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Hindsight is 2020: The Science Behind COVID-19

Tuesday, March 2

Featuring: Steven Wiley
PNNL Laboratory Fellow

DEMYSTIFYING COVID:

A Special Edition
Seminar Series

COMMUNITY
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TECHNOLOGY
SEMINAR SERIES
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The perspectives expressed here are those of the scientists involved in the presentations and do not necessarily reflect the official perspectives of PNNL, the U.S. Department of Energy, or the U.S. Government.

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PNNL is Focused on **DOE's MISSIONS** and Addressing Critical **NATIONAL NEEDS**

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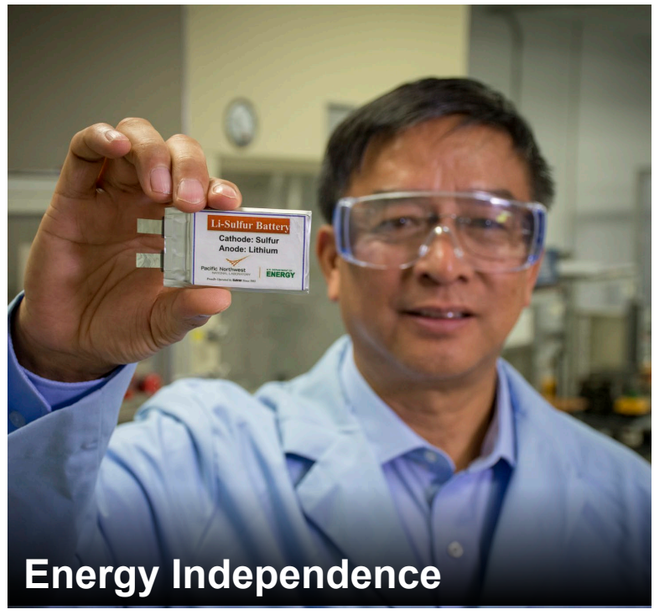

Energy Independence


National Security

Environmental Management

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PNNL is an ECONOMIC ENGINE

4,722
Employees

265
Inventions

$1.46B
Total Economic Output

$1.01B
Annual Spending

88
Patents

7,180
Jobs Generated in Washington

$465M
Total Payroll

34
Licenses

193
Companies with PNNL Roots

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50+ years developing goodwill

Historical	FY19
$28.5M	**$0.52M**
Philanthropic Investments	

Historical	FY19
347,000	**30,000**
Team Battelle Volunteer Hours	

Historical	FY19
>120	**56**
Community Organizations	

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DEMYSTIFYING COVID:

A Special Edition Seminar Series

EVERY TUESDAY
IN MARCH
5:00-6:00 P.M.

MARCH02

Hindsight is 2020: The Science Behind COVID-19

Presented by Steve Wiley

What lessons have we learned over the last few months? What's left for us to uncover? And seriously what is the difference between a cold, a flu, and COVID symptoms?

MARCH09

What Do Bats Have to Do with It?

Presented by Amy Sims

Bats, pangolins, and humans—oh my! This talk will explore the role wild animals play in the emergence of new diseases.

MARCH16

Behind the Mask: The Science on Stopping the Spread

Presented by Katrina Waters

What measures keep our communities safe? And why do some strange, sometimes serious health effects linger even after COVID-19 has gone, including a loss of taste and smell or COVID toe? Join us to find out.

MARCH23

Testing, Testing, 1, 2, 3 (And What's Up With The New Vaccine, Anyways?)

Presented by Kristin Omberg

If you're confused about COVID-19 testing and vaccines, you're not alone. This talk will explore the science behind the 400+ diagnostic tests and 200+ vaccine candidates produced over the last year.

MARCH30

Model Me This: COVID-19 Scientific Predictions and Where We Go from Here

Presented by Tim Scheibe

Using mathematical models, scientists across the globe are beginning to arrive at a more complete picture of how and why COVID-19 spread across geographical locations and human populations.

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5:00-6:00 P.M.

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TODAY'S SPEAKER

EVERY TUESDAY
IN MARCH
5:00-6:00 P.M.

MARCH 02

Steve Wiley

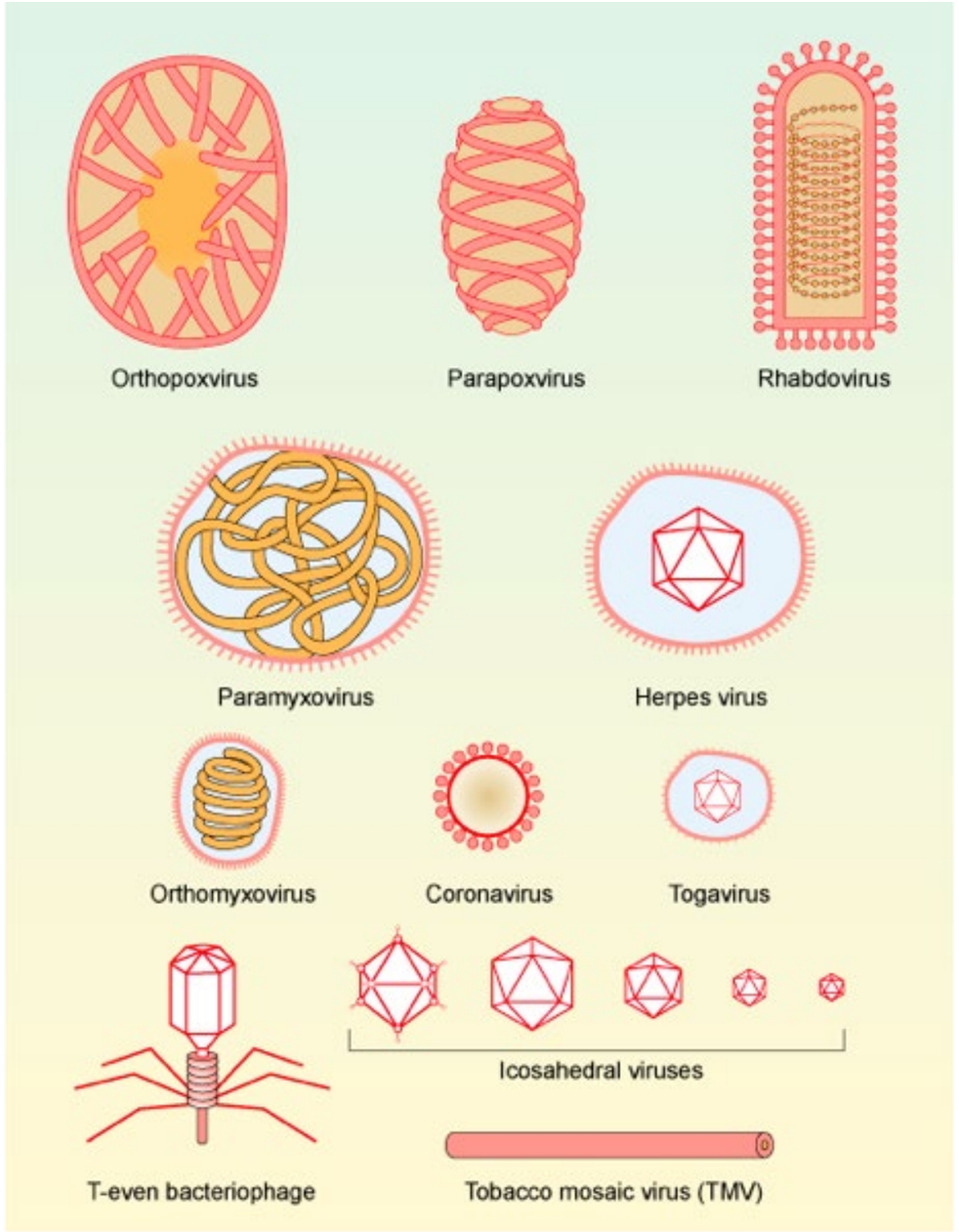
PNNL Laboratory Fellow

Hindsight is 2020

What is a virus?

- Non-living particle of genetic material
- Takes over a cell and forces them to make more virus
- Many different types
- Not all cause disease

Important: They need a host to survive!



Terminology

Pandemic

- An outbreak of a disease that is prevalent over a continent or the world

NOTE: An **epidemic** is more localized

Transmission

- Spreading a disease

Mutation

- Changes to the genome of a pathogen or organism that may impact transmission, symptoms or prior immunity

Infectious/Contagious

- The state of being able to transmit a disease to another person

Vaccine

- A preventative measure to build immunity against a specific disease

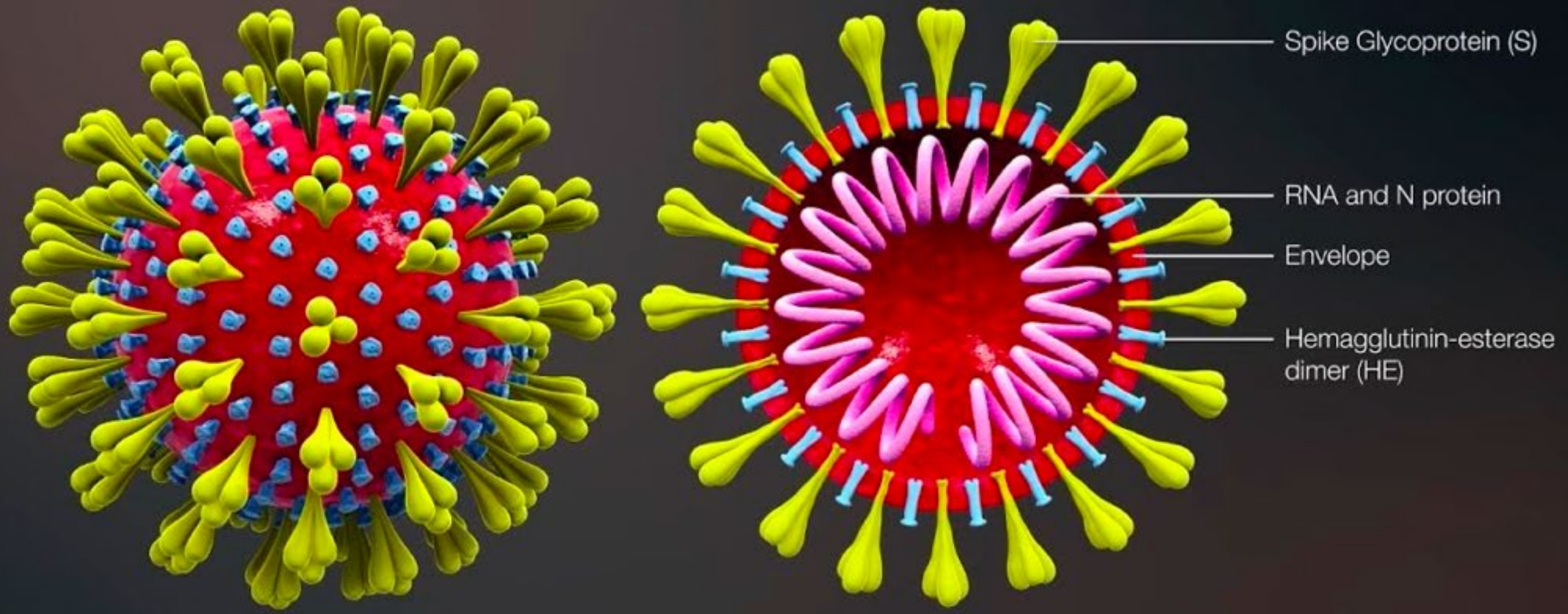
Model

- A representation of a disease or process that can recapitulate key aspects

Reservoir

- Any person, animal, plant, soil or substance in which an infectious agent normally multiplies

2019-nCoV aka SARS-CoV-2

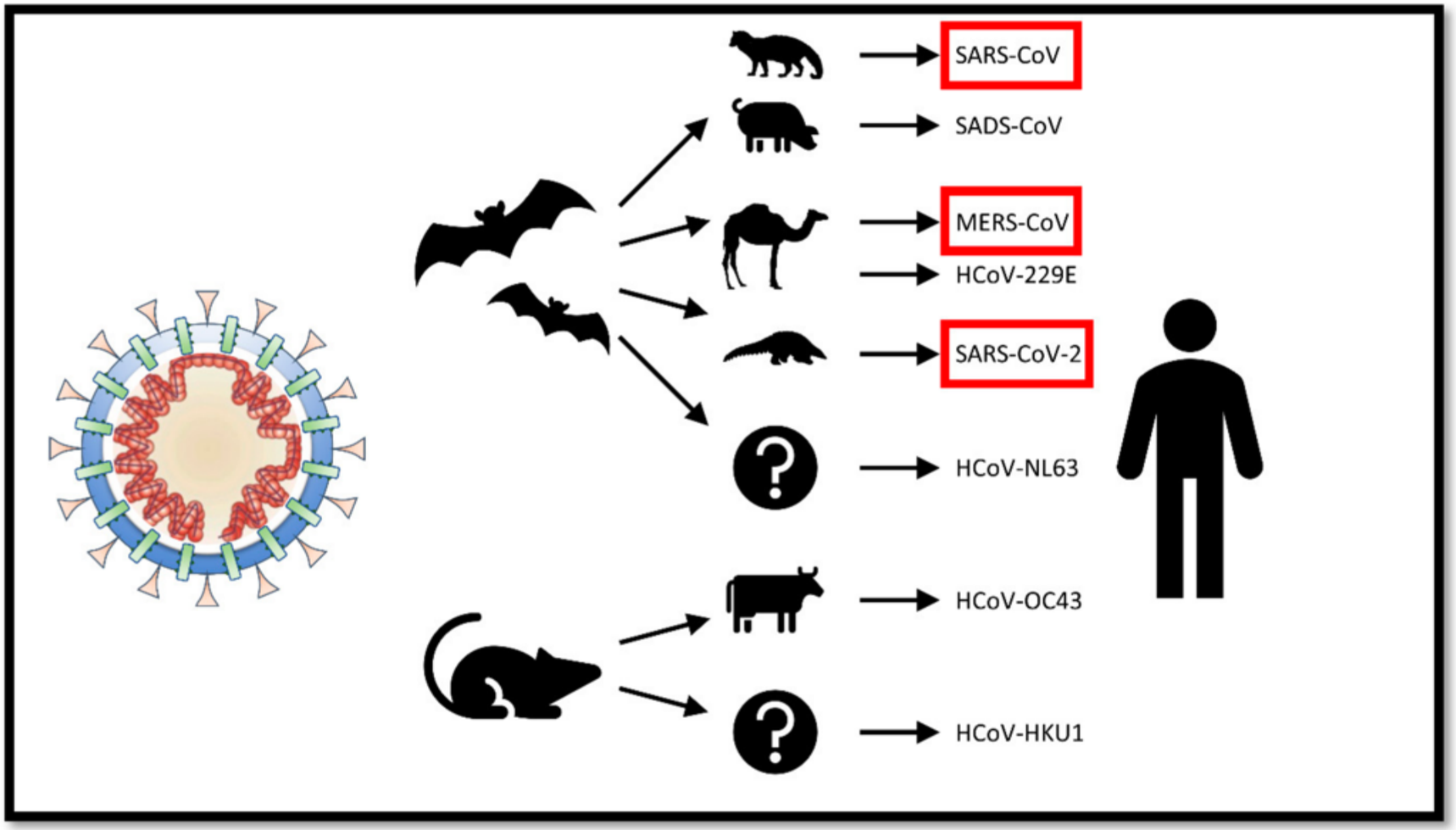


this virus causes the disease COVID-19

What is so special about coronaviruses?

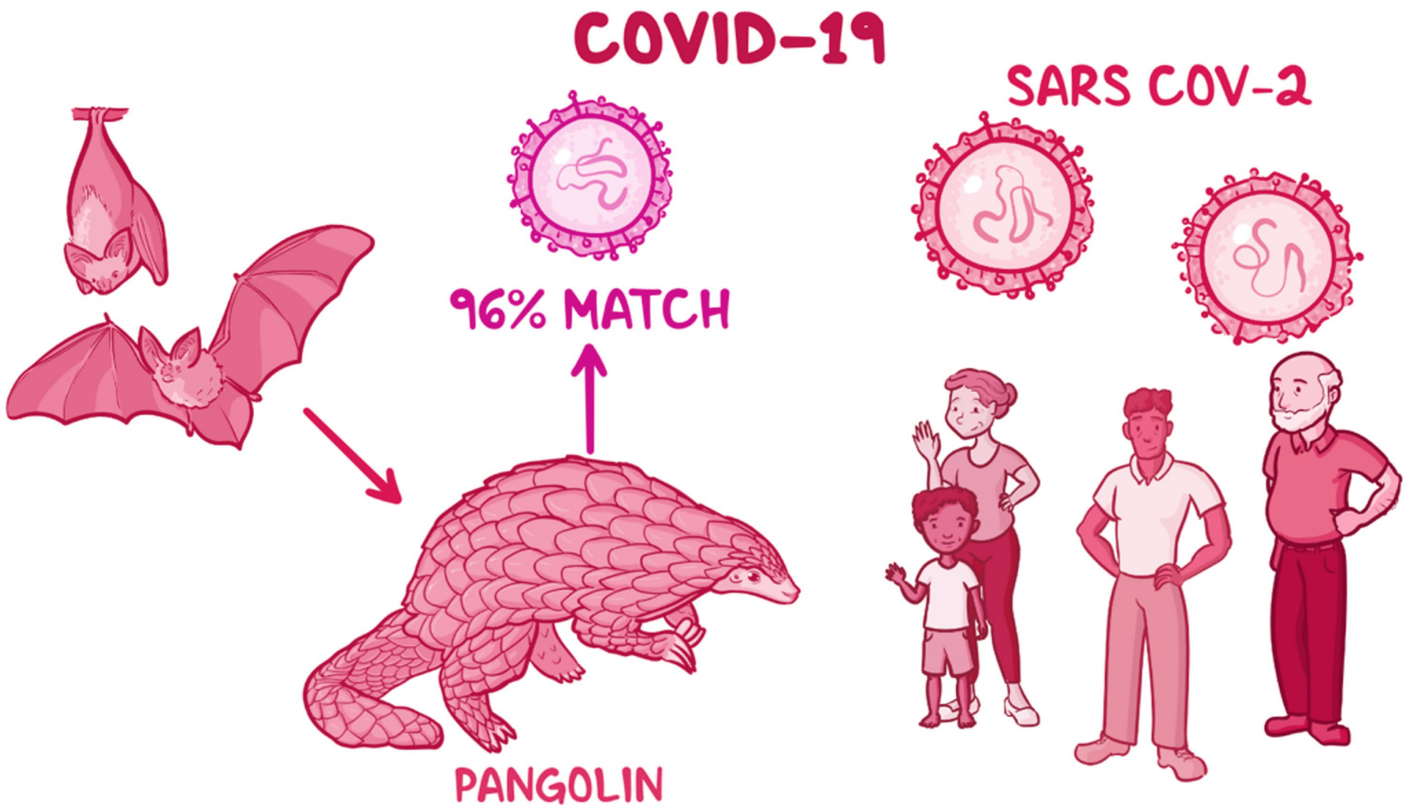
- Most viruses are highly specialized for one species
- Coronaviruses are RNA-based enveloped viruses that originated as respiratory viruses in animals
- They are called “zoonotic” viruses because they can be transmitted between different species
- When this occurs, they can become “pathogenic” (cause disease)

Recent examples of zoonotic diseases from coronaviruses



Where did COVID-19 come from?

- Closest to viruses from bat colonies
- Genetic evidence indicates that it passed through another animal first
- No evidence that it was engineered or came from a Wuhan laboratory

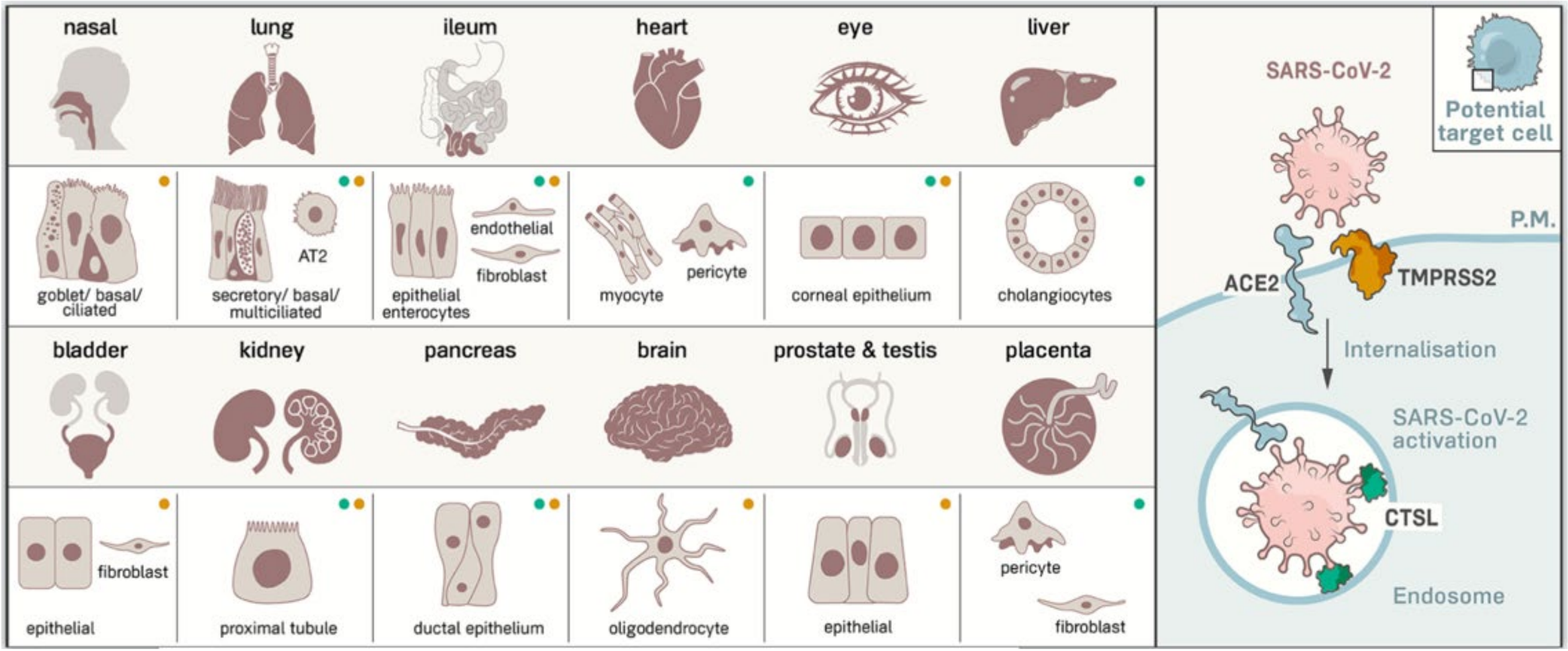


Why is it so dangerous?

- Highly transmissible
- Can be transmitted well before symptoms are seen
- Humans have not seen this virus before

- Attacks important regulatory system that controls blood pressure
- Respiratory diseases are serious for older people and those with heart issues

COVID-19 exploits the ACE2 receptor system to enter the body



Graphic: The Scientist Magazine

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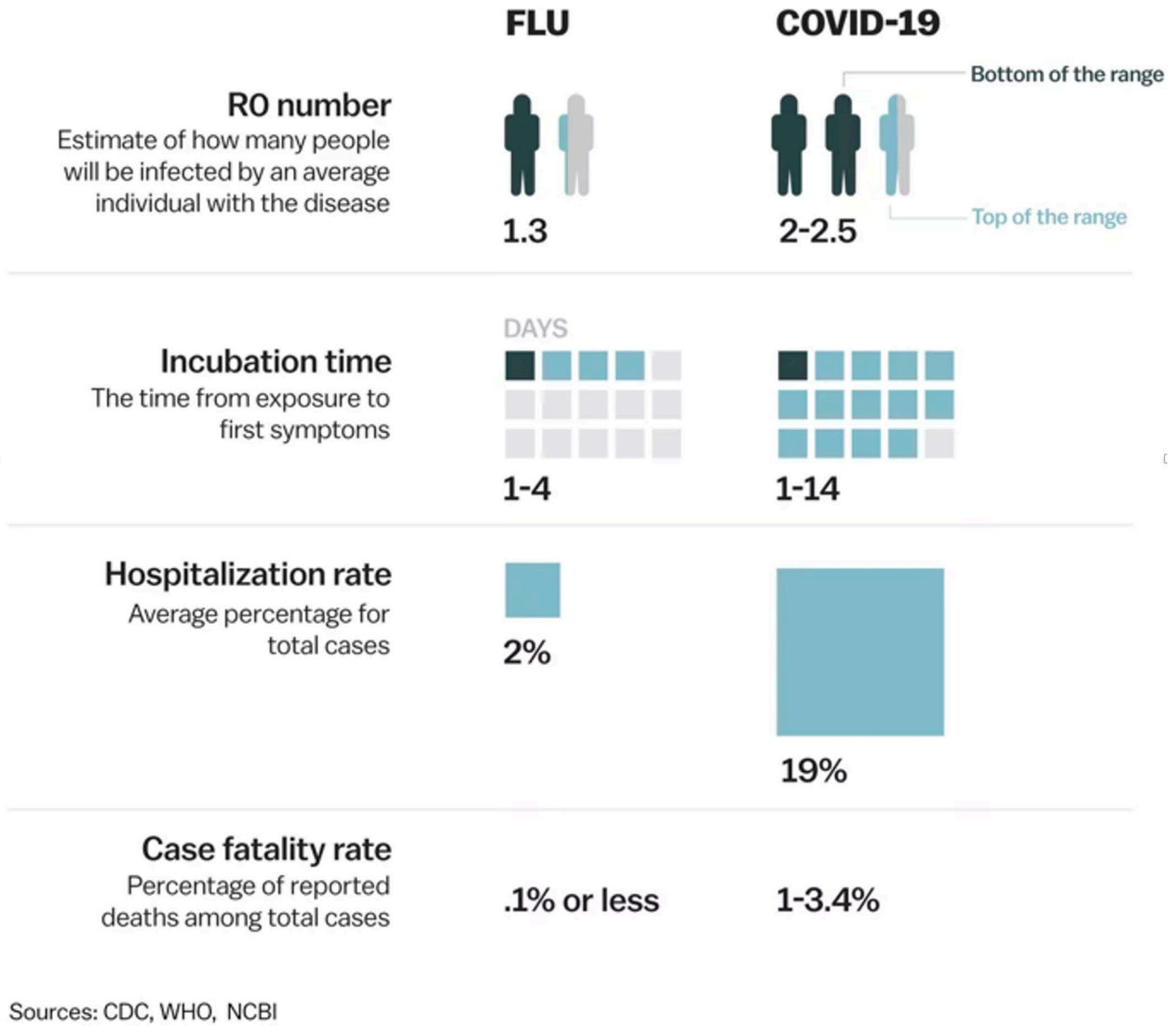
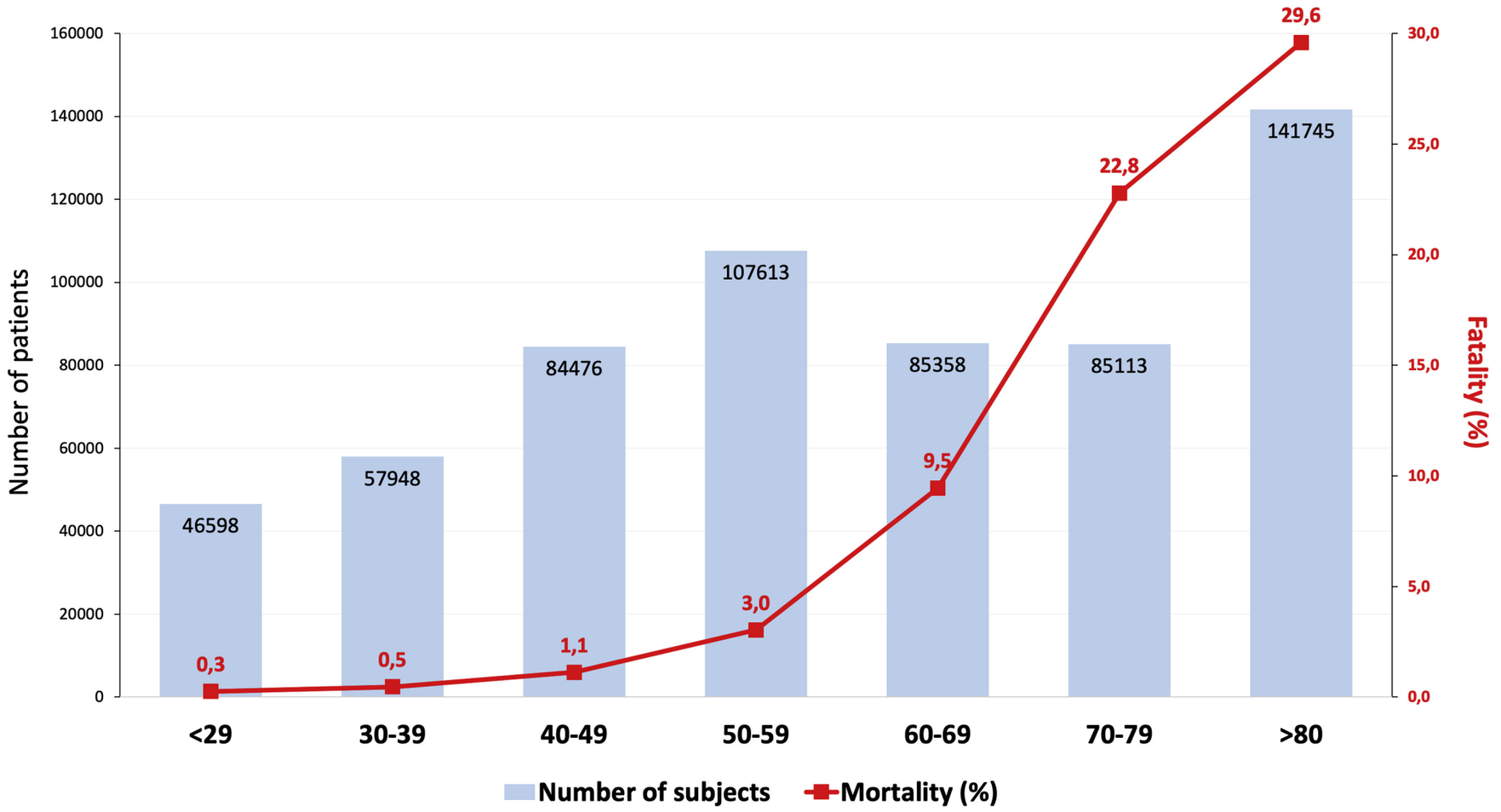
COVID-19 is intrinsically more dangerous than the flu virus

- COVID-19 symptoms are like the flu, but include shortness of breath and loss of taste-smell
- Flu symptoms include headaches as well as aches and pain



Comparing seasonal flu and COVID-19

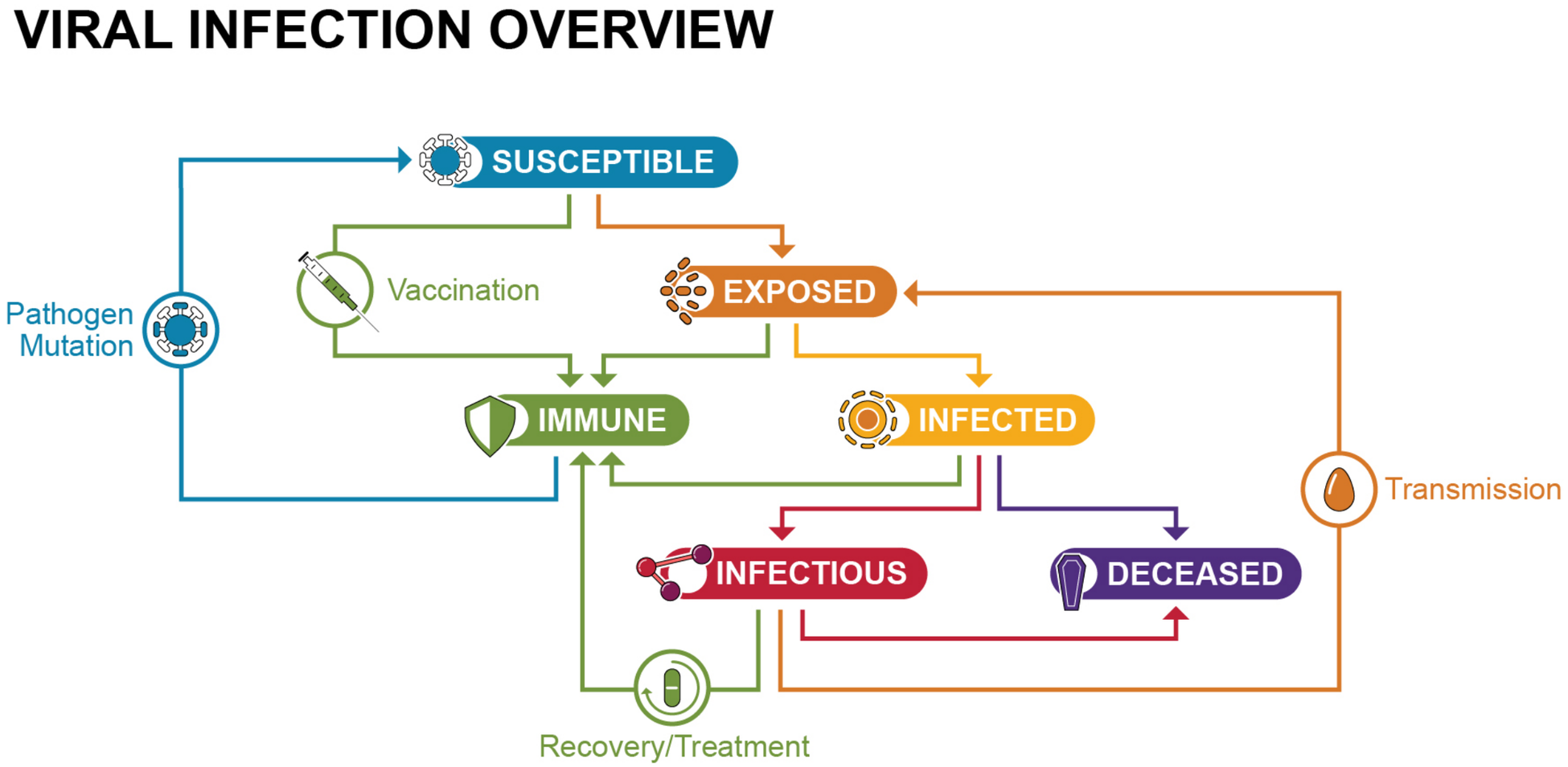
COVID-19's fatality rate is strongly biased by age



Source: Bonanad et al., (2020) JAMDA 21; 915–918

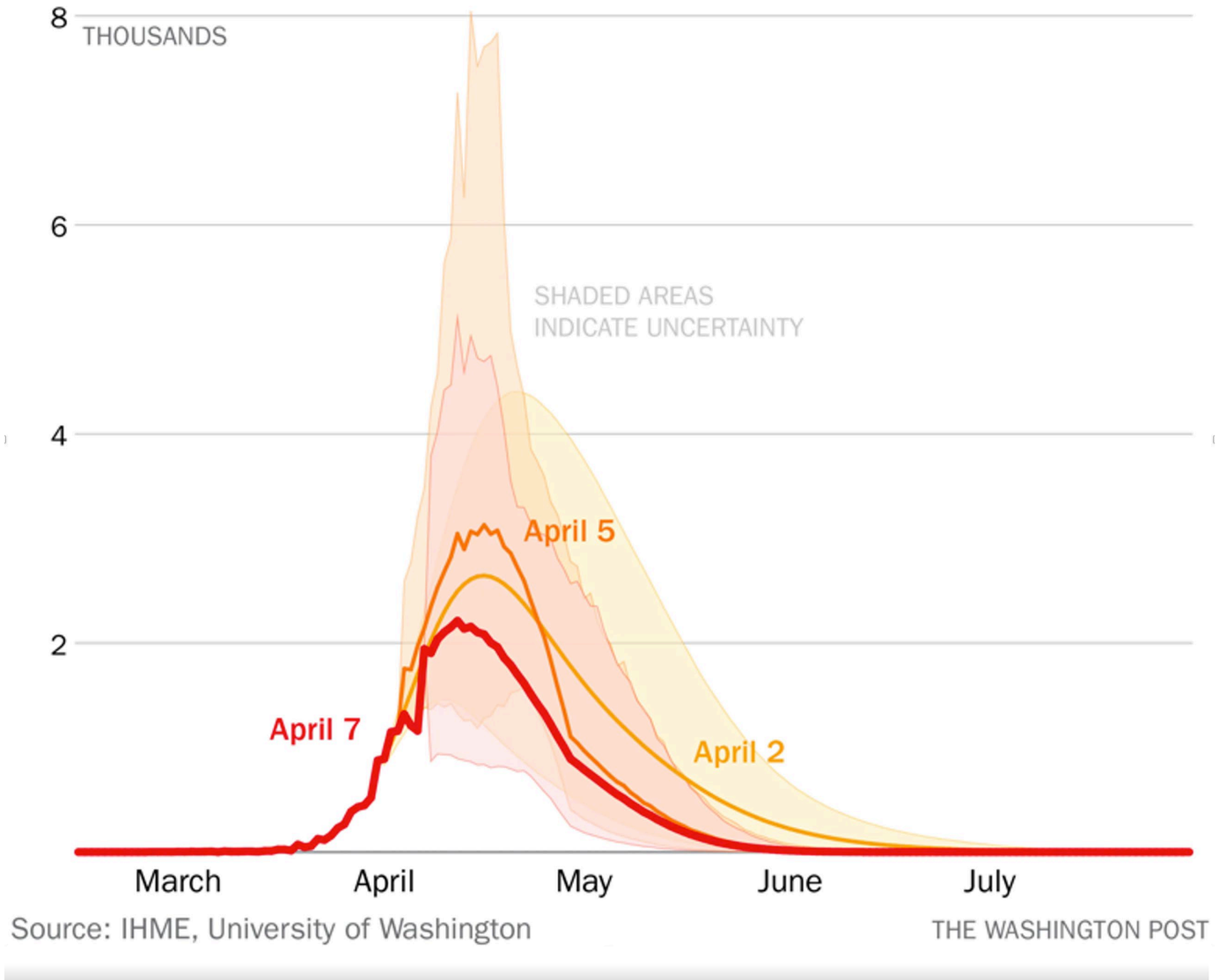
How did science respond to the pandemic?

First, we built a model



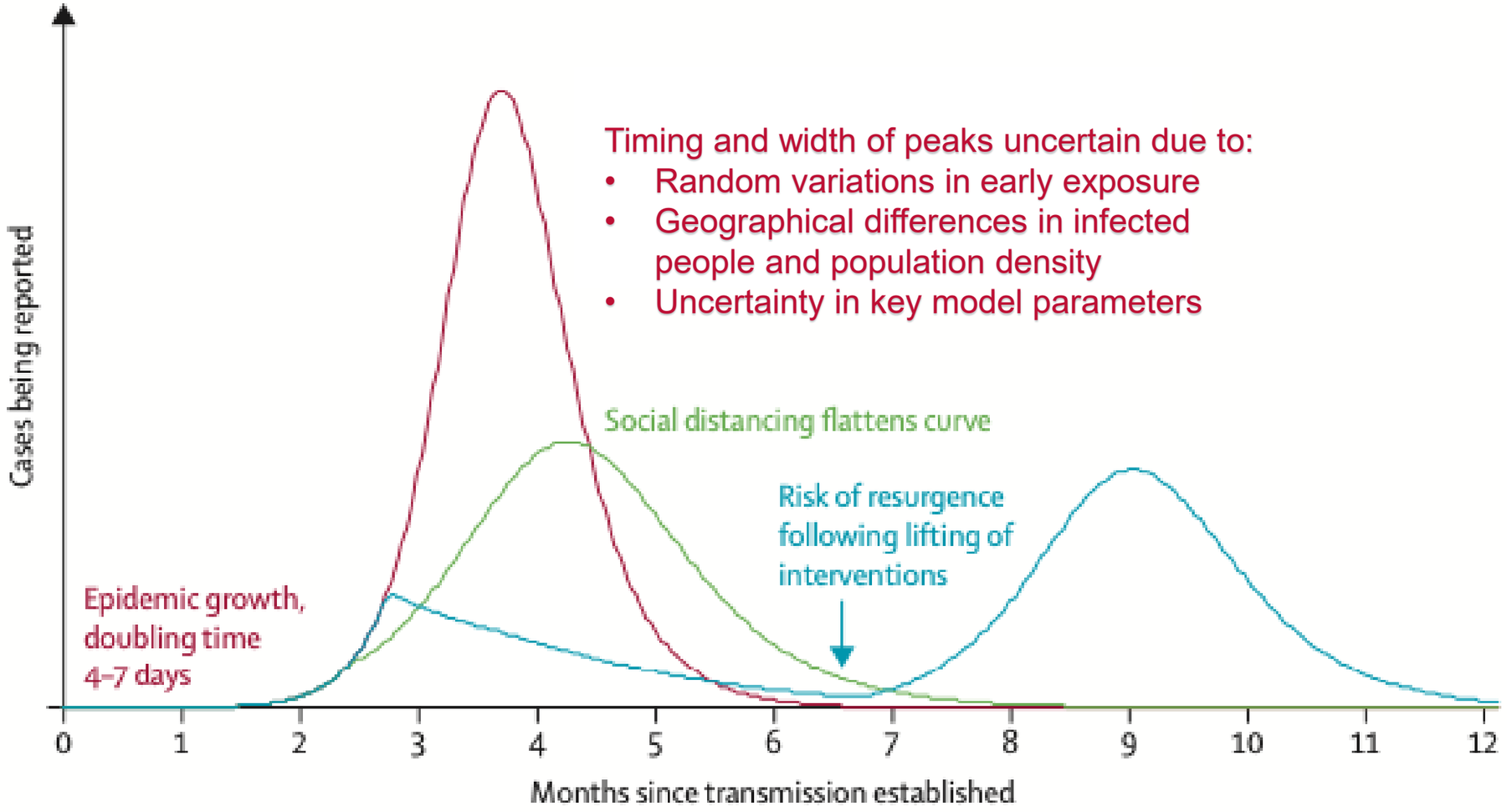
There is always a degree of uncertainty in models

- Until you collect enough data, there is always doubt in your projections
- This was responsible for the strong emphasis on testing early in the pandemic

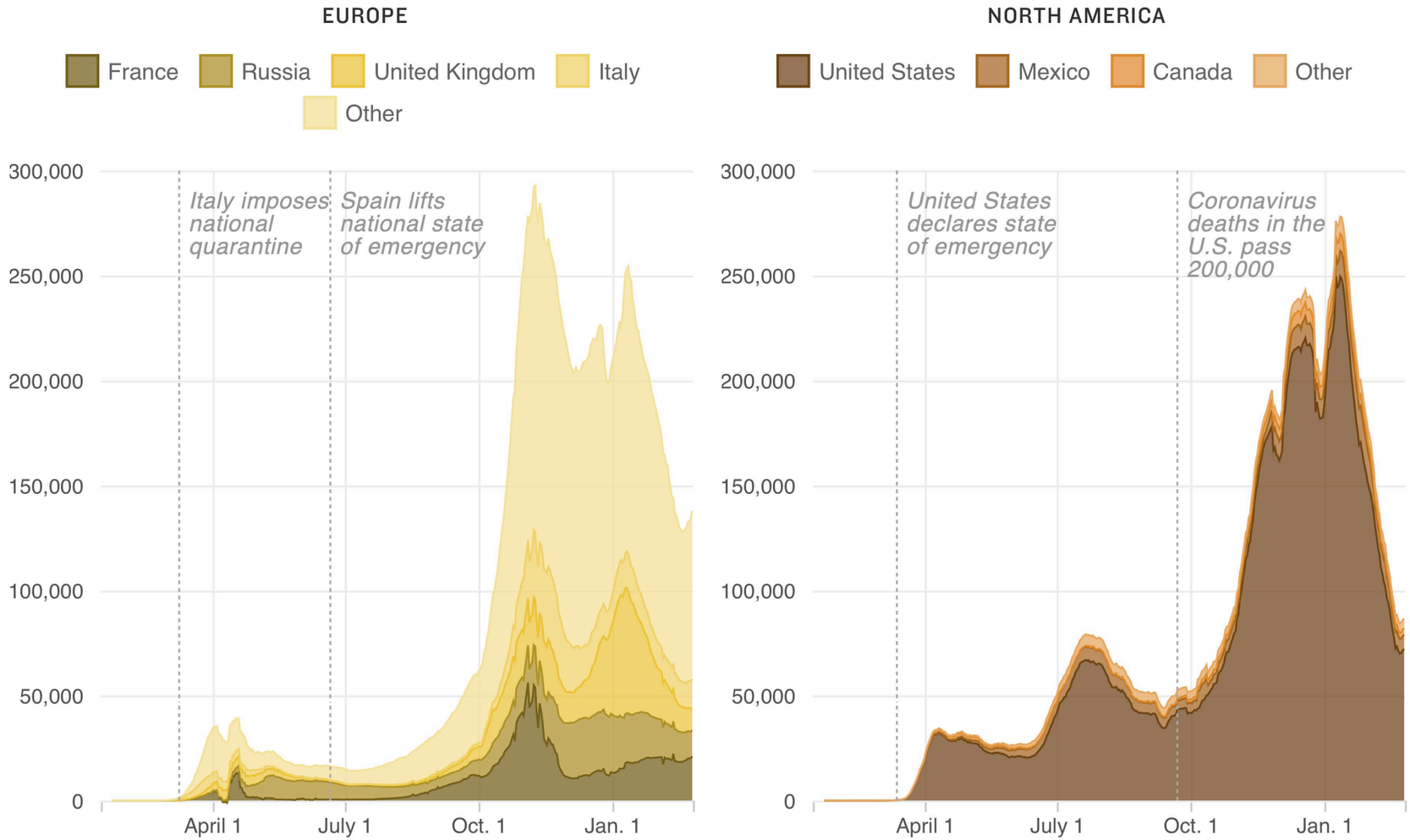


How the projected peak in deaths evolved early in the pandemic

The greatest risk early on was for a rebound



The original fears were well founded



Source: Case data from the Center for Systems Science and Engineering at Johns Hopkins University. Graphic: NPR

When will it end?

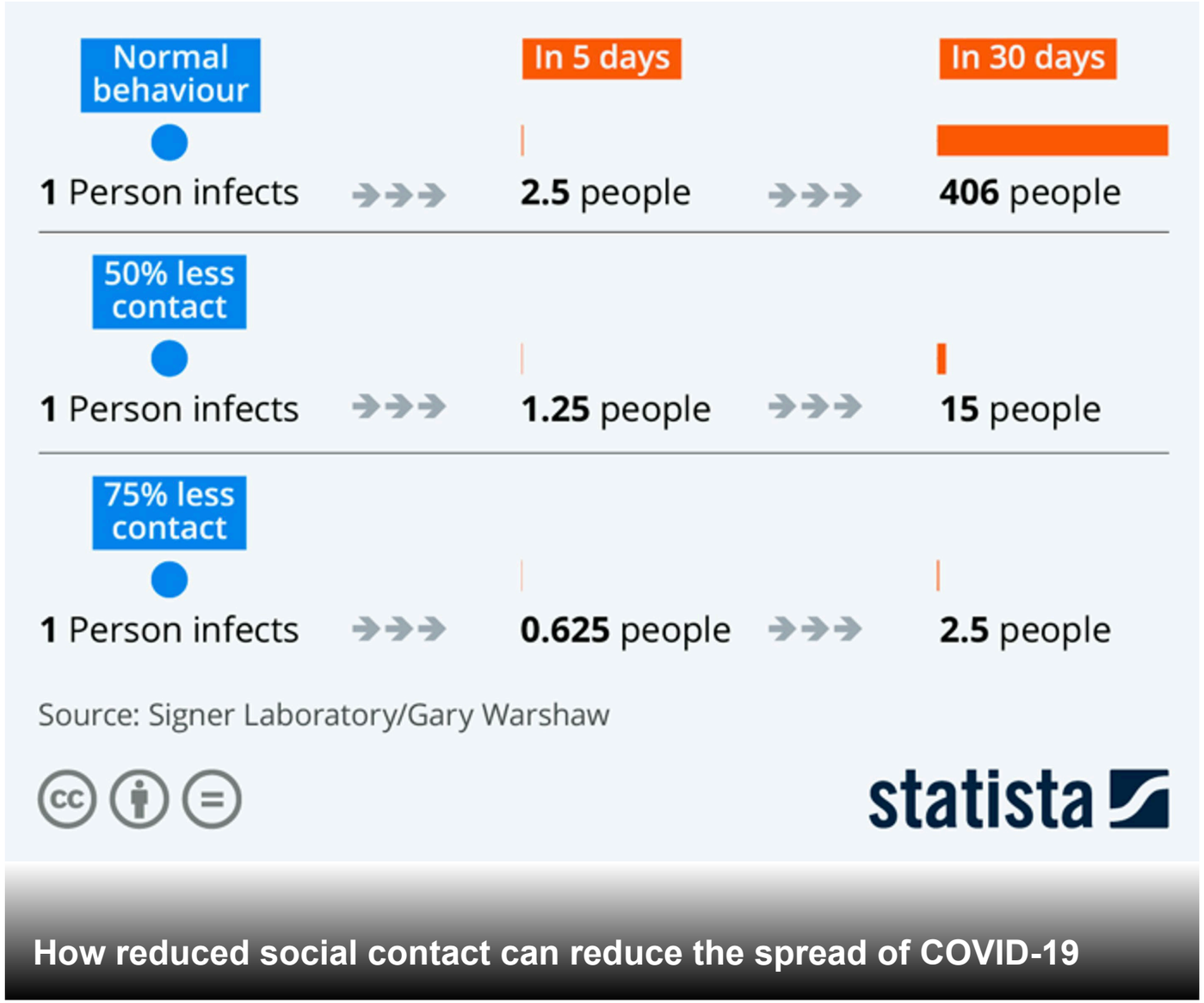
- Either until everyone is infected or most people are vaccinated
- COVID-19 is unlikely to disappear on its own
- Early lockdown measures were designed to delay infections until effective treatments were developed
- Effective treatments have now greatly reduced the chances of dying, but long-term effects are still a problem
- Developing an effective vaccine is the “endgame”

Until you are vaccinated, the best way to reduce infections is to reduce transmission

- Because the pre-infection phase of COVID-19 is so long, most transmission is likely to come from people who don’t know they have the disease
- Transmission is mostly through aerosols
- If indoors, good air flow is essential for reducing risk
- The best way to reduce transmission is by social distancing and wearing facemasks

The vital importance of social distancing

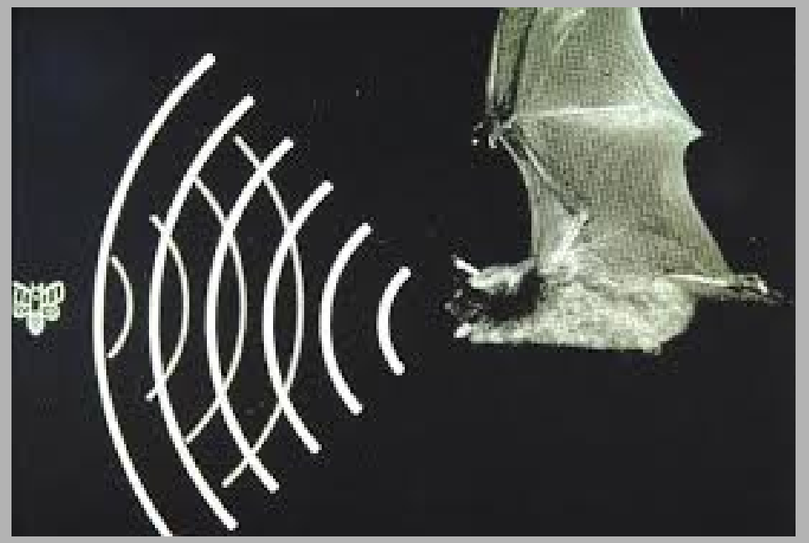
- Because COVID-19 is so transmissible, models predicted that reducing social contacts would greatly slow its spread
- Follow-up studies have verified this idea



How reduced social contact can reduce the spread of COVID-19

Bat coronaviruses have evolved to be transmitted by air

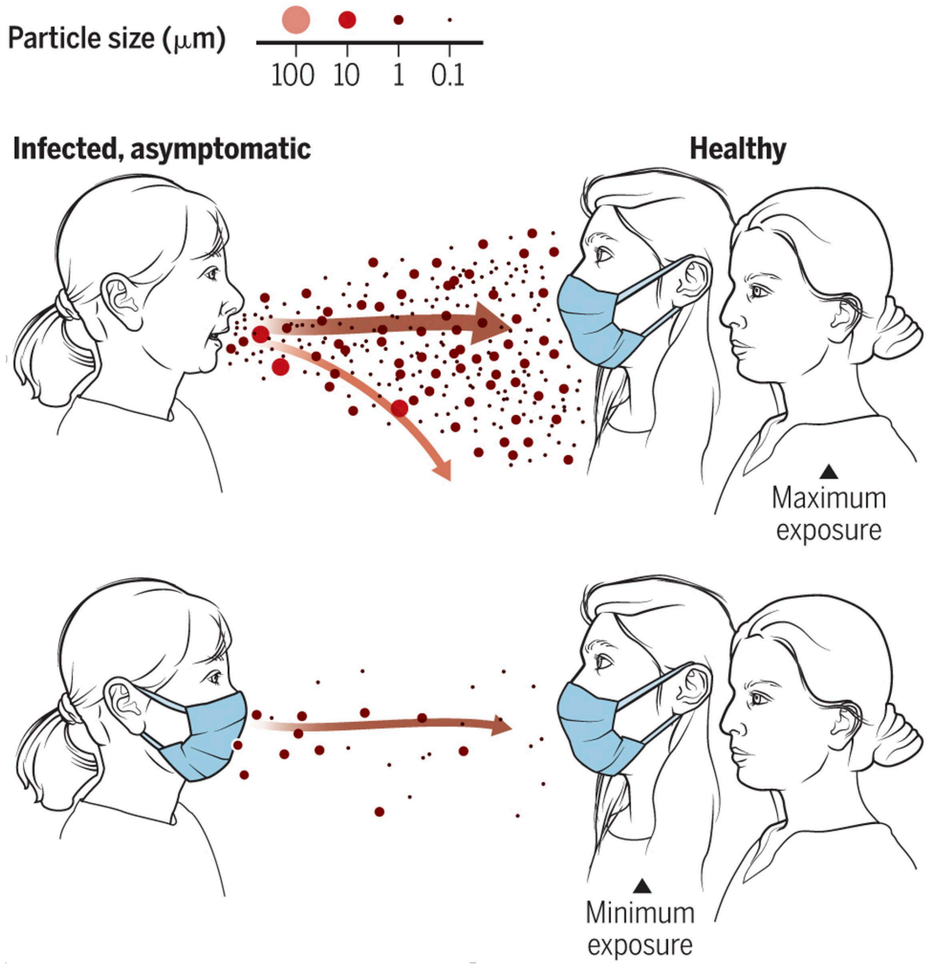
- It makes sense to avoid behavior that is optimal for disease transmission
- Use common sense when determining what types of behaviors are dangerous



Singing and loud talking in a bar resembles how bats transmit coronaviruses

Masks reduce airborne transmission

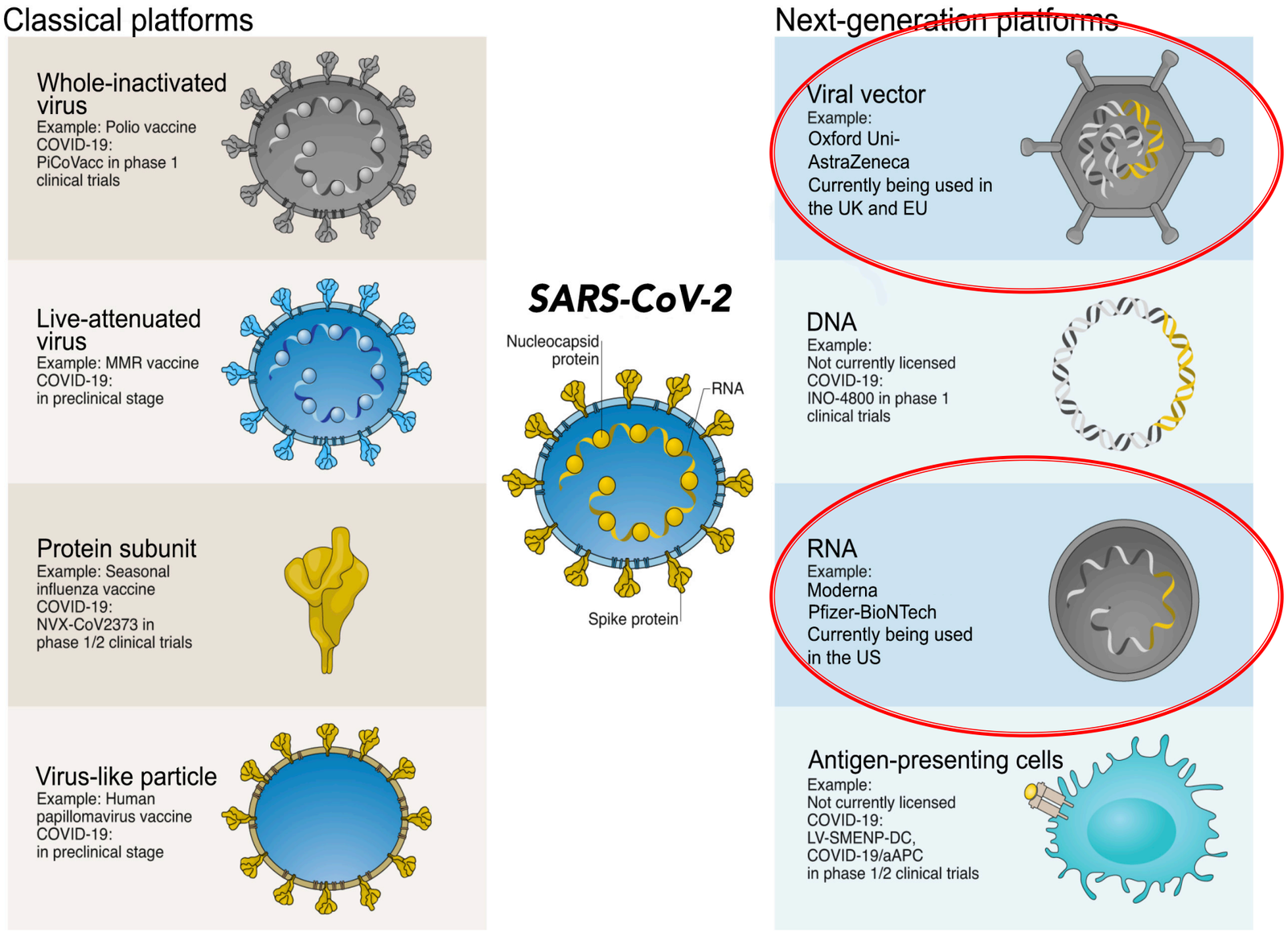
- Infectious aerosol particles can be released during breathing and speaking by asymptomatic infected individuals
- No masking maximizes exposure whereas universal masking results in the least exposure



Source: Prather et al., (2020) Science 368; 1422-1424

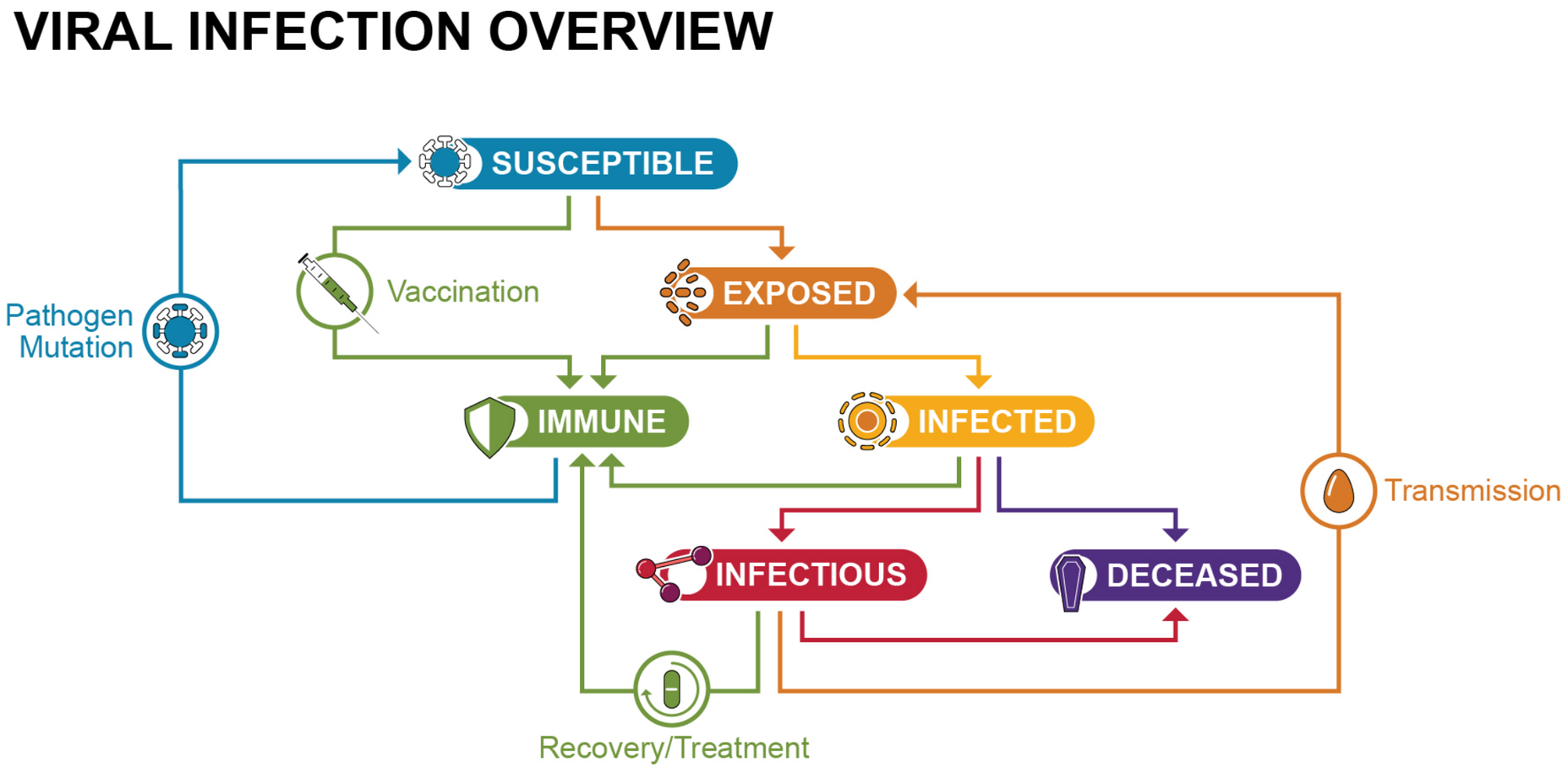
New approaches to vaccine development based on scientific research

- Classical platforms based on a century of work
- New platforms based on genome-enabled science



Source: Nature magazine

Next: we will discuss what science knows about different steps in the viral infection cycle



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SUBMIT YOUR QUESTIONS VIA THE DISCUSSION CHAT

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09 MAR

What Do Bats Have to Do with it?

Amy Sims
Biomedical Scientist

16 MAR

Behind the Mask: The Science on Stopping the Spread

Katrina Waters
Lab Fellow
Biological Sciences
Division Director