

COVID-19 Science

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'Virus' vs 'Bacteria'

The key differences between two common pathogens.



Viruses are not living organisms.



Viruses only grow and reproduce inside of the host cells they infect. When found outside of these living cells, viruses are dormant. Their “life” therefore requires the hijacking of the biochemical activities of a living cell.



Viruses are submicroscopic.



A viral infection is systemic. Viruses infect a host cell and then multiply by the thousands, leaving the host cell and infecting other cells of the body.



Systemic diseases caused by viral infection include influenza, measles, polio, AIDS, and COVID-19.

Bacteria are living organisms.



Bacteria are living organisms that consist of single cell that can generate energy, make its own food, move, and reproduce (typically by binary fission). This allows bacteria to live in many places—soil, water, plants, and the human body—and serve many purposes.



Bacteria are giant compared to viruses.



Bacterial infection is usually confined to a part of the body, described as a localized infection. Infections may be caused by the bacteria or by toxins (endotoxins) produced.



Bacterial diseases include pneumonia, tuberculosis, tetanus, and food poisoning.



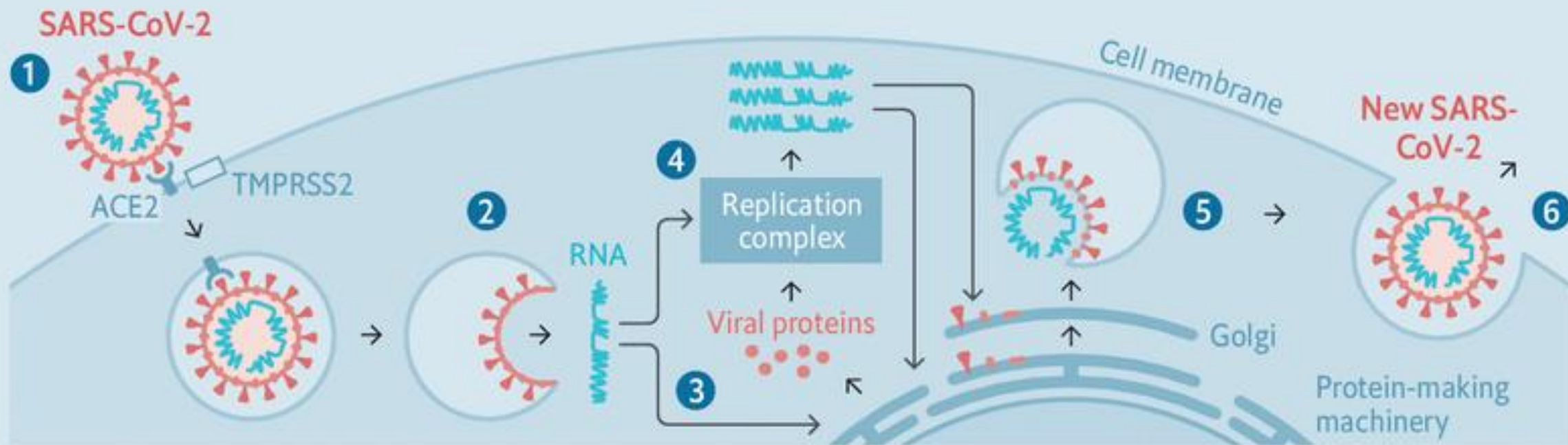
Source: <https://www.merriam-webster.com/words-at-play/virus-vs-bacteria-difference>

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Hijack

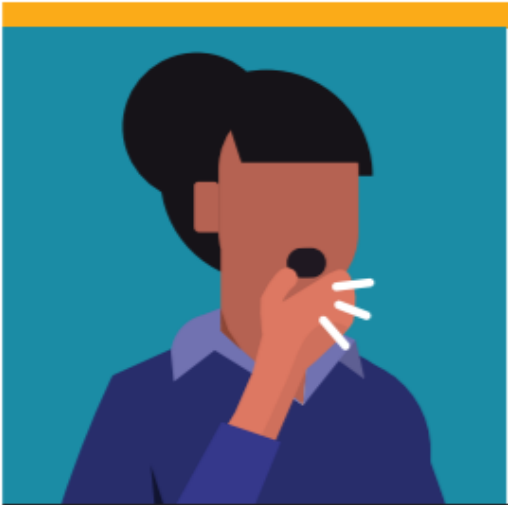
How SARS-CoV-2 replicates itself in the cells of those infected



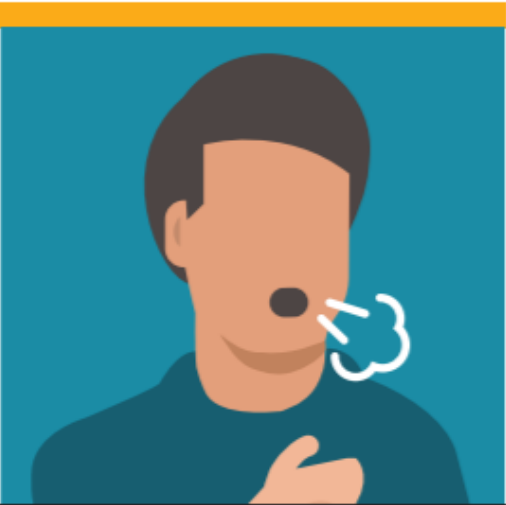
1 Spike protein on the virion binds to ACE2, a cell-surface protein. TMPRSS2, an enzyme, helps the virion enter **2** The virion releases its RNA **3** Some RNA is translated into proteins by the cell's machinery **4** Some of these proteins form a replication complex to make more RNA **5** Proteins and RNA are assembled into a new virion in the Golgi and **6** released

Sources: Song et al., *Viruses*, 2019; Jiang et al., *Emerging Microbes and Infections*, 2012; *The Economist*

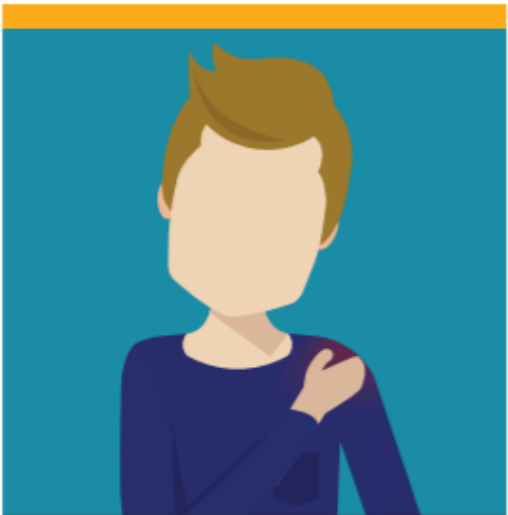
Know the symptoms of COVID-19, which can include the following:



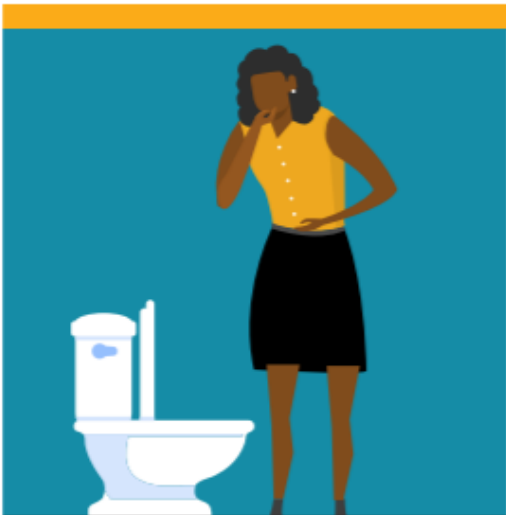
Cough, shortness of breath or difficulty breathing



Fever or chills



Muscle or body aches



Vomiting or diarrhea



New loss of taste or smell

<https://www.medmastery.com/guide/covid-19-clinical-guide/covid-19-disease-progression>

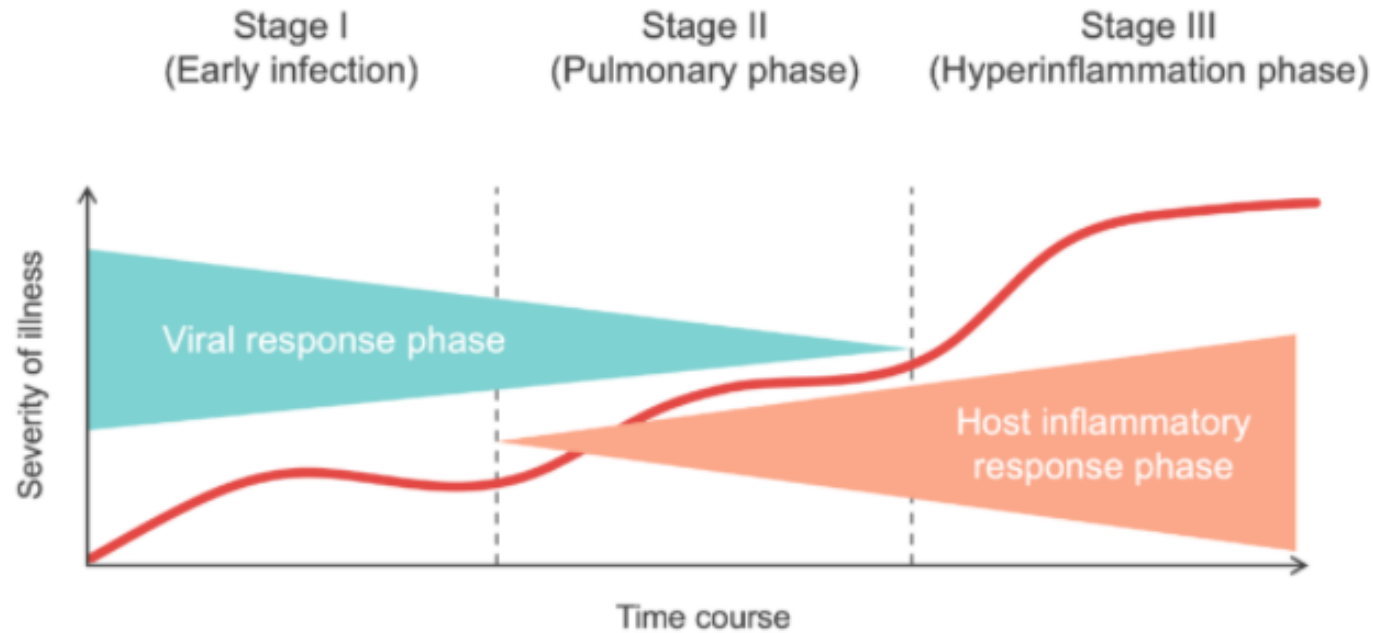
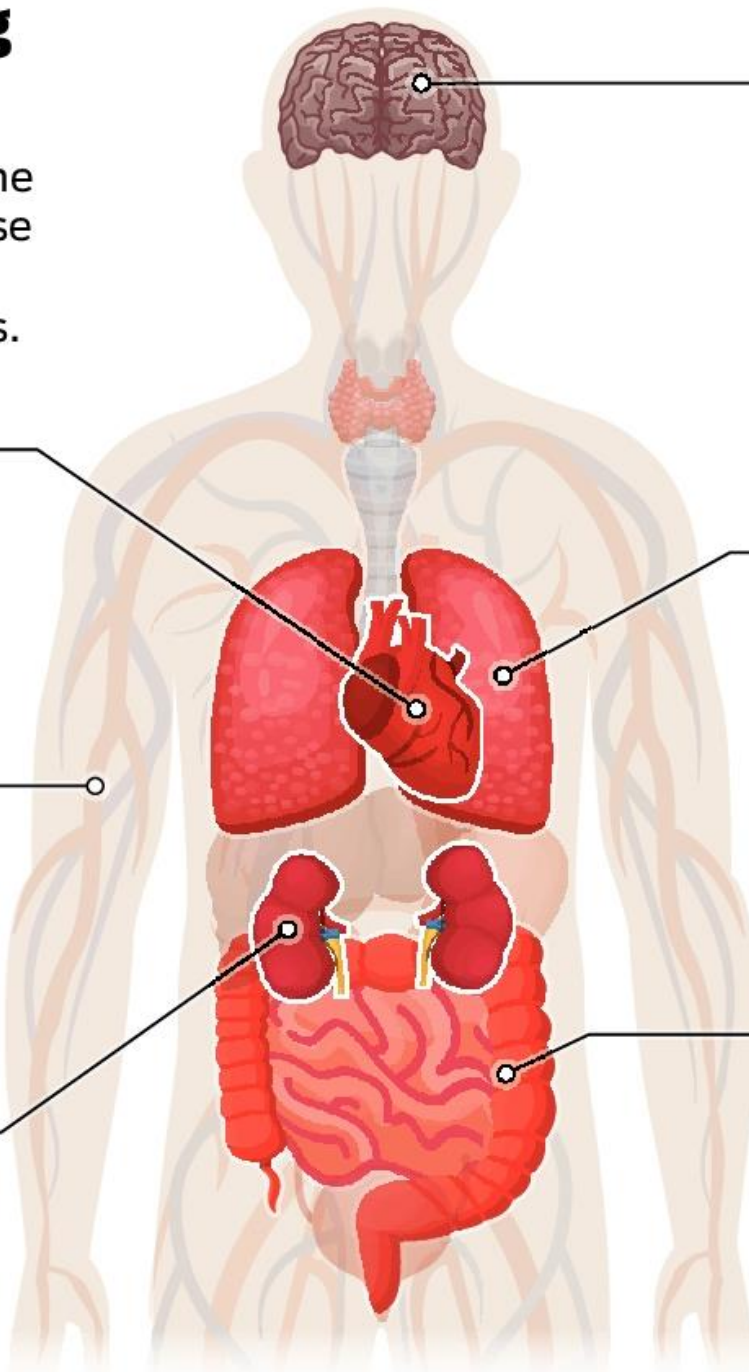


Figure 1. Infection with SARS-CoV-2 (COVID-19) can be classified into three stages of increasing severity: early infection, pulmonary phase, and hyperinflammation phase (Adapted from Siddiqi, HK, and Mehra, MR. 2020).

COVID-19's damaging effects on the body

Growing evidence suggests that the coronavirus, mostly known to cause respiratory illness, can also affect many of the body's primary organs.



Brain

People with COVID-19 have had strokes and seizures. Some have reported confusion or delirium. Not directly involving the brain but a central nervous issue: Many patients have reported losing their sense of smell.

Heart

Doctors have reported inflammation to the heart and damage to the muscle. Some patients have died from severe heart attacks.

Lungs

The virus can cause pneumonia, in which the lungs become inflamed and fill with fluid. Patients may require ventilation. As the infection progresses, the virus can cause serious lung damage, which can be fatal.

Blood vessels

Blood clotting in major arteries and veins has been reported. Clots can break off and damage multiple organs by stopping blood flow.

Kidneys

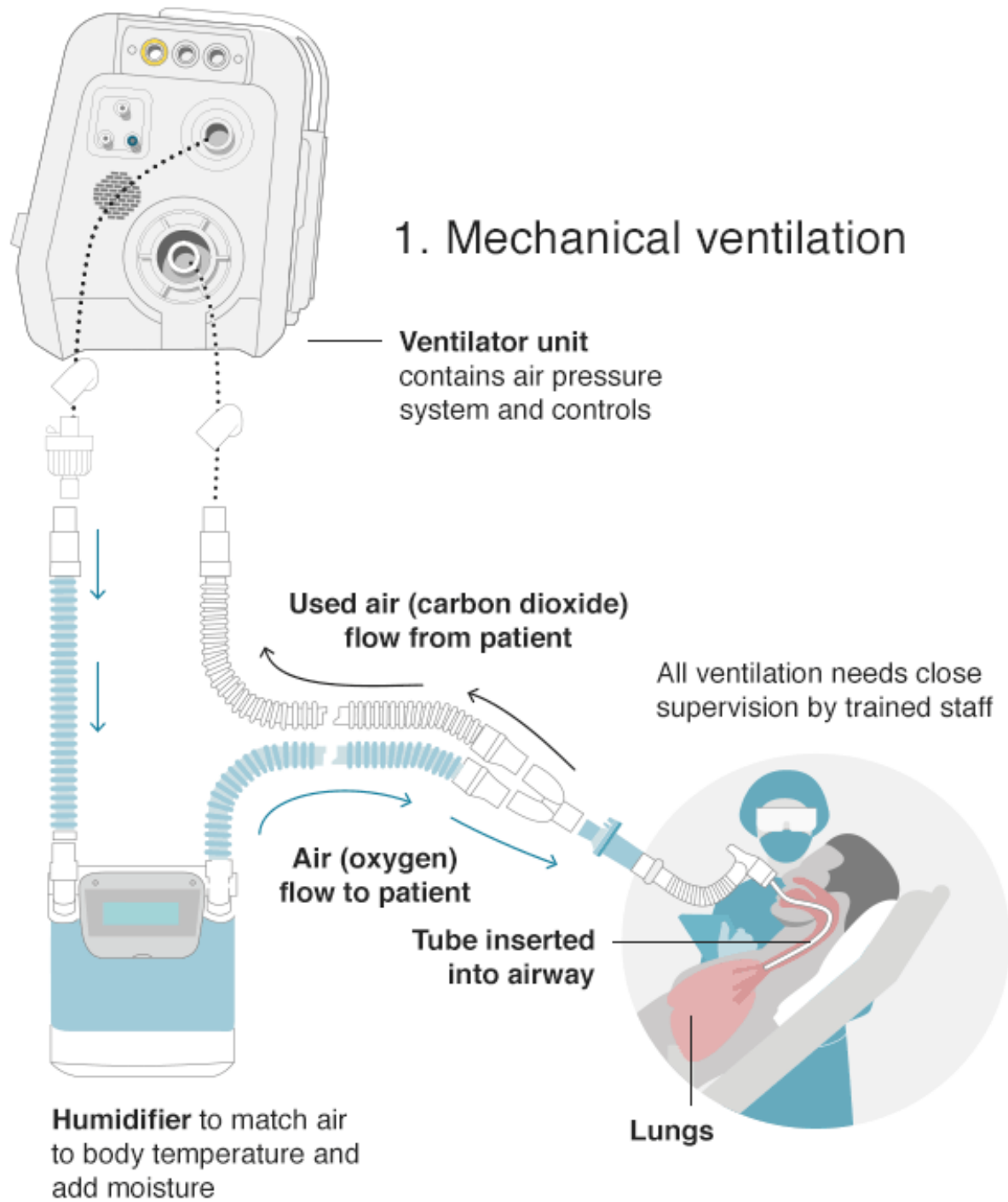
Many COVID-19 patients suffer serious kidney damage and require dialysis.

Intestines

Roughly 20% of patients report diarrhea as an early symptom. The virus has been found in the lower intestinal tract of some patients.

Patient State	Descriptor	Score
Uninfected	Uninfected; no viral RNA detected	0
Ambulatory mild disease	Asymptomatic; viral RNA detected	1
	Symptomatic; independent	2
	Symptomatic; assistance needed	3
Hospitalised: moderate disease	Hospitalised; no oxygen therapy*	4
	Hospitalised; oxygen by mask or nasal prongs	5
Hospitalised: severe diseases	Hospitalised; oxygen by NIV or high flow	6
	Intubation and mechanical ventilation, $pO_2/FiO_2 \geq 150$ or $SpO_2/FiO_2 \geq 200$	7
	Mechanical ventilation $pO_2/FiO_2 < 150$ ($SpO_2/FiO_2 < 200$) or vasopressors	8
	Mechanical ventilation $pO_2/FiO_2 < 150$ and vasopressors, dialysis, or ECMO	9
Dead	Dead	10

1. Mechanical ventilation



Ventilator unit
contains air pressure
system and controls

Used air (carbon dioxide)
flow from patient

All ventilation needs close
supervision by trained staff

Air (oxygen)
flow to patient

Tube inserted
into airway

Lungs

Humidifier to match air
to body temperature and
add moisture

Dr. Fawcett's observations on clinical care for persons with COVID19:

Main goal - prevent further damage while the body's immune response fights the infection, by:

- Boosting the immune response through passive immunization (e.g., convalescent plasma)
- A similar treatment may soon be administration of synthetic antibody (e.g., Regeneron).
- A second approach: slow viral replication while natural immune responses "catch up" via:
 - 5 day course of remdesivir.
- However, sometimes the immune response can too exuberant → "cytokine storm."
- Then, corticosteroids, e.g, methylprednisolone, may blunt this excessive immune response.

Two other important goals are:

- Alleviate suffering in patients that are not doing well; and
- Containment in the hospital and community to prevent further spread of the virus to others.

The goal of mechanical ventilation is to support patients in respiratory failure while waiting for an effective, natural immune response and/or while slowing viral replication with remdesivir.

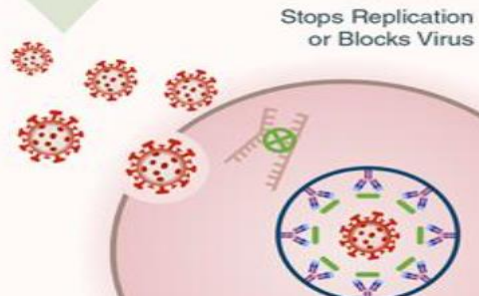
What has been learned?

REPURPOSED DRUGS

Existing first line of defense

Studying drugs that are already approved to treat other diseases to see if they are effective to treat COVID-19.

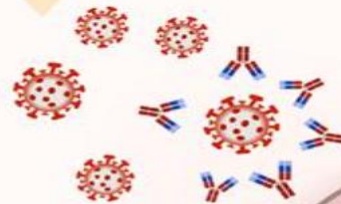
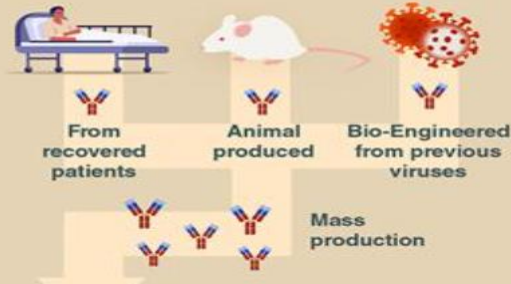
Ebola **HIV** **Malaria**



ANTIBODIES

Critical to treat this season's COVID-19

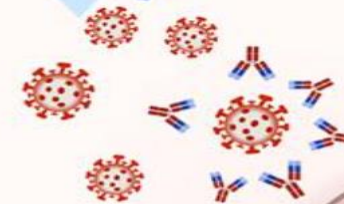
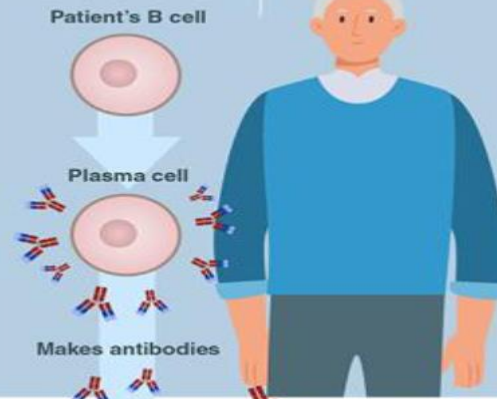
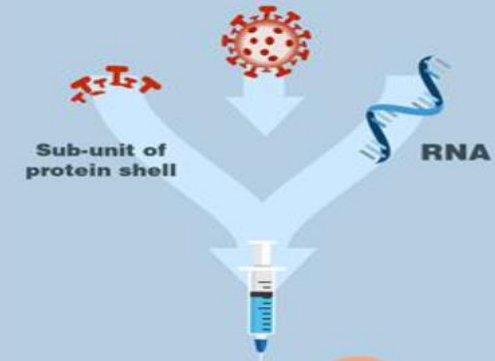
Y-shaped proteins that stick to the virus SARS-CoV-2. These can be manufactured through recombinant technology and injected into patients to prevent or reduce infection.



VACCINES

Critical to treat a seasonal COVID-19

Vaccines mimic enough of the viral infection to trigger the body's immune response which makes antibodies against the virus.



July 17, 2020 DOI: 10.1056/NEJMoa2021436

“Dexamethasone in Hospitalized Patients with Covid-19 — Preliminary Report”; The RECOVERY Collaborative Group

- The RECOVERY trial provides evidence that treatment with dexamethasone for up to 10 days reduces 28-day mortality in patients with Covid-19 who are receiving respiratory support. We found no benefit (and the possibility of harm) among patients who did not require oxygen.

October 22, 2020

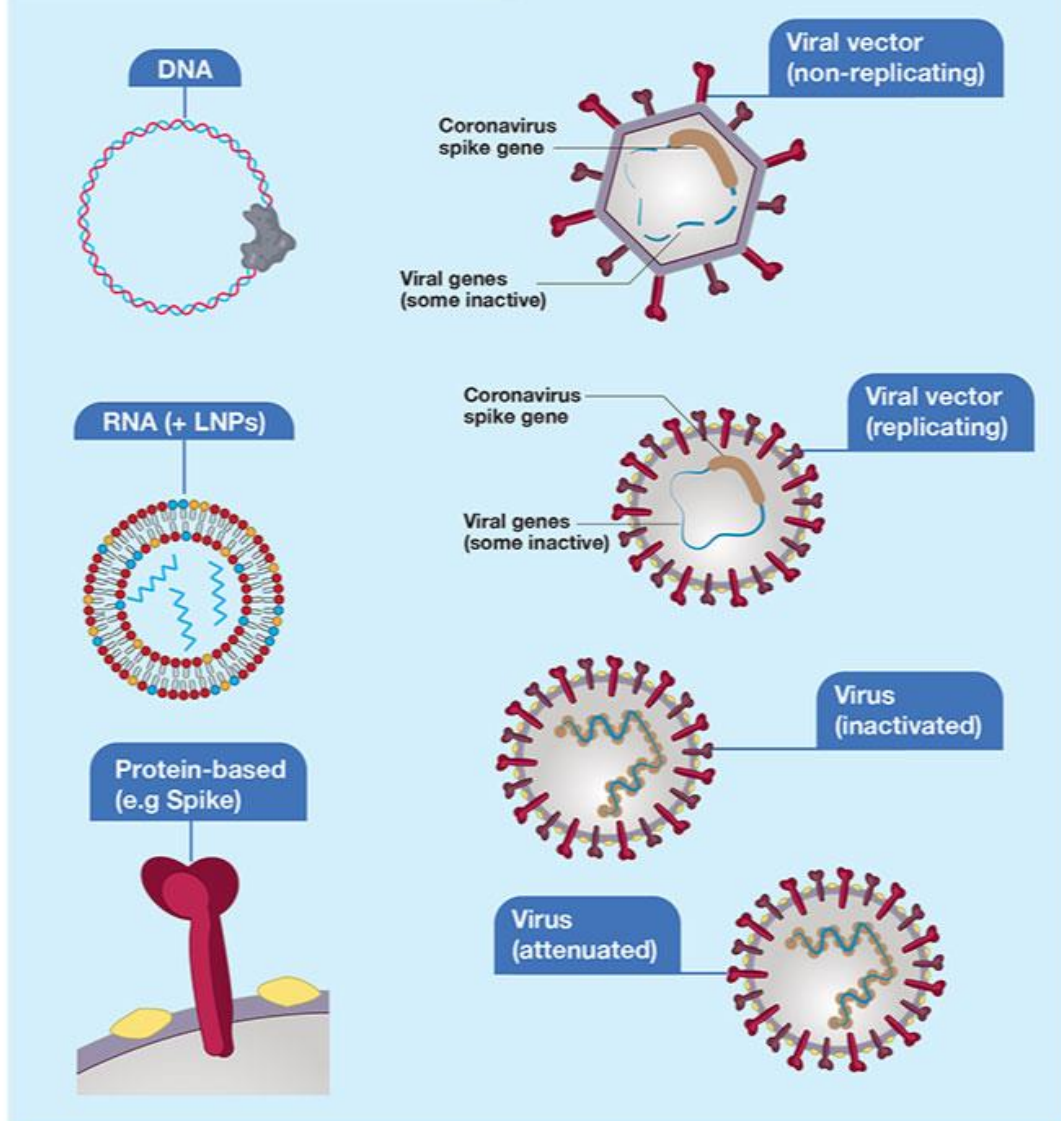
- U.S. Food and Drug Administration [approved](#) the antiviral drug Veklury (**Remdesivir**) for use in patients 12 years of age and older for the treatment of COVID-19 requiring hospitalization.
- Remdesivir should only be administered in a hospital or comparable acute care setting
- Remdesivir is the first treatment for COVID-19 to receive FDA approval.
- One [clinical trial](#) (ACTT-1), conducted by the National Institute of Allergy and Infectious Diseases, evaluated how long it took to recover from COVID-19 within 29 days of being treated.
- Recovery: discharged from the hospital or hospitalized but not requiring supplemental oxygen and no longer requiring ongoing medical care.
- The median time to recovery from COVID-19 was 10 days for the [Remdesivir] group compared to 15 days for the placebo group, a statistically significant difference.

(Note: This drug demonstrably shortened the course of illness. It is not a “cure.”)

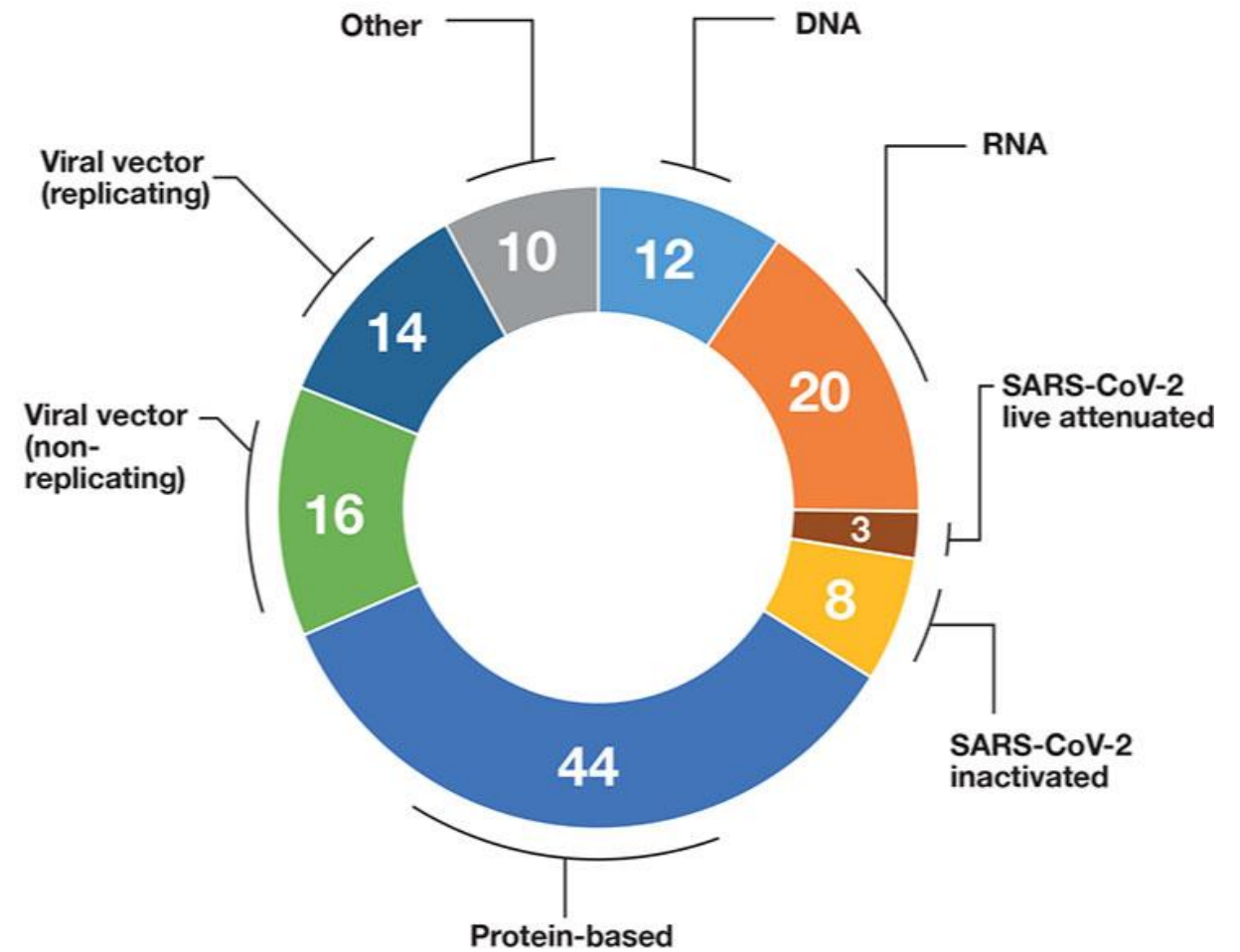
COVID-19 Vaccine

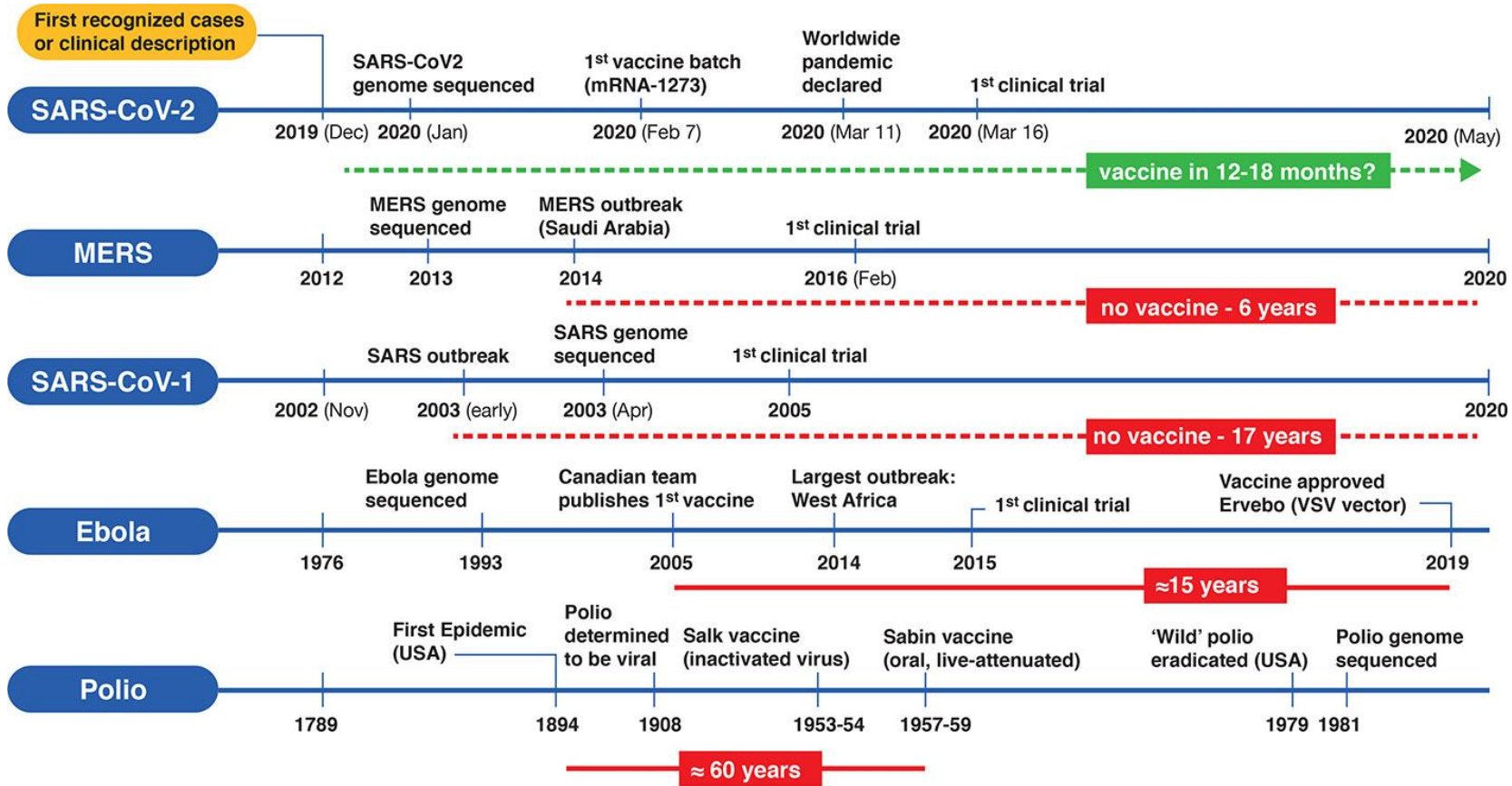


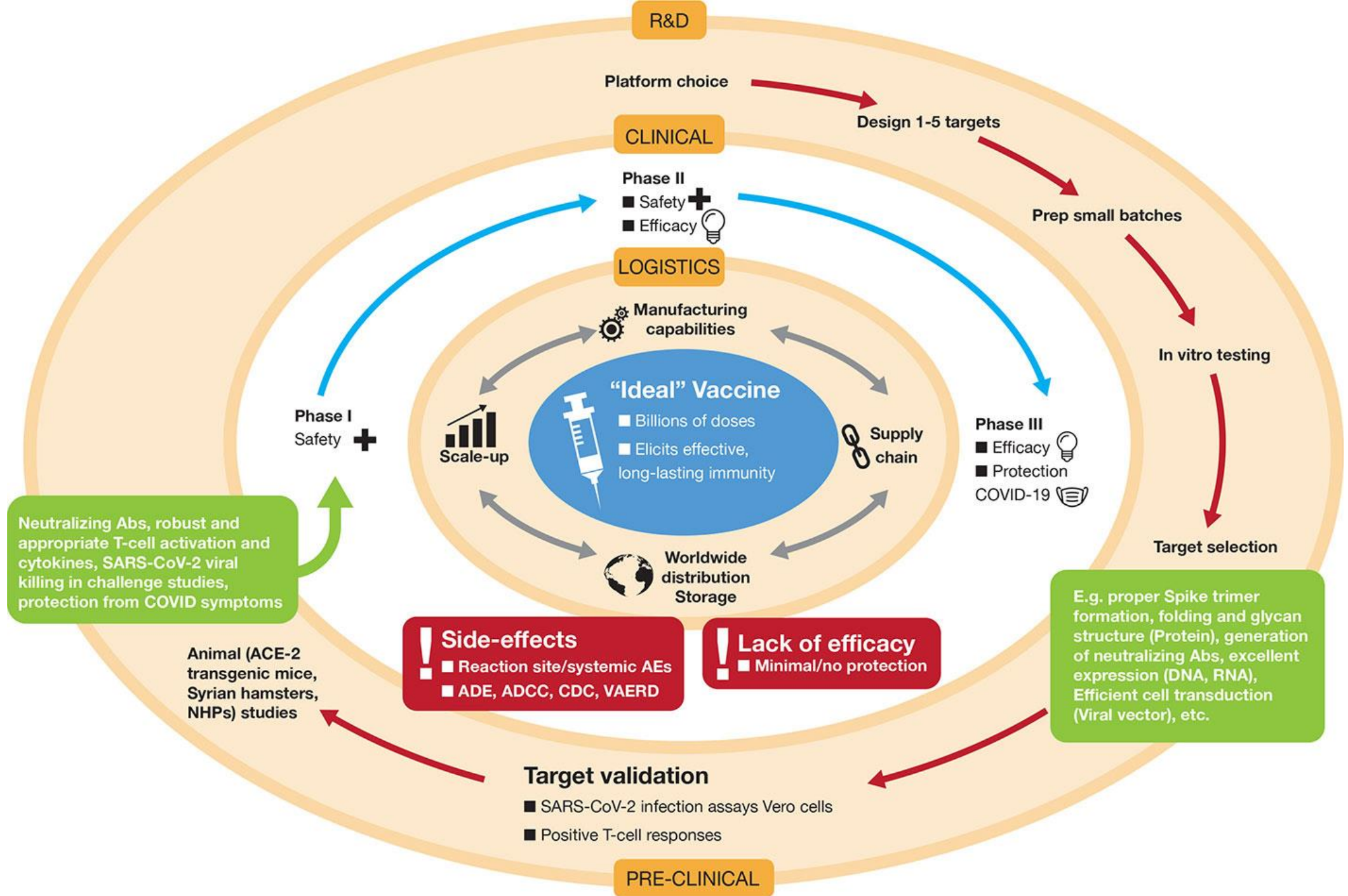
A Vaccine Platforms



B Vaccine Candidates

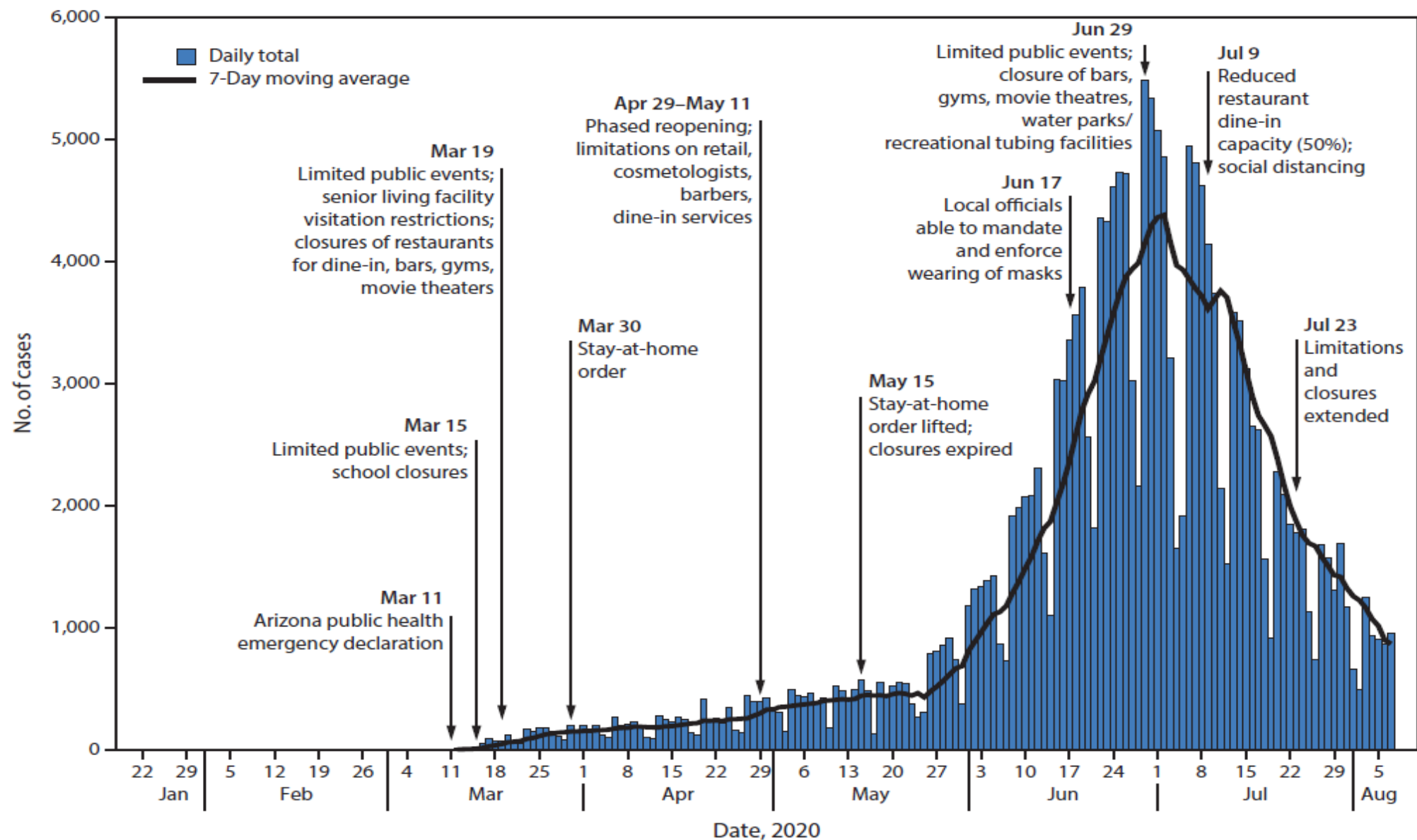






Morbidity and Mortality Weekly Report: Trends in COVID-19 Incidence After Implementation of Mitigation Measures — Arizona, January 22–August 7, 2020

FIGURE. Selected community mitigation measures* and COVID-19 case counts[†] and 7-day moving averages[§] — Arizona, January 22–August 7, 2020



Arizona's prevention and control measures over the summer months helped slow the spread of COVID-19

151% 

in cases after stay-at-home order lifted

Number of cases stabilized then decreased after multiple statewide and local prevention measures implemented



75% 

in cases following sustained prevention efforts across the state

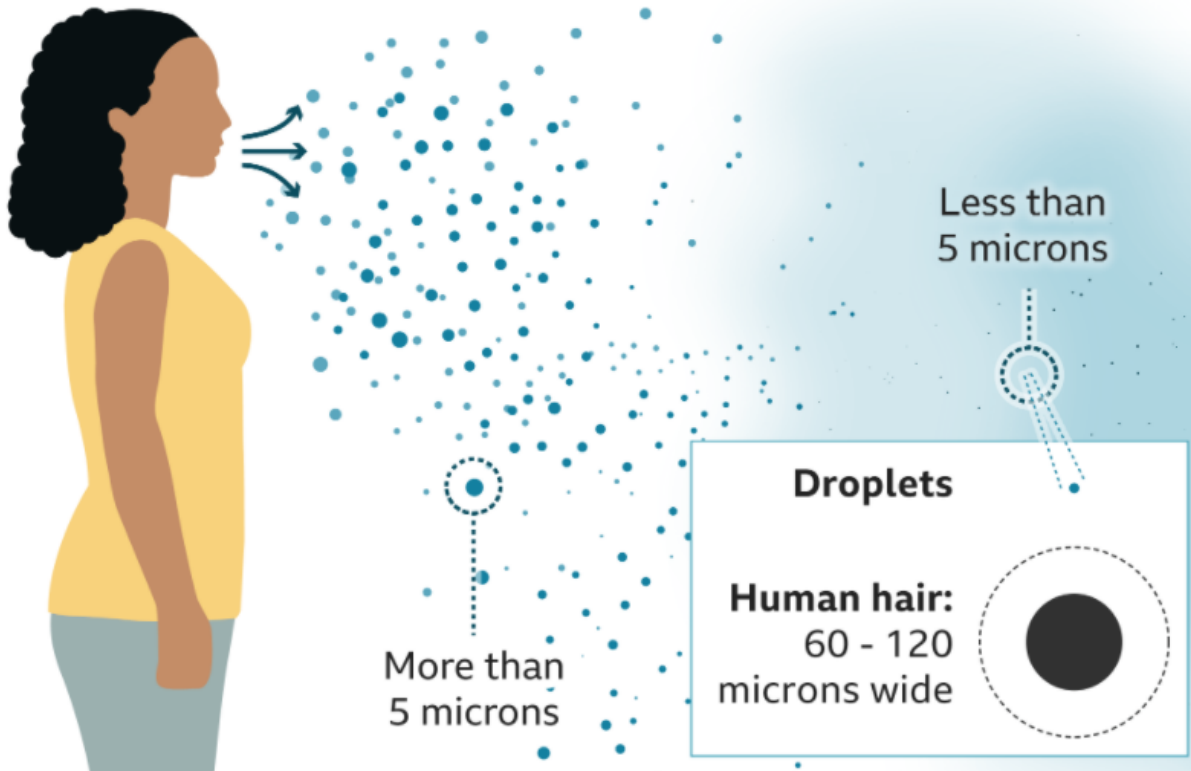
The difference between droplet and airborne transmission

Droplet transmission

Coughs and sneezes can spread droplets of saliva and mucus

Airborne transmission

Tiny particles, possibly produced by talking, are suspended in the air for longer and travel further



Source: WHO



COVID-19

CORONAVIRUS DISEASE

BE INFORMED:

Know Your Risk During COVID-19

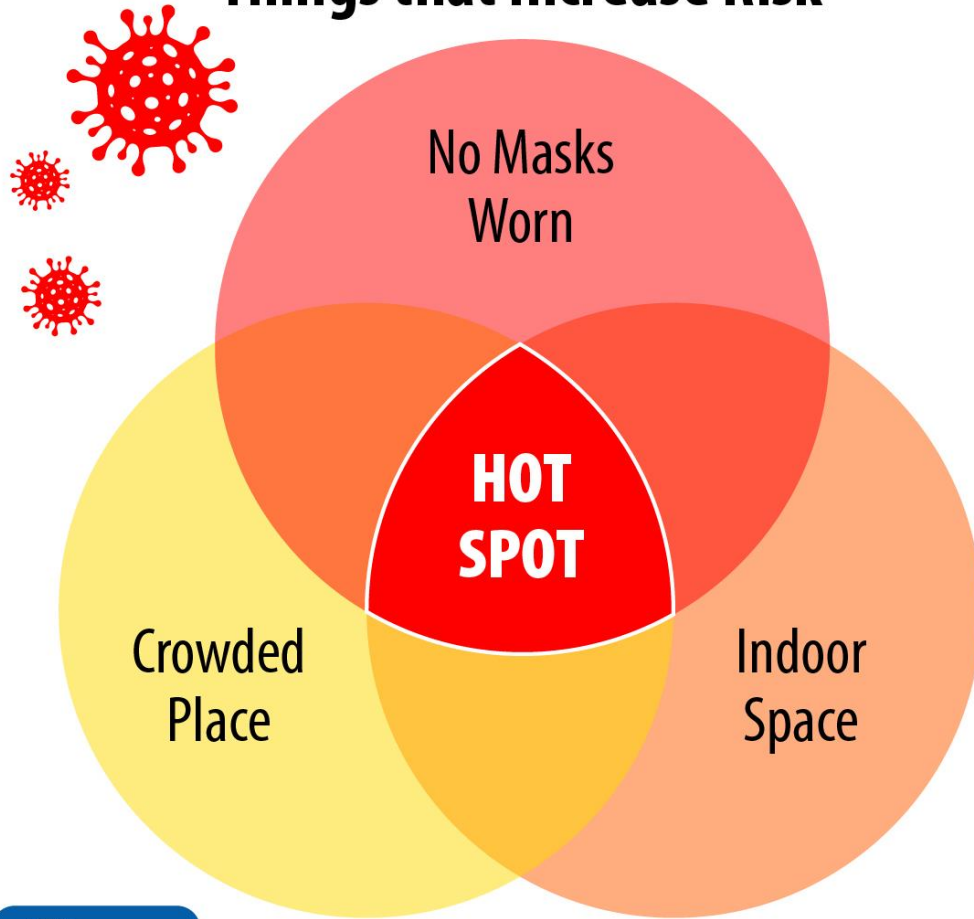
On a scale of 1 to 10, how risky is...

Ranked by physicians from the TMA COVID-19 Task Force and the TMA Committee on Infectious Diseases. Please assume that participants in these activities are following currently recommended safety protocols when possible.

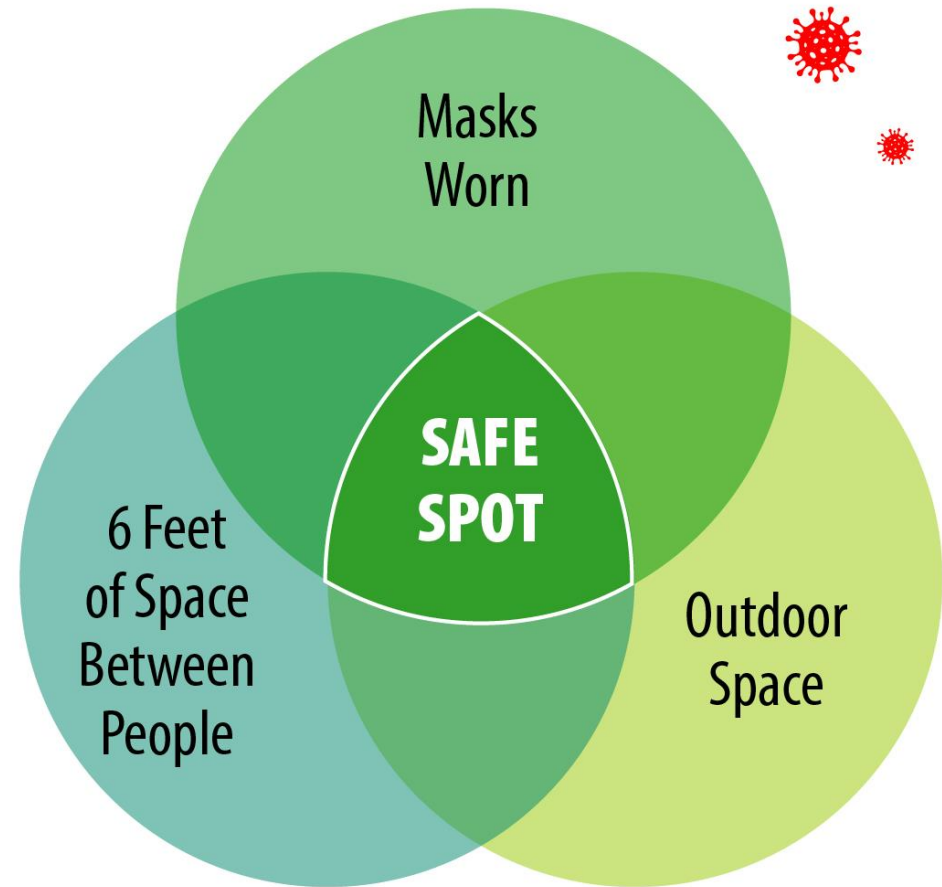


Tips for Reducing Risk of Getting COVID-19

Things that Increase Risk



Things that Decrease Risk



www.cdc.gov/coronavirus

Coronavirus Disease 2019 (COVID-19)



Face Shields

- A face shield is primarily used for eye protection for the person wearing it. **At this time, it is not known what level of protection a face shield provides to people nearby from the spray of respiratory droplets from the wearer.** There is currently not enough evidence to support the effectiveness of face shields for source control. Therefore, CDC **does not currently recommend** use of face shields as a substitute for masks.
- However, wearing a mask may not be feasible in every situation for some people for example, people who are deaf or hard of hearing—or those who care for or interact with a person who is hearing impaired. Here are some considerations for individuals who must wear a face shield instead of a mask:
 - Although evidence on face shields is limited, the available data suggest that the following face shields may provide better source control than others:
 - Face shields that wrap around the sides of the wearer’s face and extend below the chin.
 - Hooded face shields.
 - Face shield wearers should wash their hands before and after removing the face shield and avoid touching their eyes, nose and mouth when removing it.
 - Disposable face shields should only be worn for a single use and disposed of according to manufacturer instructions.
 - Reusable face shields should be cleaned and disinfected after each use according to manufacturer instructions or by following [CDC face shield cleaning instructions](#).
 - **Plastic face shields for newborns and infants are NOT recommended.**

Thank you

www.deschutes.org/covid-19
