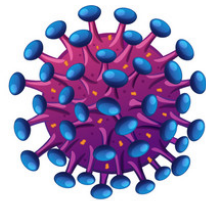
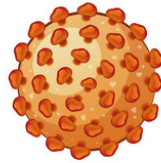


Viruses: What are they and why do they make us sick (sometimes)?



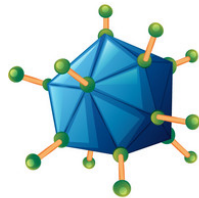
HIV



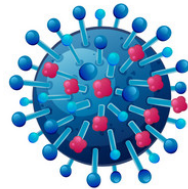
Hepatitis B



Ebola Virus



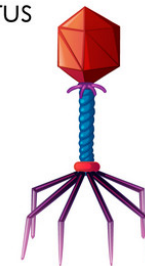
Adenovirus



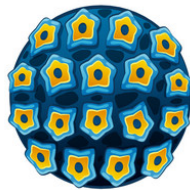
Influenza



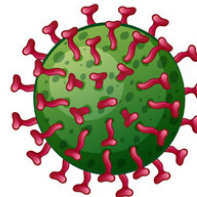
Rabies Virus



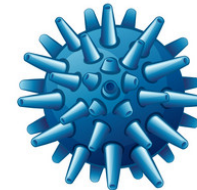
Bacteriophage



Papillomavirus



Rotavirus



Herpes Virus

Overview:

- What are viruses? What are they composed of?
- How do viruses work?
- Do all viruses make you sick?
- What happens when a virus makes you sick? (aka How does my immune system work?)
- Why is Coronavirus special? Or is it?
- How to stay healthy (or at least try to!)

What is a Virus Anyway?

- Viruses are defined as “infectious particles”

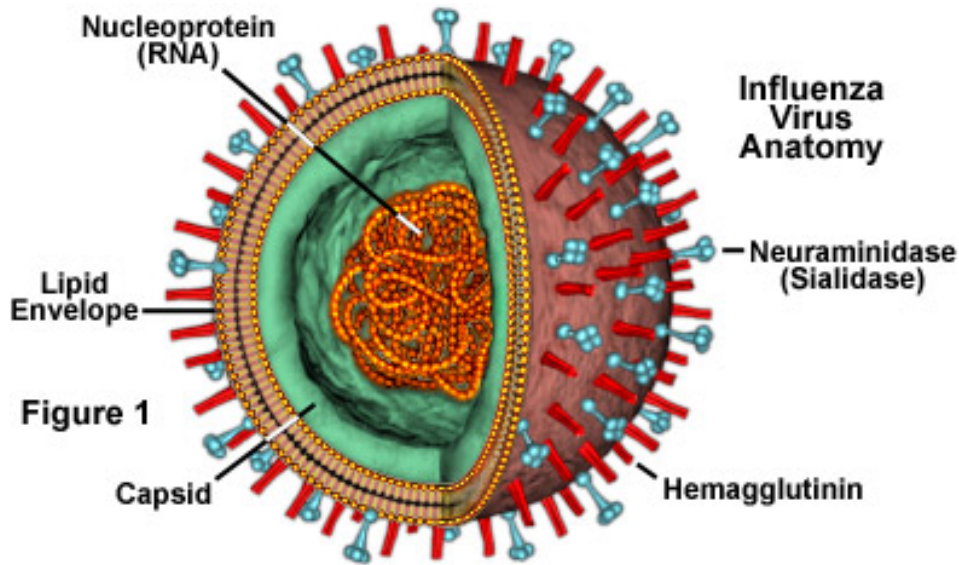
This weird description is because they are weird things

Biologically, they do not fit the definition of a living organism because:

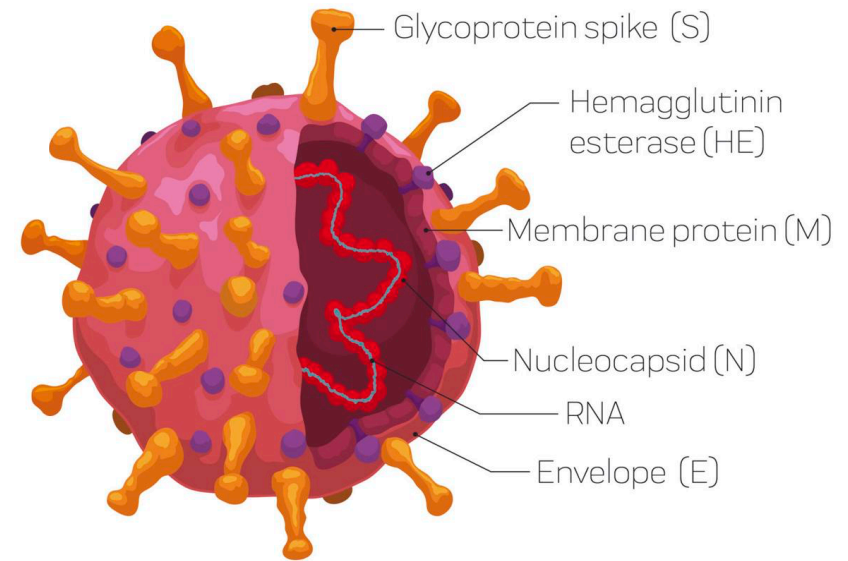
- They can't reproduce on their own
- They don't make energy rich molecules or metabolize energy outside of host cells
- They do not grow or respond to stimuli

What the heck are they then?

Virus Structure



Images not created by author



Basic parts are:

- 1) DNA or RNA genetic material
- 2) Protein Capsid (Shell)
- 3) Some have an outer membrane or envelope composed of lipids
- 4) Others may have specialized proteins or spikes on the outside too

How do Viruses make me sick?

- 1) They enter your body – frequently through your respiratory tract or mucosal membranes
- 2) Once in the right cell, they replicate
- 3) Once they have enough copies, the new viruses find new cells to infect
- 4) Repeat steps 2 & 3
- 5) Eventually, your immune system finds the invaders and attacks!

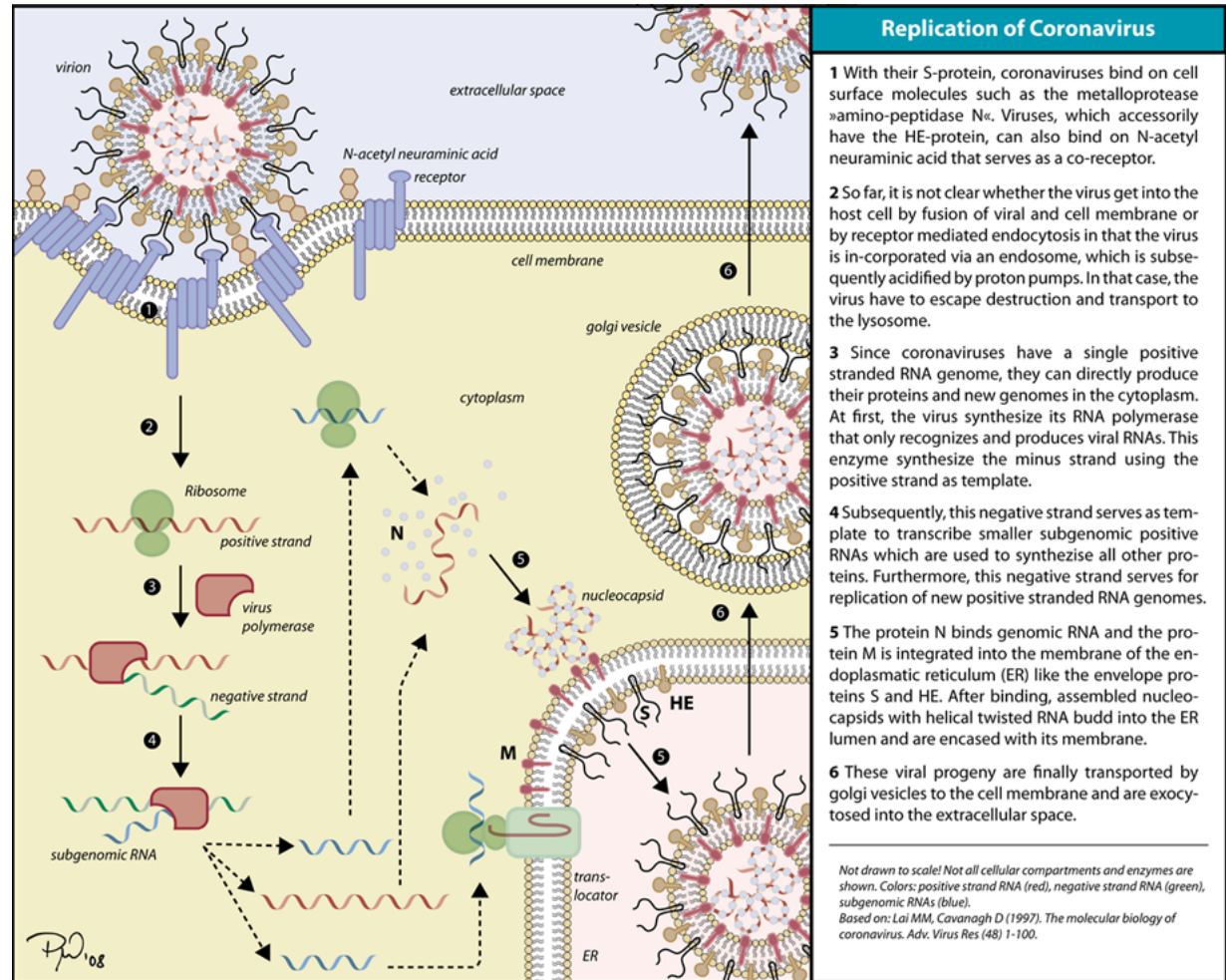


Image not created by author

Will all viruses make me sick?

- No, only those that are pathogenic – cause disease

What if I've been sick from a virus before, can I get it again?

- It depends...

Some viral infections leave a person with long-term or life-time immunity – Measles, Mumps, Chickenpox are like this

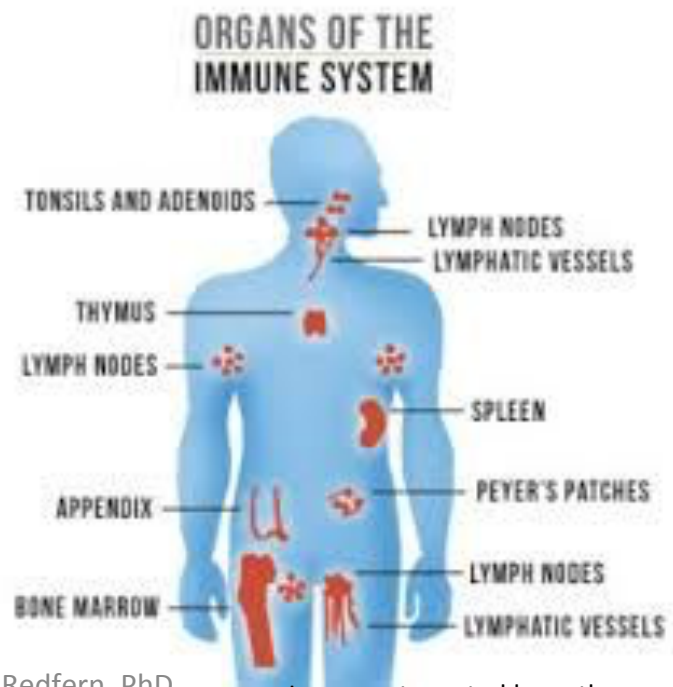
Some infections, like the flu, will not give you long-term immunity. This is because the viruses evolve very quickly over a years time. This is why you need yearly vaccines for these pathogens

My Immune System Does What?

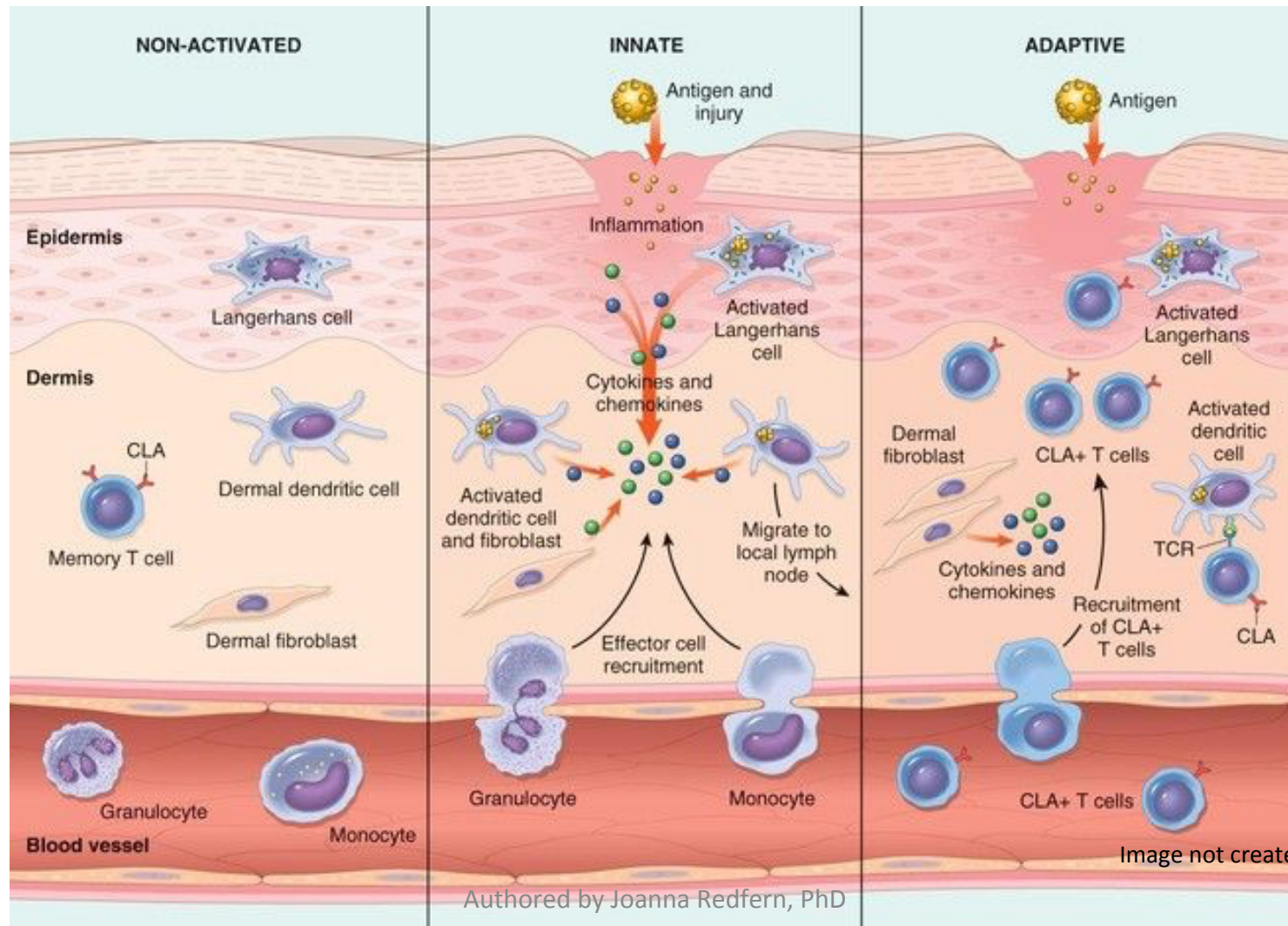
Keeps you healthy!

How does it do that?

- Fights off invaders (bacteria, viruses, fungi, protozoans, etc)
- First line of defense is physical - the outside of you – your skin and mucosal membranes
- Second line are immune cells that recognize invaders and send out a “call” to the body to fight them off



Immune System Response to a Pathogen on Your Skin



Immune System Response to a Pathogen

The Immune System uses 2 defense systems to fight infections

1) **Innate Defenses** – Falls into 2 categories, **this is a fast response system, but it has no memory**

a) External physical defenses like your skin & mucous membranes

b) Internal defenses like specialized immune cells called phagocytic cells, natural killer cells, and inflammatory responses

1) 2) **Adaptive Defenses** – **This is a slower responding system, but it does have memory**

These are carried out by lymphocytes and **includes the production of antibody proteins** that have the ability to ID pathogens and mount a fight against them over and over again

Immune System Response to a Pathogen

So, when you “catch a cold”, or the flu, or even Coronavirus your immune system does the following:

- 1) Try to stop it at the border! Catch it with skin or mucous membranes or other special cells
- 2) ID it after infection starts and send special killer cells in to take it out
- 3) Use inflammation to heat up the fight (fever) and flush it out (use fluid from leaky cells)
- 4) Also, ID the virus with lymphocytes and begin production of antibodies
- 5) Use antibody coated cells to look for the virus and stop it from invading more cells

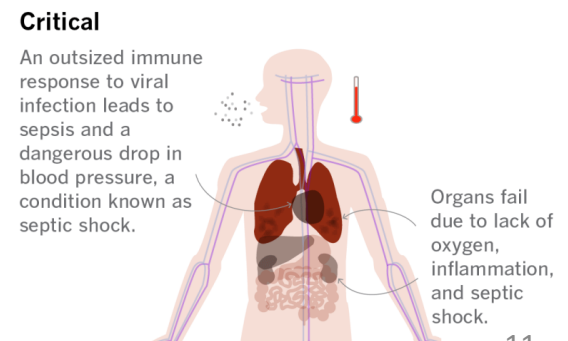
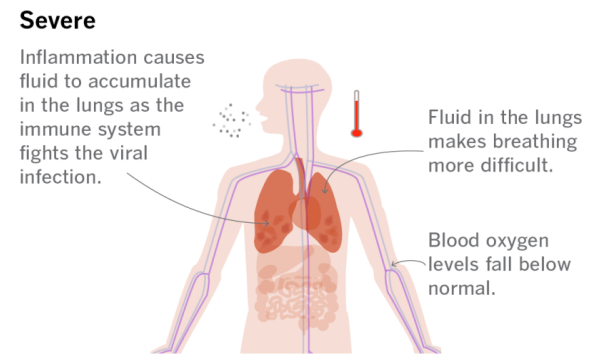
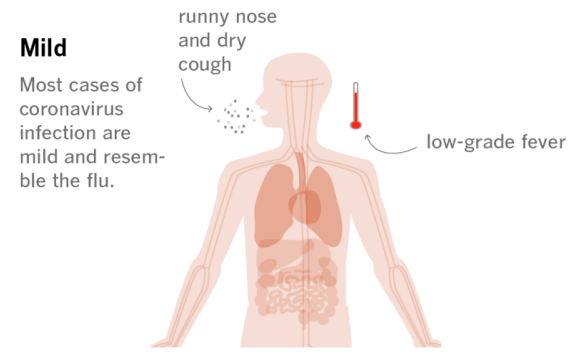
Steps 1-3 occur very quickly after infection 1-3 days....but production of antibodies - steps 4 & 5 can - take 7-14 days to get up to speed

Immune Response to Coronavirus varies

- Depending on age and health of a person infections can have different effects on the body
- While COVID-19 is generally worse for older people, other viruses like measles and mumps are worse for younger people, and some like smallpox are bad for all age groups

How COVID-19 affects the body

Researchers with the Chinese Center for Disease Control and Prevention studied nearly 45,000 confirmed cases of COVID-19, the disease caused by a new coronavirus that emerged in Wuhan, China. They found that 81% of those cases were mild, 14% were severe and 5% were critical. About half of the critically ill patients die. No deaths occurred in patients with mild or severe illness.



Immune System Response to a Pathogen

What is it that makes you feel so sick when you catch a “bug”?

- Mostly, it’s your immune system!
- Because your body wants the invader out, the fever, the body aches, the phlegm, and stuffy head are actually the result of your immune system fighting the infection
- If you are infected with a bacteria that creates a toxin, the toxin can also cause symptoms separate from your immune system, but the vomiting and diarrhea are an immune response (aka “clear it out!”)

Corona Virus: What makes it so special?

The latest and (not so) greatest virus in the neighborhood is the
Coronavirus

Why is everyone so worked up about it?

What makes it so special?

Isn't it just like the flu?

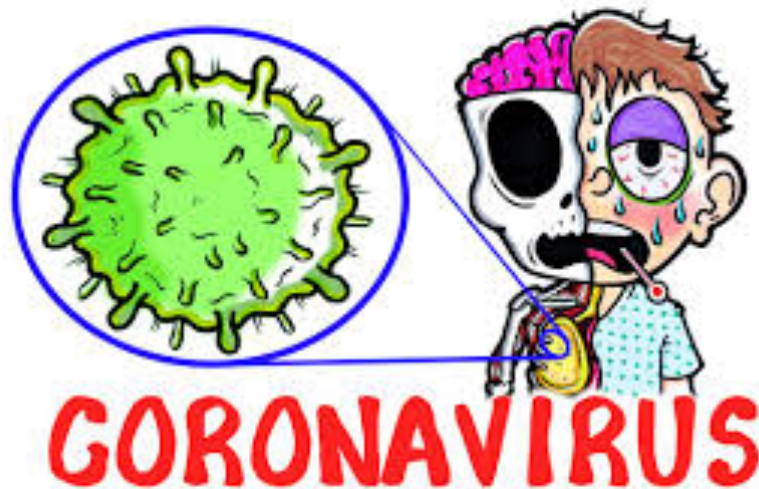


Image not created by author

Coronavirus: What makes it so special?

Coronavirus (COVID-19) is a novel/new virus to infect humans

- This means we do not have any population level immunity against this virus
- No one has had it before, so we don't have antibodies against it or anything like it yet

Because it's new, and we don't know much about it, it seems pretty scary...But does it need to be scary?

Corona Virus: What makes it so special?

The symptoms Coronavirus initially causes is very similar to the flu and common cold: Fever, cough, runny nose, sore throat, body aches, etc.

So, doesn't that make it just like the flu?

No, for a couple of reasons

- 1) It is not related to the influenza virus that causes flu or to rhinoviruses or adenoviruses that cause colds
- 2) Because it is not related, and has not infected humans before now, we have no treatments like vaccines available for preventative treatment.
- 3) While symptoms may be similar to other viral infections, the infection rate & death rate for the virus is significantly higher* than for the flu

*This rate varies across age groups and is worse for older people and people with pre-existing health problems

How easy is it to get?

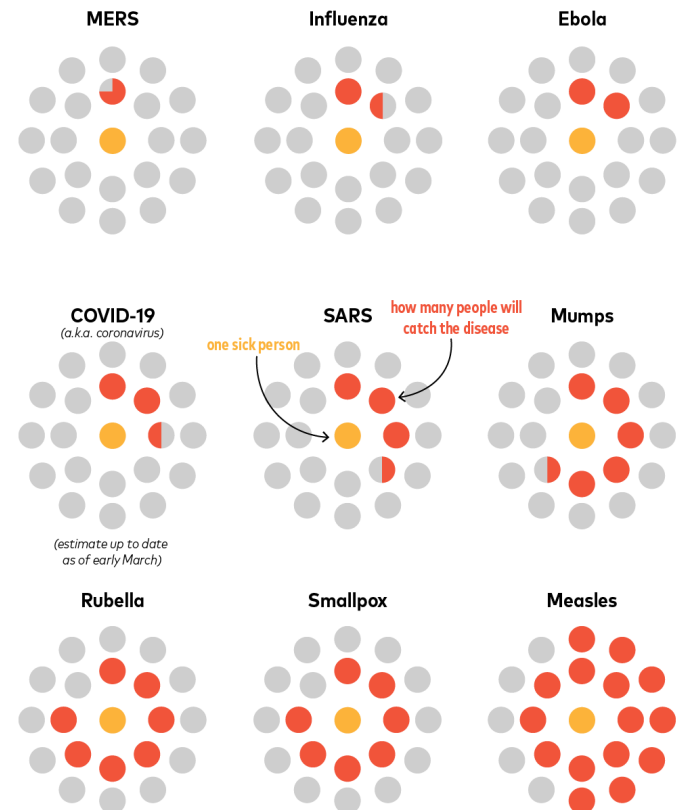
In epidemiology (study of diseases in populations) the r_0 value estimates how many people an infected person will infect

The diagram show the r_0 for COVID-19 (Coronavirus) and other viruses

Note that influenza has a lower

r_0

Also note that many conditions (measles, mumps) have much higher r_0 BUT many of those have vaccines available to prevent full blown illness



How dangerous is it?

The figure to the right compares estimated death rates for Coronavirus (COVID-19) to the Flu (Influenza)

If you are young and healthy, it is unlikely that you would die from COVID-19 infection.

However, older age and pre-existing health conditions increase the rate of complications and death considerably

For people 60 and older the rate is significant (a rate of 1.3 means of all people that age known to have been infected 1.3% died)

The rate that those 50 and older require life saving interventions such as respirators is also significantly higher than for the flu (10-30% of all cases depending on age range)

COVID-19 is far deadlier for older populations than the flu

Death rate by age group

COVID-19

10-19 years old

0.2%

20-29

0.2

30-39

0.2

40-49

0.4

50-59

1.3

60-69

3.6

70-79

8

80 and older

14.8

Flu

0-4 years old

0.007%

5-17

0.002

18-49

0.02

50-64

0.06

65 and older

0.83

Can't we just make a vaccine and make it go away?

Can we make a vaccine? Hopefully we can. However, it will take time

How long? Estimates are 12-18 months

Why so long? Once a vaccine is developed it has to go through months of clinical trials. These are tests carried out to make sure the vaccine is both safe and effective.

Why is it difficult to make flu vaccines?

Flu is a complicated virus. There are three basic types: A, B and C

Type A is the most dangerous; it can cause serious disease and triggers worldwide pandemics

Influenza type A is the most complex. On the surface of the virus there are two types of protein shapes that help to invade the body's cells: **H** and **N**

There are 18 different types of the **H protein shape** and 11 different types of the **N protein shape**

Flu virus A can make up to **144** different combinations of **H** and **N** proteins

The flu virus can also change quickly and easily

'antigenic drift' – a gradual process of genetic change that leads to even more variety for each type

Different types of virus can also combine their genetic material to make a new sub-type – this is called 'antigenic shift'

Each year's flu vaccine is made 6 months before the coming flu season using estimations about the type of virus expected to circulate

9 of every 10 years the vaccine matches the strains causing illness that winter

Author: Joanna Redfern, PhD

OXFORD UNIVERSITY

Stay Healthy!

If a vaccine is months away, what can you do to stay healthy? Or, is it better to just get sick and get over with it?

- It is not better to just get sick and get over with it for a few reasons

If you get sick, you will very likely pass the illness on to others. The virus may not get you very sick, BUT it could get a family member, co-worker, school mate, friend, neighbor, etc very sick, and every person infected will likely infect more too...

And, the virus could make you very sick too!

Easiest way to stay healthy is: **Wash your hands**, don't touch your face, avoid shaking hands, avoid obviously ill people (unless it's your job!), consider avoiding large crowds until the danger has passed!

Remember...

I want you all to stay healthy so you can pass my class!

Image not created by author