Pacific Northwest
NATIONAL LABORATORY

What Do Bats Have to Do with It?

Tuesday, March 9

Featuring: Amy Sims
PNNL Research Scientist

DEMYSTIFYING COVID:

A Special Edition
Seminar Series

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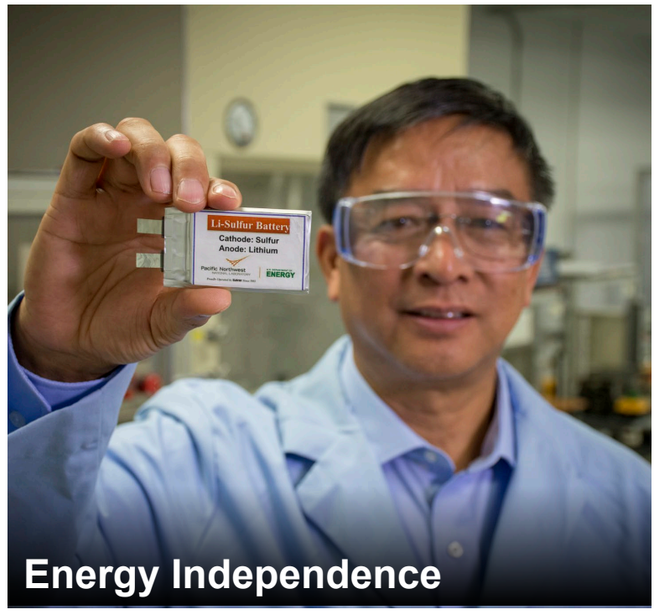
The perspectives expressed here are those of the scientists involved in the presentations and do not necessarily reflect the official perspectives of PNNL, the U.S. Department of Energy, or the U.S. Government.

Where are you joining from? (3/9/2021)

Pacific Northwest
NATIONAL LABORATORY

PNNL is focused on **DOE's MISSIONS** and addressing critical **NATIONAL NEEDS**

Scientific Discovery



Energy Independence


National Security

Environmental Management

Pacific Northwest
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PNNL is an ECONOMIC ENGINE

4,997
Employees

340
Inventions

$1.67B
Total Economic Output (FY19)

$1.1B
Annual Spending

81
Patents

8,200
Jobs Generated in Washington (FY19)

$487M
Total Payroll (FY19)

36
Licenses

194
Companies with PNNL Roots (FY19)

Pacific Northwest NATIONAL LABORATORY

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	

Visit **pnnl.gov/events**

COMMUNITY
SCIENCE & TECHNOLOGY
SEMINAR SERIES
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DEMYSTIFYING COVID:

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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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COMMUNITY REPRESENTATIVES

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

LoAnn Ayers

President & CEO

United Way of Benton
& Franklin Counties

Kate McAteer

Vice Chancellor | Academic and Student Affairs

WSU Tri-Cities

Justin Raffa

Artistic Director

Mid-Columbia
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Interim Executive Director

Tri-Cities Hispanic
Chamber of Commerce

Regional Director

Tri-Cities Campus
Heritage University

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TODAY'S SPEAKER

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

Amy Sims

Virologist

Pacific Northwest
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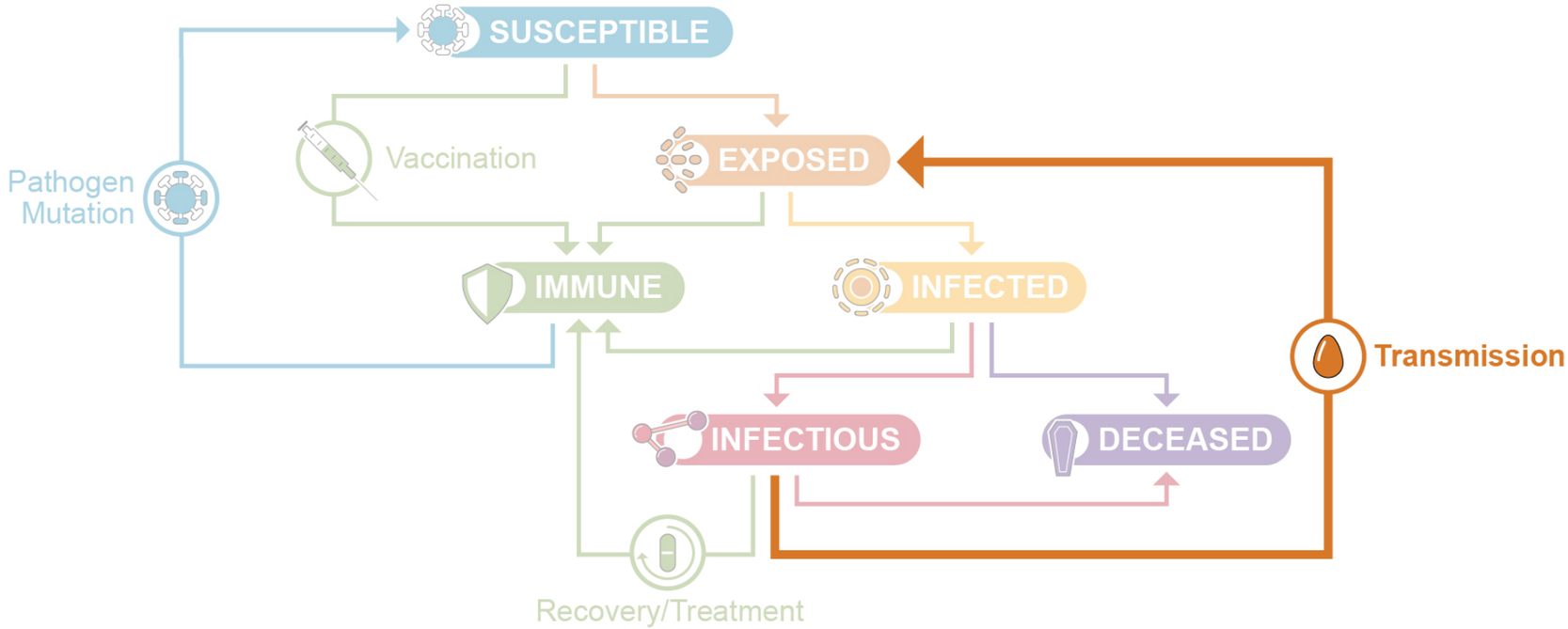
Today's discussion: transmission in the viral infection process

VIRAL INFECTION OVERVIEW



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 affect 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

COVID-19 vs. SARS-CoV 2

- SARS-CoV 2 (severe acute respiratory syndrome coronavirus 2) is the virus that causes COVID-19
- COVID-19 (coronavirus disease 2019) is a potentially severe respiratory infection caused by SARS-CoV 2

Talk overview

Virus replication and disease outcomes in animal hosts and humans

Human coronaviruses before the global COVID-19 pandemic

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SARS-CoV 2 genome changes over the course of the pandemic

Current and future COVID-19 treatment options

What happens next? How do we prepare for the future?

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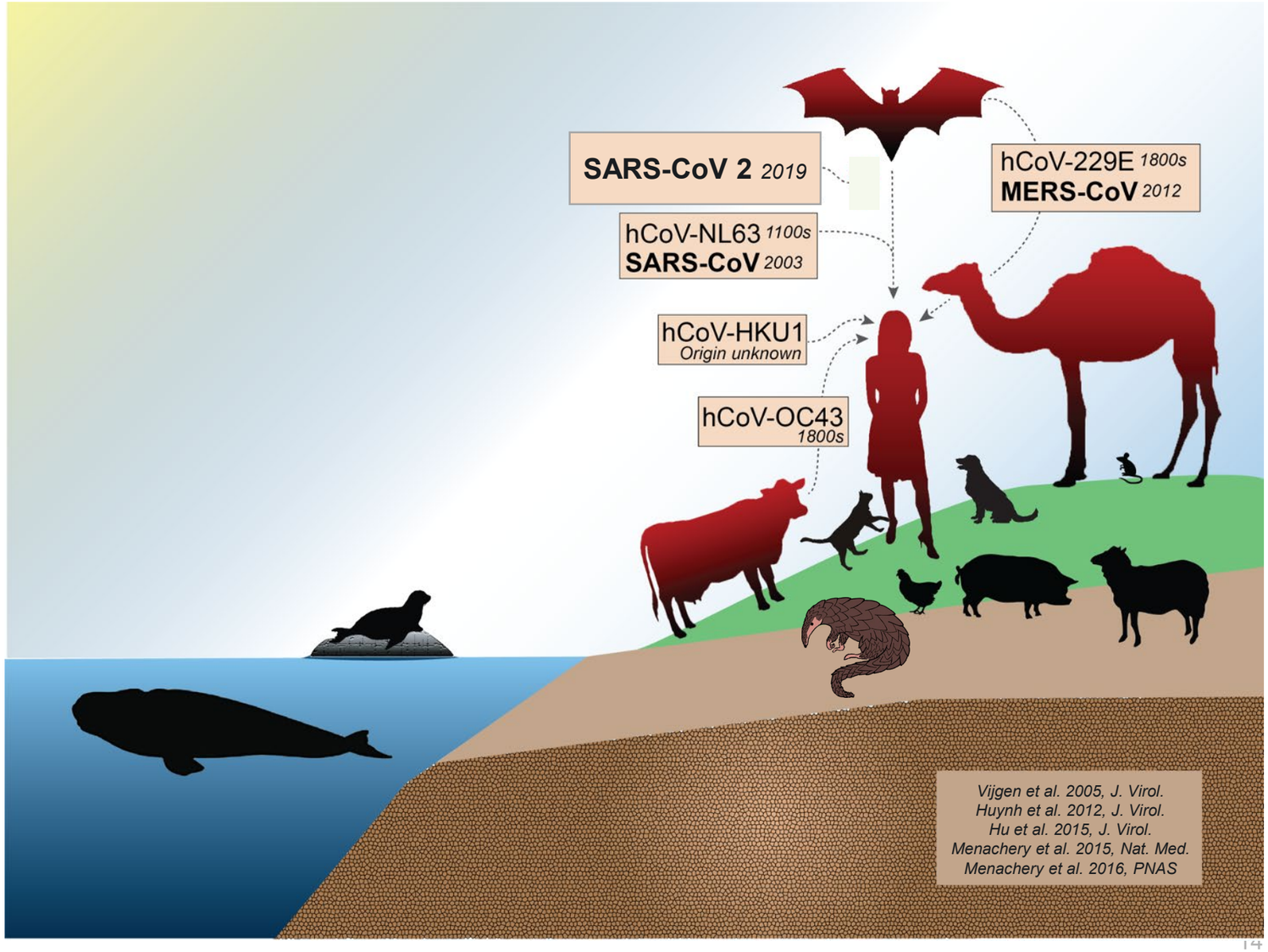
Coronavirus has emergence potential

- Coronaviruses infect a wide range of animal species
- Animal-to-human coronavirus transmission has been occurring for thousands of years
- As humans and animal habitats overlap, transmission events become more likely



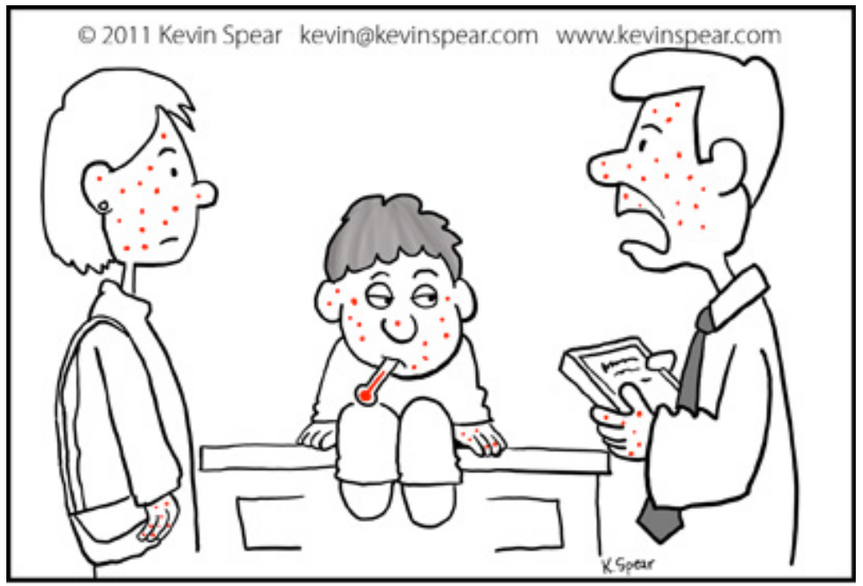
Slide design by Timothy Sheahan, Ph.D.

Do bats infected with coronaviruses get sick?

- Bats infected with coronaviruses do not have any symptoms of disease
- Current studies suggest that bats have reduced immune responses, making them an ideal animal reservoir for many viruses
- Bats are a critical part of the ecosystem

What do we still have to learn?

- How animal host to human transmission events occur and why some require additional animal species
- How to prevent transmission events from animal hosts to humans
- How to encourage public health measures to prevent future outbreaks



"Well whatever he has, it's contagious."

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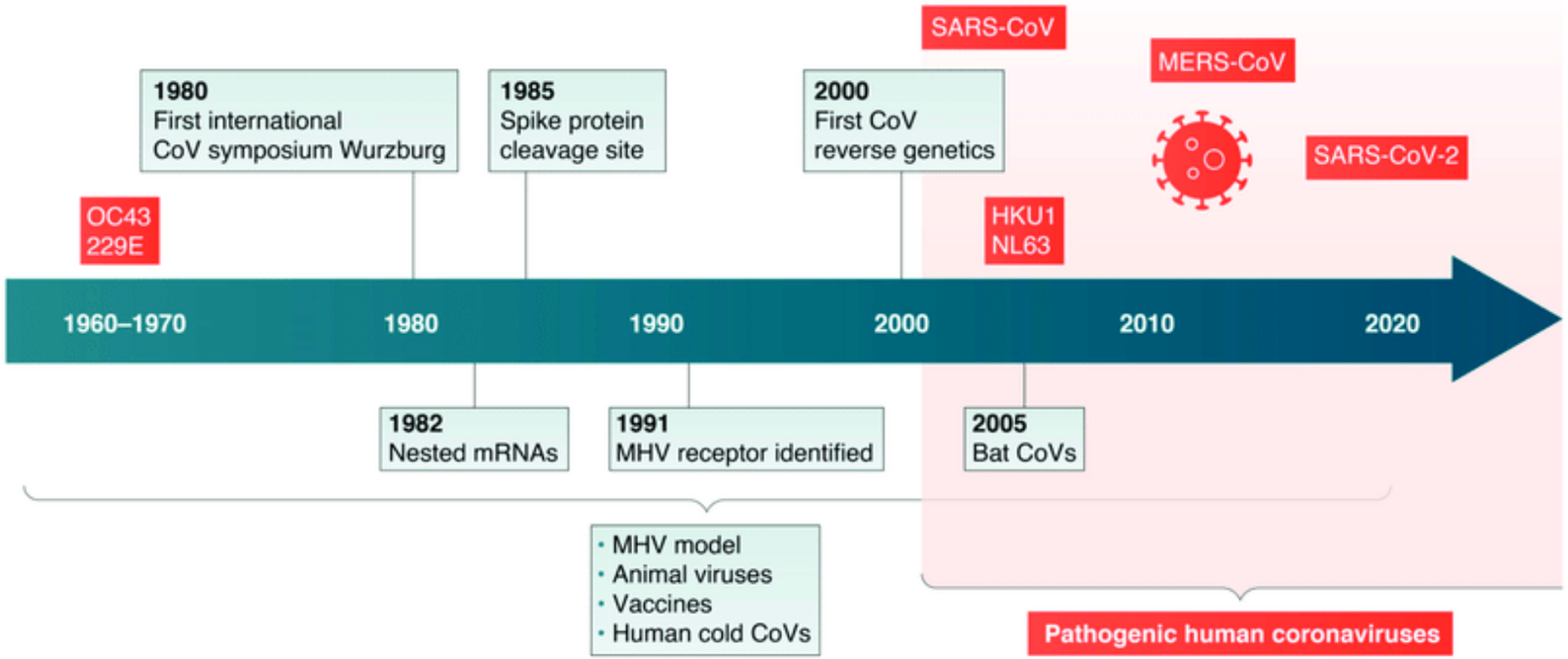
Timeline of human coronavirus identification

- Before 2003, human CoV caused the common cold in healthy individuals
- Only seven human CoV have been identified to date
- SARS-CoV “1”
  - ~8,000 cases, ~800 deaths
  - ~10% mortality
  - No longer circulating (epidemic 8 months)
- MERS-CoV
  - ~2,500 cases, ~850 deaths
  - ~34% mortality
  - 2013 to present



DOI: 10.5281/zenodo.3746871

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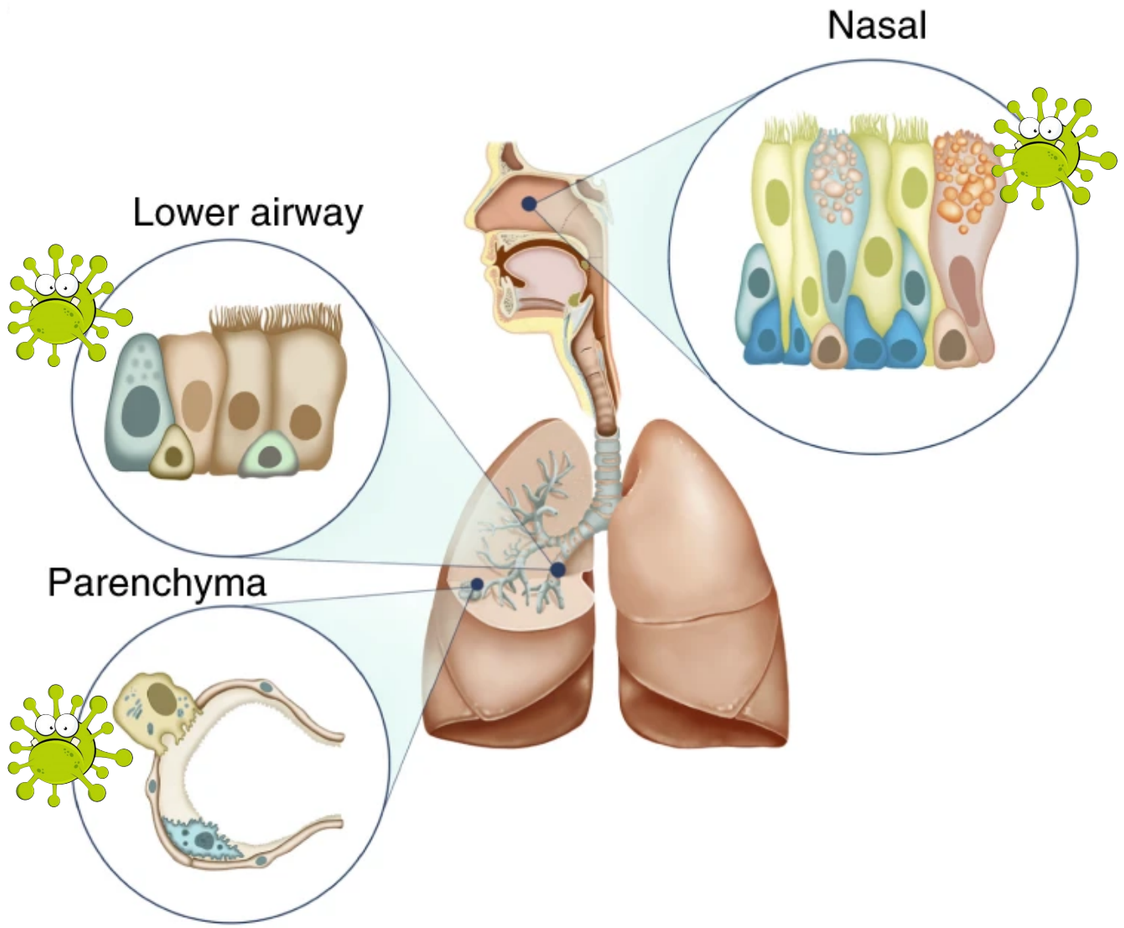
SARS-CoV 2 infects many areas in respiratory tract

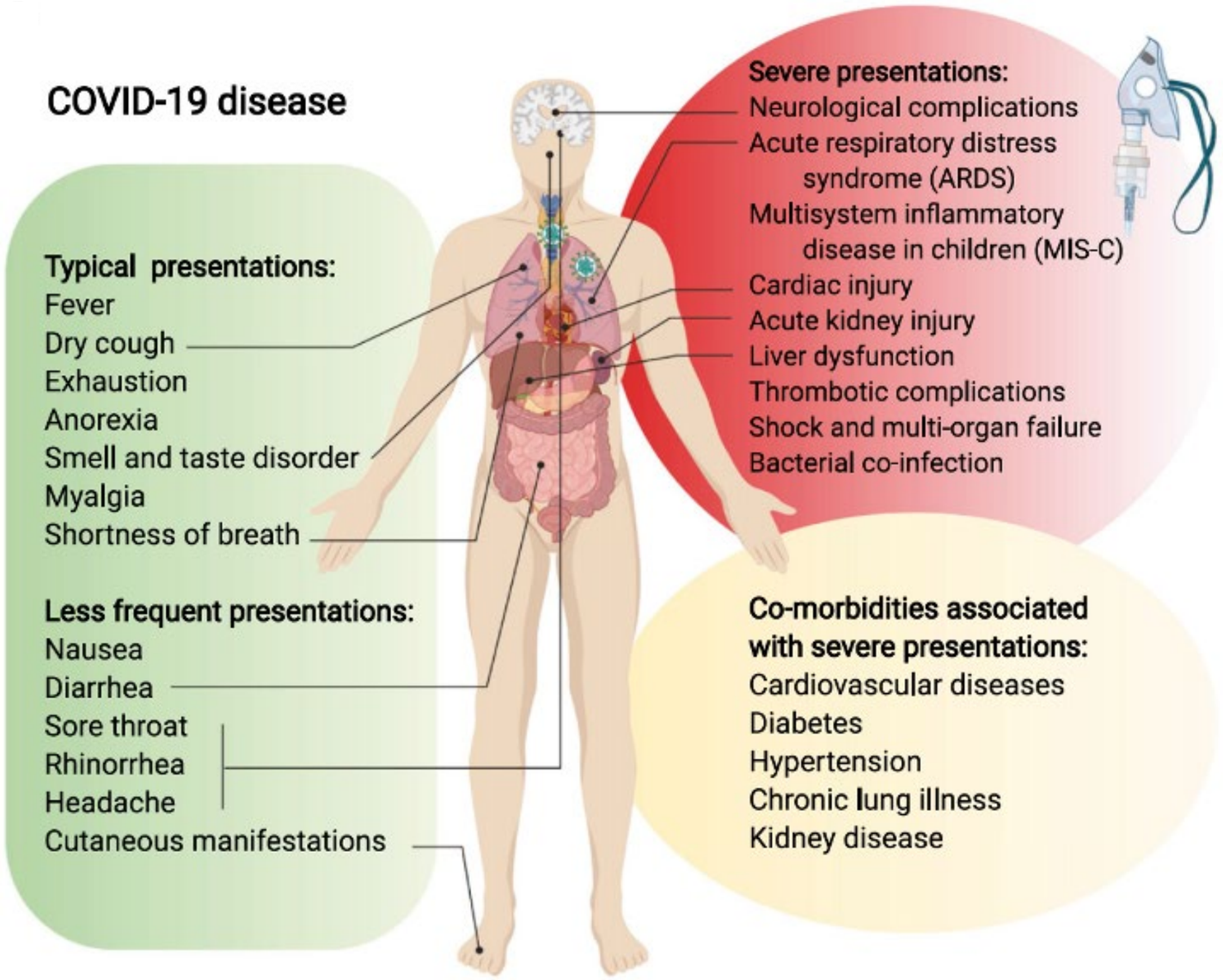
- MERS-CoV and SARS-CoV 1 replicate primarily deep within the human lung
- SARS-CoV 2 replicates in several regions of the respiratory tract, not just deep within the lung
- Facilitates transmission but also diagnostic testing



www.nature.com/articles/s41591-020-0868-6/figures/1

COVID-19 infection symptoms and disease severity

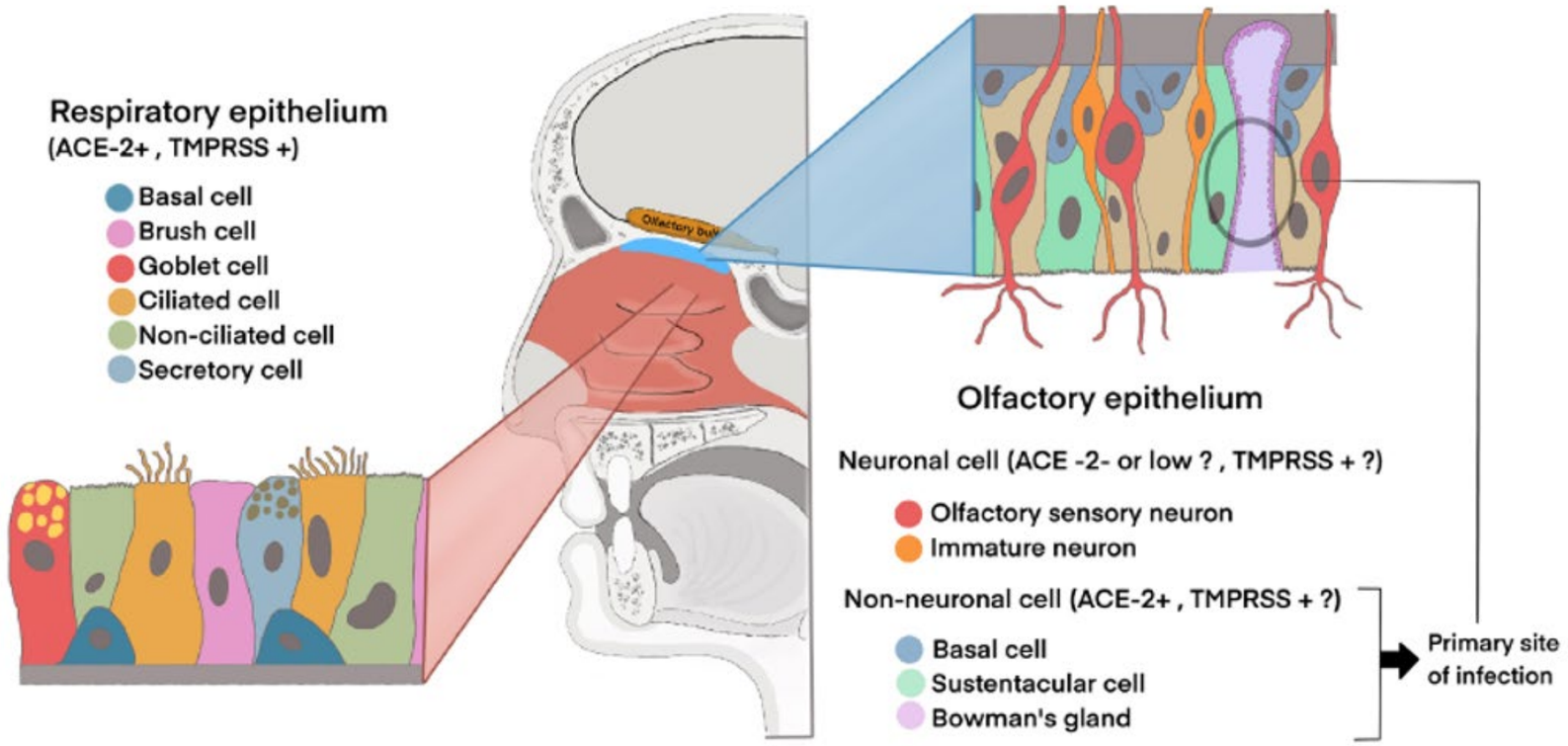
- Flu-like symptoms with loss of smell/taste most common
- Possible to have nausea, diarrhea, and skin rash
- Severe disease progression includes acute respiratory distress syndrome (ARDS), neurological complications, kidney injury, shock, multi-organ failure



www.jimmunol.org/cgi/doi/10.4049/jimmunol.2000526

SARS-CoV 2 and loss of sense of smell/taste

- Infection with a range of other respiratory viruses that replicate in the upper airways/nasal cavity can result in loss of smell and taste but usually with less frequency than is being seen with COVID-19
- Unclear if this is a result of inflammation of the nasal cavity or infection of olfactory sensory neurons as proposed above



What do we still have to learn?

- Adults with pre-existing medical conditions and why they result in more severe disease outcomes
- Multisystem Inflammatory Syndrome in Children (MIS-C)
- Why are the elderly more likely to have severe disease outcomes?
- Does blood type influence disease outcomes?

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How do viruses mutate?

- Viral enzymes make mistakes each time the genome is copied, resulting in large mutant populations
- Animal hosts/reservoirs where the virus can replicate without an effective immune response allow for a larger mutant population
- Mutations can be beneficial or harmful to the virus

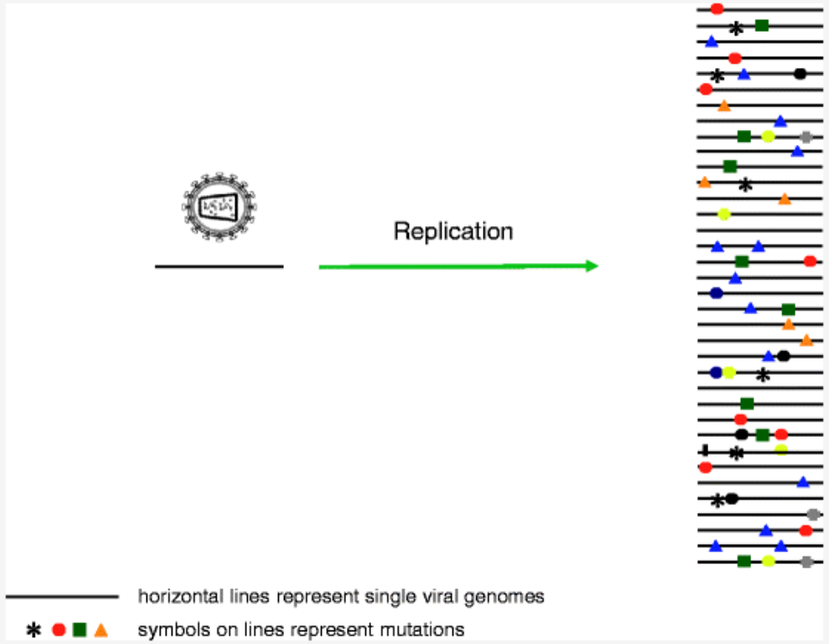
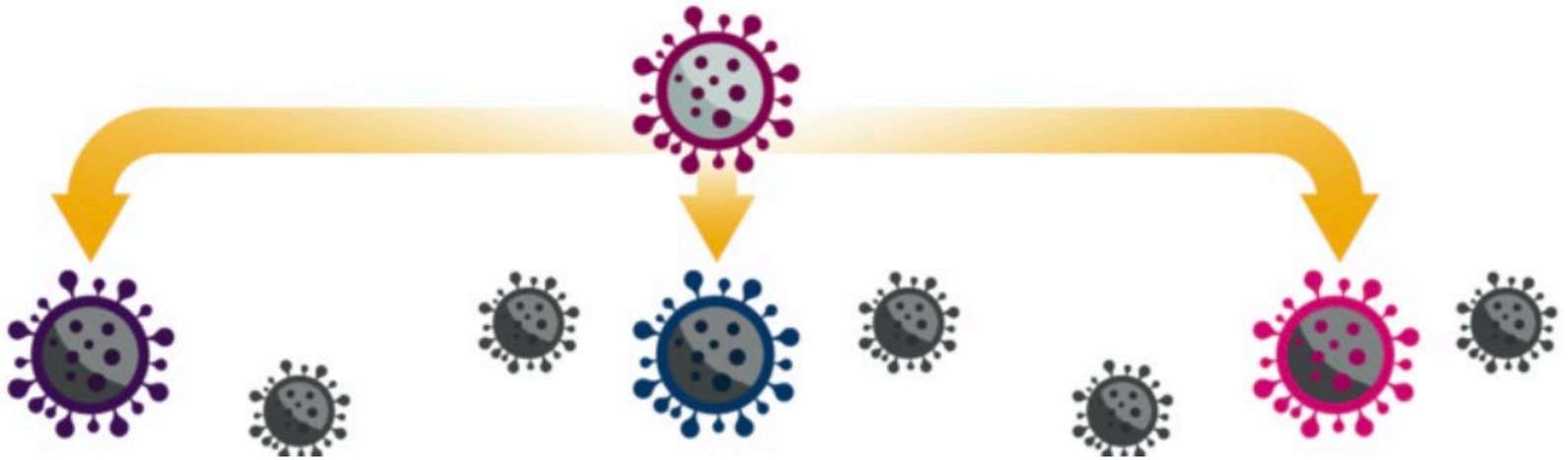


Fig. 1
Schematic representation of a viral quasispecies. Viral genomes are represented as horizontal lines, and mutations as symbols in the lines. Upon infection with an RNA virus—even with a single particle, as depicted here—viral replication leads to a mutant spectrum of related genomes, termed quasispecies

https://link.springer.com/chapter/10.1007/978-94-007-4899-6_2

Why is SARS-CoV 2 changing over time?

- Viruses require hosts to replicate
- Because viruses make mistakes each time they replicate, they can adapt to new hosts rapidly
- Viruses that can infect people faster have a distinct advantage
- Scientists are learning more about the virus as mutants are identified



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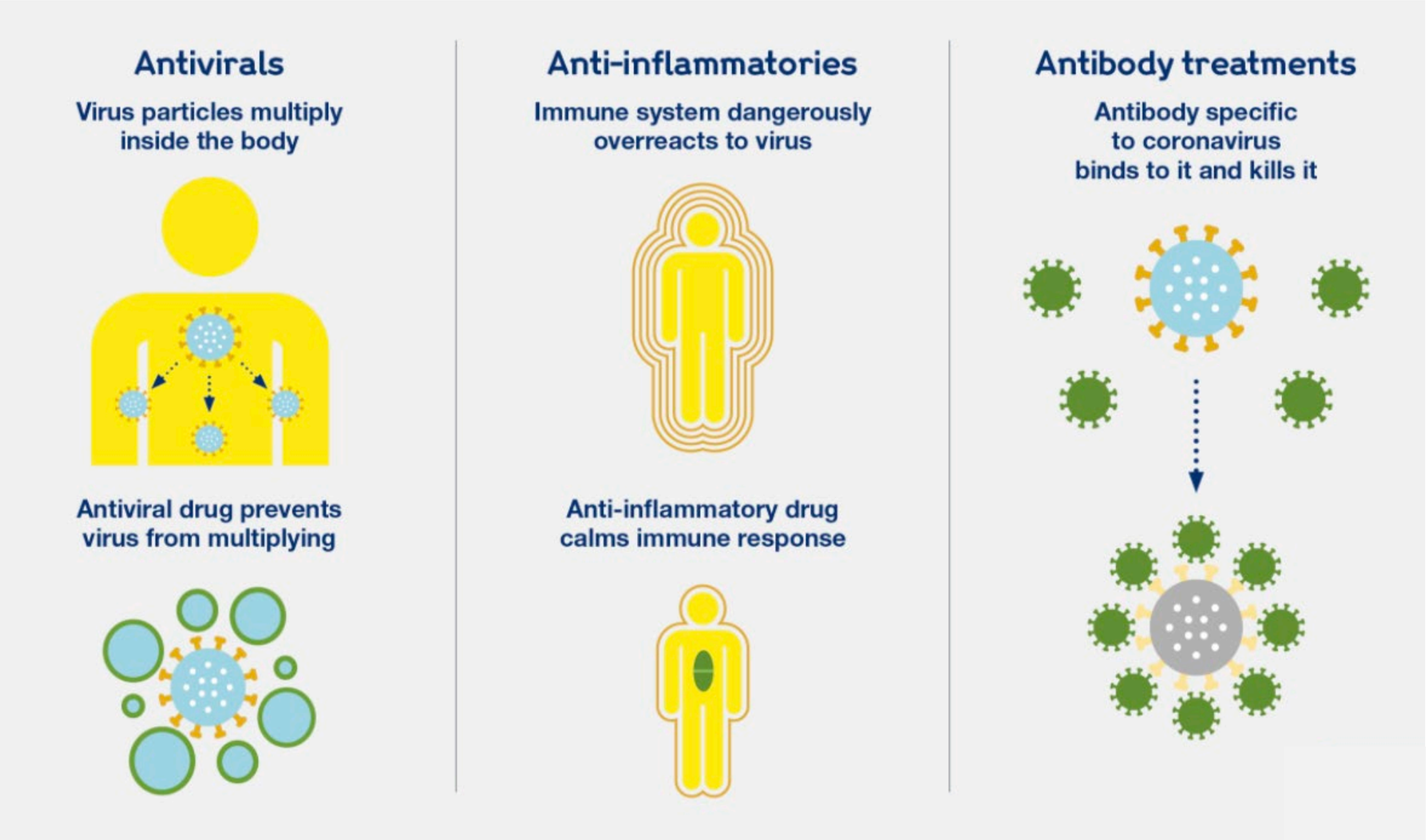
Types of CoV treatment options



https://wellcome.org/news/what-drugs-are-working-treatments-covid-19

Phases of clinical trials for treatment options

Phase 1
20-100 Healthy Volunteers

Researchers try to answer these questions:

- Is this vaccine safe?
- Are there any serious side effects?
- How does the vaccine dose relate to any side effects?
- Is the vaccine causing an immune response?

Phase 2
Several Hundred Volunteers

Researchers try to answer these questions:

- What are the most common short-term side effects?
- What's the body's immune response?
- Are there signs that the vaccine is protective?

Phase 3
1000+ Volunteers

Researchers try to answer these questions:

- How do disease rates compare between people who get the vaccine and those who do not?
- How well can the vaccine protect people from disease?

Phase 4
Vaccine is Approved

Researchers try to answer these questions:

- FDA approves a vaccine only if it's safe, effective, and benefits outweigh the risks.
- Researchers continue to collect data on the vaccine's long-term benefits and side effects.

FDA Emergency Use Authorization

Adapted from Building Vaccine Confidence in Health Systems and Clinics developed by CDC COVID-19 response vaccine task force

Source: https://covid19community.nih.gov/resources/understanding-clinical-trials

What are the current treatment options?

Treatment Option	Type of Treatment Option	Currently Approved in U.S.	Currently Approved for EUA
A	Antiviral	**YES**	
B	Antibody (patient) treatment		**YES**
C	Antibody (synthetic) treatment		**YES**
D	Antiviral + anti-inflammatory		**YES**
E	Antibody treatment		**YES**

EUA = emergency use authorization

https://www.raps.org/news-and-articles/news-articles/2020/3/covid-19-therapeutics-tracker

When will more treatment options be available?

Type of Treatment	Numbers under Investigation	Phase in Clinical Trials
Antivirals	4	2 or 3
Anti-inflammatory	16	2 or 3
Antibody treatments	12	2 or 3

These are the most up-to-date numbers for January and February 2021.

https://www.raps.org/news-and-articles/news-articles/2020/3/covid-19-therapeutics-tracker

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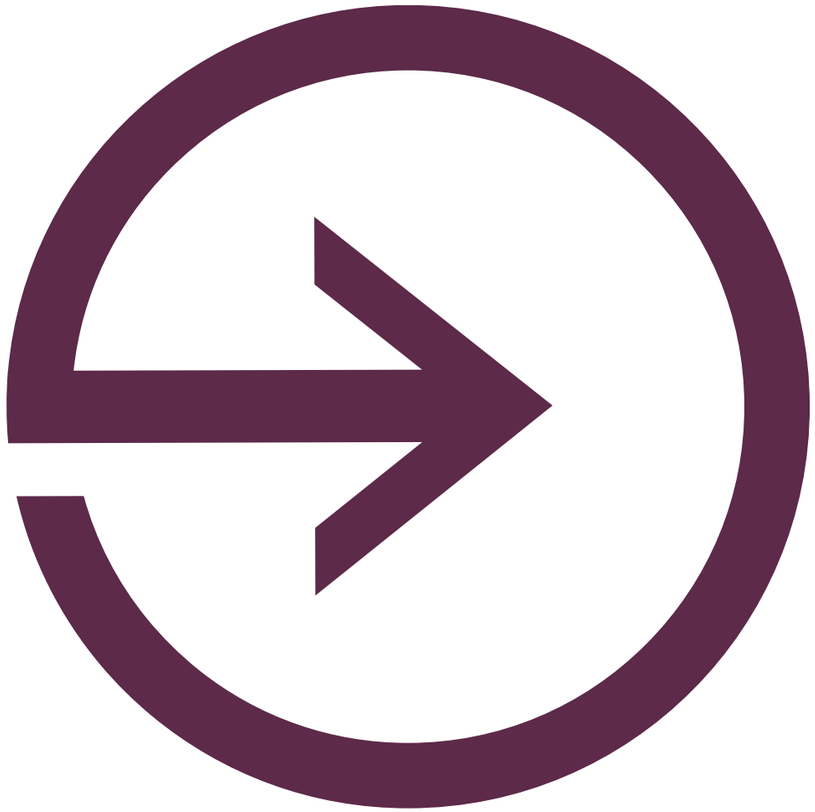
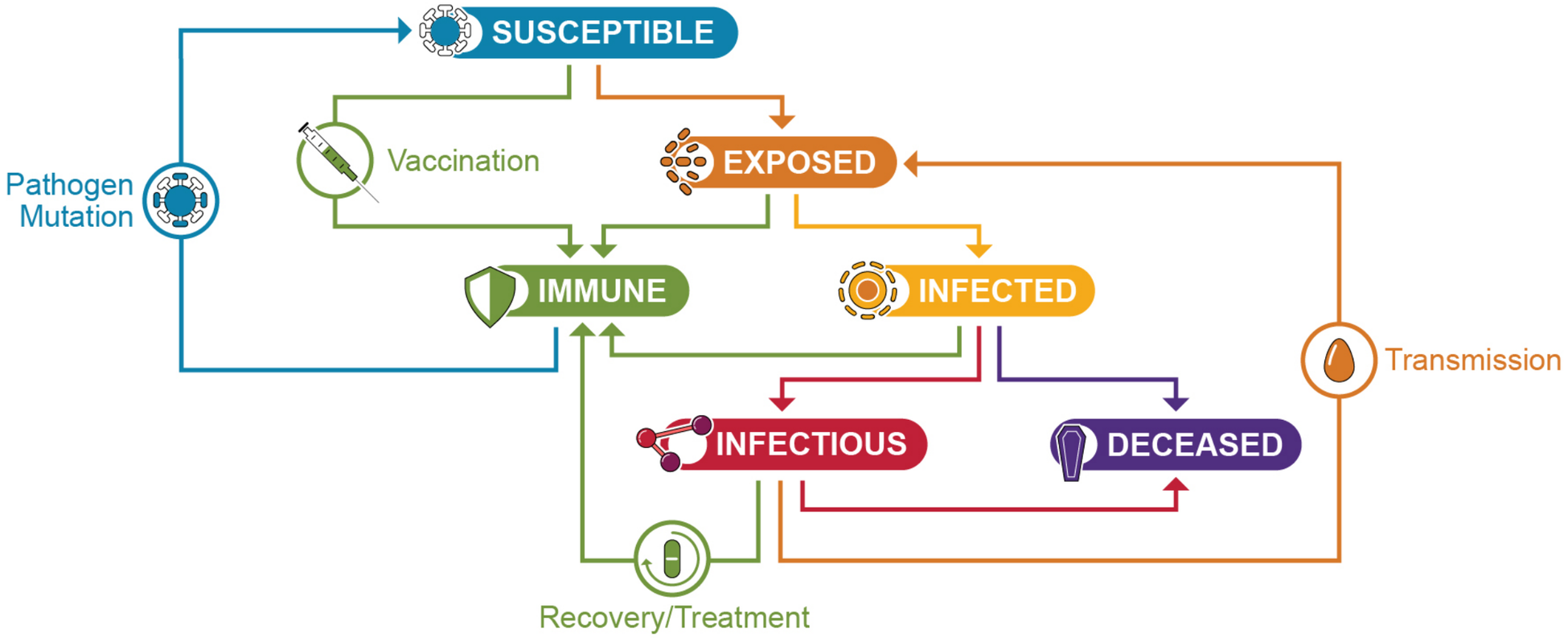
What happens next? Preparing for the future

- Scientists and medical professionals continue to learn about the virus and ways to treat patients and prevent infections
- Things everyone can continue to do in the short term:
  - Social distancing
  - Wearing masks effectively in public
  - Wash hands often
- Things everyone can do in the long term
  - Wear a mask and remain away from others if you are sick



Next week: we will discuss exposure and infection



UPCOMING EVENTS

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

16 MAR

Behind the Mask: The Science on Stopping the Spread

Katrina Waters
Lab Fellow
Biological Sciences
Division Director

23 MAR

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

Kristin Omberg
Group Leader
Chemical and Biological Signatures

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SUBMIT YOUR QUESTIONS VIA THE DISCUSSION CHAT

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Thank you

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