COVID 19 VACCINE

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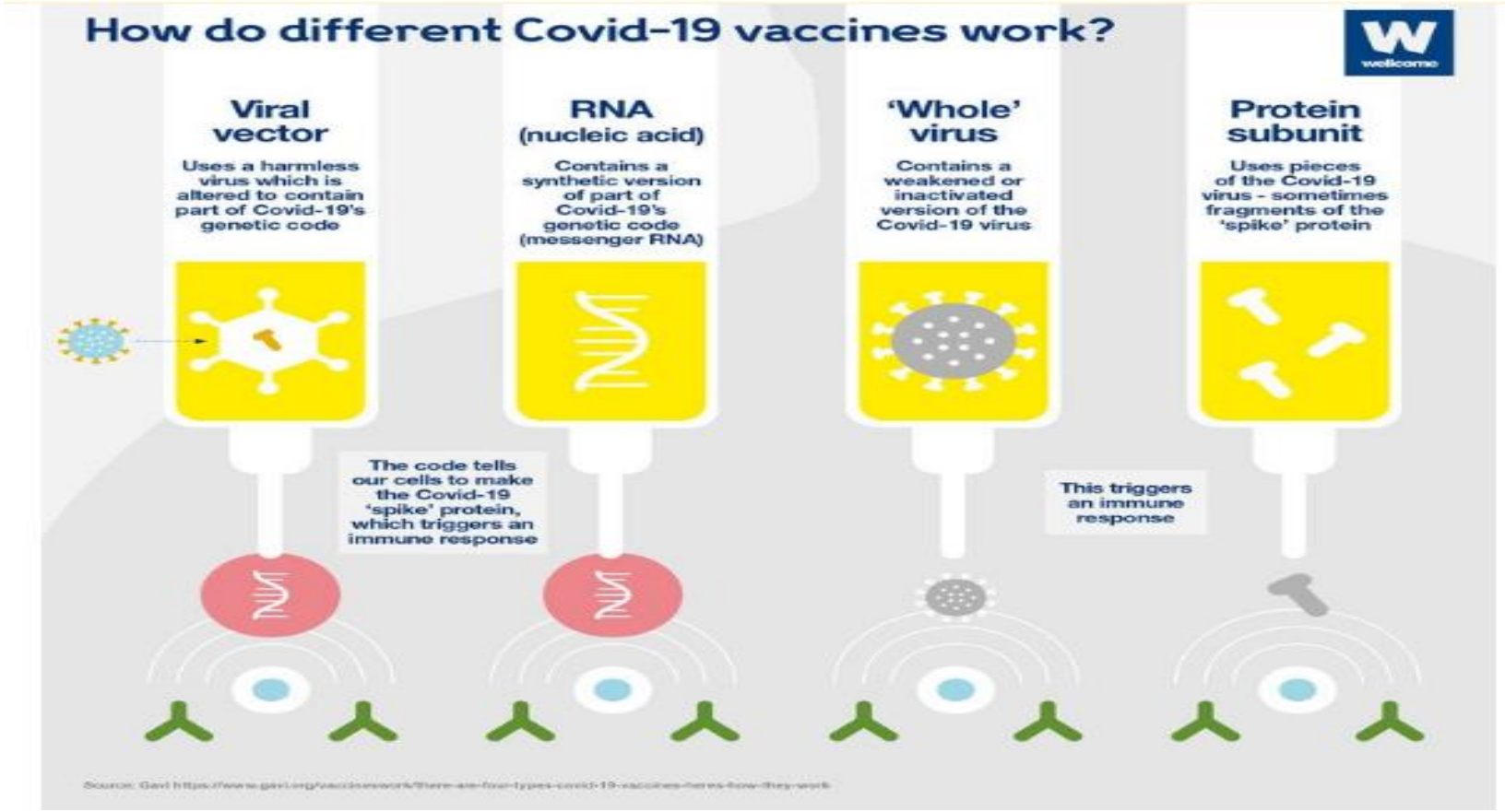

Genetic Vaccines

Types of SARS-CoV-2 vaccines for COVID-19

Genetic vaccines
(nucleic acid vaccines)

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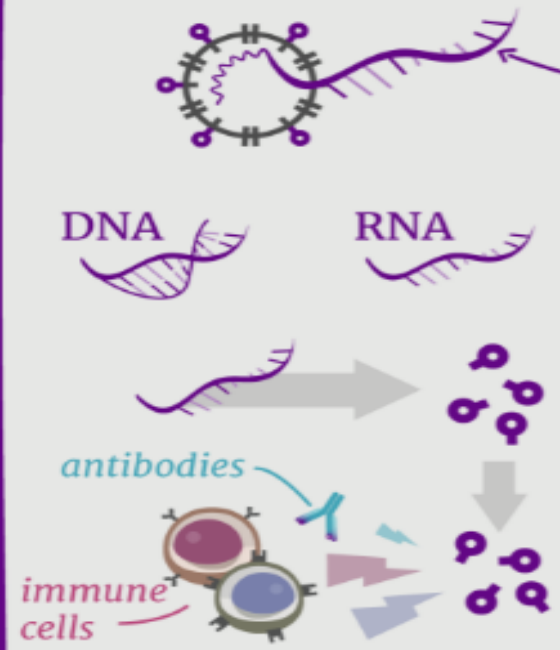

Contain a segment of **SARS-CoV-2 virus genetic material** that codes for a specific protein. Can be DNA or RNA.

Our cells use the genetic material to make the SARS-CoV-2 protein, which is recognised by the immune system to trigger a response.

This response builds immune memory, so your body can fight off SARS-CoV-2 in future.

Considerations

Low cost and fast to develop.

May need to be stored at specific low temperatures.

Approved in the UK for COVID-19

Pfizer/BioNTech & Moderna

In clinical trials for COVID-19

CureVac, Inovio Pharmaceuticals

Pfizer/BioNTech

- **Company:** Pfizer/BioNTech
- **Vaccine Name:** BNT162b2
- **Mechanism of Action:** mRNA vaccine
- **Dosing Schedule:** Two doses, 21 days apart (30 µg/dose)

Pfizer/BioNTech

- **Efficacy:** 95% at least 7 days after dose 2 in initial trial data. The company reported updated 6-month data showing the vaccine had 91.3% efficacy for those fully vaccinated, and was 95.3% effective against severe disease, as defined by the FDA.

- In the pediatric trial, the vaccine had 100% efficacy against symptomatic disease for kids ages 12 to 15, with 18 cases in the placebo group compared with none in the vaccine group 7 days after the second dose.

- **Trial Participants:** 43,548 people age 16 and up and 2,260 kids ages 12-15

Pfizer/BioNTech

- **Side Effects:** Most common were fatigue and headache after both doses, with both being more prominent after the second dose. These were **milder** for participants **over 55** compared with those age 16 to 55. In this latter group, the rates of fatigue and headache were 59% and 52%, respectively, after dose 2.
- Side effects in kids were consistent with those seen in adults. The most common ones were pain at the injection site, tiredness, headache, chills, and joint pain, which lasted 1 to 3 days after vaccination.

Pfizer/BioNTech

- **Storage:** Ultra-cold freezer required, -112ºF to -76ºF (-80ºC to -60ºC) for up to 6 months; FDA recently authorized storing undiluted, thawed vials at refrigerator temperatures (35ºF to 46ºF [2ºC to 8ºC]) for up to 1 month.
- **Variants:** lab studies have shown that the South African (B.1.351) variant may reduce antibody titers by two-thirds, but an analysis of phase III trial data from 800 participants in that country show 100% efficacy against infection, albeit with a wide 95% confidence interval (lower bound 53.1%). Similarly, data from Israel showed the vaccine remained 97% effective against symptomatic disease, hospitalizations, severe illness, and death when the B.1.1.7 or "U.K." variant was highly prevalent in that country.

Pfizer/BioNTech

- Additional data from a study in Qatar found the vaccine was 89.5% effective against any documented infection with the B.1.1.7 variant 2 weeks after the second dose, and 75% effective against infection with the B.1.351 variant at that time point, with tight confidence intervals for both cases. Overall effectiveness against severe, critical, or fatal disease was very high at 97.4%, with both variants causing the vast majority of infections in that country.
- Pfizer is studying a third "booster" dose of the original vaccine against B.1.1.7, as well as evaluating a variant-specific vaccine with a modified mRNA sequence.

Moderna

- **Company:** Moderna
- **Vaccine Name:** mRNA-1273
- **Mechanism of Action:** mRNA vaccine
- **Dosing Schedule:** Two doses, 28 days apart (100 µg/dose)
- **Efficacy:** 94.1% at least 14 days after dose 2 in initial trial data. In 6-month follow-up data, efficacy dipped to 90% against all infections, but was greater than 95% against severe disease

Moderna

- **Trial Participants:** 30,420 people age 18 and up
- **Side Effects:** Overall systemic adverse events including fever, chills, headache, and myalgia were recorded in 60% of participants after the first dose and in 80% of participants after the second dose.
- **Storage:** Frozen between -13ºF to 5ºF (-25ºC to -15ºC); can be stored refrigerated from 36ºF to 46ºF (2ºC to 8ºC) for up to 30 days prior to first use.

Moderna

- **Variants:** No clinical data; lab studies found no significant impact on neutralizing antibodies with the U.K. variant (B.1.1.7) but a six-fold reduction in neutralizing antibodies with the South African variant (B.1.351). Moderna plans to test a variant-specific booster candidate, a multivalent booster candidate, and a third dose of the original vaccine at 50 µg.

Viral Vector Vaccines

Types of SARS-CoV-2 vaccines for COVID-19

Viral vector vaccines

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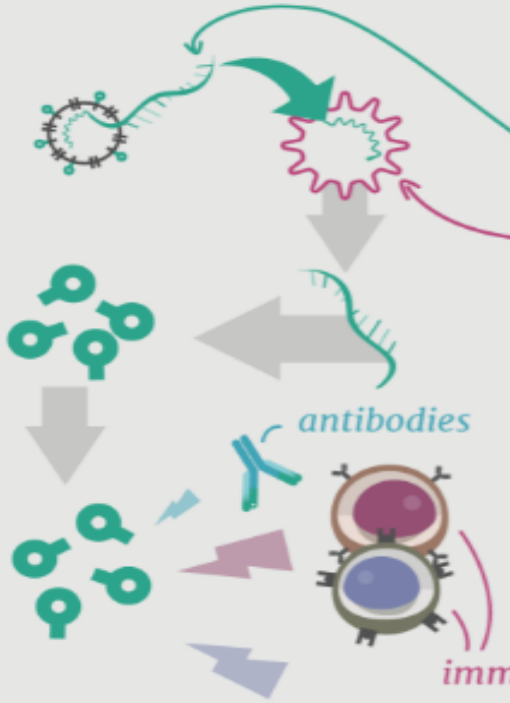

Use an unrelated harmless virus, modified to deliver **SARS-CoV-2 genetic material**. The delivery virus is known as a **viral vector**.

Our cells use the genetic material to make a specific SARS-CoV-2 protein, which is recognised by the immune system to trigger a response.

This response builds immune memory, so your body can fight off SARS-CoV-2 in future.

Considerations

Generate strong immune response.

May need to be stored at specific low temperatures.

Examples in human use for other diseases

Ebola vaccine

Approved in the UK for COVID-19

AstraZeneca/Oxford

Approved elsewhere in the world for COVID-19

Jannsen, CanSino, Gamaleya

Johnson & Johnson/Janssen

- **Company:** Johnson & Johnson/Janssen
- **Vaccine Name:** Ad26.COV2.S
- **Mechanism of Action:** Adenovirus vector vaccine
- **Dosing Schedule:** One dose (two-dose regimen under evaluation)

Johnson & Johnson/Janssen

- **Efficacy:** 72% in the U.S. and 66% globally against moderate-to-severe disease; 85% effective against severe disease, 28 days after a single dose in initial trial data. Published data remained similar.

- **Trial Participants:** 43,783 people age 18 and up

Johnson & Johnson/Janssen

- **Side Effects:** Most common systemic reactions were headache (39%), fatigue (38%), myalgia (33%), nausea (14%), and fever (9%).

- **Storage:** Stable for 2 years at -4ºF (-20ºC) but can be stored for at least 3 months at typical refrigeration temperatures of 36ºF to 46ºF (2ºC to 8ºC).

Johnson & Johnson/Janssen

- **Variants:** 57% efficacy in South Africa; 66% efficacy in South America in initial trial data (Brazil was among the countries studied, but there were no sequenced cases of the P.1 variant). In updated data, efficacy was 64% against moderate to severe-critical illness and 81.7% effective against severe-critical illness in South Africa at least 28 days after administration.

Johnson & Johnson/Janssen

- **Pause:** On April 23, the U.S. lifted a temporary pause on administration of the J&J vaccine, which had been implemented due to concerns about the increased risk of thrombosis with thrombocytopenia syndrome (TTS). After review, the CDC's Advisory Committee on Immunization Practices voted to recommend the vaccine for all adults. The FDA EUA fact sheet now warns of the risk of TTS.

Sputnik V

- Sputnik V, developed by the Gamaleya National Center of Epidemiology and Microbiology in Russia, was the first COVID-19 vaccine to be authorized.
- Along with Russia, 64 countries have approved the vaccine. These countries include Argentina, Iran, and India. The vaccine is currently being reviewed in the European Union by the European Medicines Agency.

Sputnik V

- Sputnik V is a two-part adenovirus viral vector vaccine with an efficacy rate of 91.6%Trusted Source.

- Adenoviruses are a type of virus associated with the common cold and other illnesses. They serve as the delivery vehicle for the DNA instructions to produce the spike protein of the SARS-CoV-2 virus in the body. This then triggers the production of antibodies against this spike protein, preparing the immune system for a potential infection. For the Sputnik V vaccine, it was noted that the E1 gene was removed from the vaccine in order to prevent replication.

- Each of the two doses uses a different type of adenovirus: first dose with type-26 (Ad26), then a booster dose with type-5 (Ad5). The purpose of using two different types is to lower the possibility of the body developing antibodies against the adenovirus after the first dose, which could make the second dose ineffective.

Sputnik V

- Common side effects

  flu-like illness

  headache

  fatigue

  injection-site reactions

- These side effects are similar to those of the Pfizer, Moderna, and Johnson & Johnson COVID-19 vaccines, as noted by the Centers for Disease Control and Prevention (CDC)

Inactivated Vaccines

Types of SARS-CoV-2 vaccines for COVID-19

Inactivated vaccines

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Contain **killed SARS-CoV-2 virus**.

The killed virus is recognised by the immune system to trigger a response without causing illness.

This response builds immune memory, so your body can fight off SARS-CoV-2 in future.

Considerations

May need to be administered with an adjuvant to boost immune response.

Examples in human use for other disease

Influenza vaccine

Approved elsewhere in the world for COVID-19

Sinovac, Sinopharm, Bharat Biotech

In clinical trials for COVID-19

Shifa-Pharmed, Chinese Academy of Medical Sciences

Attenuated Vaccines

Types of SARS-CoV-2 vaccines for COVID-19

Attenuated vaccines

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Contain **weakened SARS-CoV-2 virus**.

The weakened virus is recognised by the immune system to trigger a response without causing illness.

This response builds immune memory, so your body can fight off SARS-CoV-2 in future.

Considerations

A well-known approach which requires time and extensive testing.

The immune response resembles the natural infection.

Examples in human use for other disease

Oral Polio vaccine

In clinical trials for COVID-19

Codagenix

Sinopharm

- The Sinopharm COVID-19 vaccine, BBIBP-CorV, which the Beijing Bio-Institute of Biological Products (BBIBP) developed, is the first Chinese COVID-19 vaccine that the World Health Organization (WHO) has authorized for emergency use.

Sinopharm

- The Sinopharm vaccine contains SARS-CoV-2 that has undergone treatment with a chemical called beta-propiolactone. This chemical binds to the virus's genetic material and stops it from replicating and causing COVID-19. The vaccine also contains an adjuvant in the form of aluminum hydroxide. Adjuvants help strengthen the body's immune response to vaccines.
- When an individual receives the vaccine, their body's immune system identifies the inactivated virus as foreign and makes antibodies against it. If the vaccinated person subsequently comes into contact with SARS-CoV-2, their immune system launches an immune response against it.

Sinopharm

- The WHO recommends the Sinopharm vaccine for people aged 18 years and older, with a gap of 3–4 weeks between the two doses. The global health agency estimates overall vaccine efficacy to be about 78%, although it notes that trial data are lacking for adults over the age of 60 years.
- Alpha: Very
- Good
- Beta:poor
- Delta:Good

Sinopharm

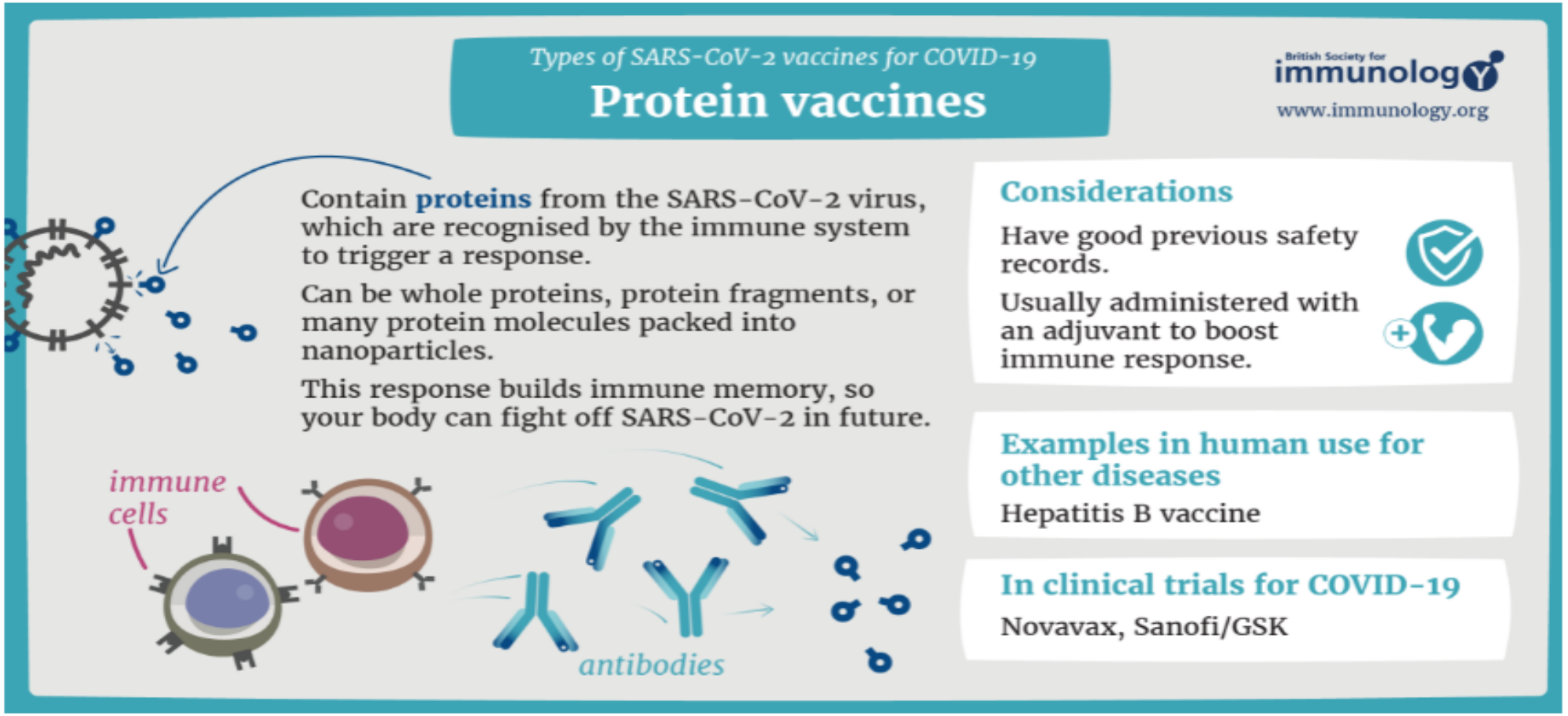
- Common side effects

  headaches

  fatigue

  injection site reactions

Protein Vaccines



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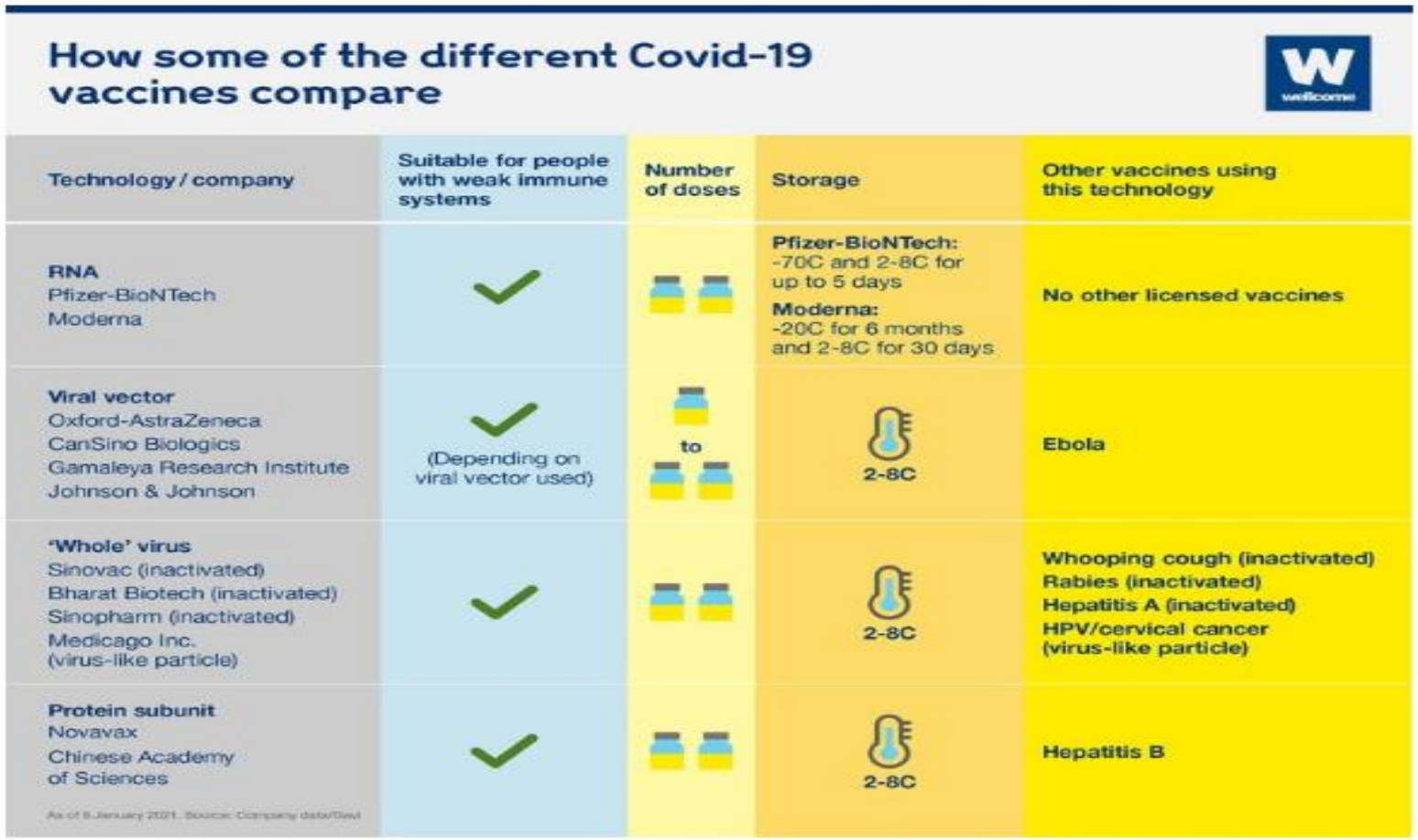

How some of the different Covid-19 vaccines compare

Technology / company	Suitable for people with weak immune systems	Number of doses	Storage	Other vaccines using this technology
RNA Pfizer-BioNTech Moderna	✓	2	**Pfizer-BioNTech:** -70C and 2-8C for up to 5 days **Moderna:** -20C for 6 months and 2-8C for 30 days	**No other licensed vaccines**
Viral vector Oxford-AstraZeneca CanSino Biologics Gamaleya Research Institute Johnson & Johnson	✓ (Depending on viral vector used)	1 to 2	2-8C	**Ebola**
'Whole' virus Sinovac (inactivated) Bharat Biotech (inactivated) Sinopharm (inactivated) Medicago Inc. (virus-like particle)	✓	2	2-8C	**Whooping cough (inactivated)** **Rabies (inactivated)** **Hepatitis A (inactivated)** **HPV/cervical cancer (virus-like particle)**
Protein subunit Novavax Chinese Academy of Sciences	✓	2	2-8C	**Hepatitis B**

As of 8 January 2021. Source: Company data/Gavi

Vaccine Efficacy

- All reported VEs are higher than the 50% criterion required by WHO, FDA and EMA, indicating that the currently developed COVID-19 vaccines are efficacious against symptomatic COVID-19 in early stage (about 2-3 months) after vaccination . However, the long-term protective effect of the approved vaccines is currently unknown.

Vaccine Efficacy

- The VE reported for elderly population is relatively lower. This is concerning because the elderly are more susceptible to SARS-CoV-2 and show a higher death rate . Most published data for current vaccines show relatively lower VE for the elderly . Moderna mRNA vaccine showed a 95.6% VE for people younger than 65, but the VE dropped to 86.4% for people over 65. Pfizer mRNA vaccine showed a VE of 94.7% in the elderly population over 65, which is comparable to that observed in younger population .

Vaccine Efficacy

- The evidences for VE can be unreliable due to complicated demographic characteristics, such as population and geography.

- VEs were affected by locally circulating variants.

Vaccine Efficacy

- The dose and dosage influence the efficacy of the vaccine.

Although the AstraZeneca adenovirus vectored vaccine used a two-dose immunization regimen, the interim phase 3 clinical report showed that one standard dose provided similar protection as two standard doses regimen, with 55% (1 dose) and 60.3% (2 doses) VE in the UK recipients, and 71.2% (1 dose) and 64.2% (2 doses) VE in Brazilian recipients.