



**Brigham and Women's Hospital**

Founding Member, Mass General Brigham

# **The Next Pandemic: Are We Prepared?**

**Intensive Review of Internal Medicine**

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Medical Director of Infection Control

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Brigham and Women's Hospital

Professor of Medicine and Population Medicine

Harvard Medical School





## **Michael Klompas MD, MPH**

Medical Director of Infection Control, Brigham and Women's Hospital  
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# Disclosures

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- **Grant funding**

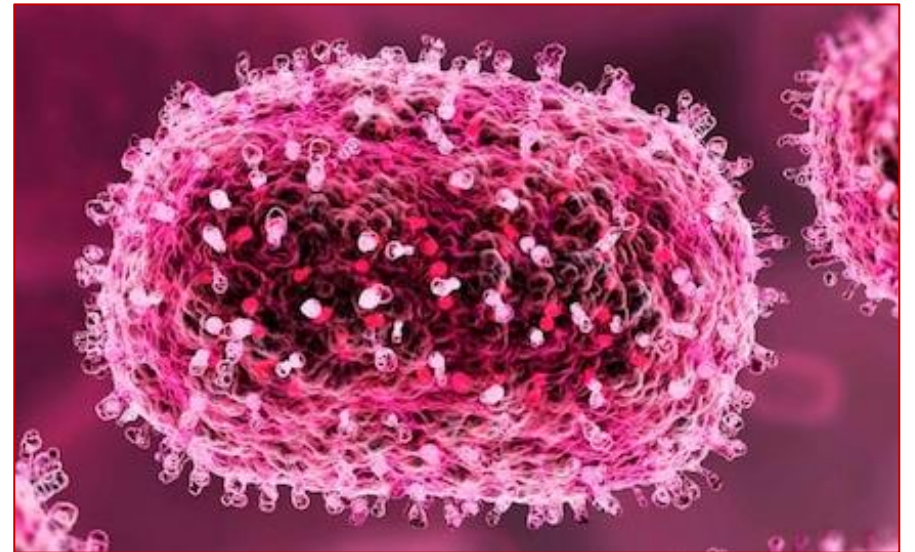
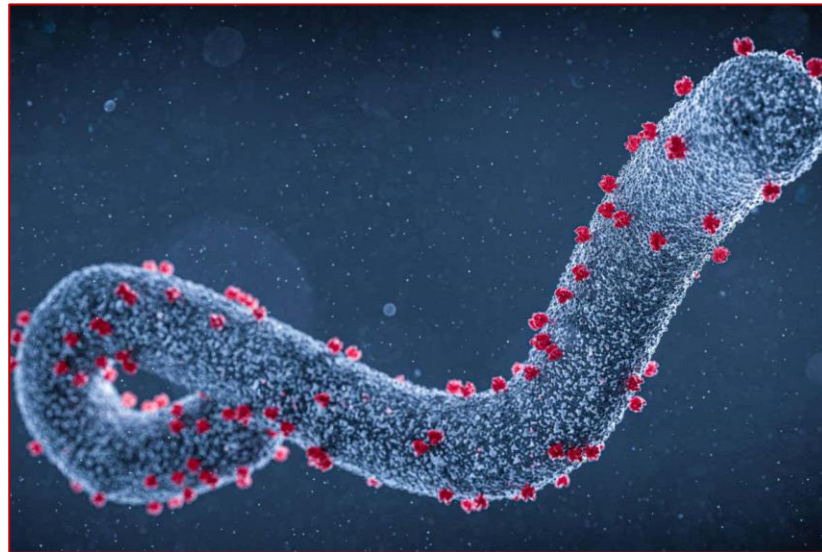
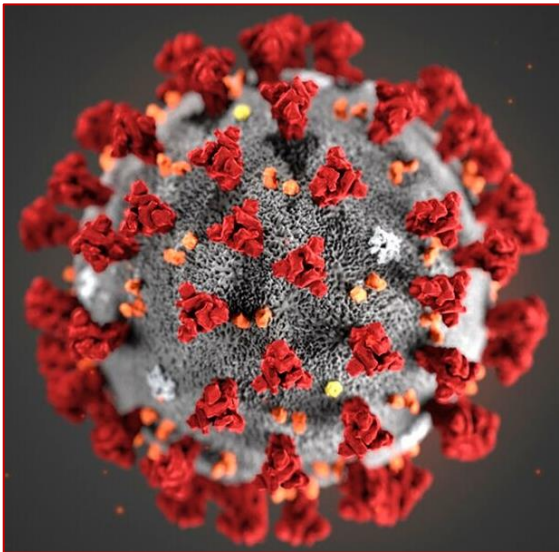
- Centers for Disease Control and Prevention
- Massachusetts Department of Public Health
- Agency for Healthcare Research and Quality

- **Royalties**

- UpToDate Inc.
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# The Players





# SARS-CoV-2



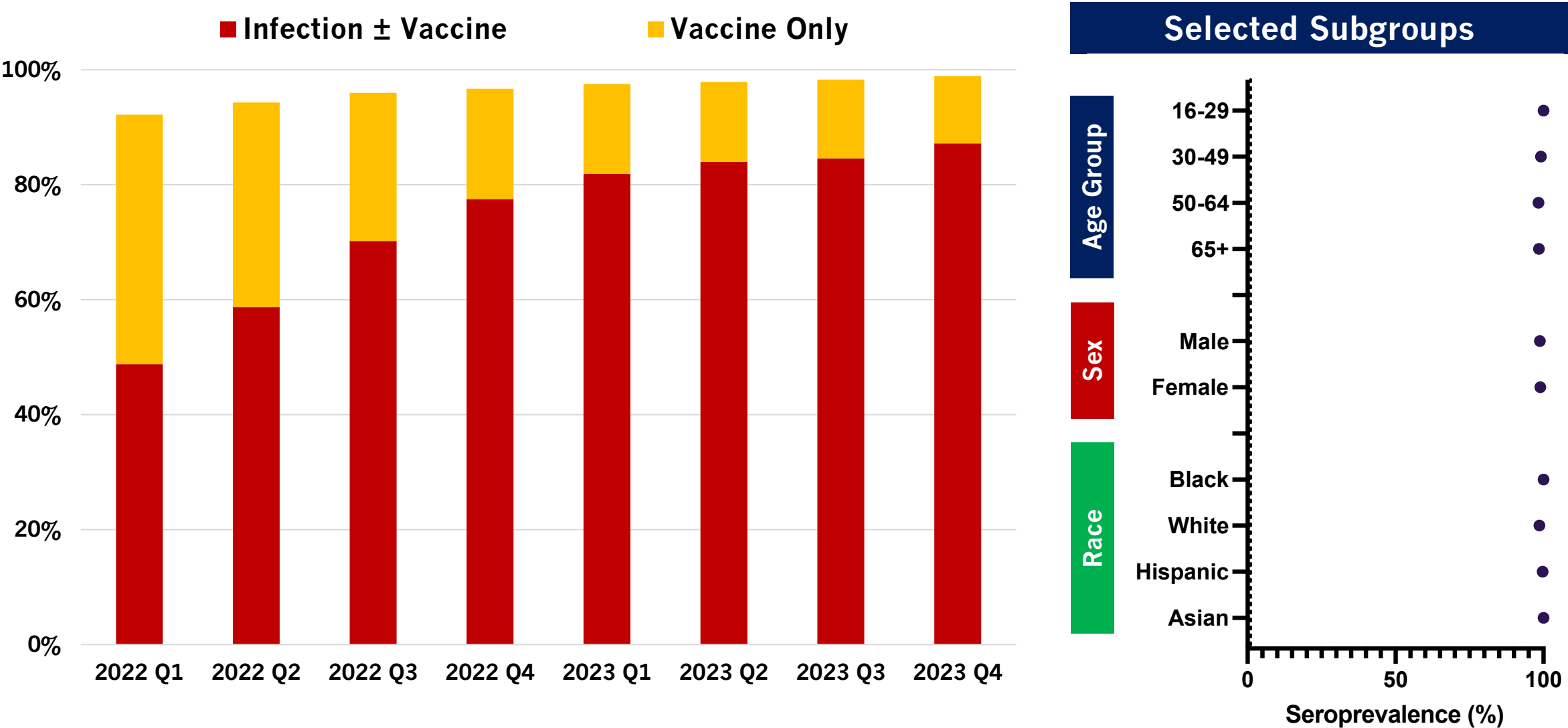




**1.2 million US deaths**

[witf.org/2021/10/30/covid-19-memorial-creators-reflect-as-world-nears-5m-deaths/](https://witf.org/2021/10/30/covid-19-memorial-creators-reflect-as-world-nears-5m-deaths/)

# SARS-CoV-2 Immunity in the US



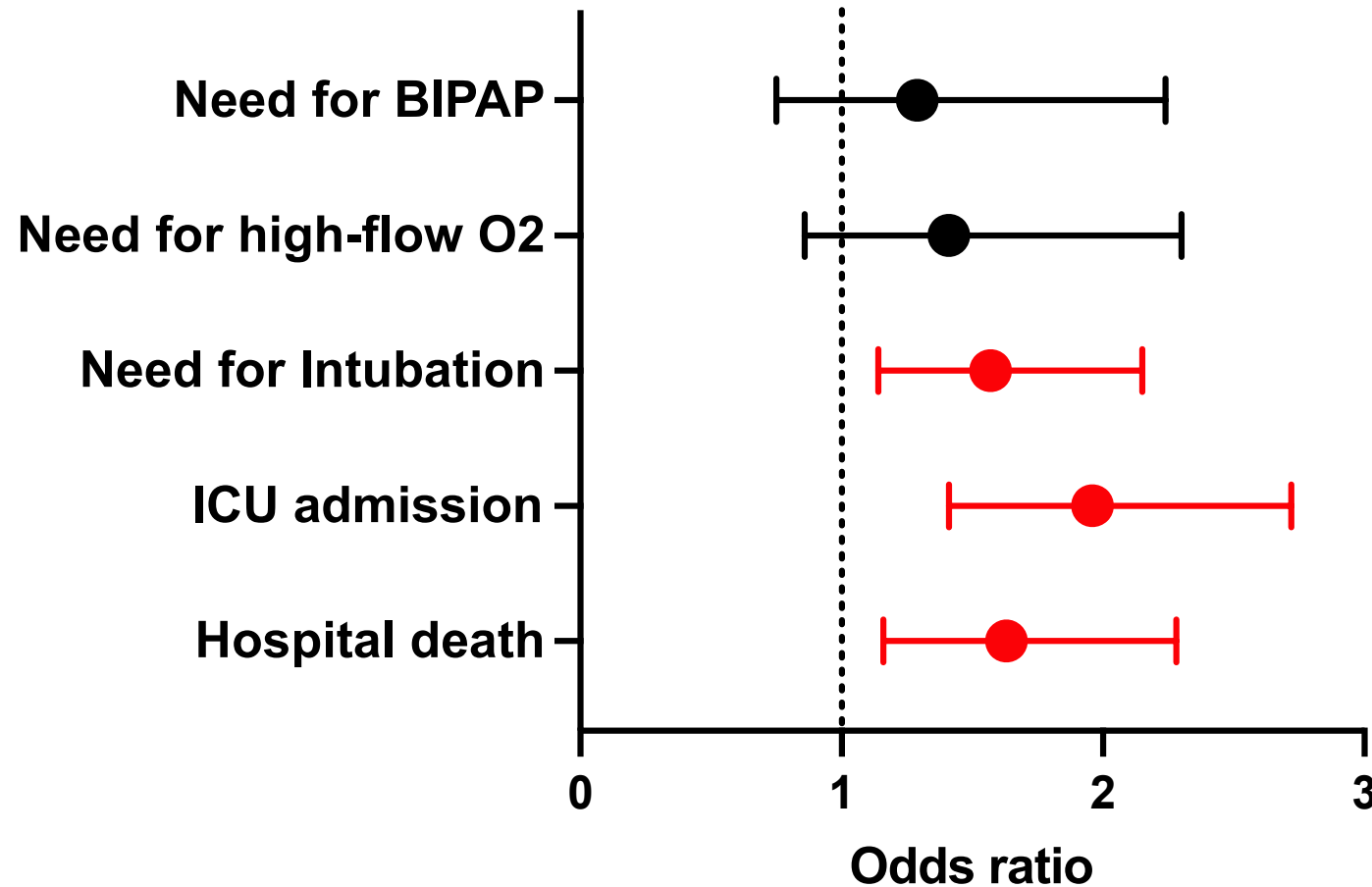






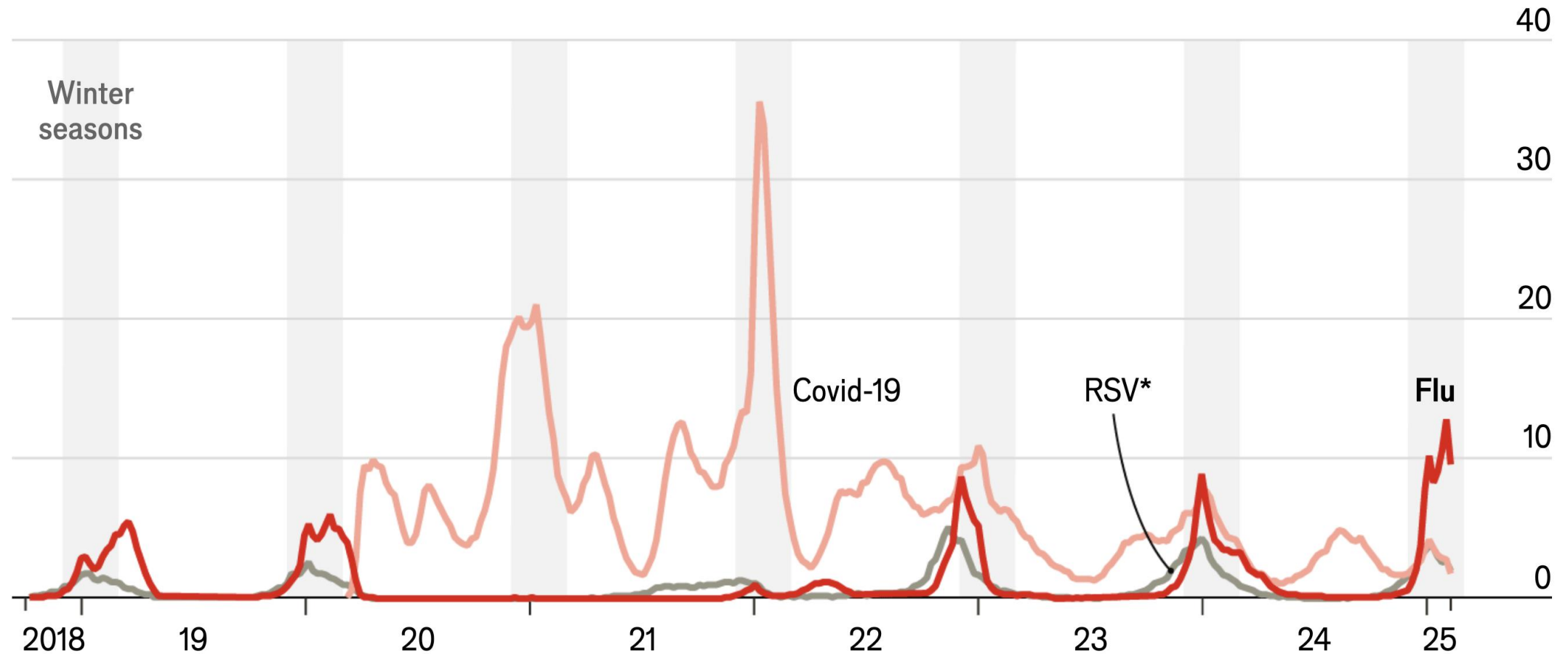
# Morbidity and Mortality of Nosocomial **Omicron**

865 hospital-onset SARS-CoV-2 Omicron infections propensity-matched to 1,730 control patients, 5 hospitals, MA



# Covid vs Flu vs RSV Hospitalizations

United States, weekly hospitalisations per 100,000 people



Source: Centres for Disease Control and Prevention

\*Respiratory syncytial virus



# Avian Influenza



# Avian Influenza in the USA 2024-?

- Endemic in wild birds worldwide
- Spread to US domestic poultry (>175 million birds affected thus far)
- Increasingly widespread in cattle (1,074 cases in 17 states thus far)
- Sporadic detections in >20 other mammal species
- 70 human cases in the US thus far
  - Almost all **MILD**; 1 death
- No human-to-human spread



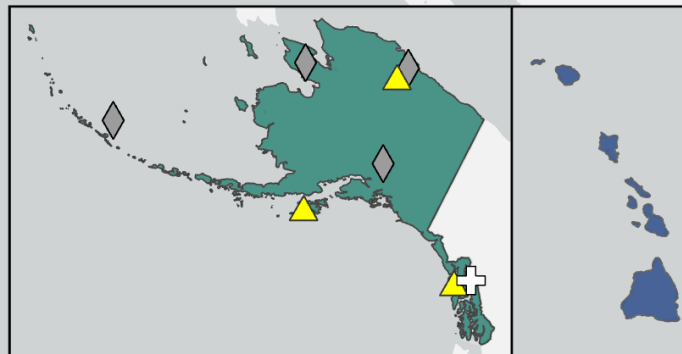




# Detections of HPAI in Wild and Captive Wild Mammals, May 2022 to Present

Points are approximations based on the county of detection and may represent multiple detections.

National Wildlife Disease Program  
USDA/APHIS/Wildlife Services  
Updated July 1, 2025



## Flyway

- Pacific
- West Pacific
- Central
- Mississippi
- Atlantic

## Species

- Bear
- Captive wild cat<sup>1</sup>
- Domestic cat<sup>2</sup>
- Lagomorph
- Marine mammal
- Mustelid
- Raccoon
- Rodent
- Skunk
- Virginia opossum
- Wild canine
- Wild cat

0 800 Miles

\*See website table notes for footnote descriptions



# Ebola





A close-up photograph of two bats hanging upside down from a tree branch. The bat in the foreground is in sharp focus, showing its brown fur, large dark eyes, and black wings. The second bat is visible in the background, slightly out of focus. The background consists of green foliage and a bright sky.

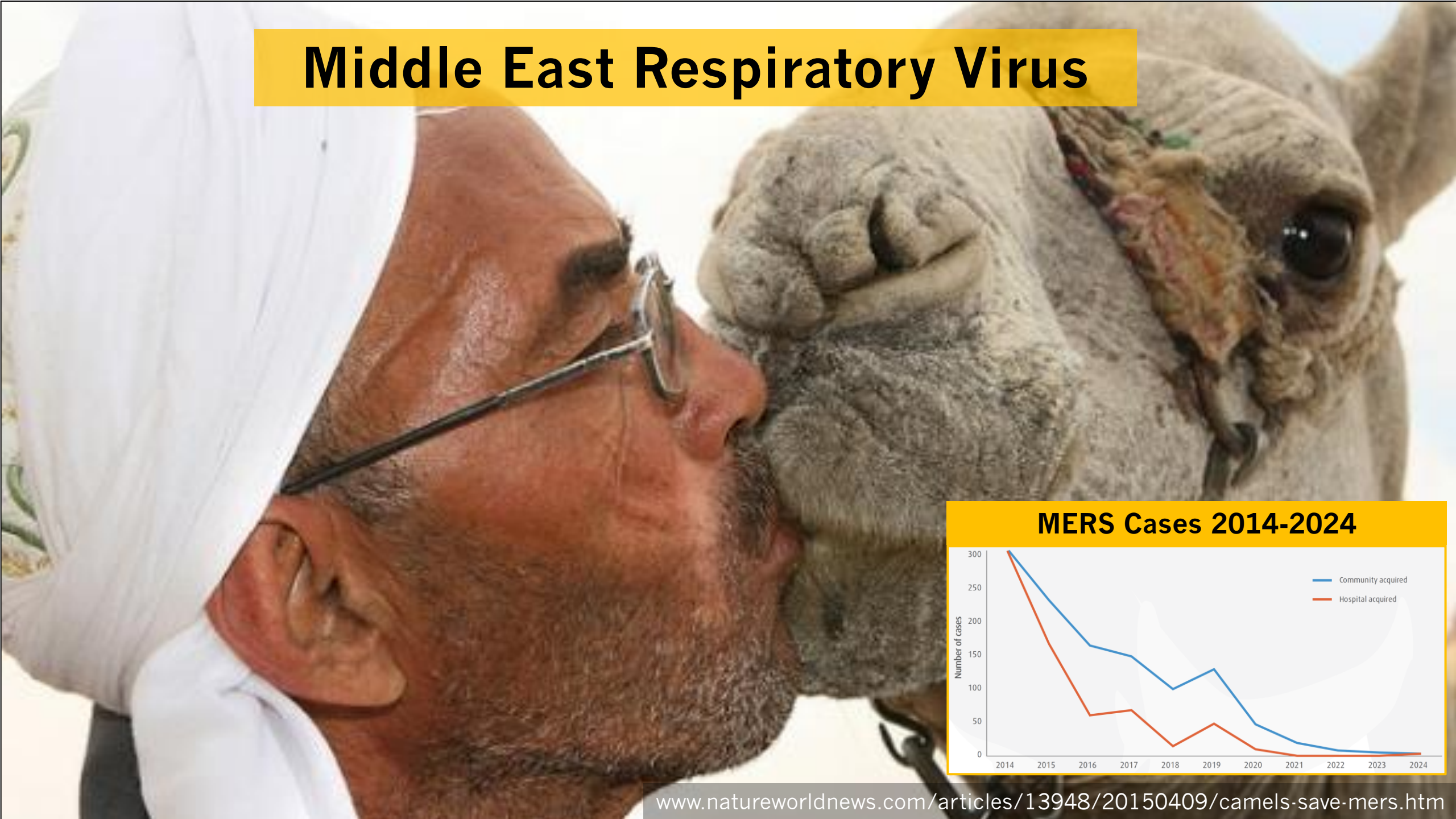
# Marburg

## **Viral hemorrhagic fever similar to Ebola**

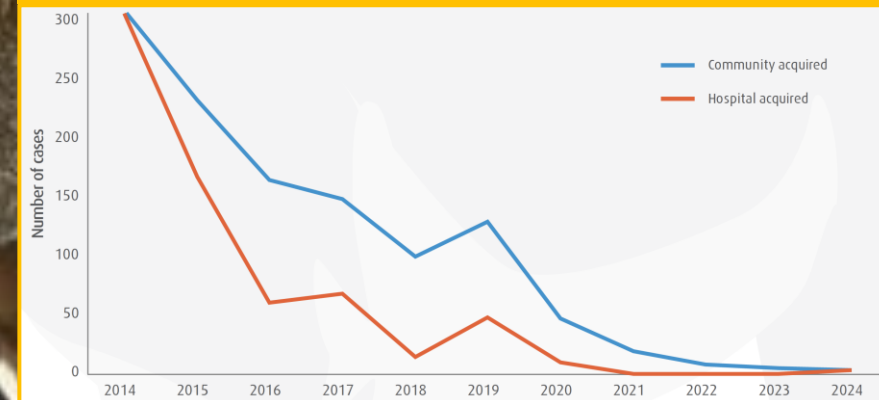
- Recent outbreaks Rwanda and Tanzania
- Rwanda (2024): 66 cases, 15 deaths
- Tanzania (2025): 114 cases, 10 deaths



# Middle East Respiratory Virus



## MERS Cases 2014-2024

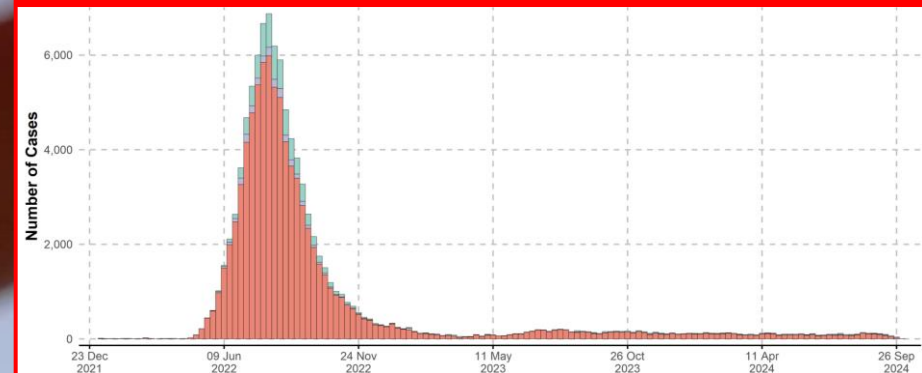




# Mpox



## USA Mpox Case Counts, 2022-2024





MEASLES  
TESTING





# US Measles Cases **since Jan 2025**

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[nbcnews.com/health/health-news/measles-outbreak-texas-vaccines-kids-cases-what-know-rcna194216](https://www.nbcnews.com/health/health-news/measles-outbreak-texas-vaccines-kids-cases-what-know-rcna194216)

- 1,319 cases in 40 states
- 13% hospitalized
- 3 deaths
- 92% unvaccinated
  - 4% one dose MMR
  - 4% two doses MMR





# Countries with MERS Cases



# MERS Outbreak in South Korea

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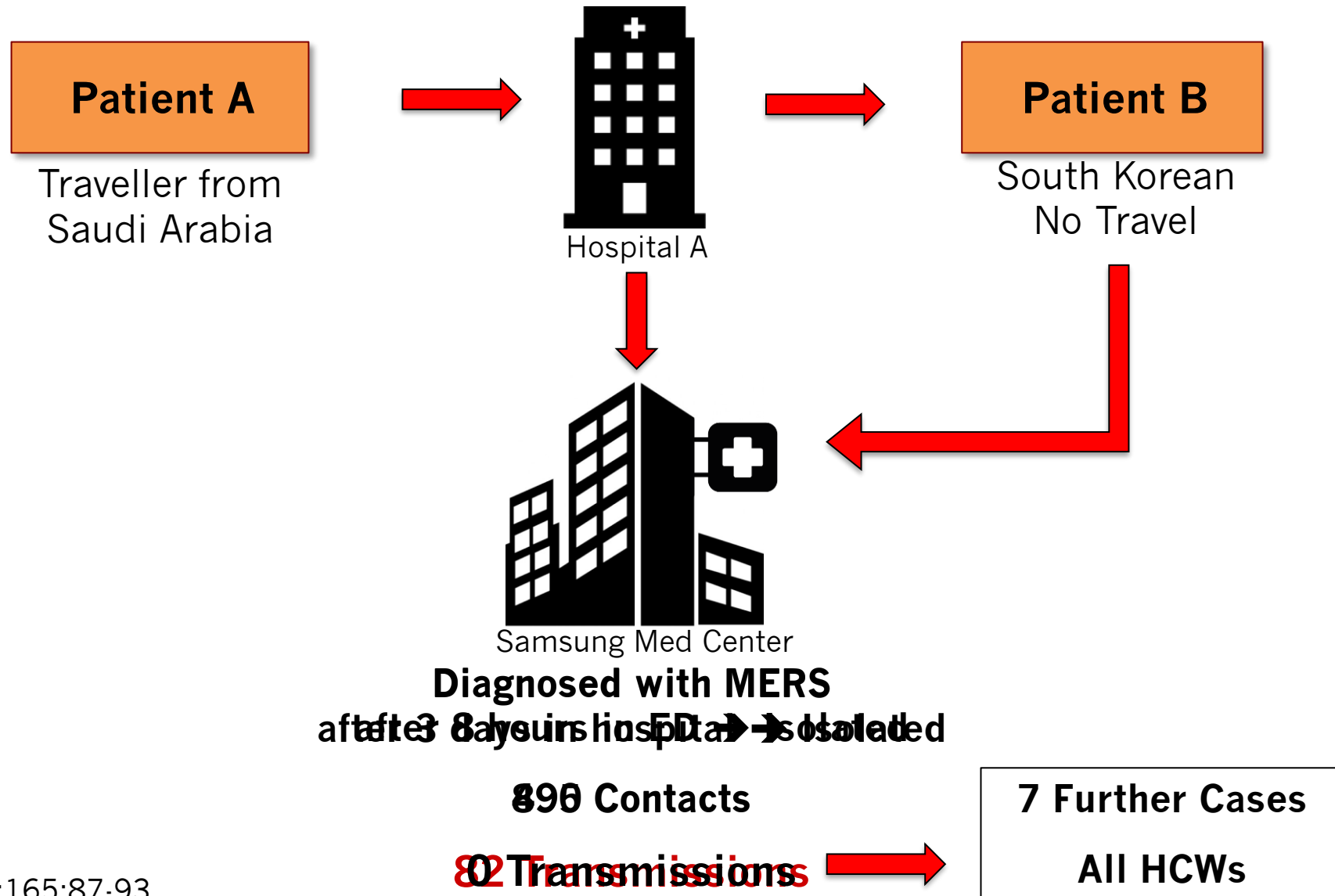
**186 cases**  
**38 deaths**

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# Samsung Medical Center

1950 bed Tertiary Care Center: 92 MERS Cases



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# The Good



<http://www.film.com/wp-content/uploads/2013/09/THE-GOOD-THE-BAD-BILLY-PERKINS.jpg>

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**We better understand transmission**

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A man with a beard and glasses is shown in profile, coughing. A dense spray of white droplets is visible coming from his mouth against a black background.

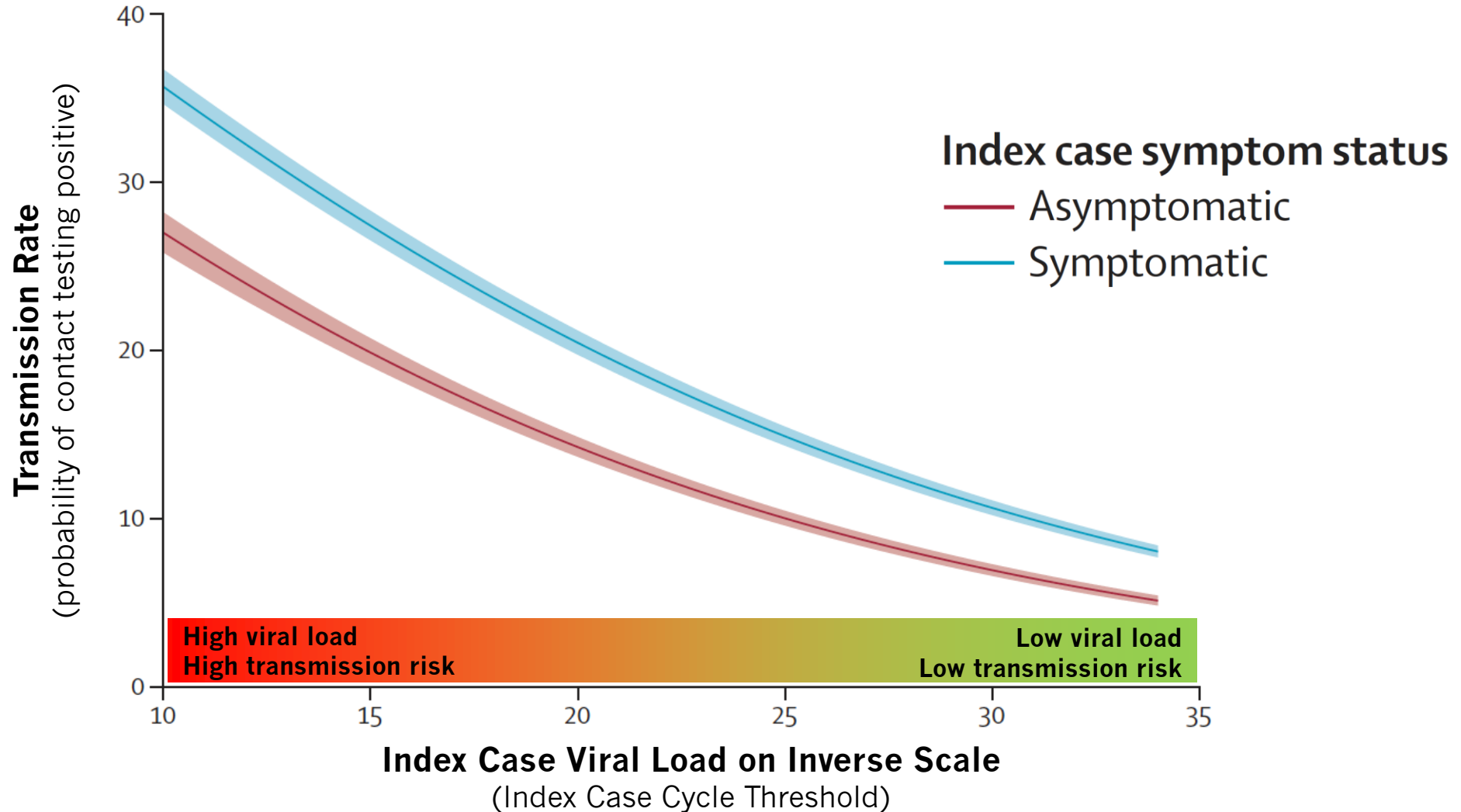
**Aerosols can carry any  
respiratory virus, not just  
SARS-CoV-2**

**Influenza  
RSV  
Rhinovirus  
SARS-CoV-1  
MERS...**



# Viral Load Predicts Transmission Risk

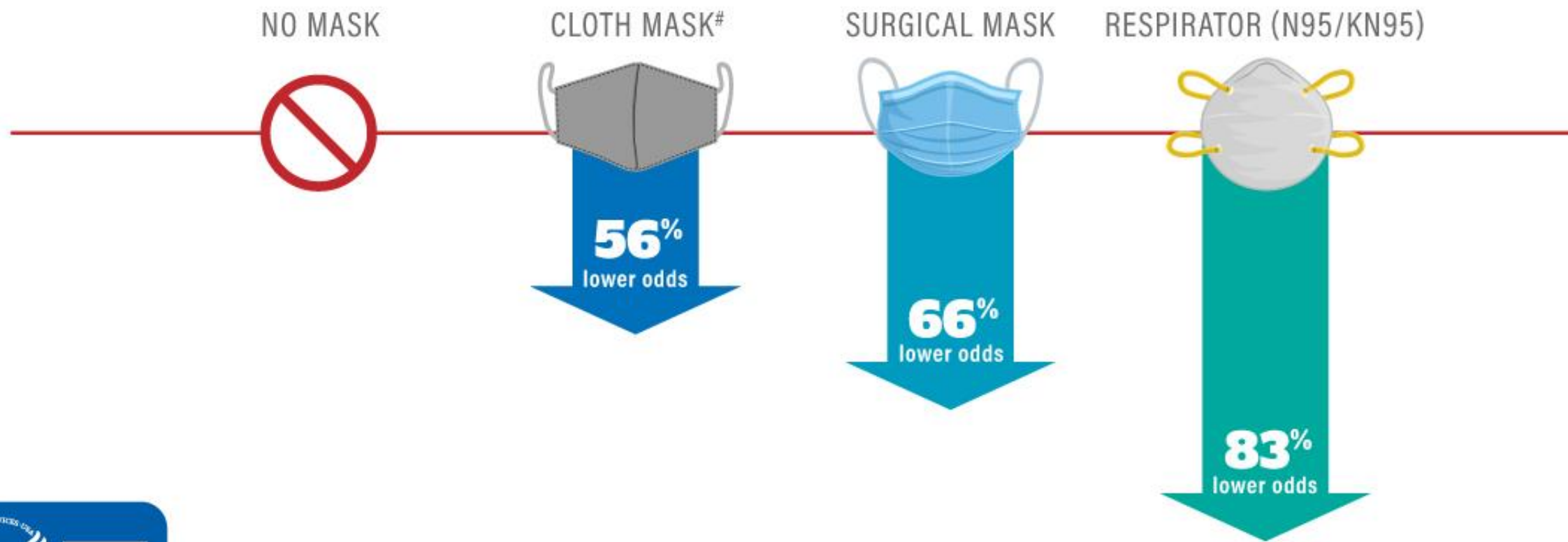
*Secondary attack rates amongst 1,173,643 contacts of 6,263,786 index cases, UK, Jan 2021-Jan 2022*



People who reported always wearing a mask in indoor public settings were less likely to test positive for COVID-19 than people who didn't\*

## WEARING A MASK LOWERED THE ODDS OF TESTING POSITIVE

Among 534 participants reporting mask type<sup>†</sup>



[bit.ly/MMWR7106](https://bit.ly/MMWR7106)

\* Matched case-control study, 1,828 people, Feb 10–Dec 1, 2021

<sup>†</sup> Compared people with similar characteristics (e.g., vaccination)

<sup>#</sup> Not statistically significant

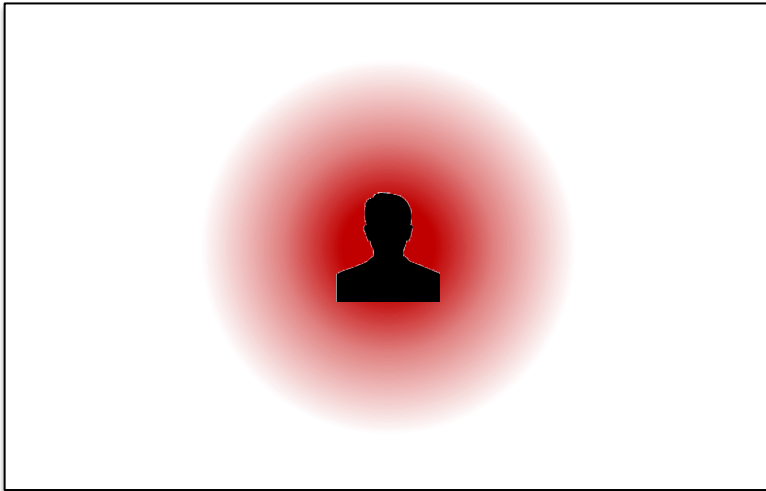
**MMWR**



# Impact of Ventilation on Viral Exposure

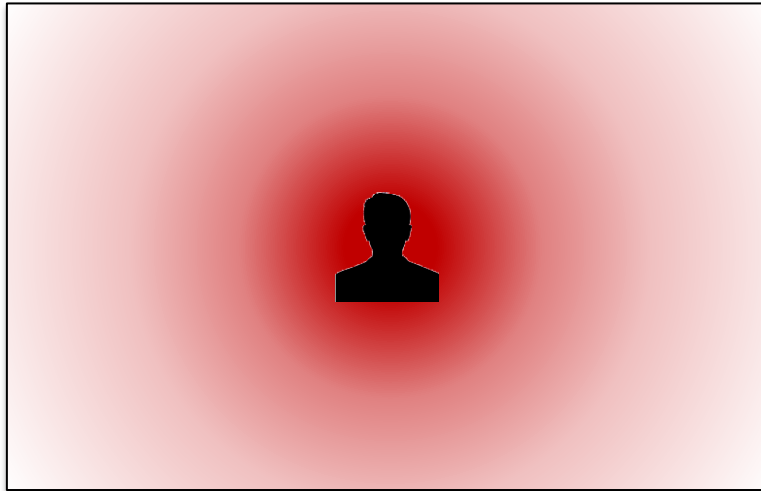
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**Well ventilated  
outdoor area**



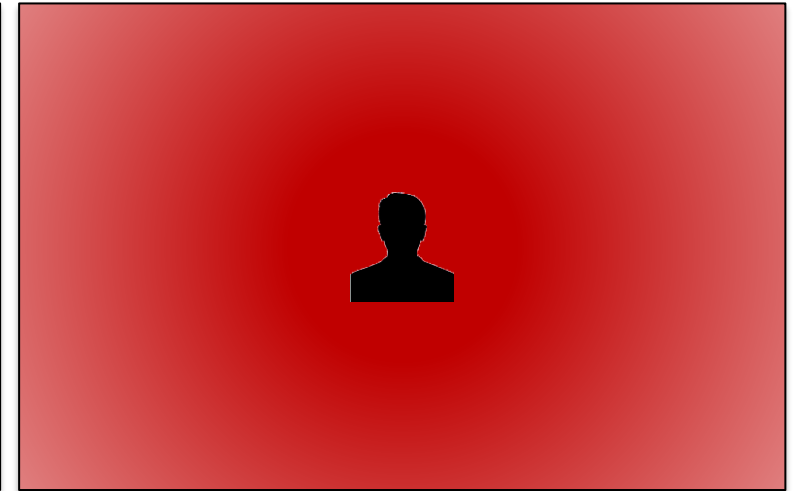
*Dense viral plume at source,  
rapidly dilutes with distance*

**Moderately ventilated  
indoor area**



*Dense viral plume at source,  
gradual dilution with distance*

**Poorly ventilated  
indoor area**



*Dense viral cloud  
throughout the room*

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# Personal Protective Equipment





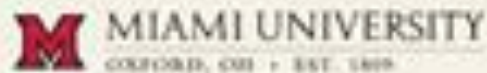


JOHNS HOPKINS  
MEDICINE

# EBOLA

## PREPAREDNESS: PPE GUIDELINES

Produced in collaboration with:



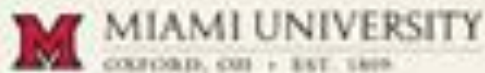


JOHNS HOPKINS  
MEDICINE

# MARBURG

## PREPAREDNESS: PPE GUIDELINES

Produced in collaboration with:





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**We have better testing and  
monitoring tools**

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**COVID-19**

**FLU A+B**

C  
T

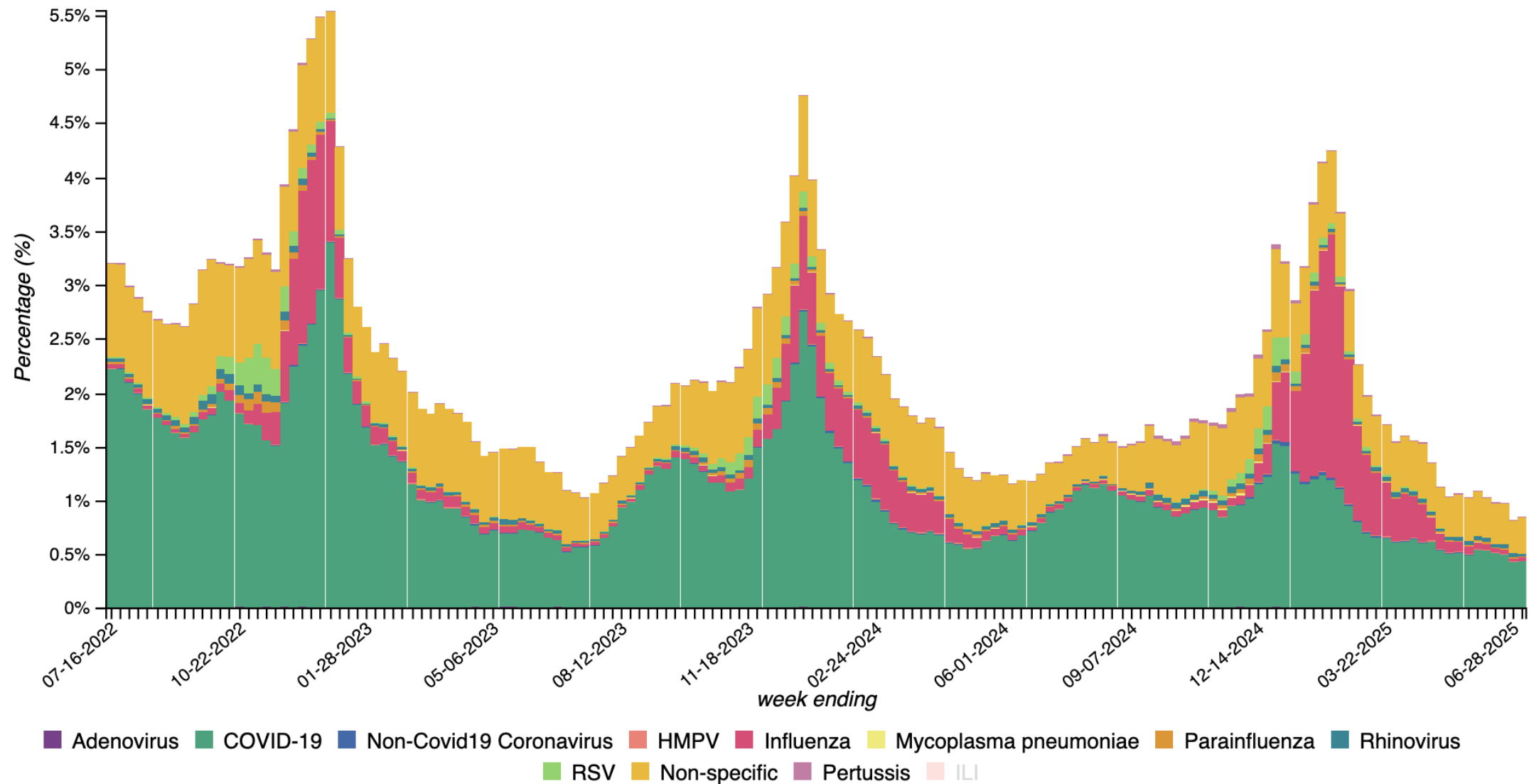


C  
B  
A





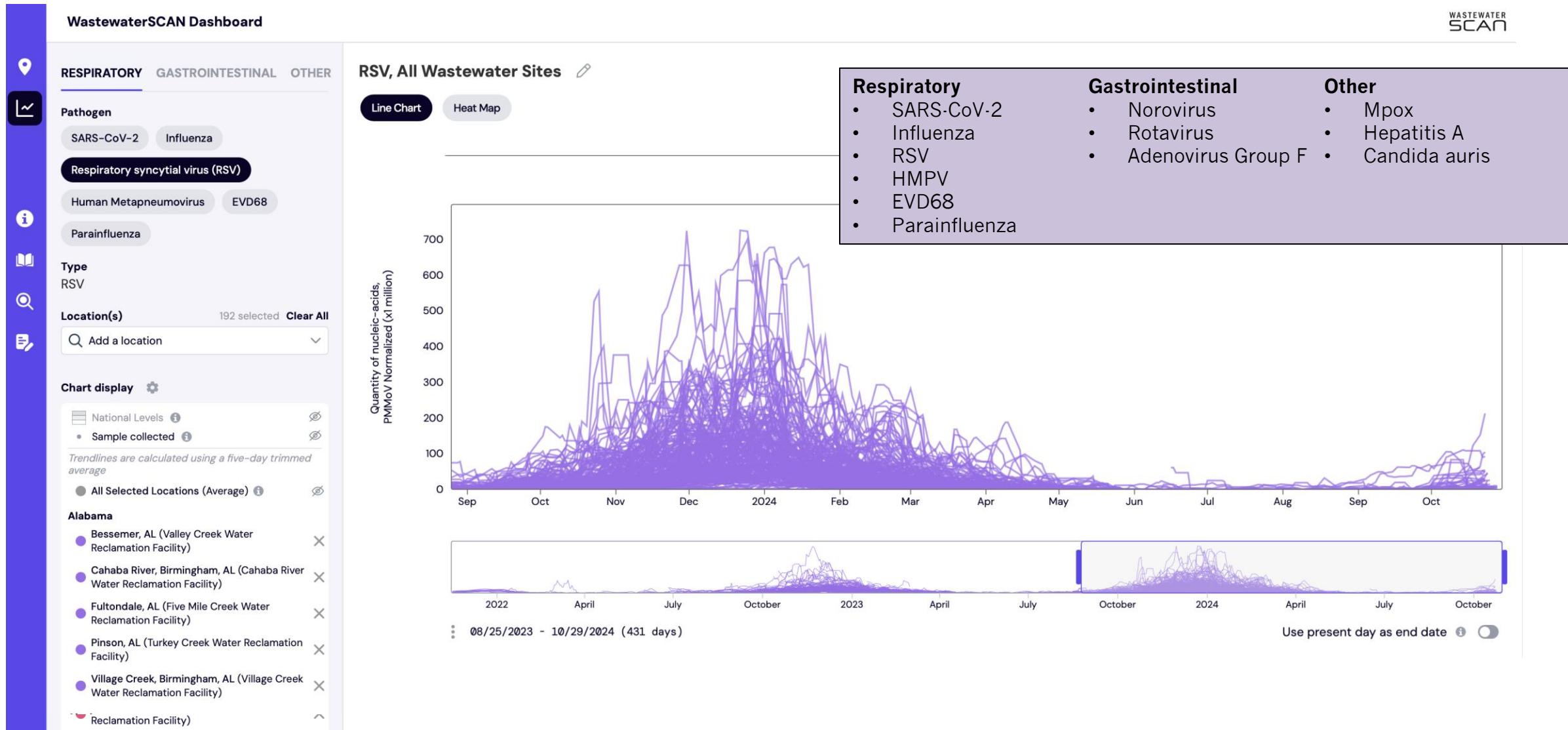
# Massachusetts Respiratory Viral Surveillance Dashboard







# MANY Pathogens Under Wastewater Surveillance



Explore yourself at: [data.wastewaterscan.org](https://data.wastewaterscan.org)



# whole genome sequencing



## Feb 9. 2021

The diagram illustrates a network of interactions between medical teams and patients across three units. The nodes are categorized by shape and color, representing different medical teams or roles. The connections represent interactions between these teams and patients.

**Unit 1:** Includes Patient 1, Room 3 (WGS D1), Patient 2, Room 3 (WGS D5), Patient 3, Room 2 (D2), Patient 2, Room 10 (WGS D5), Patient 4, Room 10 (WGS D5), Patient 5, Room 10 (WGS D10), Patient 6, Room 10 (WGS D13), and an 'Other' node (WGS D17). Medical teams involved include RN (D3, D10), MD (D5, D10, D8), UA (WGS D14), RPH (D9), and Transport (D12).

**Unit 2:** Includes Patient 7, Room 1 (WGS D10), Patient 8, Room 1 (WGS D14), Patient 9, Room 6 (WGS D10), Patient 10, Room 10 (WGS D14), Patient 11, Room 5 (WGS D8), Patient 12, Rooms 4, 8-10 (WGS D11), Patient 13, Room 4 (WGS D18), and Patient 14, Room 8 (WGS D6). Medical teams involved include MD (WGS D7, D12), RN (D9, D10, D11, D12, D15, D20), CT Tech (WGS D13), SLP (WGS D9), PCA (WGS D10, D14, D11, D17), UA (D5, D12, D15), and Phleb (D11).

**Unit 3:** Includes Patient 1, Room 1 (WGS D1), Patient 7, Room 1 (WGS D10), Patient 8, Room 1 (WGS D14), Patient 9, Room 6 (WGS D10), Patient 10, Room 10 (WGS D14), Patient 11, Room 5 (WGS D8), Patient 12, Rooms 4, 8-10 (WGS D11), Patient 13, Room 4 (WGS D18), and Patient 14, Room 8 (WGS D6). Medical teams involved include MD (WGS D7, D12), RN (D9, D10, D11, D12, D15, D20), CT Tech (WGS D13), SLP (WGS D9), PCA (WGS D10, D14, D11, D17), UA (D5, D12, D15), and Phleb (D11).

**Legend:**

- Medicine Team 1 (Blue)
- Medicine Team 2 (Yellow)
- Medicine Team 3 (Green)
- Medicine Team 4 (Purple)
- Neurology Team (Pink)
- Pulmonary Transplant Team (Orange)
- Cardiology Team (Red)

1. Transmission despite use of surgical masks (WGS confirmed)
2. Roommate to roommate transmission frequent despite 7ft spacing & curtain
3. Single test on admission or post-exposure can miss incubating cases

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**We have powerful new vaccines  
and effective treatments**

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mRNA vaccines



Drew Weissman

Katalin Kariko

2023 NOBEL PRIZE

IN PHYSIOLOGY OR MEDICINE

A **VACCINE** CAN TAKE YOUR **INFECTION** FROM



**WILD** TO *mild*



#FIGHT FLU





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# The Bad

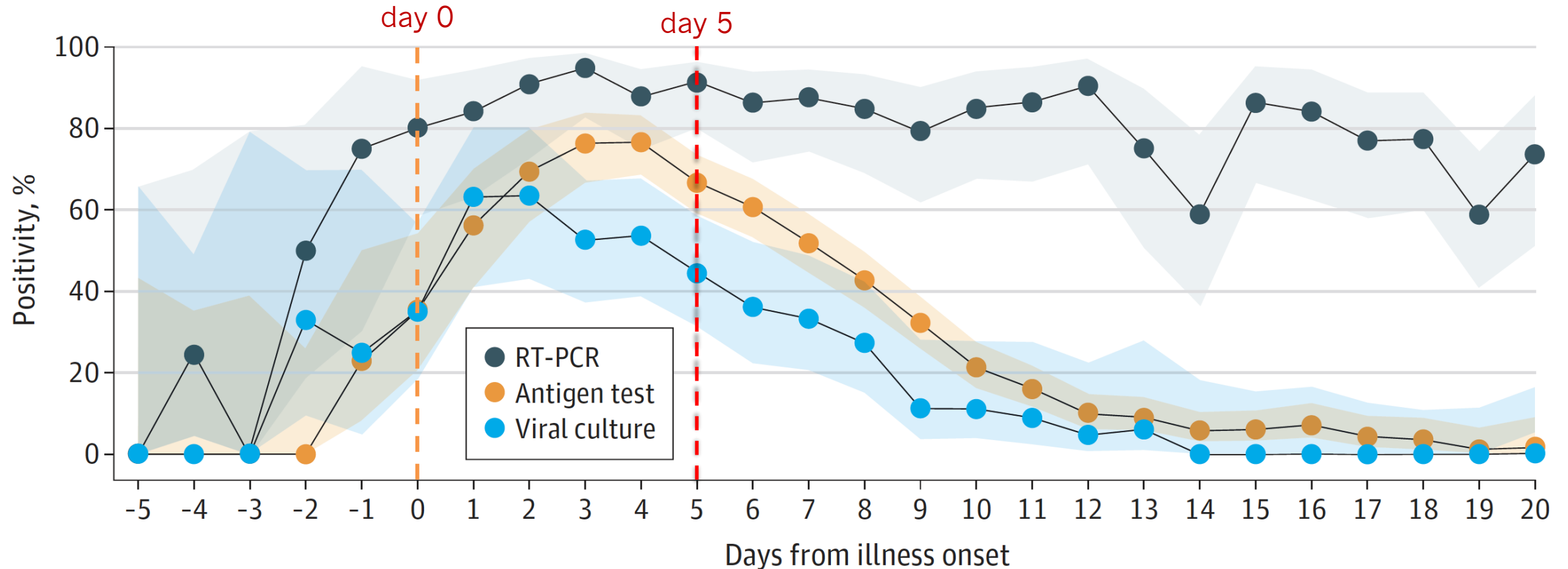


<http://www.film.com/wp-content/uploads/2013/09/THE-GOOD-THE-BAD-BILLY-PERKINS.jpg>

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# PCR vs Antigen vs Culture and Time to Clearance

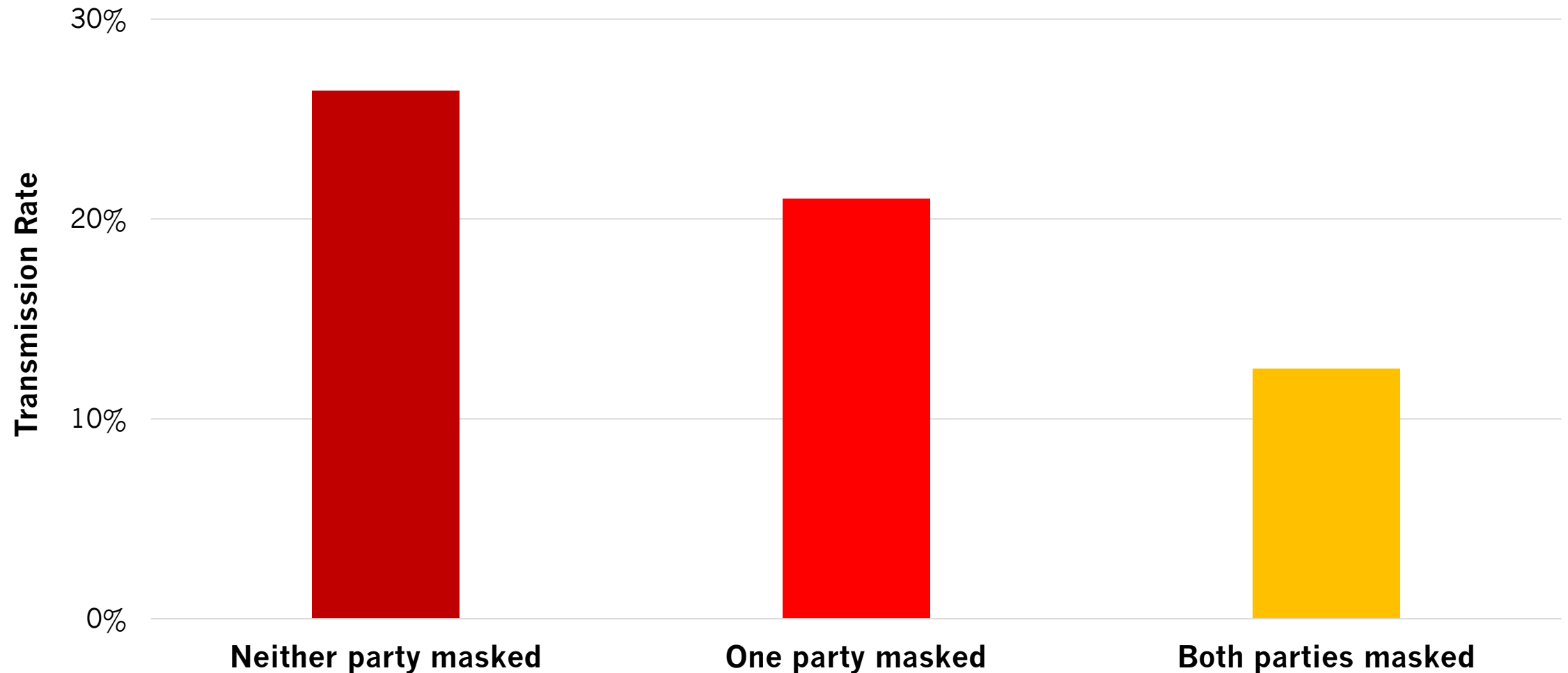
Daily antigen and intermittent viral cultures in 225 people with PCR-confirmed SARS-CoV-2, San Diego & Denver, Jan-April 2021

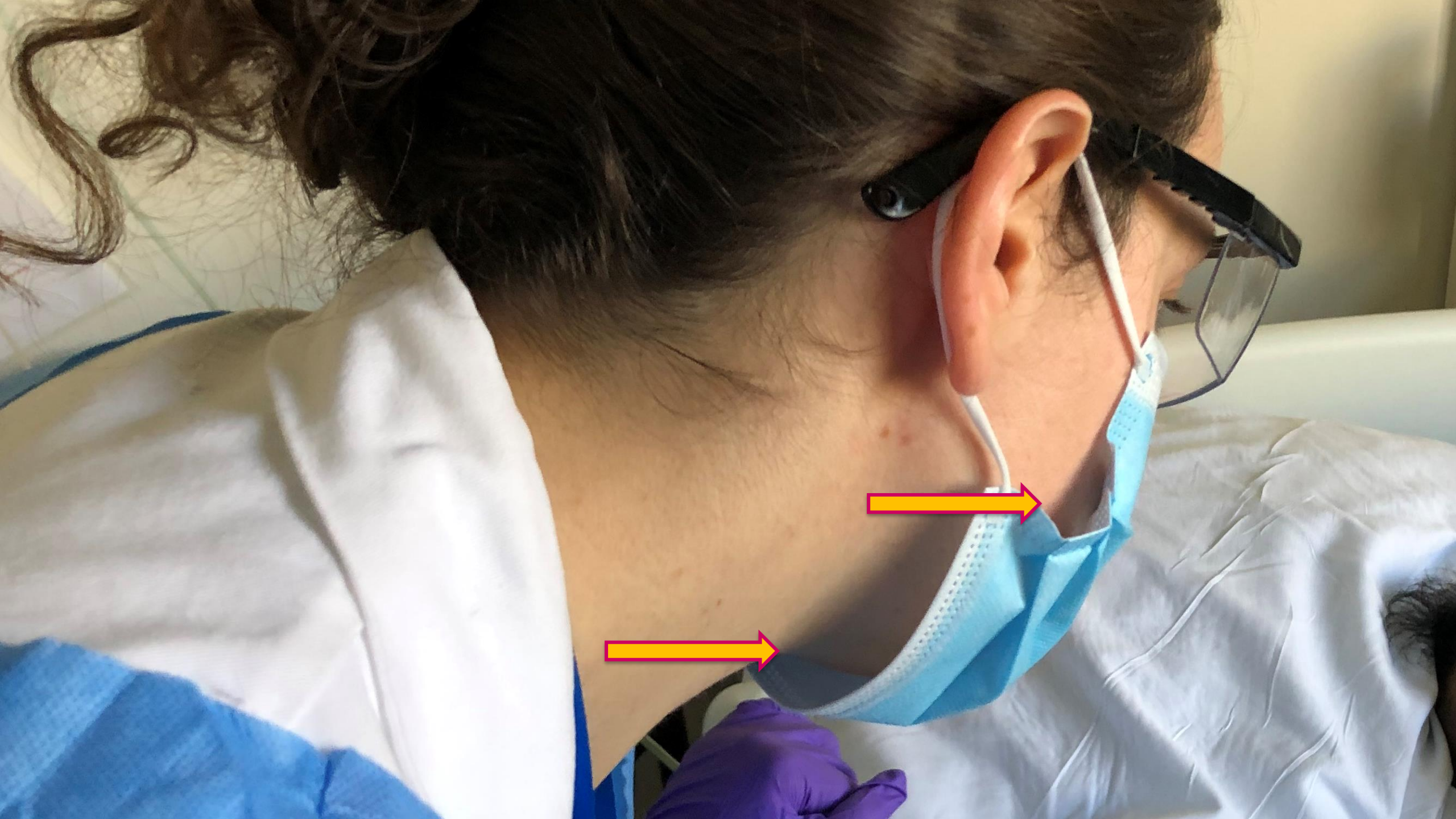




# Masking Effectiveness in Practice

*Transmission rates amongst 969 close contacts of 431 people with Covid-19, Johnson County Public Health, Iowa*

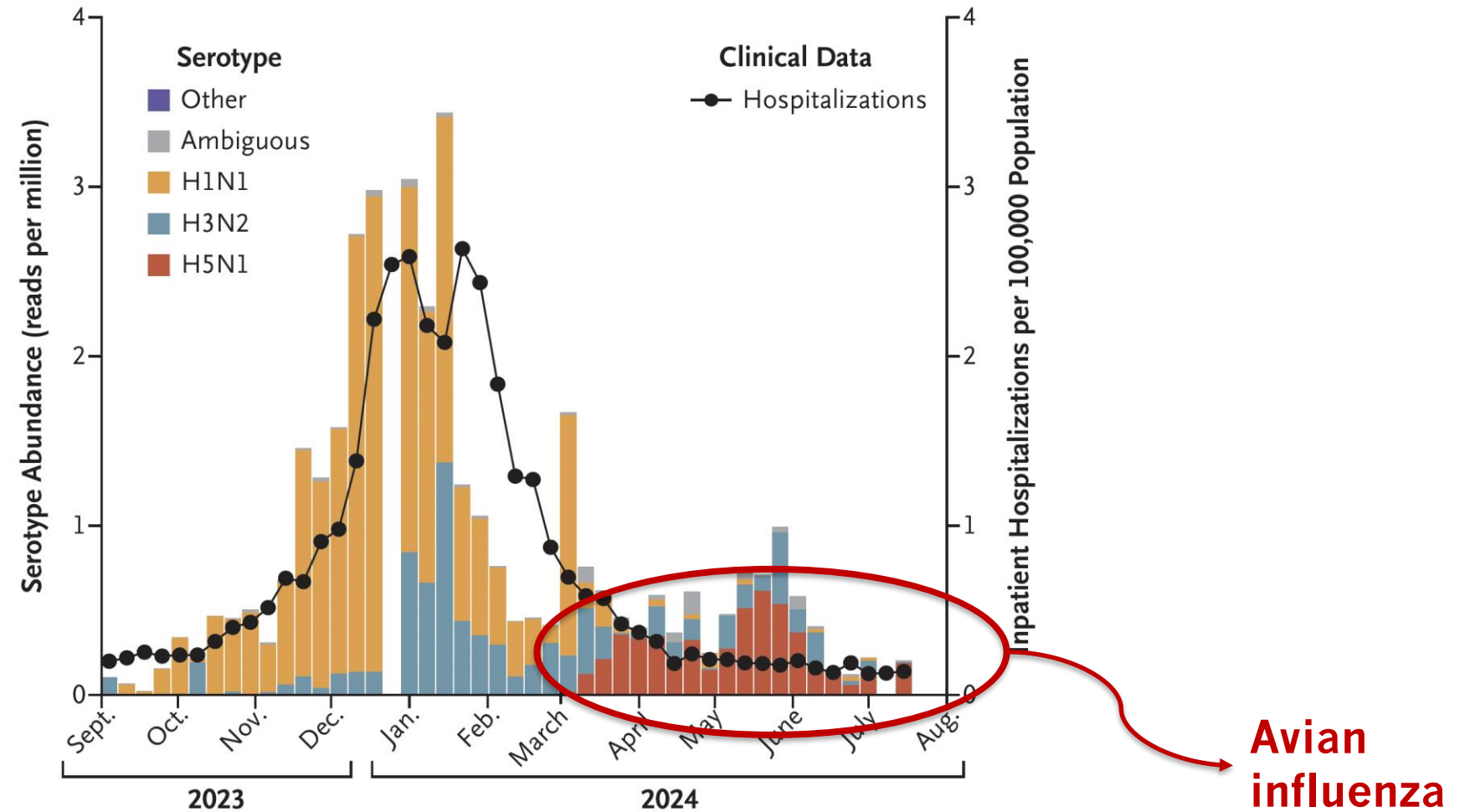






# Wastewater surveillance does not differentiate between human vs animal infections, mild and severe disease, etc.

*Influenza A Virus in 10 Texas Communities' Wastewater*



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**Our tests, vaccines, and treatments can't  
work if we don't use them**

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# The Ugly



<http://www.film.com/wp-content/uploads/2013/09/THE-GOOD-THE-BAD-BILLY-PERKINS.jpg>

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lab-leak

cover-up

depopulation

die  
plot  
china

infertility

death

dead

pregnant

cia

population-control  
mind-control

kill

ivermectin

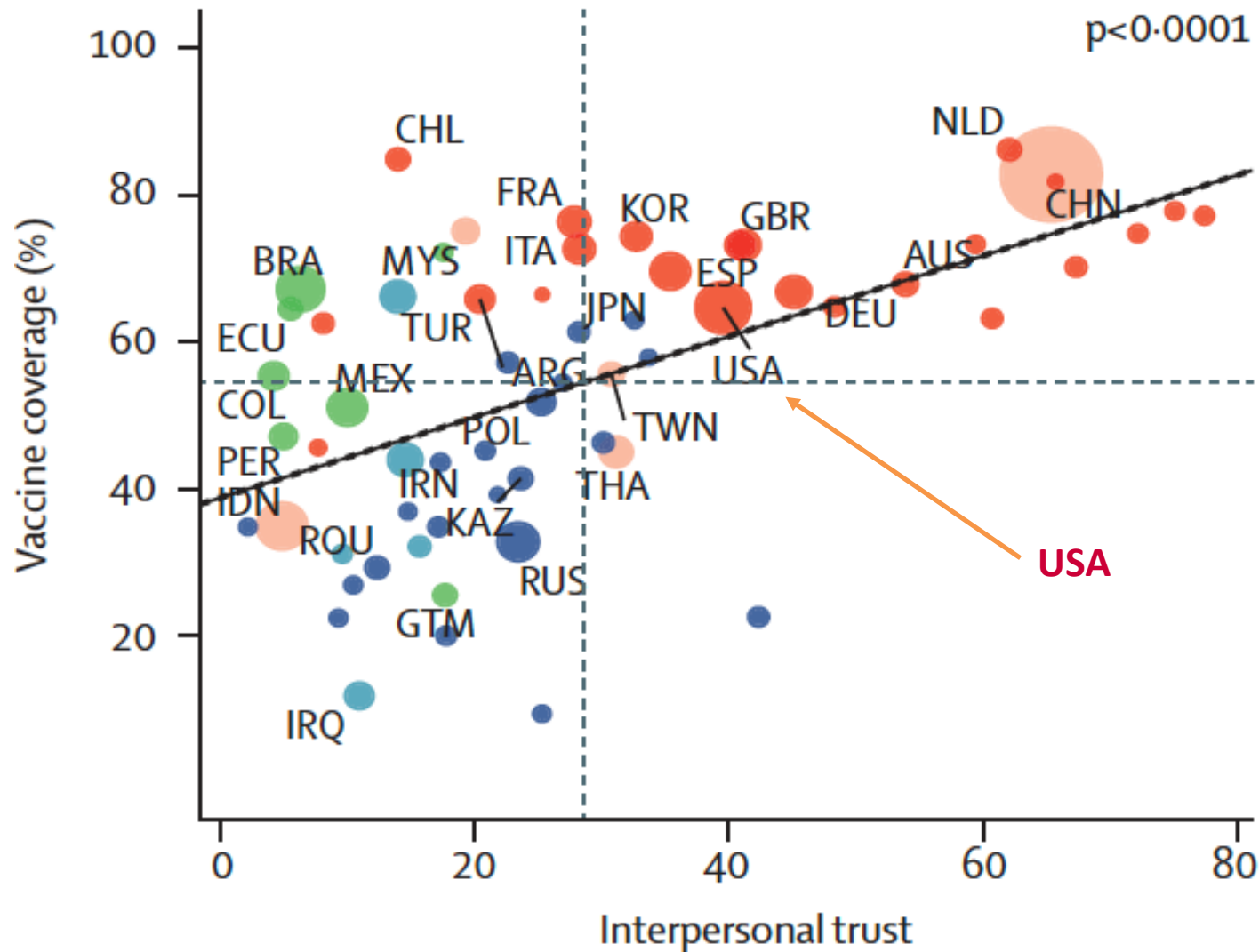
fertility

bill-gates

wuhan



# The Importance of Trust



**Global analysis of factors associated with Covid case counts and fatality rates**

**Factors associated with infection fatality rates:**

- Country age profile
- Gross Domestic Product
- National mean body mass index

**Factors associated with vaccine coverage:**

- Trust between individuals
- Trust in government
- Lack of government corruption

# Summary

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- Old and new pathogens with epidemic potential are a fact of life – **new outbreaks will always occur**
  - **We have powerful new tools** we can deploy
    - Deeper understanding of transmission, effective PPE, home tests, advanced surveillance systems, targeted treatments, effective vaccines
  - But our tools can only help us if we use them. Our safety and the safety of our patients depend upon **trust in science, trust in public health, and trust in one another**
-



# Thank You!

## For all the lives we touch

Clean hands protect our patients.

Always perform hand hygiene  
and help others do the same.



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