COVID 19 Pandemic: Evolution and Epidemiology

Learning Objectives

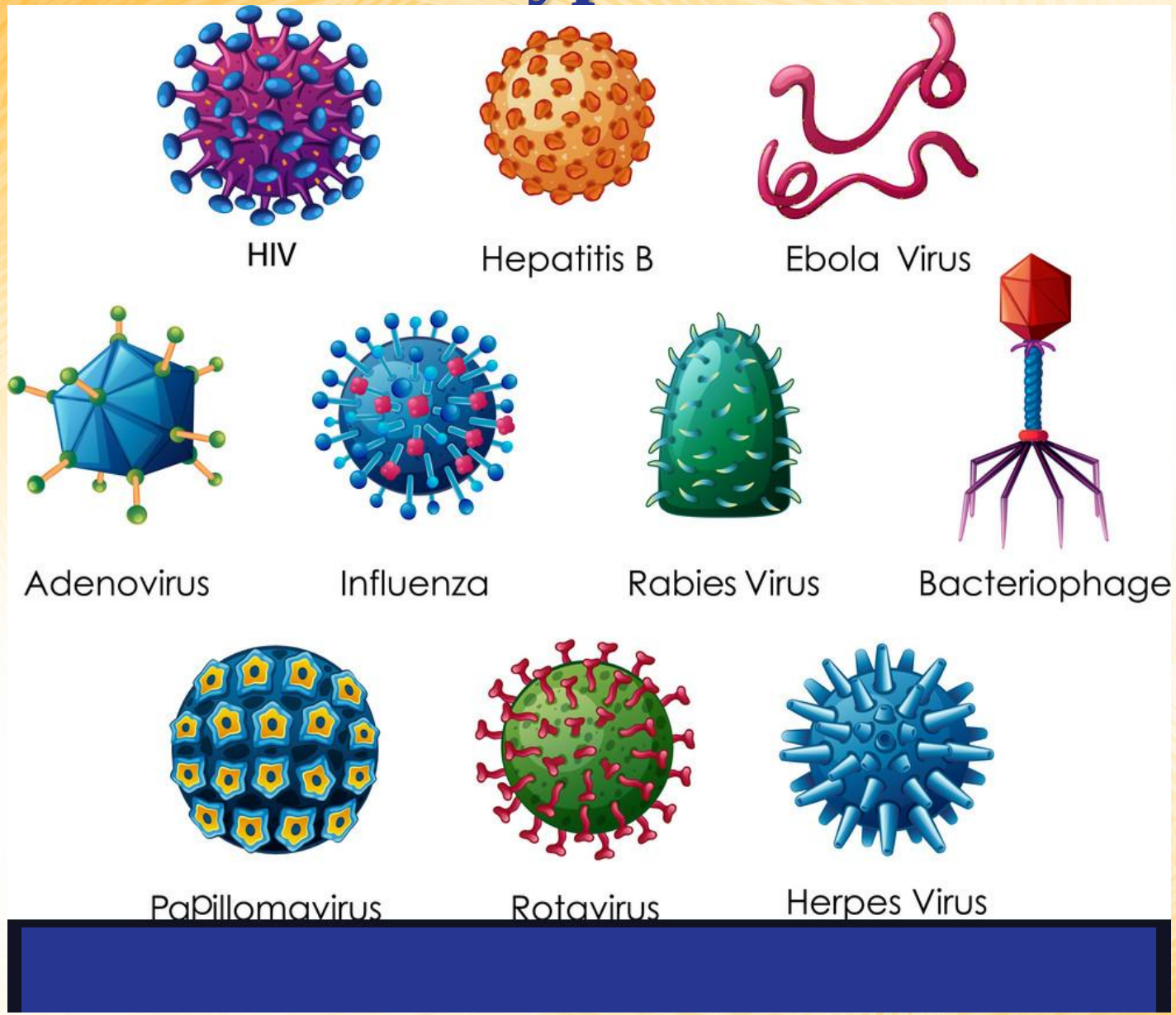
- Describe the anatomical characteristics of a virus
- Review viral mutation
- Describe the evolution of the COVID virus
- Define the global consequences of COVID

Corona Virus SARS-CoV-2 (COVID-19)

General Characteristics of Viruses

- **Obligatory intracellular parasites**
- Contain DNA or RNA
- Contain a protein coat
- Some are enclosed by an envelope
- Some viruses have spikes
- Most viruses infect only specific types of cells in one host
- **Host range** is determined by specific host attachment sites and cellular factors

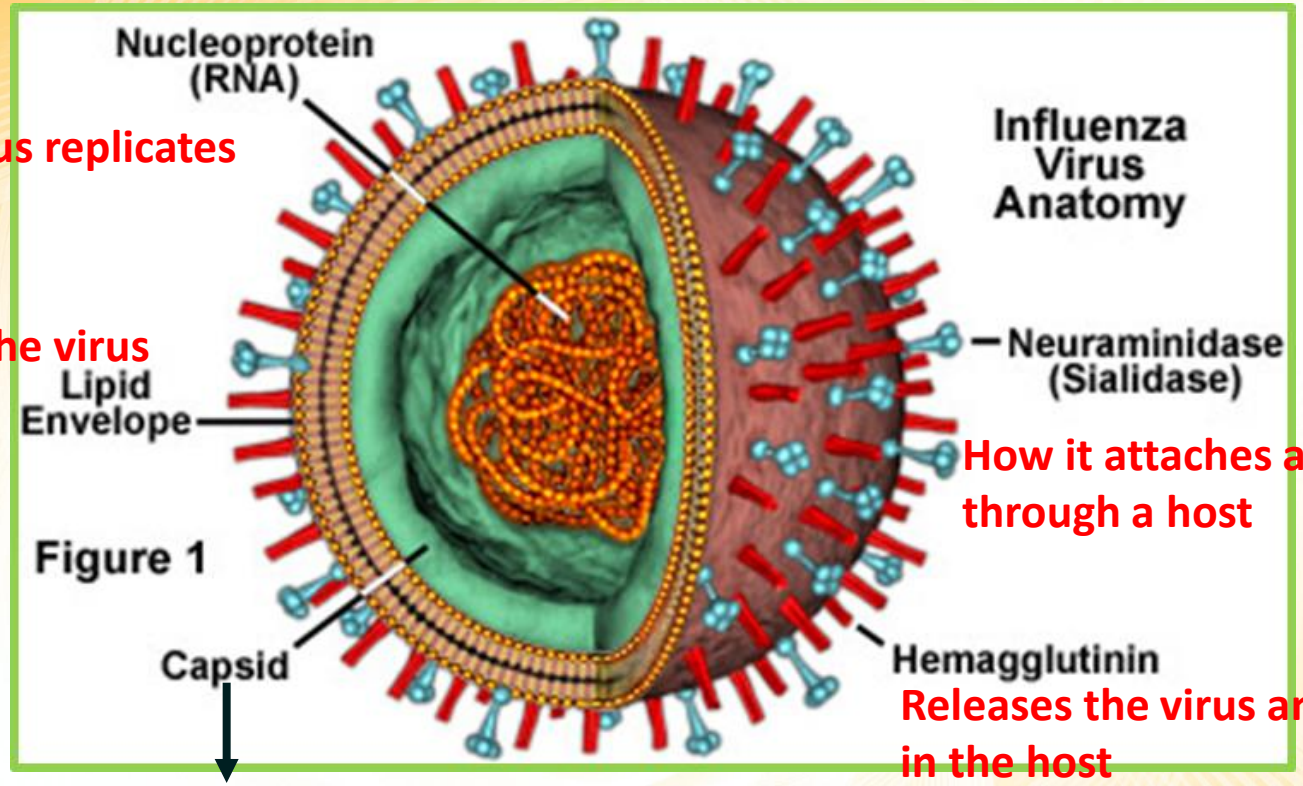
Different Types of Viruses



Anatomy of A Virus

How the virus replicates

Protects the virus

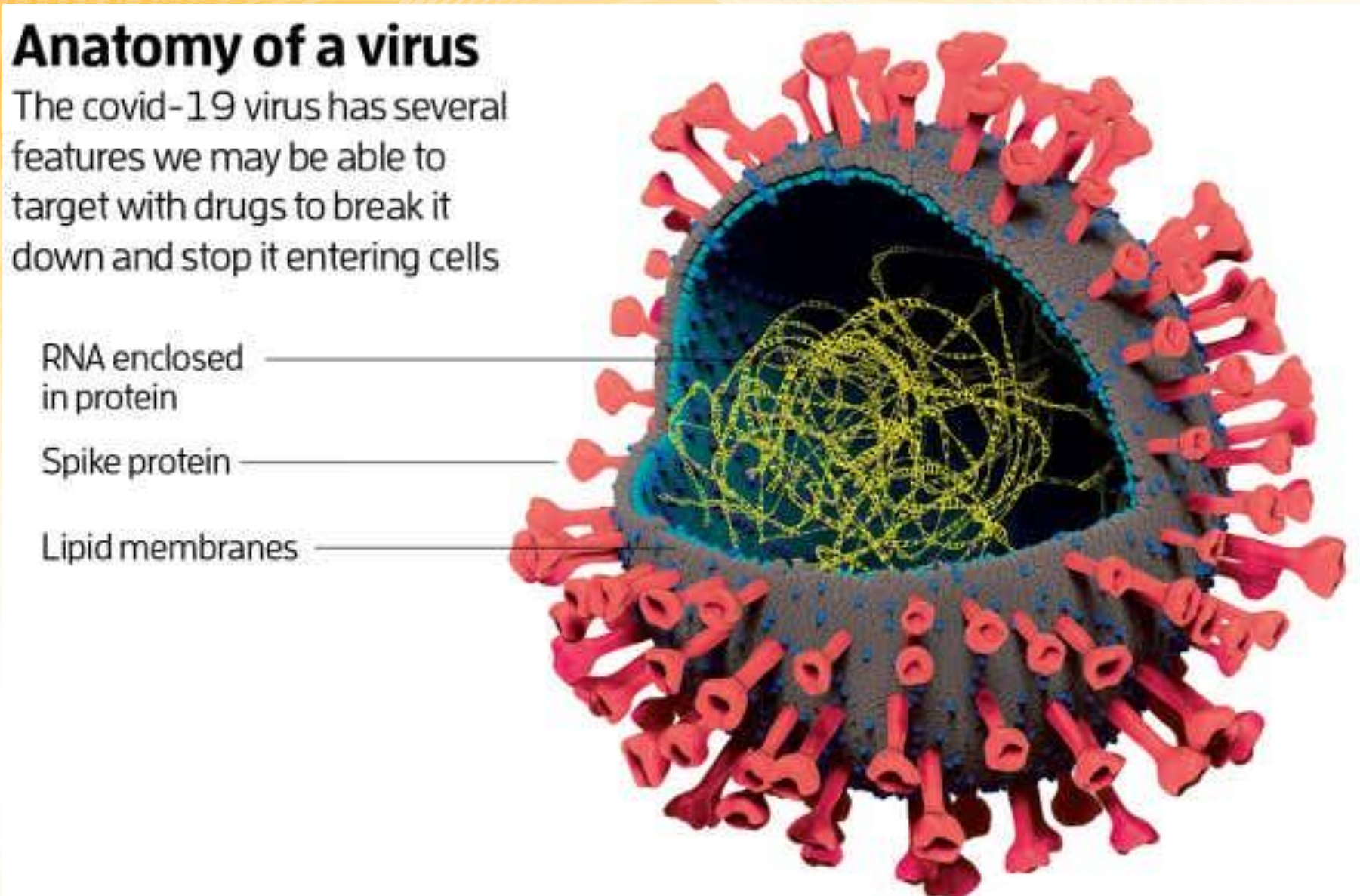


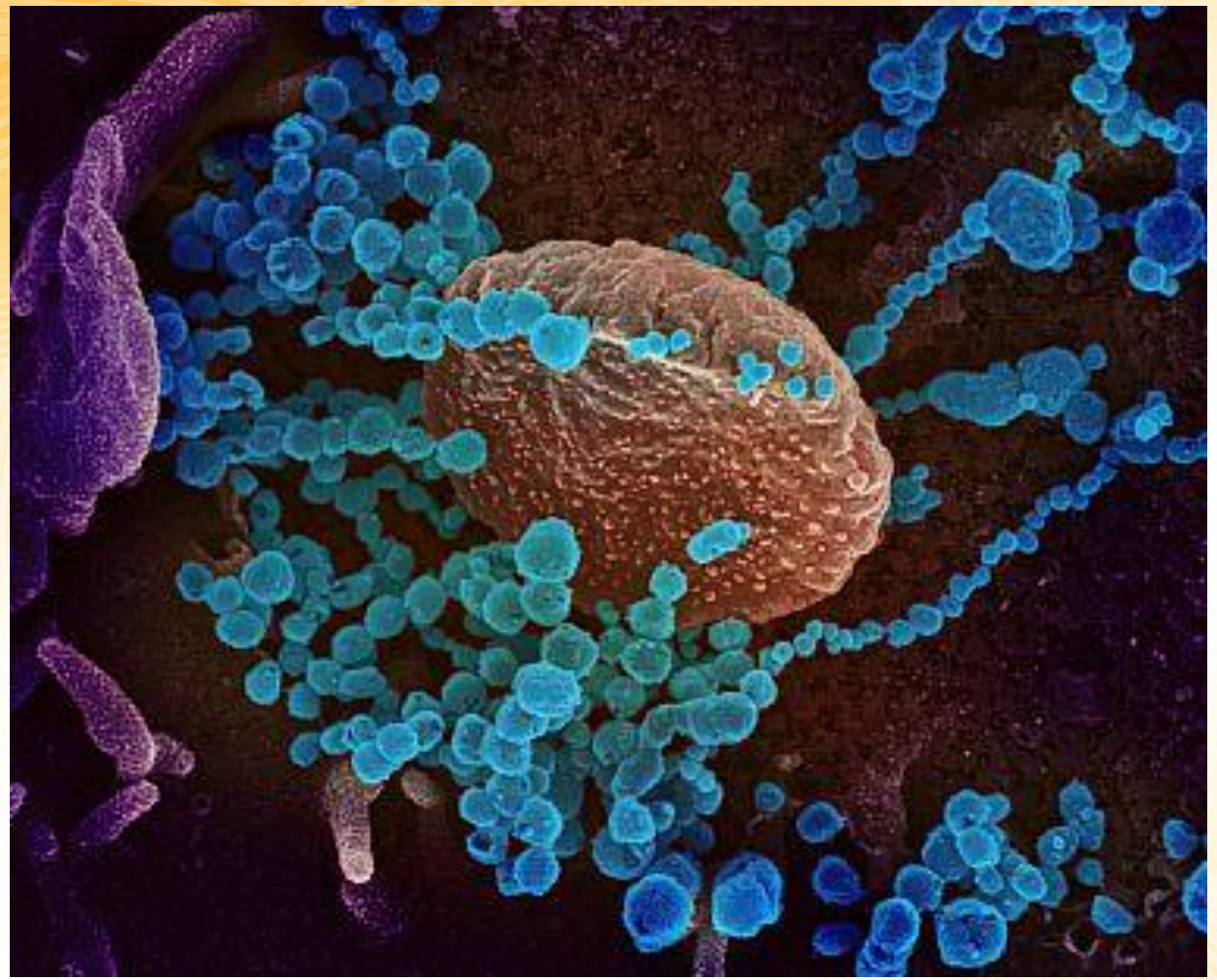
How it attaches and spreads through a host

Releases the virus antibodies in the host

1) it protects the nucleic acid from digestion by enzymes,
2) contains special sites on its surface that allow the virion to attach to a host cell, and
3) provides proteins that enable the virion to penetrate the host cell membrane and, in some cases, to inject the infectious nucleic acid into the cell's cytoplasm.

COVID Virus

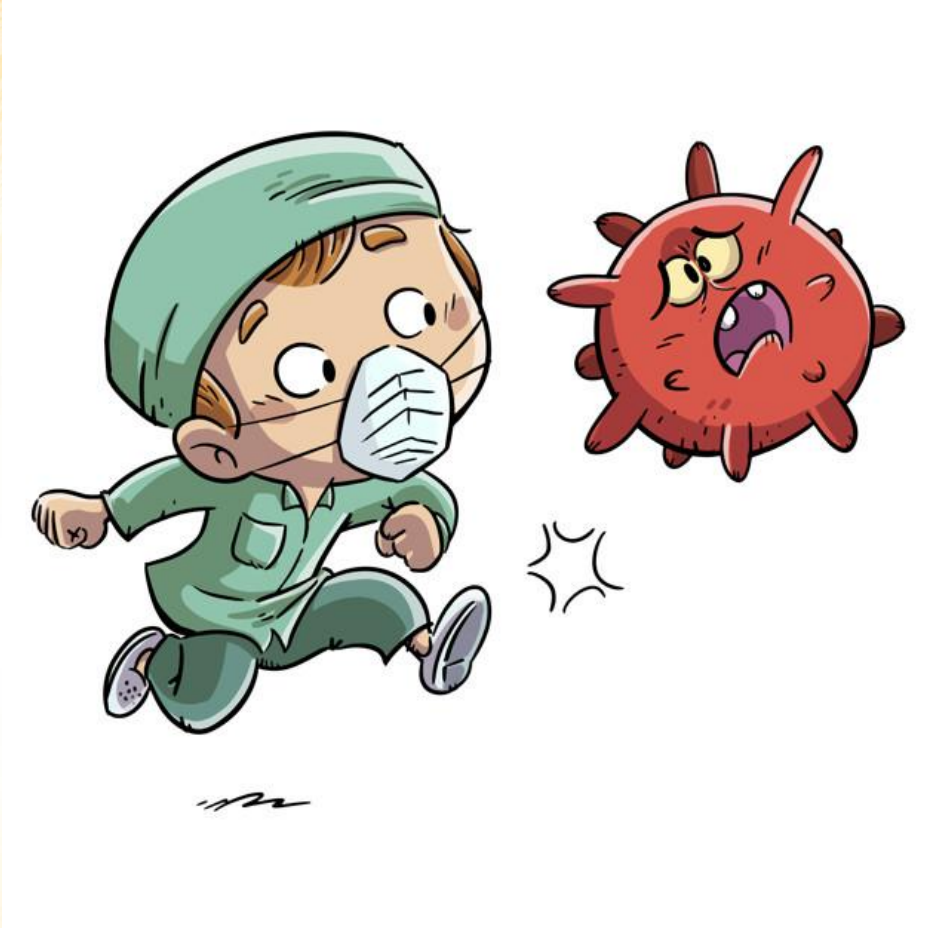

Anatomy of a virus
The covid-19 virus has several features we may be able to target with drugs to break it down and stop it entering cells
RNA enclosed in protein
Spike protein
Lipid membranes



This colorized scanning electron microscope image shows SARS-CoV-2 (round blue objects), the virus that causes COVID-19, emerging from the surface of cells cultured in the lab.

HIERARCHY OF SUSCEPTIBILITY

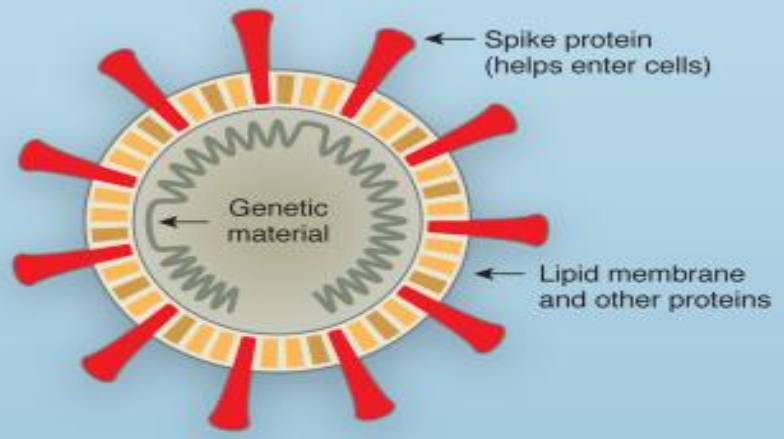
What Kills A Virus?



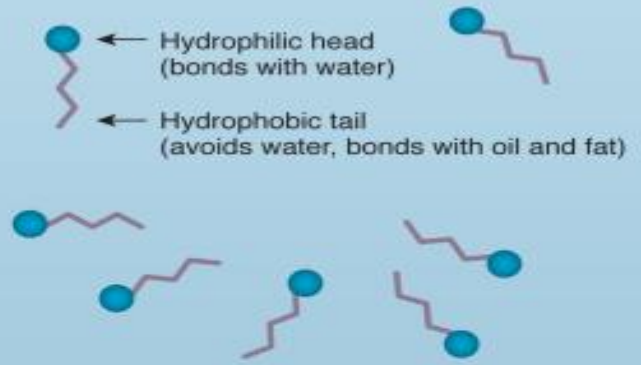
How Soap Works

Washing with soap and water is an effective way to destroy and dislodge many microbes, including the new coronavirus.

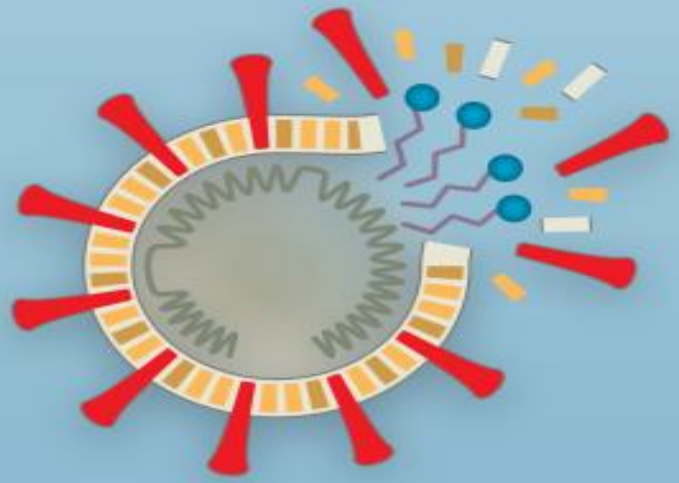
THE CORONAVIRUS has a membrane of oily lipid molecules, which is studded with proteins that help the virus infect cells.



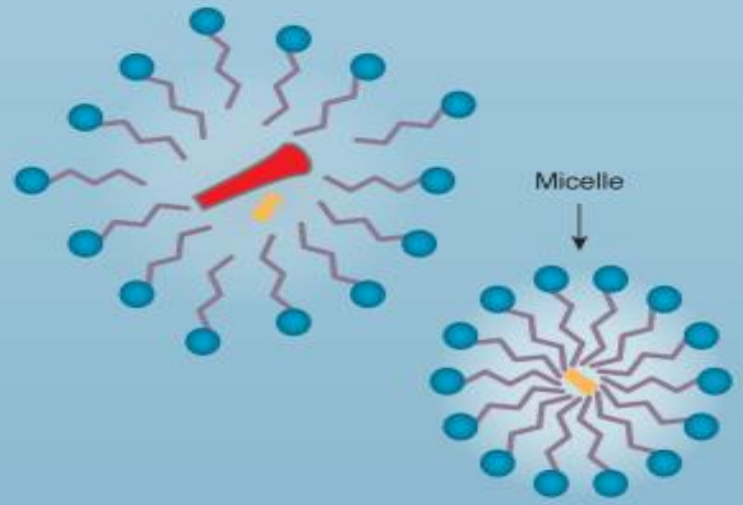
SOAP MOLECULES have a hybrid structure, with a head that bonds to water and a tail that avoids it.



SOAP DESTROYS THE VIRUS when the water-shunning tails of the soap molecules wedge themselves into the lipid membrane and pry it apart.

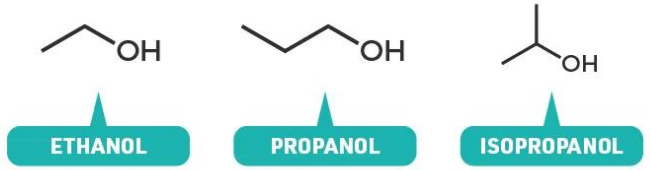


SOAP TRAPS DIRT and fragments of the destroyed virus in tiny bubbles called micelles, which wash away in water.



HOW HAND SANITISERS PROTECT AGAINST INFECTIONS

WHAT'S IN HAND SANITISERS?

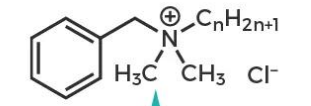


ETHANOL | PROPANOL | ISOPROPANOL

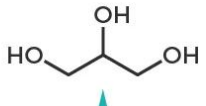
Alcohol-based sanitisers contain 60-95% alcohol. Most contain either ethanol, n-propanol, isopropanol, or a combination of these.

CHLORHEXIDINE

Chlorhexidine and benzalkonium chloride are also found in some sanitisers. Both are also used in non-alcohol-based sanitisers.



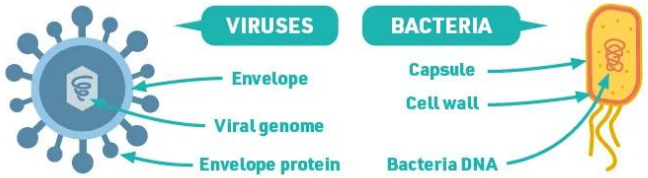
BENZALKONIUM CHLORIDE



GLYCEROL

Other ingredients include glycerol, which acts as a moisturiser to stop your skin drying out. Hydrogen peroxide is added to prevent bacterial contamination in the hand sanitiser.

HOW DO HAND SANITISERS WORK?



Alcohols in hand sanitisers alter (denature) the structure of proteins. They destroy the cell wall and membranes of bacteria cells, and the envelope of viruses (including coronavirus). They're less effective against non-enveloped viruses. Non-alcohol-based sanitisers also kill bacteria but are less effective against viruses.

HOW EFFECTIVE ARE THEY?

MINIMUM OF 60% ALCOHOL

Hand sanitisers with >60% alcohol are effective if applied generously. However, they don't kill all virus types and are less effective on dirty or greasy hands.

WASH HANDS FOR 20 SECONDS

Hand washing with soap for 20 seconds washes away bacteria and viruses, and also removes dirt and grease. Antibacterial soaps are no more effective.

CLEANERS, SANITIZERS, DISINFECTANTS, VIRUCIDES AND STERILANTS

CLEANER

AIDS IN SOIL REMOVAL

A cleaner simply aids in removing soil from a surface. Although cleaning does remove germs from surfaces– it doesn't kill them.

SANITIZER

REDUCES NUMBER OF BACTERIA

A sanitizer lowers the number of bacteria on surfaces to levels that are considered safe by public health organizations. These products tend to be faster and safer than disinfectants, but disinfectants usually have broader kill claims.

DISINFECTANT

KILLS FUNGI, BACTERIA AND VIRUSES

A disinfectant kills infectious fungi, bacteria and viruses (but not bacterial spores) on hard environmental surfaces.

VIRUCIDE

KILLS VIRUSES

A virucide destroys or irreversibly inactivates viruses in the inanimate environment.

STERILANT

ELIMINATES ALL FUNGI, BACTERIA, VIRUSES AND SPORES

A sterilant is used to destroy or eliminate all forms of microbial life including:
- Fungi
- Viruses
- All forms of bacteria and their spores

Any product that claims to kill bacteria, viruses, mold or fungi must be registered with the EPA as a pesticide.

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CLOROX
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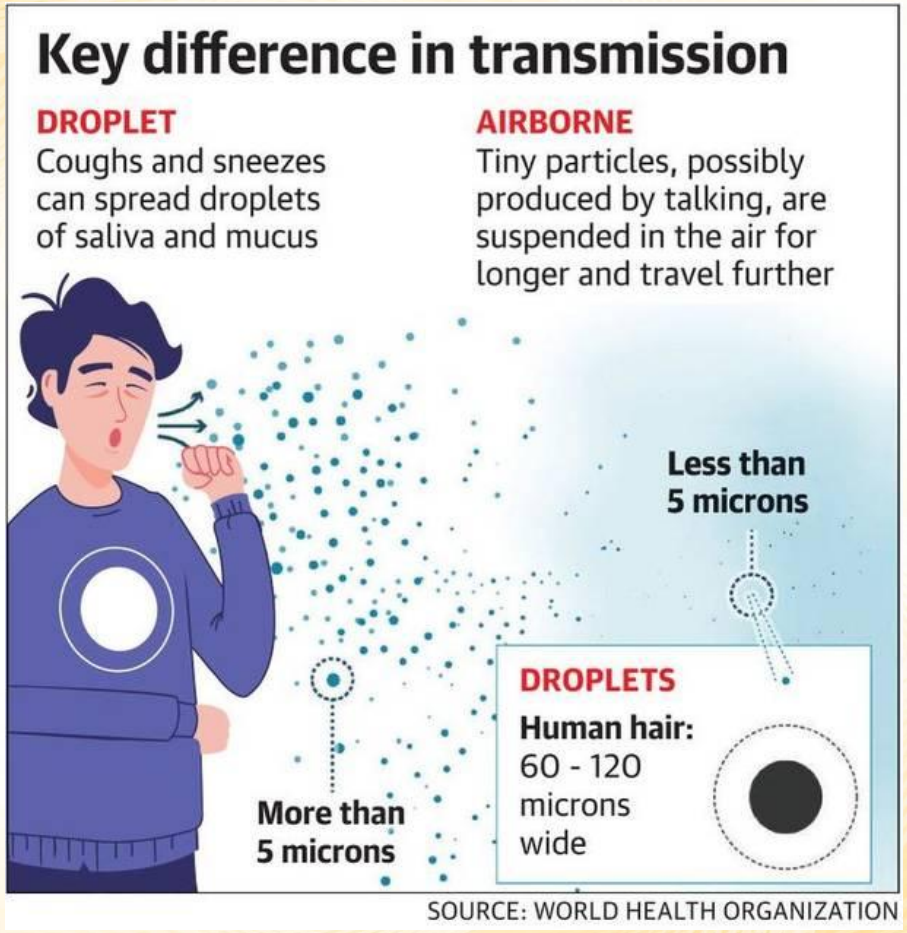
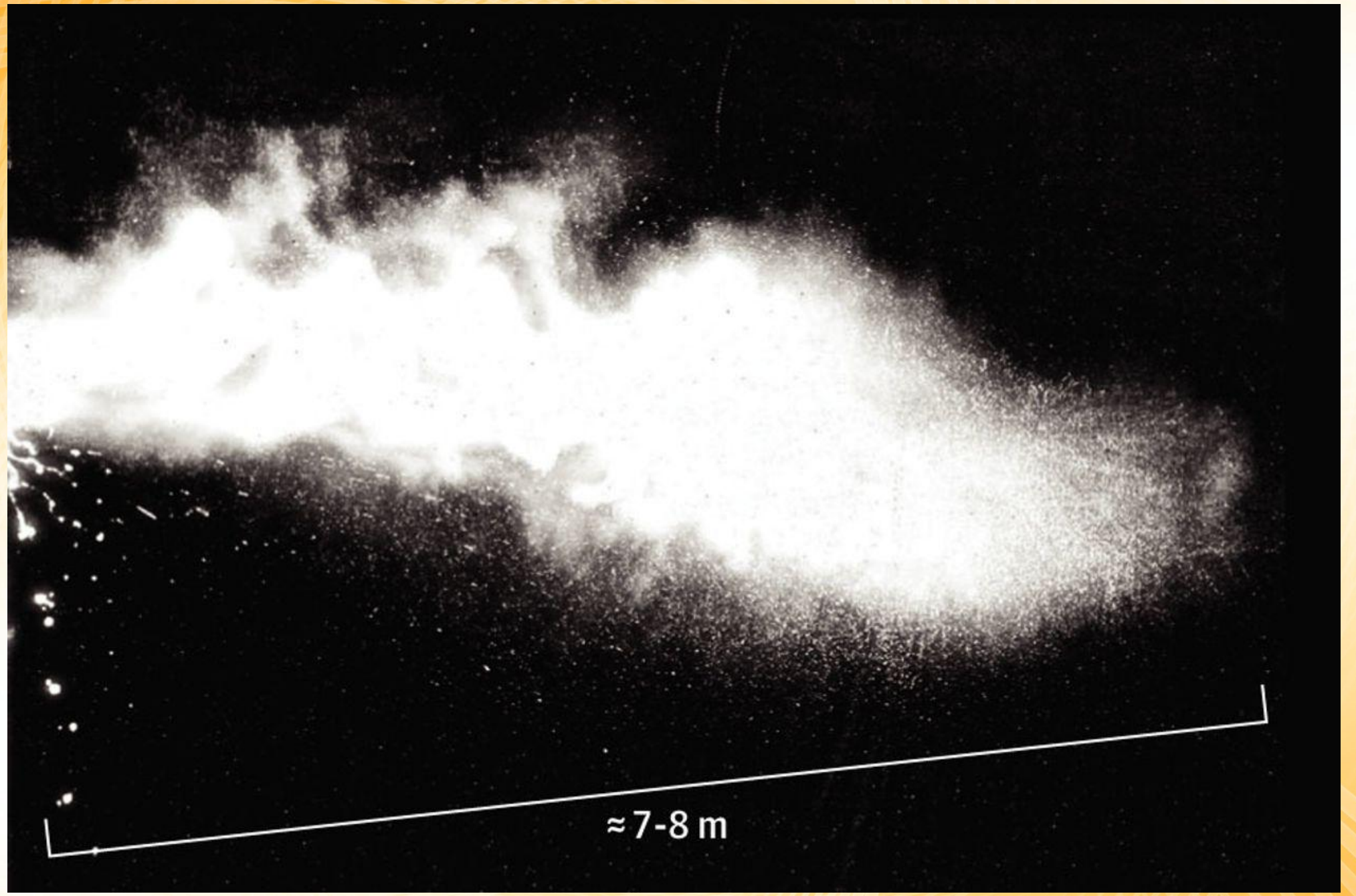
How Do Viruses Spread?



Disease spreads very quickly especially in crowded circumstances through coughing

Courtesy of Professor Davidhazy, Rochester Institute of Technology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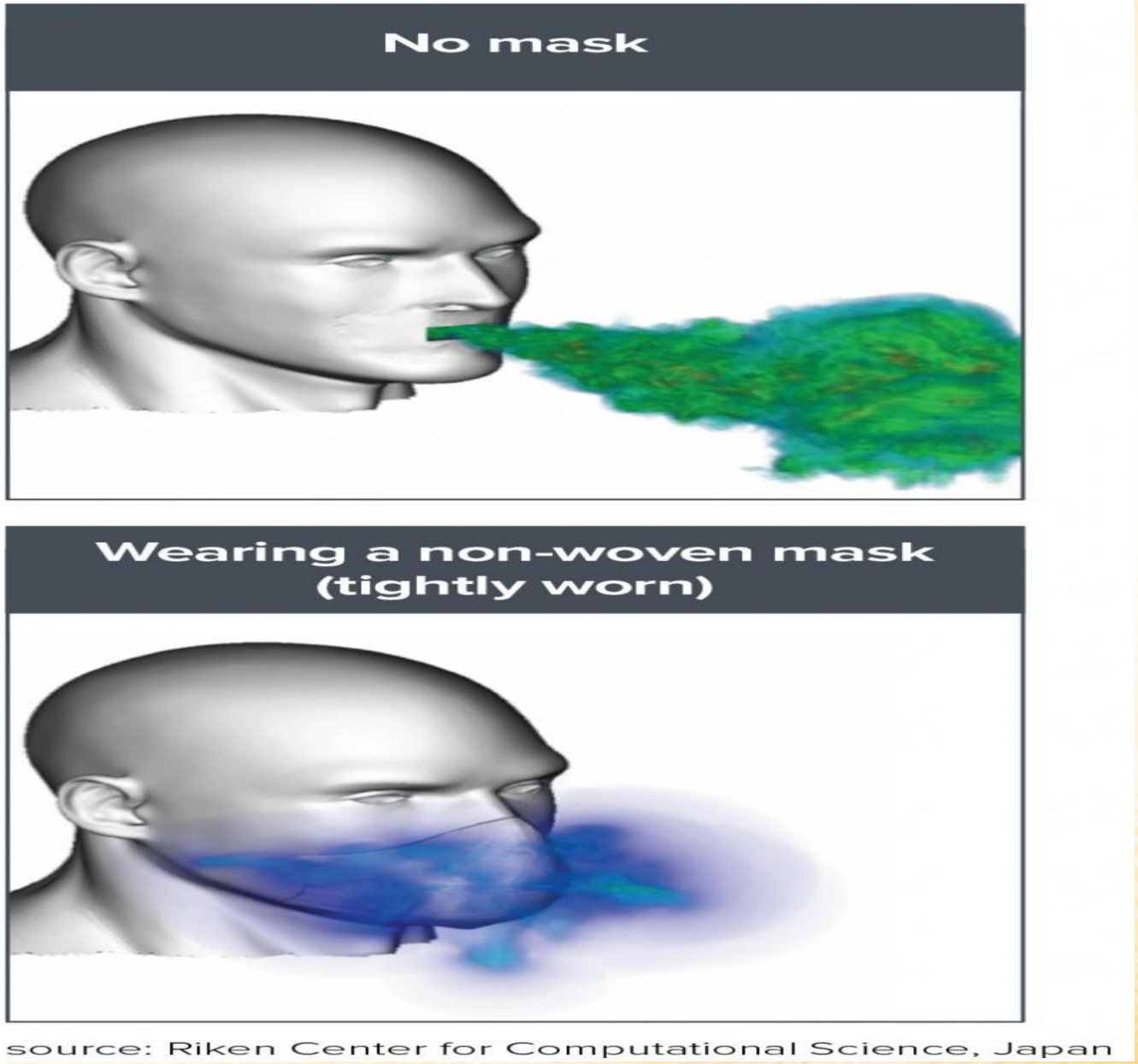


source: Riken Center for Computational Science, Japan

1

Crowded places

with many people nearby

2

Close-contact settings

Especially where people have close-range conversations

3

Confined and enclosed spaces

with poor ventilation

1

The risk is higher in places where

Treatment

- Prevention !!!!
  - Vaccination
- Antiviral drugs
  - Tamiflu-tablet
    - Relenza-spray inhaler
      - Caution in use with asthmatics
- Rest, fluids, anti-inflammatory drugs

Influenza Vaccine

Age Group	Recommended Vaccine	Live vaccine?	Types of flu strains protected	Reason for recommendation
Children aged 6 months to 2 years	Egg-grown quadrivalent vaccine (QIVe)	**No**	**Four**	LAIV is not suitable for children under two
Children aged 2 – 17 years	Live attenuated influenza vaccine (LAIV)	**Yes**	**Four**	Nasal vaccine helps to reduce spread of flu virus in children
Adults aged 18 – 64 years	Quadrivalent influenza vaccine: Egg-grown (QIVe) Cell-based (QIVc)	**No**	**Four**	Quadrivalent vaccines protect against four types of flu strain
Adults aged 65 or over	Adjuvanted trivalent influenza vaccine (aTIV)	**No**	**Three**	"Adjuvant" is added to the vaccine to make it more effective in older people

Antiviral Treatment

Table 1. Profile of antiviral agents for influenza

Antiviral drug	Mechanism of action	Route of Administration	Dose	Influenza types Affected
Amantadine	Blocks influenza virus uncoating and entry into respiratory cells	Oral	100 mg twice daily*	A
Zanamivir †	Blocks activity of viral neuraminidase	Inhaler device	10 mg twice daily	A and B
Oseltamivir †	Blocks activity of viral neuraminidase	Oral	75 mg twice daily	A and B

* 100 mg daily is preferred in some elderly patients and in those experiencing side effects. The dose must be modified in the case of renal impairment
† Recently licensed in Canada

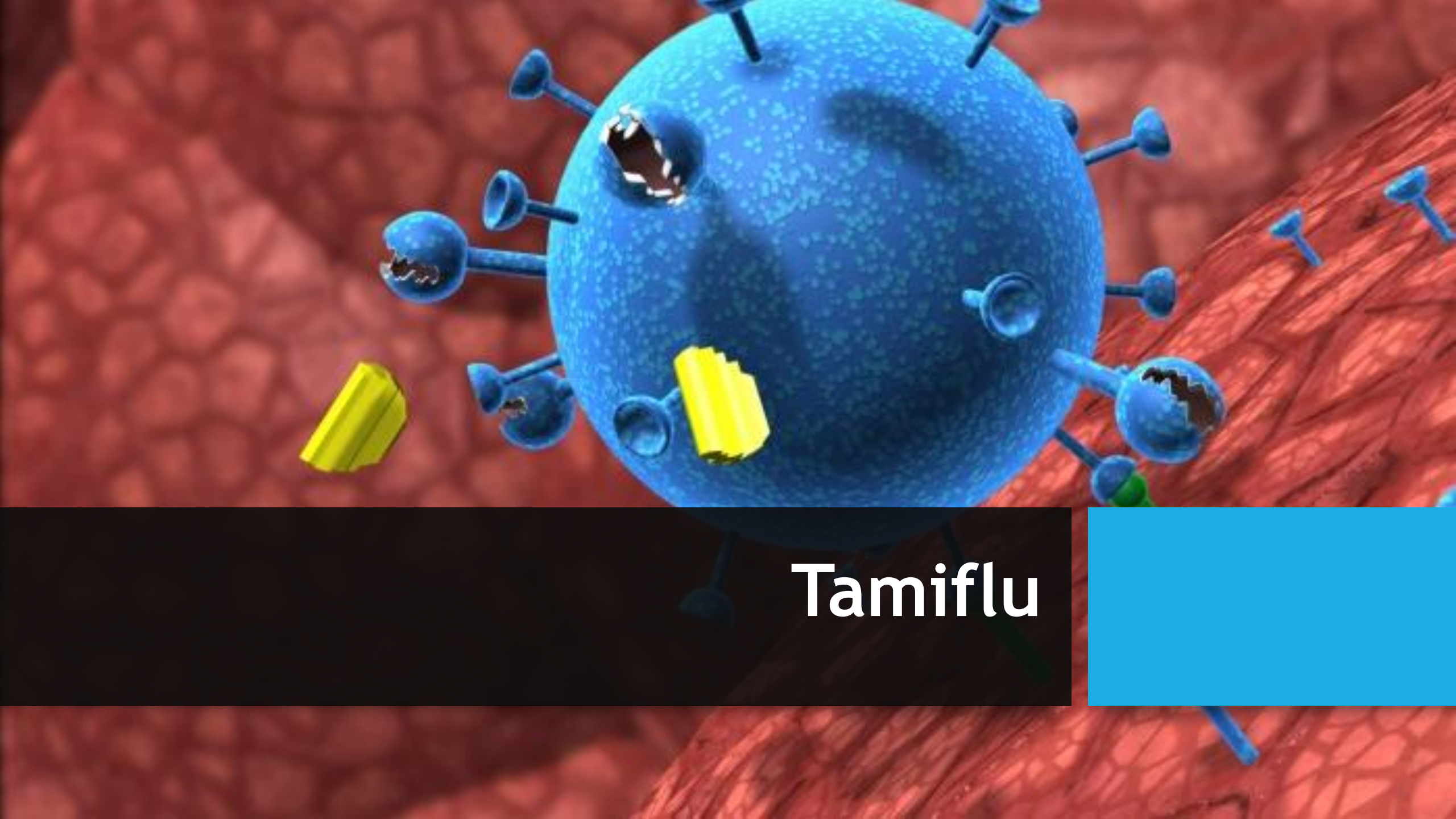
Tamiflu (Oseltamivir)

Suppresses and decreased the spread of type A and B virus by blocking the action of neuramindaise.(how virus attaches and spreads)

By blocking this enzyme it prevents the virus to spread from infected cells to healthy cells.

Most effective if started within 48 hours of onset of symptoms and by can reduce the duration of the flu by 1-2 days.

Adult dosage 75mg twice a day for five days.



Tamiflu

FACT:
Drinking methanol, ethanol or bleach DOES NOT prevent or cure COVID-19 and can be extremely dangerous

Methanol, ethanol, and bleach are poisons. Drinking them can lead to disability and death.

Methanol, ethanol and bleach are sometimes used in cleaning products to kill the virus on surfaces – however you should never drink them. They will not kill the virus in your body and they will harm your internal organs.

To protect yourself against COVID-19, disinfect objects and surfaces, especially the ones you touch regularly. You can use diluted bleach or alcohol for that. Make sure you clean your hands frequently and thoroughly and avoid touching your eyes, mouth and nose.

World Health Organization

#COVID19 #coronavirus

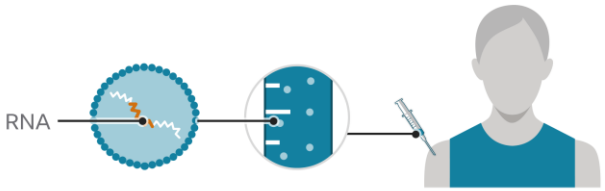
5 April 2020

COVID Vaccines

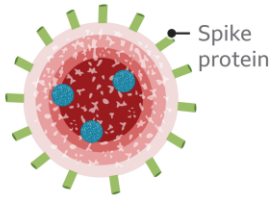
COVID 19 Vaccines Types

How an RNA vaccine works

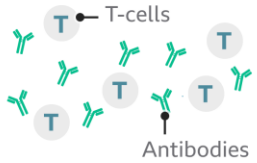
1. Scientists take part of the virus's genetic code and turn it into a vaccine that is injected into the patient



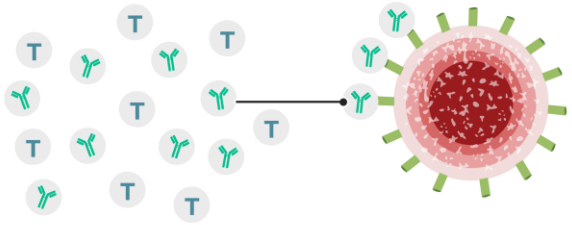
2. The vaccine enters the cells and tells them to produce the coronavirus spike protein



The body's immune system reacts, produces antibodies and activates T-cells to destroy cells with the spike protein



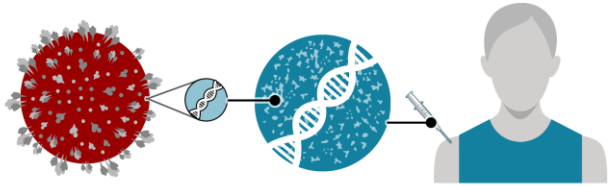
3. If the patient later catches coronavirus, the antibodies and T-cells are triggered to fight the virus



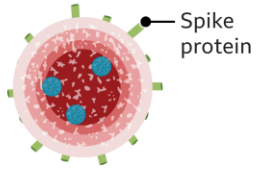
Source: Nature BBC

How the Oxford vaccine works

1. Scientists take genes for the spike protein on the surface of the coronavirus and put them into a harmless virus to make a vaccine. This is injected into the patient



2. The vaccine enters cells which then start to produce the spike protein



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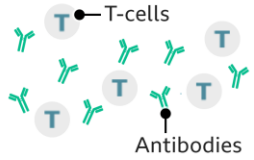

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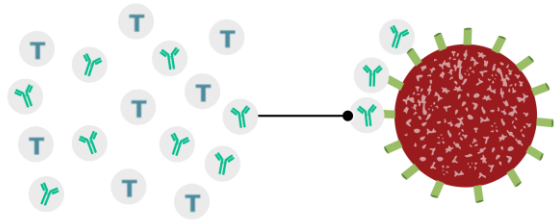


Source: Nature BBC

VIRAL-VECTOR VACCINES

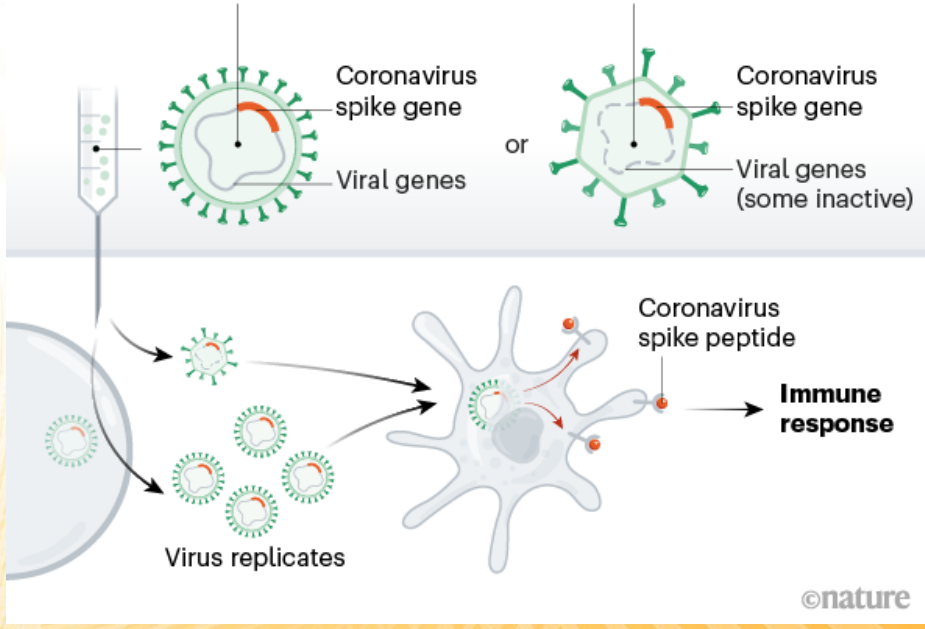
Replicating viral vector (such as weakened measles)

The newly approved Ebola vaccine is an example of a viral-vector vaccine that replicates within cells. Such vaccines tend to be safe and provoke a strong immune response. Existing immunity to the vector could blunt the vaccine's effectiveness, however.

Non-replicating viral vector (such as adenovirus)

No licensed vaccines use this method, but they have a long history in gene therapy. Booster shots can be needed to induce long-lasting immunity.

US-based drug giant Johnson & Johnson is working on this approach.



Available COVID Vaccines

How some of the Covid-19 vaccines compare

Company	Type	Doses	Storage
Oxford Uni-AstraZeneca	Viral vector (genetically modified virus)	x2	2 to 8°C (6 months)
Moderna	RNA (part of virus genetic code)	x2	-25 to -15°C (7 months)
Pfizer-BioNTech	RNA	x2	-80 to -60°C (6 months)
Gamaleya (Sputnik V)	Viral vector	x2	-18.5°C (liquid form) 2 to 8°C (dry form)
Sinovac (CoronaVac)	Inactivated virus (weakened virus)	x2	2 to 8°C
Novavax	Protein-based	x2	2 to 8°C
Janssen	Viral vector	x1	2 to 8°C (3 months)

Source: UK government, Reuters

BBC

Global Herd Immunity Remains Out of Reach Because of Inequitable Vaccine Distribution

- In the race between infection and injection, injection has lost.
- Public health experts estimate that approximately 70% of the world's 7.9 billion people must be fully vaccinated to end the COVID-19 pandemic. As of June 21, 2021, 10.04% of the global population had been fully vaccinated, nearly all of them in rich countries.
- Only 0.9% of people in low-income countries have received at least one dose.
- I am a scholar of global health who specializes in health care inequities. Using a data set on vaccine distribution compiled by the Global Health Innovation Center's Launch and Scale Speedometer at Duke University in the United States, I analyzed what the global vaccine access gap means for the world.

Many nations, including the United States, Australia and Japan, have procured **enough doses to vaccinate more people than actually live there**. Other nations can only **vaccinate less than one-fourth of their populations**. Countries marked in gray do not have country-specific vaccine dose data available. Some nations may have more access to doses than this data reflects, through multinational agreements that could not be directly attributed to specific countries.

Somalia

Total population: 15,442,905

Doses procured: 200,000

Share of population able to be fully vaccinated by procured doses: 1.3%

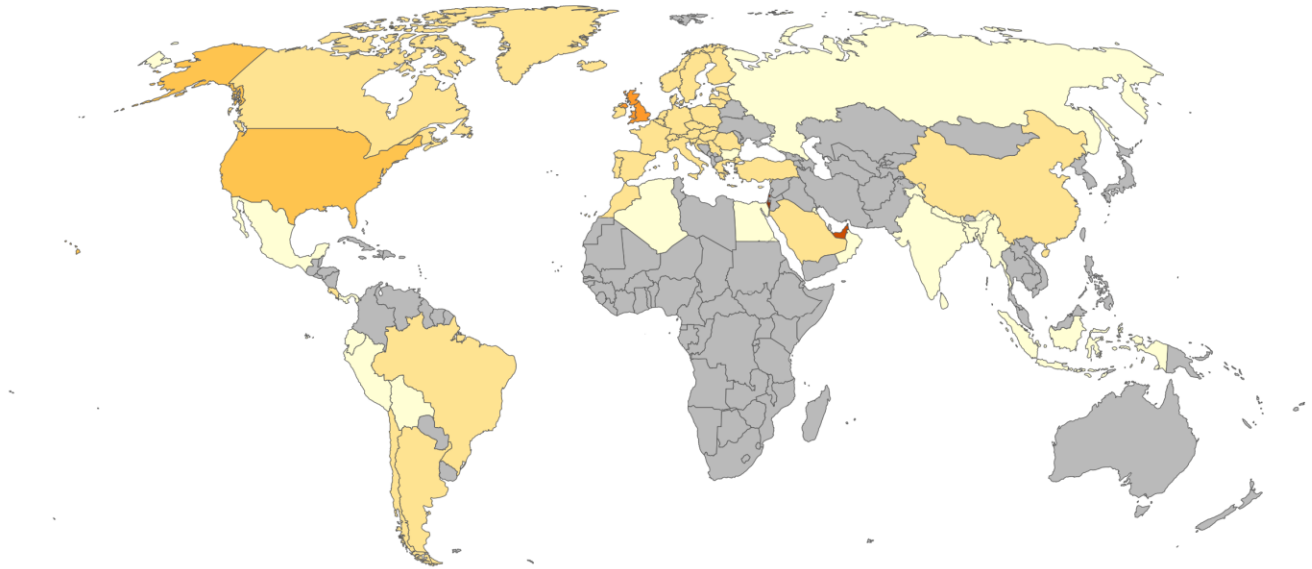
Data as of June 18, 2021.

Benin, for example, has obtained about 203,000 doses of China's Sinovac vaccine – enough to fully vaccinate 1% of its population. Honduras, relying mainly on AstraZeneca, has procured approximately 1.4 million doses. That will fully vaccinate 7% of its population. In these "vaccine deserts," even front-line health workers aren't yet inoculated.

Where is the vaccine being given?

Total reported vaccine doses administered per 100 people

Below 1
1-10
10-20
20-30
30-40
40-50
50 or more
No data

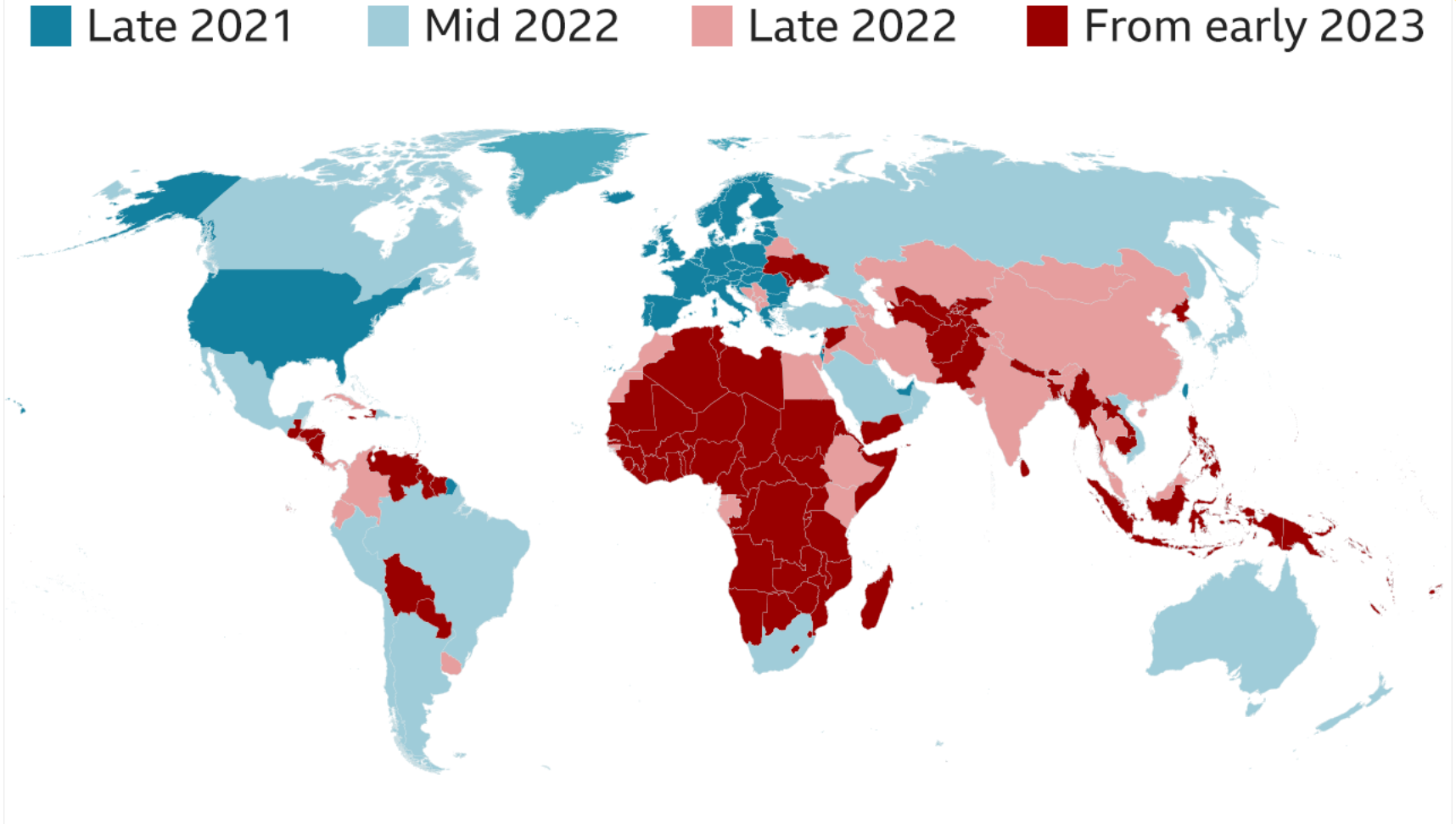


Note: Total vaccinations refers to the number of doses given, not necessarily the number of people vaccinated

Source: OWID, gov.uk dashboard, ONS, updated 1130 GMT on 11 Feb

BBC

When will countries be fully covered?



Source: The Economist Intelligence Unit, 27 Jan 2021

BBC

Mixing Covid-19 vaccines not a good idea: New study hints at more side effects but no safety concerns

During the study, the volunteers were administered a combination of vaccines either AstraZeneca as a first dose and Pfizer as a second dose; Pfizer as both doses or AstraZeneca as both doses. The Lancet report states that it was observed that people who got mixed dosage had more side effects with **34** per cent reporting feeling feverish, compared to only **10** per cent who were given Astera Zeneca as both dosages.

Meanwhile, **41** per cent of volunteers who received the Pfizer vaccine first and the AstraZeneca vaccine second reported experiencing fever as a side effect compared to only **21** per cent of volunteers given the Pfizer vaccine for both doses experiencing such side effects.

FDA approves Remdesivir to treat COVID-19

The drug works by preventing viruses from making copies of themselves. It was first developed by Gilead to treat Ebola, and research over the past few years showed that it could block the coronaviruses SARS and MERS from replicating inside cells. That's why scientists turned to it for this new coronavirus.

For the past few months, remdesivir has been part of the standard treatment for COVID-19 patients in many hospitals in the US. The benefits of the treatment appear to be limited. Clinical trials of the drug show that it may help some patients recover more quickly, but that it may not prevent death from the disease.

Most clinical trials have given remdesivir to the sickest patients, who may not see the biggest benefit from the drug — because it stops the virus from replicating, it could be more effective earlier on in someone's illness, before the virus has spread through their body.

No evidence it improves COVID outcomes!!!

Scientists work toward an elusive dream: a simple pill to treat Covid-19 :☺

- The first drug poised to check all the boxes of an ideal antiviral is molnupiravir, invented at the Emory Institute for Drug Development and developed by Merck and Ridgeback Biotherapeutics. The drug is what's known as a nucleoside analog, designed to throw a wrench in the process of viral replication by tricking SARS-CoV-2 into corrupting its own genetic material.
- Behind Merck's drug is a treatment from Atea Pharmaceuticals that builds on prior antiviral success. Atea's drug, AT-527, targets an enzyme key to viral replication, a similar approach to Gilead Sciences' curative treatments for hepatitis C.
- Catchily named PF-07321332, Pfizer's drug targets SARS-CoV-2's backbone enzyme, the linchpin of the virus's replication process. That enzyme, called 3CL, is one of two that are specific to all coronaviruses. That means if Pfizer can find the right dose, and run the right trials, it might have a treatment not just for SARS-CoV-2 but future pandemic viruses.

Flu Viruses Mutations

A flu virus can mutate 413 times in a given season

Human DNA has changed 1% in 40 million years

Flu RNA can change 1% in 4 days!!!!!

Avian flu humans

Usually highly pathological

- Often is responsible for death rates>50%

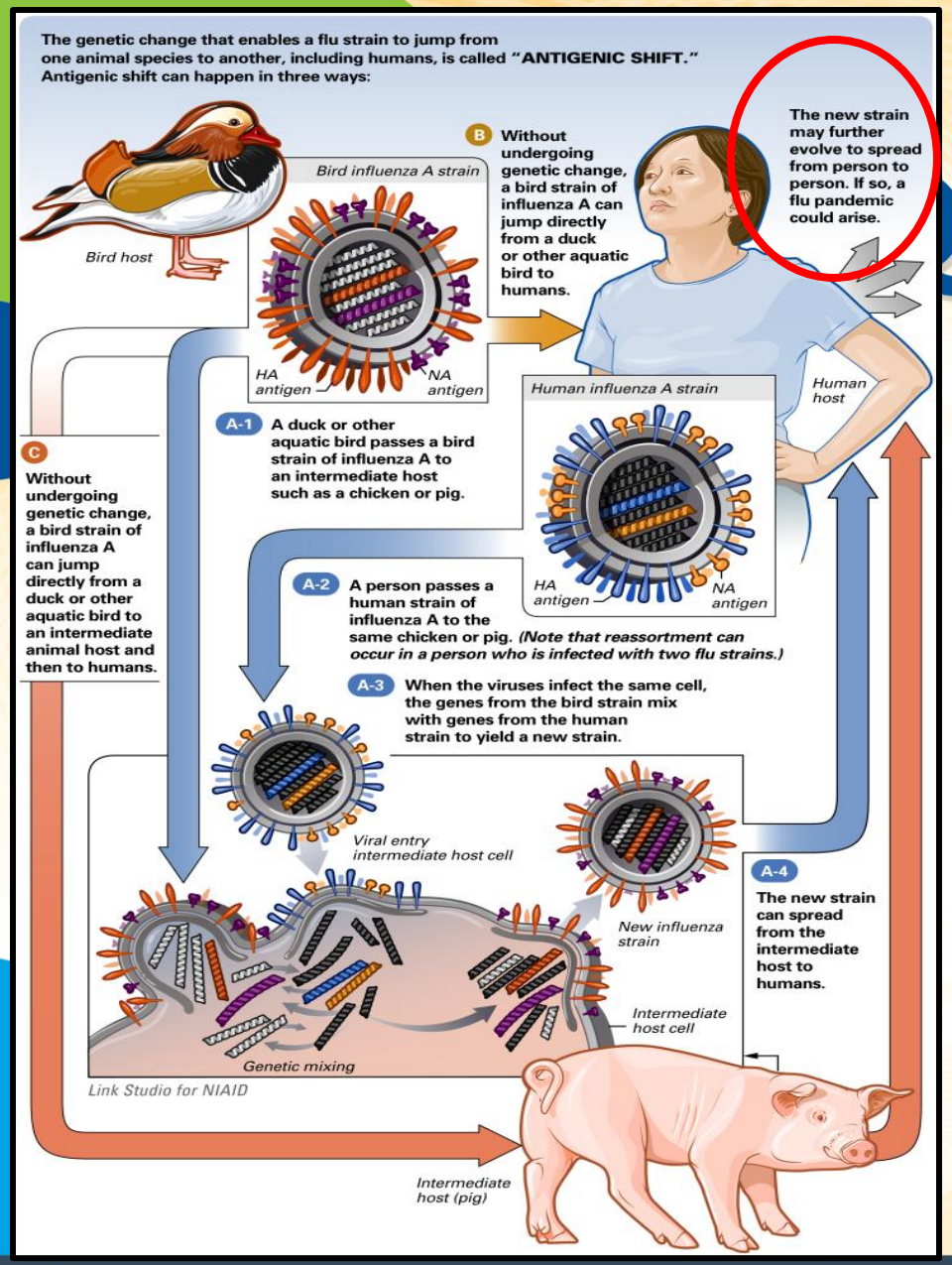
Drift and Shift in Virus

Virus are changing all the time.

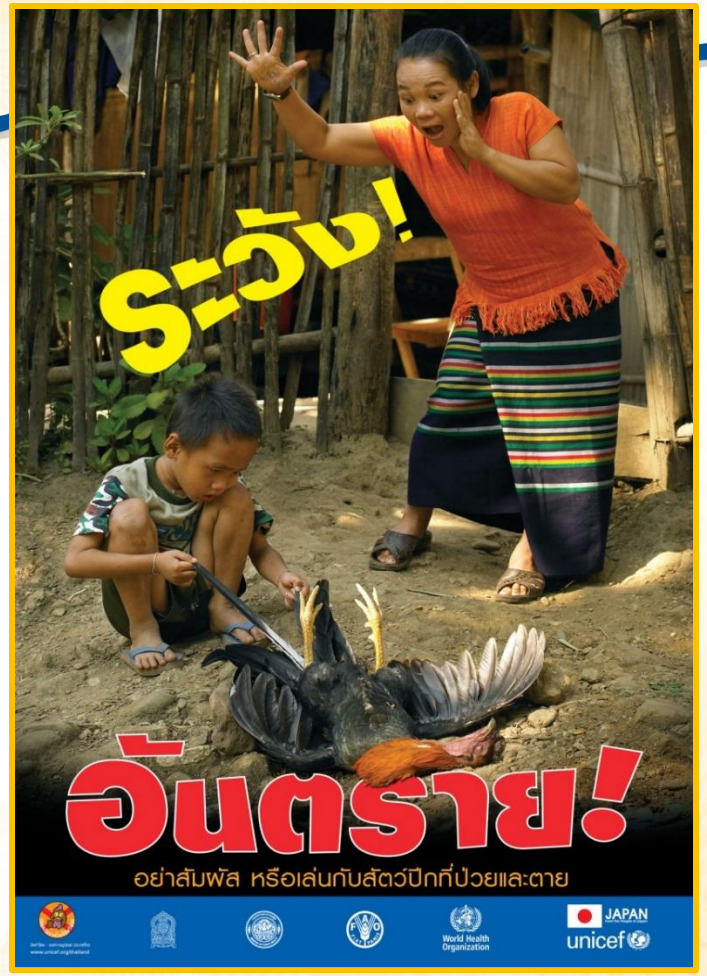
This why a person can get the flu repeated times in a lifetime.

When a new virus strain develops-antibodies to an earlier virus does not recognize the new strain.

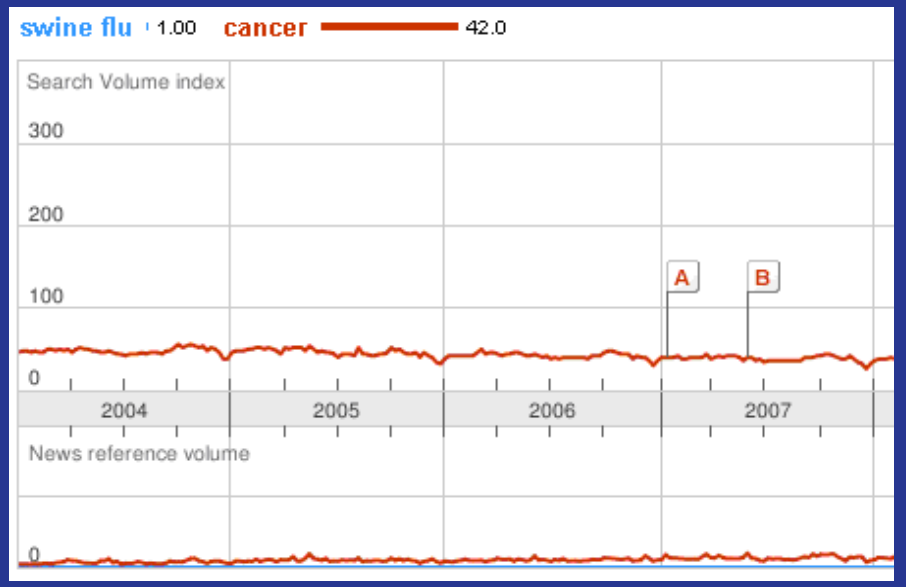
An Antigentic shift refers an abrupt change to produce a novel subtype virus that is not usually seen in humans—Avian Flu.


The genetic change that enables a flu strain to jump from one animal species to another, including humans, is called "ANTIGENIC SHIFT." Antigenic shift can happen in three ways:
Bird host
Bird influenza A strain
HA antigen
NA antigen
B Without undergoing genetic change, a bird strain of influenza A can jump directly from a duck or other aquatic bird to humans.
The new strain may further evolve to spread from person to person. If so, a flu pandemic could arise.
Human host
Human influenza A strain
HA antigen
NA antigen
A-1 A duck or other aquatic bird passes a bird strain of influenza A to an intermediate host such as a chicken or pig.
C Without undergoing genetic change, a bird strain of influenza A can jump directly from a duck or other aquatic bird to an intermediate animal host and then to humans.
A-2 A person passes a human strain of influenza A to the same chicken or pig. (Note that reassortment can occur in a person who is infected with two flu strains.)
A-3 When the viruses infect the same cell, the genes from the bird strain mix with genes from the human strain to yield a new strain.
Viral entry intermediate host cell
New influenza strain
A-4 The new strain can spread from the intermediate host to humans.
Intermediate host cell
Genetic mixing
Link Studio for NIAID
Intermediate host (pig)

Qu ns?


ระวัง!
อันตราย!
อย่าสัมผัส หรือเล่นกับสัตว์ปีกที่ป่วยและตาย
World Health Organization
JAPAN
unicef

Future Flu Fears



Why Do Viruses Mutate?

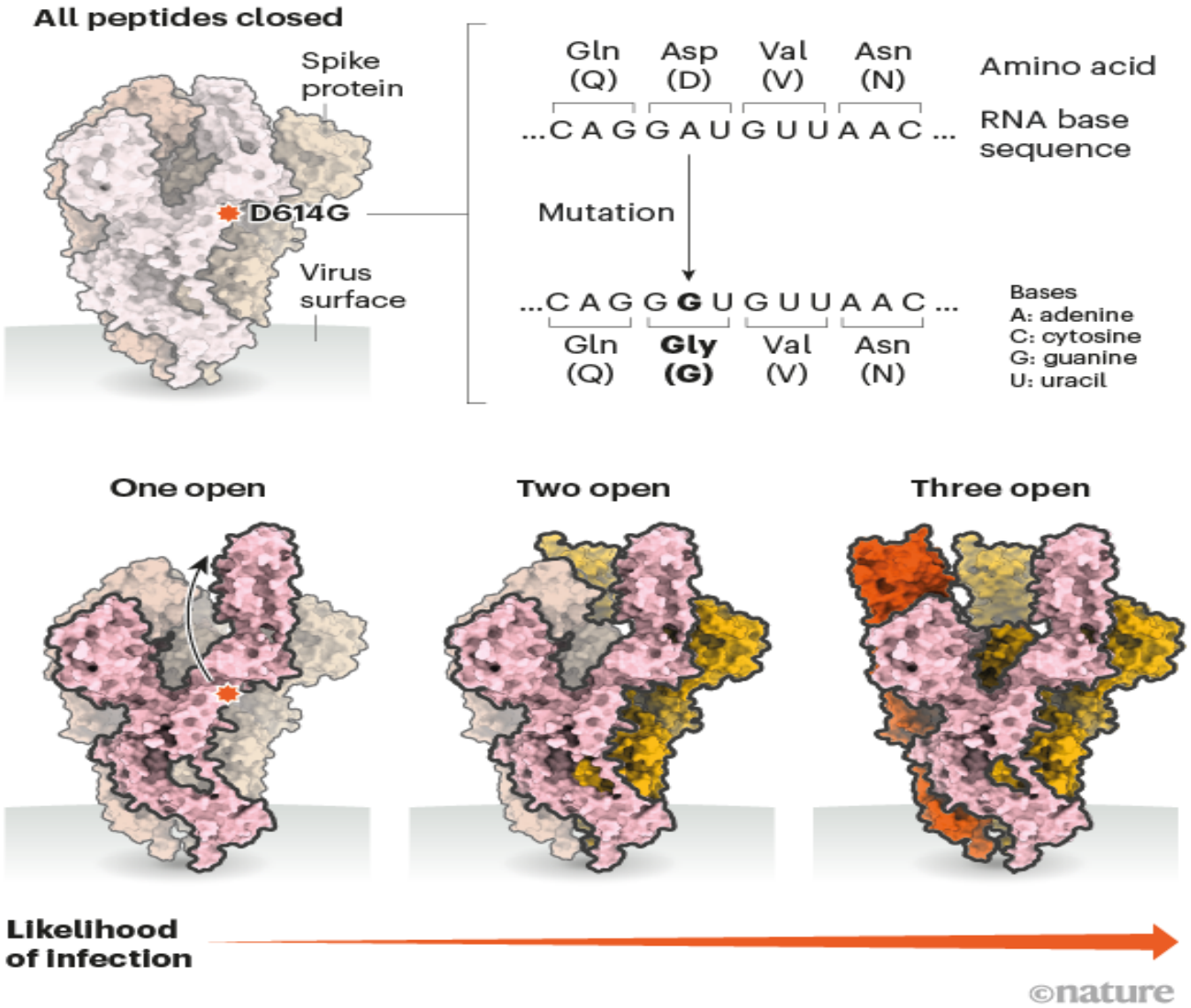
All viruses, including the one that causes Covid-19, mutate.

These tiny genetic changes happen as the virus makes new copies of itself to spread and thrive.

Most are inconsequential, and a few can even be harmful to the virus's survival, but some can make it more infectious or threatening to the host - humans.

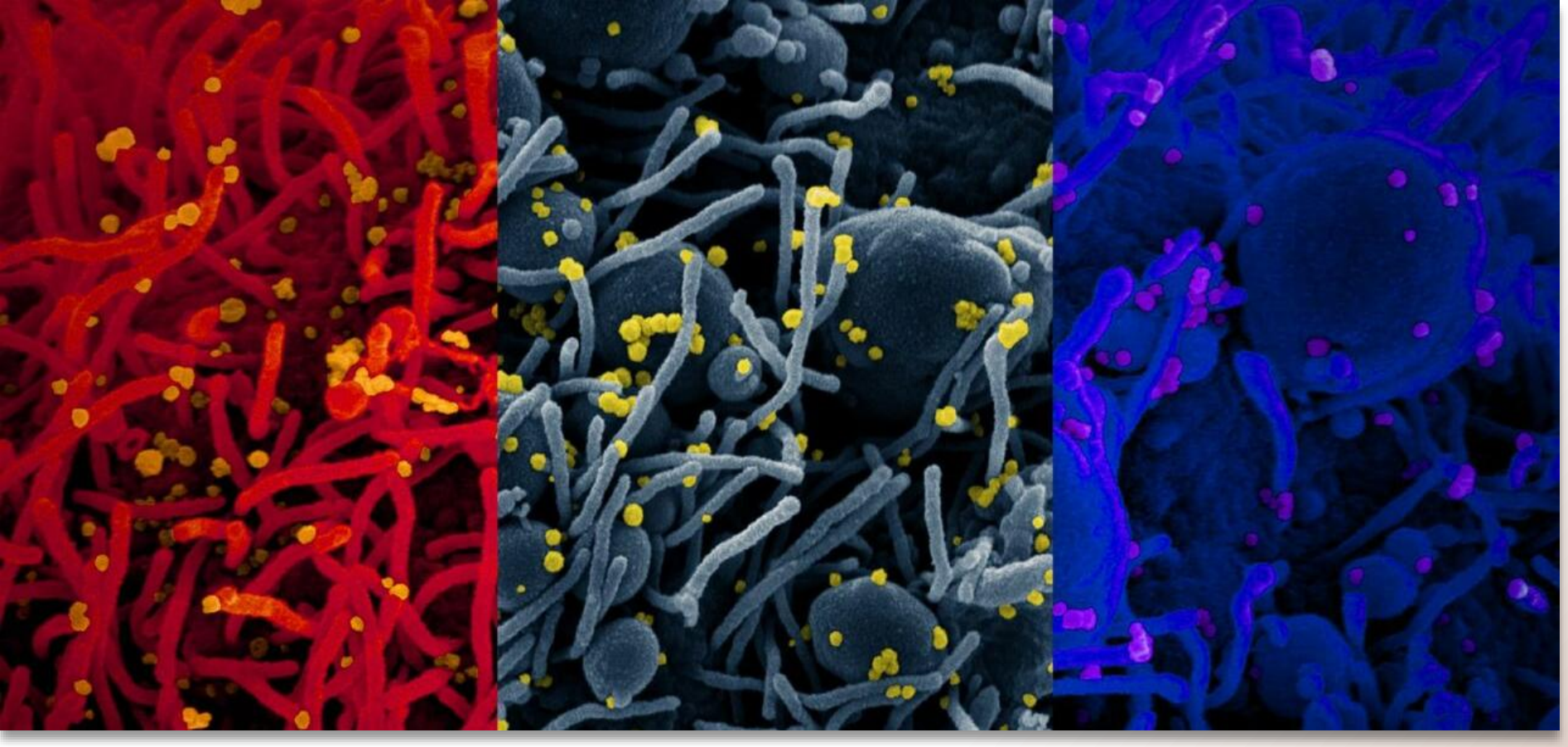
THE MUTATION THAT LOOSENS THE SPIKE PROTEIN

Spike proteins on SARS-CoV-2 bind to receptors on human cells, helping the virus to enter. A spike protein is made up of three smaller peptides in 'open' or 'closed' orientations; when more are open, it's easier for the protein to bind. The D614G mutation — the result of a single-letter change to the viral RNA code — seems to relax connections between peptides. This makes open conformations more likely and might increase the chance of infection.



ons?

Lehigh Valley Health Network



Three SARS-CoV-2 Variants Circulating

According to the National Institute of Allergy & Infectious Diseases (NIAID), three variants of the SARS-CoV-2 virus have been identified and are in circulation throughout the world

- The variant (B.1.1.7 lineage) was first detected in the United Kingdom (UK) in September 2020;
- The variant (B.1.351 lineage) was first detected in October 2020 in the Republic of South Africa (RSA); and
- The variant (P.1 lineage) was first detected in Brazil in December 2020.
- The NIAID says 47 countries (including the US) have recorded viral genetic sequences from cases involving the B.1.1.7 lineage (UK). In the United States, 293 cases involving the B.1.1.7 lineage have been reported in 25 states.
- The B.1.351 lineage (RSA) has been recorded in 20 countries, but not yet in the US, according to NIAID.
- Meanwhile, the P1 lineage (Brazil) has been found in five countries, with one reported case of P1 lineage in the United States, NIAID says.

Three Current COVID Variants

B.1.351, which was identified in South Africa

- The B.1.351 variant has not been shown to cause more severe illness than earlier versions. But there is a chance that it could give people who survived the original coronavirus another round of mild or moderate COVID-19.
- There is new evidence from laboratory studies that some immune responses driven by current vaccines could be less effective against some of the new strains. The immune response involves many components, and a reduction in one does not mean that the vaccines will not offer protection.

B.1.1.7 variant from England

- Researchers have preliminary evidence that some of the new variants, including B.1.1.7, seem to bind more tightly to our cells. This appears to make some of these new strains ‘stickier’ due to changes in the spike protein. Studies are underway to understand more about whether any of the variants are more easily transmitted.

What Does COVID Mutation Mean? #1

- With most of the world still susceptible to SARS-CoV-2, it's unlikely that immunity is currently a major factor in the virus's evolution. But as population-wide immunity rises, whether through infection or vaccination, **a steady trickle of immune-evading mutations could help SARS-CoV-2 to establish itself permanently, says Sheahan, potentially causing mostly mild symptoms when it infects individuals who have some residual immunity from a previous infection or vaccination. "I wouldn't be surprised if this virus is maintained as a more common, cold-causing coronavirus."**
- But it's also possible that our immune responses to coronavirus infections, including to SARS-CoV-2, aren't strong or long-lived enough to generate selection pressure that leads to significantly altered virus strains.

What Does COVID Mutation Mean? #2

- **Worrisome mutations could also become more common if antibody therapies aren't used wisely — if people with COVID-19 receive one antibody, which could be thwarted by a single viral mutation, and create a super virus**. Cocktails of monoclonal antibodies, each of which can recognize multiple regions of the spike protein, might lessen the odds that such a mutation will be favored through natural selection, researchers say.
- Vaccines arouse less concern on this score because, like the body's natural immune response, they tend to elicit a range of antibodies.

What Does COVID Mutation Mean? #3

- **It's even possible that the D614G change could make the virus an easier target for vaccines**, Montefiori's team found in a study posted to bioRxiv in July. Mice, monkeys and humans that received one of a number of experimental RNA vaccines, including one being developed by drug maker Pfizer in New York City, produced antibodies that proved more potent at blocking G viruses than D viruses.

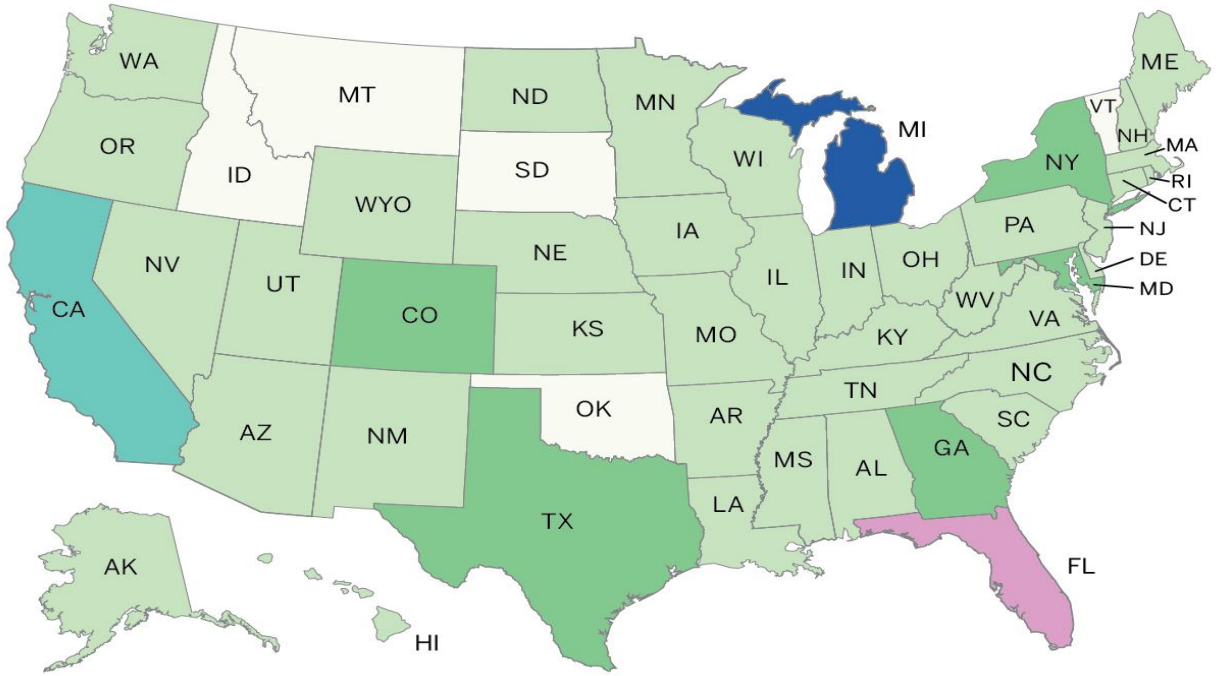
ons?

CORONAVIRUS VARIANTS IN THE U.S.

Number of reported cases

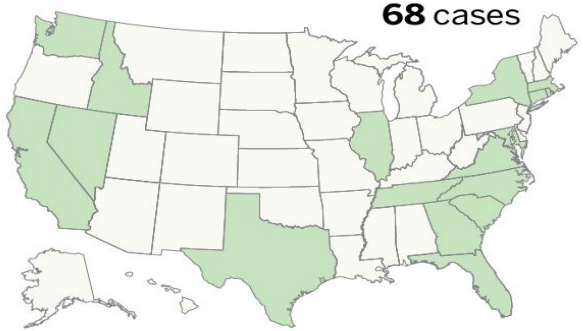
0 | 1-100 | 101-200 | 201-300 | 301-400 | 401-500 | 500-600 | 601-700

Variant B.1.1.7 Originated in the U.K. **2,672** cases reported as of March 4



B.1.351 Originated in South Africa

68 cases



P.1 Originated in Brazil

13 cases

Source: CDC

BAY AREA NEWS GROUP

WHO classifies triple-mutant Covid variant from India as global health risk

- Maria Van Kerkhove, the WHO's technical lead for Covid-19, said the agency will provide more details in its weekly situation report on the pandemic Tuesday but added that the variant, known as **B.1.617**, has been found in preliminary studies to spread more easily than the original virus and there is some evidence it may able to evade some of the protections provided by vaccines.
- The country is averaging about 3,879 Covid deaths per day, according to data compiled by Johns Hopkins University, though media reports indicate the official figure is being understated. It has reported an average of about 391,000 new cases per day over the past seven days — up about 4% from a week ago, Johns Hopkins University data shows.
- The variant has since spread to other countries, including the United States.

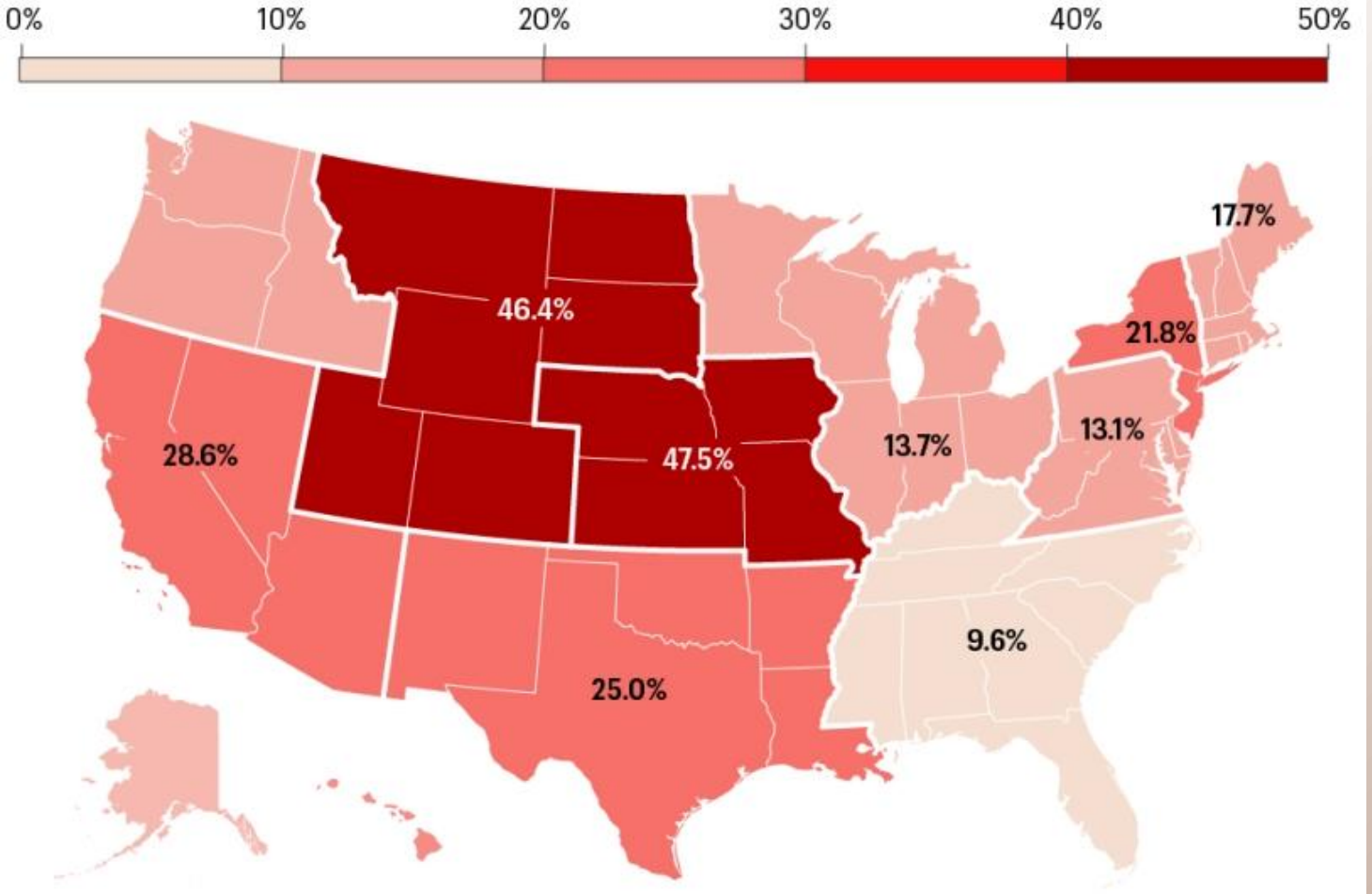
ns?

COVID-19 patients in India are developing deadly 'black fungus' infections which can lead to blindness

- Some hospitals in India have seen a rise in mucormycosis, a life-threatening infection known as "black fungus."
- Experts say steroids used to treat COVID-19 may be linked fueling the uptick by dampening patients' immune systems.
- One doctor in Mumbai said 11 of his patients have required life-saving eye removal surgery.

DELTA VARIANT PREVALENCE IN THE U.S.

COVID-19 DELTA VARIANT CASES BY REGION, AS A SHARE OF NEW CASES

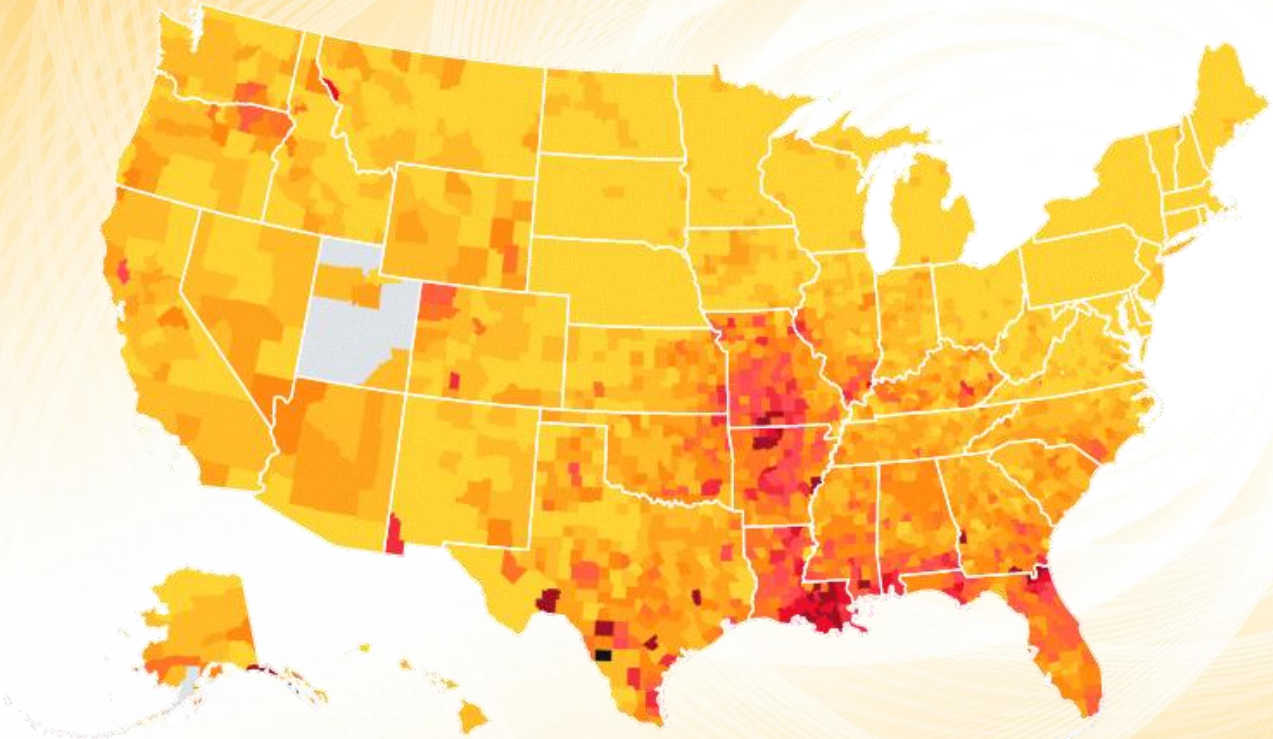


SOURCE: CDC

TWO WEEKS PERIOD ENDING JUNE 19, 2021

FORTUNE

Delta variant: Doctor cautions Americans about traveling to Florida



- “The Delta variant is a game changer,” Hilton said. “New cases nationwide are up 140% in the last two weeks. Our hospitalizations are up 34%, and our deaths, unfortunately, are increasing by 33%. We're not finished with this pandemic.”

Delta Variance

- 1. Delta is more contagious than the other virus strains.
  - 1 person infects 5-6 others
- 2. Unvaccinated people are at risk for greater illness.
  - 99.5% of ICUs admissions are unvaccinated
- 3. Delta could lead to 'hyperlocal outbreaks.'
  - Example southern US
- 4. There is still more to learn about Delta.
  - Different symptoms and course
- 5. Vaccination is the best protection against Delta.
  - No treatment for COVID!!!

Fauci says he expects no new U.S. lockdowns despite surging Delta cases

- "I don't think we're going to see lockdowns," Fauci, who is also director of the National Institute of Allergy and Infectious Diseases, said on ABC's "This Week."
- "I think we have enough of the percentage of people in the country - not enough to crush the outbreak - but I believe enough to not allow us to get into the situation we were in last winter."
- Although Fauci does not think the United States will need to shut down again as it did last year, he warned on ABC that "things are going to get worse" as the Delta variant continues to spread.

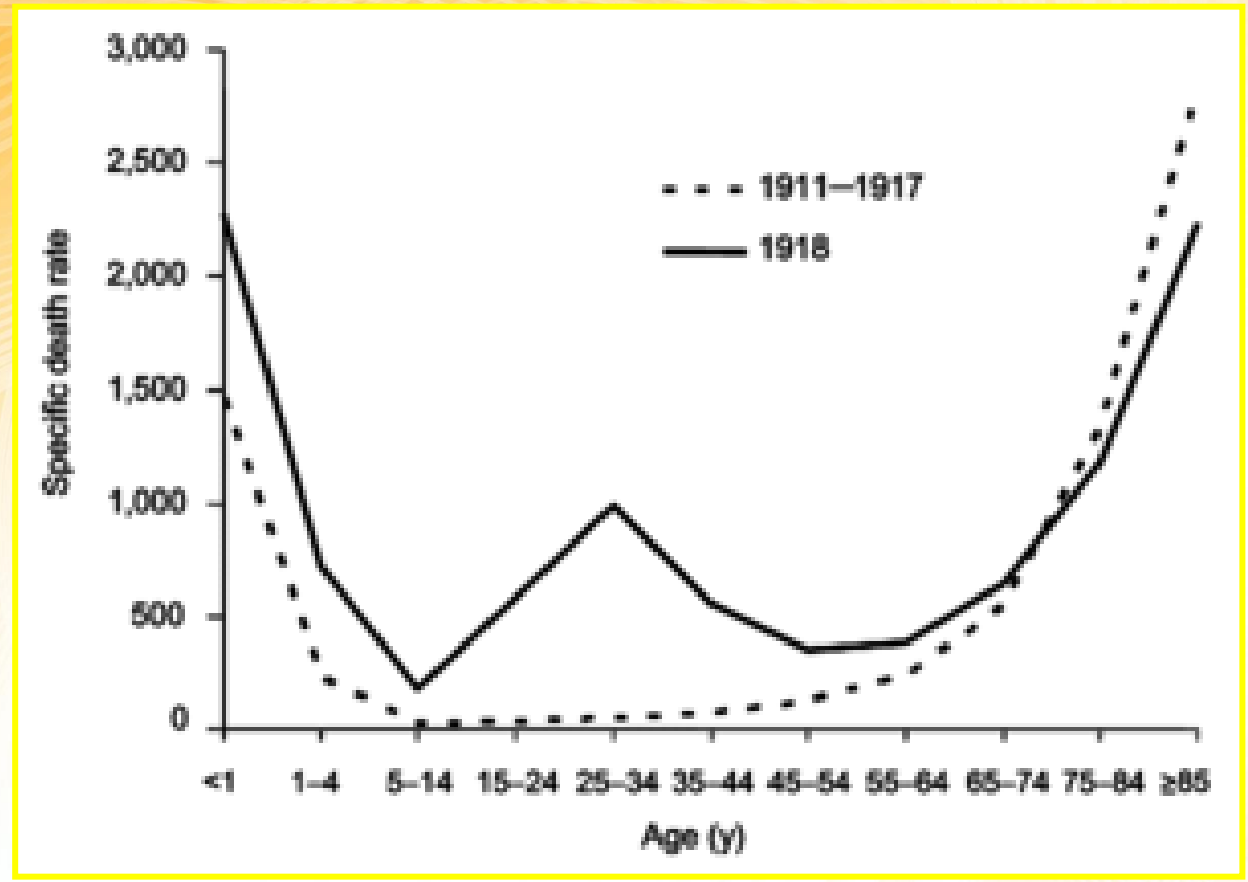
A New, Infectious Coronavirus Is Detected In Malaysia – And It's Coming From Dogs

Canine pneumonia!!!

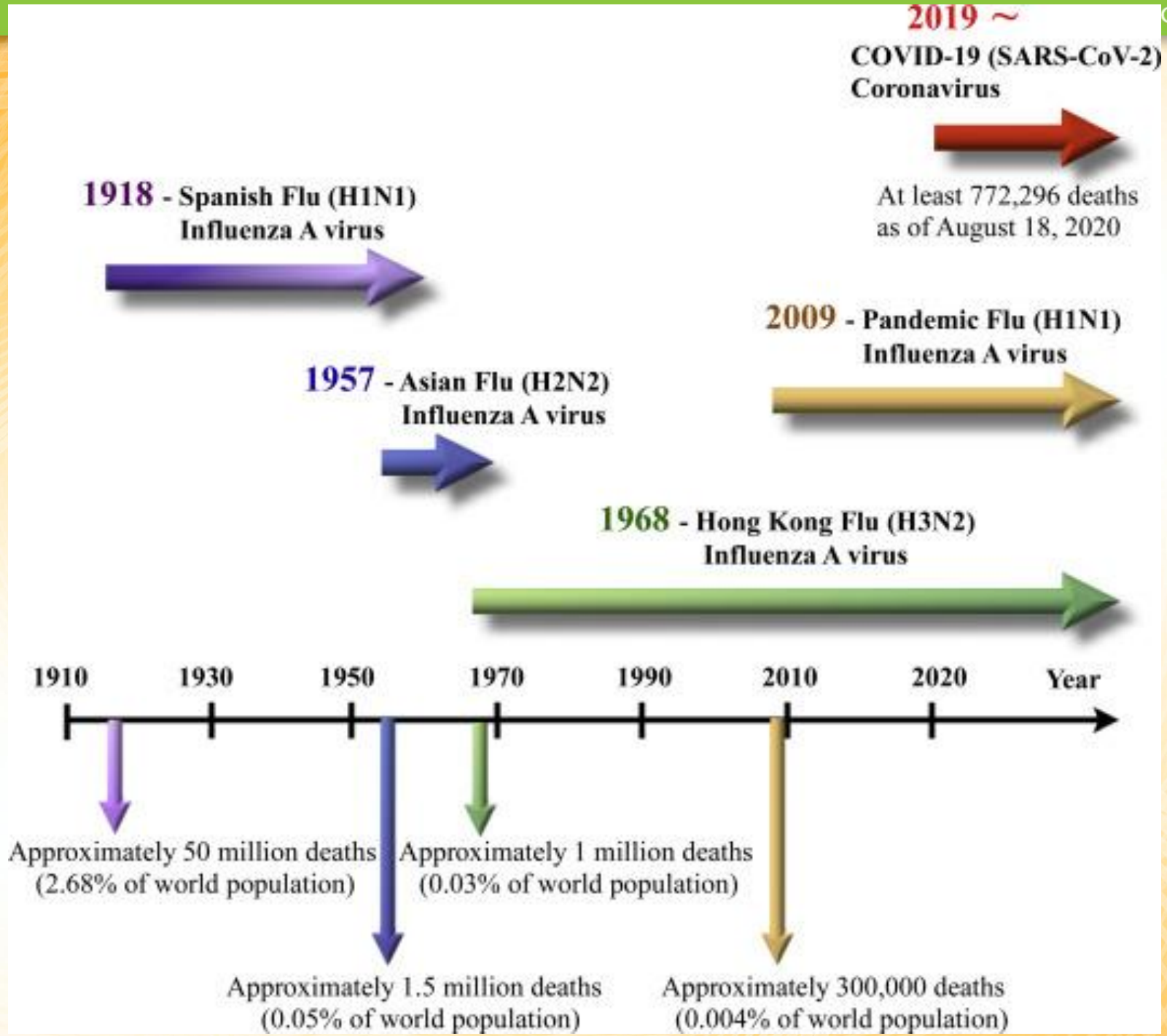
- For many scientists, this pattern points to a disturbing trend: Coronavirus outbreaks aren't rare events — but will likely occur every decade or so.
- Now, scientists are reporting that they have discovered what may be the latest coronavirus to jump from animals into people. And it comes from a surprising source: dogs.
- In the first batch of samples tested last year, Gray and Xiu found evidence of an entirely new coronavirus associated with pneumonia in hospitalized patients — mostly in kids. This virus may be the eighth coronavirus known to cause disease in people, the team reports Thursday in the journal *Clinical Infectious Diseases*.
- The samples came from patients at a hospital in Sarawak, Malaysia, taken by a collaborator in 2017 and 2018. "These were deep nasal swabs, like doctors collect with the COVID-19 patients," says Gray.
- The patients had what looked like regular pneumonia. But in eight out of 301 samples tested, or 2.7%, Xui and Gray found that the patients' upper respiratory tracts were infected with a new canine coronavirus — a dog virus.

90-Year-Old Woman Infected with UK and South African COVID-19 Variants at the Same Time

- Researchers in Belgium report on the case of a 90-year-old woman who was simultaneously infected with two different variants of concern (VOCs) of COVID-19, in a case report being presented at the European Congress of Clinical Microbiology & Infectious Diseases (ECCMID) held online this year.
- On March 3, 2021, the woman, whose medical history was unremarkable, was admitted to the OLV Hospital in the Belgian city of Aalst after a spate of falls. She tested positive for COVID-19 on the same day. She lived alone and received nursing care at home, and had not been vaccinated against COVID-19.
- Initially, there were no signs of respiratory distress and the patient had good oxygen saturation. However, she developed rapidly worsening respiratory symptoms, and died five days later.
- When the patient's respiratory sample was tested for VOCs with PCR, they discovered that she had been infected by two different strains of the virus–one which originated in the UK, known as B.1.1.7 (Alpha), and another that was first detected in South Africa (B.1.351; Beta).
- The presence of both strains was confirmed by PCR on a second respiratory sample, by sequencing of the S-gene and by whole genome sequencing.



Spanish Flu Endemic


2019 ~
COVID-19 (SARS-CoV-2)
Coronavirus
At least 772,296 deaths
as of August 18, 2020
1918 - Spanish Flu (H1N1)
Influenza A virus
2009 - Pandemic Flu (H1N1)
Influenza A virus
1957 - Asian Flu (H2N2)
Influenza A virus
1968 - Hong Kong Flu (H3N2)
Influenza A virus
1910
1930
1950
1970
1990
2010
2020
Year
Approximately 50 million deaths
(2.68% of world population)
Approximately 1 million deaths
(0.03% of world population)
Approximately 1.5 million deaths
(0.05% of world population)
Approximately 300,000 deaths
(0.004% of world population)

VISUALLY | ANNAPURANI V

How Covid-19 compares with Spanish Flu

A lot has been discussed about how the corona virus is quite akin to the Spanish Flu of 1918. Here's an overview of the two pandemics to understand how similar or different they are from each other

	SPANISH FLU	COVID-19
When did it break out?	1918 	2019 
What caused the pandemic?	H1N1 Virus	SARS-CoV-2
Virus source	 Birds	 Descendant from a bat corona virus
Virus reproduction number (R naught*)	 1.4-2.8	 5.7
Origin	First identified in military personnel in the US in the spring of 1918. Reports suggest that more US soldiers died from the 1918 flu than in the World War 1 battle	The first human cases were reported in Wuhan City, China, in December 2019. Reports suggest a wholesale food market in Wuhan was the source of the outbreak
Number of people killed	At least **50 million** worldwide **6,75,000** in the US alone	**0.73 million** (As on August 11, 3.40 pm) **1,66,192** in the US alone (As on August 11, 3.40 pm)
Number of people infected	About **500 million** (About one-third of the then world population)	**20.2 million** (As on August 11, 3.40 pm)
Symptoms	Fever, cough, shortness of breath, fatigue, sore throat, runny nose, body pain, headache, vomitting and diarrhea	
Spread	1. Through respiratory droplets by coughing, sneezing or talking 2. Through physical human touch 3. Coming in contact with a surface/object that could possibly have the virus on it and then touching his/her eyes, nose, mouth 	
Most affected groups	Kids younger than **5 years old**, youngsters in the **20-40 age** group	Adults **over 65 years** with underlying health conditions
Control efforts	Isolation, quarantine, closing schools, suspending public gatherings 	Isolation, quarantine, closing schools, public places, suspending public gatherings
Vaccine	None	**139** candidates in pre-clinical stage **28** in clinical stage (As on August 10)

*Average number of new people who will contract the disease by each infected person

Graphic: KS Gunasekar

Sources: CDC, BMC Medicine, Healthline, Biospace, WHO, History, news reports, Worldometer

Close Relatives of the Coronavirus May Have Been in Bats for Decades

Based on the evolutionary relationship among the 68 coronaviruses, the researchers estimate that the branch of the virus family tree that leads to SARS-CoV-2 diverged from related viruses between 1948 and 1982. Those dates suggest that the coronavirus lineage that gave rise to the virus behind the pandemic has been present in bats for decades.

Human Coronavirus Types

Common human coronaviruses

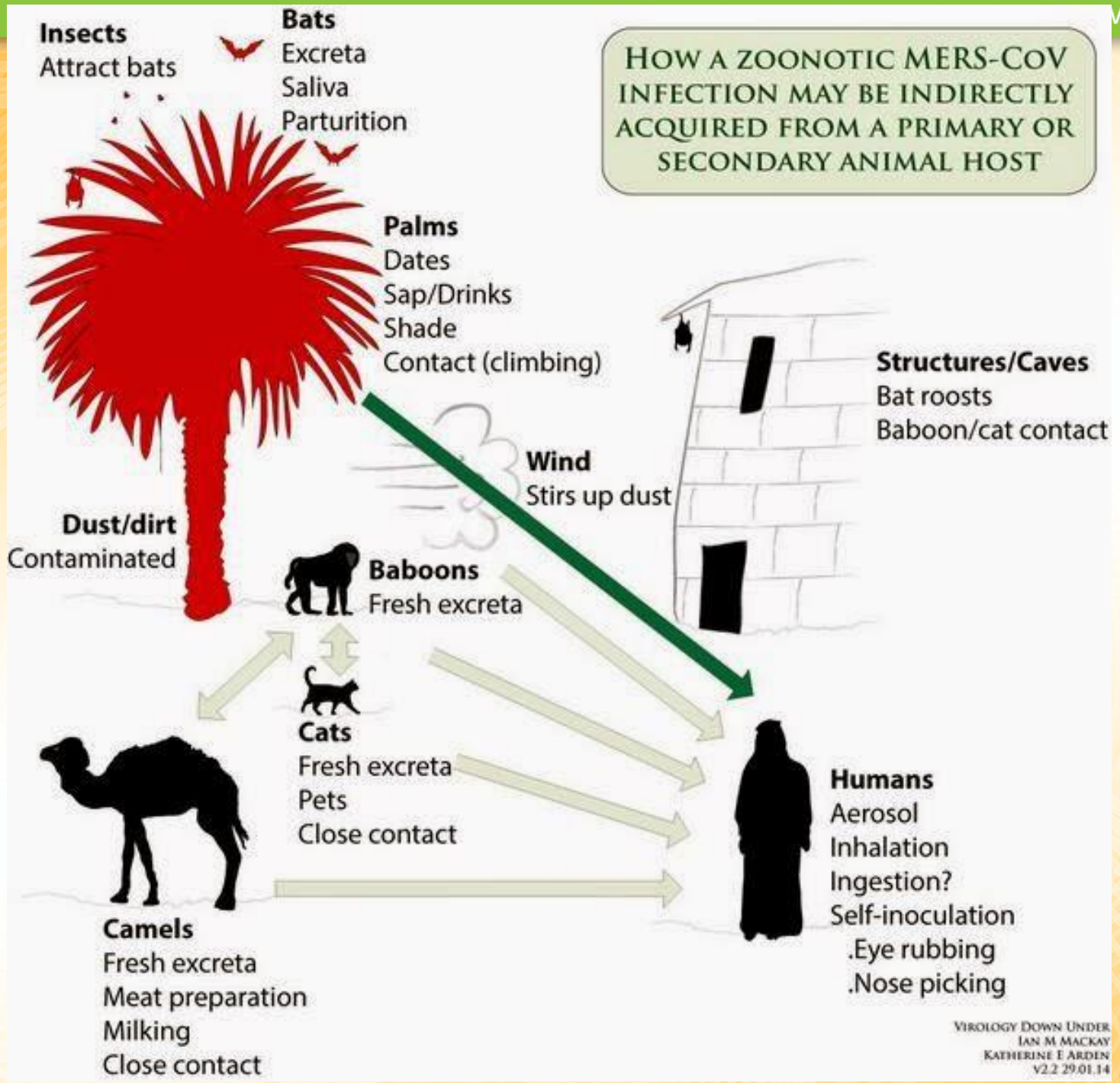
1.229E (alpha coronavirus)
2.NL63 (alpha coronavirus)
3.OC43 (beta coronavirus)
4.HKU1 (beta coronavirus)

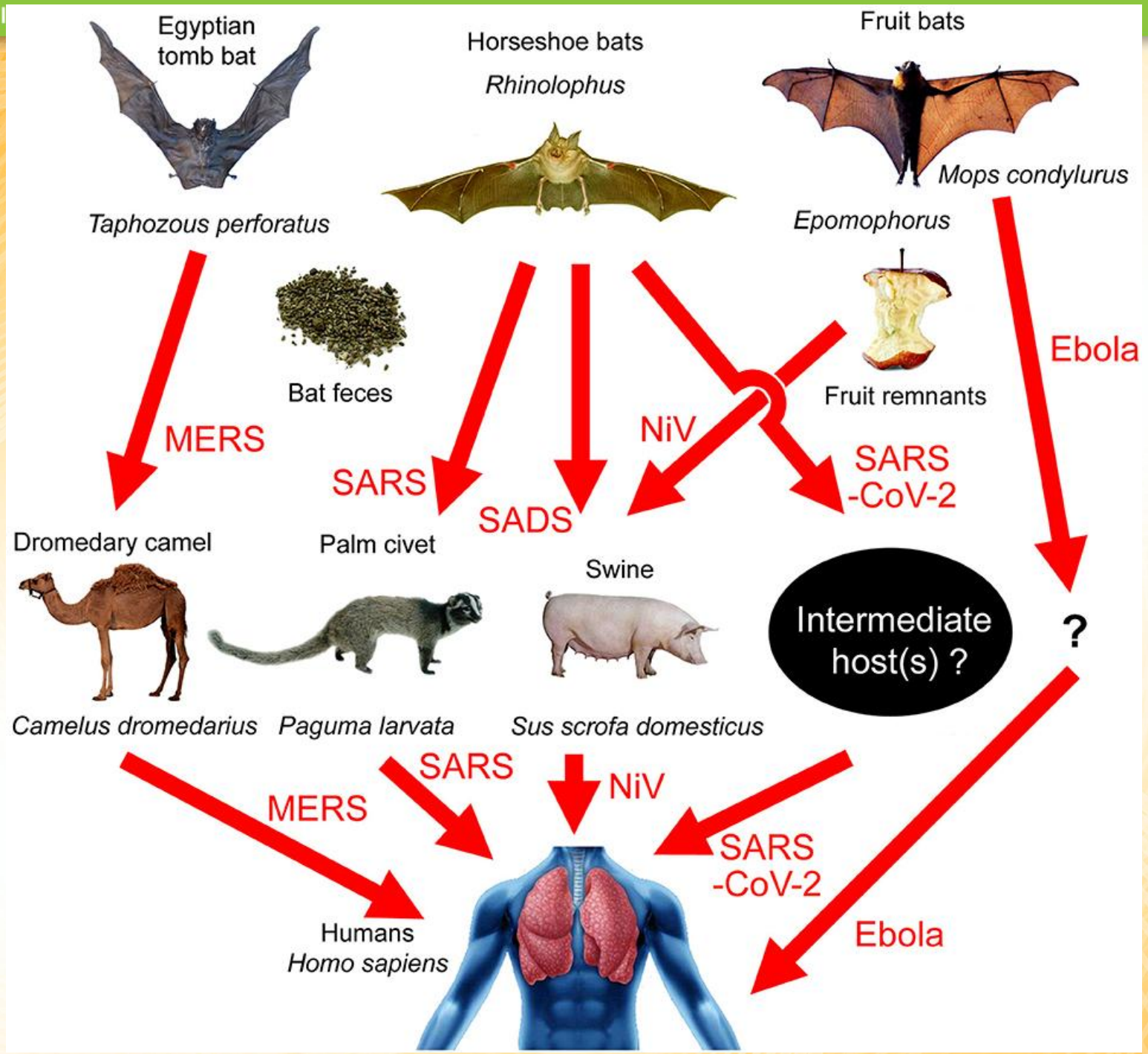
Other human coronaviruses

5.MERS-CoV (the beta coronavirus that causes Middle East Respiratory Syndrome, or MERS)
6.SARS-CoV (the beta coronavirus that causes severe acute respiratory syndrome, or SARS)
7.**SARS-CoV-2 (the novel coronavirus that causes coronavirus disease 2019, or COVID-19)**

People around the world commonly get infected with human coronaviruses 229E, NL63, OC43, and HKU1.

Sometimes coronaviruses that infect animals can evolve and make people sick and become a new human coronavirus. Three recent examples of this are 2019-nCoV, SARS-CoV, and MERS-CoV.


How a zoonotic MERS-CoV infection may be indirectly acquired from a primary or secondary animal host
Insects
Attract bats
Bats
Excreta
Saliva
Parturition
Palms
Dates
Sap/Drinks
Shade
Contact (climbing)
Structures/Caves
Bat roosts
Baboon/cat contact
Wind
Stirs up dust
Dust/dirt
Contaminated
Baboons
Fresh excreta
Cats
Fresh excreta
Pets
Close contact
Humans
Aerosol
Inhalation
Ingestion?
Self-inoculation
.Eye rubbing
.Nose picking
Camels
Fresh excreta
Meat preparation
Milking
Close contact
Virology Down Under
Ian M Mackay
Katherine E Arden
V2.2 29.01.14


Egyptian tomb bat
Taphozous perforatus
Horseshoe bats
Rhinolophus
Fruit bats
Mops condylurus
Epomophorus
Bat feces
Fruit remnants
MERS
SARS
SADS
NiV
SARS -CoV-2
Ebola
Dromedary camel
Palm civet
Swine
Intermediate host(s) ?
?
Camelus dromedarius
Paguma larvata
Sus scrofa domesticus
MERS
SARS
NiV
SARS -CoV-2
Ebola
Humans
Homo sapiens

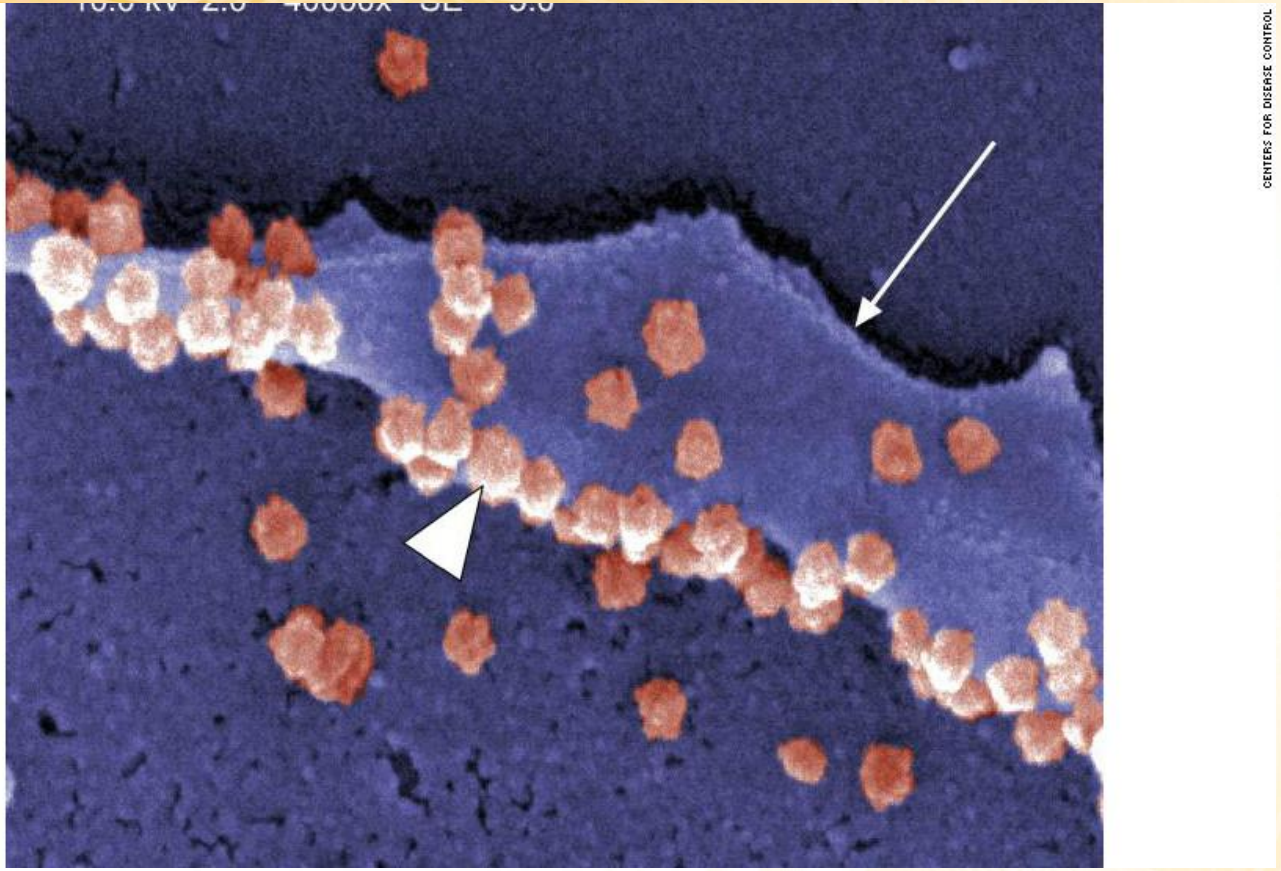
Severe Respiratory Syndrome (SARS)

- Viral breakout first identified in 2003
- Effected over 8,000 people world wide, mostly Asia
- Disease can lead to severe respiratory distress and is transmitted by cough, sneeze, or hand contact.
- Has the potential to cause a world-wide pandemic!!!

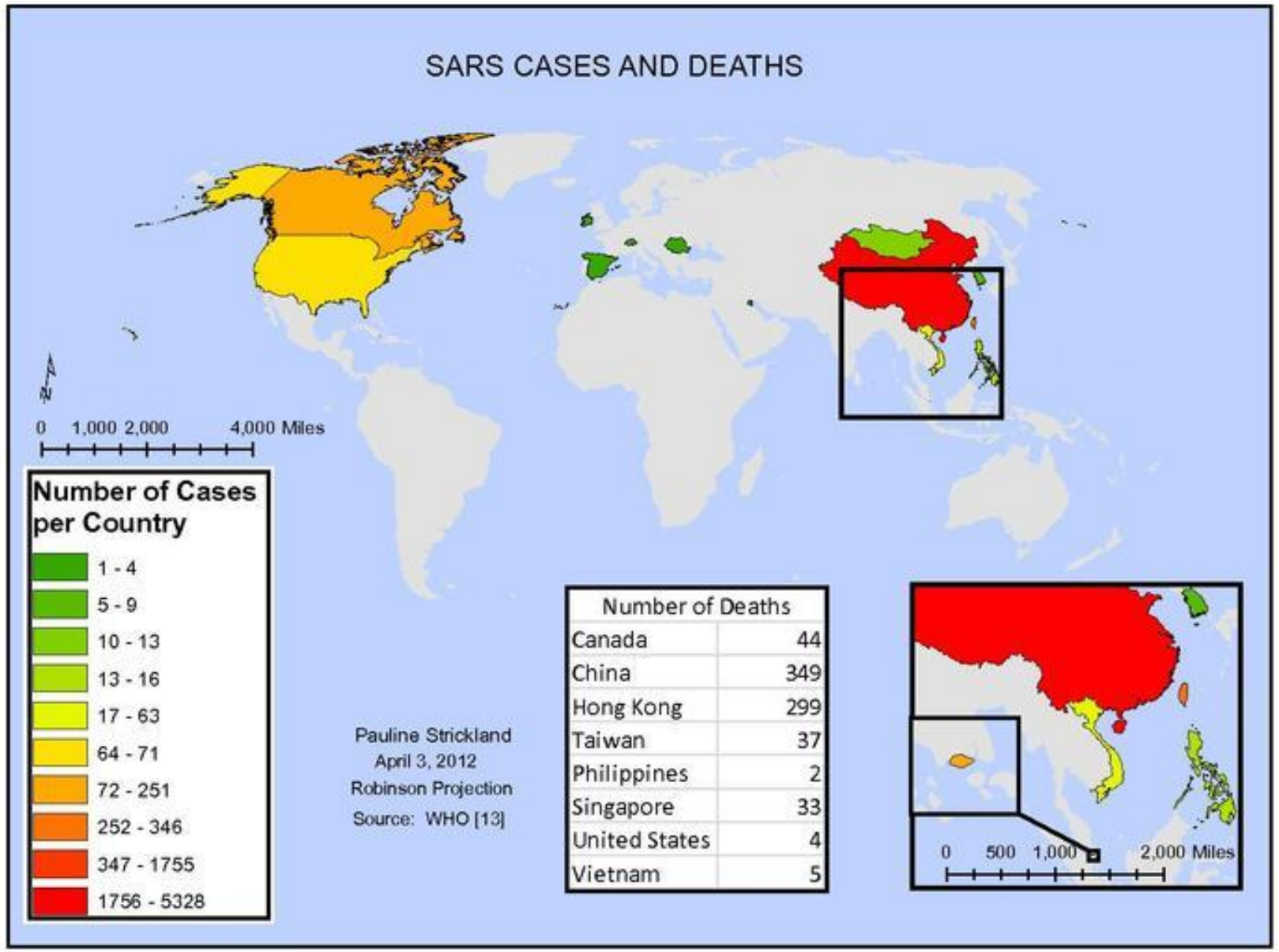
SARS

A viral respiratory disease of zoonotic (Cat)origin caused by the SARS coronavirus .

Between November 2002 and July 2003, an outbreak of SARS in southern China caused an eventual 8,273 cases and 775 deaths
reported in multiple countries with the majority of cases in Hong Kong.(9.6% death rate) according to the World Health Organization
in weeks, SARS spread from Hong Kong to infect individuals
in 37 countries in early 2003.



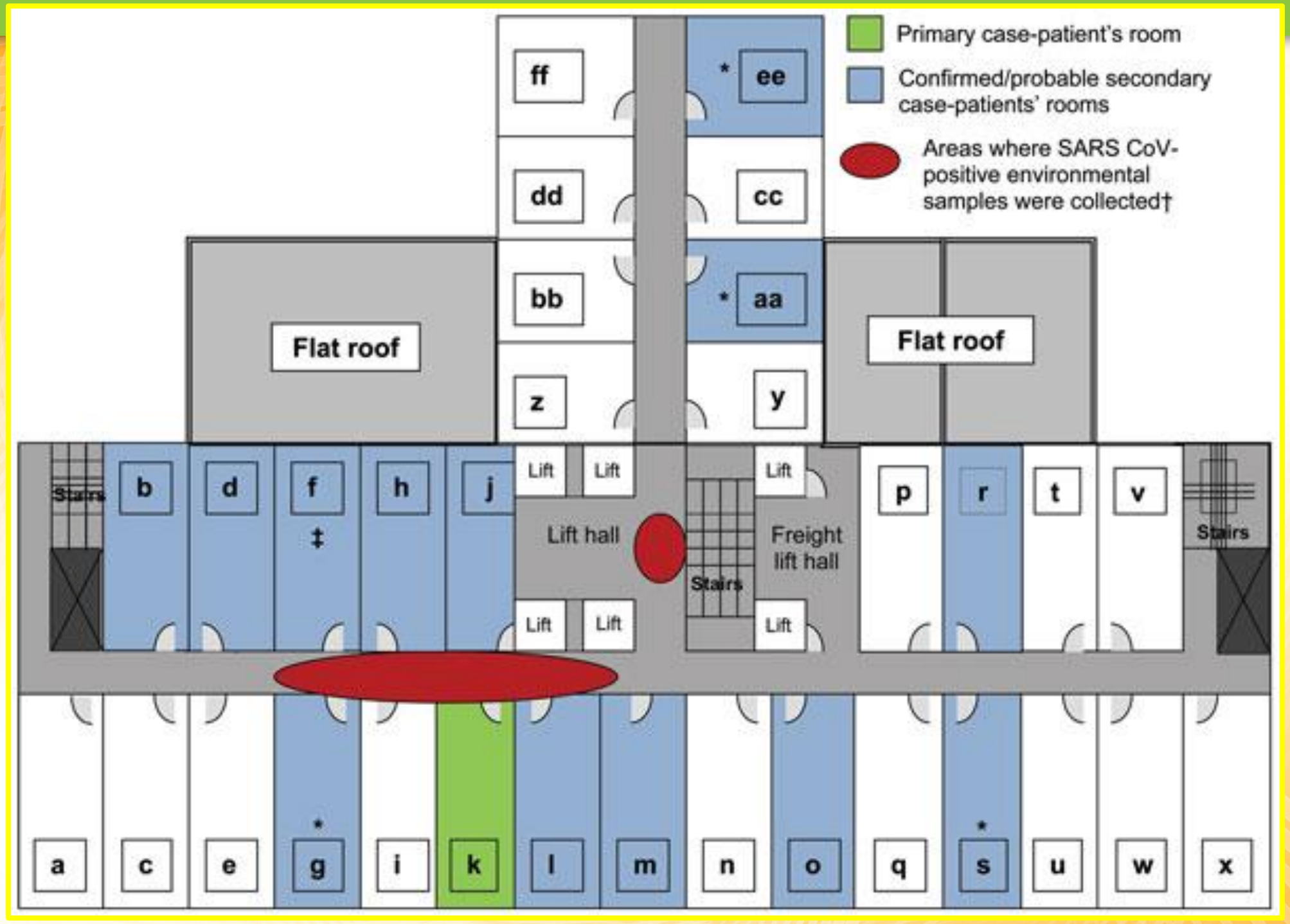
The SARS virus, a coronavirus like the common cold, is shown in pink in this electron micrograph image from the Centers for Disease Control.


SARS CASES AND DEATHS
0 1,000 2,000 4,000 Miles
Number of Cases per Country
1 - 4
5 - 9
10 - 13
13 - 16
17 - 63
64 - 71
72 - 251
252 - 346
347 - 1755
1756 - 5328
Pauline Strickland
April 3, 2012
Robinson Projection
Source: WHO [13]
Number of Deaths
Canada 44
China 349
Hong Kong 299
Taiwan 37
Philippines 2
Singapore 33
United States 4
Vietnam 5
0 500 1,000 2,000 Miles

Make It Happen

In Hong Kong, the first cohort of affected people were discharged from the hospital on 29 March 2003. The disease spread in Hong Kong from a mainland doctor who arrived in February and stayed at the ninth floor of the Metropole Hotel in Kowloon infecting 16 of the hotel visitors.

Those visitors traveled to Canada, Singapore, Taiwan, and Vietnam, spreading SARS to those locations.


Primary case-patient's room
Confirmed/probable secondary case-patients' rooms
Areas where SARS CoV-positive environmental samples were collected†
Flat roof
Flat roof
ff
ee
dd
cc
bb
aa
z
y
Stairs
b
d
f
‡
h
j
Lift
Lift
Lift hall
Lift
Lift
Lift
Stairs
Freight lift hall
Lift
Lift
p
r
t
v
Stairs
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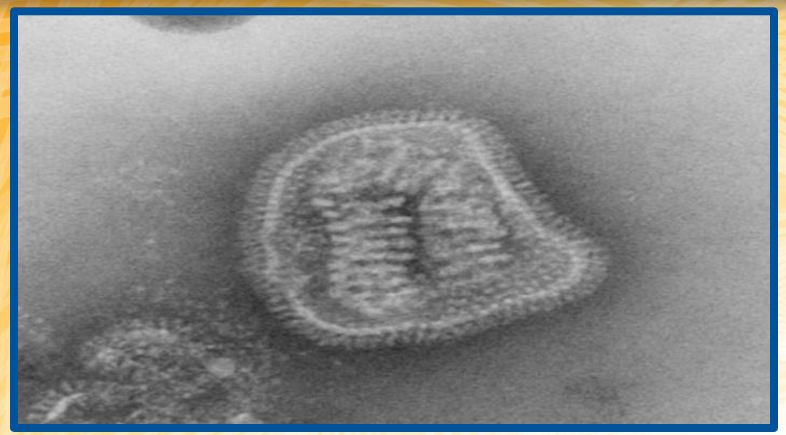
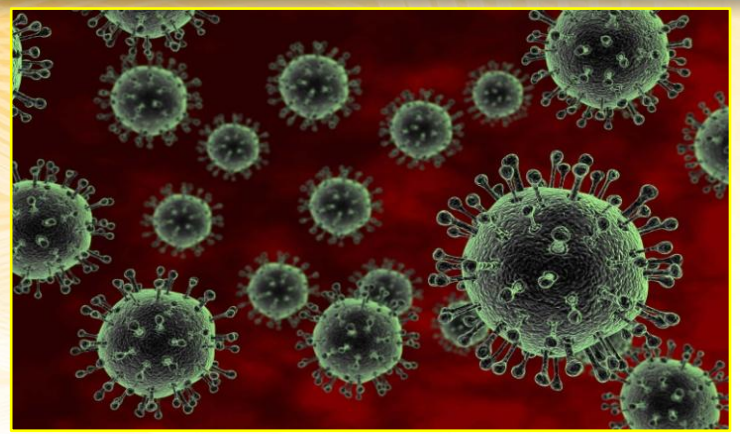
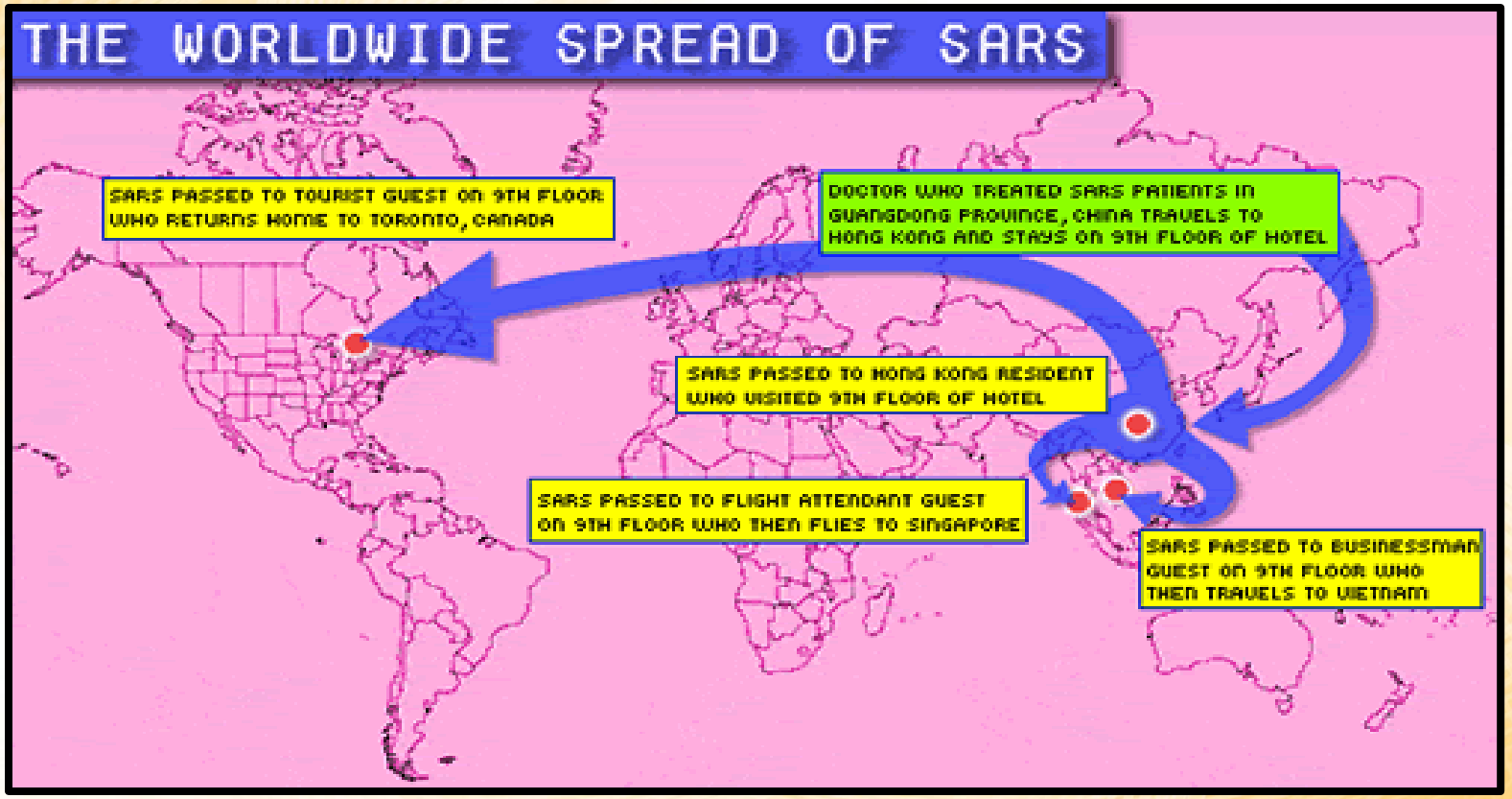
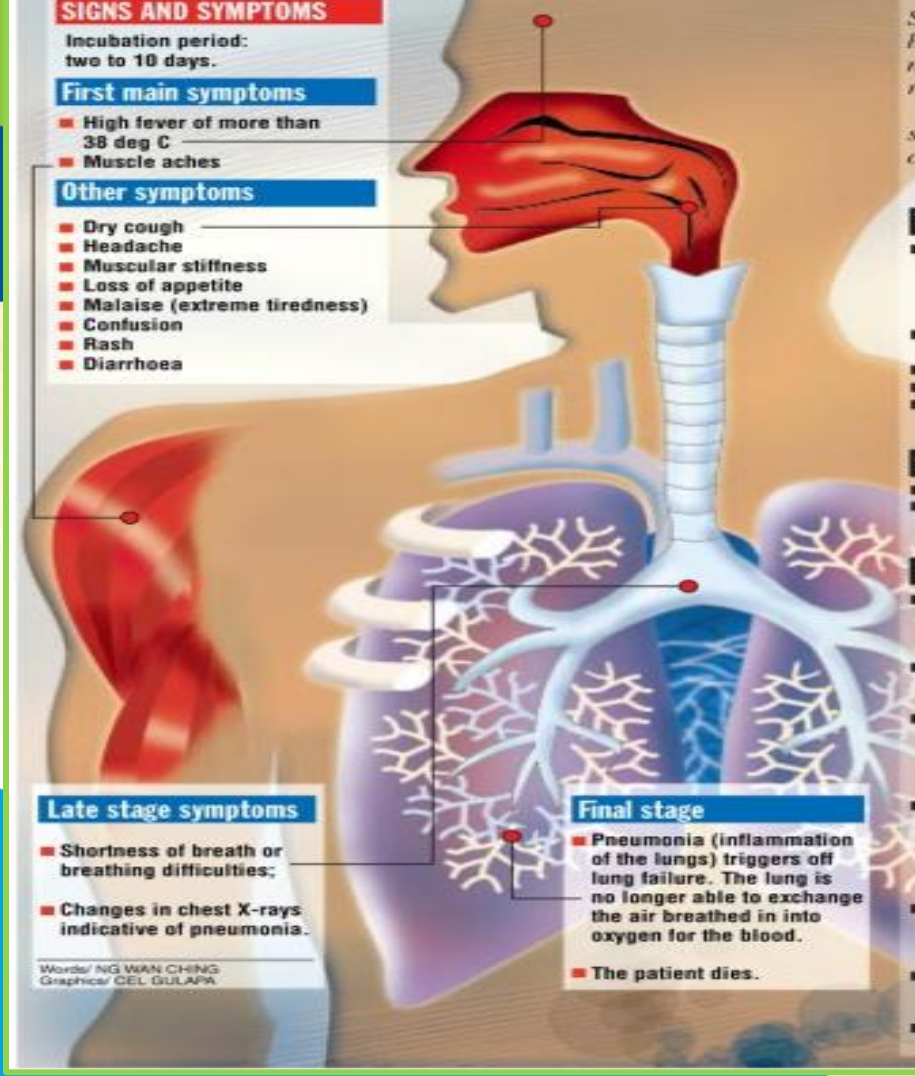





THE WORLDWIDE SPREAD OF SARS
SARS PASSED TO TOURIST GUEST ON 9TH FLOOR WHO RETURNS HOME TO TORONTO, CANADA
DOCTOR WHO TREATED SARS PATIENTS IN GUANGDONG PROVINCE, CHINA TRAVELS TO HONG KONG AND STAYS ON 9TH FLOOR OF HOTEL
SARS PASSED TO HONG KONG RESIDENT WHO VISITED 9TH FLOOR OF HOTEL
SARS PASSED TO FLIGHT ATTENDANT GUEST ON 9TH FLOOR WHO THEN FLIES TO SINGAPORE
SARS PASSED TO BUSINESSMAN GUEST ON 9TH FLOOR WHO THEN TRAVELS TO VIETNAM

SARS OUTBREAK

Sars virus: Tell-tale signs...



SIGNS AND SYMPTOMS

Incubation period: two to 10 days.

First main symptoms

- High fever of more than 38 deg C
- Muscle aches

Other symptoms

- Dry cough
- Headache
- Muscular stiffness
- Loss of appetite
- Malaise (extreme tiredness)
- Confusion
- Rash
- Diarrhoea

Late stage symptoms

- Shortness of breath or breathing difficulties;
- Changes in chest X-rays indicative of pneumonia.

Words/ NG WAN CHING
Graphics/ CEL GULAPA

Final stage

- Pneumonia (inflammation of the lungs) triggers off lung failure. The lung is no longer able to exchange the air breathed in into oxygen for the blood.
- The patient dies.

SCIENTISTS and doctors around the world have made breakthroughs over the last two months in the war against severe acute respiratory syndrome.

Much more is known about the dreaded virus since The New Paper s first info-graphics ran on Mar 27.

Here are the latest findings:

THE VIRUS

- Can be excreted in large amounts by infected people in their stool and urine. This raises the distinct possibility that less than vigorous hygiene - particularly a lack of hand-washing - can lead to its spread on surfaces in the home and elsewhere;
- Can survive for at least 24 hours on a plastic surface at room temperature;
- Can live for up to four days in human waste;
- Viable indefinitely at 0 degrees;
- Is killed by disinfectants such as bleach, ethanol, phenol, formaldehyde and paraformaldehyde.

STILL UNKNOWN

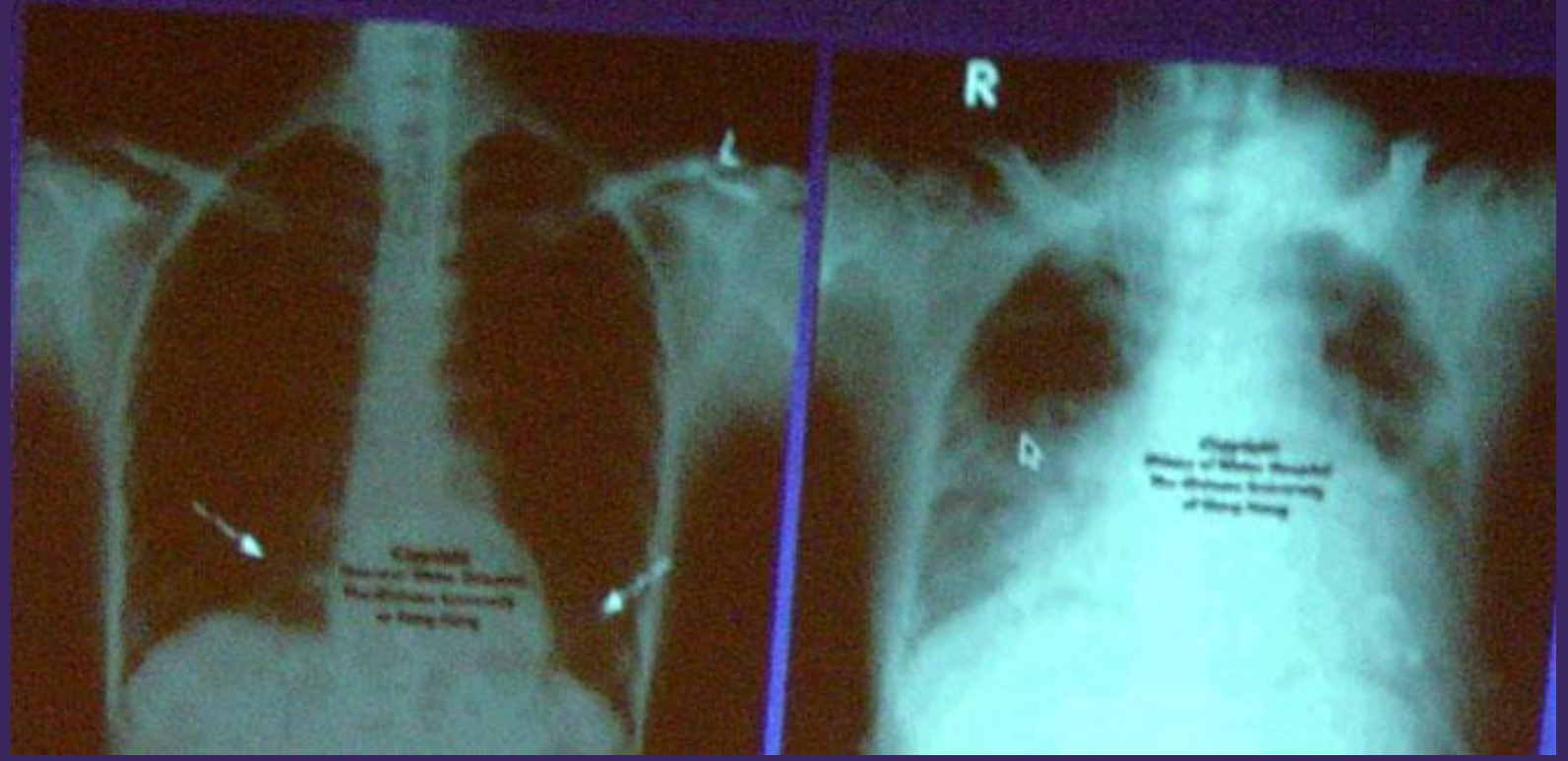
- The amount of virus needed to infect a person;
- Whether a discharged Sars patient is still capable of excreting the virus and for how long.

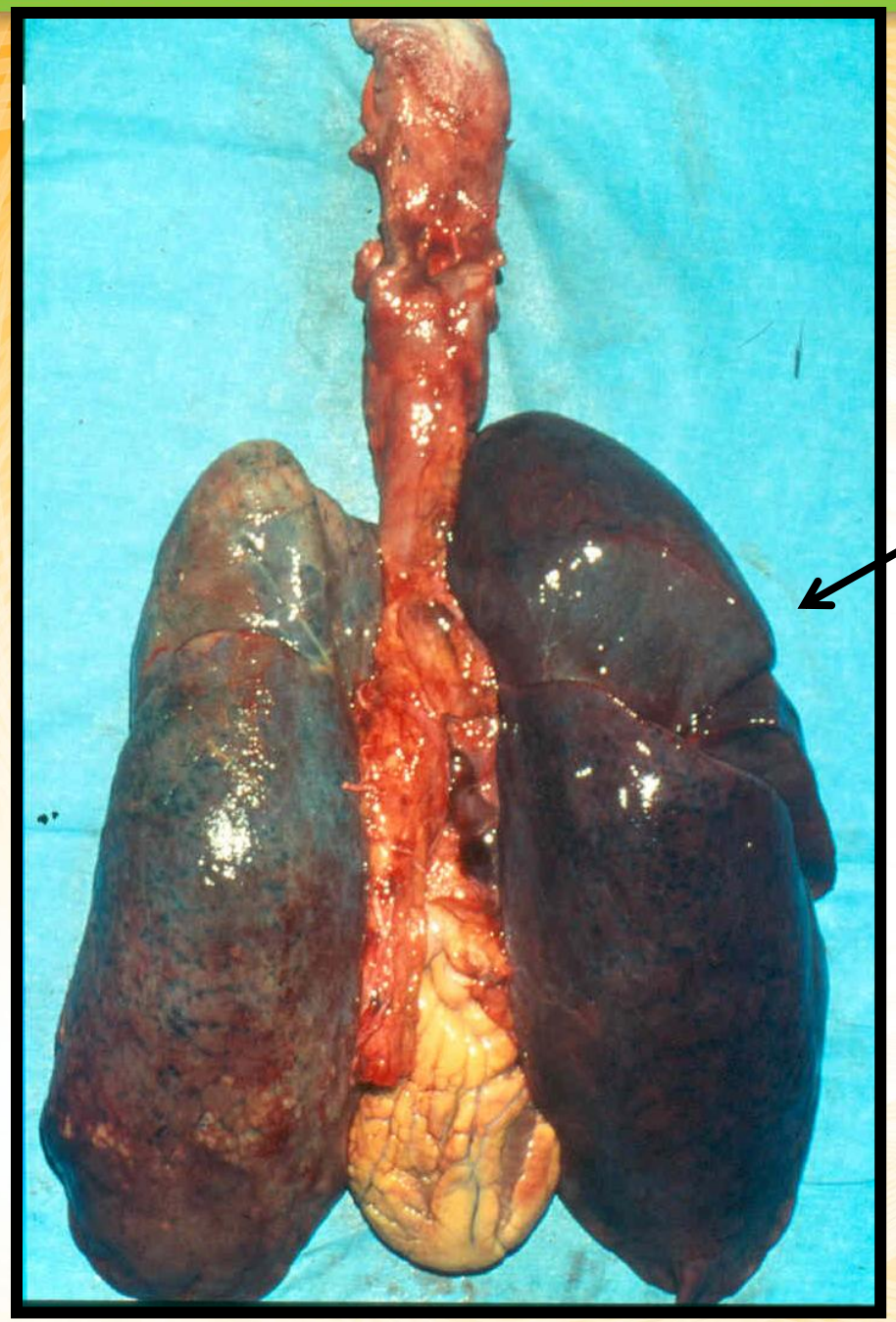
DO'S AND DON'TS

- Wash your hands often, especially after touching surfaces.
- Avoid touching your face in general.
- The body is not sterile and the virus can enter the respiratory system through the nose, mouth and eyes.
- Do not spit in public places. If you must, do it in the toilet where it can be flushed down the toilet or sink.
- If you have a fever of 38 deg C, see a doctor straight away.
- Always see the same doctor, do not doctor hop.
- And wear a mask on the way to see the doctor.
- Always cough and sneeze into a tissue or handkerchief.
- Take your temperature at least twice a day.
- Adults have a fever when their temperature is 37.7 deg C and above (ear temperature), 37.3 deg C and above (mouth) and 37 deg C and above (armpit).
- Children have a fever when their temperature is 37.9 deg C and above (ear), 37.6 deg C and above (mouth) and 37.3 deg C and above (armpit).
- Do not self-medicate if you are going to visit a doctor, because it may interfere with his diagnosis and treatment of your illness.

ons?

How SARS Kill Patients





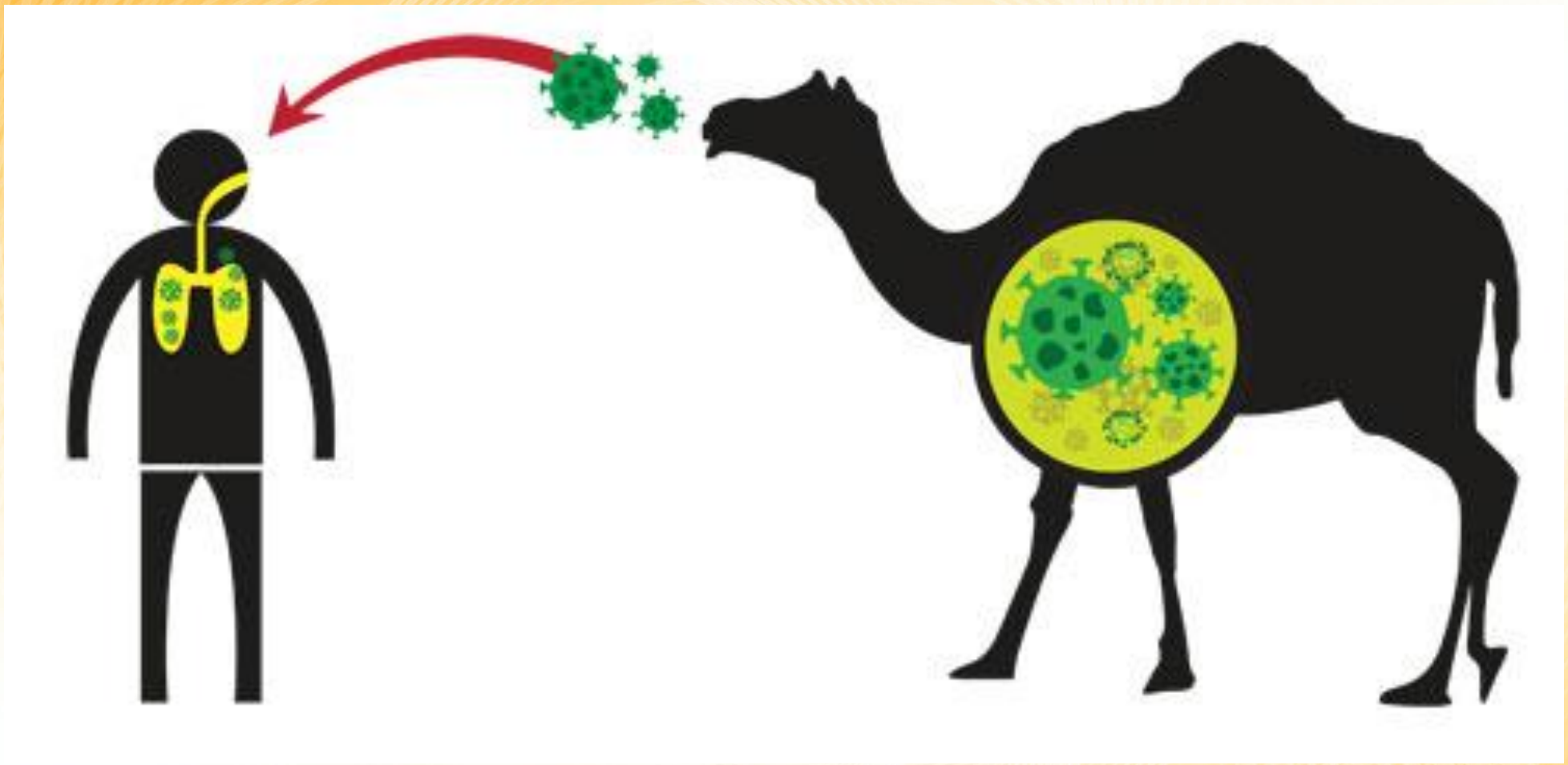
Liver like appearance

What Happen To SARS?

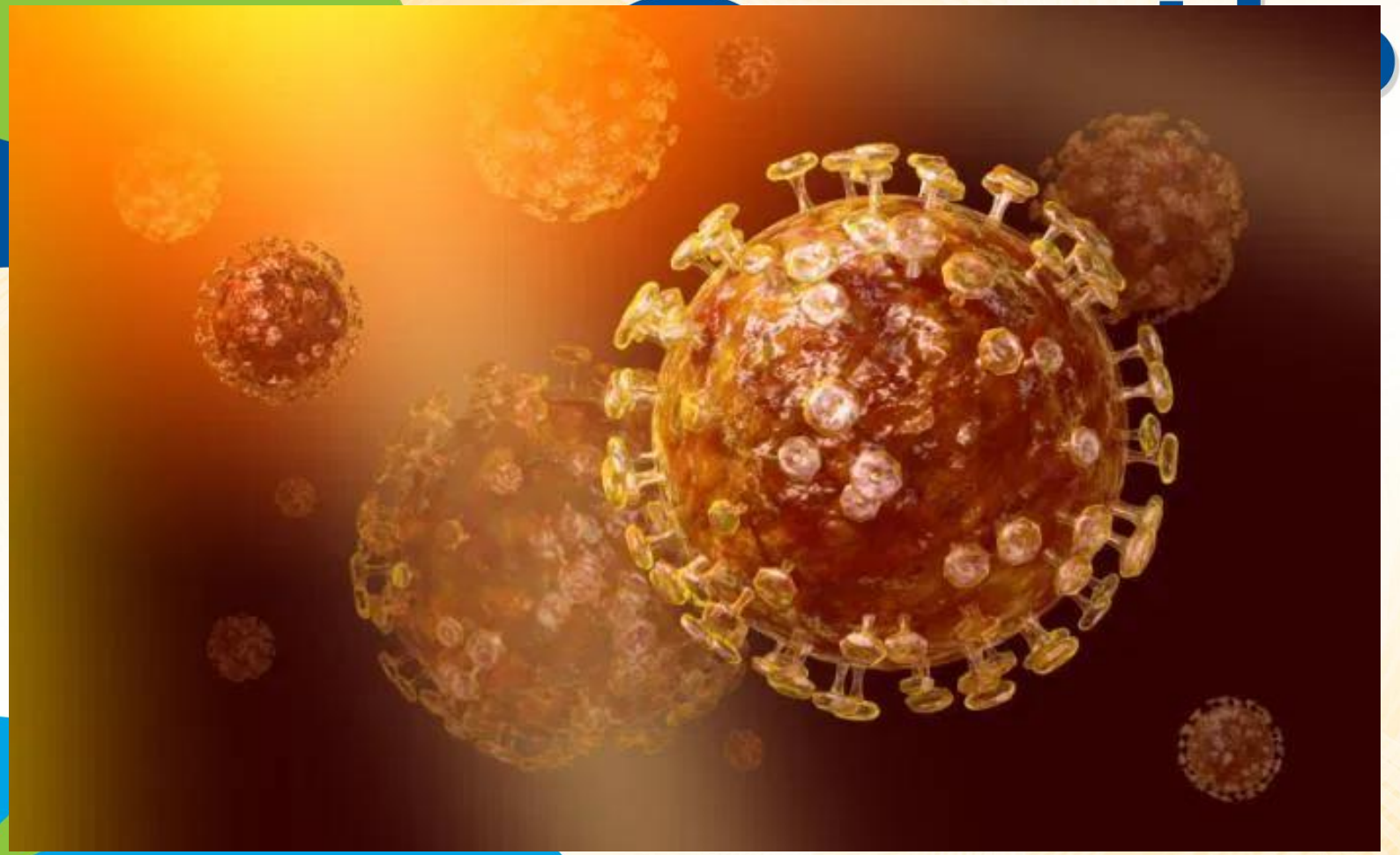
- Was too virulent, killed off hosts to quick?
- Mutated to extinction?
- Again, a practice run for COVID?

MERS (Camel Flu)

- Saudi Arabia has been at the center of a Middle East outbreak of MERS that began two years ago.
- The virus has spread among health care workers, most notably at four facilities in that county last spring.
- At least 400 people have had the respiratory illness, and more than 100 people have died. All had ties to the Middle East region or to people who traveled there.
- The MERS virus has been found in camels, but officials don't know how it is spreading to humans. It can spread from person to person, but officials believe that happens only after close contact. Not all those exposed to the virus become ill.
- It has killed nearly a third of the people it sickened. That's a far higher percentage than seasonal flu or other routine infections. But it is not as contagious as flu, measles or other diseases. There is no vaccine or cure and there's specific treatment except to relieve symptoms.



MERS



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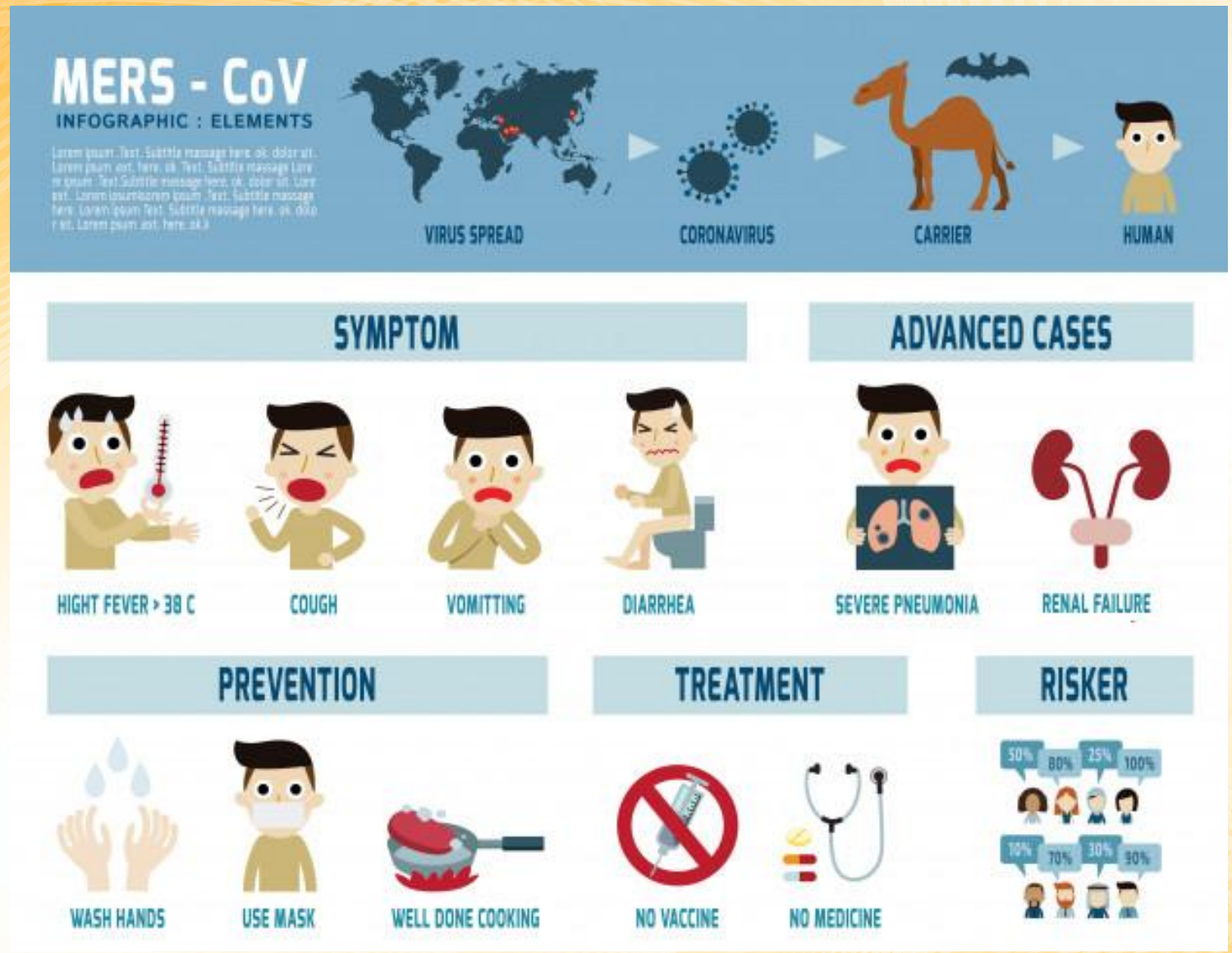

MERS - CoV
INFOGRAPHIC : ELEMENTS
VIRUS SPREAD
CORONAVIRUS
CARRIER
HUMAN
SYMPTOM
ADVANCED CASES
HIGHT FEVER > 38 C
COUGH
VOMITTING
DIARRHEA
SEVERE PNEUMONIA
RENAL FAILURE
PREVENTION
TREATMENT
RISKER
WASH HANDS
USE MASK
WELL DONE COOKING
NO VACCINE
NO MEDICINE
50%
80%
25%
100%
10%
70%
30%
90%

All cases are linked to the Arabian Peninsula

Health officials first reported the disease in Saudi Arabia in September 2012. Through retrospective (backward-looking) investigations, they later identified that the first known cases of MERS occurred in Jordan in April 2012. So far, all cases of MERS have been linked through travel to, or residence in, countries in and near the Arabian Peninsula.

The largest known outbreak of MERS outside the Arabian Peninsula occurred in the Republic of Korea in 2015. The outbreak was associated with a traveler returning from the Arabian Peninsula.

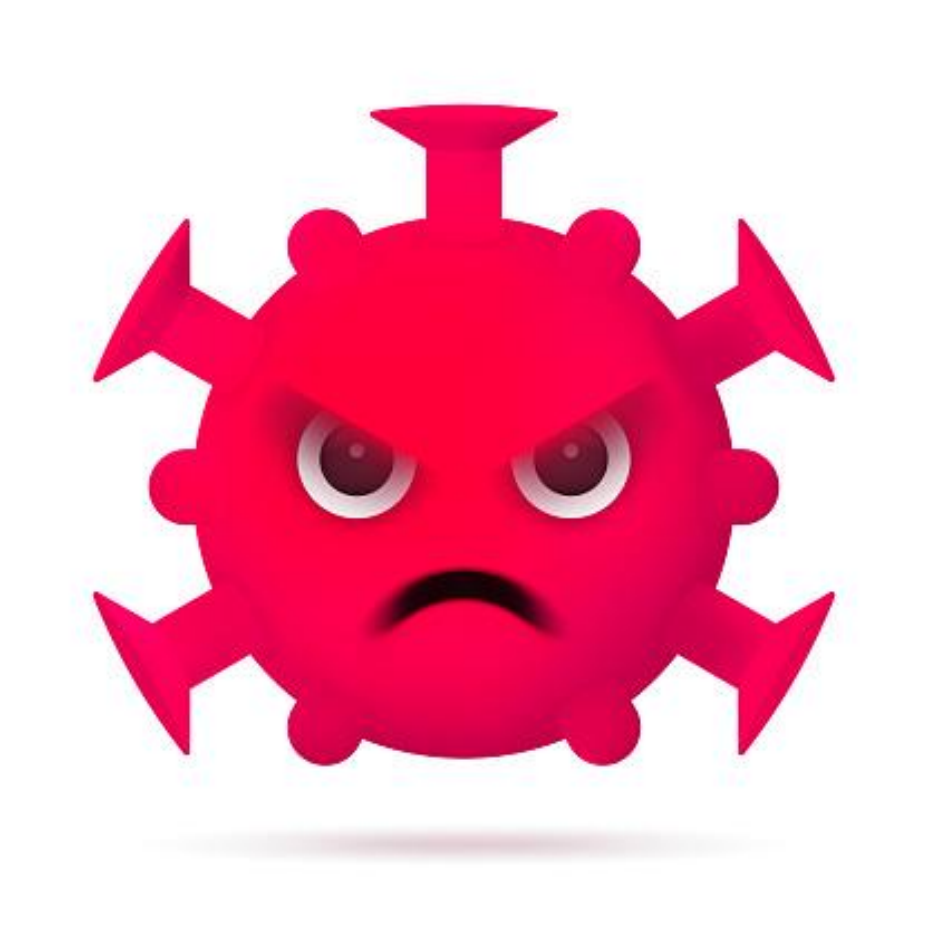
MERS in the U.S.

MERS represents a very low risk to the general public in this country. Only two patients in the U.S. have ever tested positive for MERS-CoV infection—both in May 2014—while more than 1,300 have tested negative. CDC continues to closely monitor the situation.

In May 2014, CDC confirmed two unlinked imported cases of MERS in the United States—one to Indiana, the other to Florida. Both cases were among healthcare providers who lived and worked in Saudi Arabia. Both traveled to the U.S. from Saudi Arabia, where scientists believe they were infected. Both were hospitalized in the U.S. and later discharged after fully recovering.

Practice run for COVID?

Evolution of COVID 19

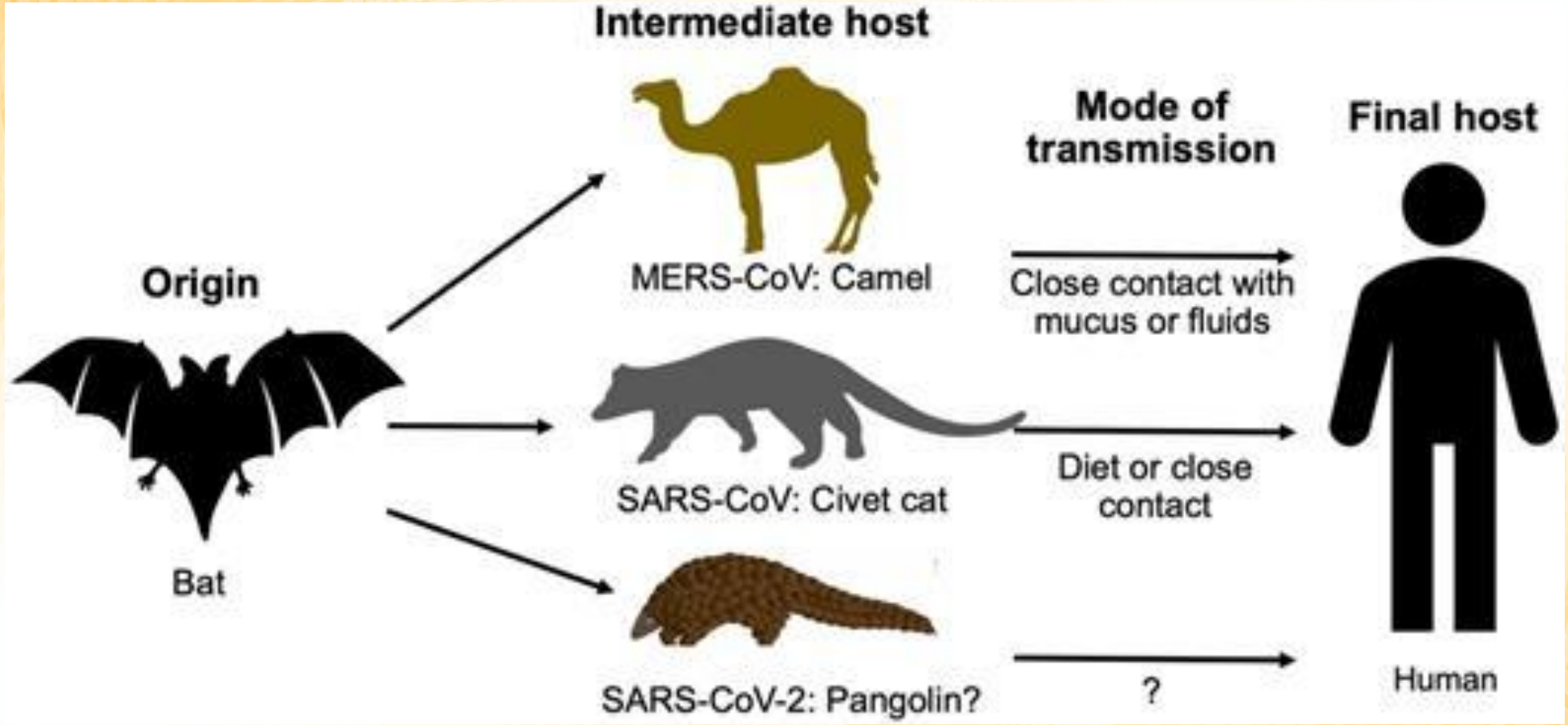


Questions?

Theory One: Bats

Horse Shoe Bat

Only through robust science and the study of the natural world will we be able to truly understand the natural history and origins of zoonotic diseases like COVID-19. This is pertinent because our ever-changing relationship and increasing contact with wildlife is raising the risk of new deadly zoonotic diseases emerging in humans. SARS-CoV-2 is not the first virus that we have acquired from animals and certainly will not be the last.

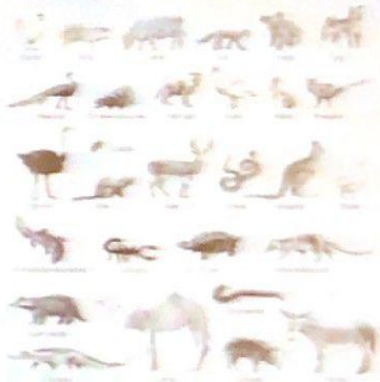

Intermediate host
Mode of transmission
Final host
Origin
MERS-CoV: Camel
Close contact with mucus or fluids
SARS-CoV: Civet cat
Diet or close contact
Bat
SARS-CoV-2: Pangolin?
?
Human

Smuggled pangolins are killed for their scales to be used in traditional Chinese medicine. They are suspected to be the world’s most-trafficked mammal, apart from humans.

Chinese Wet Market?

Chinese "Wet" Market

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How Did the Pandemic Start?

- Pangolins are sold for food in live-animal "wet markets" in China -- facilities that have long been suspected of being ground zero for the spread of viruses originating in animals to people.
- However, the pangolin coronaviruses sampled in their new study are just too dissimilar from **SARS**-CoV-2 to infect humans, so it's possible that some intermediary species -- not pangolins or bats -- was involved in the process whereby SARS-CoV-2 acquired the ability to latch onto and infect human cells.
- SARS-CoV-2 appears to be a sort of hybrid strain, somewhere between the **strains** isolated from either pangolins or bats, the researchers said.
- "In our study, we demonstrated that indeed SARS-CoV-2 has a rich evolutionary history that included a reshuffling of genetic material between bat and pangolin coronavirus before it acquired its ability to jump to humans.

Questions?

Wuhan Theory: Escaped Virus

The Lab Leak Hypothesis

- **Wuhan Institute of Virology** near the original epicenter of the Covid-19 outbreak
- **Shi Zhengli**, a renowned virologist at the Wuhan lab. She told **Scientific American** last year that she recalled being told in December 2019 about a mysterious pneumonia caused by a coronavirus spreading in the city of Wuhan and wondering if the pathogen came from her lab.
- There have been reports that researchers at the institute were performing **gain-of-function experiments**, where a natural virus is modified to become more virulent or to better infect humans.
- Chan also noted that the **Huanan Seafood Wholesale Market** in Wuhan was initially suspected as the location where a SARS-CoV-2 spillover from animals to humans occurred, but to date, **no infected animal has been identified** and Chinese researchers have **ruled it out** as the origin of the virus.

2013 China Miners

- **The case of six miners** in China who fell ill in 2012 after being hired to clear a cave of bat guano. The Wuhan Institute of Virology was called in to investigate. Researchers from the lab tested bats from the mine for coronaviruses and found an unidentified strain resembling SARS; several bats were infected with more than one virus. That created opportunities for recombination, in which viruses undergo rapid, large-scale mutations that create new pathogens.
- Three miners died of COVID 19 like pathophysiology

Did the Virus Leak From A Lab?

- The WHO report also concludes that it's highly unlikely that the coronavirus escaped from a lab at the Wuhan Institute of Virology. Most scientists say that evidence overwhelmingly favors SARS-CoV-2 having spilled over from animals into humans, but a few have backed the idea that the virus was intentionally or accidentally leaked from a lab.
- The Wuhan researchers also said that they hadn't kept any live virus strains similar to SARS-CoV-2.
- In their discussions with the investigative team, showing that similar viruses exist in animals in China, rather than in their lab.
- They further explained that everyone in the lab has safety training and psychological evaluations, and that their physical and mental health are continuously monitored.

UK, US scientists call for fuller probe into COVID-19 Wuhan lab leak theory

- A group of leading UK and US scientists, including Indian-origin Cambridge University immunology and infectious disease expert Ravindra Gupta, on Friday, called for more investigation to determine the origin of the COVID-19 pandemic, including the theory of an accidental release from a lab in the central Chinese city of Wuhun.
- They caution that hypotheses about both natural and laboratory spillovers must be taken seriously until there is sufficient data. "Theories of accidental release from a lab and zoonotic spillover both remain viable,

Which Theory is Most likely?

- More answers about the roots of the pandemic may emerge in the coming months, but it's likely that further inquiries won't be enough to satisfy everyone. Even after the pandemic fades away, the virus that caused it may long frustrate and confound.

Pandemic