

COVID-19. EXPLAINED.

**AN E-BOOK BY
RAVISHANKAR IYER**

It's war.

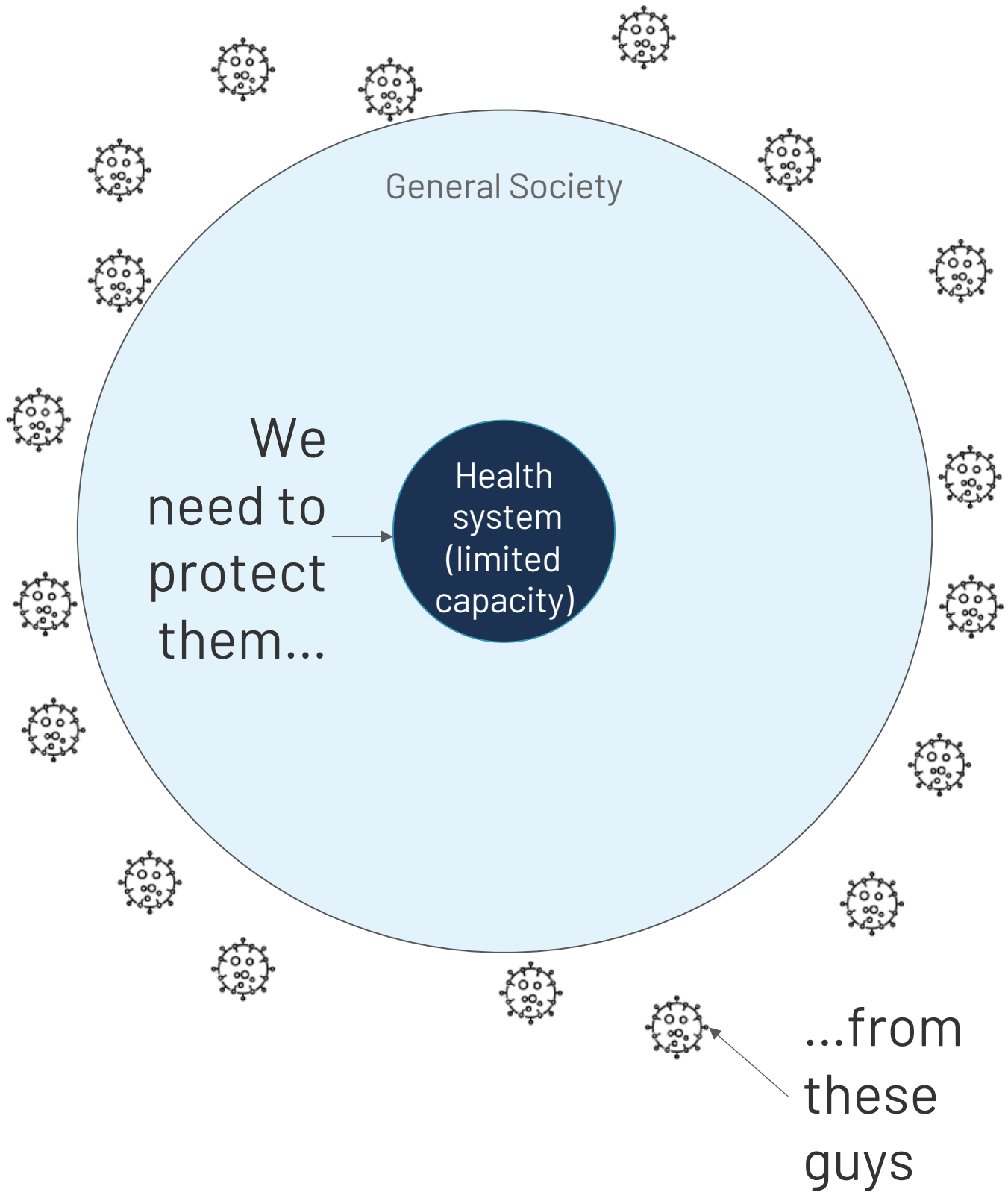
And we're all in it together.

Irrespective of who's at fault
for this deadly second wave,
one thing is certain.

All of us need to shore up our
knowledge of this deadly virus.

We need to know our enemy.

And...

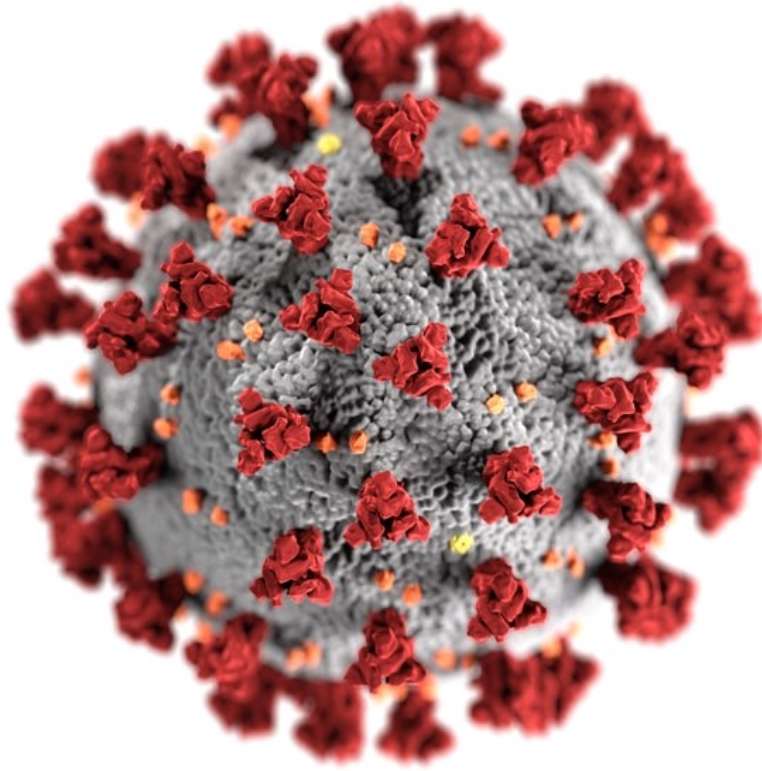


Let's get started

This story-series aims to provide a layperson understanding of:

- *How your lungs function normally?*
- *What is this virus?*
- *The disease caused by the virus and how it affects us*
- *Its progression across stages*
- *Its diagnosis*
- *Its treatment and*
- *Implications for us*

Needless to say, it is NOT medical advice. Please check with your physician for any case-specific advice.



CHAPTER 1

GETTING TO KNOW THE VIRUS (AND YOUR LUNGS)

A. The Virus



Hi there.

I'm a virus.

Aka, "a piece of bad news wrapped up in a protein"*

I have a confession. I can't do much on my own. As in, I can't even ... reproduce.

But all you need to do is take me in. Through the nose, mouth or other opening. Then I come alive, and begin to do my thing.

Copying.



I live for one objective only: to make as many copies of myself as I can.

Which will make further copies.
Which will make more.

You get the picture.

* Defined evocatively by biologists Jean and Peter Medawar , 1977.

But in order to do that, I need one of your cells. Because, you see, your cells have an inbuilt copying machine which I can hijack....

...only once I enter the cell.



Entering your cell is tricky – they're pretty well defended. Except there are some entry points...

So cells in some parts of your body have a "receptor protein" called ACE2

Receptor proteins do a bunch of stuff, but some are like gates for a cell. Think a USB inlet in a laptop.

Oh, but you would need a USB stick to access that inlet right?

Guess what those spikes of mine are for?



My spikes fit your ACE-2 receptors like a key to a lock.

And voila, I can enter your cell... and begin doing my replication thing.



I know what you're thinking ...
"Ok, but viruses have been around for quite some time... what makes this guy so bad?"



I'm glad you asked.

I call it "the Goldilocks" effect

Let me explain.

You see, I come from a family of coronaviruses.
And it takes a bit of artistry to create something like me



I'm going to use this 2x2 chart
(Oooh, so Mckinsey of me)

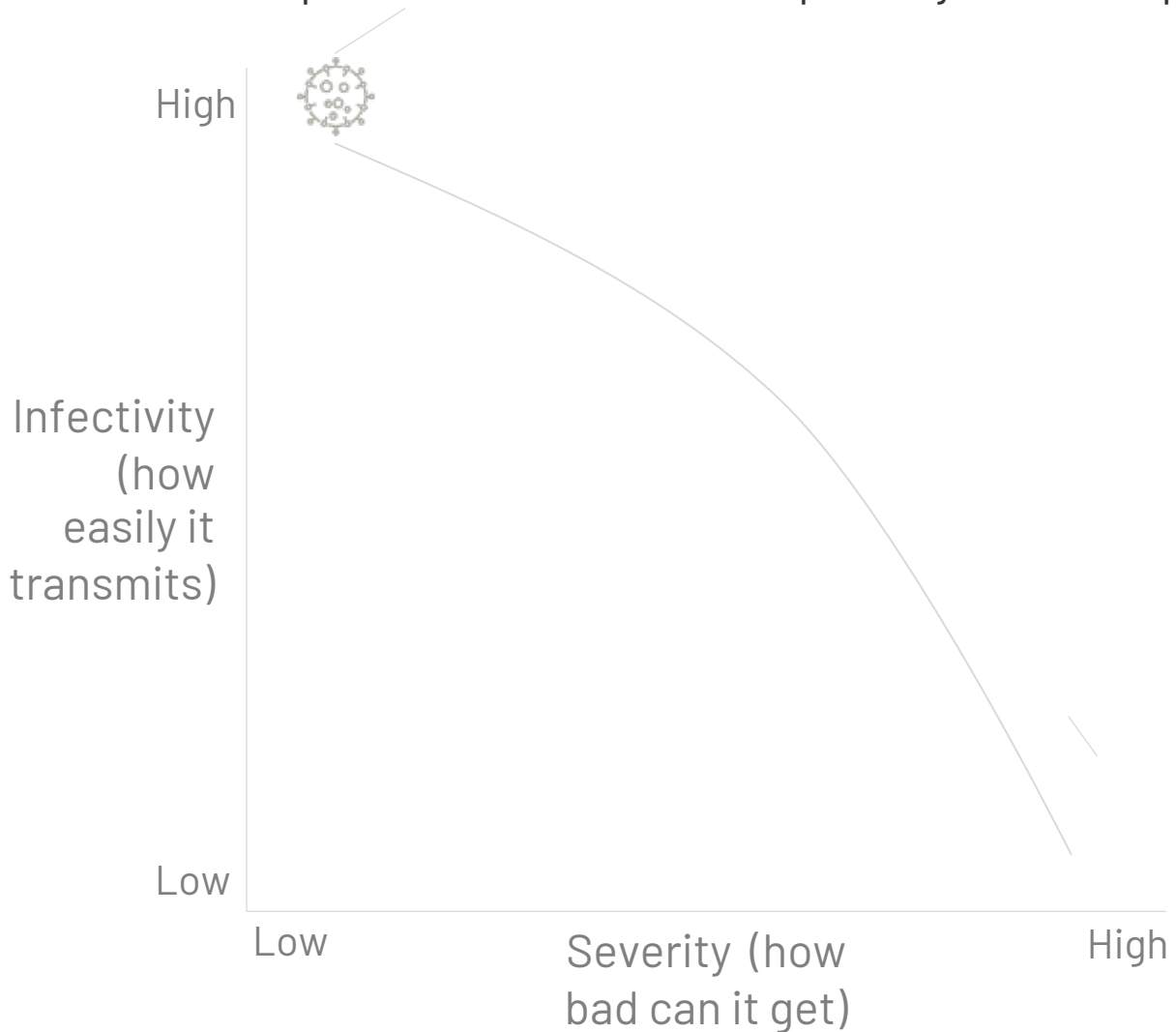


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1. Meet Cousin Common Cold

He gets high marks for effort. Works his pants off. But doesn't inspire any fear. Wimp!



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Infectivity
(how
easily it
transmits)

2. And then there's Cousin MERS (Middle East Respiratory Syndrome)

He's the family showoff. I keep telling him during reunions – If you kill your hosts so soon, how will you reach others?



Low

Low

Severity (how
bad can it get)

High

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High



3. Sars-CoV-2

Finally, that's me.
Just the right balance.



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Why am I so deadly?

One, stealth. My genius was to not be an over-achiever like MERS.

“Tao guang yang hui” (Keep a low profile) – Deng Xiaoping, China

Most people who get me remain blissfully unaware as I multiply in them. And spread to others.

But the other reason that makes me deadly (unlike Common Cold) is that I strike you where it really hurts. A lot.

Your lungs.



On that note, let's change track and understand one of our most important organs.

One that has a critical weakness.

B. The Lungs



Hey folks.

We're your lungs. Our celebrity quotient may be low (esp. compared to Heart), but we're a pretty big deal.

So, your body expends energy all the time. It gets this energy from food. But the sugar – and other elements – trapped in food need to be released for you to get the energy.

This release operation needs a fuel. That fuel is oxygen.



Think of your body as a large industrial complex with different factories engaged in different tasks, all requiring energy. All these tasks are fueled by oxygen.

We, the lungs, are the central power-plant supplying this oxygen to the entire body. And we work 24x7x365...

Visually, think of us as an upside down tree. Your trachea is the main stem.



The main branches are called bronchi. These keep splitting into tiny branches called bronchioles. Each lung has about 30,000 bronchioles. Yup, it is dense.

But that's not where the action happens.

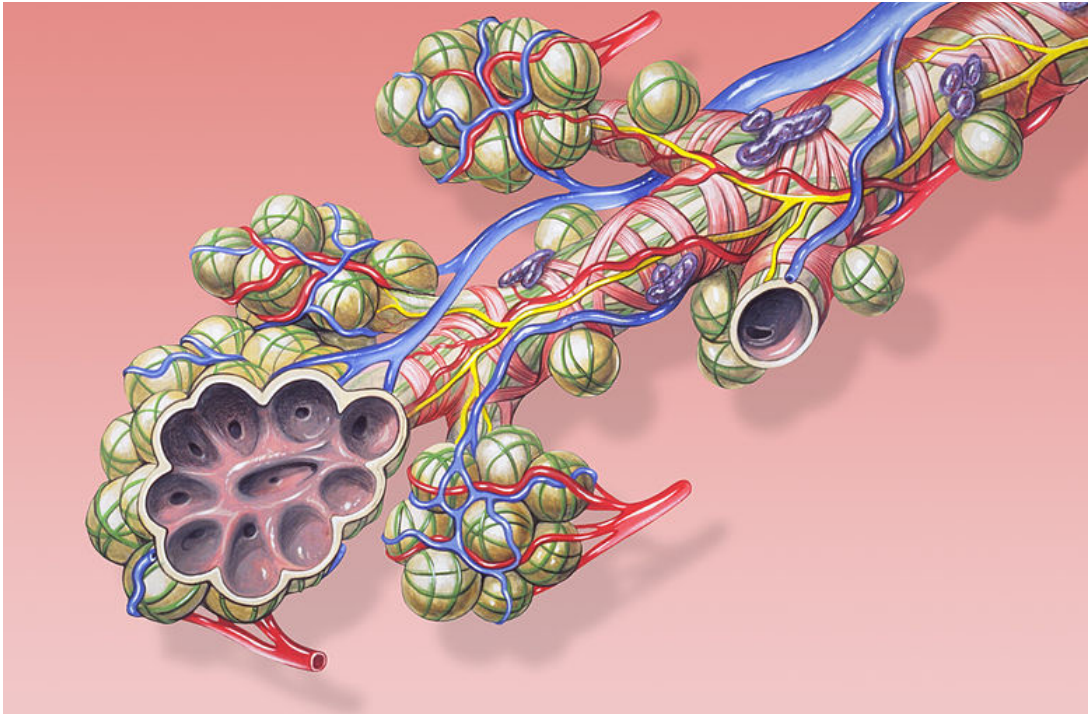
The real action happens at the ends of bronchioles. Meet the alveoli.



Think of alveoli as the leaves on your lung-tree.

Alveoli are tiny sacs (that are clumped together look like bunches of grapes).

Hang on, this will need a diagram...



Don't get grossed out – that's just you!

So the grape like clumps are alveoli (singular 'alveolus').

Notice the blue and red lines? They are your capillaries carrying impure blood (blue) from the heart and oxygenated blood (red) to the heart.

The system of transfer – from alveoli to bloodstream – is quite amazing...





Imagine a goods train passing slowly by a platform. It cannot stop, but it still needs to load and unload some cargo.

The alveoli is the platform. The capillary is the train. The Red Blood Cell is the wagon.

And the items getting transferred are oxygen and carbon dioxide

So, as the dense network of capillaries passes by the alveoli, it unloads the CO^2 (to be exhaled out) and loads each RBC with some life-giving O^2 .

This exchange happens every living moment of your life.



Your body has 300M such alveoli-platforms.

Two things about them which are critical to know...



One, they have reeeeeaaaaally thin walls. You would too, if you needed to pass material 24x7 between them.

If an alveolus is blown up to the size of an apple, the wall would be about as thick as the apple's skin.

Remember this, we'll revisit it later.



Two, the alveoli's surface consists of two types of cells, imaginatively named Type 1 and (you guessed it) Type 2.

Type 1 cells cover 95% of the surface area. The smaller Type 2 cells produce a key ingredient which holds the shape of the alveolus.

Oh, and the Type-2 guys are also abundant in... ACE-2 receptors¹ (yup, those same USB inlets).

That's good news for you-know-who.

1. They are not the only cells with ACE-2 receptors. These are found throughout your respiratory system (apart from other regions). But we focus on the alveoli since they are vulnerable sites www.storyrules.com

C. Virus, meet Lungs



They say size does matter.

I think that's rubbish.

Take me. I'm between 50-140 nanometres in diameter.

Oh really, my alveoli are about 0.2 millimetres (or 200 microns across)



WHOA.

That's HUUUUUGE.

(Btw, the guys reading this have no clue)

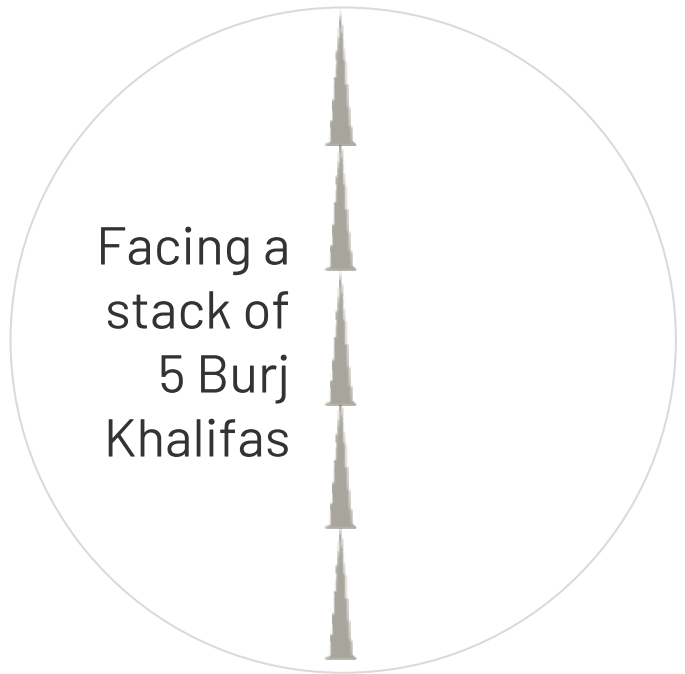
Yup, time to use a Bill-Bryson-esque 'blow-up' analogy...





Imagine standing in front of FIVE Burj Khalifas stacked on top of each other

That's a 2-m tall human inside this circle



Facing a stack of 5 Burj Khalifas



That's how I'll look in front of an alveolus.

That's me inside this circle



And this is the alveolus – about 200 microns or twice your hair's breadth

Needless to add, this is not to scale.



Ok, we get it. You're tiny.

But how exactly do you affect us?

I mean we do have a mean defense system, you know right?

Haha, right, your defense system.

Hey why don't you tell the readers about that and I'll share my strategy to breach it...

PS: Gross alert, guys



Haha, very funny.

You don't realise the difficulty of my job.

Have you felt the air quality in our cities?

Sigh, let me explain how I (try to) keep myself safe...

Hehe, start with the mucus na. Pretty please!



Alright, alright.

Nasal-hair, mucus, cilia, macrophages. These are my lines of defense. Happy now?

So the nasal hair is not something useless you pull out when bored. It filters out largish foreign particles when you breathe. (Gross out all you want, it's a life-saver)

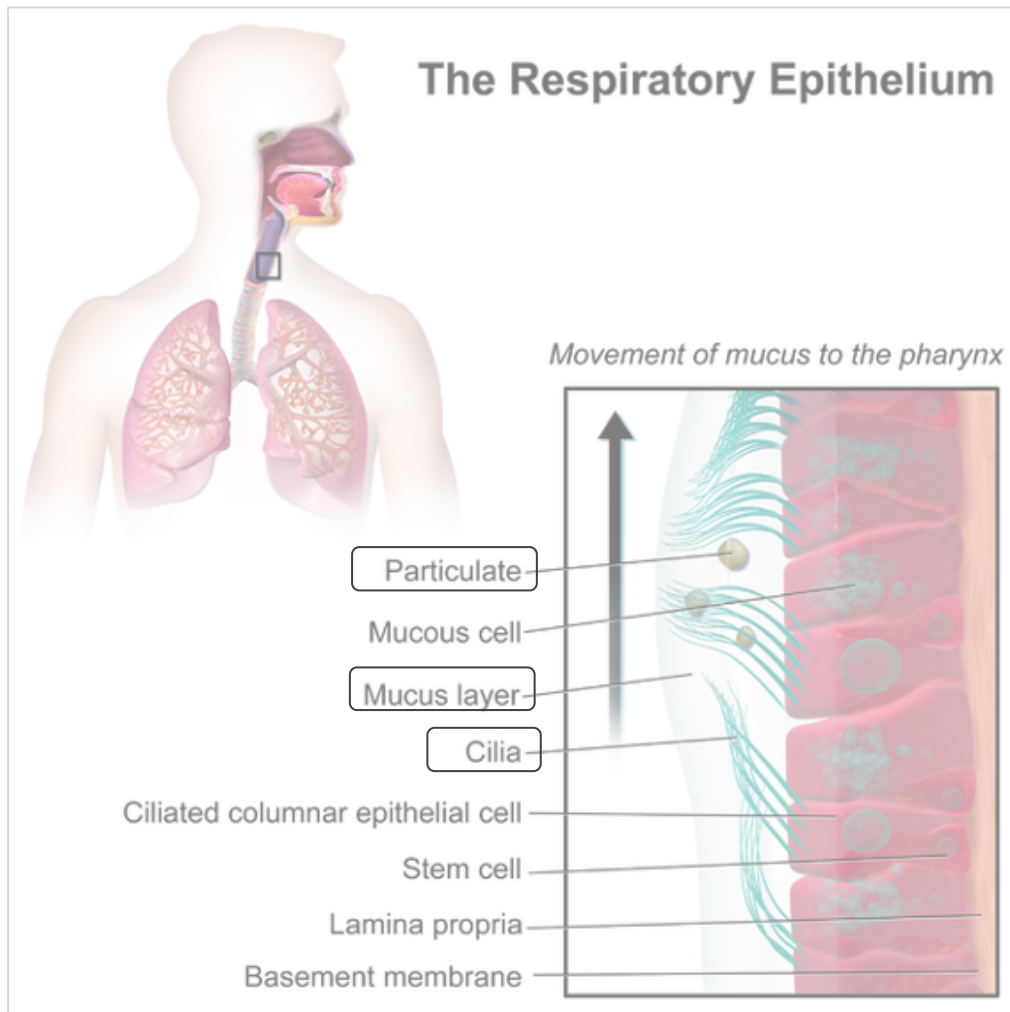
Any foreign particles that pass the nose will mostly get stuck in the sticky mucus that lines the airway to the lungs.

The airways are also lined with millions of hair-like particles called cilia... Who am I kidding... this will need an image... (brace yourself)



Right, here's the deal.

- Particulate: Bad guys
 - Mucus layer: Sticky layer which traps said bad guys
 - Cilia: hair like paddles which 'beat' the bad guys up, where they're expelled usually by coughing
- But we still haven't seen the really tough cops....





If some naughty microbes, bacteria etc. do escape the first two lines of defense, they have a tough fate awaiting them.

The alveolar macrophages.

Remember the alveoli? Where the Oxygen exchange happens?

Well, we realized that it is a vulnerable spot, given its mission-critical Ops and thin walls.

So we built in a powerful security system.



Think of the alveolar macrophages as an elite Z-Category security detail for your alveoli.

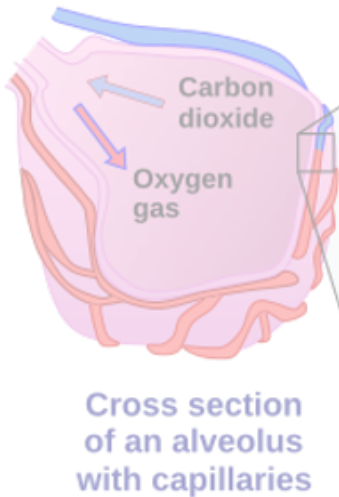
They stand guard on the platform as the exchange takes place

I like how they deal with offending micro-organisms...

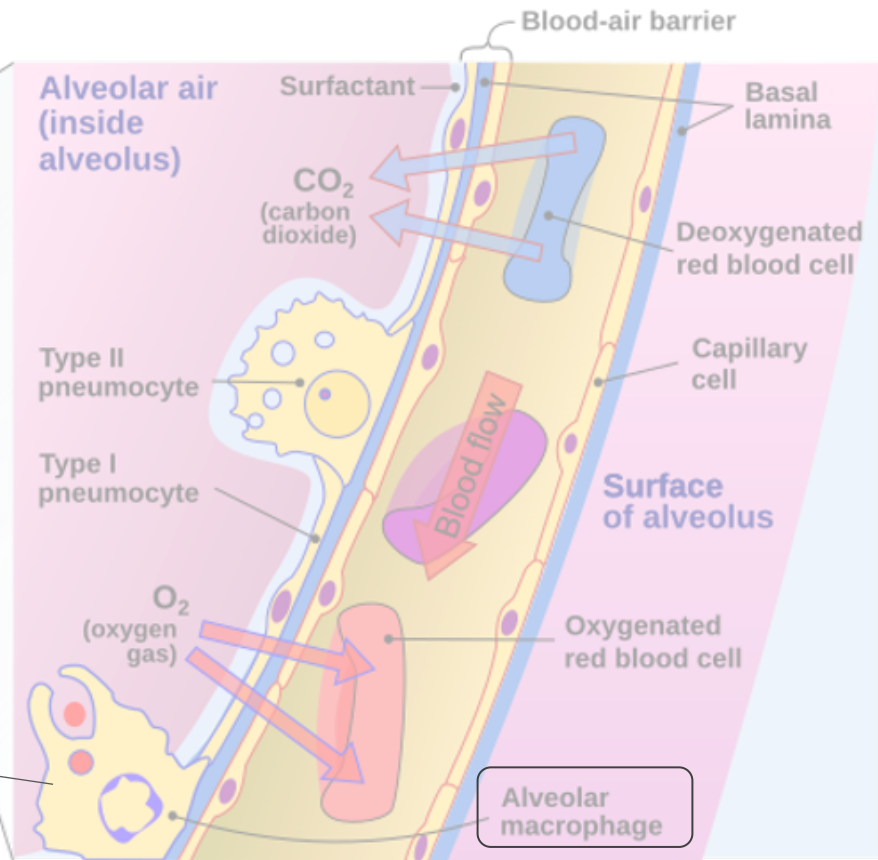
They. Just. Gobble. Them. Up.

No niceties, arrest, trial, judge business.

Direct – “aaaaa-gobak”



If you are a micro-organism, beware of this guy



(Clap, clap) Impressive stuff!

Now, I'm sure you guys want to know what exactly happens when I invade right?



Yes, but before that , I think we need to introduce my Defense Forces.

The Human Immune System.

It's time to get in some new characters in the story...



COMING
SOON

CHAPTER 2

THE HUMAN IMMUNE SYSTEM

OUR DEFENSE FORCES

While I've tried to be comprehensive in my list of sources, I may have missed some out – apologies for the same!

Size of Coronavirus: The Size of SARS-CoV-2 and its Implications

<https://www.news-medical.net/health/The-Size-of-SARS-CoV-2-Compared-to-Other-Things.aspx>

How Covid-19 attacks your lungs

<https://www.indiaspend.com/how-covid-19-affects-your-lungs/>

About the ACE2 receptor

<https://theconversation.com/what-is-the-ace2-receptor-how-is-it-connected-to-coronavirus-and-why-might-it-be-key-to-treating-covid-19-the-experts-explain-136928>

Also: <https://www.youtube.com/watch?v=IPSQ0i2B8AU> by The Print

Size of Alveolus: The Alveoli in Your Lungs

[https://www.healthline.com/health/alveoli-function#:~:text=Each%20alveolus%20\(singular%20of%20alveoli,that%20also%20have%20thin%20walls](https://www.healthline.com/health/alveoli-function#:~:text=Each%20alveolus%20(singular%20of%20alveoli,that%20also%20have%20thin%20walls)

About Alveoli:

<https://www.healthline.com/health/alveoli-function#alveoli-health>

The Body: A Guide for Occupants by Bill Bryson

Cleveland Clinic: Respiratory system

<https://my.clevelandclinic.org/health/articles/21205-respiratory-system#:~:text=The%20respiratory%20system%20is%20the,waste%20gases%20like%20carbon%20dioxide.>

All about Alveolar macrophages

<https://www.atsjournals.org/doi/full/10.1164/rccm.2210007#:~:text=Alveolar%20macro phages%20are%20the%20primary,and%20the%20mucociliary%20transport%20system>

How Coronavirus attacks the cell

<https://www.nytimes.com/interactive/2020/03/11/science/how-coronavirus-hijacks-your-cells.html>

<https://www.nytimes.com/video/us/100000007046988/nursing-home-coronavirus.html?playlistId=video/coronavirus-news-update>

Bad news in a protein: Inside the Coronavirus genome

<https://www.nytimes.com/interactive/2020/04/03/science/coronavirus-genome-bad-news-wrapped-in-protein.html#:~:text=A%20virus%20is%20%E2%80%9Csimply%20a virus%20that%20c>

Stay safe. Get vaccinated.

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