Masterclass Viruskenner 2021

NEW RESPIRATORY VIRUSES

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Erasmus MC
Universitair Medisch Centrum Rotterdam

Disease X

- Imagine you work in an emergency room.
- Your job is:
  - Care for sick people
  - Make a diagnosis
  - Admit people to the hospital or send them home.
  - … And quickly please!
- How do you recognize a new disease?

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Disease X

- Signs and symptoms which have never been seen before?
- A sudden increase in a certain type of disease?
- More young and healthy people with a disease?
- A normal disease which suddenly:
  - Becomes more severe.
  - Doesn’t respons well to standard treatment.

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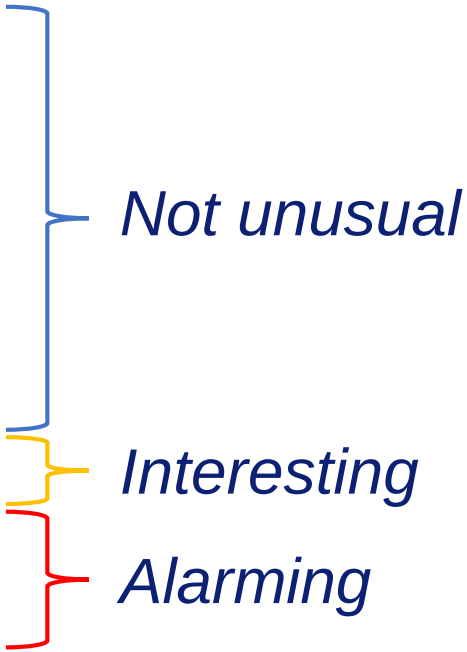
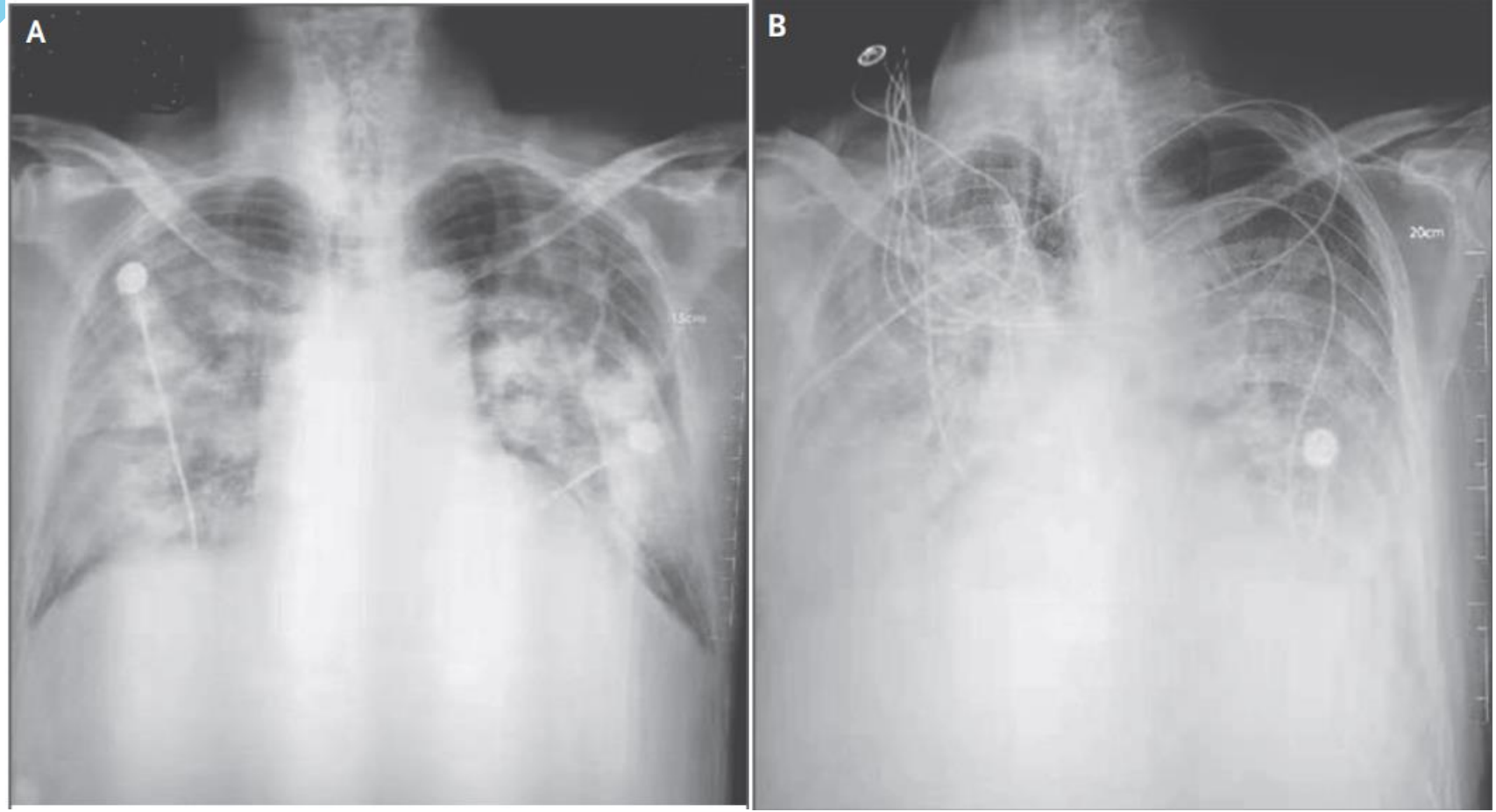
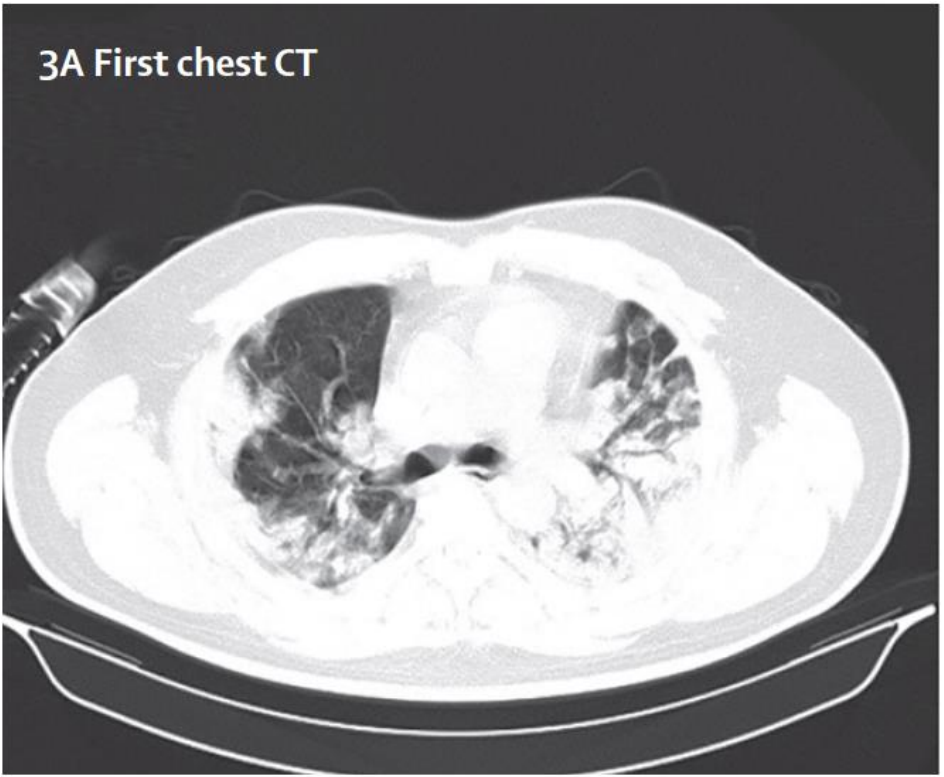
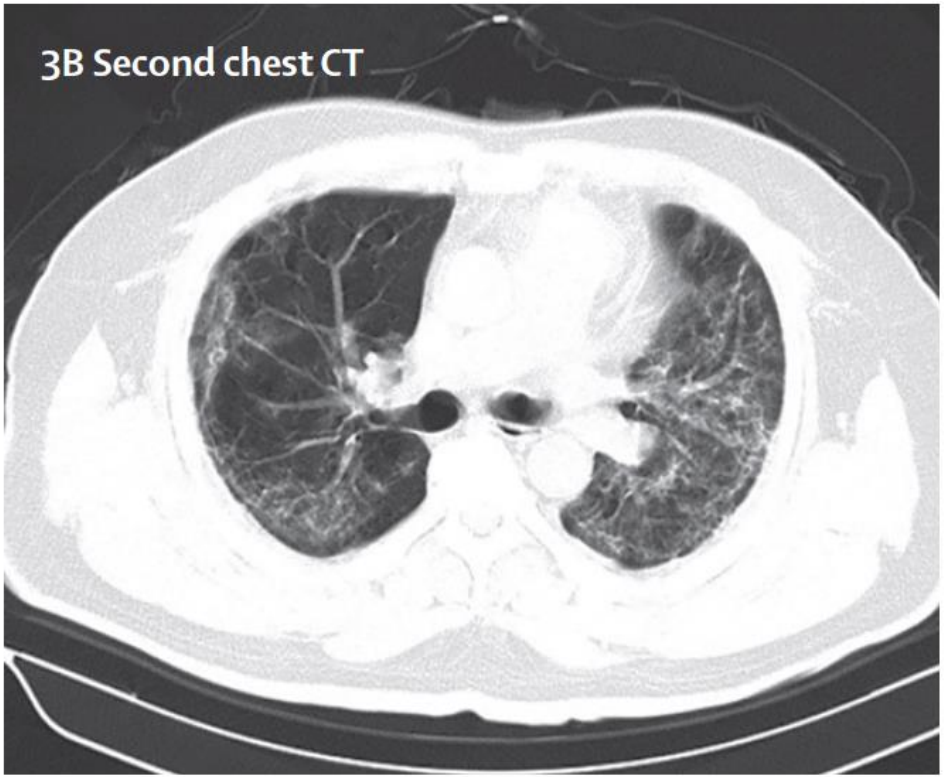
Disease X example

- 55 year old man with diabetes.
- Has the following complaints since 7 days:
  - Cough.
  - Fever.
  - Out of breath, getting worse.
  - Chest pain.
- Works on a market with live animals.
- Later that day, 20 more people come to your ER with the same symptoms!




A
B


3A First chest CT


3B Second chest CT

Outbreak investigation.

World Health Organization

- Where has your patient been?
  - Travel?
  - Public places, mass gatherings?
  - Hospitals, nursing homes?
  - Schools, day care centers?
- What did he/ she do there?
  - Animal contact?
  - Been in the wild?
  - Work with bacteria or viruses?
- Who has the patient been in contact with?
  - Sick people?
  - Family?
  - Colleagues?

Rijksinstituut voor Volksgezondheid en Milieu
Ministerie van Volksgezondheid, Welzijn en Sport

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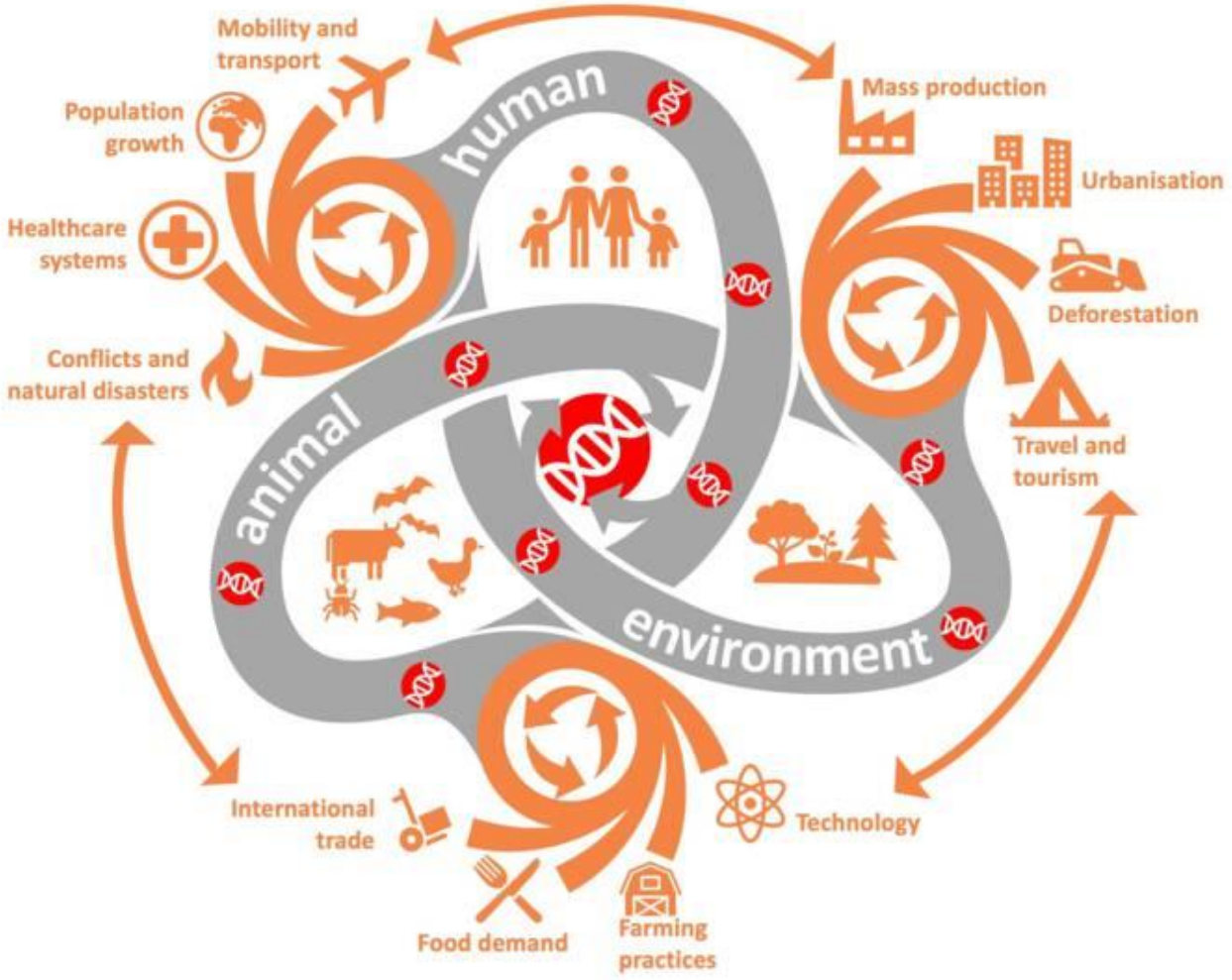


Catching the bad guy: Oldschool

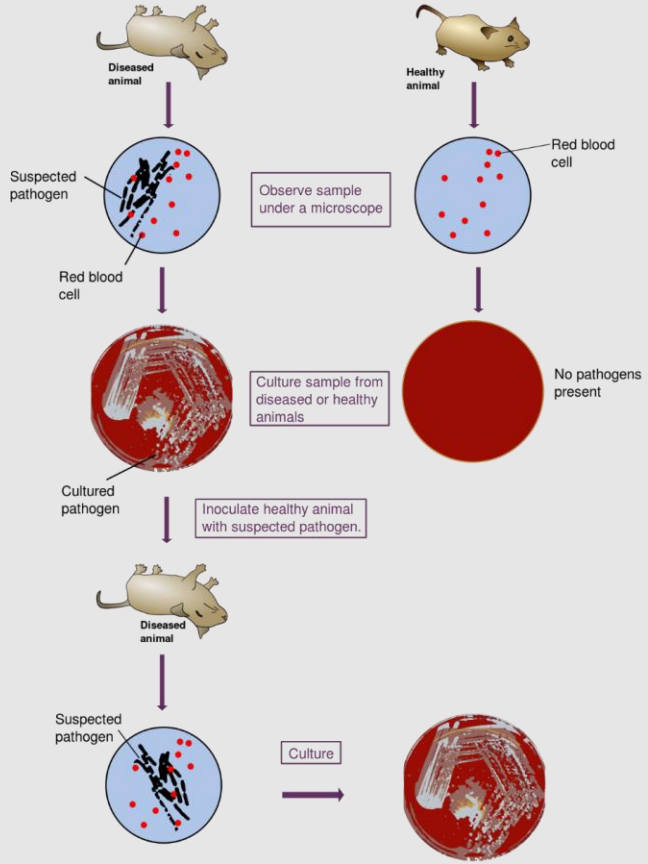
Koch's Postulates:

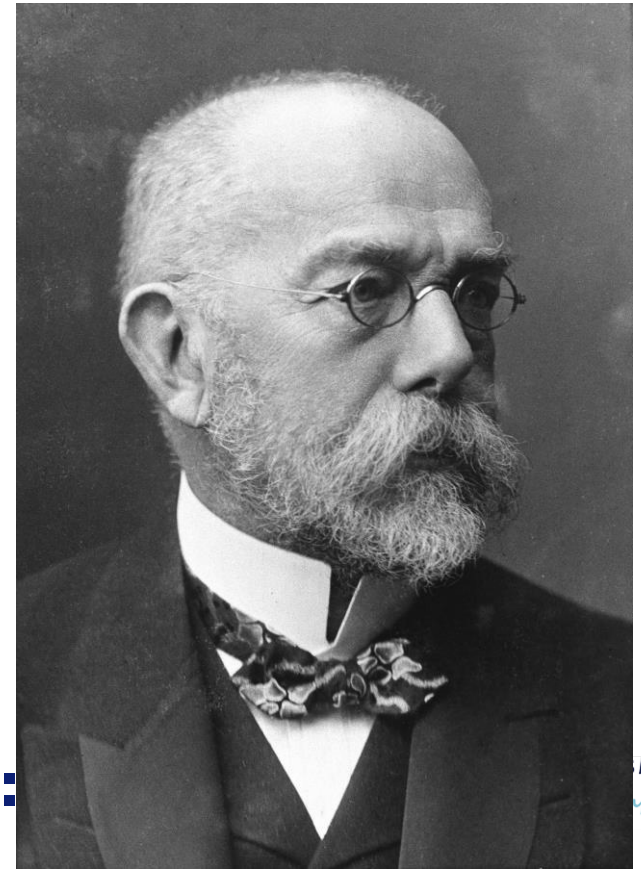
① The microorganism must be found in abundance in all organisms suffering from the disease, but should not be found in healthy organisms.

② The microorganism must be isolated from a diseased organism and grown in pure culture.

③ The cultured microorganism should cause disease when introduced into a healthy organism.

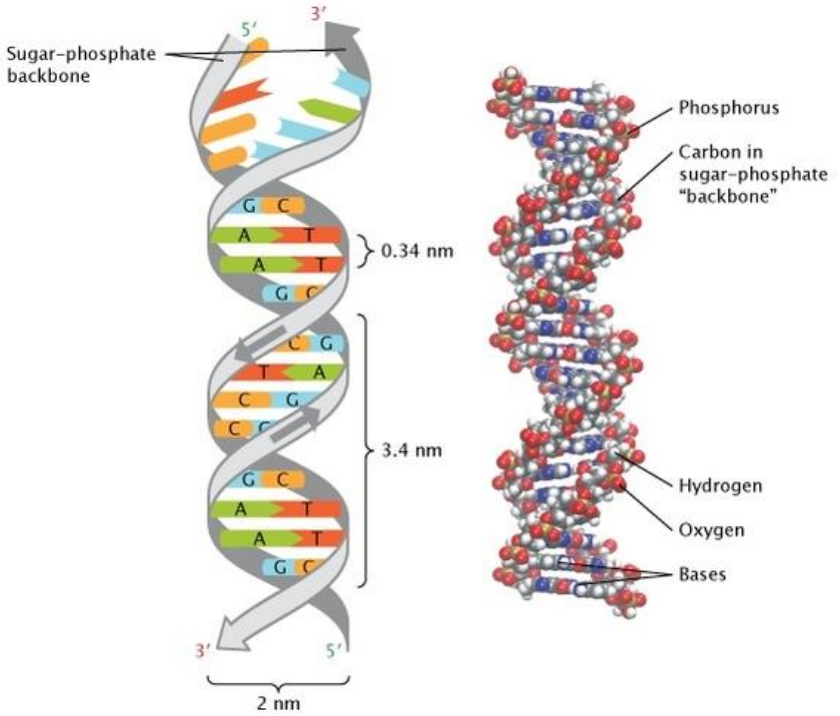
④ The microorganism must be reisolated from the inoculated, diseased experimental host and identified as being identical to the original specific causative agent.





Modern techniques: DNA and RNA

- Nucleic acids make up the code that forms all life on Earth.
- Discovered in the 1950's (Watson & Crick)
- DNA and RNA can be copied (PCR) …
- …And read in a lab: Gene Sequencing.
- Much quicker, easier and accurate than culture
- Tiny amounts of DNA and RNA can still be detected!

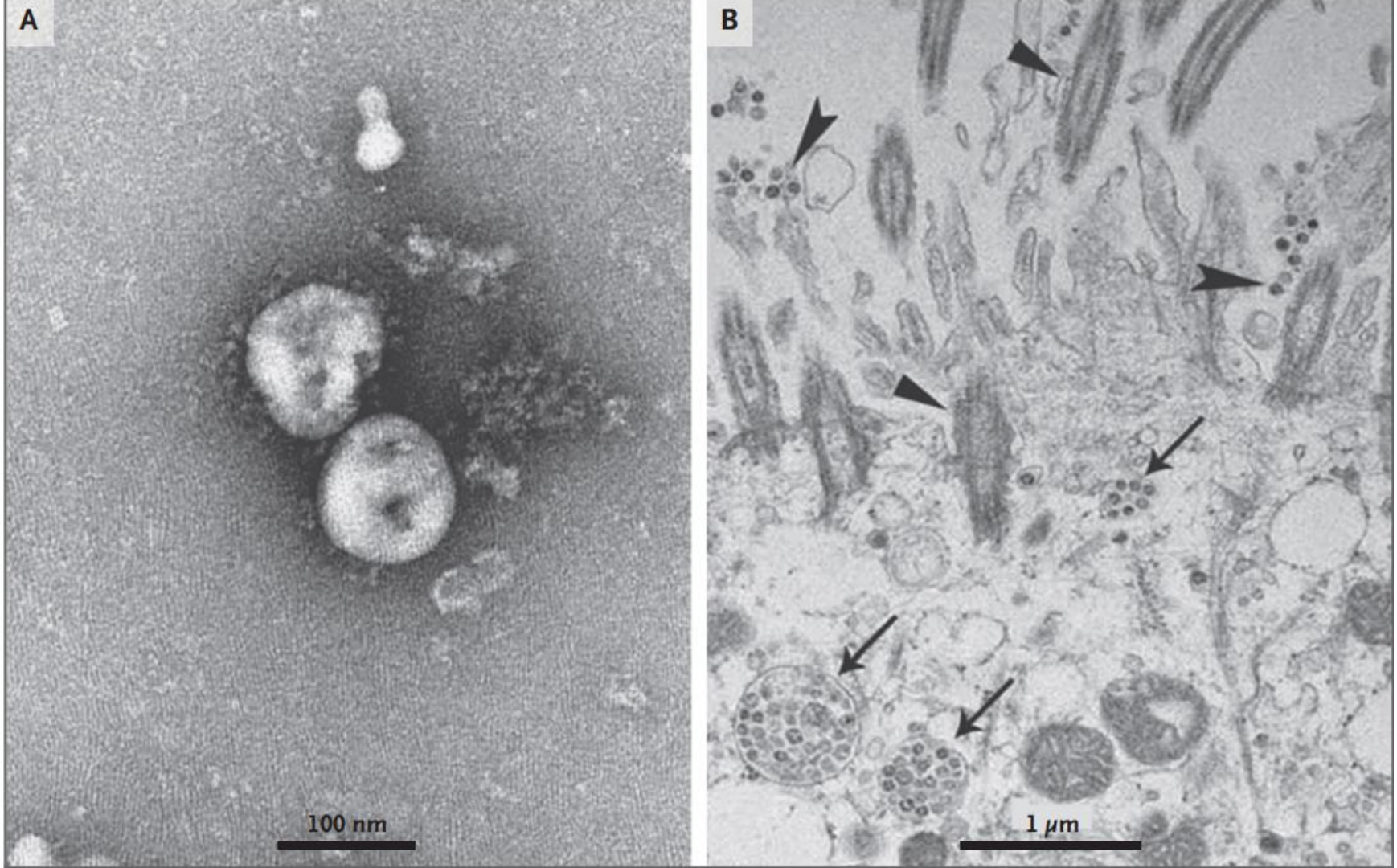


How to find our virus

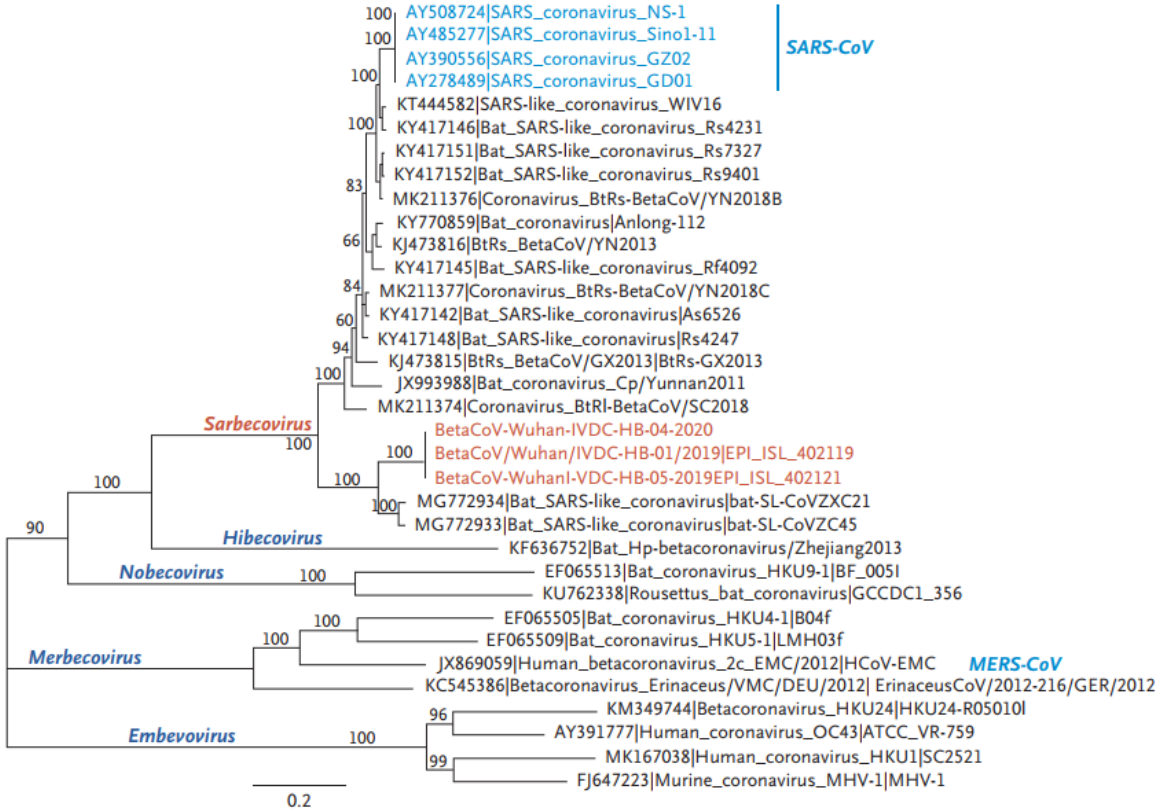
- What do you send for the lab to investigate?
- Which tests should we perform?
- Which viruses and bacteria do you already know?

Tests

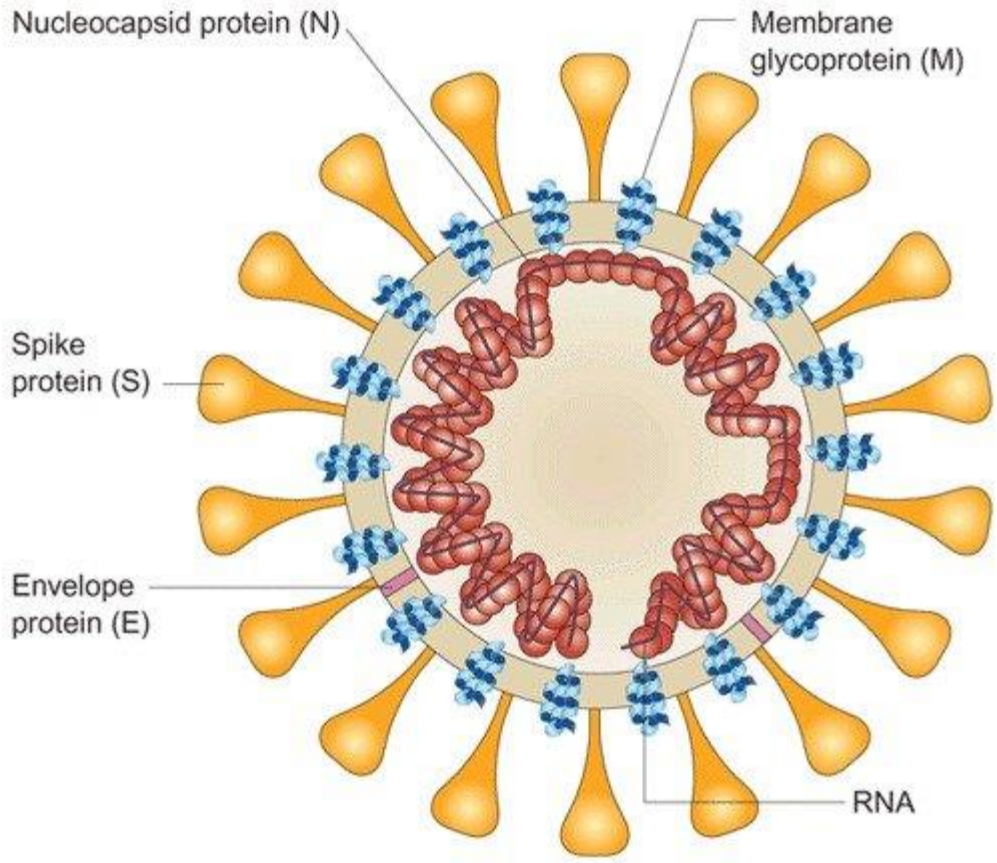
- Source of your material: from where you expect the pathogen to be → airway mucus.
- First look at the ‘usual suspects’
- Special PCR tests can detect large number of viruses/ bacteria within a family: Coronavirus
- Sequencing: decode the virus and determine
    - Class (Beta- coronavirus)
    - Lineage: Sarbecovirus (SARS-like)
- Culture the virus
- Look at it through an electron microscope. .


A
100 nm
B
1 μm

Virus family tree: phylogeny.

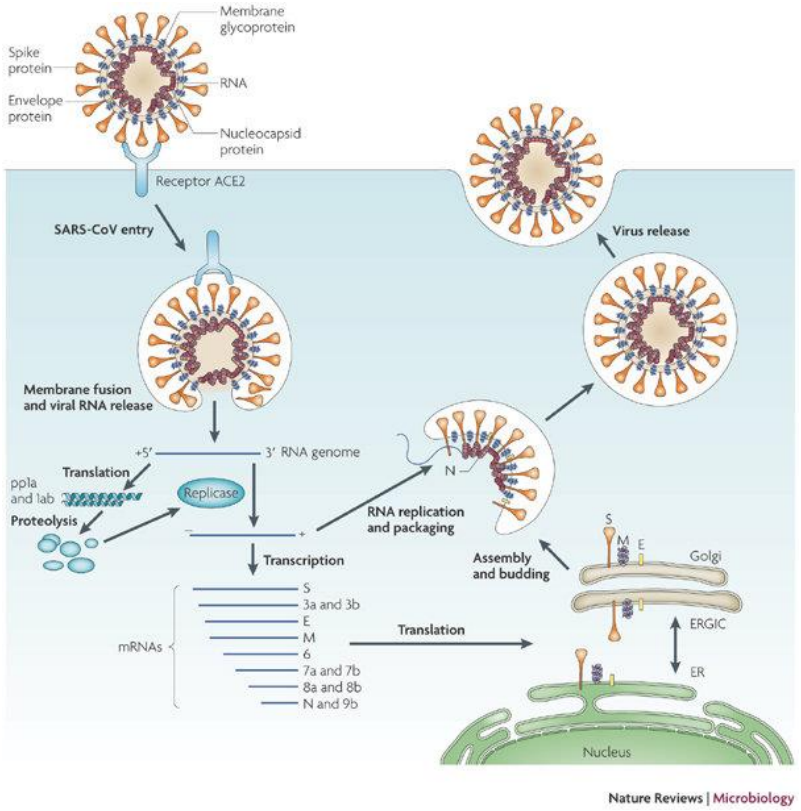


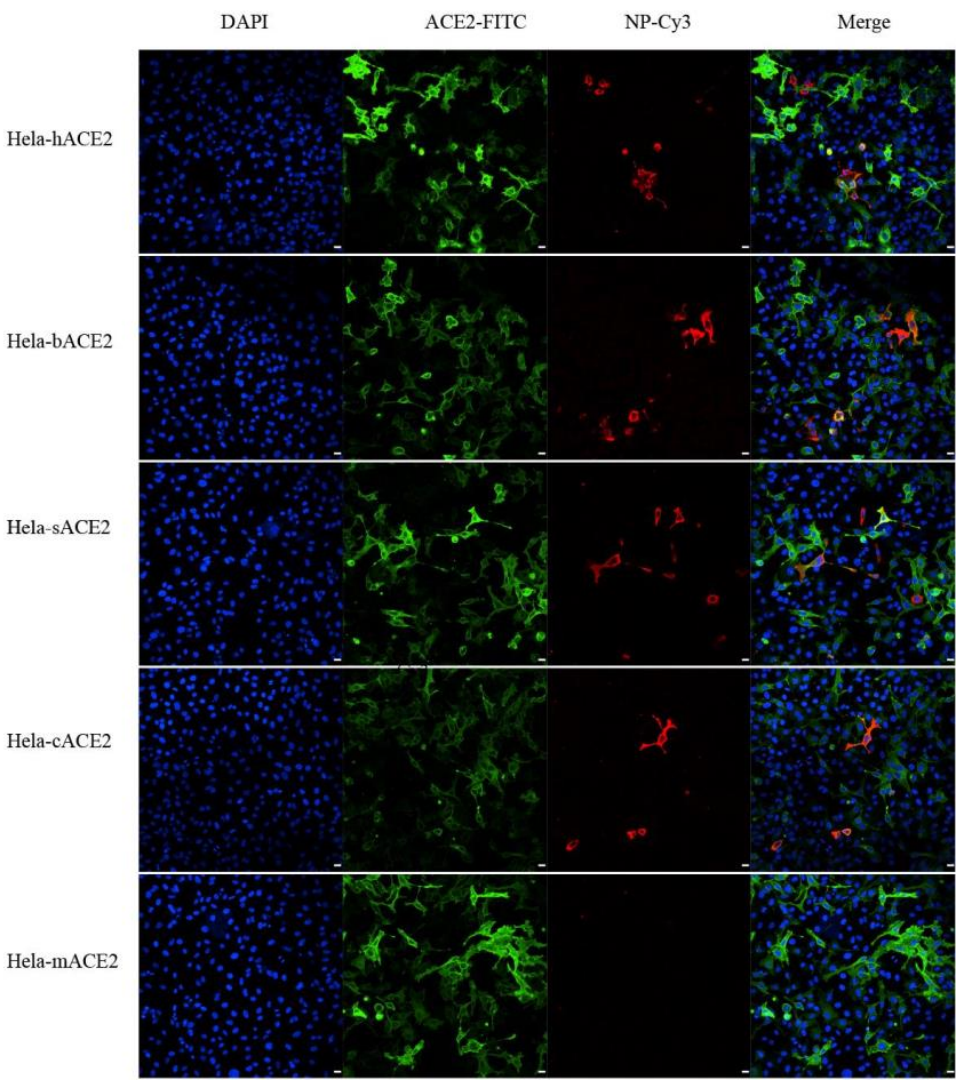
How does the virus work?



How does it infect?

- Cell entry
- Replication
- Formation of new viral particles
- Find its weakness!
- Develop new vaccines and drugs.




DAPI
ACE2-FITC
NP-Cy3
Merge
Hela-hACE2
Hela-bACE2
Hela-sACE2
Hela-cACE2
Hela-mACE2

Research takes time...

...What do we do in the mean time

- Share your findins with the world, without creating panic!
- Make sure you can detect the virus
- Track and trace
- Find the source of the outbreak: animal species?
- Ensure hygiene to slow the spread.
- Quarantine travelers from affected areas.
- Isolate those who have it.

Vaccines are here!

- … But there's not enough for everyone.
- Who gets it first?
  - Old or young?
  - Nurses and doctors?
  - Rich people?
  - People who have not had COVID-19 before?
  - What if we give everyone a small piece?

https://www.instagram.com/diederikgommers/

- Does the vaccine only protect the person who gets the shot?
- What happens to the virus when we are all vaccinated?
- What about new variants?