Mythbusting COVID-19 vaccines

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Key points

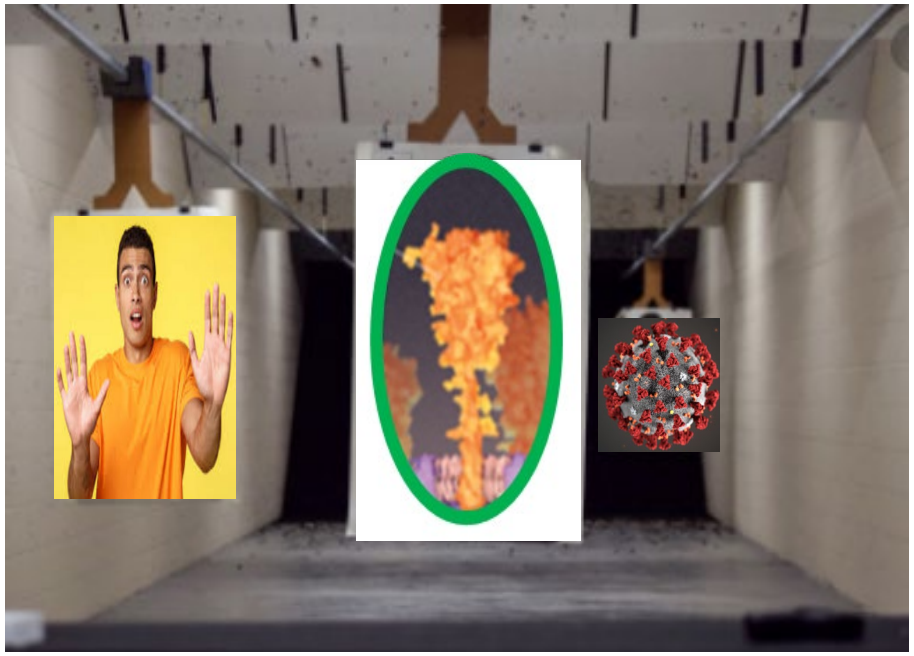
- How do they work?
  - mRNA vaccines (Pfizer and Moderna)
  - Viral vector (Janssen/J&J and AstraZeneca)
  - Protein-based (Novavax, GSK and Sanofi)
- Are they safe?
- Are they effective?
- Other frequently asked questions … and answers!
- On a personal note: Why I got the COVID-19 vaccine

How do they work?

- Vaccines provide a safer way to teach our immune system how to recognize and destroy viruses or bacteria that shouldn't be there – **without the need to get sick first.**

- Viral or bacterial surface proteins are used as the "targets" to train our immune system in many existing vaccines.

How do they work?



- All COVID-19 vaccines use the SARS-CoV-2 virus spike protein as the target for our immune system to recognize and learn to destroy the virus.
  - The main difference between the COVID-19 vaccines is how the target protein is made.
  - Pfizer and Moderna mRNA vaccines are really only “new technology” in that mRNA is where the process to make the target protein starts.

How do they work?
mRNA vaccines

- mRNA is shorthand for “messenger RNA.”
- mRNA: The “written” messages (recipe/instructions) our cells use to make proteins.
- In this case, the mRNA instructions in the vaccine tells our cells how to build the SARS-CoV-2 virus spike protein.

How do they work?

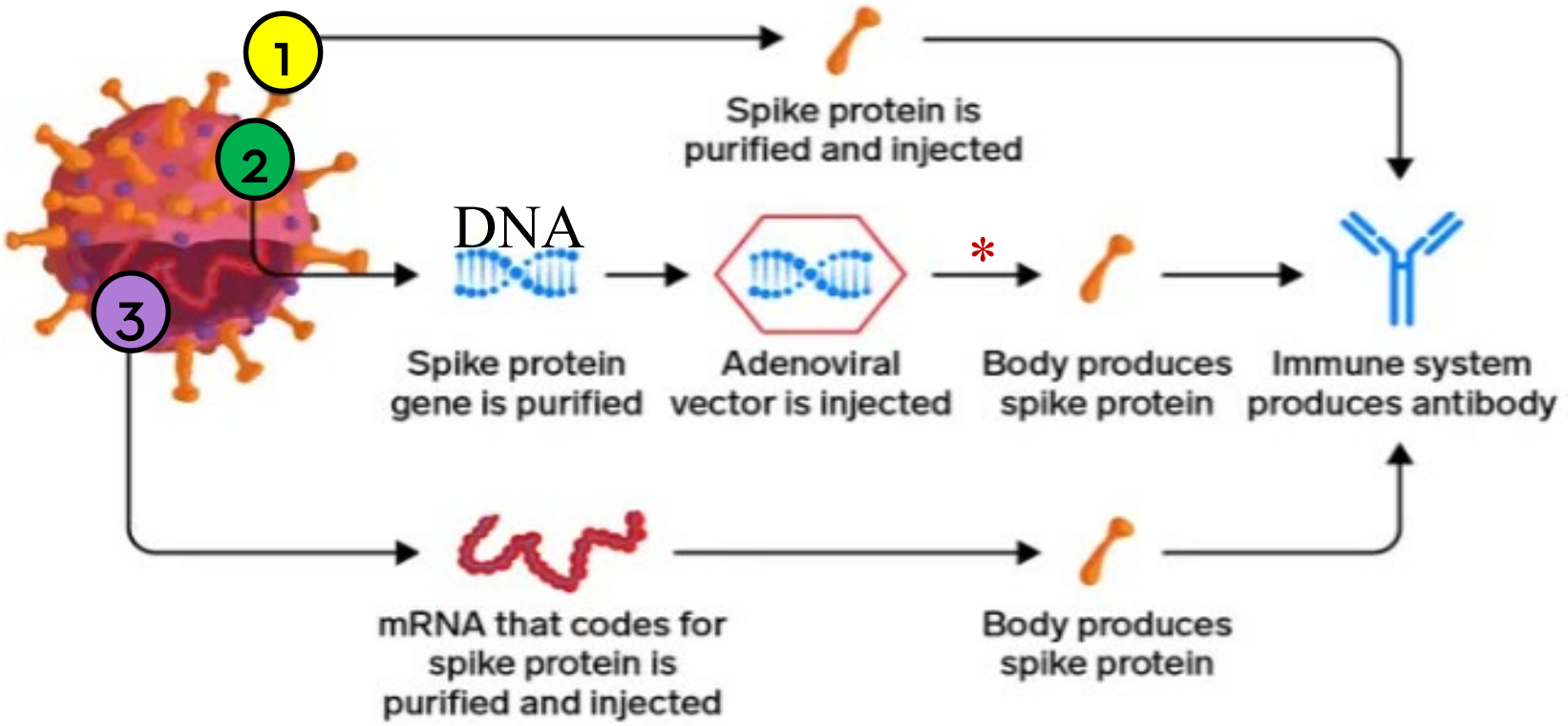
- If different types of vaccines for COVID-19 built the spike protein like we might build a bookshelf…

Three types of coronavirus vaccines

1 **Protein-based**
- -Novavax
- -GSK
- -Sanofi

2 **Viral vector**
- -Janssen/J&J
- -AstraZeneca

3 **mRNA**
- -Pfizer
- -Moderna



Source: National Institutes of Health presentation at Senate hearing on September 9, 2020

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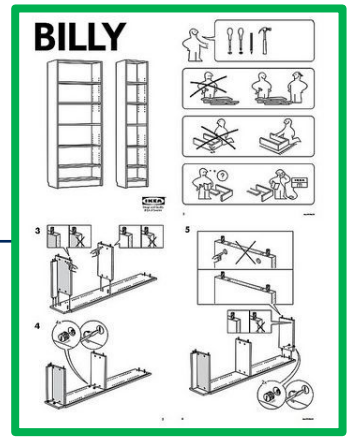

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Are they safe? YES

- The same process to evaluate safety for other vaccines and medications is being followed.
  - Development was swift because vast resources were applied.
  - All of the regular agencies and groups that are involved with ensuring vaccine safety (FDA, CDC, ACIP and others) rigorously monitored vaccine development and reviewed trial results.
  - Additional monitoring programs (e.g. V-Safe) were created so that even rare side effects can be quickly identified as more people are vaccinated.

Are they safe? YES

- You *cannot* get COVID-19 from any of these vaccines.
  - They are not made using live or weakened virus particles, and they provide instructions for only one of the viral proteins.
  - mRNA is degraded by the natural processes within cells after the spike protein is made.
  - They do not change your genes.

Are mRNA vaccines safe? YES

- What is actually in these vaccines?
  - mRNA instructions
  - Lipid (fatty) envelope, stabilized by polyethylene glycol (PEG)
  - Salts, sugars and buffers
- The mRNA vaccines do not contain eggs, wheat, gelatin, preservatives, fetal cells, latex (or microchips!)

- Persons with allergic reactions (including severe allergic reactions) not related to these vaccines or their components, such as other injectable medicines or vaccines, as well as allergies to foods, pets, venom or environmental allergies, can safely get these vaccines.

Who should not get the vaccine

- Persons with an immediate allergic reaction to polyethylene glycol (or polysorbate)

- Persons with a history of severe allergic reaction (anaphylaxis) or an immediate allergic reaction after a prior dose of an mRNA COVID-19 vaccine or any of its components

Reported reactions — mRNA vaccines

Reactogenicity	Pfizer (16-55 y/o)	Pfizer (>55 y/o)	Moderna (<65 y/o)	Moderna (>65 y/o)
Local:				
Redness	5% **6%**	5% **7%**	3% **9%**	2.3% **7.4%**
Swelling	6% **6%**	7% **7%**	6.7% **12.6%**	4.4% **10.8%**
Pain at injection site	83% **78%**	71% **66%**	86.9% **90.1%**	74% **83.4%**
Systemic:				
Fatigue	47.4% **59.4%**	34.2% **50.5%**	57% **81.9%**	38.5% **58.4%**
Headache	41.9% **51.7%**	25.2% **39%**	35.4% **62.8%**	33.3% **46.4%**
Muscle pain	21.3% **37.3%**	13.9% **28.7%**	23.7% **61.3%**	19.8% **46.9%**
Chills	14.0% **35.1%**	6.3% **22.7%**	9.2% **48.3%**	5.4% **30.6%**
Joint pain	11.0% **21.9%**	8.6% **18.9%**	16.6% **45.2%**	16.4% **34.9%**
Fever	3.7% **15.8%**	1.4% **10.9%**	0.9% **17.4%**	0.3% **10.2%**
Nausea/vomiting	1.2% **1.9%**	0.5% **0.7%**	9.3% **21.3%**	5.2% **11.8%**

What we still don't know

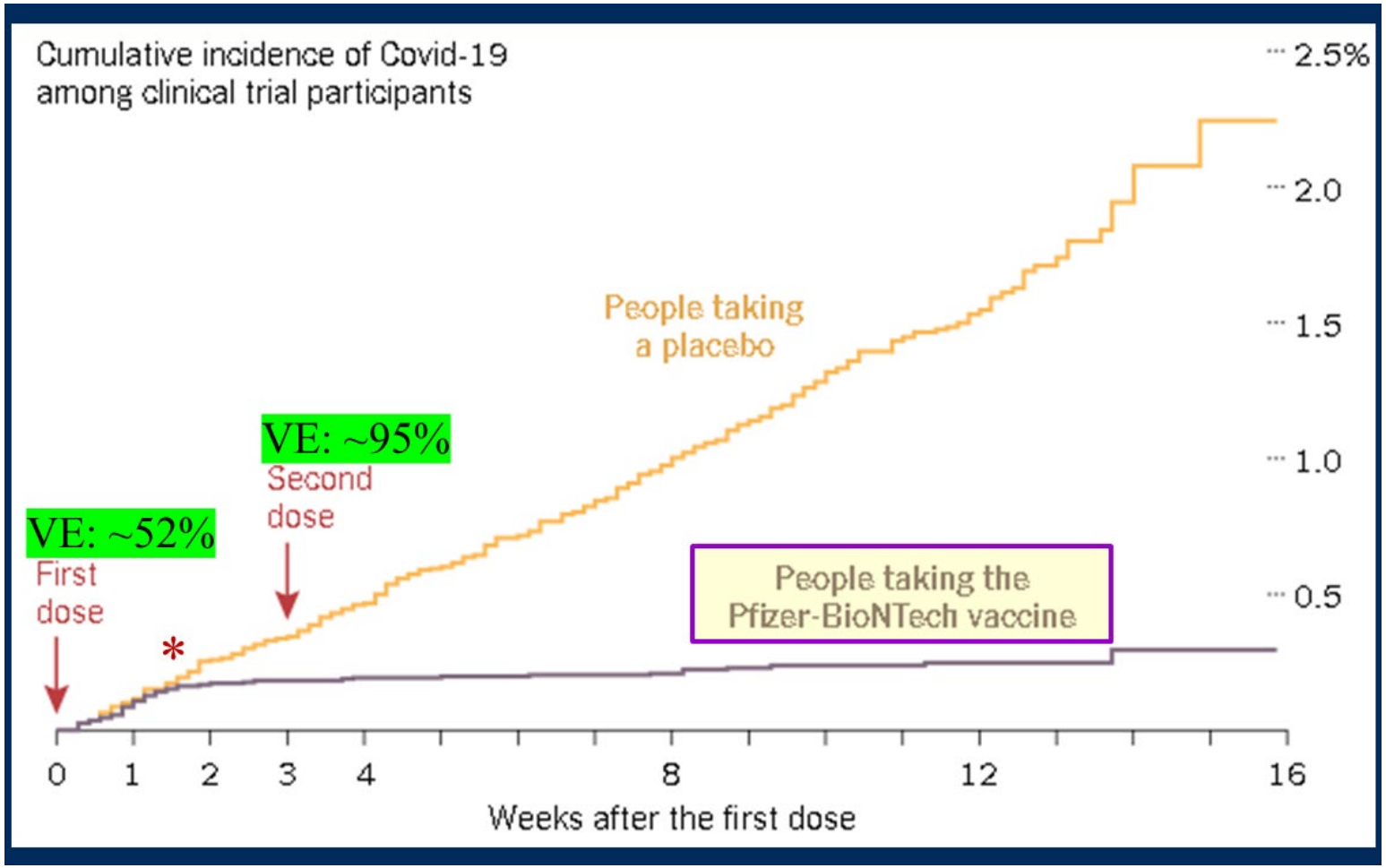
- Groups not included in clinical trials, or for which we have limited safety and efficacy data:
  - Pregnant and lactating women
  - Persons with a history of anaphylaxis and severe allergic reactions
  - Persons with autoimmune conditions
  - Severely immunocompromised individuals

Are they effective?

	Pfizer	Moderna
Efficacy against COVID-19:	95% 7d after 2nd dose	94.5% 14d after 2nd dose
Demographic differences?	No	No
Children?	? (<16 y/o)	? (<18 y/o)
Co-morbidity differences?	No	No

Are they effective?

- Pfizer data is shown.
- Moderna data is very similar.



Are they effective?

- Janssen/Johnson & Johnson vaccine
  - Applied for FDA emergency use authorization on Feb. 4; will present data to the FDA on Feb. 26.
  - Viral vector-based vaccine, requires a single dose
  - 28 days after vaccination:
    - 85% efficacy in preventing severe illness (all regions)
    - 66% efficacy overall

Are they effective?

- Novavax vaccine
  - Has not yet applied for FDA emergency use authorization, but will likely do so soon
  - Protein-based vaccine; two doses 21 days apart
  - UK phase 3 trial interim results, starting 28 days after first dose:
    - 89.3% efficacy at preventing disease
  - South African study
    - 60% efficacy in South Africa

FAQs

How long does immunity last after vaccination?

We are still waiting to determine how long immunity lasts after infection and after vaccination. But we know that immunity with both lasts at least several months. Stay tuned!

Isn't developing natural immunity better than immunity from vaccines?

No! Many vaccines produce more reliable immunity than the infection they were developed to prevent. Many people who are infected with COVID-19 have symptoms that may last weeks or months. Even young and healthy people can die from COVID-19 and its complications. Unless you have a contraindication to vaccination, the risk associated with COVID-19 is much higher than the potential risks of vaccination.

Should I get the vaccine if I've already had COVID-19?

As long as you have recovered and been released from isolation, you can get the vaccine. But you may be asked to wait 90 days, since we know most people are protected against becoming infected again for at least this long.

FAQs

I just had a high-risk exposure to someone with COVID-19. Should I get the vaccine?

Wait until your 14-day quarantine is over, unless you're in a congregate setting or due for your second dose.

Can I get the vaccine if I had COVID-19 and was treated with monoclonal antibodies or convalescent plasma?

Yes, but wait at least 90 days, as these antibodies may make vaccination during this period less effective.

What if I was in a vaccine trial?

Vaccination is still recommended because you may have received a placebo instead of the actual vaccine.

Will the vaccine protect against the new virus variants I've heard about?

Studies are being done now; so far it looks like most of the vaccines will provide at least partial protection. Partial protection against developing severe COVID-19 is still much safer than NO protection against COVID-19. The more people that have at least partial protection the safer we ALL will be.

FAQs

What if I'm pregnant or lactating?

Studies are ongoing; there are no obvious risks based on how the vaccine works, or in studies of these vaccines in pregnant animal models, but a discussion with your personal doctor is recommended. Pregnancy is a risk factor for developing more severe COVID-19, and in those who are at higher risk of exposure (such as health care workers) the benefit likely outweighs the risk associated from a lack of explicit data. Of note, there is also NO evidence suggesting that these (or any other vaccines, for that matter) cause or will cause problems with fertility. It is important that pregnant women who have a fever after vaccination treat it.

When can I throw a mask burning party?

Not yet. We don't yet know if vaccination prevents infection completely enough to prevent further transmission of the virus, or if it just prevents recipients from illness and symptoms if they are infected.
Until we do, assume you can still become asymptomatically infected and infect others. As a health care worker, you have priority access to the vaccine, but it will take longer before your family, friends and everyone in our community have access to it, too.

Why I got the COVID-19 vaccine

1. I've reviewed the safety and efficacy data; these vaccines are safe and highly effective. Pfizer and Moderna may be the first mRNA vaccines used widely, but I'm certain they won't be the last!
2. I care about my own health, as well as the health of my patients, my family and the community — and I want to be part of the solution.
3. The data show the vaccines will help protect me from getting sick. I anticipate that we will soon also find they help protect others indirectly, even if that protection isn't perfect.
   – Until we know more about this, you'll see me wearing a mask and keeping my distance, though!
4. It may be a year or more before we can really start to return to "normal." *The quickest way to get there is to ensure everyone has some level of protection against COVID-19.* Vaccines will play a huge role in this, while minimizing unnecessary deaths.
5. **I want to safely see and hug my family again, be able to see friends in person and see when people smile at one another!**

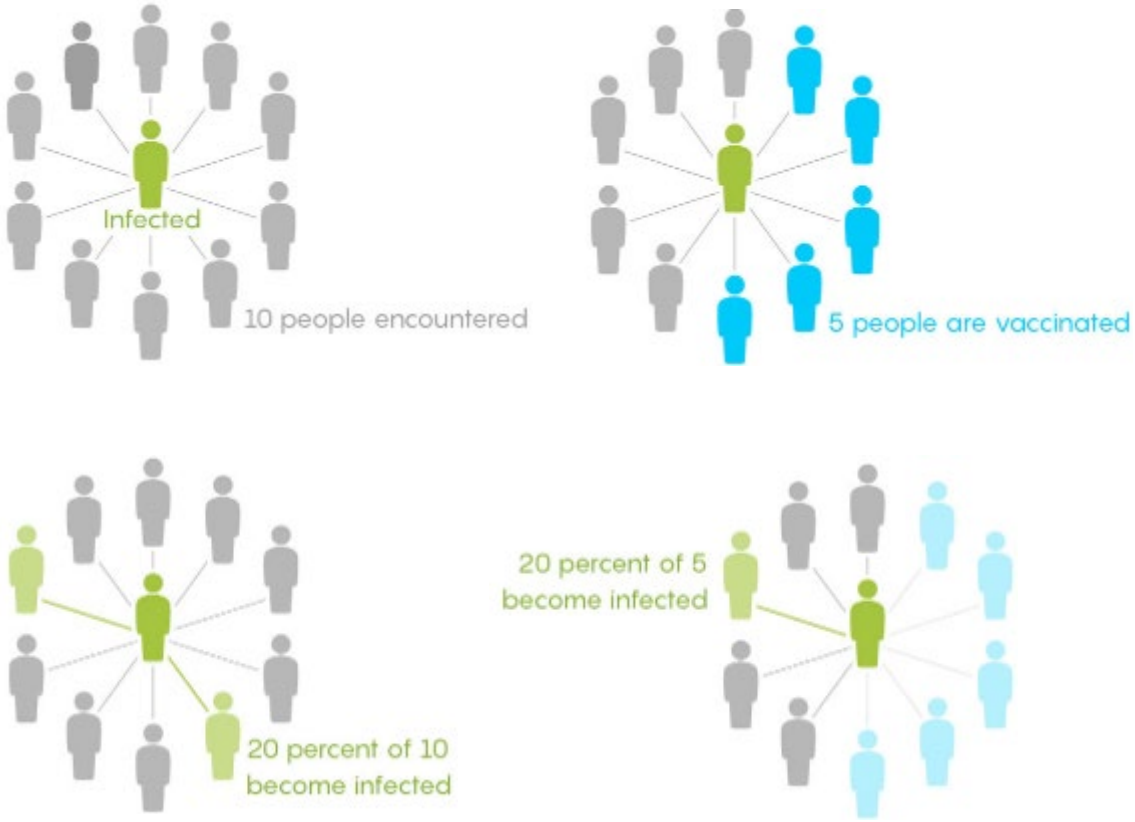

Questions?

Additional resources

- https://www.cdc.gov/coronavirus/2019-ncov/vaccines/faq.html
- https://www.cdc.gov/coronavirus/2019-ncov/vaccines/facts.html
- https://www.nejm.org/covid-vaccine/faq
- https://www.idsociety.org/covid-19-real-time-learning-network/vaccines/vaccines-information--faq/
- https://covidvaccine.mo.gov/facts/ Section on “Rumor Control”
- https://www.nytimes.com/interactive/2021/health/how-covid-19-vaccines-work.html?action=click&state=default&region=hub&context=storyline_hub&module=styln-coronavirus-vaccines&variant=show&pgtype=LegacyCollection

Effective reproduction number

$R_0 = 2$



Vaccine efficacy of 80%: If half of the 10 people are vaccinated, then 20% of 6 people become infected (1.2 people)

Vaccine efficacy of 60%: If half of the 10 people are vaccinated, then 20% of 7 people become infected (1.4 people)

Effective reproduction number

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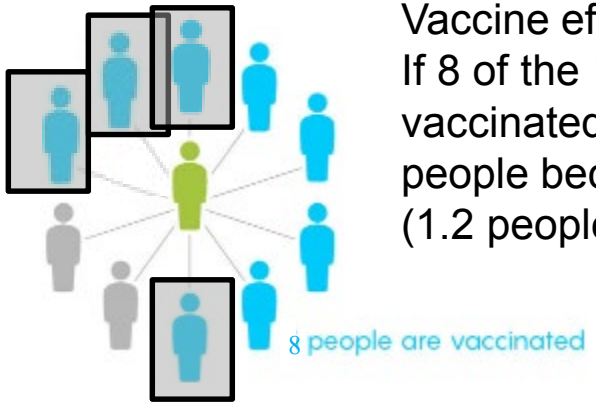
Vaccine efficacy of 80%:
If half of the 10 people are vaccinated, then 20% of 6 people become infected (1.2 people)



Vaccine efficacy of 50%:
If 8 of the 10 people are vaccinated, then 20% of 6 people become infected (1.2 people)

You can have the same impact → decreasing disease transmission through either:

1. Increasing efficacy of a vaccine
2. Vaccinating more people with a less effective vaccine

https://www.quantamagazine.org/flu-vaccines-and-the-math-of-herd-immunity-20180205/
https://d2r55xnwy6nx47.cloudfront.net/uploads/2018/02/SafetyInNumbers_Worksheet.pdf
https://www.nytimes.com/2020/11/20/health/covid-vaccine-95-effective.html