

# COVID19

What do we know

What should we do

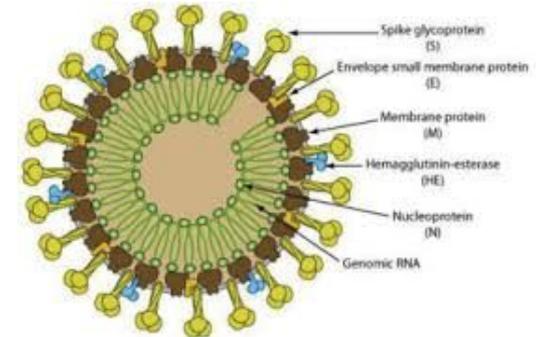
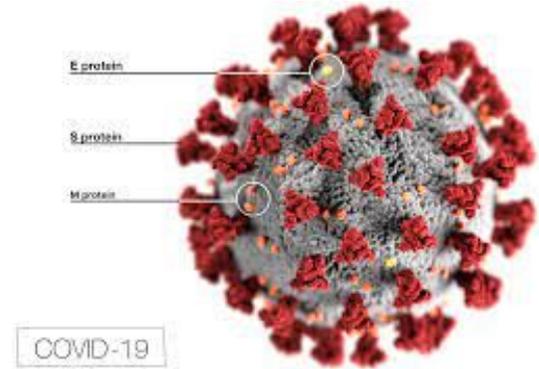
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# COVID19 = CoronaVirus-Disease 2019 (2019-nCoV-2)

- **Coronaviruses are common** - 4 other coronaviruses typically represent 25 percent of common colds.
- **Coronaviruses have caused epidemics before**
  - **SARS-cov-1 occurred in China in 2003-4**
    - 8000 infections, 774 deaths,
    - no cases since 2004
  - **MERS-cov - started in the middle east in 2012**
    - 2500 infections, 866 deaths so far.
    - Infrequent cases through 2020.
- **An Epidemic respiratory illness in 1890**
  - Now appears to have been due to coronavirus that infected cattle transmitted to people

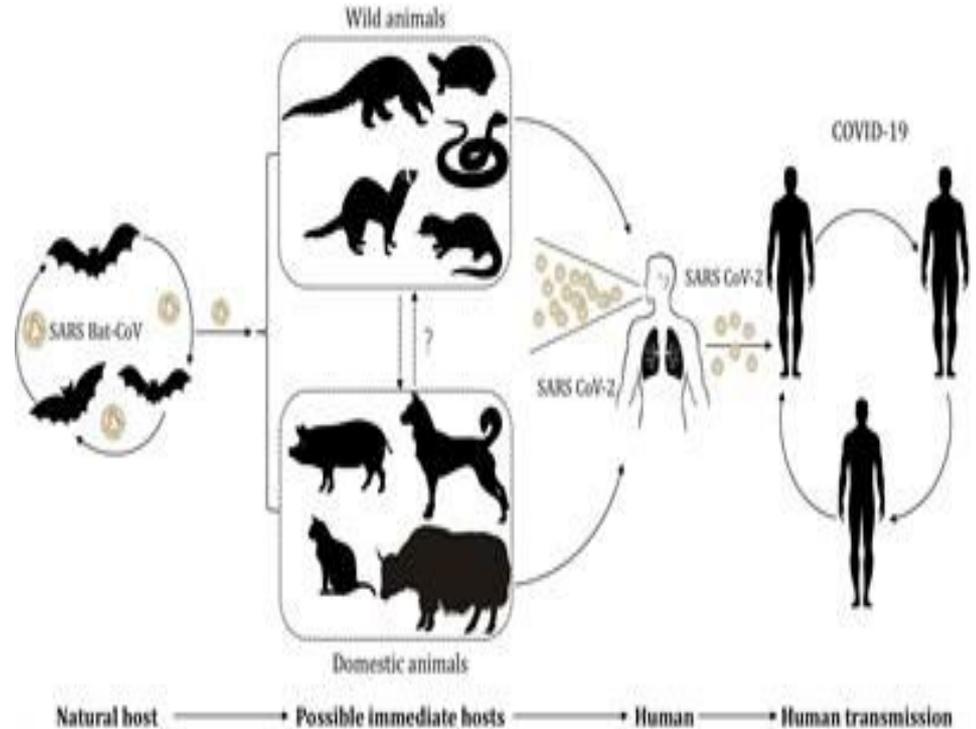


# Covid19 is new but not unexpected...

SaRS-CoV-2 most closely related to a coronavirus found in bats in provinces in southwest china (96% similar). Yunnan province

Probably spread to other animals (weasel, pangolin (like an armadillo), domestic animals?, on wild animal markets in southern provinces (Sichuan, Guizhou, Hunan)

Initial epidemic in humans. Wuhan, China (Hunan Province).



# Covid19 spread across the world in weeks undetected

Covid may have been in Wuhan as early as November or December 2019 (covid19)

In January from air travel a few cases were found in Thailand, Borneo, Japan and Australia, but did not develop large outbreaks.

In January travelers from China likely brought covid to the United States and Italy

A Champions league soccer match February 19th, between Italy and Spain appears to have caused the huge outbreak in Europe (Italy, France, Spain, UK)

In the United States in 2020 the President of the United States was briefed that coronavirus would “spread globally” January 23 and 28th. The Coronavirus Taskforce was established January 29th, but White House messages were downplayed until mid March, because the president wanted to “give people hope”

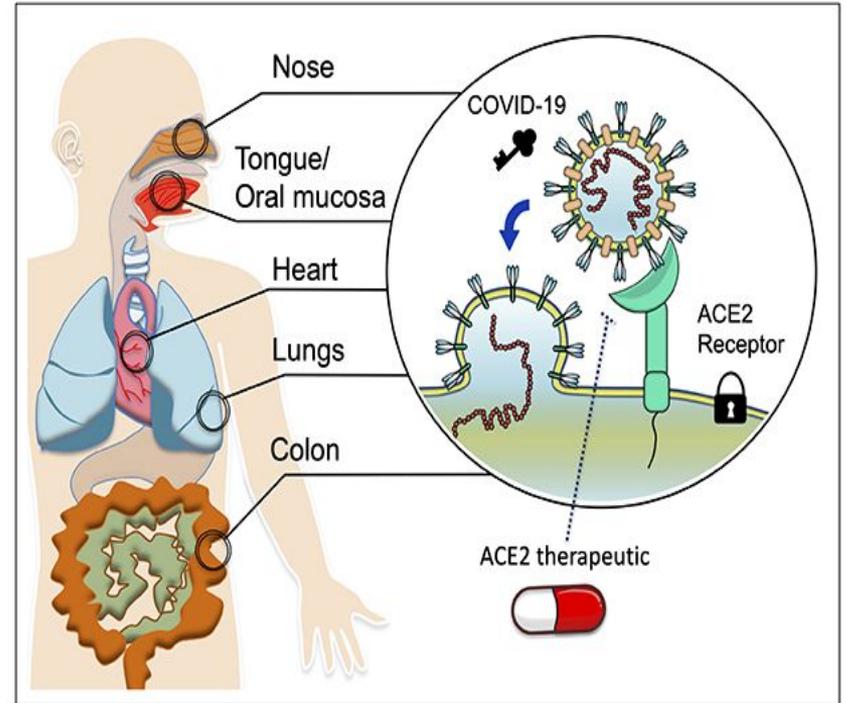
The United States has held the infamous lead of cases of covid19 since mid March 2020, and continues to have twice as many infections and more deaths than any other nation in April 2021.

# Covid19 is a perfect storm virus

The Spike Protein binds to a human receptor, the ACE2 receptor, that's all over the body - nose, mouth lining, heart, lungs, throughout the intestine, kidneys, and testes, blood vessels smooth muscle cells lining vessels in the brain The ACE2 receptor

Once bound it injects it's RNA to make our cells make the 29 proteins that build new coronaviruses.

Studies estimate SARS-cov2 generates between 1 and 100 Billion virus particles during peak infection.



# Covid19 - perfect storm - respiratory through breath

Although SAR-coV2 can spread by sneezing and coughing like a cold, it primarily spreads through the air as aerosols - through simple breathing

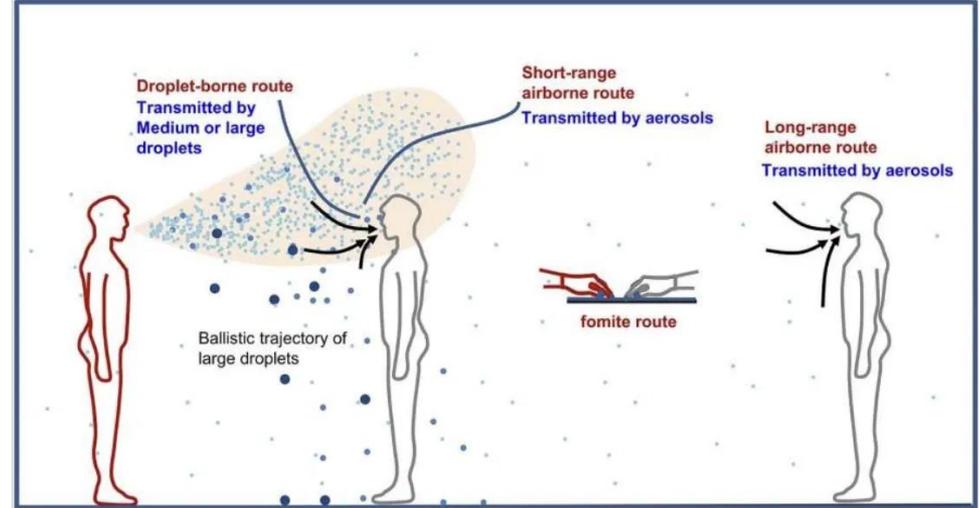
Peak infection

Less than 6 feet

More than 10 minutes

Indoors with poor air circulation

Chance of infection approaches 100%



# Covid19 - perfect storm...3 days before illness

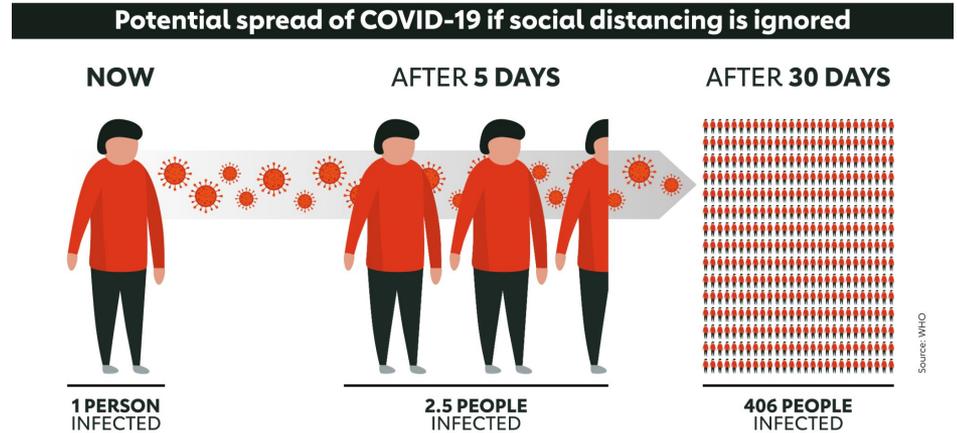
Unlike most colds or Flu Covid is contagious, 3 days before symptoms, 10 days total.

An infected person typically spreads Covid19 to 2-3 people

A superspreading event is also trouble

Washington state choir practice. 2 hours.

32 confirmed cases, 20 probable, only 8 not infected. 87% infected that night.

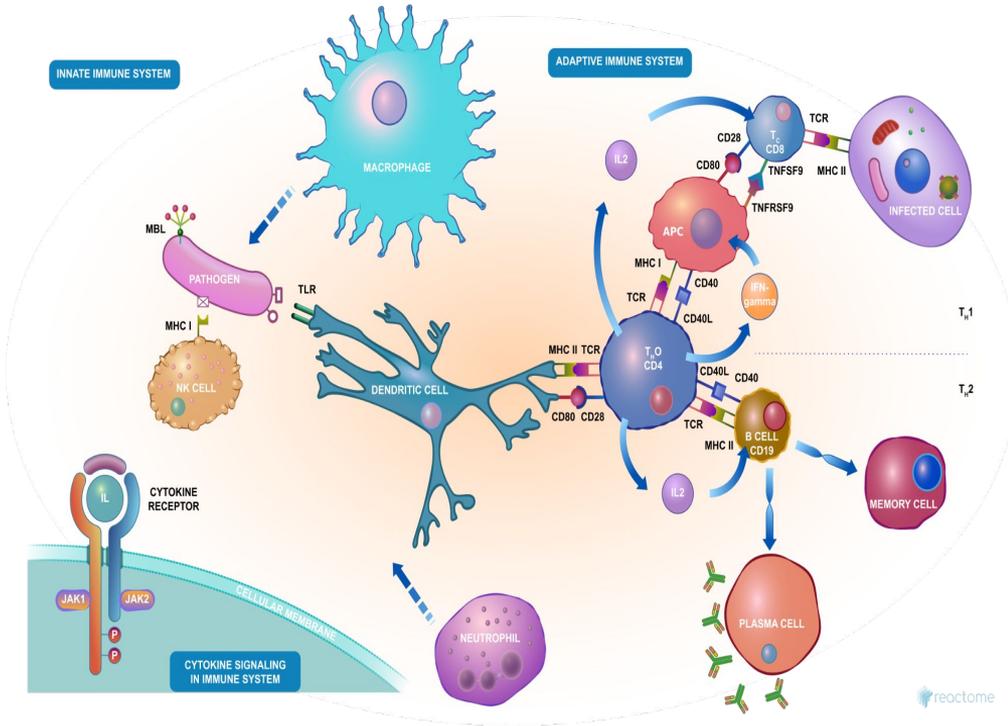


# Covid perfect storm - Our immune system in chaos

Covid19 Infection generates a tremendous inflammatory immune response

Cytokines, Interferon, Chemokines, Bradykinins...these inflammatory molecules are extreme in sick patients

When the Adaptive Immune system of antibodies, B cells, and T cells respond with natural immunity 3-5 days into the infection the large burden of infection and extreme reaction of the immune system cause great damage to lungs... blood vessels and many organs (heart, kidney, brain vessels...)



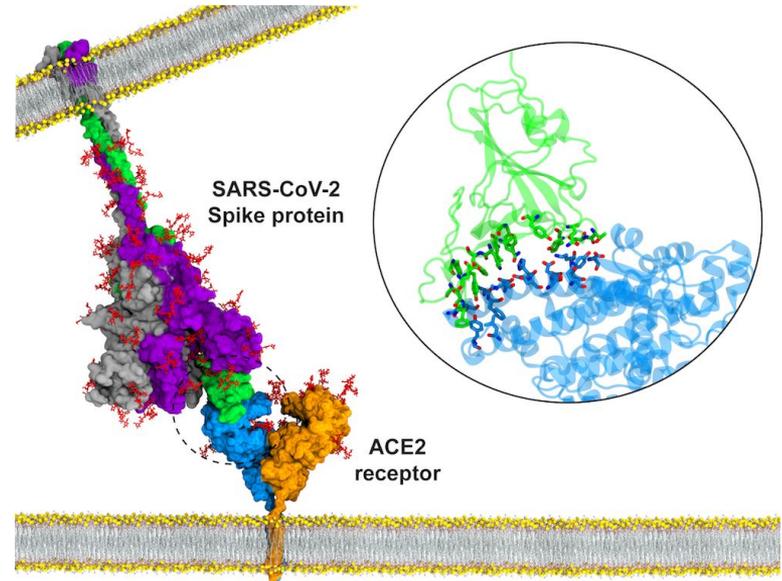
# The Spike Protein is Covid19's key - the target of vaccines

The SARS-nCoV-2 virus genetic code is made of a single strand of RNA of 30,000 letters (the human genome is 3 billion letters).

The genes of the Covid-19 virus lets the virus make 27 (or 29...) proteins.

These proteins let the virus copy itself, block our immune system, and build its shell to infect more cells. The spike protein is one of the 3 proteins on the outside (envelope) of the virus.

The Spike protein lets SARS-nCoV-2 bind to human cells and infect us. Blocking this protein with an antibody is the source of vaccine immunity



# Many ways to make vaccines - quick or cheaper way - use virus

**Whole Inactivated Virus** - grow and chemically treat live virus to inactivate it

CanVax

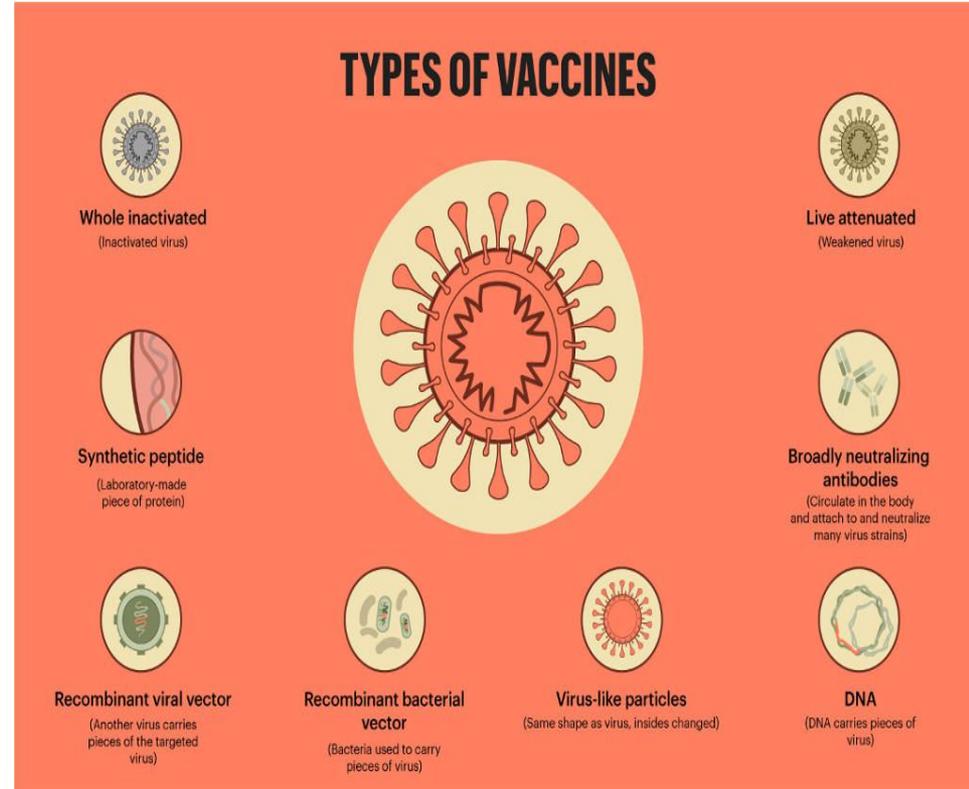
SinoVax -

**Viral Vectors** - use another cold virus - Adenovirus to deliver the spike protein genetic instructions

Johnson & Johnson

Astra Zeneca

Sputnik V -



# Many ways to make vaccines - but simple design has won

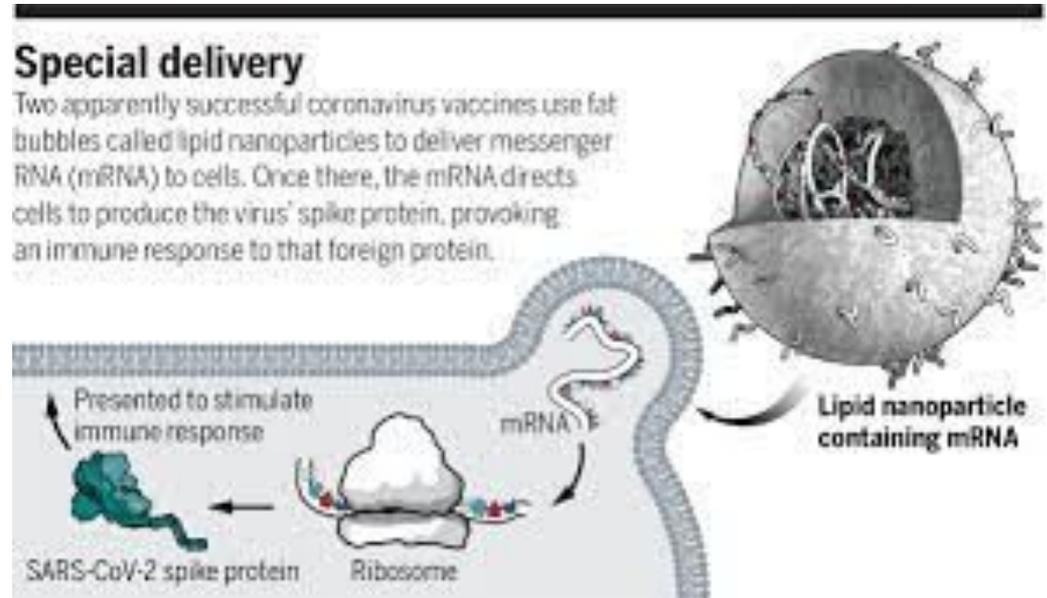
**mRNA technology** is component vaccine, only the code for 1 protein, not 30 or 50 genes, or whole viruses

mRNA vaccines, use messenger RNA to instruct our cells to make copies of only a part of the spike protein, not the whole virus. When the spike protein shows on our cells we make antibodies, and generate immunity.

The trick for mRNA vaccines is making a shell to get to the cells, this is made of a lipid nanoparticle...a little fat droplet.

This is quite fragile, so it must stay super cold

6 ingredients. 1 string of mRNA, sodium, potassium, 3 lipids to make the shell. *“Like candy in a shell”*



# What do we know about safety - Two are more effective

## Moderna & Pfizer

In North America and Europe, two mRNA vaccines were approved first, by Moderna and Pfizer/Biontech

Phase 3 studies = tens of thousand people given shot or placebo.  
Effectiveness was 90-95%.

When 100 people in the study reported covid19 infection

95 had placebo. 5 had vaccine.

## J&J and AstraZeneca

Were approved in North Am and EU several months later, and have each had several regulators initiating pauses due to problems with study data, issues with manufacturing,

75% effectiveness protect from infection

75 placebo, 25 vaccinated -covid infection

# Vaccines - Two are are safer - Moderna and Pfizer

## **Moderna + Pfizer/Biontech**

100 million doses each given

No pattern of adverse events

## **Johnson & Johnson + Astra Zeneca/Oxford**

AstraZeneca -

10 per 1 million doses - blood clotting events

J&J -

1 per million doses - blood clotting events

(15 events in 8+ million doses given

7 per million - blood clot events

- in women 18-50 years old

# Vaccination like Aviation

## Moderna / Pfizer

100 million flights no major accidents

100 million doses no pattern of adverse events



## J&J / AstraZeneca

10 serious events per million doses =

1 event per 100,000 doses

In aviation this level of risk is insufficient



# The safety threshold for approval is different

National Governments are balancing

Risk of deaths to the population at risk

Risk of further deaths from delay in  
vaccination

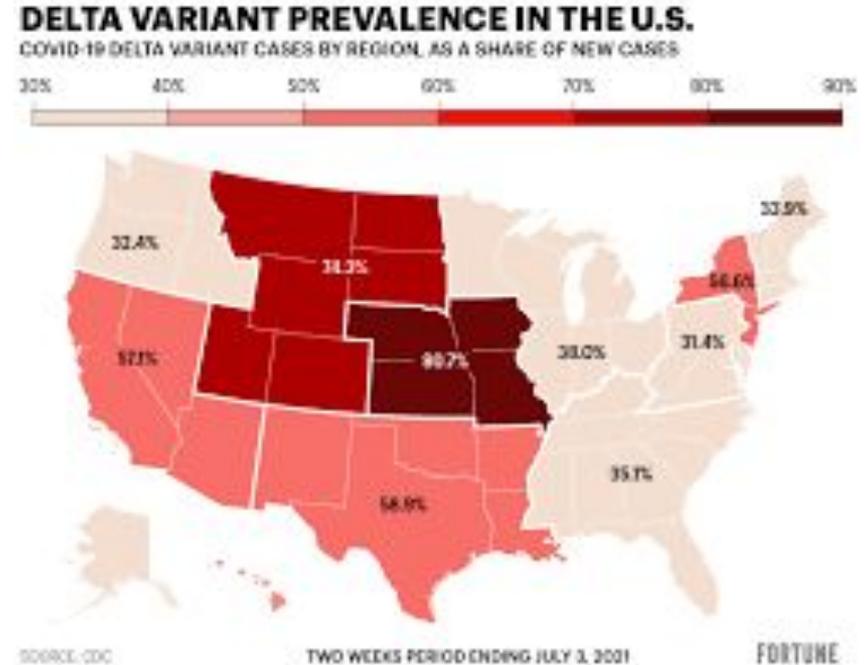
The 3 approved vaccines in the US have  
very high safety thresholds, but the mRNA  
vaccines currently have a significantly  
better safety profile than J&J



# The Delta Variant

The Delta variant is the most recent mutation or variation of the covid19 virus as it infects, reproduces and adapts. Covid only mutates when it infects us.

Covid19 coronaviruses **mutate** and have created variants that are much more infectious (sometimes twice as easily spread) and more dangerous (often 50% more invasive). Neighborhoods, Counties, States or Countries with low vaccination rate are now facing a virus that can infect them more easily, put them in the hospital more often, and infect them *again*. *Many people who already were infected last year by Covid19 appear to be able to get reinfected and ill from the variants.*

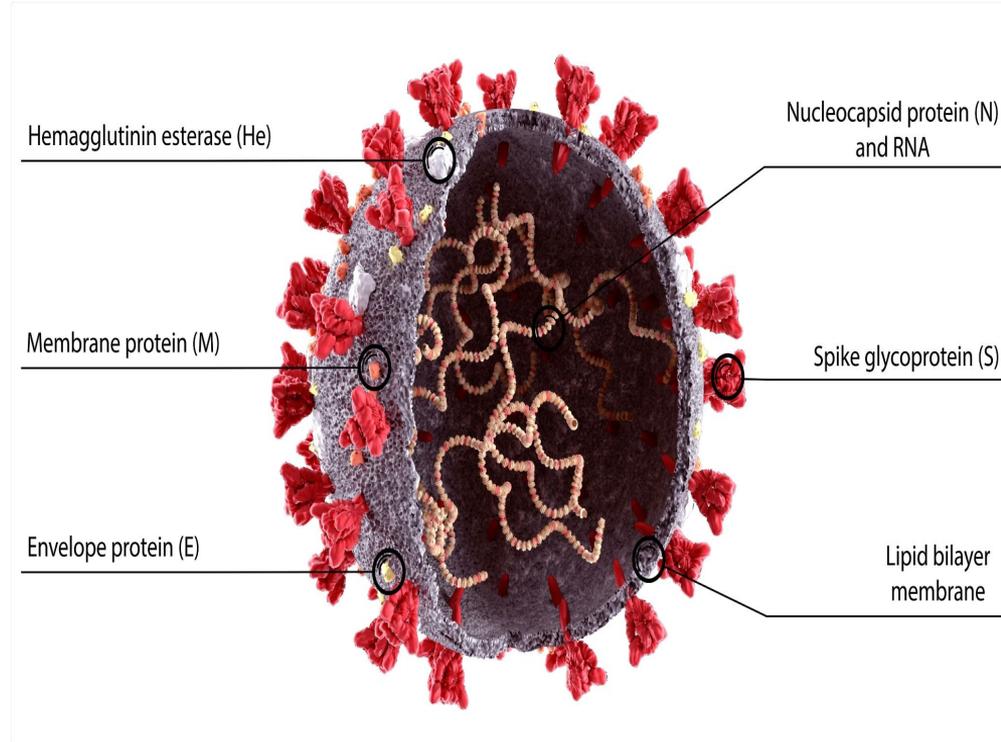


# Covid changes as it infects the unvaccinated - Delta

Each time more unvaccinated, unprotected people are infected with covid19, small errors as the virus makes our body copy itself can create a virus that is slightly better at infection, growth, or damaging it's host...that's us.

Delta grows more quickly, infects more easily and seems to be more damaging.

As each new person gets infection without immunity, another variant gets to infect more people, delta is not the last change. Until everyone is vaccinated, Covid will grow and change.

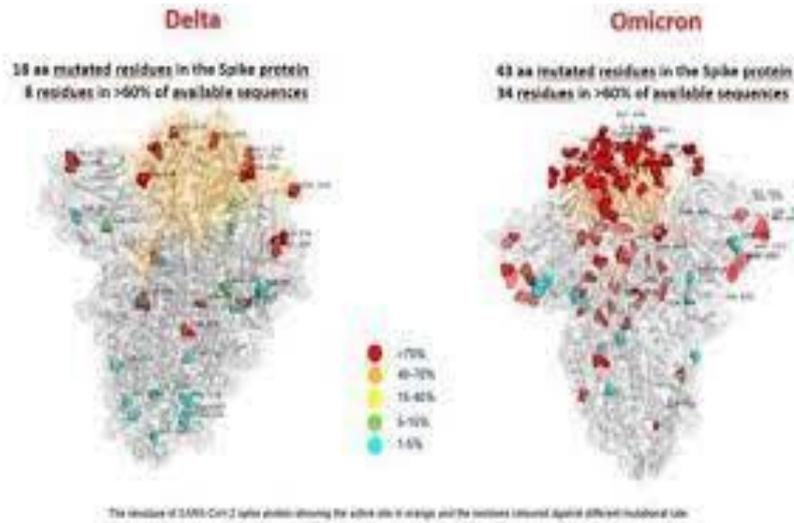


# Covid19, mutates again, Omicron Variant

The Omicron Variant emerged in fall 2021, almost 2 years after the original SARS-nCoV2 virus came into contact with humanity.

This time the variant was first noticed by South African scientists, who characterized the virus to have more than 50 mutations.

It spread more rapidly and became the most contagious Covid of all



# Omicron is the most infectious Coronavirus yet, spread extremely quickly, but is less aggressively deadly.

## Omicron Difference

- **More Contagious** - spreads easier
- **More Rapid Growth** - fully infectious in
  - 1-2 days instead of 5 days
  - *fortunately...*
- **Spreads to lungs more slowly** - so aggressive pneumonia takes longer

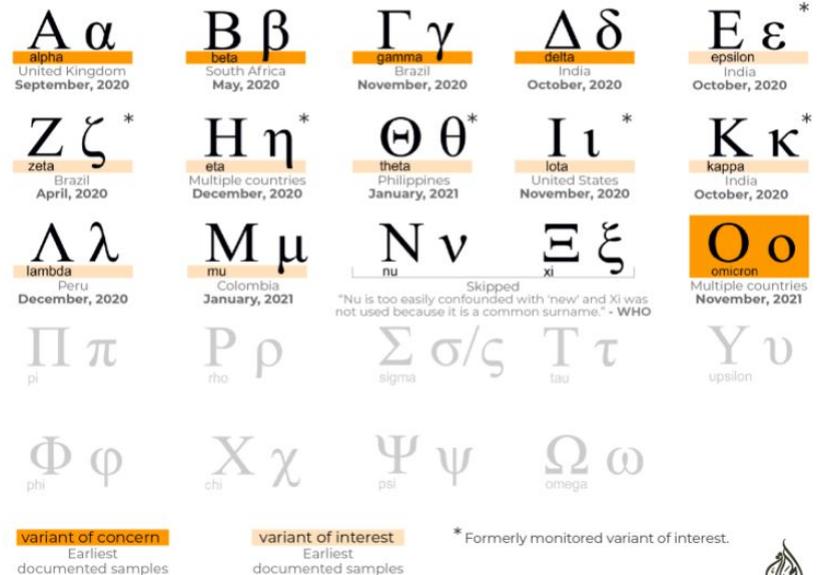
This gives the immune system time to fight back.

If the patient is VACCINATED...

## COVID-19

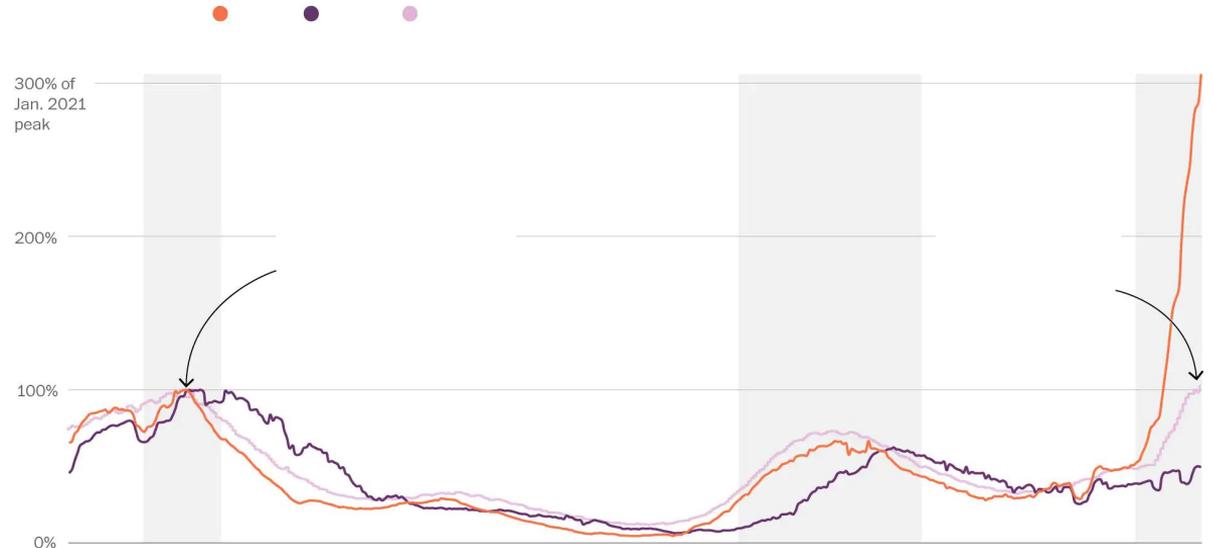
### How variants are named

The WHO has identified **five variants of concern (VOC)** and **eight variants of interest (VOI)**. They are named after the letters of the **Greek alphabet**.



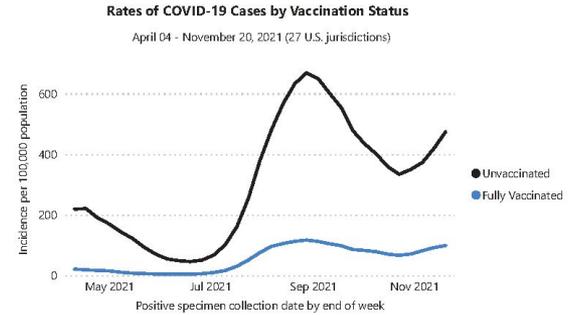
# Omicron became dominant faster than any Covid variant But much less deadly - Why? ....Vaccination and treatment

The Omicron wave winter 2022 has generated twice as much infection spread than the delta wave in fall 2021 or alpha and original covid in winter 2021. The rate of hospitalizations in new year 2022 is similar to 2021, but deaths are significantly lower.



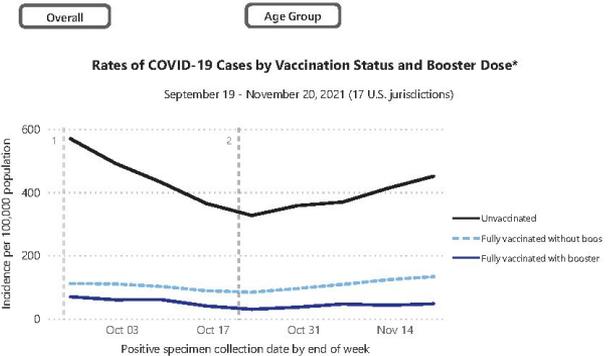
Delta and Omicron caused many more cases, but vaccination decreased the hospitalization and deaths....

The race between our group immunity and the Covid19 opportunity to mutate and reinfect



In October, unvaccinated persons had:

**5X** Risk of Testing Positive for COVID-19 **AND** **14X** Risk of Dying from COVID-19 compared to fully vaccinated persons



In October, unvaccinated persons had:

**10X** Risk of Testing Positive for COVID-19 **AND** **20X** Risk of Dying from COVID-19 compared to fully vaccinated persons with additional or booster doses

# The Rest of the Pandemic is a Race: Variant vs Immunity

## Virus - Infect - Assault - Transmit

Covid19 -Original = **5-7** days

Covid - Delta - = **3-5** days

Covid-**Omicron** - = **1-3** days

## Immune Response

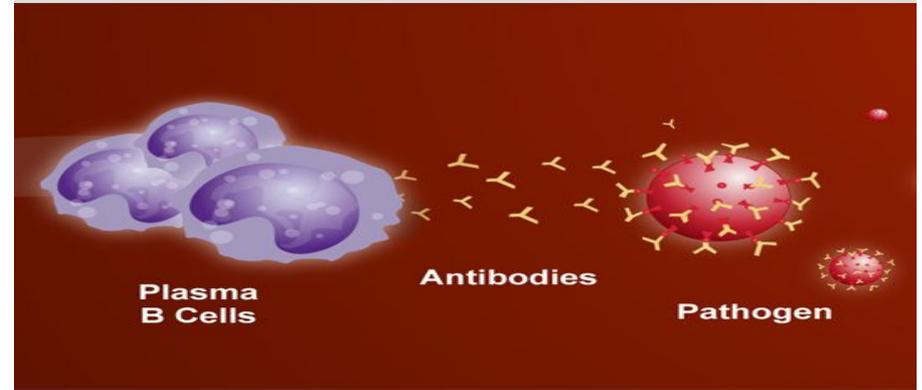
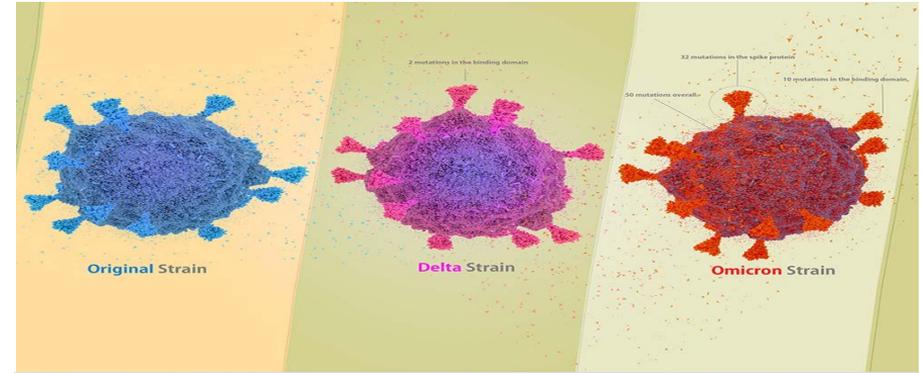
Unvaccinated = **5** days

Partial Vaccinated = **1-3** days

Full Vacc /Booster = **Hours!**

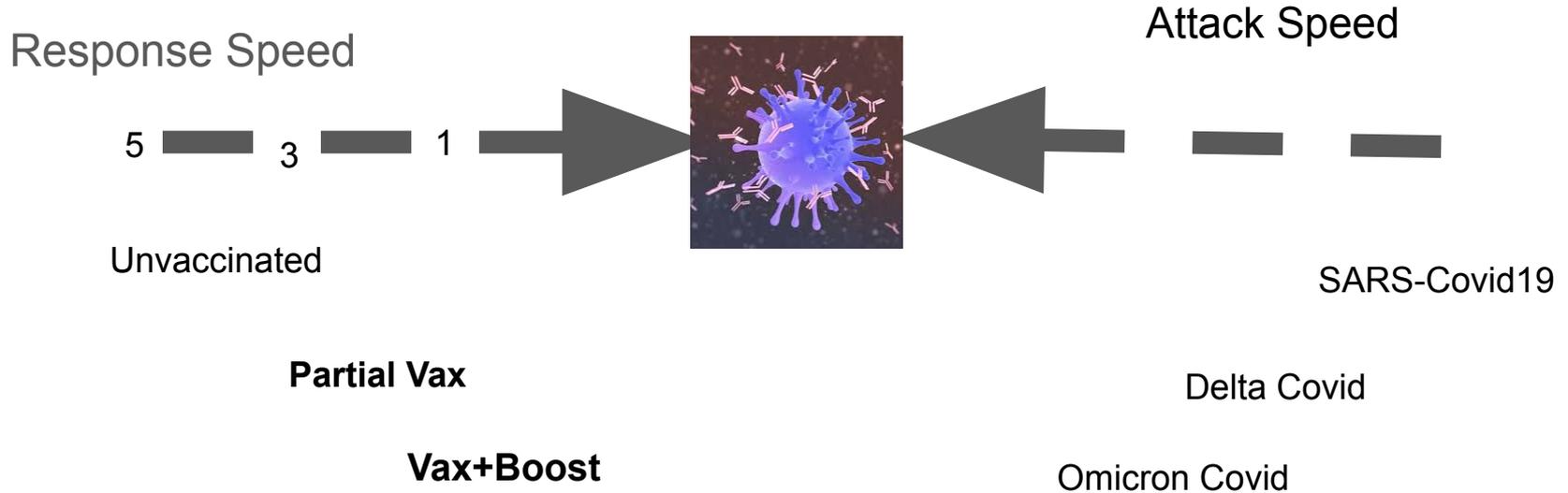
**Mutation selects for speed**

**Immunity enables speed**



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# Our Immunity vs Virus Adaption



Vaccination doesn't prevent us from being infected by covid, it lets our immune system start fighting the infection immediately, instead of the 5 day delay of natural immunity.

When Covid virus changes, our immune system is delayed by the change, but each dose of vaccine or

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