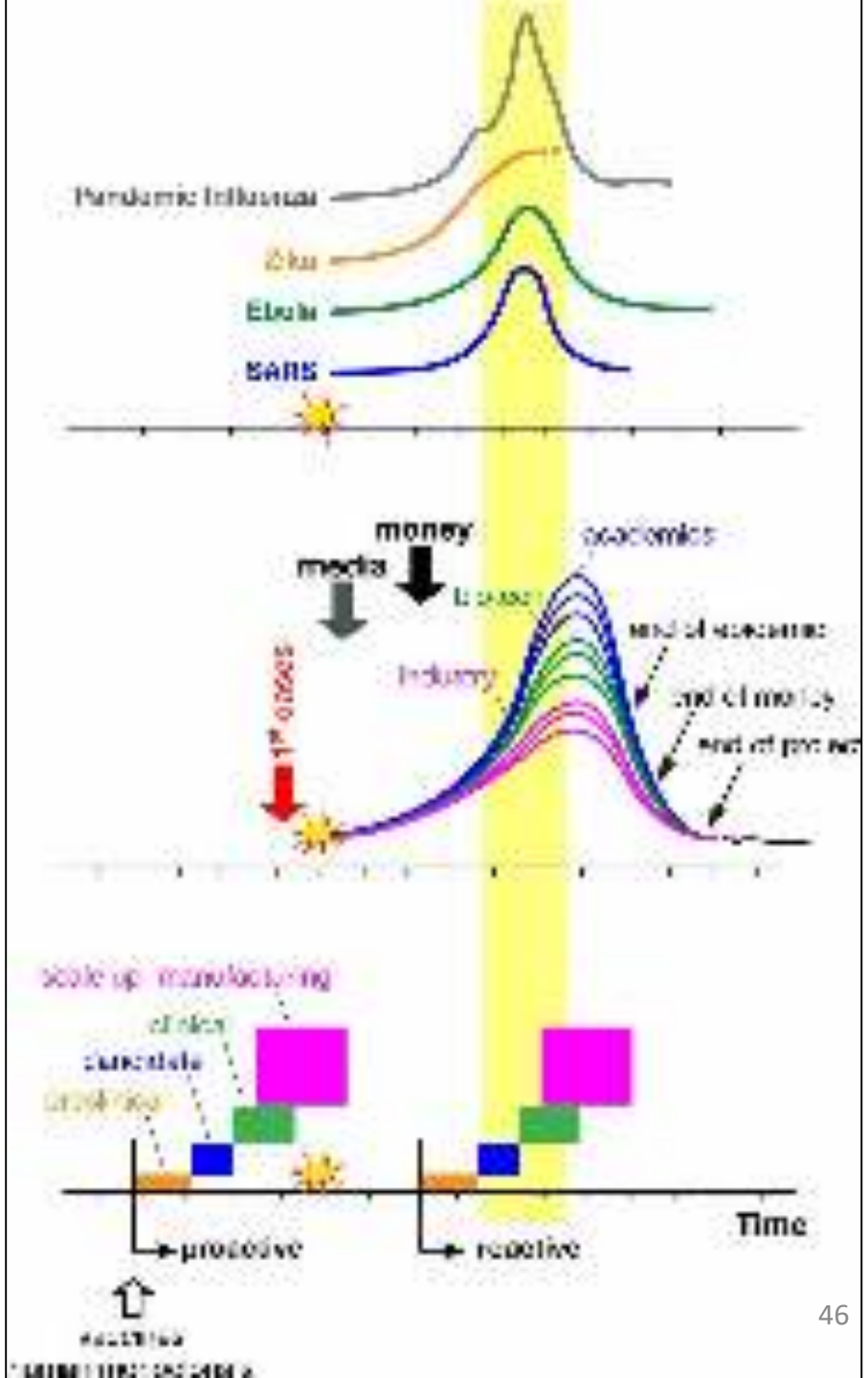
How Can We Speed up Vaccine Development, Production and Distribution?

Fig. 1. Schematic representations of the progression of some emerging diseases:

- (*Top*), the progression of vaccine development activities following an emerging infection

- (*Middle*), and the steps required for vaccine delivery using the present, reactive, approach compared with the proposed, proactive, approach for vaccines and human monoclonals

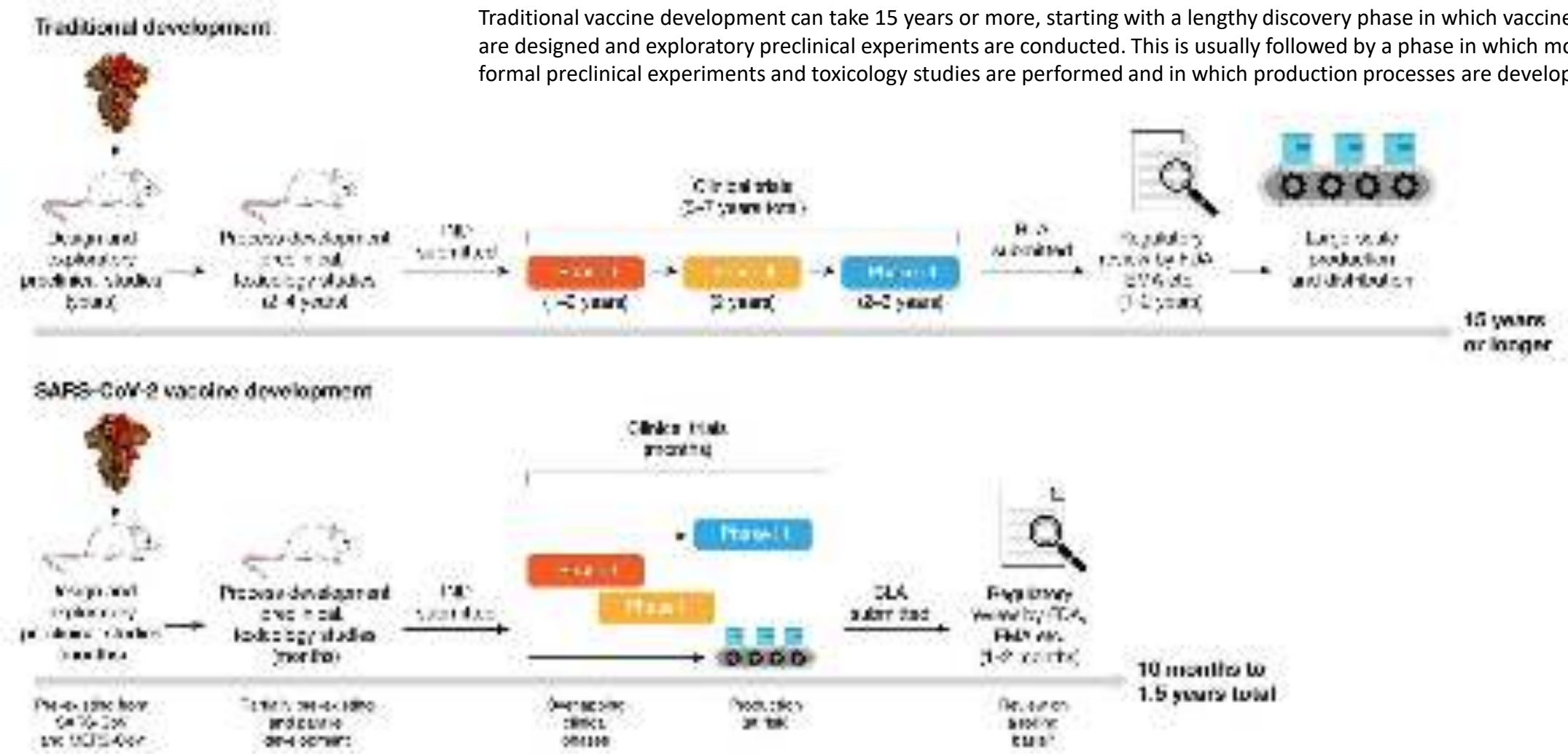
- (*Bottom*). Temporal scales and frequency of cases are for illustrative purposes only and differ for each disease. Industry indicates large vaccine manufacturers.



Bloom, DE, et al (2017). Emerging infectious diseases: A proactive approach. https://www.pnas.org/content/114/16/4055

Traditional and accelerated vaccine-development pipelines.

Traditional vaccine development can take 15 years or more, starting with a lengthy discovery phase in which vaccines are designed and exploratory preclinical experiments are conducted. This is usually followed by a phase in which more formal preclinical experiments and toxicology studies are performed and in which production processes are developed.



Krammer, F. (2020.09.23). SARS-CoV-2 vaccines in development. *Nature* **586,** 516–527 (2020). https://doi.org/10.1038/s41586-020-2798-3

Operation Warp Speed (USA)

- **Operation Warp Speed** (**OWS**) is
  - a public–private partnership initiated by the U.S. government to
    - facilitate and accelerate the
    - development,
    - manufacturing, and
    - distribution of COVID-19 vaccines,
    - therapeutics, and
    - diagnostics.
- The first news report of Operation Warp Speed was on April 29, 2020 and the program was officially announced on May 15, 2020.
- The program was initially being funded with $10 billion,with additional funds allocated through BARDA.
- Funding was increased to about $18 billion by October 2020.

https://en.wikipedia.org/wiki/Operation_Warp_Speed

Government Funding of Research & Development

- Pfizer has said it declined funding from a key government vaccine development program.
- But the company has received a $1.95-billion government contract to manufacture 100 million doses of its product if it's proved effective.

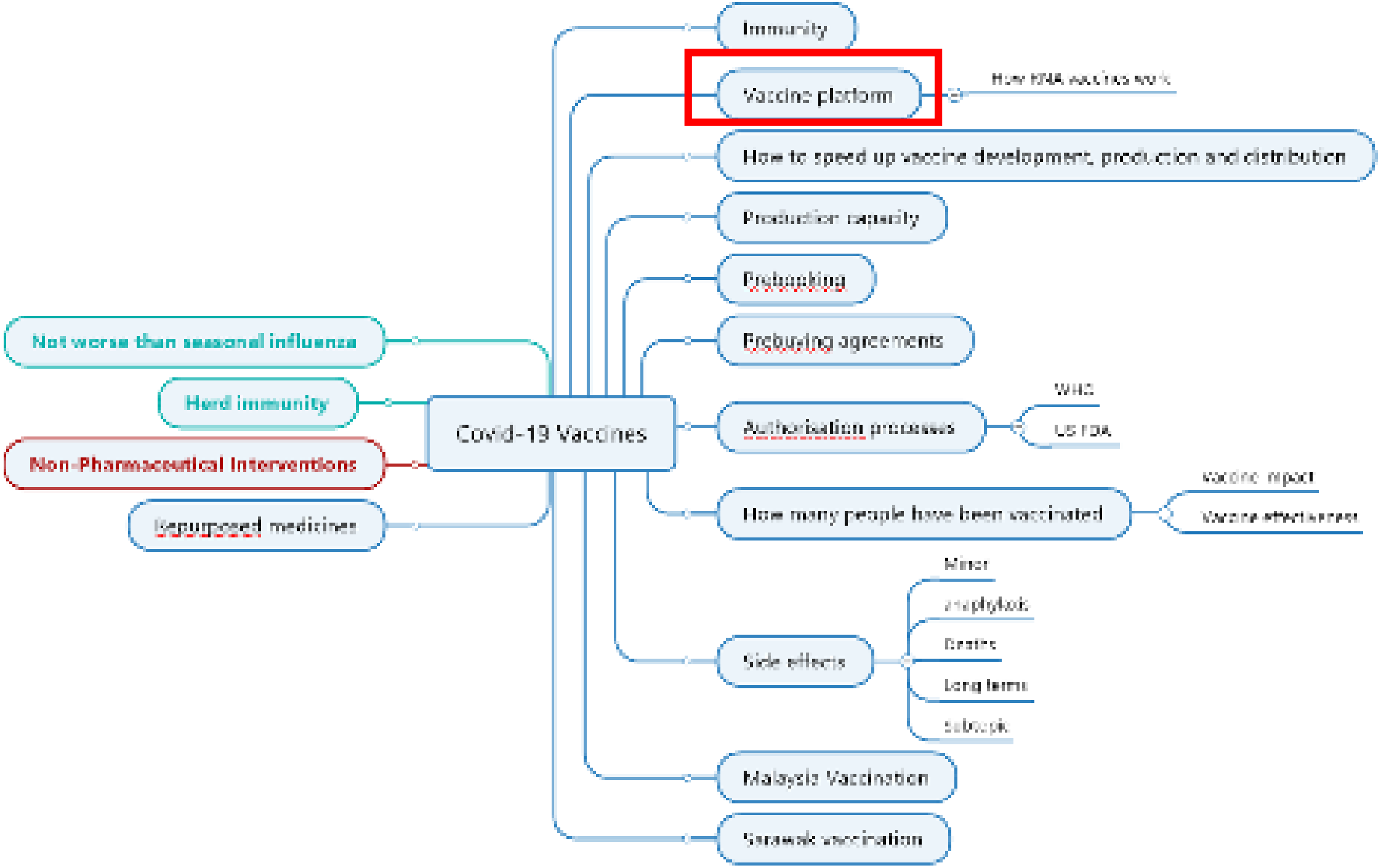
- Moderna vaccine
  - federal funding of the company's effort approaches $1 billion, and
  - the government owns at least one patent crucial for the product's manufacture.

Michael Hiltzik (2020.11.16). **Column: Private firms keep stranglehold on COVID vaccines, though you paid for the research**
https://www.latimes.com/business/story/2020-11-16/who-owns-the-covid-vaccines

History of How the US Government had to Assume Responsibility for Vaccine Adverse Effects

- During the mid-1970s, there was an increased focus on personal health and more people became concerned about vaccine safety.
- Several lawsuits were filed against vaccine manufacturers and healthcare providers by people who believed they had been injured by the diphtheria, pertussis, tetanus (DPT) vaccine.
- Damages were awarded despite the lack of scientific evidence to support vaccine injury claims.
- As a result of these decisions, liability and prices soared, and several vaccine manufacturers halted production.
- A vaccine shortage resulted and public health officials became concerned about the return of epidemic disease.
- To reduce liability and respond to public health concerns, Congress passed the National Childhood Vaccine Injury Act (NCVIA) in 1986.

CDC (2020.09.09). **Overview, History, and How the Safety Process Works. https://www.cdc.gov/vaccinesafety/ensuringsafety/history/index.html**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Covid-19 Vaccines
Authorisation processes
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US FDA
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What Vaccine Platform to Choose

Molecular-Based Vaccines

- In the fight against newly emergent viruses, vaccine design might benefit from a range of platform technologies, including:
  - nucleic acid vaccines, viral-vector vaccines, and recombinant protein-based vaccines (likely to be administered with adjuvants).
- Compared with conventional vaccines, such as live attenuated and inactivated vaccines,
  - molecular-based platforms might offer a
    - more versatile tool against new emergent viruses,
    - allowing a more fast, low-cost, and scalable vaccine manufacturing.
  - Essentially, these platforms rely on the use of a system to deliver and present a new antigen (or a synthetic gene) to rapidly target an emergent pathogen.

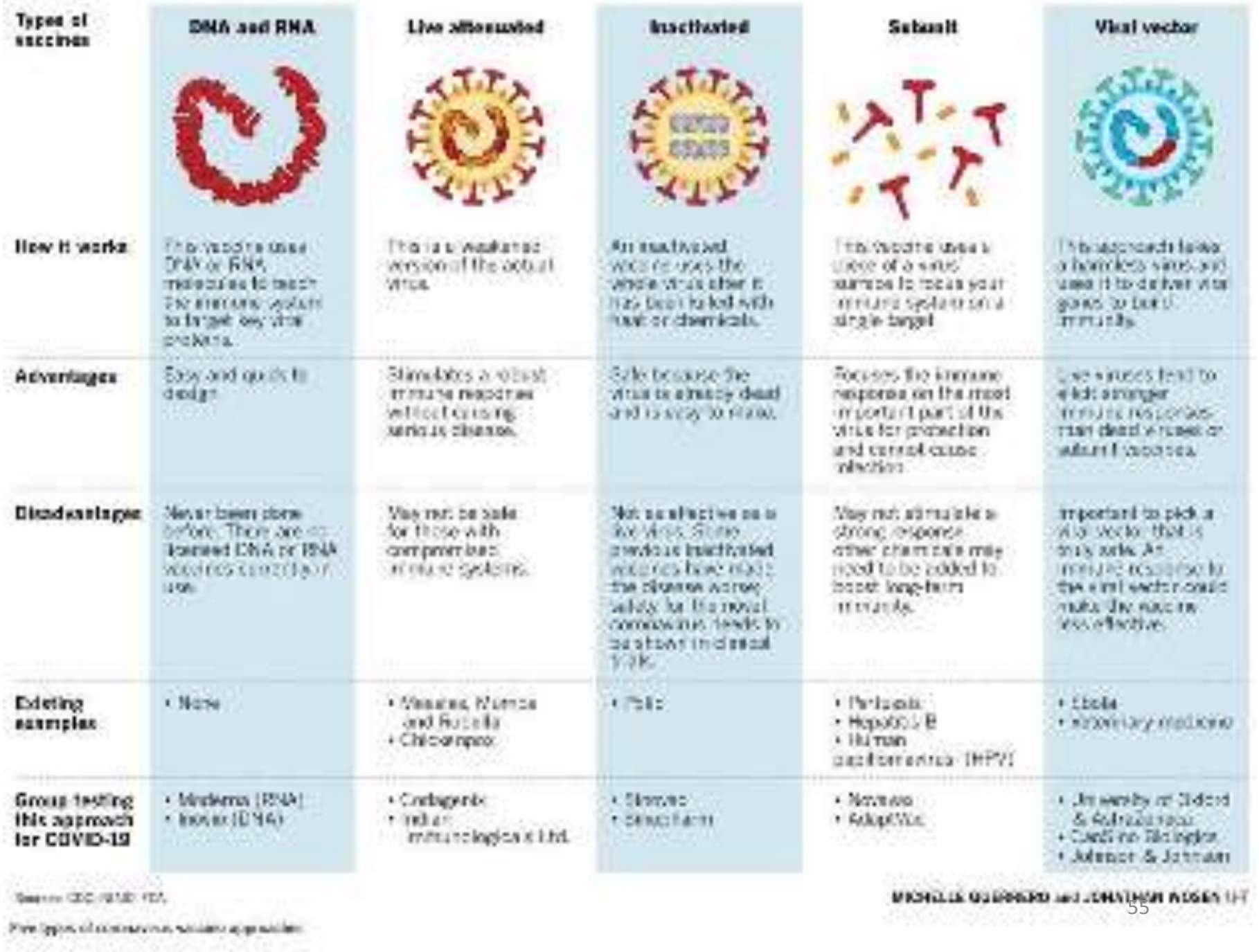
Maria Trovato, et al (2020.09.03). Viral Emerging Diseases: Challenges in Developing Vaccination Strategies. Frontiers in Immunology; vol. 11: p2130. https://www.frontiersin.org/article/10.3389/fimmu.2020.02130

Molecular-Based Vaccines

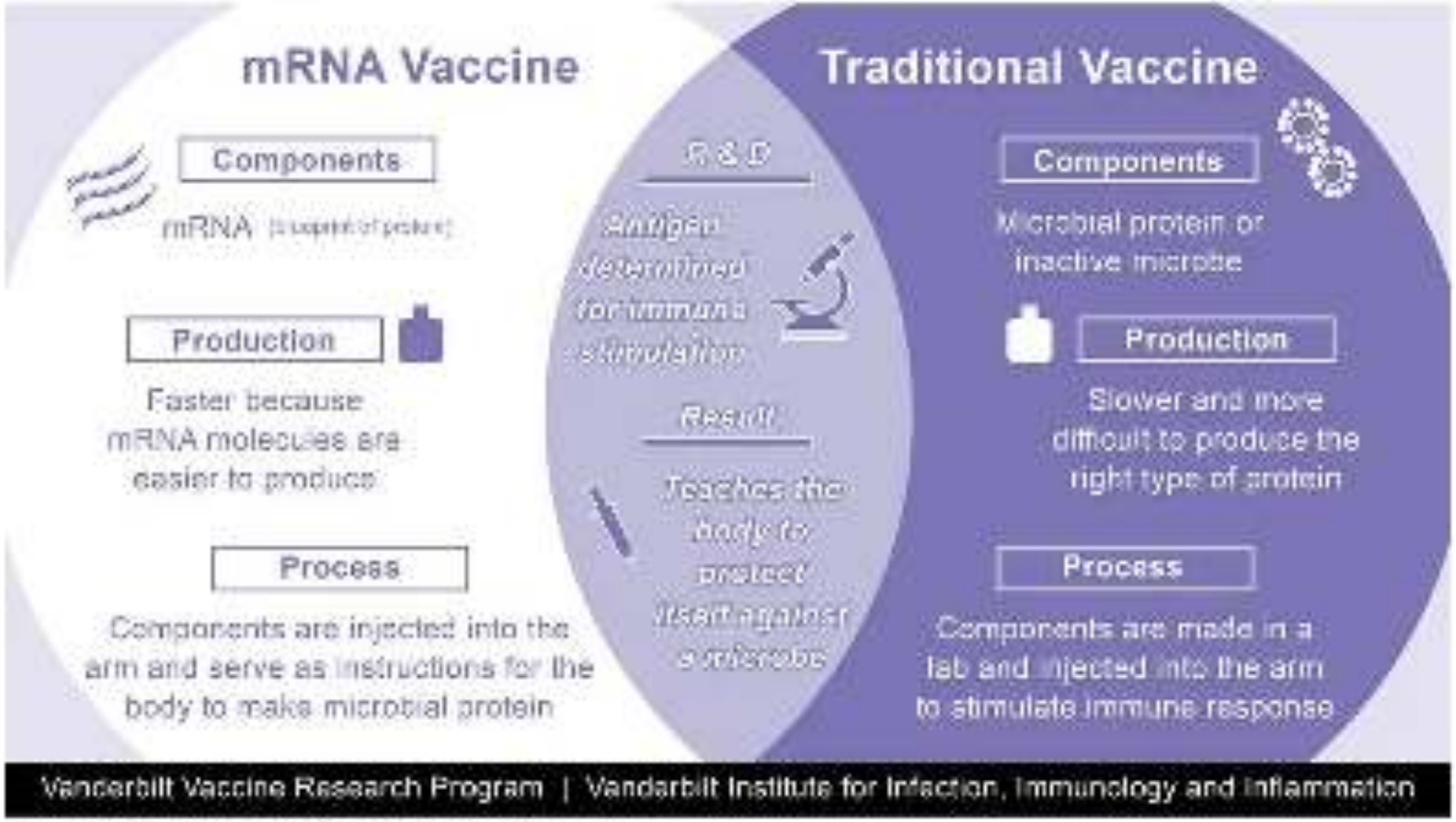
- Theoretically, once a platform has previously met safety and efficacy requirements to be moved and advanced into the market,
  - a candidate vaccine against a new virus might profit from the same system, production, and purification protocols, only replacing the disease target antigen (or inserted gene), thus streamlining the vaccine discovery.

Maria Trovato, et al (2020.09.03). Viral Emerging Diseases: Challenges in Developing Vaccination Strategies. Frontiers in Immunology; vol. 11: p2130. https://www.frontiersin.org/article/10.3389/fimmu.2020.02130

Types of coronavirus vaccines approach



https://www.sandiegouniontribune.com/news/science/story/2020-06-06/race-for-vaccine



A comparison of traditional with the new mRNA vaccines

Sanjay Mishra. (2020.11.19). **How mRNA vaccines from Pfizer and Moderna work, why they're a breakthrough and why they need to be kept so cold. https://theconversation.com/how-mrna-vaccines-from-pfizer-and-moderna-work-why-theyre-a-breakthrough-and-why-they-need-to-be-kept-so-cold-150238**

What are problems with mRNA?

- **What are problems with mRNA?**
- MRNA technology isn't new.
- It was shown a while back that when synthetic mRNA is injected into an animal, the cells can produce a desired protein.
- But the progress remained slow.
- That's because mRNA is not only notoriously unstable and easy to degrade into smaller components,
- it is also easily destroyed by the human body's immune defenses, which make delivering it to the target very inefficient.

Sanjay Mishra. (2020.11.19). **How mRNA vaccines from Pfizer and Moderna work, why they're a breakthrough and why they need to be kept so cold. https://theconversation.com/how-mrna-vaccines-from-pfizer-and-moderna-work-why-theyre-a-breakthrough-and-why-they-need-to-be-kept-so-cold-150238**

What are problems with mRNA?

- But beginning in 2005, researchers figured out how to stabilize mRNA and package it into small particles to deliver it as a vaccine.
- The mRNA COVID-19 vaccines are expected to be the first using this technology to be approved by the FDA.
- After a decade of work, the mRNA vaccines are now ready for evaluation.
- Physicians will be watching for unintended immune reactions, which can be both helpful and detrimental.

Sanjay Mishra. (2020.11.19). **How mRNA vaccines from Pfizer and Moderna work, why they're a breakthrough and why they need to be kept so cold. https://theconversation.com/how-mrna-vaccines-from-pfizer-and-moderna-work-why-theyre-a-breakthrough-and-why-they-need-to-be-kept-so-cold-150238**

Why keep mRNA supercold?

- The most important challenge for development of a mRNA vaccine remains its inherent instability,
- because it is more likely to break apart above freezing temperatures.
- Modification of the mRNA building blocks and development of the particles that can cocoon it relatively safely have helped the mRNA vaccine candidates.
- But this new class of vaccine still requires unprecedented freezer conditions for distribution and administration.

Sanjay Mishra. (2020.11.19). **How mRNA vaccines from Pfizer and Moderna work, why they're a breakthrough and why they need to be kept so cold. https://theconversation.com/how-mrna-vaccines-from-pfizer-and-moderna-work-why-theyre-a-breakthrough-and-why-they-need-to-be-kept-so-cold-150238**

Contents of Pfizer and Moderna Vaccines

Pfizer-BioNTech COVID-19 vaccine is made of the following ingredients

- **mRNA** – Also known as messenger ribonucleic acid, mRNA is the only active ingredient in the vaccine.

- The mRNA molecules contain the genetic material that provide instructions for our body on how to make a viral protein that triggers an immune response within our bodies.

- The immune response is what causes our bodies to make the antibodies needed to protect us from getting infected if exposed to the coronavirus.

https://www.hackensackmeridianhealth.org/HealthU/2021/01/11/a-simple-breakdown-of-the-ingredients-in-the-covid-vaccines/

Pfizer-BioNTech COVID-19 vaccine is made of the following ingredients

•**Lipids –** The following lipids are in the new COVID vaccine.
•Their main role is to protect the mRNA and provide somewhat of a “greasy” exterior that helps the mRNA slide inside the cells.

- (4-hydroxybutyl)azanediyl)bis(hexane-6,1-diyl)bis
- (2-hexyldecanoate), 2 [(polyethylene glycol)-2000]-N,N-ditetradecylacetamide
- 1,2-Distearoyl-snglycero-3- phosphocholine
- cholesterol

https://www.hackensackmeridianhealth.org/HealthU/2021/01/11/a-simple-breakdown-of-the-ingredients-in-the-covid-vaccines/

Pfizer-BioNTech COVID-19 vaccine is made of the following ingredients

•**Salts –** The following salts are included in the Pfizer vaccine and help balance the acidity in your body.

- potassium chloride
- monobasic potassium phosphate
- sodium chloride
- dibasic sodium phosphate

•**Sugar –** Basic table sugar, also known as sucrose, can also be found in the new COVID vaccine.

- •This ingredient helps the molecules maintain their shape during freezing.

https://www.hackensackmeridianhealth.org/HealthU/2021/01/11/a-simple-breakdown-of-the-ingredients-in-the-covid-vaccines/

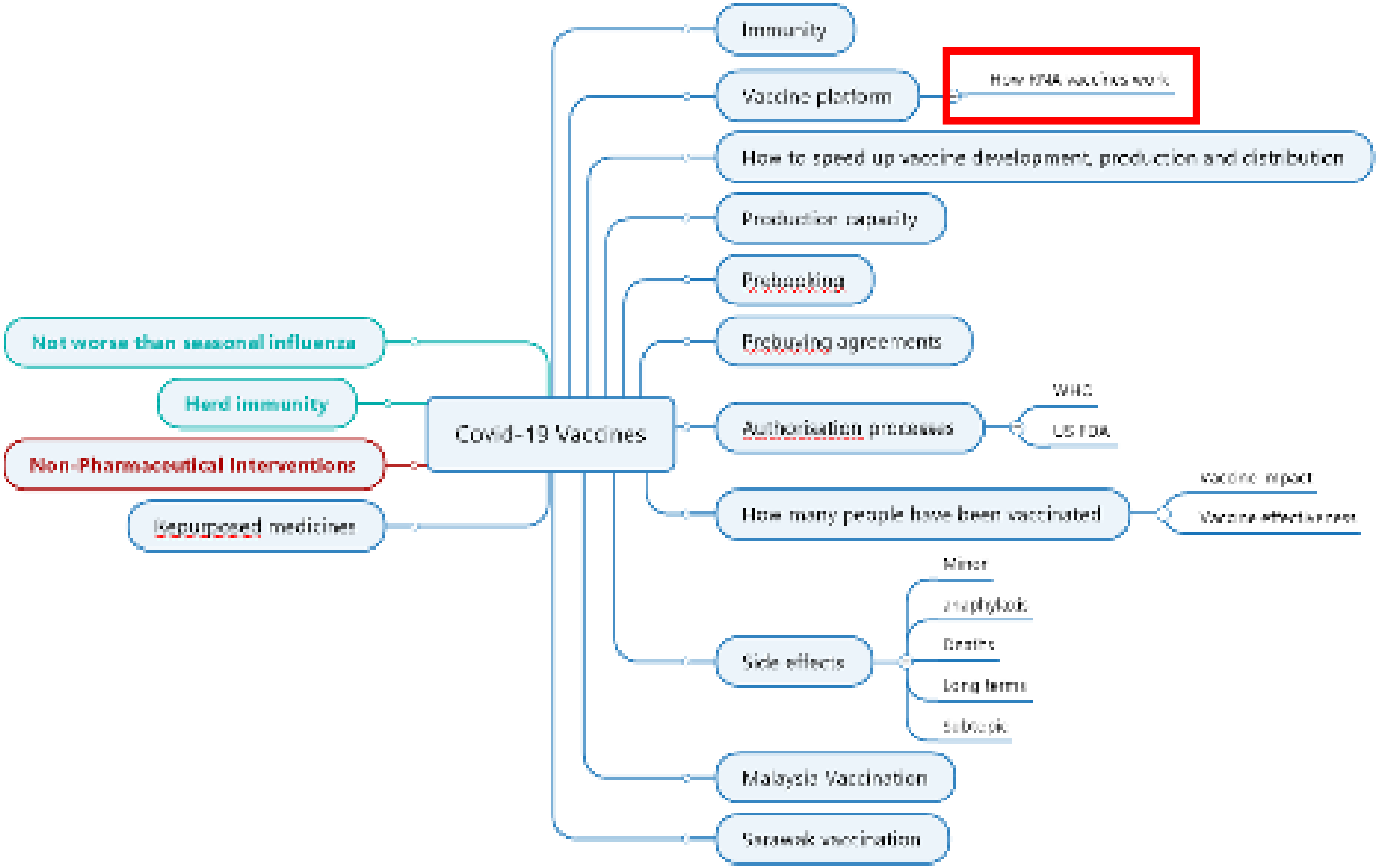
Moderna COVID-19 Vaccine is made of the following ingredients

- **mRNA –** Like the Pfizer BioNTech vaccine, Moderna's also uses mRNA technology to build antibodies against COVID-19.
- **Lipids** – The Moderna vaccine also requires lipids to help deliver the mRNA to the cells.
  - SM-102
  - 1,2-dimyristoyl-rac-glycero3-methoxypolyethylene glycol-2000 [PEG2000-DMG]
  - cholesterol
  - 1,2-distearoyl-snglycero-3-phosphocholine [DSPC]

The remaining ingredients (below), including acids, acid stabilizers, salt and sugar all work together to maintain the stability of the vaccine after it's produced.

- **Acids**
  - Acetic acid
- **Acid Stabilizers**
  - Tromethamine & Tromethamine hydrochloride
- **Salts**
  - Sodium acetate
- **Sugar**
  - Sucrose

https://www.hackensackmeridianhealth.org/HealthU/2021/01/11/a-simple-breakdown-of-the-ingredients-in-the-covid-vaccines/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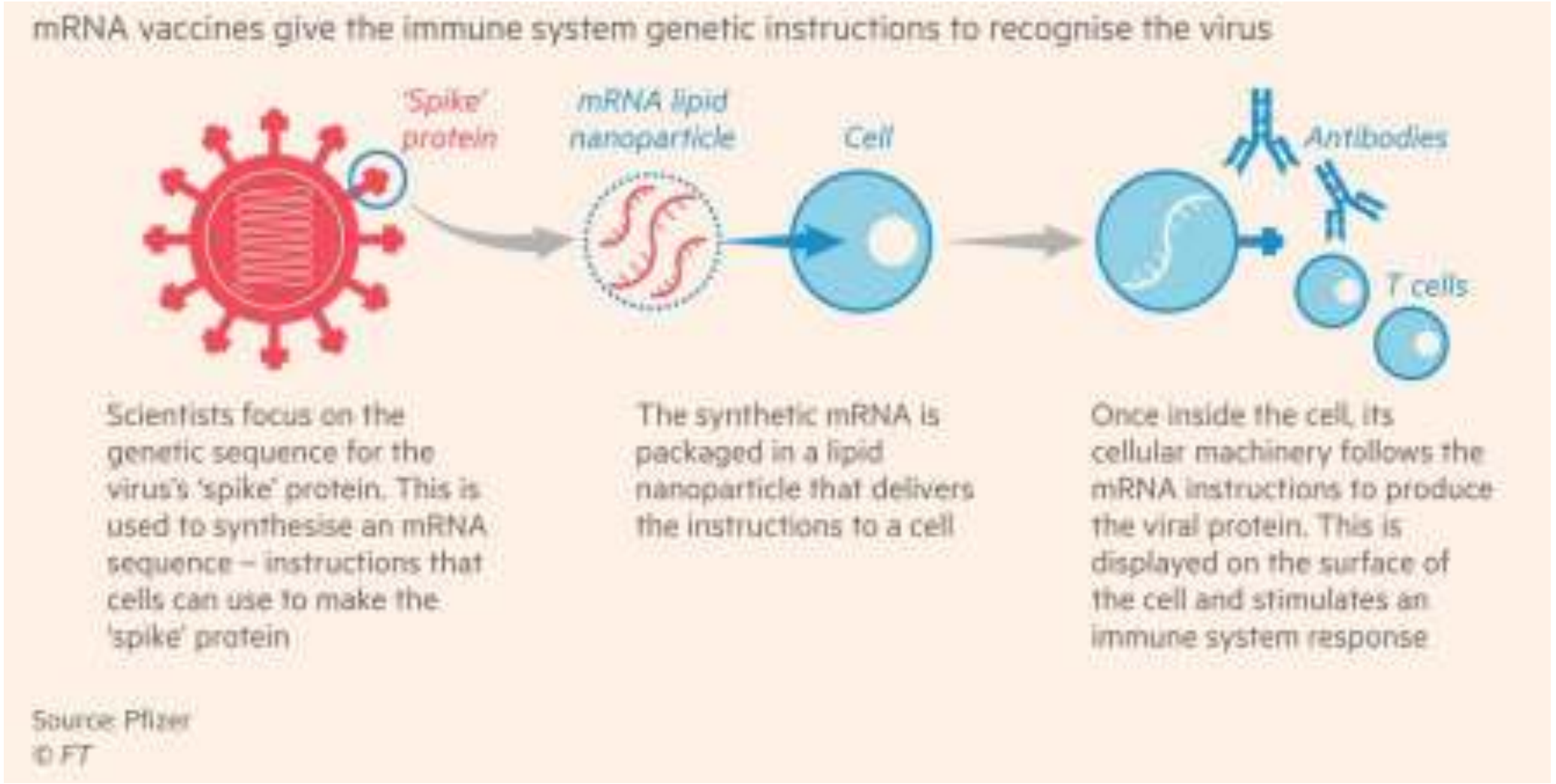
How mRNA Vaccines work

How the Pfizer-BioNTech Vaccine works

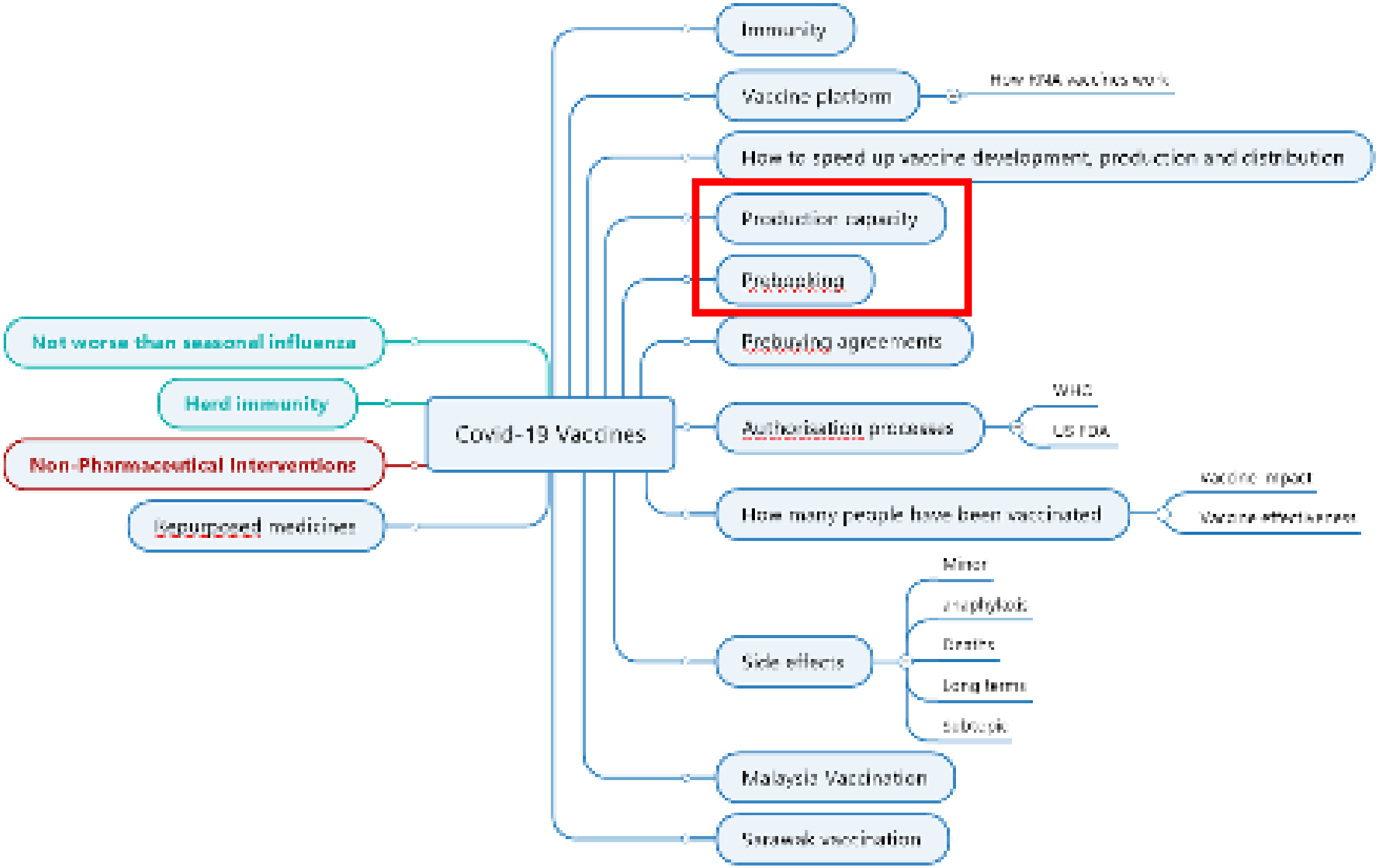


https://www.ft.com/content/74e41528-80c3-4b0f-b343-be43d90f0311

Facts about COVID-19 mRNA Vaccines

- **They cannot give someone COVID-19.**
  - mRNA vaccines do not use the live virus that causes COVID-19.
- **They do not affect or interact with our DNA in any way.**
  - mRNA never enters the nucleus of the cell, which is where our DNA (genetic material) is kept.
  - The cell breaks down and gets rid of the mRNA soon after it is finished using the instructions (72 hours).

https://www.cdc.gov/coronavirus/2019-ncov/vaccines/different-vaccines/mRNA.html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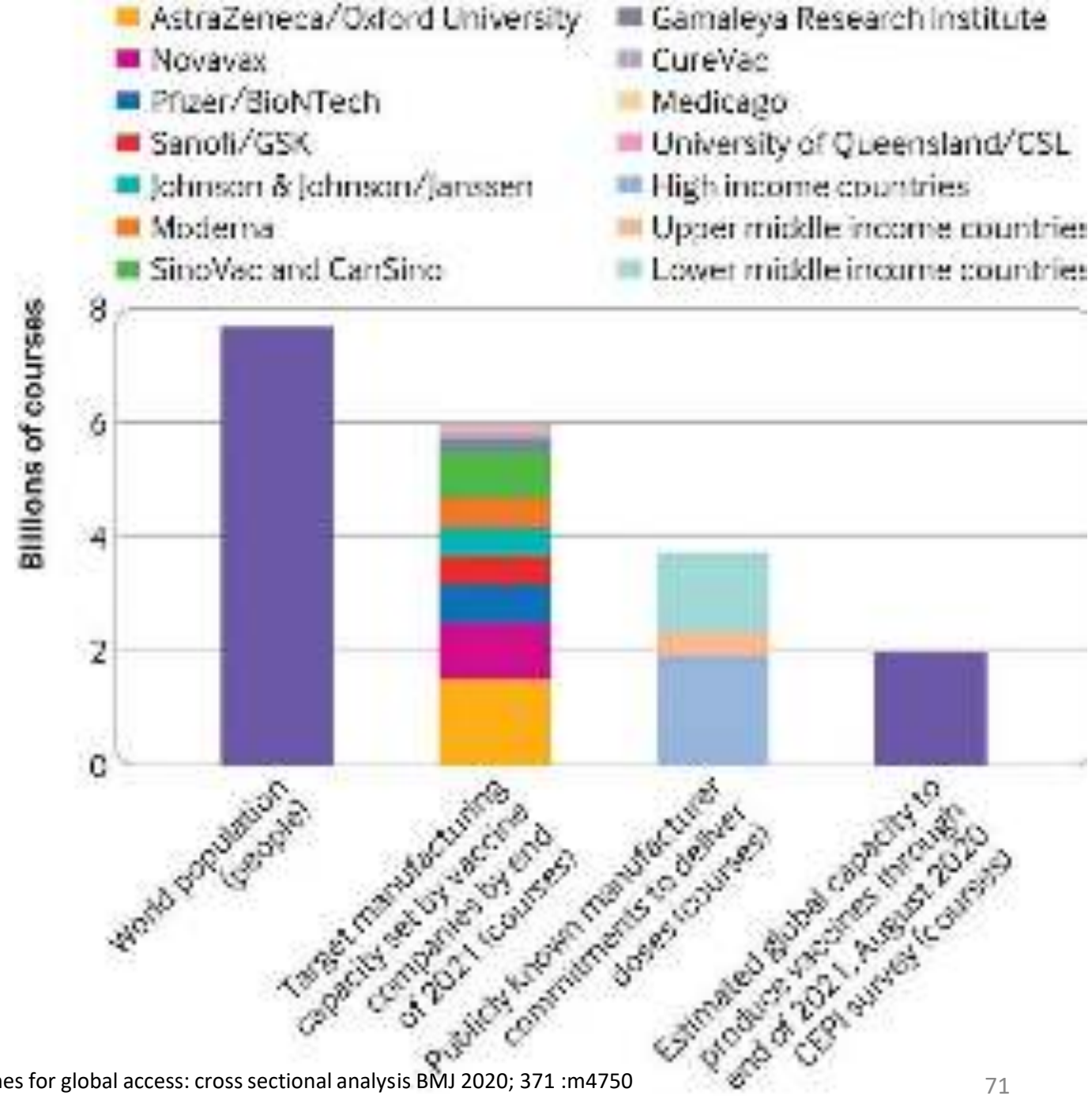
Vaccine production capacity and pre-booking by countries

Projected manufacturing capacity by end of 2021 of lead companies producing coronavirus disease 2019 vaccines.

Vaccine courses are assumed to require two doses, except for CanSino, which proposes to be one dose per course.
Johnson & Johnson/Janssen's vaccine candidate is being tested for both a one dose and two doses course, but for purposes of this study's analysis, is assumed to be a two dose course vaccine.

CEPI=Coalition for Epidemic Preparedness Innovations



So Anthony D, Woo Joshua. (2020.12.07). Reserving coronavirus disease 2019 vaccines for global access: cross sectional analysis BMJ 2020; 371 :m4750

Premarket commitments for coronavirus disease 2019 vaccines, per capita.

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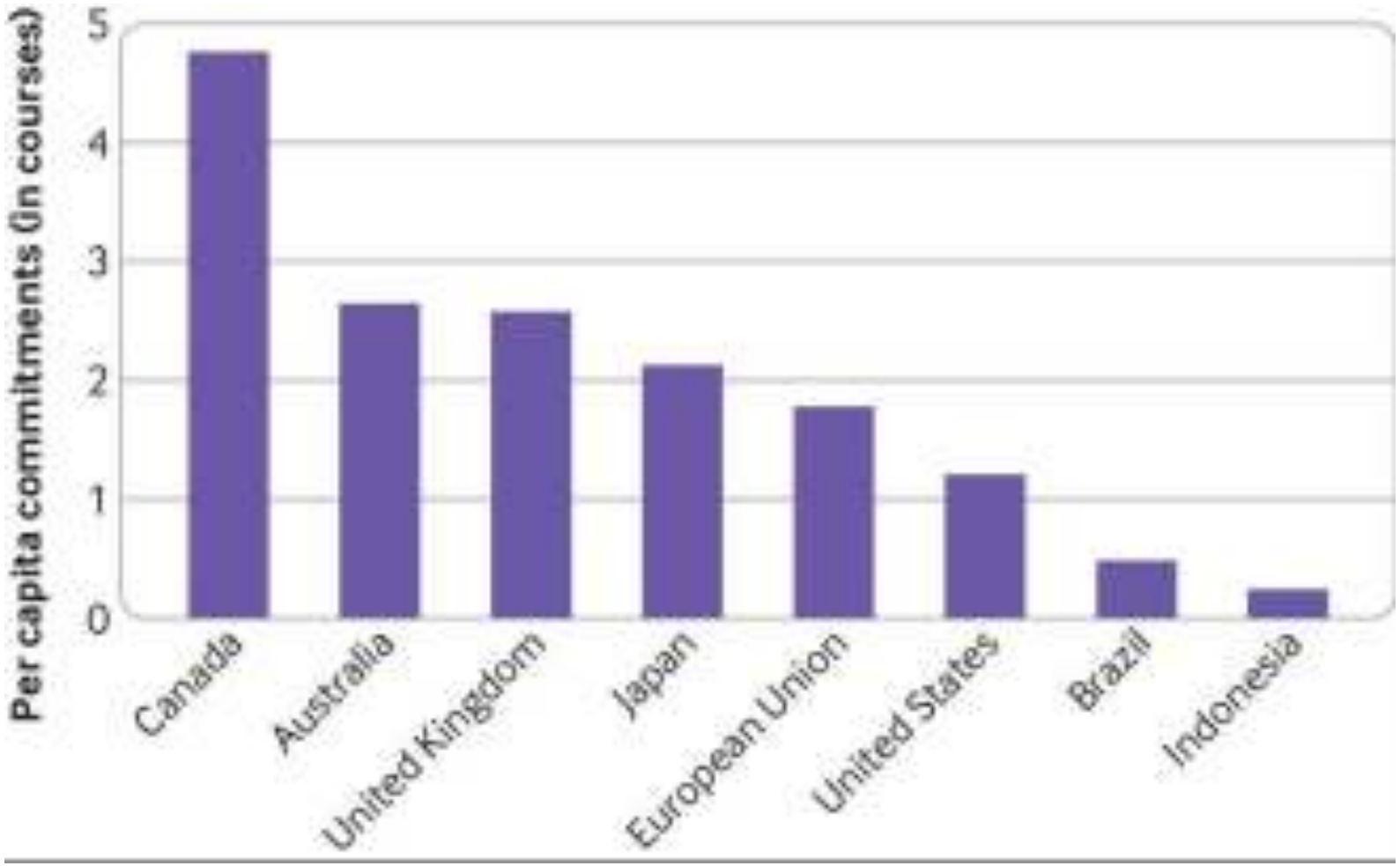
Johnson & Johnson/Janssen's vaccine candidate is being tested for both a one dose and two doses course, but for purposes of this study's analysis, is assumed to be a two dose course vaccine.

The vaccine courses for the European Union include premarket purchase commitments not only by the European Union but also by the European Inclusive Vaccines Alliance



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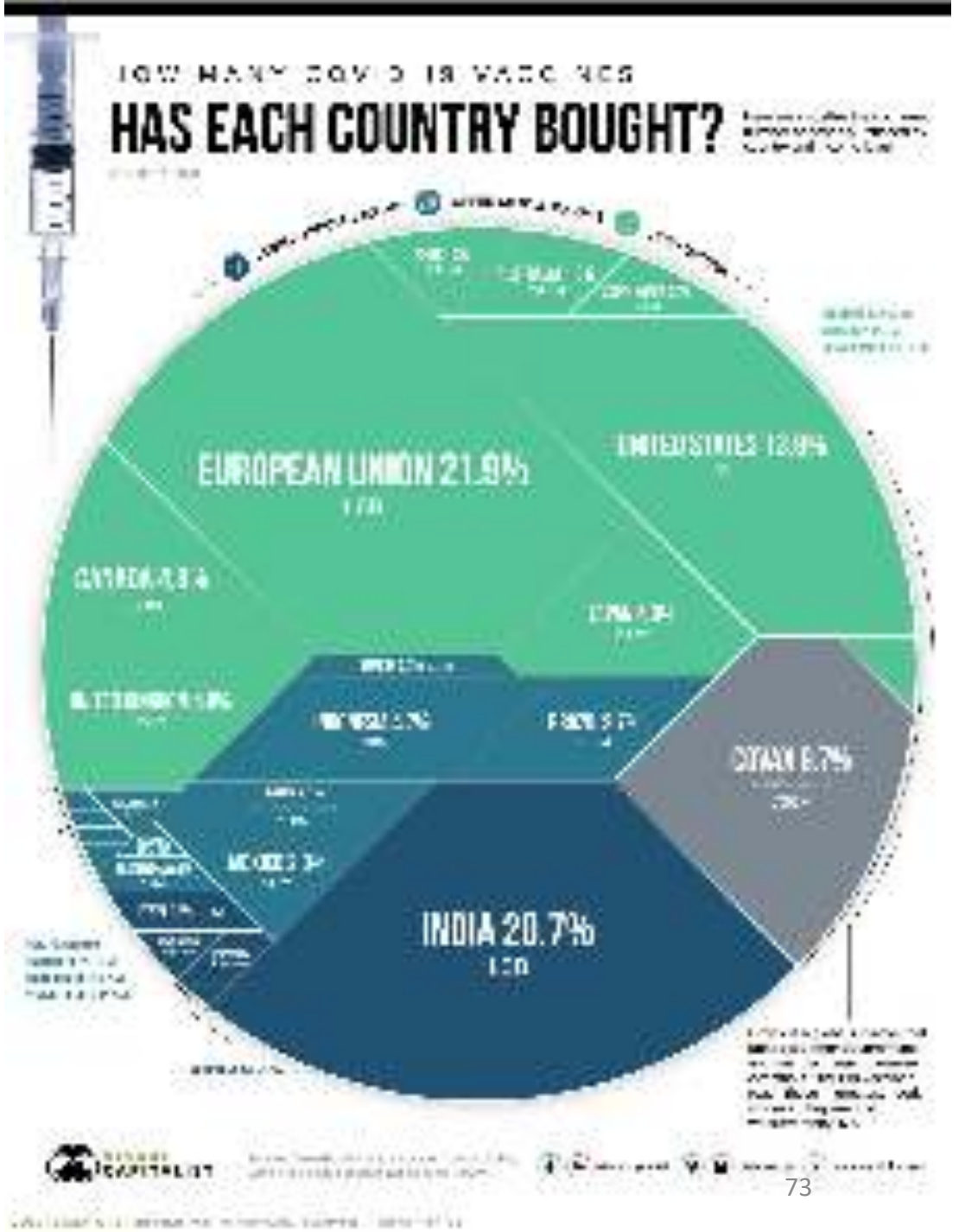
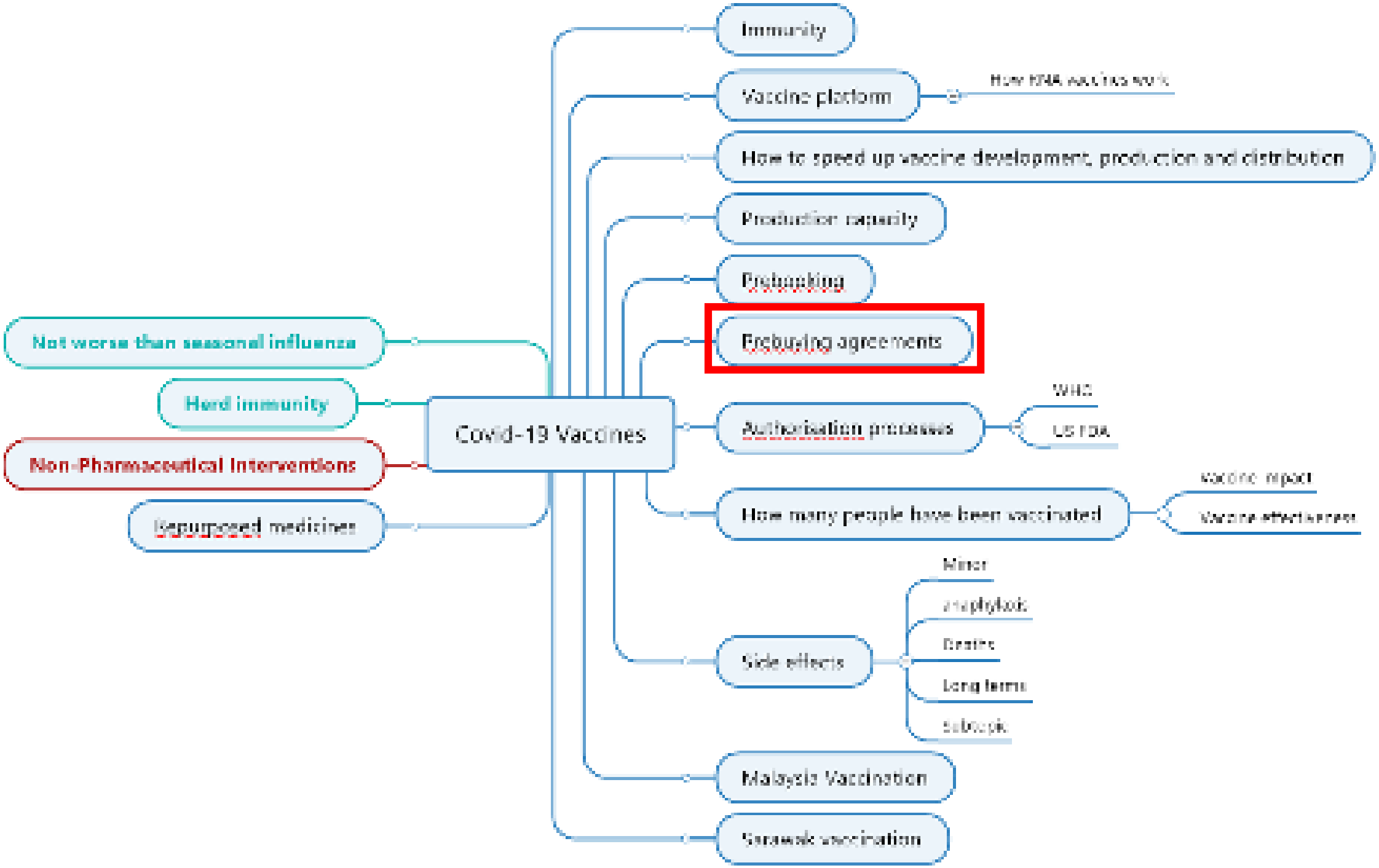


https://www.visualcapitalist.com/tracking-covid-19-vaccines-around-the-world/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US FDA
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Should Countries Invest in Vaccines & If ‘Yes’, how early should they move

Updated Feb 7, 2021, 12:38 pm

SINGAPORE - Last June (**June 2020**), Singapore sealed its first deal to buy Covid-19 vaccines - before any of the more than 200 vaccine candidates had even started their phase three clinical trials.

- It decided not to wait for the trials, and even paid a premium on the price, in order to secure some early stock of vaccines for people here at high risk, such as healthcare workers and the elderly.
- That was for the Moderna mRNA vaccine, which has yet to be approved for use here.
- Singapore signed two more purchase agreements in August - with Sinovac which produces a traditional vaccine, and Pfizer-BioNTech which also uses mRNA.
- These purchases should provide sufficient vaccines for the entire adult population. But Singapore is buying more.

https://www.straitstimes.com/singapore/health/how-singapore-picked-its-covid-19-vaccines


THE STRAITS TIMES SINGAPORE HEALTH

How Singapore picked its Covid-19 vaccines

Israel's clever coronavirus vaccination strategy

- The fact that the nation of 9 million people was able to secure such large quantities of vaccine has to do with the special terms Israel negotiated in contracts with manufacturers.
- Unlike the EU, Israel did not keep these contracts under lock and key, but made the agreement with Pfizer available on the internet.
- According to the agreement, Israel pays significantly more than the EU for each vaccine dose of the BioNTech-Pfizer vaccine,
  - reportedly about €23 ($28) per dose compared with the €12 paid by the EU.
- In addition, the Israeli state retains product liability.
- The European Union, on the other hand, was very keen that BioNTech-Pfizer continue to be liable for the safety of the product.

https://www.dw.com/en/israels-clever-coronavirus-vaccination-strategy/a-56586888

Israel's clever coronavirus vaccination strategy

- Most importantly, Israel's government agreed with vaccine manufacturers to
  - provide weekly data from the vaccination campaign to them.
  - This includes infection and vaccination numbers, as well as patient demographics such as age and gender.

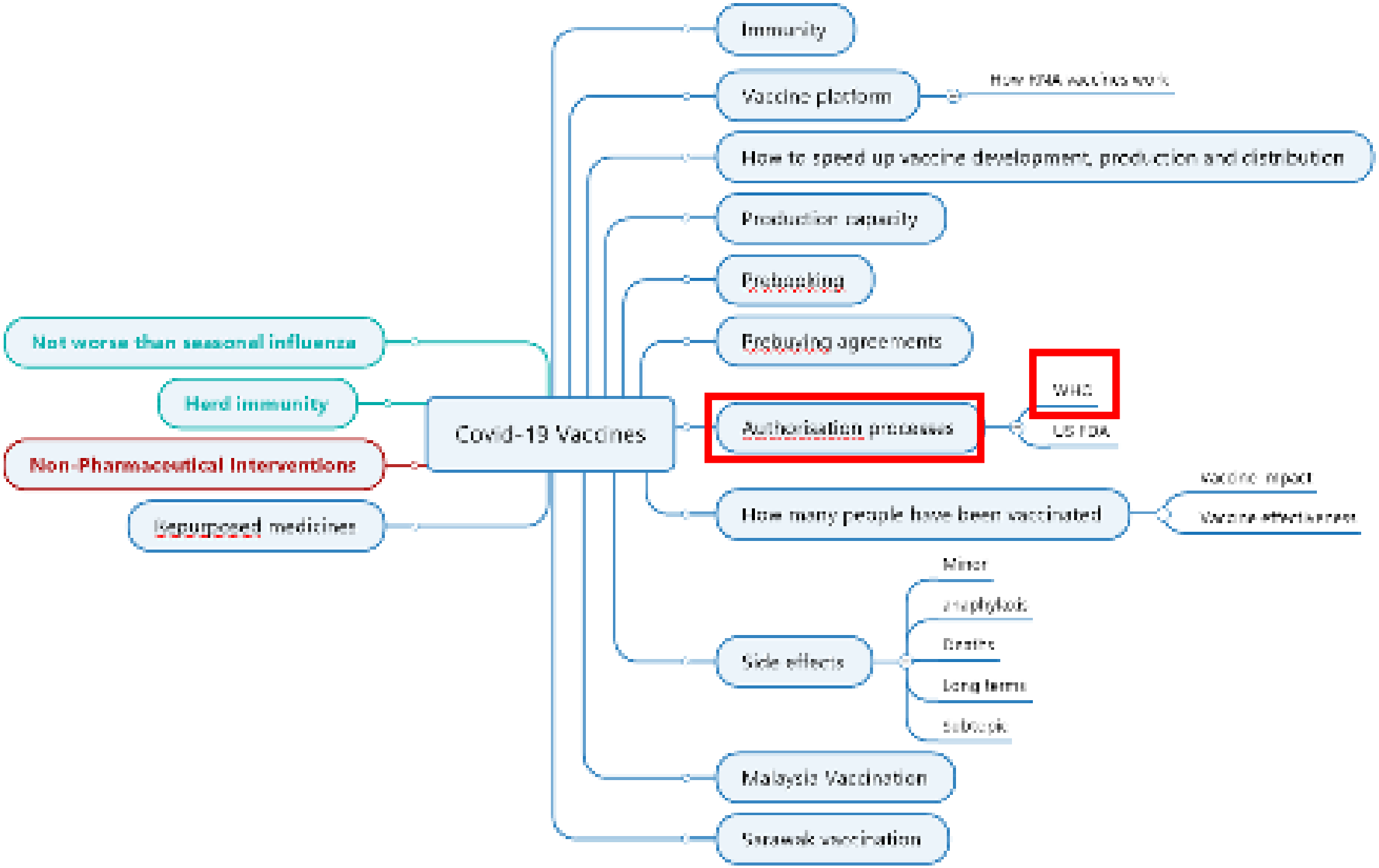
- The data is sent to Pfizer anonymously, according to Israeli officials.

https://www.dw.com/en/israels-clever-coronavirus-vaccination-strategy/a-56586888

Israel's clever coronavirus vaccination strategy

- Thanks to the digitized health care system in Israel, the
  - pharmaceutical companies not only receive data quickly and reliably,
  - but above all they get much more data than they would from any other study.
- It is an invaluable source of information for the pharmaceutical companies.
- In return, the manufacturers committed to supplying Israel with vaccines until immunization of 95% of the population is achieved.
- On December 20th 2020, Israel launched its COVID-19 vaccination campaign

https://www.dw.com/en/israels-clever-coronavirus-vaccination-strategy/a-56586888


Immunity
Vaccine platform
How to speed up vaccine development, production and distribution
Production capacity
Prebunking
Prebuying agreements
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Herd immunity
Non-Pharmaceutical Interventions
Repurposed medicines
Covid-19 Vaccines
Authorisation processes
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US FDA
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Side effects
Minor
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Which Vaccines will be Considered for EUL by the WHO

WHO Target Product Profiles for COVID-19 Vaccines

Version 3 - 29 April 2020

Purpose of the document

Selected disease areas are identified as WHO priorities for research and product development. In the case of COVID-19, target product profile development followed the COVID-19 Global research and innovation forum: towards a research roadmap. The target audience includes vaccine scientists, product developers, manufacturers and funding agencies.

All the requirements contained in WHO guidelines for WHO policy recommendation and prequalification will also apply. The criteria below lay out some of the considerations that will be relevant in WHO's case-by-case assessments of COVID-19 vaccines in the future.

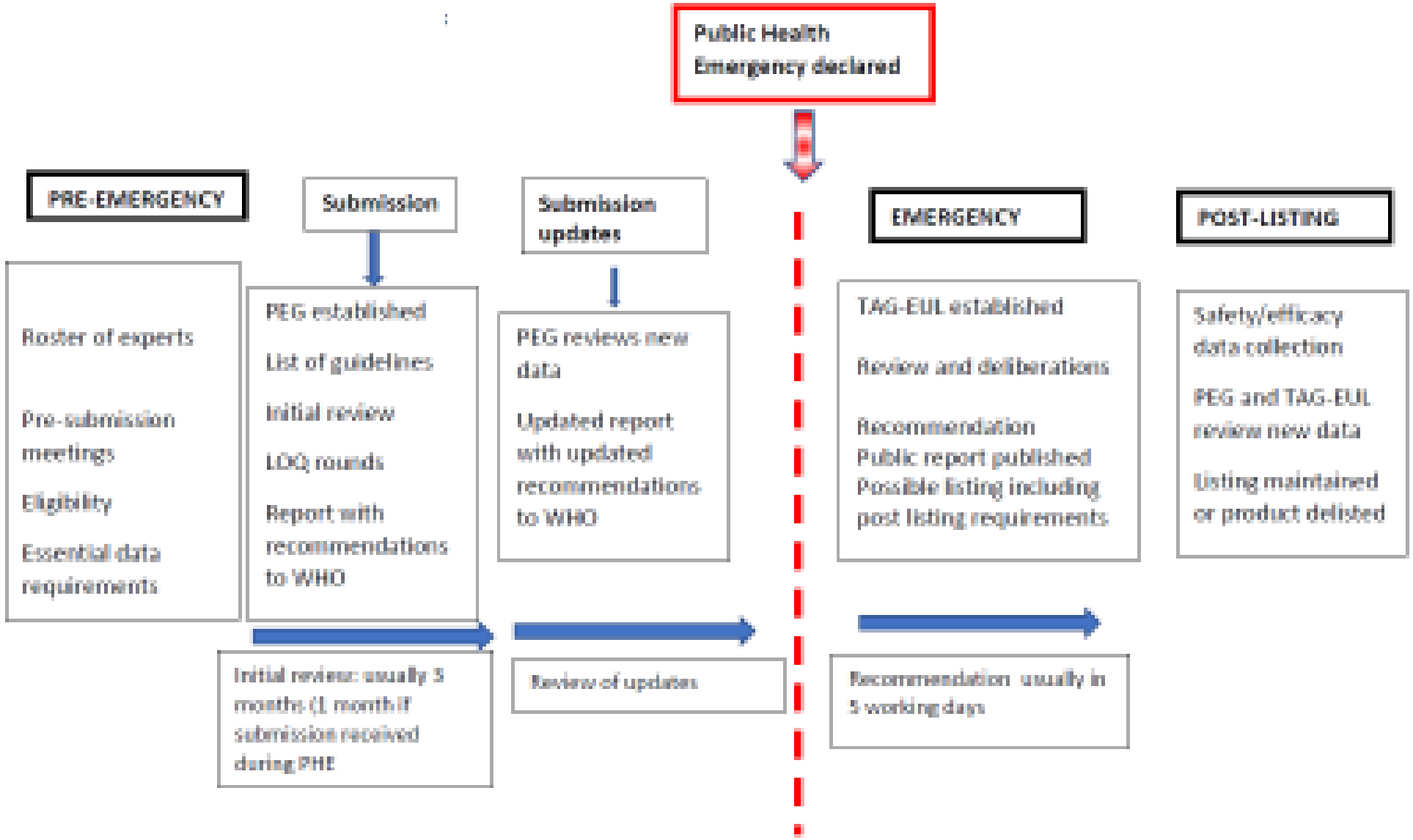
https://www.who.int/publications/m/item/who-target-product-profiles-for-covid-19-vaccines

Which Vaccine to Choose - TPP

Vaccine characteristic Indication for use	**Preferred** Outbreak: For active immunization of persons in the area of an on-going outbreak for the prevention of COVID-19; to be used in conjunction with other control measures to curtail or end an outbreak. LT: For active immunization of at-risk persons to prevent COVID-19	**Critical or Minimal** Outbreak: For active immunization of persons in the area of an on-going outbreak for the prevention of COVID-19; to be used in conjunction with other control measures to curtail or end an outbreak LT: For active immunization of at-risk persons to prevent COVID-19

Flowchart for the Emergency Use Listing (EUL) Process by the WHO

PEG- Product Evaluation Group
LOQ – List of Questions
TAG-EUL - Technical Advisory Group for Emergency Use Listing



WHO (2020.12.14). Emergency use listing procedure. https://www.who.int/publications/m/item/emergency-use-listing-procedure

list of activities during the three phases of the EUL

Activity	Pre-emergency	Emergency	Post-listing
Agreements between WHO and relevant NRAs	✓		
Establishment of roster of experts by WHO	✓		
Assessment by WHO of eligibility of specific products	✓	✓	
Development of consensus by the PLG on requirements	✓	✓	
Pre-submission meetings between WHO and applicant	✓	✓	
Assignment of assessment pathway by WHO	✓	✓	
Establishment of expert groups (PLG and TAG-EUL) by WHO	✓	✓	
Assessment of submission by PLG	✓	✓	
Assessment of PLG report by TAG-EUL		✓	
Submission of updates by manufacturer	✓	✓	✓
Decision on listing by WHO		✓	
Post-listing monitoring			✓
Decision by WHO on whether to extend listing		✓	✓
Possible post-listing changes by WHO			✓

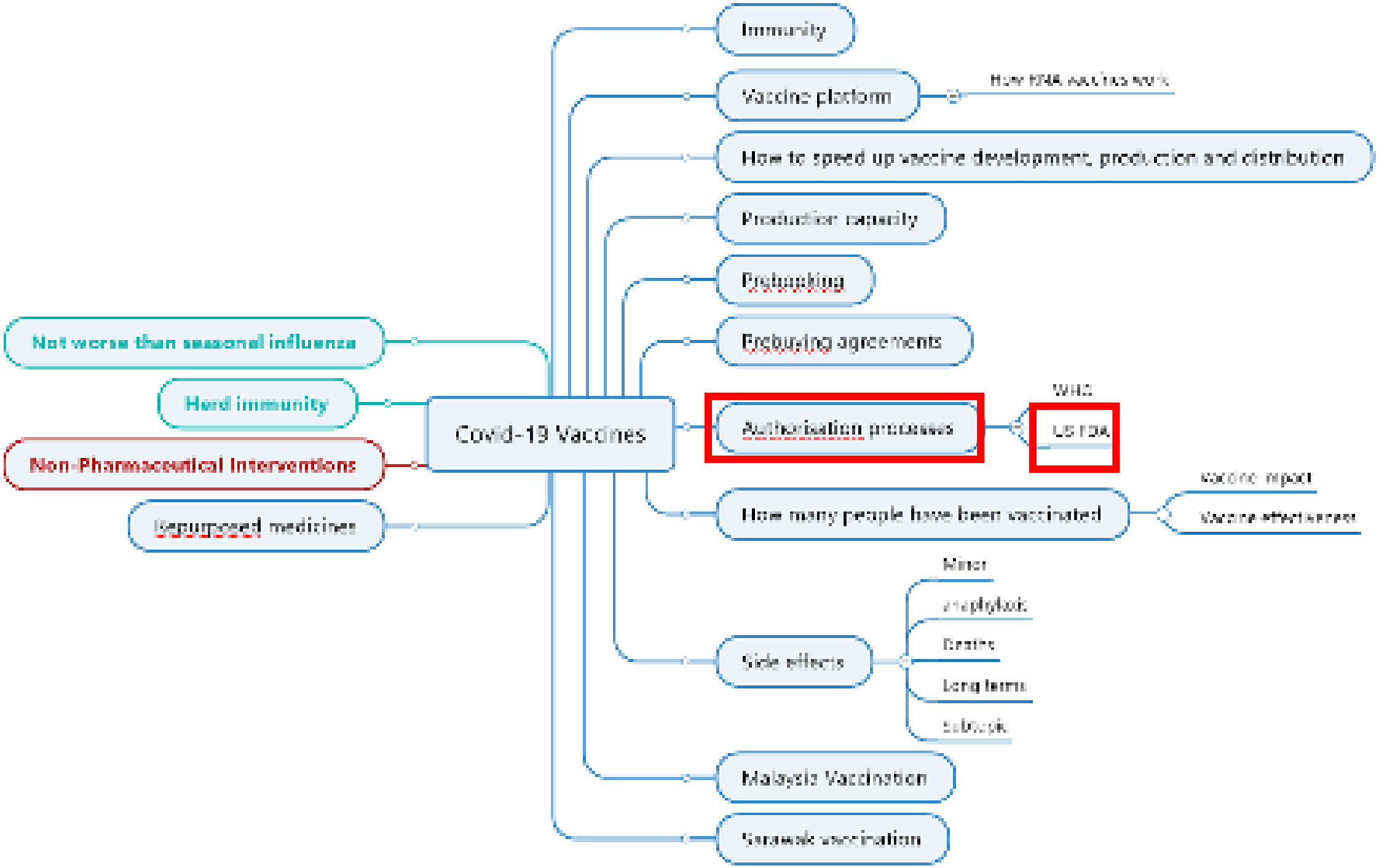
WHO (2020.12.14). Emergency use listing procedure. https://www.who.int/publications/m/item/emergency-use-listing-procedure

Status of COVID-19 Vaccines within WHO EUL/PQ evaluation process

NRA = National Regulatory authority
EOI = Expression of Interest

	Manufacturer	Name of Vaccine	NRA of Record	Platform	EOI accepted	Pre-submission meeting held	Dossier accepted for review?	Status of assessment**	Anticipated decision date***
1.	[illegible]	BNT162b2/COMIRNATY Tozinameran (INN)	EMA	Nucleoside modified mRNA	✓	✓	✓	Finalized	31/12/20
2.	[illegible]	AZD1222	Core – EMA Non-COVAX	Recombinant ChAdOx1 adenoviral vector encoding the Spike protein antigen of the SARS-CoV-2.	✓	✓	Accepted core data of AZ – non-Covax Data for Covax expected in Mar 15 2021	Non Covax Core data Planned	NA March – April 2021
3.	SK BIO	AZD1222	MFDS KOREA	Recombinant ChAdOx1 adenoviral vector encoding the Spike protein antigen of the SARS-CoV-2.	✓	✓	✓	Finalized	15 Feb 2021
4.	Serum Institute of India	Covishield (ChAdOx1_nCoV-19)	DCGI	Recombinant ChAdOx1 adenoviral vector encoding the Spike protein antigen of the SARS-CoV-2.	✓	✓	✓	Finalized	15 Feb 2021
5.	Sinopharm / BIBP	SARS-CoV-2 Vaccine (Vero Cell), Inactivated (InCoV)	NMPA	Inactivated, produced in Vero cells	✓	✓	✓	In progress	Earliest March
6.	sinovac	SARS-CoV-2 Vaccine (Vero Cell), Inactivated	NMPA	Inactivated, produced in Vero cells	✓	✓	Additional expected end of Feb 2021		Earliest March
7.	moderna	mRNA-1273	EMA	mRNA-based vaccine encapsulated in lipid nanoparticle (LNP)	✓	✓	Additional data expected week starting 15 Feb 2021		Estimated end of Feb 2021
8.	[illegible]	Ad26.COV2.S	EMA	Recombinant, replication-incompetent adenovirus type 26 (Ad26) vectored vaccine encoding the (SARS-CoV-2) Spike (S) protein	✓	✓	Rolling data to EMA – Dec, 29 Jan and 15 Feb 2021. To submit for EUL on 19 Feb 2021	Not yet started Use abridged procedure relying on EMA	March - April 2021
9.	[illegible]	Sputnik V	Russian NRA	Human Adenovirus Vector-based Covid-19 vaccine	Additional information submitted	Several meetings held	Rolling data started 06 and additional data expected week starting 22 Feb 2021		
10.	CanSinoBIO	Ad5-nCoV	NMPA	Recombinant Novel Coronavirus Vaccine (Adenovirus Type 5 Vector)	✓	✓	Rolling data starting April 2021		
11.	Vector State Research Centre of Virology and Biotechnology	EpiVacCorona	Russian NRA	Peptide antigen	Letter received not EOI. Reply sent on 15/01/2021				

https://extranet.who.int/pqweb/sites/default/files/documents/Status_COVID_VAX_16Feb2021.pdf Accessed on 24 Feb 2021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US FDA Emergency Use Authorisation path

FDA's evaluation of an EUA request for a COVID-19 vaccine

Part of FDA's evaluation of an EUA request for a COVID-19 vaccine includes

- evaluation of the chemistry,
- manufacturing,
- and controls information for the vaccine.

Sufficient data should be submitted to ensure the quality and consistency of the vaccine product.

FDA (2020.12.18), The Path for a COVID-19 Vaccine from Research to Emergency Use Authorization https://www.fda.gov/media/143890/download. Accessed on 24 Feb 2021

FDA's evaluation of an EUA request for a COVID-19 vaccine

FDA will use all available tools and information including:

- records reviews,
- site visits,
- and previous compliance history,

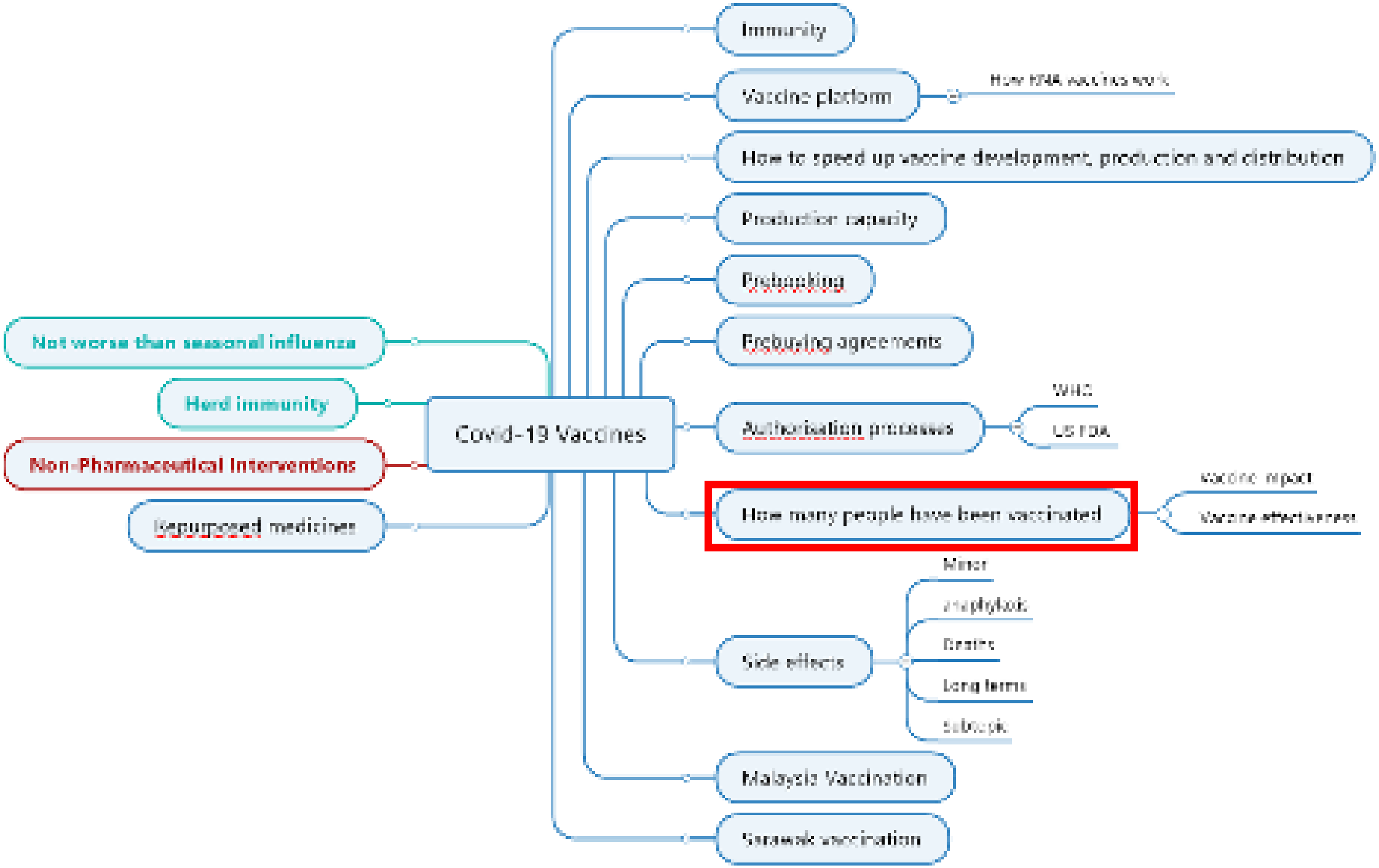
to assess compliance with current good manufacturing practices.

FDA (2020.12.18), The Path for a COVID-19 Vaccine from Research to Emergency Use Authorization https://www.fda.gov/media/143890/download. Accessed on 24 Feb 2021

FDA's evaluation of an EUA request for a COVID-19 vaccine

- FDA has made clear in its October 2020 guidance
- entitled Emergency Use Authorization for Vaccines to Prevent COVID-19,
- that, for a COVID-19 vaccine for which there is adequate manufacturing information to ensure its quality and consistency,

FDA (2020.12.18), The Path for a COVID-19 Vaccine from Research to Emergency Use Authorization https://www.fda.gov/media/143890/download. Accessed on 24 Feb 2021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Herd immunity
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Repurposed medicines
Covid-19 Vaccines
Authorisation processes
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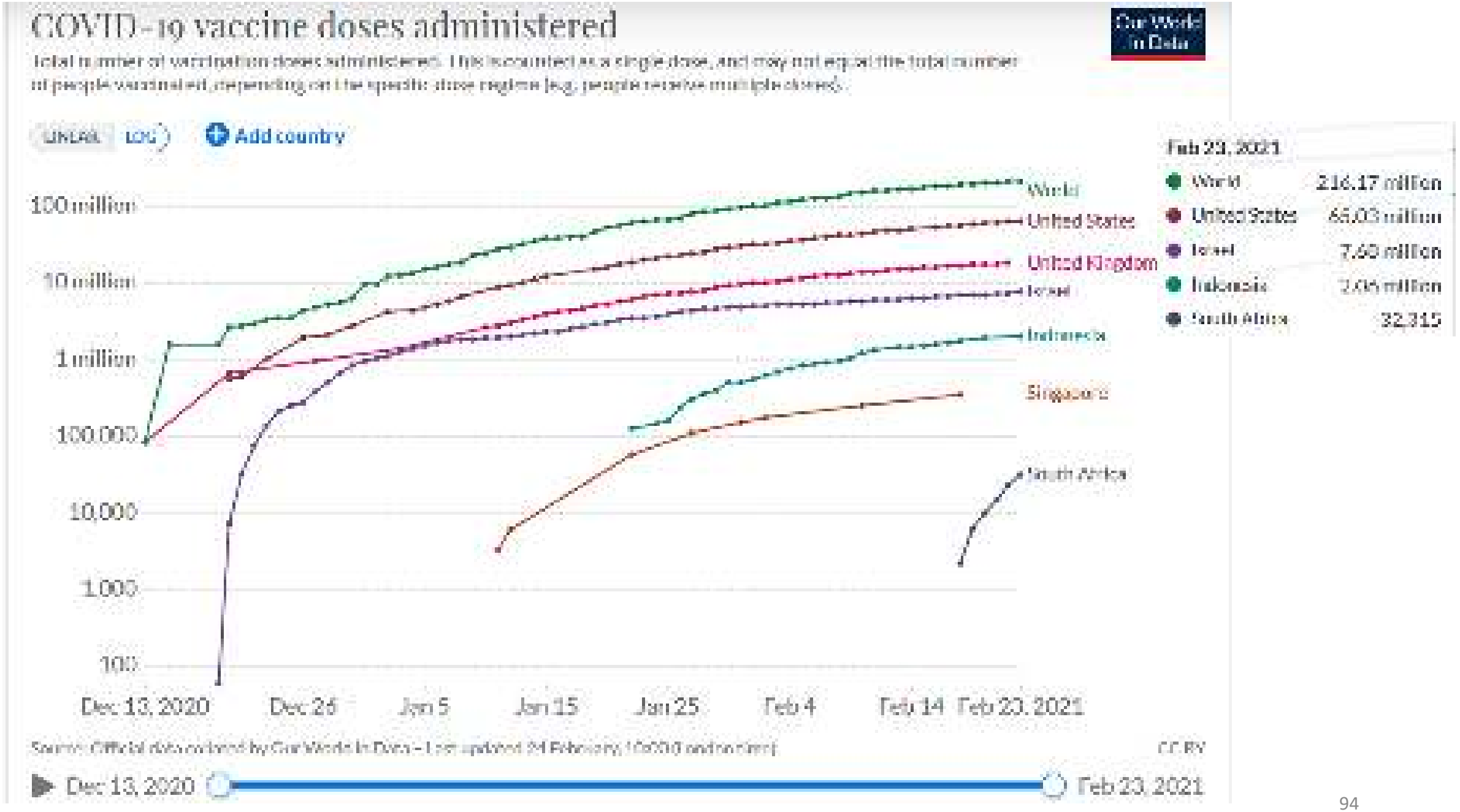
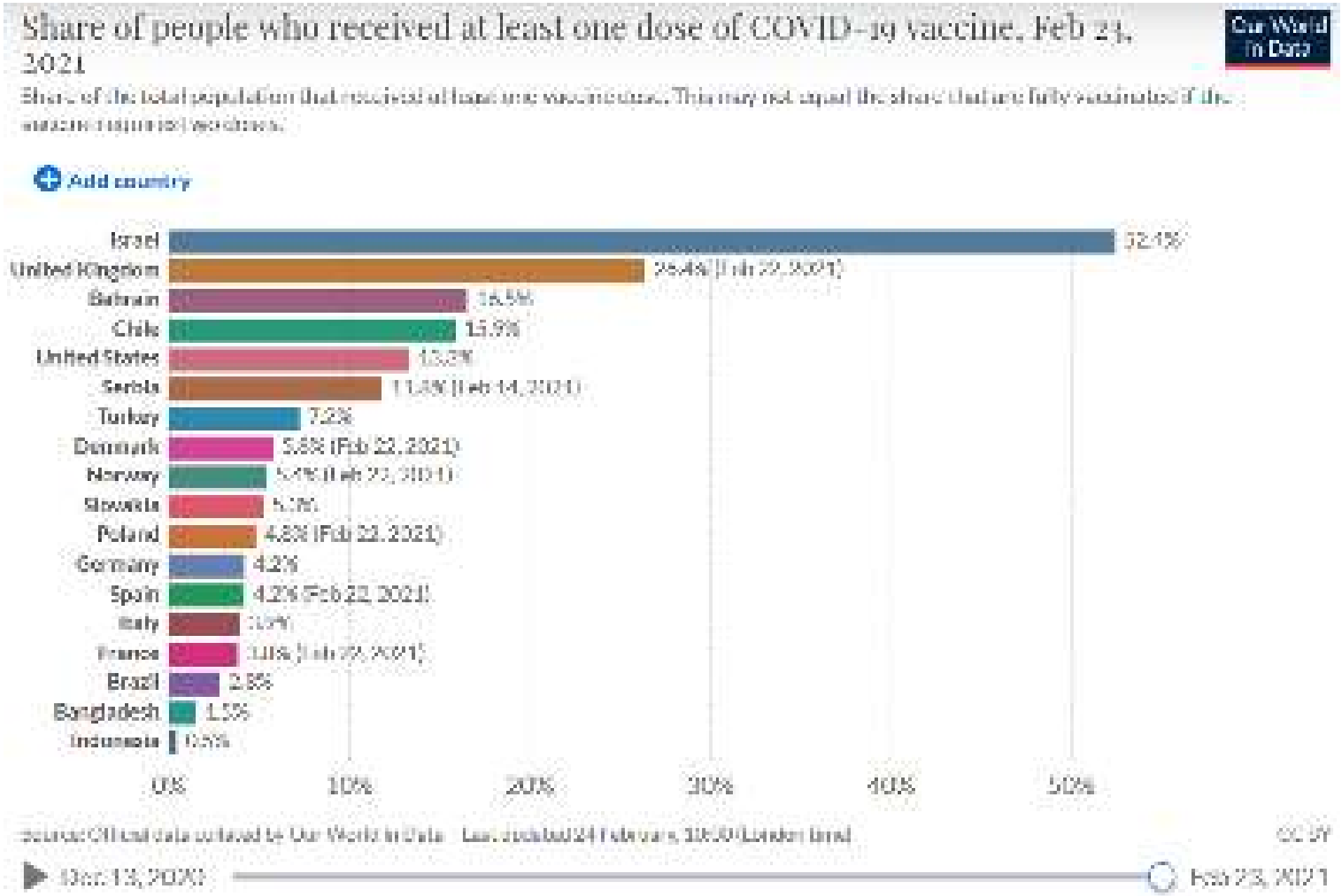
How many people have been vaccinated in the world?



https://ourworldindata.org/covid-vaccinations?country=ISR~SGP~GBR



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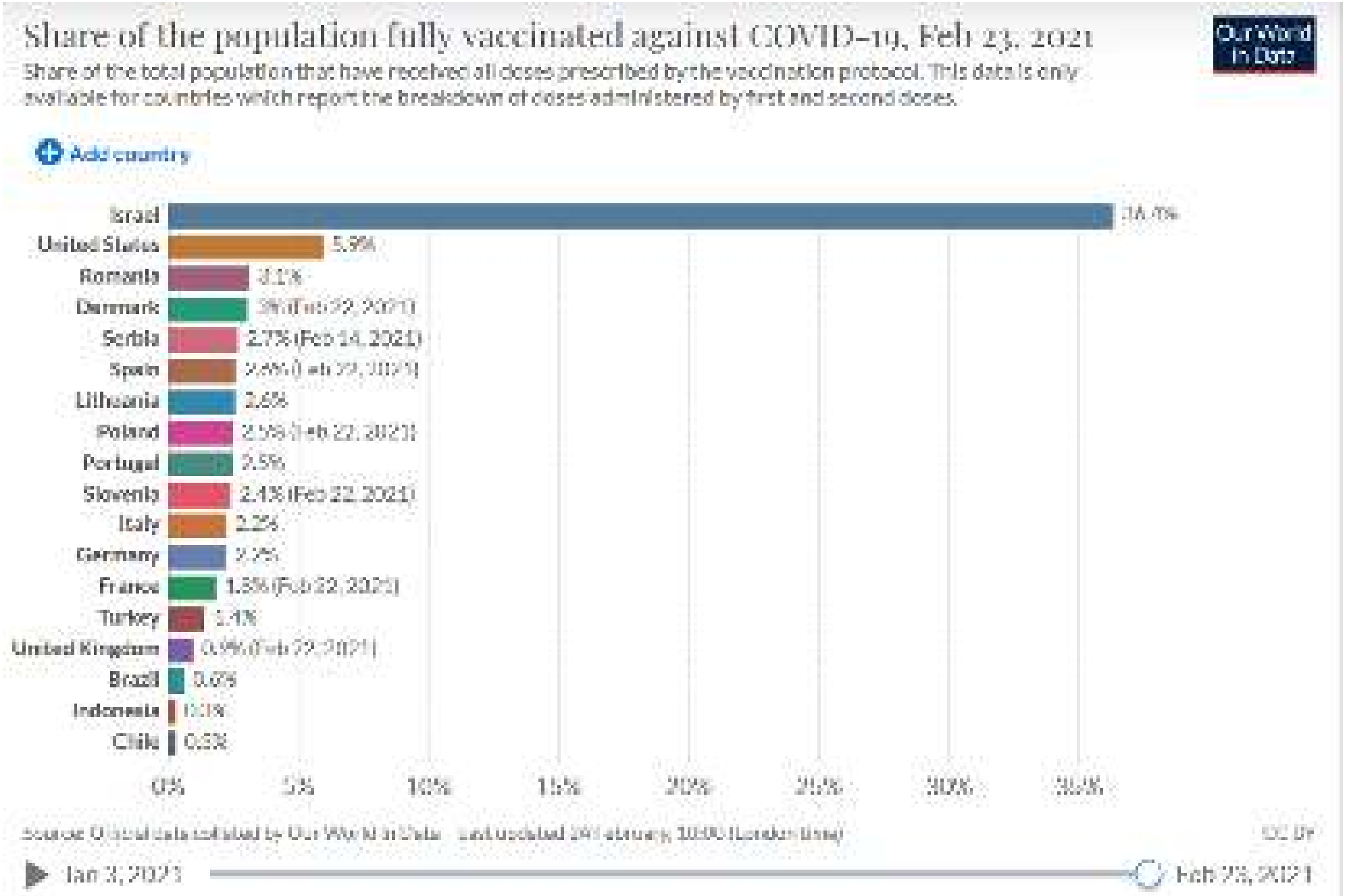
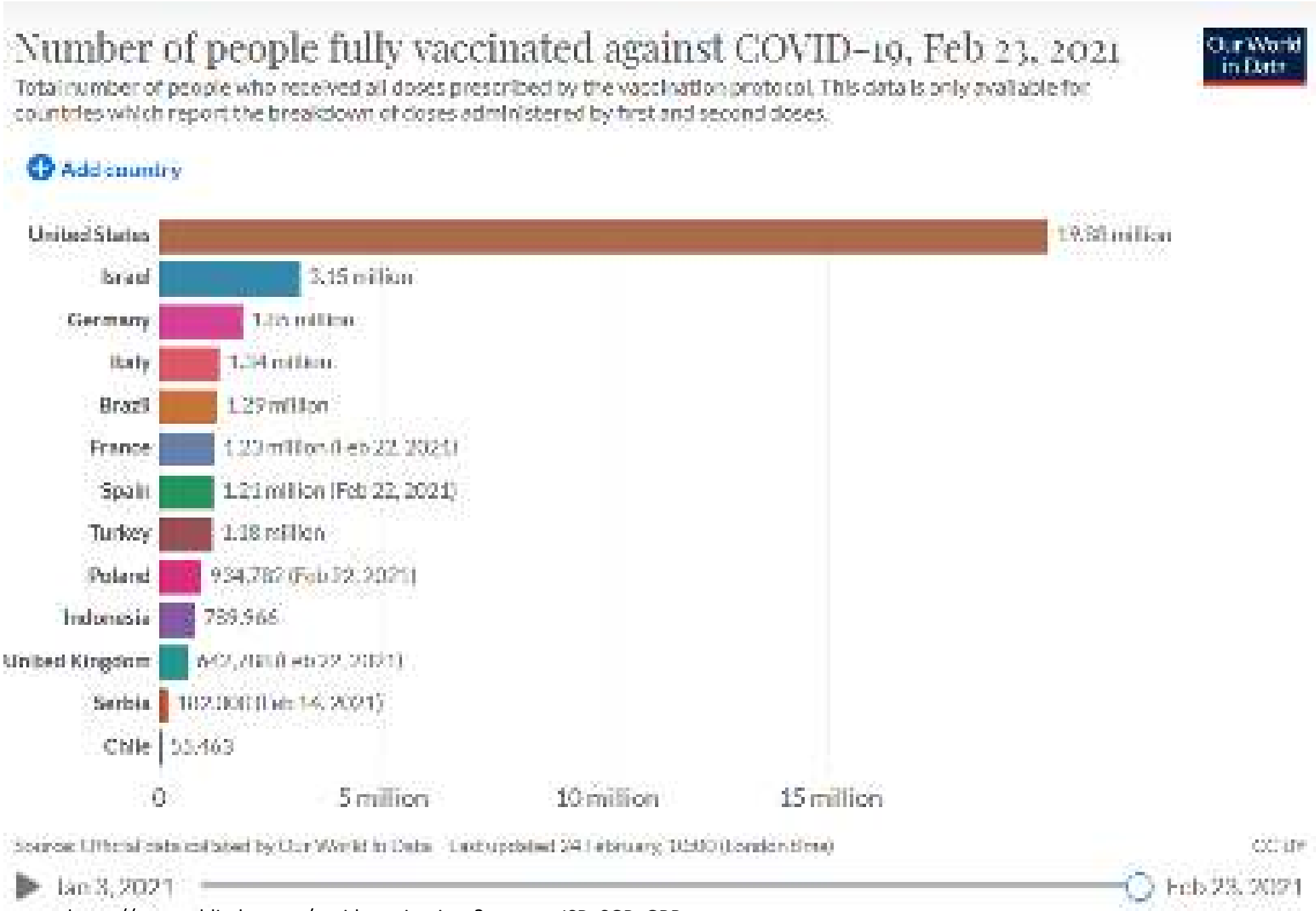
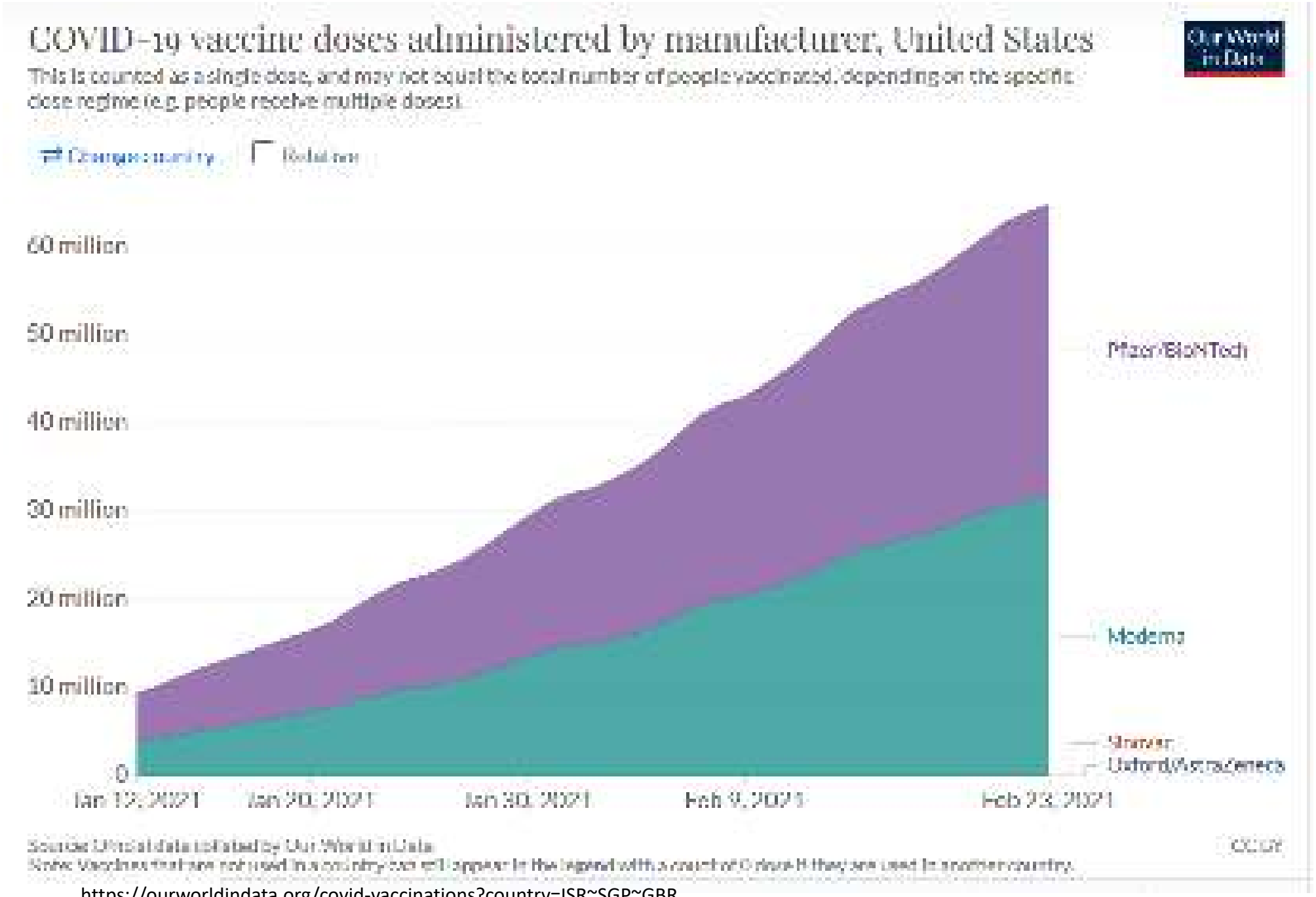


https://ourworldindata.org/covid-vaccinations?country=ISR~SGP~GBR

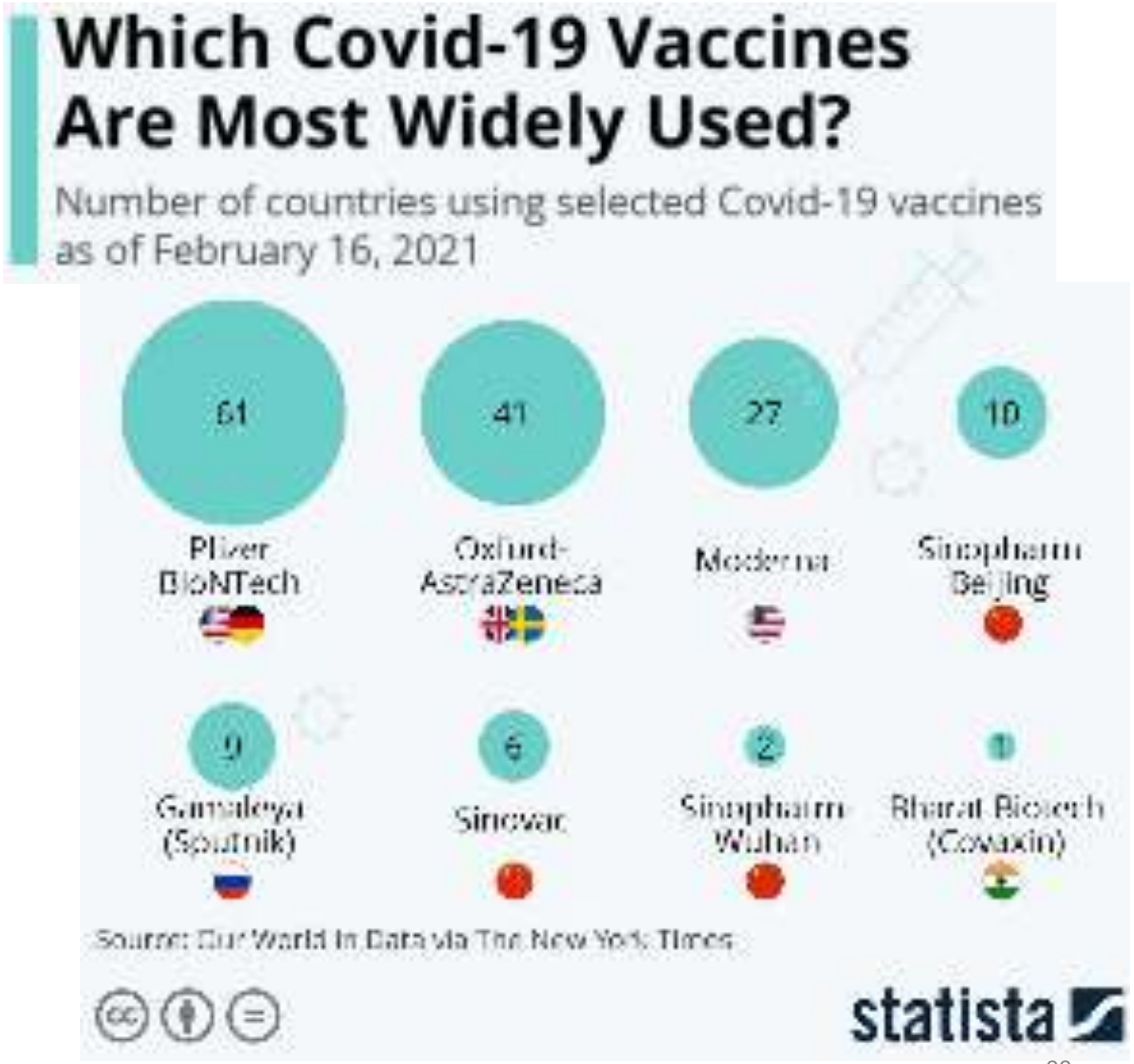


https://ourworldindata.org/covid-vaccinations?country=ISR~SGP~GBR



https://ourworldindata.org/covid-vaccinations?country=ISR~SGP~GBR

Covid-19 vaccines used in the world



https://www.statista.com/chart/24191/number-of-countries-using-selected-covid-19-vaccines/

Leading Vaccines

Developer	How It Works	Phase	Status
Pfizer-BioNTech	mRNA	2 3	Approved in several countries. Emergency use in U.S., E.U., other countries.
Moderna	mRNA	3	Approved in Switzerland. Emergency use in U.S., U.K., E.U., others.
Gamaleya	Ad26, Ad5	3	Early use in Russia. Emergency use in other countries.
Oxford-AstraZeneca	ChAdOx1	2 3	Emergency use in U.K., E.U., other countries.
CanSino	Ad5	3	Limited use in China.
Johnson & Johnson	Ad26	3	
Vector Institute	Protein	3	Early use in Russia.
Novavax	Protein	3	
Sinopharm	Inactivated	3	Approved in China, U.A.E., Bahrain. Emergency use in Egypt, other countries.
Sinovac	Inactivated	3	Approved in China. Emergency use in Brazil, other countries.
Sinopharm-Wuhan	Inactivated	3	Limited use in China, U.A.E.
Bharat Biotech	Inactivated	3	Emergency use in India.

Coronavirus Vaccine Tracker

By Carl Zimmer, Jonathan Corum and Sui-Lee Wee Updated Feb. 23, 2021

https://www.nytimes.com/interactive/2020/science/coronavirus-vaccine-tracker.html

Covid-19 Cautious?

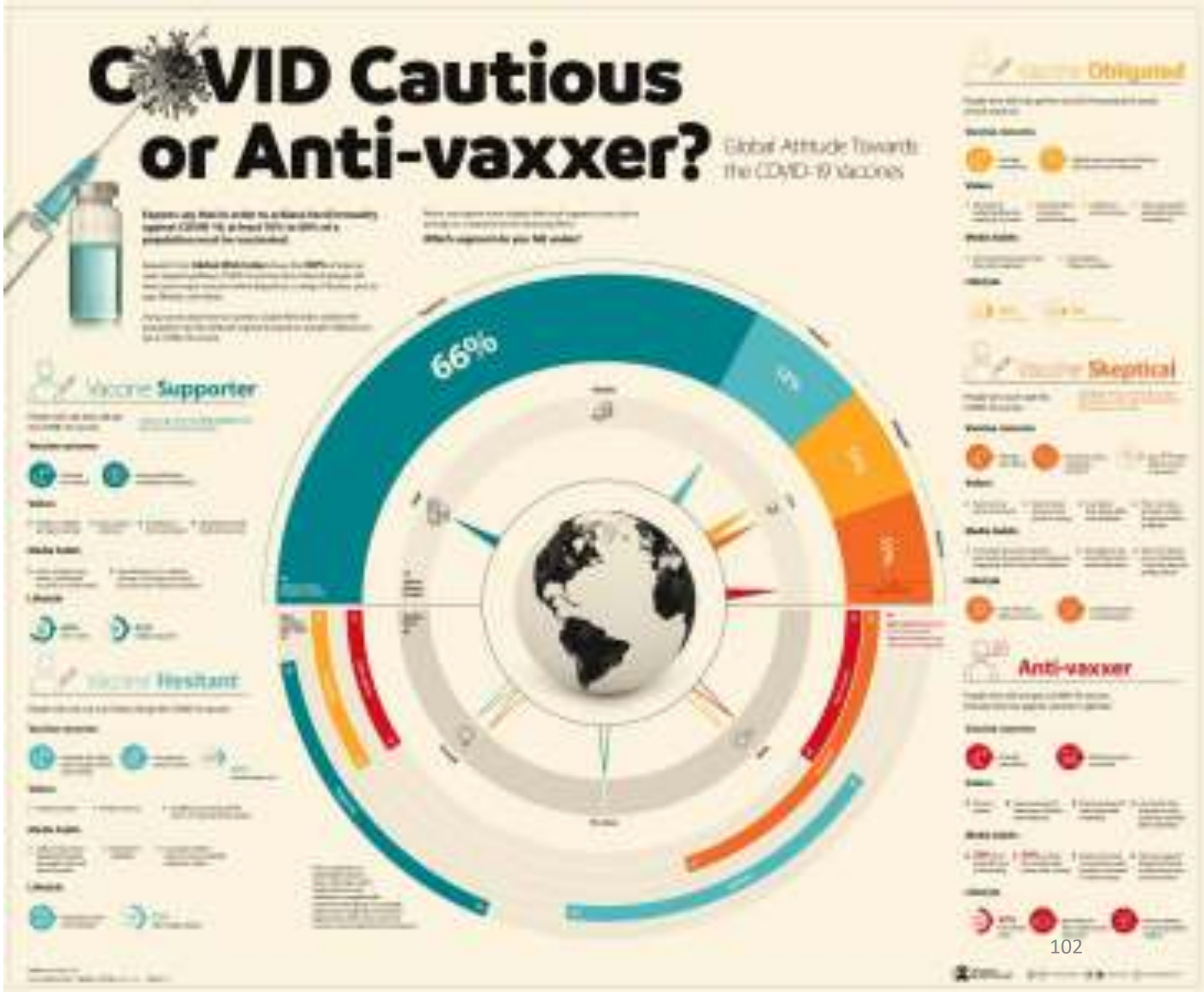
Vaccine supporter (will get the Covid-19 vaccine) = 66%

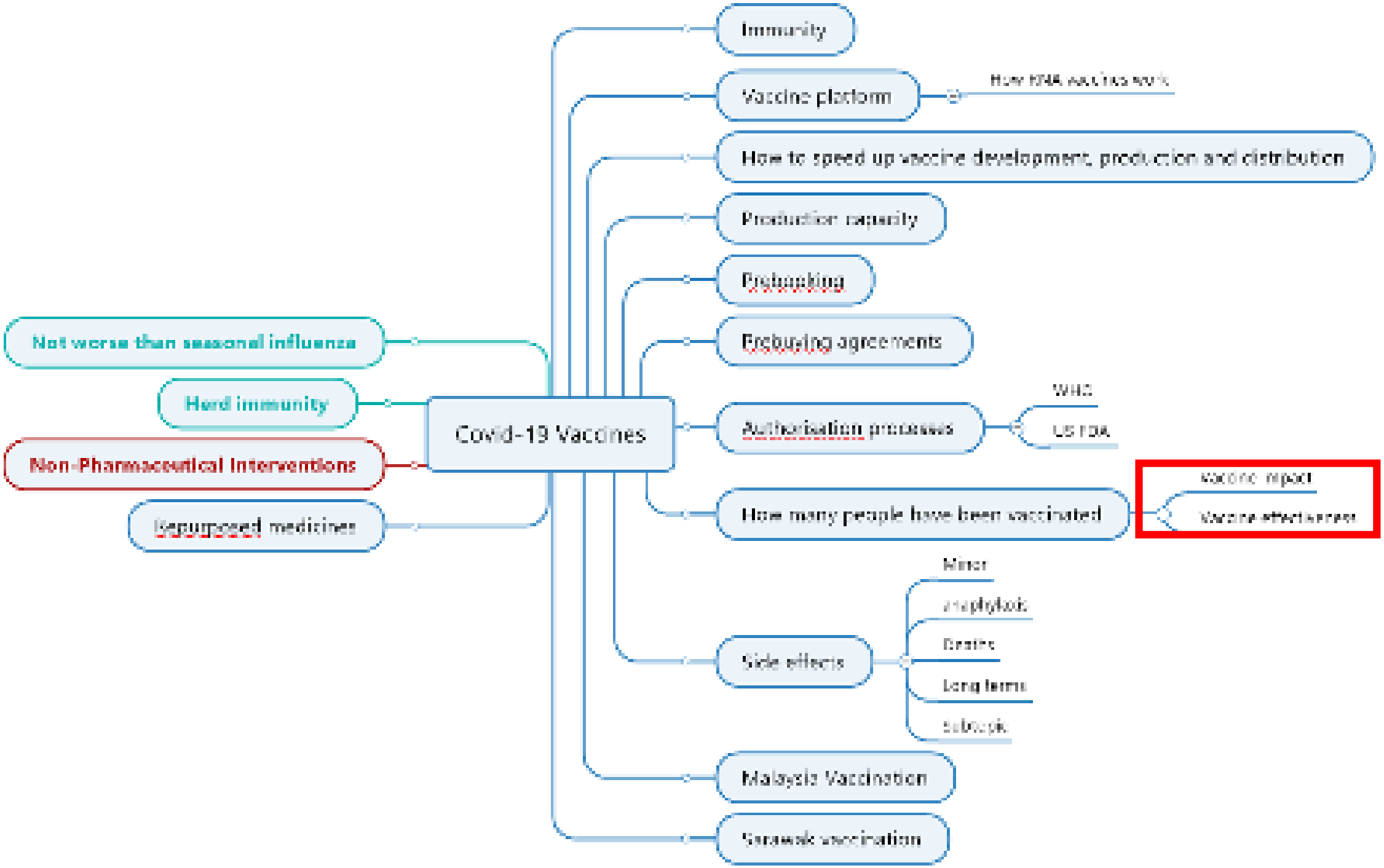
Vaccine Hesitant (not sure whether they will get the vaccine) =12%

Vaccine obligated (will only get the vaccine if necessary for travel, school, work, etc) = 11%

Vaccine skeptical (won't get Covid-19 vaccine) = 11%
Out of this,
Antivaxxer (won't get any vaccines in general) = **1.4%**

https://www.visualcapitalist.com/wp-content/uploads/2021/02/attitudes-covid-19-vaccines-full.html
Accessed on 24 Feb 2021

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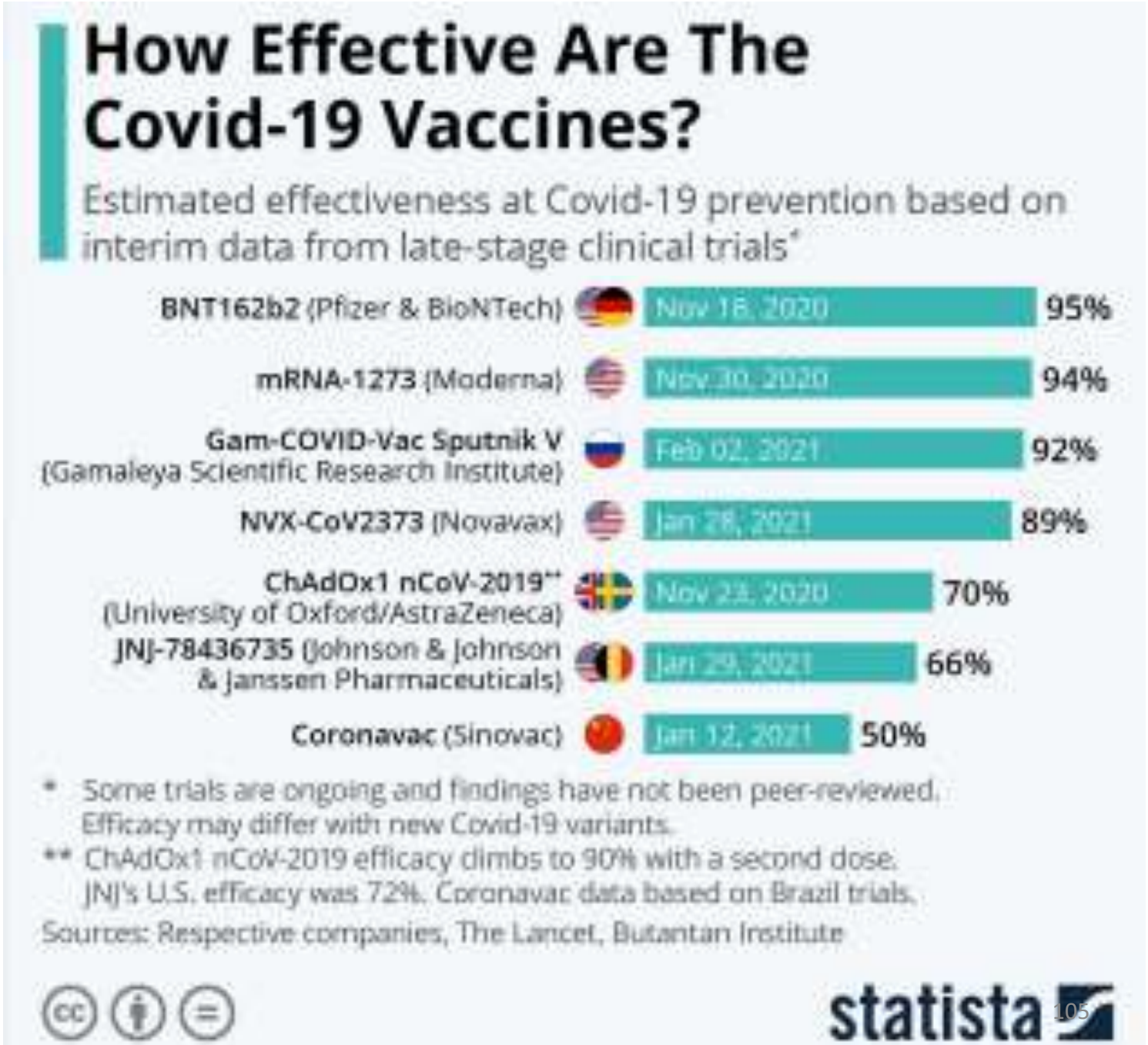
Vaccine Efficacy

https://www.statista.com/chart/23510/estimated-effectiveness-of-covid-19-vaccine-candidates/



Leading Covid-19 Vaccines

Developer	Country	Clinical phase	Efficacy	Doses	Approved in at least one country	Approved in United States
CanSino	China	3		1	Yes	
Sinopharm (Beijing)	China	3	79%	2	Yes	
Sinopharm (Wuhan)	China	3			Yes	
Sinovac	China	3	50%	2	Yes	
Bharat	India	3		2	Yes	
Gamaleya	Russia	3	92%	2	Yes	
Vector Institute	Russia	3		2	Yes	
Oxford-AstraZeneca	United Kingdom, Sweden	3	62%–90%*	2	Yes	
Pfizer-BioNTech	United States, Germany	2 and 3	95%	2	Yes	Yes
Johnson & Johnson	United States	2 and 3	57%–85%**	1		
Moderna	United States	3	95%	2	Yes	Yes
Novavax	United States	3	89%	2		

*Efficacy depends on dosage. **Efficacy depends on severity of infection and on COVID-19 variant.

Source: New York Times.

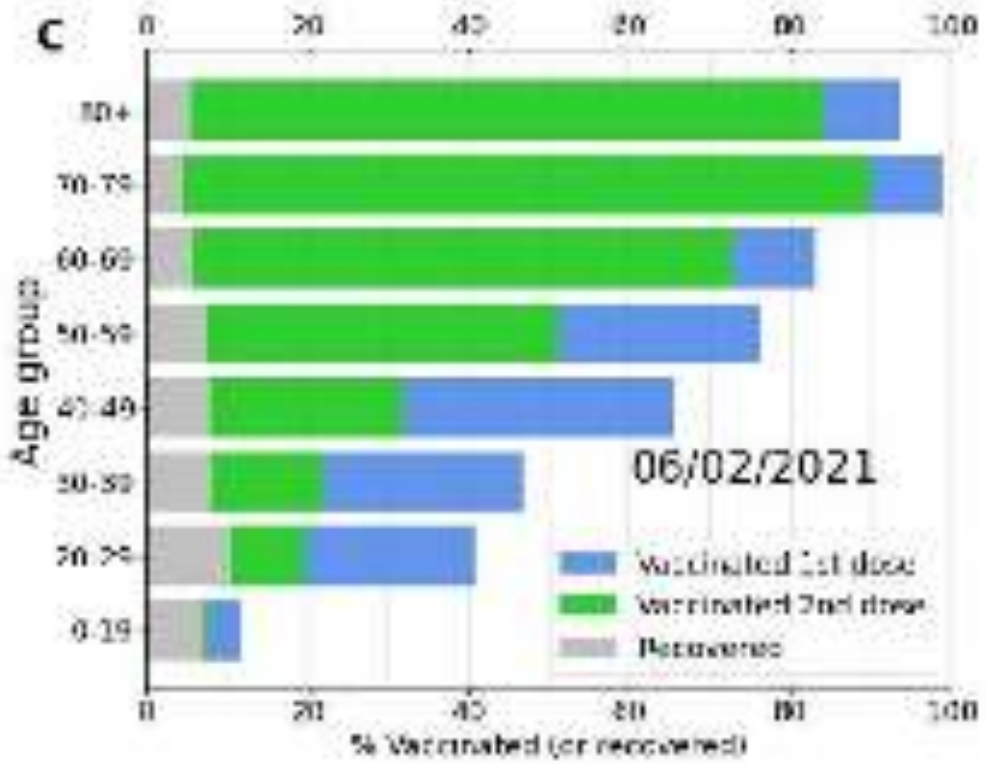
Claire Felter. Last updated February 5, 2021. **A Guide to Global COVID-19 Vaccine Efforts. https://www.cfr.org/backgrounder/guide-global-covid-19-vaccine-efforts**

How Effective is the vaccine in real-life conditions

Israel's Covid-19 Vaccination

- The national vaccination campaign has led Israel to be the country with the **highest rate of vaccinated individuals per capita, with 45.3% and 29.7% of the population having received the first or the second vaccine dose,** respectively, or recovered from COVID-19, to date (February 6, 2021).
- In parallel, during the early weeks of the vaccination campaign, the number of cases and hospitalized patients has rapidly increased, along with the local emergence of the B117 variant 9, leading the government to impose a third lockdown on 8th of January 2021

Vaccinated or recovered percentage per age group.



Hagai Rossman, et al. (2021.02.09). Patterns of COVID-19 pandemic dynamics following deployment of a broad national immunization program. https://www.medrxiv.org/content/10.1101/2021.02.08.21251325v1.full.pdf

Real-life Effects of the Vaccines in Israel

- Assessing the real-life effect of the vaccines,
  - in order to show that the high efficacy observed under ideal clinical trial conditions is also seen in routine care, is highly important.
- This can be analysed by either assessing the real-life impact of vaccination programmes at a population level (termed “vaccine impact” (VI))
- or by assessing the direct protective effect of the vaccine at the individual level (termed “vaccine effectiveness” (VE)) 10.

Hagai Rossman, et al. (2021.02.09). Patterns of COVID-19 pandemic dynamics following deployment of a broad national immunization program. https://www.medrxiv.org/content/10.1101/2021.02.08.21251325v1.full.pdf

Covid-19 Vaccine Effectiveness at the real-life Setting

- On the individual level,
  - a first report from one of the largest Israeli health maintenance organizations (HMO's) concluded an effectiveness of
    - 51% for the first dose of BNT162b2 vaccine
    - after 13-24 days in a real-life setting

Hagai Rossman, et al. (2021.02.09). Patterns of COVID-19 pandemic dynamics following deployment of a broad national immunization program. https://www.medrxiv.org/content/10.1101/2021.02.08.21251325v1.full.pdf

Vaccine Impact of Covid-19 Vaccination in Israel

- approximately one and a half month after the initiation of the vaccination campaign,
- with 80% of individuals older than 60 years old already vaccinated (February 6th, 2021),
- there was an approximately
  - 49% drop in number of cases,
  - 36% drop in COVID-19 related hospitalizations, and
  - 29% drop in critically ill patients **compared to 21 days ago**.

- multiple other factors may have influenced these results,
  - several observations suggest that these patterns are driven to a considerable degree by the vaccines.

Hagai Rossman, et al. (2021.02.09). Patterns of COVID-19 pandemic dynamics following deployment of a broad national immunization program. https://www.medrxiv.org/content/10.1101/2021.02.08.21251325v1.full.pdf

Vaccine Impact of Covid-19 Vaccination in Israel

- Notably, although previous reports have indicated that efficacy of the vaccine is already evident after the first dose,
  - the improvement in the number of new cases and hospitalized patients has occurred only 21 days following the vaccination campaign

Hagai Rossman, et al. (2021.02.09). Patterns of COVID-19 pandemic dynamics following deployment of a broad national immunization program. https://www.medrxiv.org/content/10.1101/2021.02.08.21251325v1.full.pdf

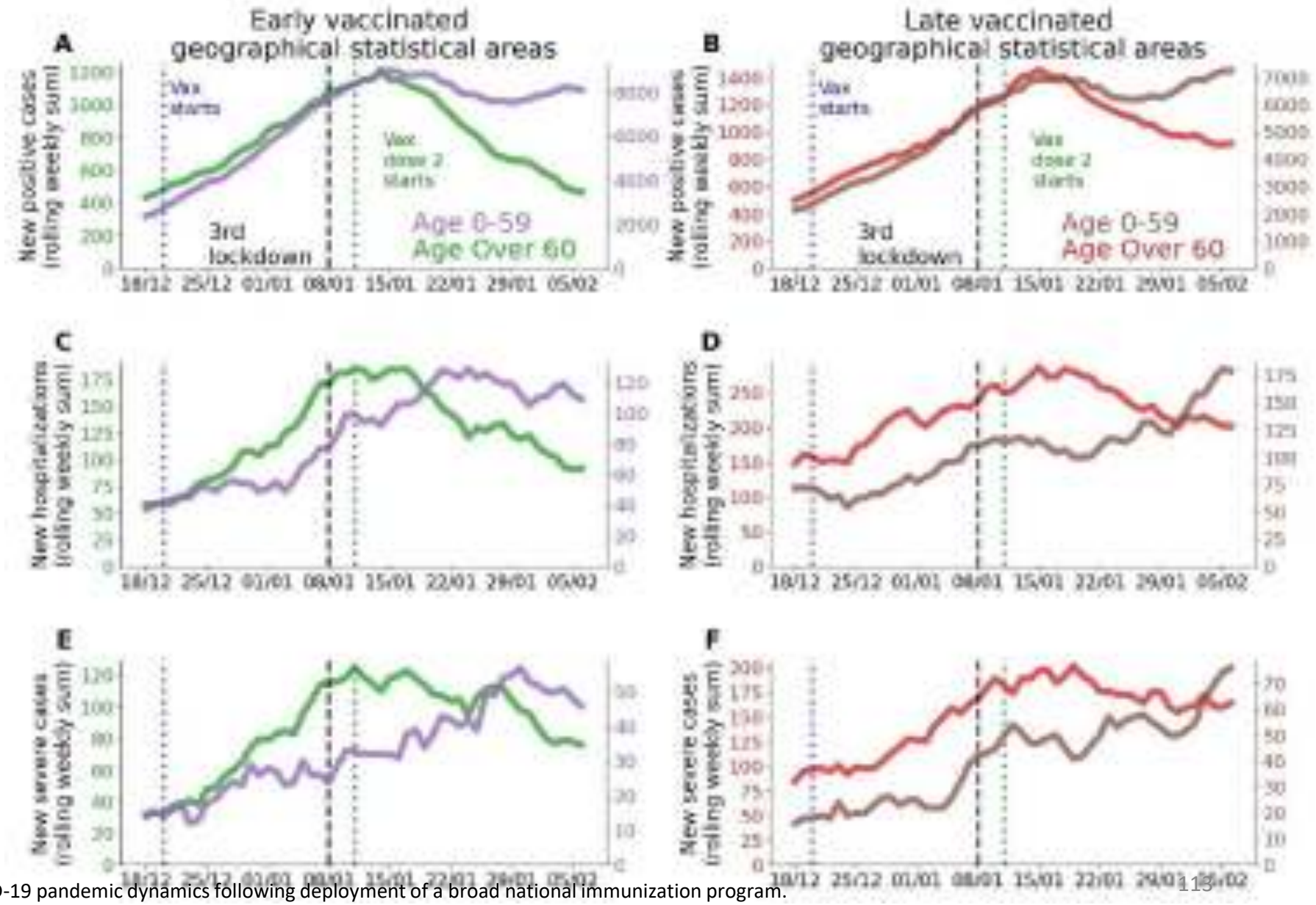
Impact of Covid-19 Vaccination in Israel

Comparison between age groups 0-59 years old and 60+ years old from early- and late-vaccinated Geographical Statistical Areas (GSAs).

In all figures the initiation of the vaccination campaign is shown as a dashed purple line, the third lockdown start

date is shown as a dashed black line and the date in which individuals have started to receive the 2nd dose of the

vaccine is marked as a dashed green line.



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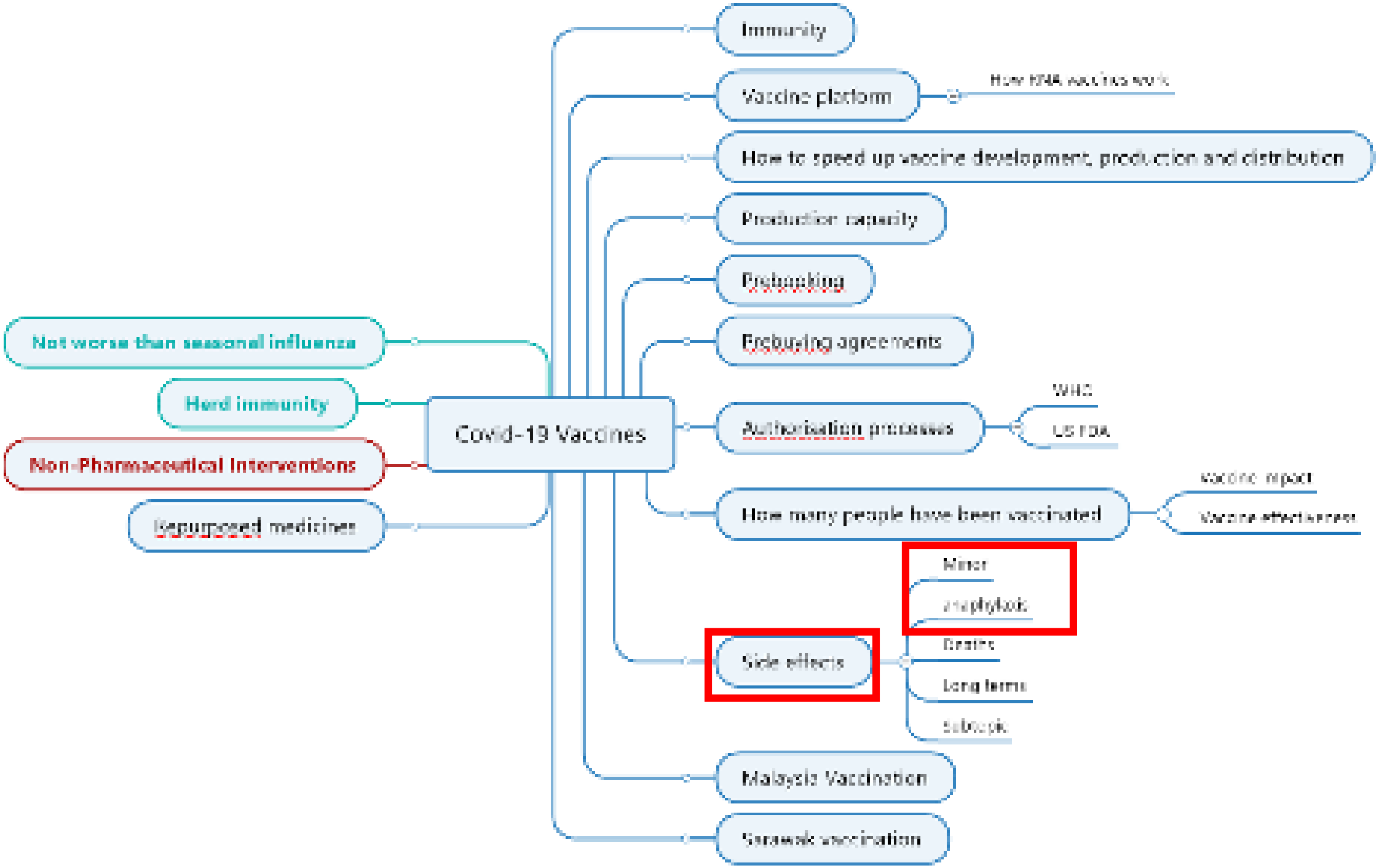
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Adverse Reactions of the Pfizer Vaccine

How often did allergic reactions occur?

- A summary of the study is as follows:
- As of December 23, 2020, **1,893,360 doses** of the Pfizer COVID-19 vaccine were given.
- There were **4,393 (0.2%) adverse events** reported.
- There were **175 cases of possible allergic reactions.**
- After further review,
  - 86 were non-anaphylactic,
  - 61 were not an allergic reaction, and
  - 7 are still under review

https://www.oakbrookallergists.com/2021/01/07/allergic-reactions-to-pfizer-covid-19-vaccine/
Oak Brook Allergist (2021.01.07). New Study on Allergic Reactions to the Pfizer COVID-19 Vaccine

Anaphylaxis due to after receiving Pfizer vaccine

- Overall, **21 cases were determined to be anaphylaxis**.
- The reaction occuring within 15 minutes of vaccinations with 71% of these cases.
- The rate of anaphylaxis to this point is estimated to be **11.1 per 1 million doses (approximately 1 per 100,000)**.
- So far, **17 of the 21 cases were in people with a documented history of allergies or allergic reactions.**
  - Seven people had a history of anaphylaxis.
- Of these 21 people who experienced anaphylaxis, all of them recovered.

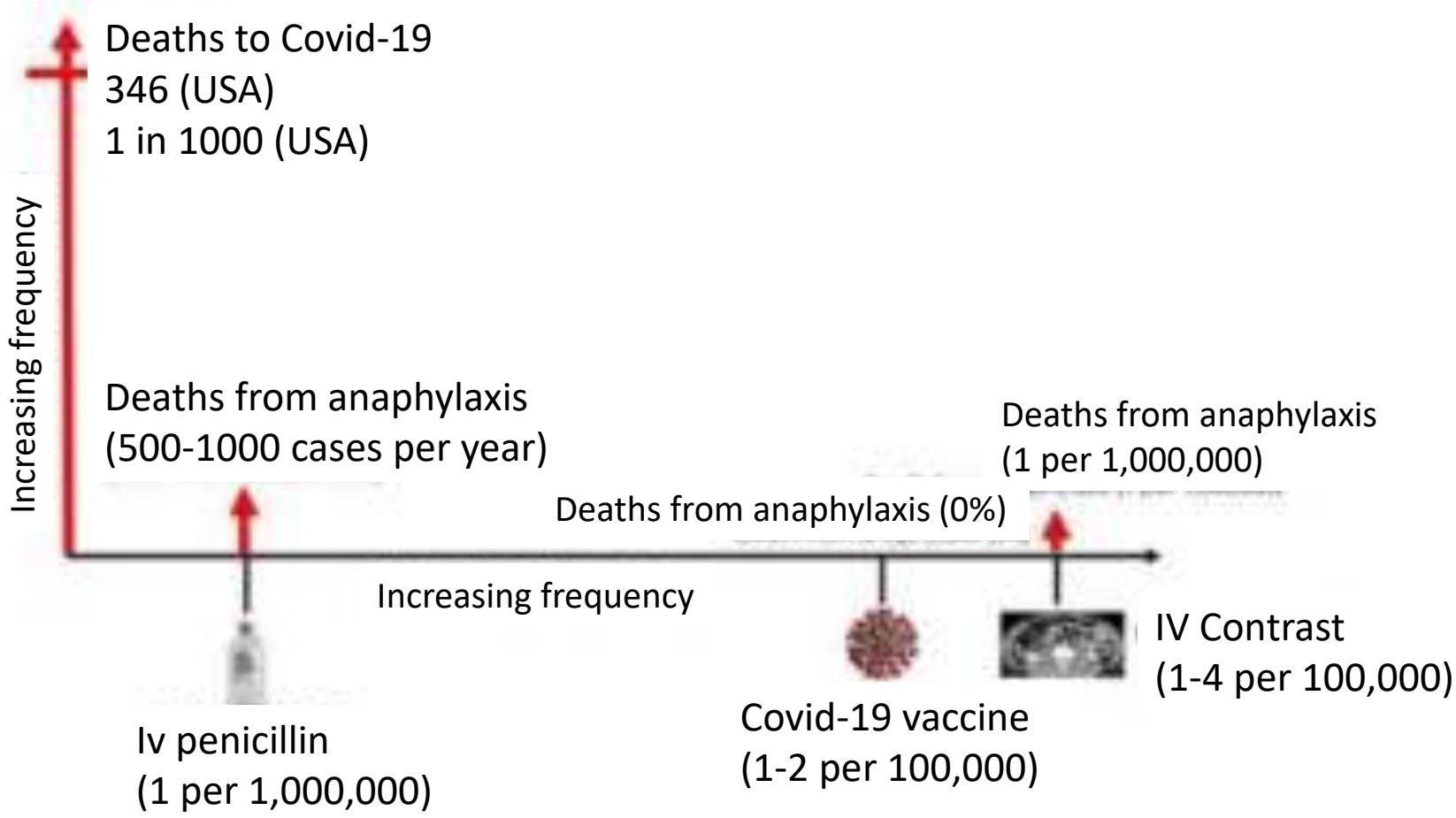
https://www.oakbrookallergists.com/2021/01/07/allergic-reactions-to-pfizer-covid-19-vaccine/
Oak Brook Allergist (2021.01.07). New Study on Allergic Reactions to the Pfizer COVID-19 Vaccine

Pfizer Vaccine versus Influenza Vaccine

- **Putting these reactions into context**
- This report shows that the rate of severe allergic reactions to this vaccine are very rare.
- The rate of anaphylaxis to the influenza vaccine and intravenous penicillin is 1 per 1 million doses.
- The image in the next slide puts into context the rate of anaphylaxis to this vaccine compared to the death rate in the United States.

https://www.oakbrookallergists.com/2021/01/07/allergic-reactions-to-pfizer-covid-19-vaccine/
Oak Brook Allergist (2021.01.07). New Study on Allergic Reactions to the Pfizer COVID-19 Vaccine

How often do we see anaphylaxis?



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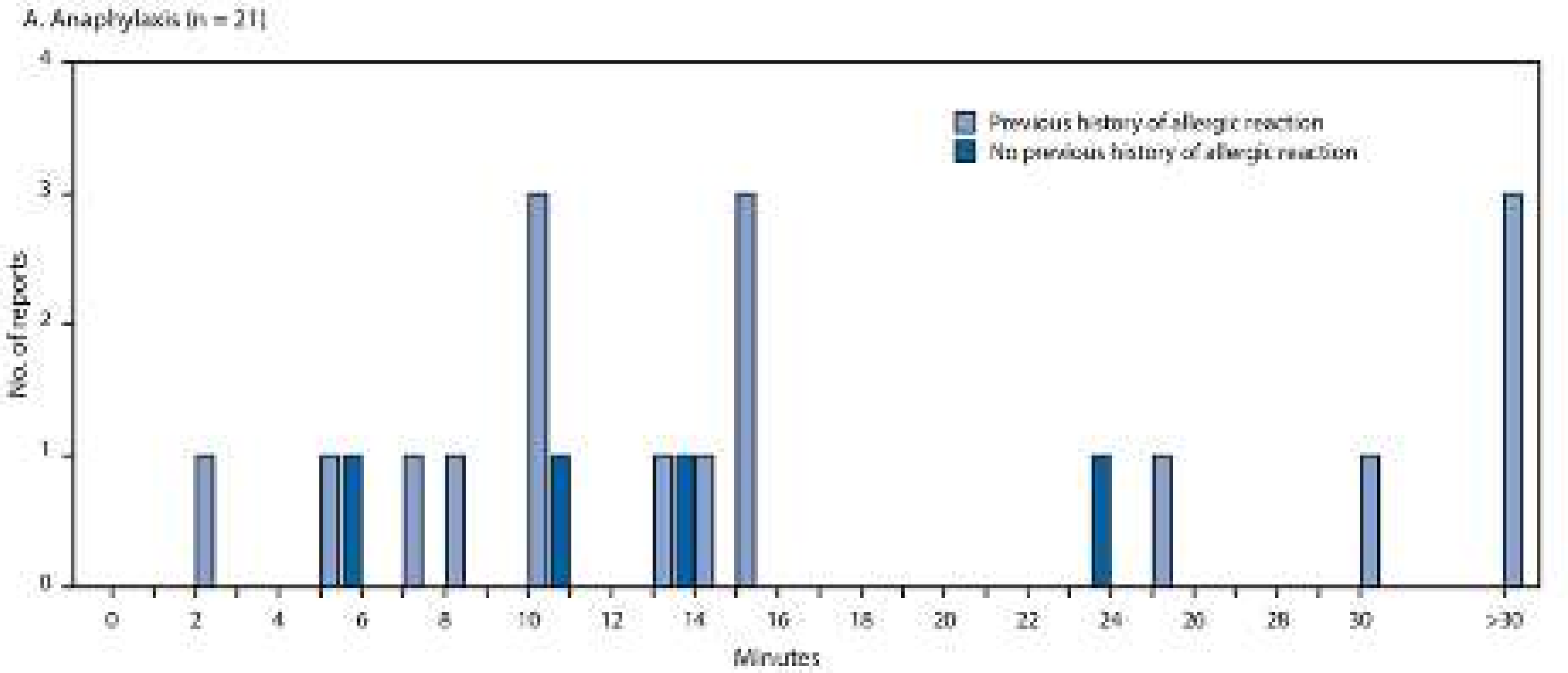
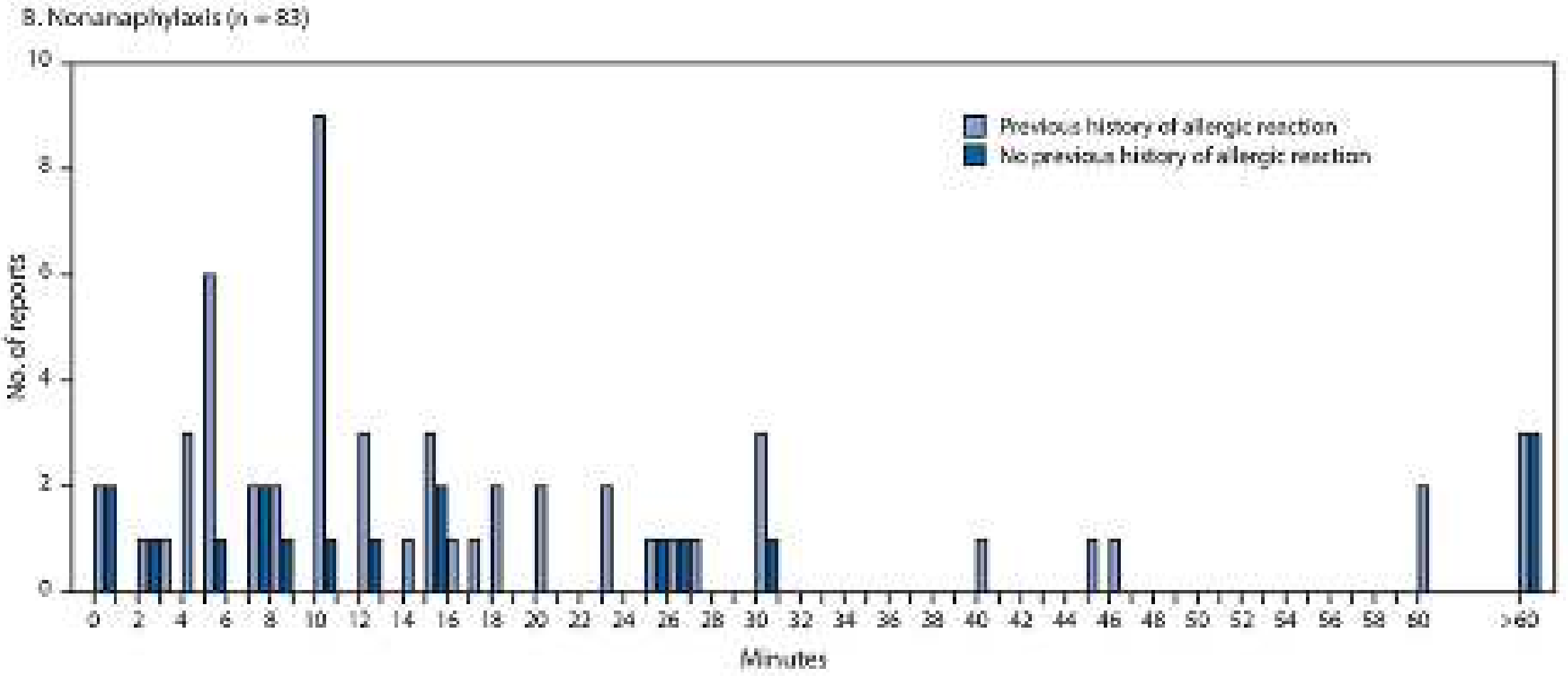
vaccine receipt to onset of anaphylaxis (A)* and nonanaphylaxis allergic reactions (B)† after receipt of Pfizer-BioNTech COVID-19 vaccine — Vaccine Adverse Events Reporting System, United States, December 14–23, 2020



Allergic Reactions Including Anaphylaxis After Receipt of the First Dose of Pfizer-BioNTech COVID-19 Vaccine — United States, December 14–23, 2020. MMWR Morb Mortal Wkly Rep 2021;70:46–51. DOI: http://dx.doi.org/10.15585/mmwr.mm7002e1external

vaccine receipt to onset of anaphylaxis (A)* and nonanaphylaxis allergic reactions (B)† after receipt of Pfizer-BioNTech COVID-19 vaccine — Vaccine Adverse Events Reporting System, United States, December 14–23, 2020



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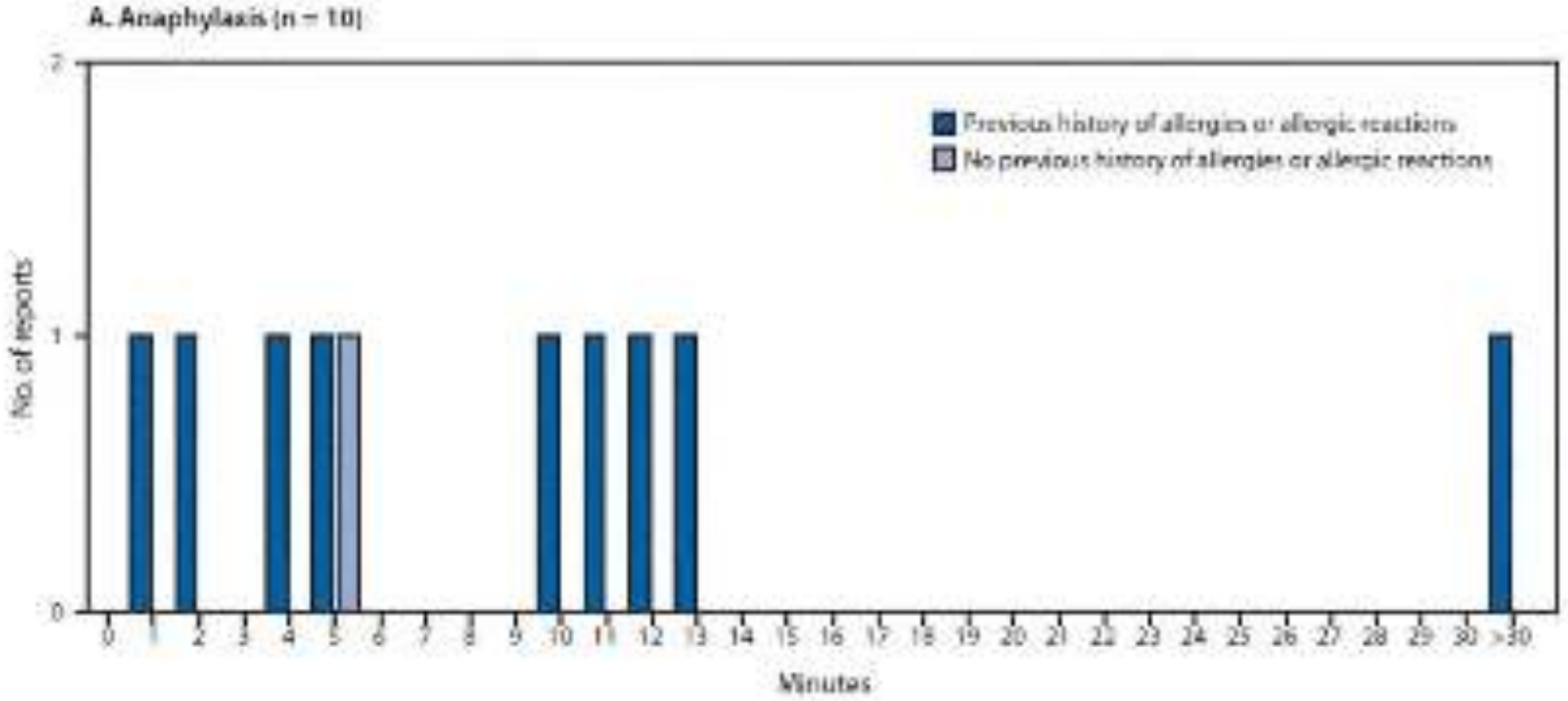
Adverse Reactions to the Moderna Vaccine

Moderna Vaccine

- **What is already known about this topic?**
- Anaphylaxis is a severe, life-threatening allergic reaction that occurs rarely after vaccination.
- **What is added by this report?**
- During December 21, 2020–January 10, 2021, monitoring by the Vaccine Adverse Event Reporting System detected 10 cases of anaphylaxis after administration of a reported 4,041,396 first doses of Moderna COVID-19 vaccine (2.5 cases per million doses administered).
- In nine cases, onset occurred within 15 minutes of vaccination.
- No anaphylaxis-related deaths were reported.

Allergic Reactions Including Anaphylaxis After Receipt of the First Dose of Moderna COVID-19 Vaccine — United States, December 21, 2020–January 10, 2021. MMWR Morb Mortal Wkly Rep 2021;70:125–129. DOI: http://dx.doi.org/10.15585/mmwr.mm7004e1external icon

Minutes from vaccine receipt to onset of anaphylaxis (A)* and nonanaphylaxis allergic reactions (B)† after receipt of the first dose of Moderna COVID-19 vaccine — Vaccine Adverse Events Reporting System (VAERS), United States, December 21, 2020–January 10, 2021



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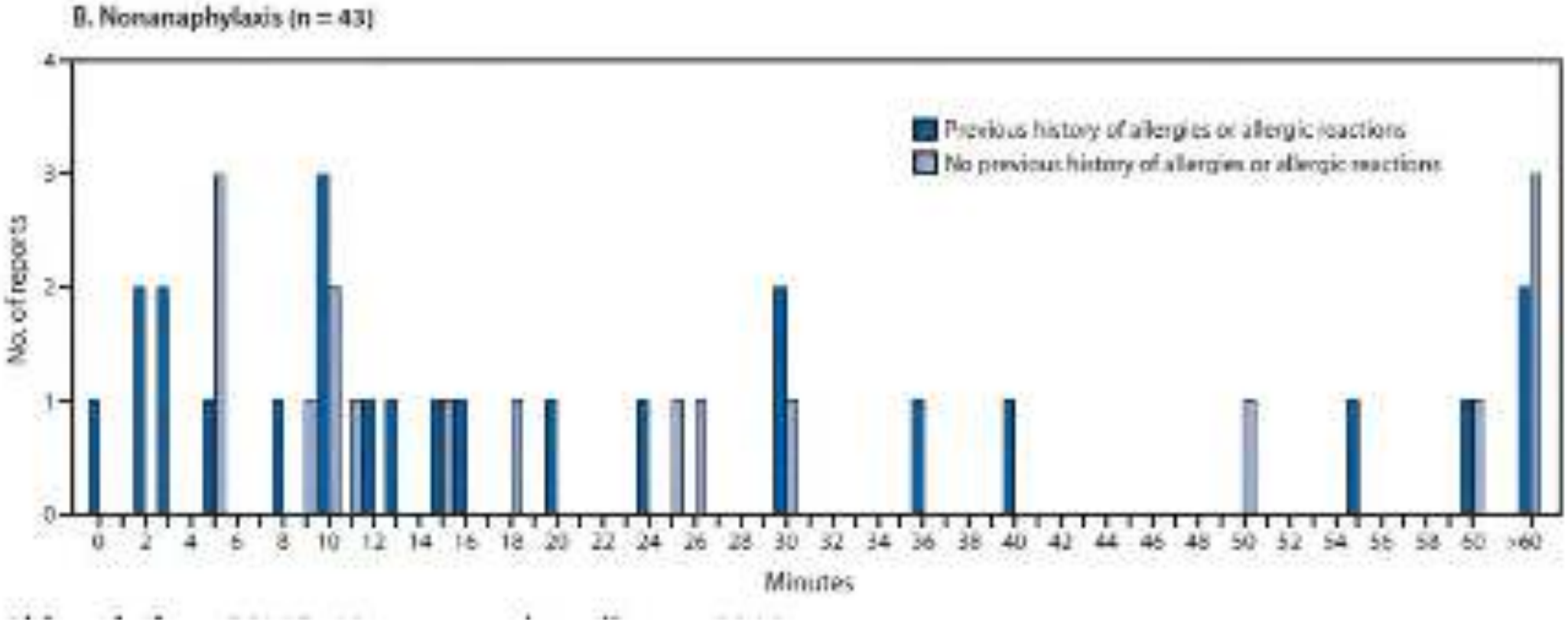

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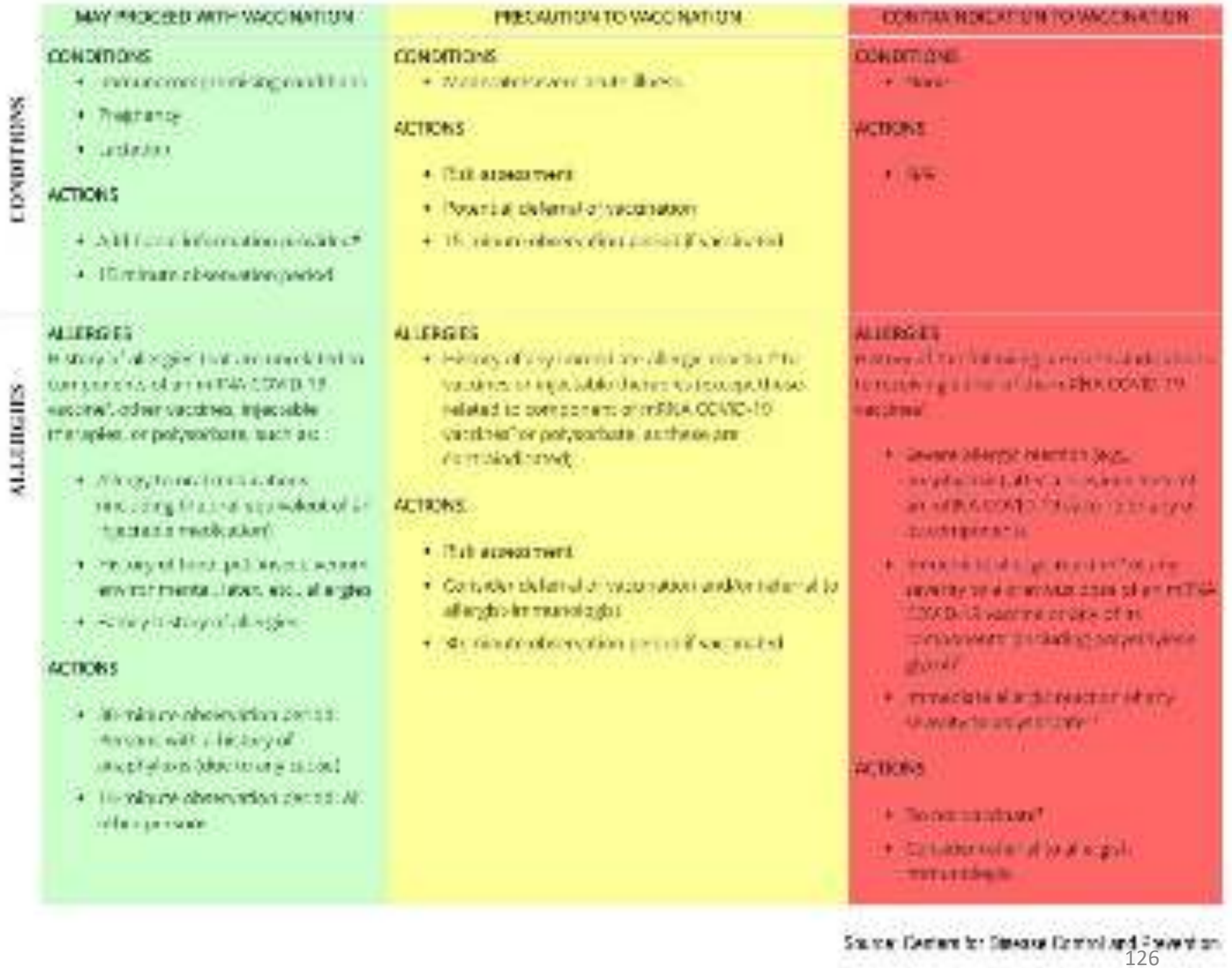
US,CDC checklist prior to Covid-19 Vaccination



What About the Side Effects

Yellow Card Reporting in the UK

Medicines & Healthcare products Regulatory Agency

MHRA
Regulating Medicines and Medical Devices

Coronavirus Vaccine - summary of Yellow Card reporting

Data included: 09/12/2020 to 07/02/2021

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/962432/Coronavirus_vaccine_-_summary_of_Yellow_Card_reporting.pdf

UK's Covid-19 Vaccination Programme

- In UK by week ending 07 February 2021,
  - at least 12,294,006 people have received their first vaccination
    - (an estimated 7.5 million first doses of the Pfizer/BioNTech vaccine and
    - 5 million doses of the Oxford University/AstraZeneca Vaccine)
  - with 512,581 second doses administered.

- The current priority groups of the immunisation campaign include
  - people over the age of 70 years,
  - care home residents and workers, and
  - frontline health and social care workers.

Medicines and Healthcare Products Regulatory Agency. Coronavirus (covid-19) vaccine adverse reactions. 2021. https://www.gov.uk/government/publications/coronavirus-covid-19-vaccine-adverse-reactions Accessed on 25 Feb 2021

UK's Yellow Card Scheme

- The Yellow Card scheme is a mechanism by which anybody can voluntarily report any suspected adverse reactions or side effects to the vaccine.
- It is very important to note that a Yellow Card report does not necessarily mean the vaccine caused that reaction or event.
- We ask for any suspicions to be reported, even if the reporter isn't sure if it was caused by the vaccine.
- Reports to the scheme are known as suspected adverse reactions (ADRs).
- The primary purpose of Yellow Card reporting is to detect new safety concerns.

Medicines and Healthcare Products Regulatory Agency. Coronavirus (covid-19) vaccine adverse reactions. 2021. https://www.gov.uk/government/publications/coronavirus-covid-19-vaccine-adverse-reactions Accessed on 25 Feb 2021

Overall Reporting Rate of the Yellow Card

- The overall reporting rate is in the order of 3 to 4 Yellow Cards per 1,000 doses administered for both vaccines.
- It is known from the clinical trials that the more common side effects for both vaccines can occur at a rate of more than one in 10 doses
- (for example, local reactions or symptoms resembling transient flu-like symptoms).

Medicines and Healthcare Products Regulatory Agency. Coronavirus (covid-19) vaccine adverse reactions. 2021. https://www.gov.uk/government/publications/coronavirus-covid-19-vaccine-adverse-reactions Accessed on 25 Feb 2021

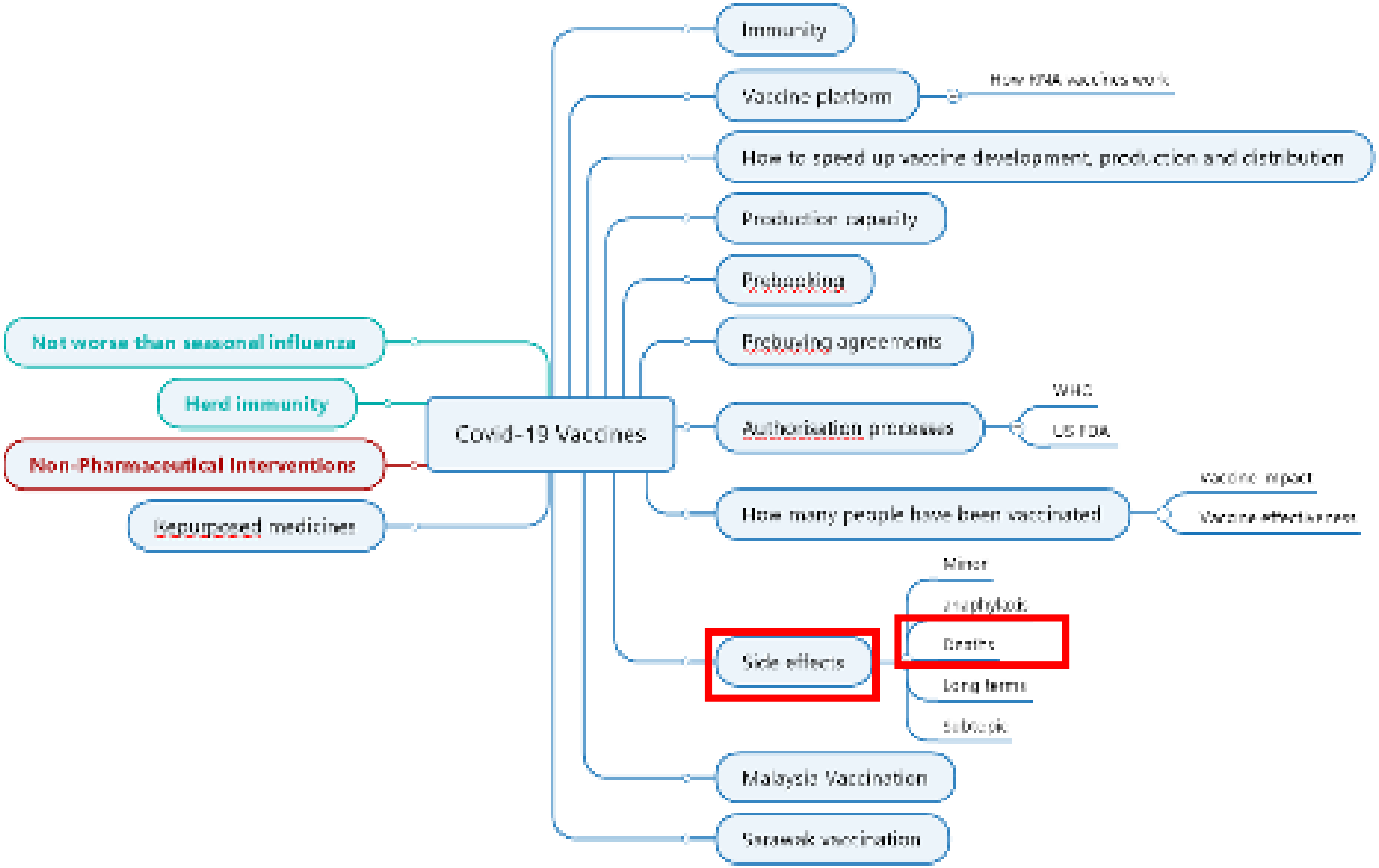
Types of Adverse Reactions Reported

- For both vaccines, detailed review of all reports has found that the overwhelming majority relate to
  - injection-site reactions
    - (sore arm for example) and
  - generalised symptoms
    - such as a ‘flu-like’ illness, headache, chills, fatigue (tiredness), nausea (feeling sick), fever, dizziness, weakness, aching muscles, and rapid heartbeat.
- Generally, these happen shortly after the vaccination and are not associated with more serious or lasting illness.

Medicines and Healthcare Products Regulatory Agency. Coronavirus (covid-19) vaccine adverse reactions. 2021. https://www.gov.uk/government/publications/coronavirus-covid-19-vaccine-adverse-reactions Accessed on 25 Feb 2021

- These types of reaction reflect the acute immune response triggered by the body to the vaccines,
  - are typically seen with most types of vaccine and tend to resolve within a day or two.
- The nature of reported suspected ADRs across all ages is broadly similar,
- although, as seen in the clinical trials and as is usually seen with other vaccines, they may be reported more frequently in younger adults.

Medicines and Healthcare Products Regulatory Agency. Coronavirus (covid-19) vaccine adverse reactions. 2021. https://www.gov.uk/government/publications/coronavirus-covid-19-vaccine-adverse-reactions Accessed on 25 Feb 2021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Vaccine impact
Vaccine effectiveness
Side effects
Mild
Anaphylaxis
Deaths
Long term
Malaysia Vaccination
Seroweek vaccination

Deaths Among the Elderly in Norway

Deaths in Norway

- On January 14, 2021 the Norwegian Medicines Agency (Noma) reported that 23 people had died after receiving their first dose of the Pfizer/BioNTech vaccine.
- Those who died were described as having severe underlying health conditions and were all aged 75 or over.
- (The number of deaths has since risen to 33, out of about 55,000 people who have received the first dose of the vaccine in the country.)
- The deaths made international headlines, raising alarm that the (typically mild) side effects of the vaccine could cause the elderly who receive it to die

Grace Browne (2021.01.26). **Norway's elderly Covid-19 vaccine deaths aren't what they seem. https://www.wired.co.uk/article/norway-deaths-coronavirus-vaccine**

Deaths in Norway

- on January 19, 2021, the Norwegian Institute of Public Health released a statement saying that no link had been established between Pfizer/BioNTech's vaccine and any post-vaccination deaths in the country.
- The World Health Organisation (WHO) echoed the sentiment in a statement on January 22, saying that it saw no evidence that the vaccine had contributed to the deaths.

Grace Browne (2021.01.26). **Norway's elderly Covid-19 vaccine deaths aren't what they seem. https://www.wired.co.uk/article/norway-deaths-coronavirus-vaccine**

Deaths in Norway

- Determining whether the Norwegian deaths are truly a cause for concern means putting these seemingly scary numbers into context.
- In Norway, an estimated 45 people die in nursing homes or similar institutions every day.
- The country also has a low threshold for reporting adverse vaccination reactions, encouraging healthcare providers to report possible reactions even when any causal relationship is very unclear.

Grace Browne (2021.01.26). **Norway's elderly Covid-19 vaccine deaths aren't what they seem. https://www.wired.co.uk/article/norway-deaths-coronavirus-vaccine**

Shouldn’t We Worry About Antibody-Dependent Enhancement (ADE)?

Antibody-Dependent Enhancement (ADE) in Dengue

- If a person is infected by one serotype of dengue virus,
  - they typically have mild disease and generate a protective immune response,
  - including neutralizing antibodies, against that serotype.
- But, if that person is infected with a second serotype of dengue virus,
  - the neutralizing antibodies generated from the first infection may bind to the virus
  - and actually increase the virus's ability to enter cells,
  - resulting in ADE and causing a severe form of the disease, called dengue hemorrhagic fever.

Paul A. Offit, and Heather Monk Bodenstab (2021.01.25). **Antibody-dependent Enhancement (ADE) and Vaccines**
https://www.chop.edu/centers-programs/vaccine-education-center/vaccine-safety/antibody-dependent-enhancement-and-vaccines

Might COVID-19 vaccines sensitize humans to antibody-dependent enhanced (ADE) breakthrough infections?

- This is unlikely because coronavirus diseases in humans lack the
  - clinical,
  - epidemiological,
  - biological, or
  - pathological attributes of ADE disease exemplified by dengue viruses (DENV).
- In contrast to DENV, SARS and MERS CoVs predominantly infect respiratory epithelium, not macrophages.

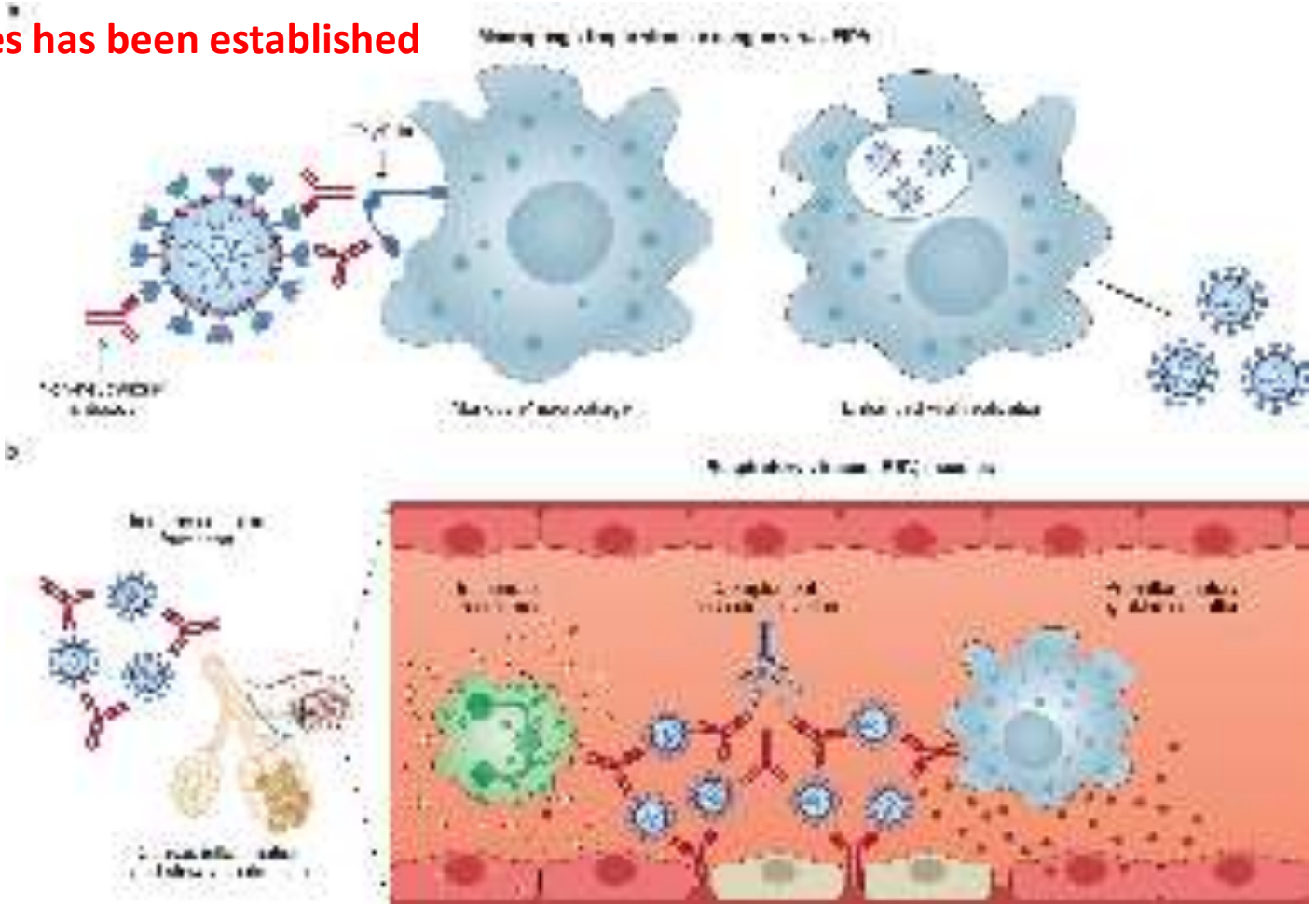
Scott B Halstead and Leah Katzelnick (2020.11.13). **COVID-19 Vaccines: Should We Fear ADE?**
J Infect Dis. 2020 Nov 13;222(12):1946-1950. doi: 10.1093/infdis/jiaa518.

Two main Antibody Dependent Enhancement (ADE) mechanisms in viral disease.

No definitive role for ADE in human coronavirus diseases has been established

a, For macrophage-tropic viruses such as dengue virus and FIPV, non-neutralizing or sub-neutralizing antibodies cause increased viral infection of monocytes or macrophages via FcγRIIa-mediated endocytosis, resulting in more severe disease.

b, For non-macrophage-tropic respiratory viruses such as RSV and measles, non-neutralizing antibodies can form immune complexes with viral antigens inside airway tissues, resulting in the secretion of pro-inflammatory cytokines, immune cell recruitment and activation of the complement cascade within lung tissue. The ensuing inflammation can lead to airway obstruction and can cause acute respiratory distress syndrome in severe cases. COVID-19 immunopathology studies are still ongoing and the latest available data suggest that human macrophage infection by SARS-CoV-2 is unproductive.



Lee, W.S., Wheatley, A.K., Kent, S.J. *et al.* (2020.09.09) Antibody-dependent enhancement and SARS-CoV-2 vaccines and therapies. *Nat Microbiol* **5,** 1185–1191 (2020). https://doi.org/10.1038/s41564-020-00789-5

Will the Vaccines be Effective Against the New Variants?

RNA Viruses Change Frequently

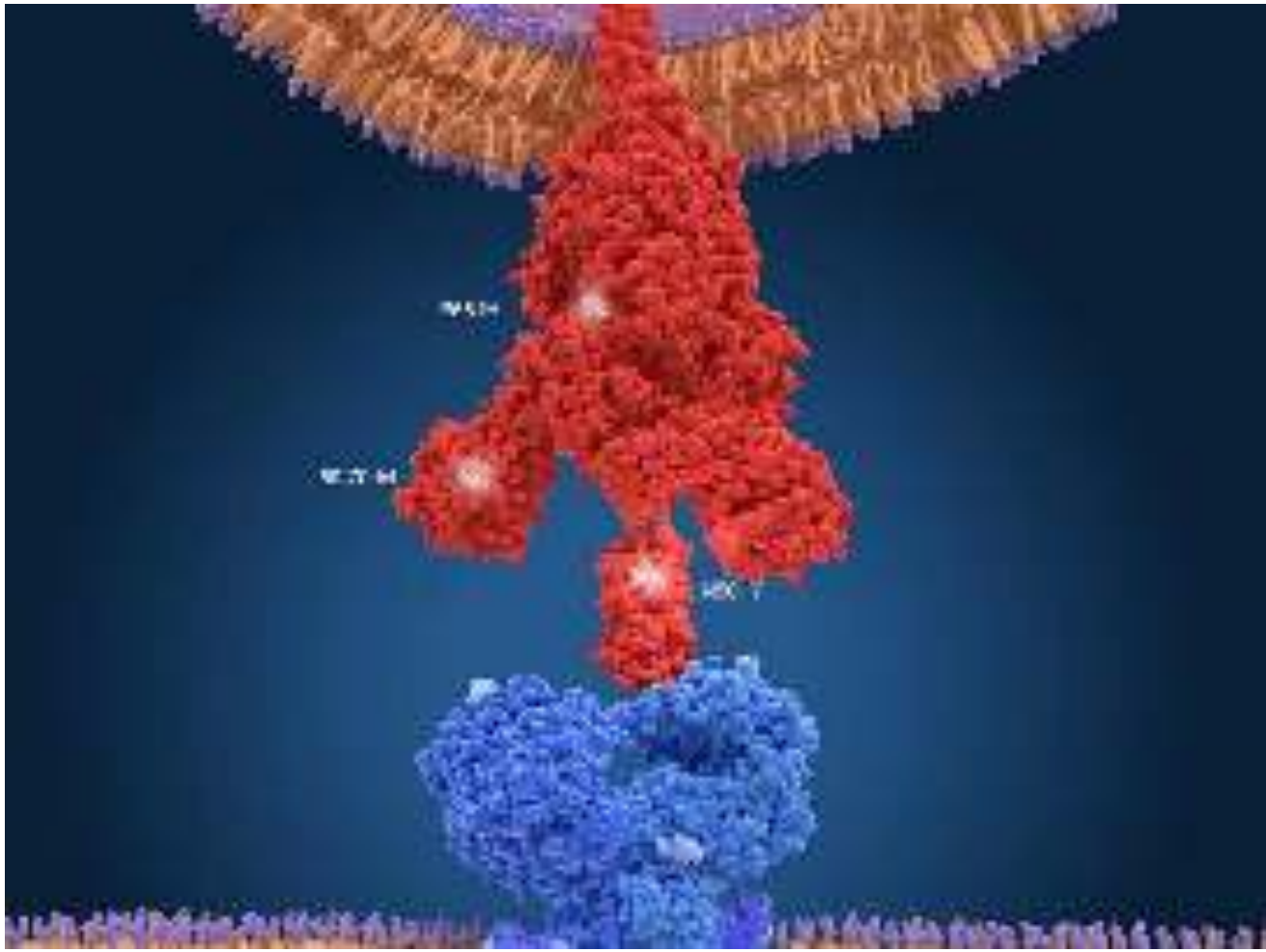
- The genetic material of all viruses is encoded in either DNA or RNA;
  - one interesting feature of RNA viruses is that they change much more rapidly than DNA viruses.
- Every time they make a copy of their genes they make one or a few mistakes.
- This is expected to occur many times within the body of an individual who is infected with COVID-19.

Richard Kuhn (2021.02.03). Coronavirus variants, viral mutation and COVID-19 vaccines: The science you need to understand. https://theconversation.com/coronavirus-variants-viral-mutation-and-covid-19-vaccines-the-science-you-need-to-understand-153771

New variant of the SARS-CoV-2 coronavirus

The U.K. variant, known as B.1.1.7., seems to **bind more tightly to the protein receptor** called ACE2, which is on the surface of human cells.

The South African variant, known as 501.V2, *has multiple mutations in the gene that encodes the spike protein*. These mutations **help the virus evade an antibody response**.



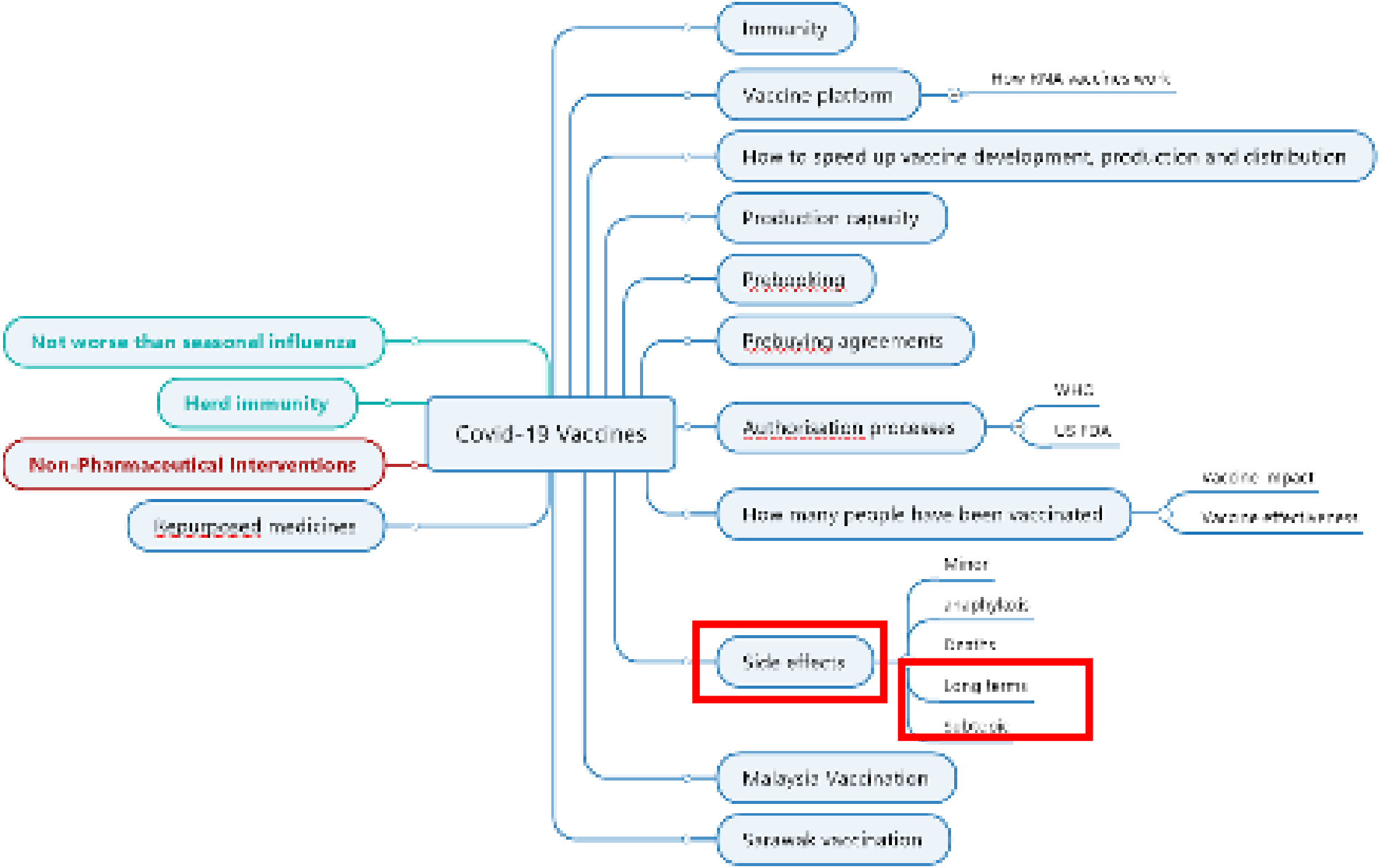
The new variant of the SARS-CoV-2 coronavirus, B.1.1.7., was first identified in the U.K. in December. The red object is a spike protein of the coronavirus, and it interacts with the (blue) ACE2 receptor on the human cell to infect it. The mutations of the new variant are labeled, showing their position on the spike protein. Juan Gaertner/Science Photo Library via Getty Images

Richard Kuhn (2021.02.03). Coronavirus variants, viral mutation and COVID-19 vaccines: The science you need to understand. https://theconversation.com/coronavirus-variants-viral-mutation-and-covid-19-vaccines-the-science-you-need-to-understand-153771

RNA Vaccines Can Be Tweaked to be Effective Against New Variants

- Right now, the public doesn't need to be concerned about the current vaccines.
- The leading vaccine manufacturers are monitoring how well their vaccines control these new variants and are ready to tweak the vaccine design to ensure that they will protect against these emerging variants.
- Moderna, for example, has stated that it will adjust the second or booster injection to more closely match the sequence of the South African variant

Richard Kuhn (2021.02.03). Coronavirus variants, viral mutation and COVID-19 vaccines: The science you need to understand. https://theconversation.com/coronavirus-variants-viral-mutation-and-covid-19-vaccines-the-science-you-need-to-understand-153771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US FDA
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Minor
Anaphylaxis
Deaths
Long term
Malaysia Vaccination
Seramik vaccination

What About the Long-Term Side Effects?

How to Know the Long-term Side Effects of Covid-19 Vaccine

- Of course, the only way to know what, if any, long-term side effects result from the use of these mRNA vaccines is to
  - follow the participants of the Pfizer and Moderna clinical trials,
  - vaccinate and study many more people, and
    - then follow all of them for several years.

- That effort is well underway.
- In fact, the Center for Disease Control (CDC) developed a new smartphone-based tool, “v-safe,” to increase the CDC’s ability to rapidly detect any safety issues with the Covid-19 vaccines

Ellen Matloff (2020.12.18). What Are The Long-Term Safety Risks Of The Pfizer and Moderna Covid-19 Vaccines? https://www.forbes.com/sites/ellenmatloff/2020/12/18/what-are-the-long-term-safety-risks-of-the-pfizer-and-moderna-covid-19-vaccines/?sh=273fa92b68f3

Long-Term Safety

- What do we know about the potential long-term side effects of mRNA vaccines now?
- mRNA vaccines are not as new as you may think.
  - mRNA vaccines have been studied over the past two decades and
  - have shown great promise for both infectious disease and cancer.
- mRNA vaccines have several benefits over the traditional vaccines (that are made using a piece of a dead or weakened virus).
- The benefits of the mRNA vaccines over these traditional vaccines include
  - safety.
    - Because mRNA vaccines are not using a live virus, there is no potential risk of being infected with the condition (in this case, Covid-19).
  - effectiveness.
    - mRNA is efficient and can be taken up and used by the body quickly.
  - are quicker and easier to produce than traditional vaccines,
    - because they are produced in a laboratory instead of in an egg or other mammalian cell.
    - Therefore, mRNA vaccine production can be controlled more closely, and
    - is less expensive and faster to produce in large quantities.

Ellen Matloff (2020.12.18). What Are The Long-Term Safety Risks Of The Pfizer and Moderna Covid-19 Vaccines? https://www.forbes.com/sites/ellenmatloff/2020/12/18/what-are-the-long-term-safety-risks-of-the-pfizer-and-moderna-covid-19-vaccines/?sh=273fa92b68f3

Long-Term Safety

- What do we know about the potential long-term side effects of mRNA vaccines now?
- This is not the first time that an mRNA vaccine has been used in humans.
    - In 2009: The first human trial of an mRNA vaccine began in a small group of patients who had prostate cancer.
        - Overall, that mRNA vaccine was well tolerated and had a good safety profile.
    - In 2013 a clinical trial began of an mRNA rabies vaccine in healthy human adults.
        - This rabies trial was important because the safety requirements for a vaccine in a healthy population are more stringent than those for a vaccine being used to treat a disease.
        - The study ran from 2013-2016, and continues to collect long-term safety data.
        - But overall, this vaccine was deemed generally safe and tolerable.
- mRNA vaccines are now in use in clinical trials for HIV, the Zika virus, and influenza.

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Long-Term Safety

- We will all feel more comfortable when
  - millions of people have received the mRNA Covid-19 vaccines and
  - we have years of data to prove that they are as safe and effective as we believe them to be.

- Unfortunately, time is not on our side,
- But we have
  - more than enough data to understand the risks of Covid-19 infection and its deadly consequences.;
  - enough short-term data on the mRNA COVID vaccines and
  - long-term data on other mRNA vaccines to make emergency use authorization a reasonable decision.

Ellen Matloff (2020.12.18). What Are The Long-Term Safety Risks Of The Pfizer and Moderna Covid-19 Vaccines? https://www.forbes.com/sites/ellenmatloff/2020/12/18/what-are-the-long-term-safety-risks-of-the-pfizer-and-moderna-covid-19-vaccines/?sh=273fa92b68f3

Long-Term Safety

- But what do we know about the potential long-term side effects of mRNA vaccines now?
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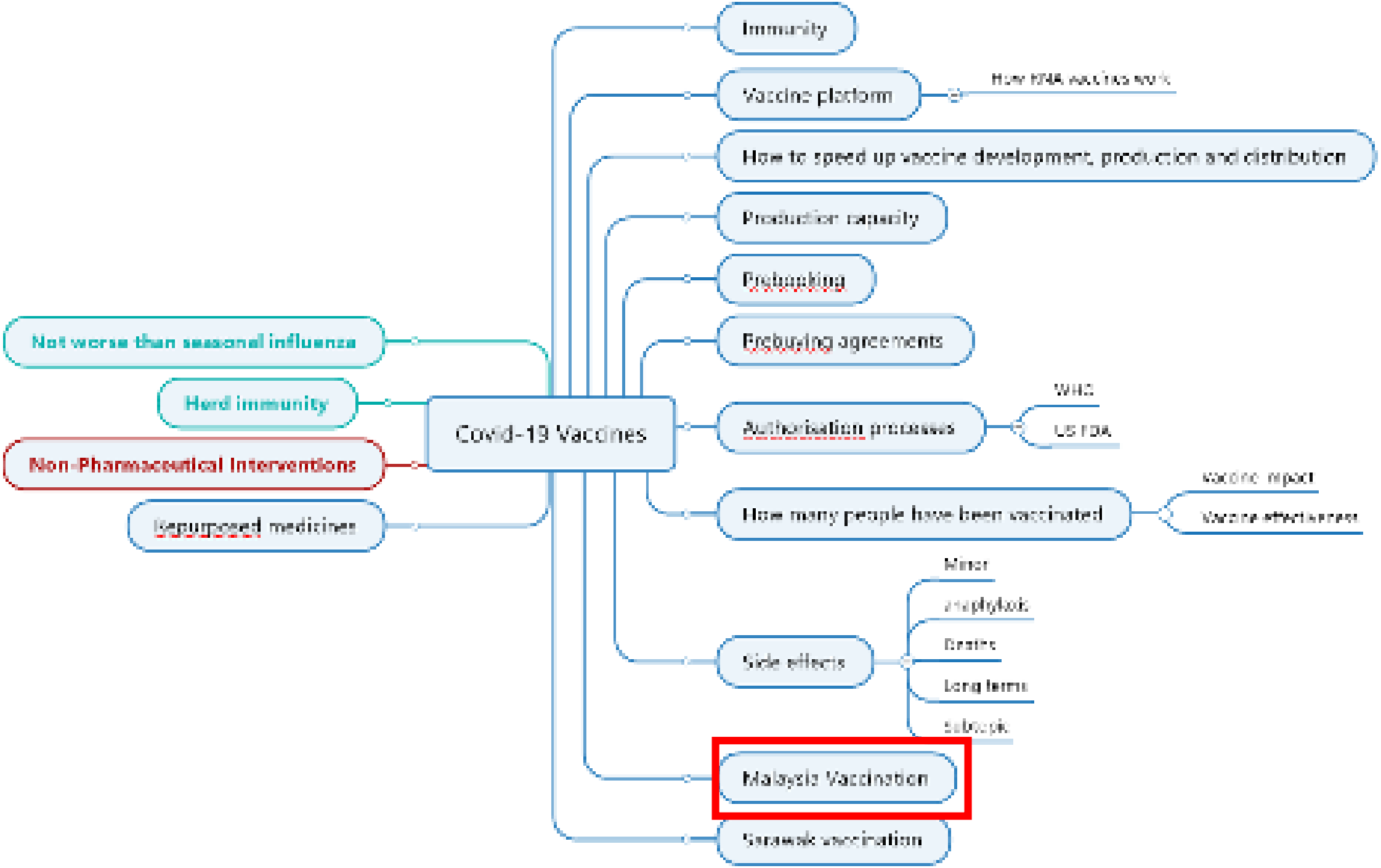
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Malaysia Vaccination
Stratosk vaccination

Malaysia Covid-19 Vaccination Plan

PM Muhyiddin receives first Covid-19 vaccine as Malaysia kicks off mass inoculation campaign

https://www.straitstimes.com/asia/se-asia/pm-muhyiddin-receives-first-covid-19-vaccine-as-malaysia-kicks-off-mass-inoculation

Covid-19 Vaccines for Malaysia

- 21 Feb 2021
    - 312,390 doses of the first batch of vaccines from Pfizer-BioNTech,
- 03 Mar 2021
    - 182,520 doses are scheduled to arrive

- The country has signed a deal to buy a total of
    - 25 million doses of the Pfizer-BioNTech vaccine, which cover 39 per cent of its population.
    - 12 million doses from China's Sinovac
    - 6.4 million doses of Sputnik V vaccine from Russia
- It has also ordered a total of
    - 6.4 million doses from British-Swedish pharmaceutical firm AstraZeneca,
- The authorities said last week that they were in the final stages of talks with US company Johnson & Johnson to
    - procure its single-dose vaccine, which it aims to use on the vulnerable population, such as undocumented migrants.

https://www.straitstimes.com/asia/se-asia/pm-muhyiddin-receives-first-covid-19-vaccine-as-malaysia-kicks-off-mass-inoculation

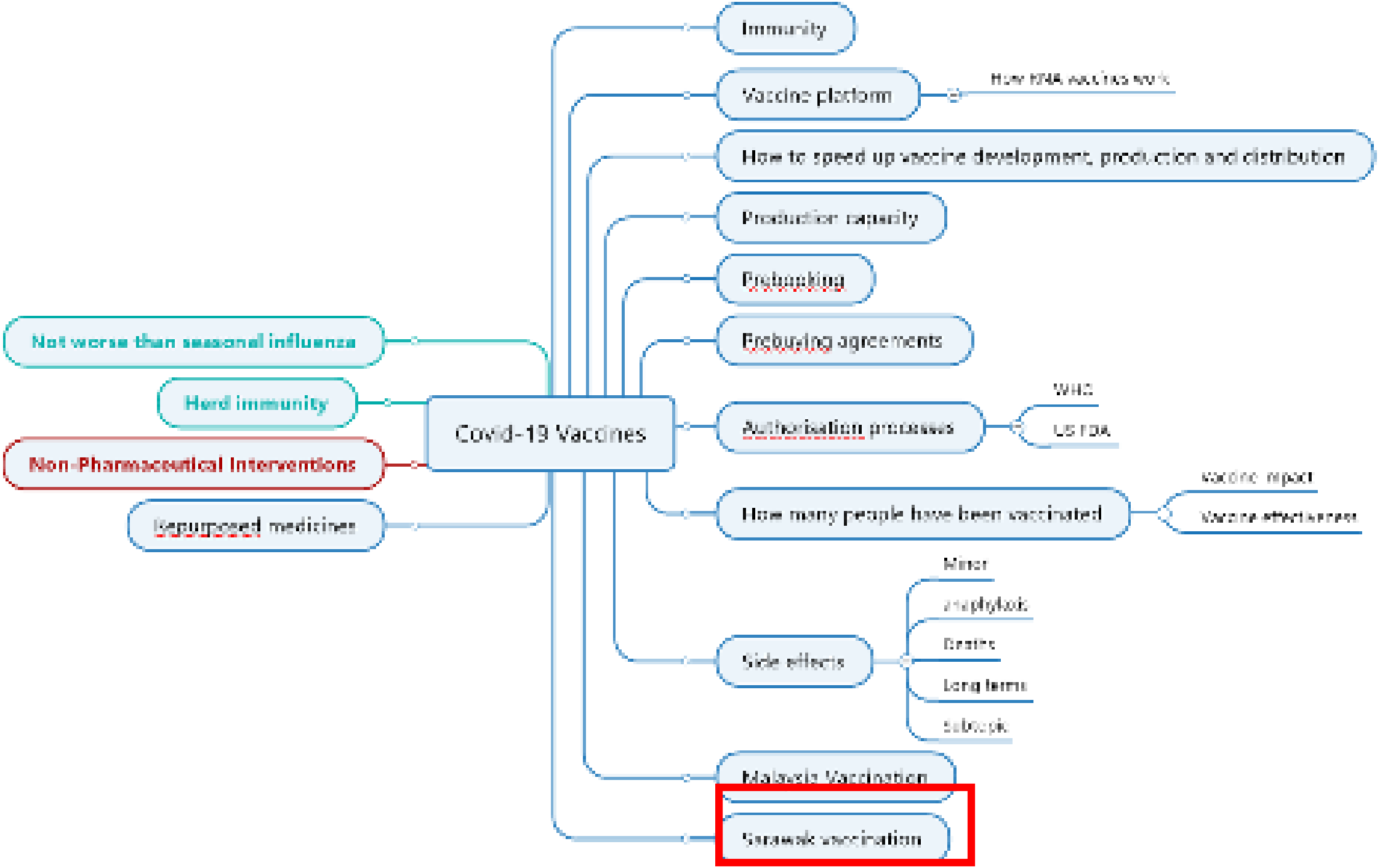
Malaysia to receive Sinovac Covid-19 vaccine on Saturday

Thursday, 25 Feb 2021 07:03 PM MYT

- The Sinovac vaccine, called CoronaVac,
  - was secured through a supply agreement involving **14 million doses** inked between Pharmaniaga Bhd and Chinese pharmaceutical company, Sinovac Life Sciences Co Ltd.

- Pharmaniaga chairman said out of the total,
  - 12 million doses would be supplied to the Health Ministry and
  - 2 million doses would be channelled to private hospitals, and the entire distribution exercise was expected to be completed by year-end.

https://www.malaymail.com/news/malaysia/2021/02/25/malaysia-to-receive-sinovac-covid-19-vaccine-on-saturday/1952880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Strawberry vaccination

Sarawak Covid-19 Vaccination Plan

Sarawak Covid-19 Vaccination Plan

Executive Summary

POLICY AND TARGET

- To cover **2,019,431** Sarawak population aged 18 and above
- Free to all eligible and consented individual both citizen and non-citizen resides in Malaysia
- Currently only Pfizer Vaccine is approved by NPRA to use in Malaysia

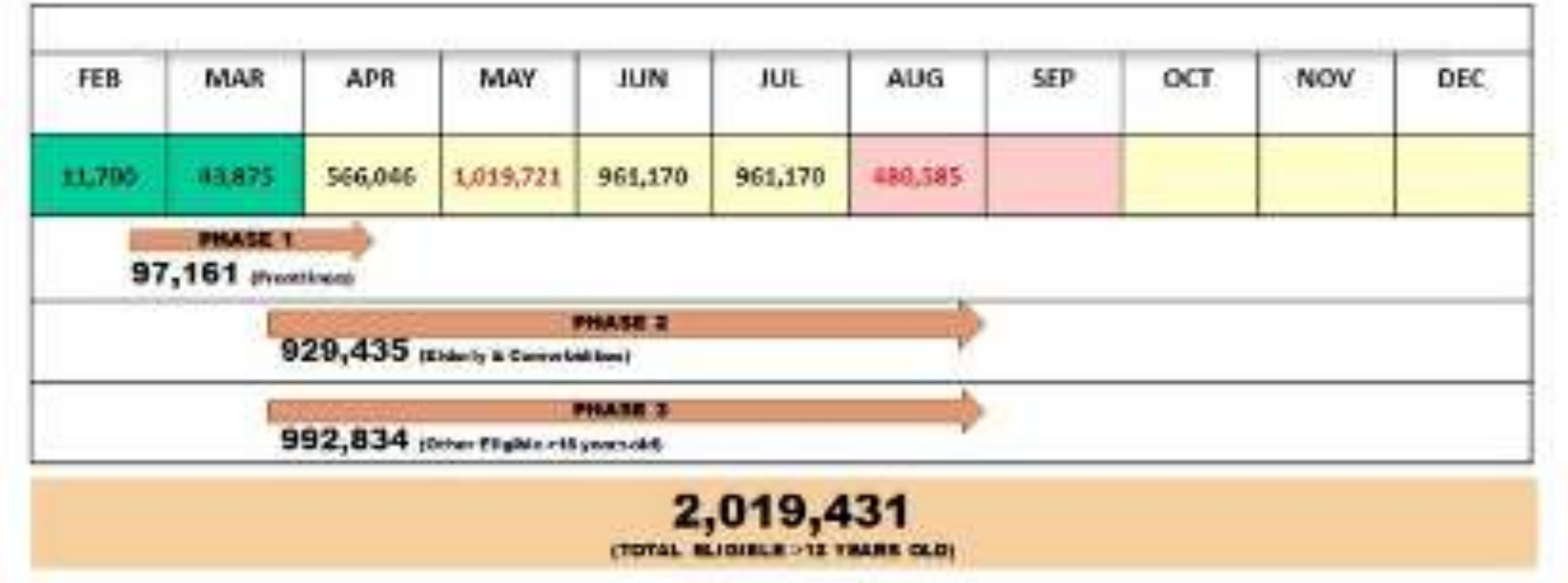
IMPLEMENTATION PHASE

- 3 phases of implementation in 7 months duration (Feb –August 2021)
- Phase 1 – end of Feb to April end 2021, for Frontl-liners
- Phase 2 & 3, April -August 2021

Subject to change - based on the vaccine supply

Source: Dr Radziah Mohamad, Sarawak Health Department.

Sarawak Covid-19 Target Population Coverage by Month 2021



Source: Dr Radziah Mohamad, Sarawak Health Department.

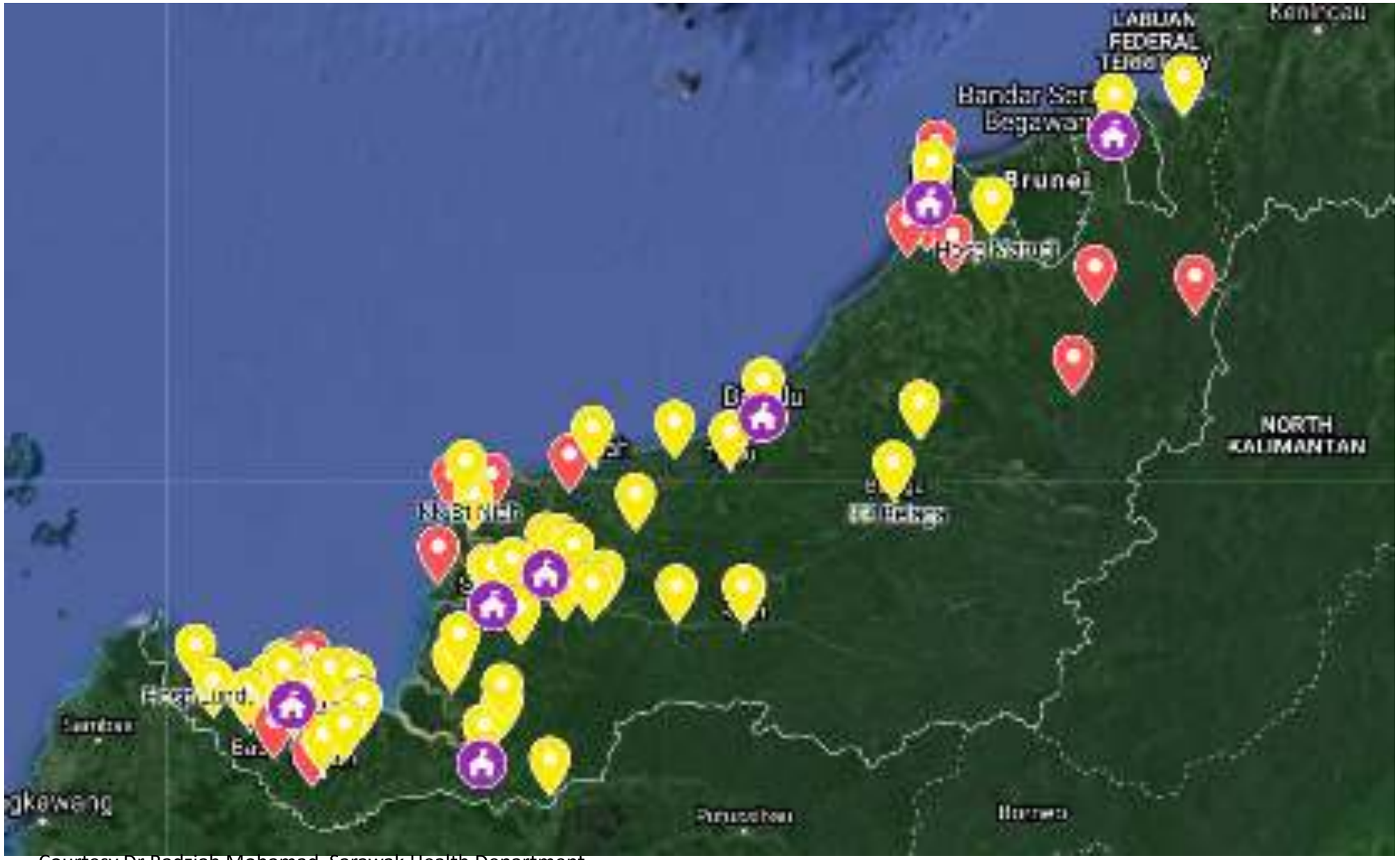
Storage Centre with Ultra-Low-Temperature Fridge (ULTF)

Facility	Number of ULTF
CFLN Kuching	2
MUSB Sri Aman	1
MUSB Sarikei	1
MUSB Sibu	1
Hospital Bintulu	1
MUSB Miri	1
MUSB Limbang	1
Total	8

*CFLN = Cawangan Farmasi Logistik Negeri
** MUSB = Makmal Ubat dan Stor Bahagian

Courtesy Dr Radziah Mohamad, Sarawak Health Department

DISTRIBUTION OF VACCINATION STORAGE (PSV) AND VACCINATION CENTRES (PPV)



PSV 8

Frontliner
(Phase 1)
PPV 53

Community
(Phase 2 & 3)
PPV 69
(including 54
PPV phase 1)

Courtesy Dr Radziah Mohamad, Sarawak Health Department

DISTRIBUTION OF VACCINATION CENTRES (PPV) BY DIVISION

BIL	DIVISION	District	Lokasi
1	Kuching	Kuching	SGH
2	Kuching	Kuching	KK Petra Jaya
3	Kuching	Kuching	KK Batu Kawa
4	Kuching	Kuching	KK Tanah Puteh
5	Kuching	Kuching	KK Sentosa
6	Kuching	Kuching	KK Jalan Masjid
7	Kuching	Bau	Hosp Bau
8	Kuching	Bau	KK Singai
9	Kuching	Lundu	Hosp Lundu
10	Kuching	Lundu	KK Stungkor
11	Samarahan	Samarahan	Pusat Jantung Sarawak
12	Samarahan	Samarahan	KK Kota Samarahan
13	Samarahan	Asajaya	KK Asajaya
14	Samarahan	Asajaya	KK Sadong Jaya
15	Samarahan	Simunjan	Hospital Simunjan
16	Samarahan	Simunjan	KKIA Simunjan Bandar
17	Serian	Serian	Hospital Serian
18	Serian	Serian	KKIA Serian
19	Sri Aman	Sri Aman	Hospital Sri Aman
20	Sri Aman	Sri Aman	KK Sri Aman
21	Sri Aman	Lubok Antu	KK Lubok Antu
22	Betong	Betong	Hospital Betong
23	Betong	Betong	KK Mid Layar
24	Betong	Betong	KK Pusa
25	Betong	Saratok	Hosp Saratok
26	Sarikei	Sarikei	Hospital Sarikei
27	Sarikei	Sarikei	KK Sarikei
28	Sarikei	Meradong	KK Bintangor
29	Sarikei	Julau	KK Julau
30	Sarikei	Pakan	KK Pakan

Courtesy Dr Radziah Mohamad, Sarawak Health Department

DISTRIBUTION OF VACCINATION CENTRES (PPV) BY DIVISION

BIL	DIVISION	District	Lokasi
31	Sibu	Sibu	Hosp Sibu
32	Sibu	Sibu	KK Jalan Lanang
33	Sibu	Sibu	KK Sibu Jaya
34	Sibu	Selangau	KK Selangau
35	Sibu	Kanowit	Hosp Kanowit
36	Kapit	Kapit	Hosp Kapit
37	Kapit	Kapit	KK Kapit
38	Kapit	Song	KK Song
39	Kapit	Belaga	KK Belaga
40	Kapit	Belaga	KK Sungai Asap
41	Mukah	Mukah	Hosp Mukah
42	Mukah	Mukah	KKIA Mukah
43	Mukah	Daro	Hosp Daro
44	Bintulu	Bintulu	Hosp Bintulu
45	Bintulu	Bintulu	KK Jepak
46	Bintulu	Tatau	KK Tatau

BIL	DIVISION	District	Lokasi
47	Miri	Miri	Hosp Miri
48	Miri	Miri	KK Bandar Miri
49	Miri	Miri	KK Bt Niah
50	Miri	Marudi	Hosp Marudi
51	Limbang	Limbang	Hosp Limbang
52	Limbang	Lawas	Hosp Lawas
53	Limbang	Lawas	KK Lawas

Courtesy Dr Radziah Mohamad, Sarawak Health Department

CodeBlue
Health is a human right

Sarawak's 'Last Frontier' To Dry Run Pfizer Vaccine

https://codeblue.galencentre.org/2021/01/28/sarawaks-last-frontier-to-dry-run-pfizer-vaccine/

Sarawak Covid-19 Vaccine Target Product Profile

	Vaccine options (score)							
Vaccine characteristic	**Pfizer**	**Moderna**	**Gamaleya**	**OxAZ**	**Janssen**	**Sinovac**	**Novavax**	**Sinopharm**
Indication for use	5	5	5	5	5	5	5	5
Contraindication	3	3	3	3	3	3	3	3
Target population	3	3	3	3	3	3	3	3
Safety/Reactogenicity	4	4	4	4	4	4	4	4
Measures of Efficacy	5	5	5	3	3	2	4	4
Reported Efficacy (%)	95	94.1	91.6	62.1	66	50.4	86	79
Efficacy towards new UK and SA strains	1	1	1	1	1	1	5	1
Dose regimen	1	1	1	1	5	1	1	1
Durability of protection	5	5	5	5	5	5	5	5
Route of Administration	5	5	5	5	5	5	5	5
Product Stability and Storage	1	2	2	5	5	5	5	5
Stand-alone product	1	5	1	5	5	5	5	5
Presentation	3	3	3	3	3	3	3	3
KKM Registration and conditional use	5	5	3	3	3	3	3	3
Accessibility and Scalability	2	2	3	3	3	5	3	3
Logistic practicality	1	2	2	5	5	5	5	5
Price per dose (USD)	20	37	10	4	10	30	16	72.5
Cost score	3	2	4	5	4	2	4	1
Clinical trials code (clinicaltrials.gov)	NCT04368728	NCT04470427	NCT04530396	NCT04324606, NCT04400838, NCT04444674	NCT04505722	NCT04456595	NCT04611802	No data

Based on the WHO Target Product Profiles for COVID-19 Vaccines (9 April 2020).
https://www.who.int/publications/m/item/who-target-product-profiles-for-covid-19-vaccines.