



...Breakthrough Infections...

*Dr. James Dobbins
OLLI, 17 September 2021*

OMG...Breakthrough Infections...WTH?



*Dr. James Dobbins
OLLI, 17 September 2021*



...Breakthrough Infections...

*Dr. James Dobbins
OLLI, 17 September 2021*

Huh?...Breakthrough Infections...Z Z Z Z Z Z Z



*Dr. James Dobbins
OLLI, 17 September 2021*

Bramhall77
NYDN



AND
YOU
ARE...?

MISINFORMATION

WAR

FAMINE

PESTILENCE

DEATH

MISINFORMATION

Topics That We'll Discuss Today

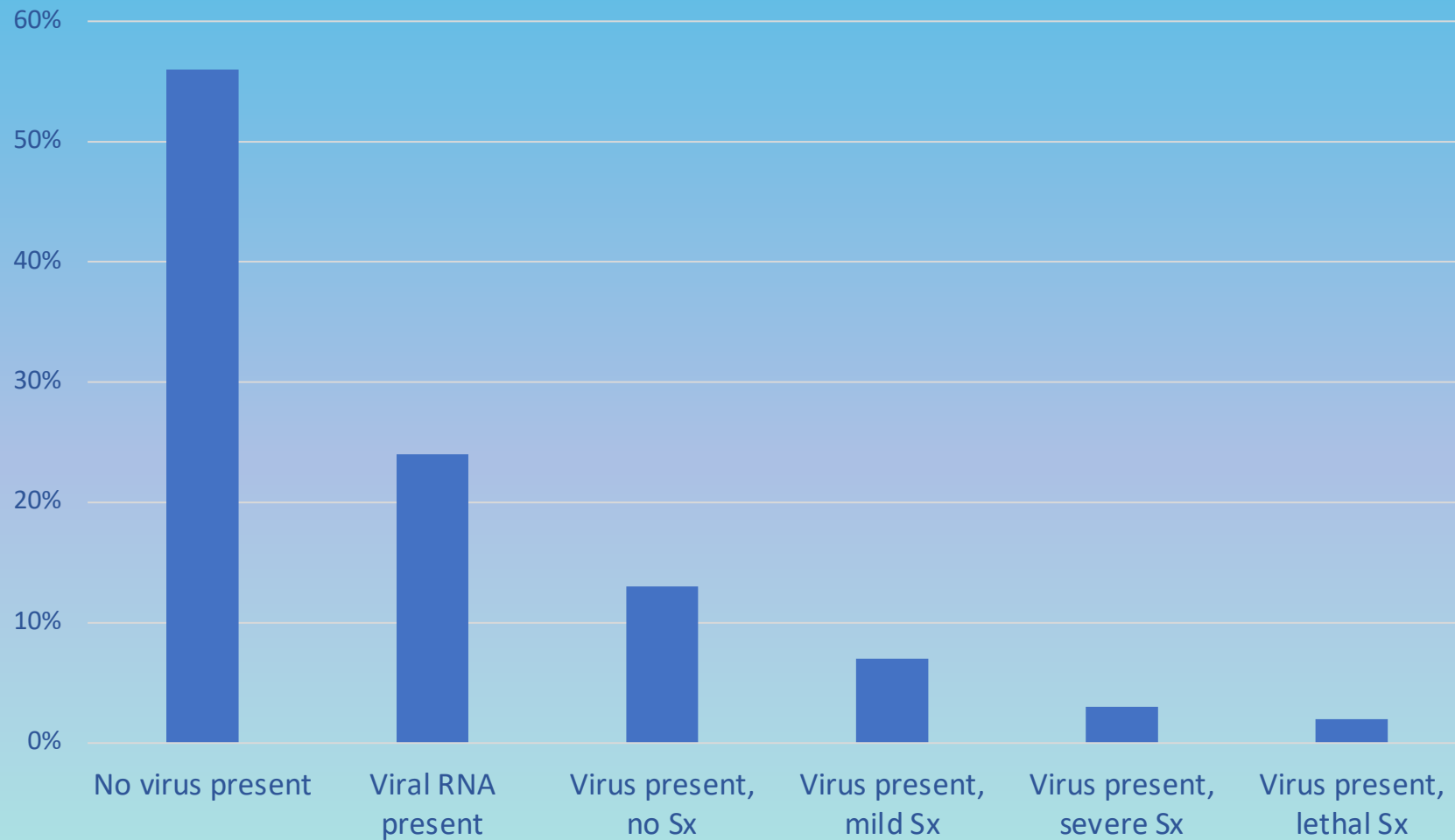
- The case definition for Covid-19
- Booster doses
- Breakthrough infections
- The current Covid-19 situation
- Additional information on the origin of SARS-CoV-2
- Update on influenza

Case Definition for Covid-19

The Case Definition and Breakthrough Infections

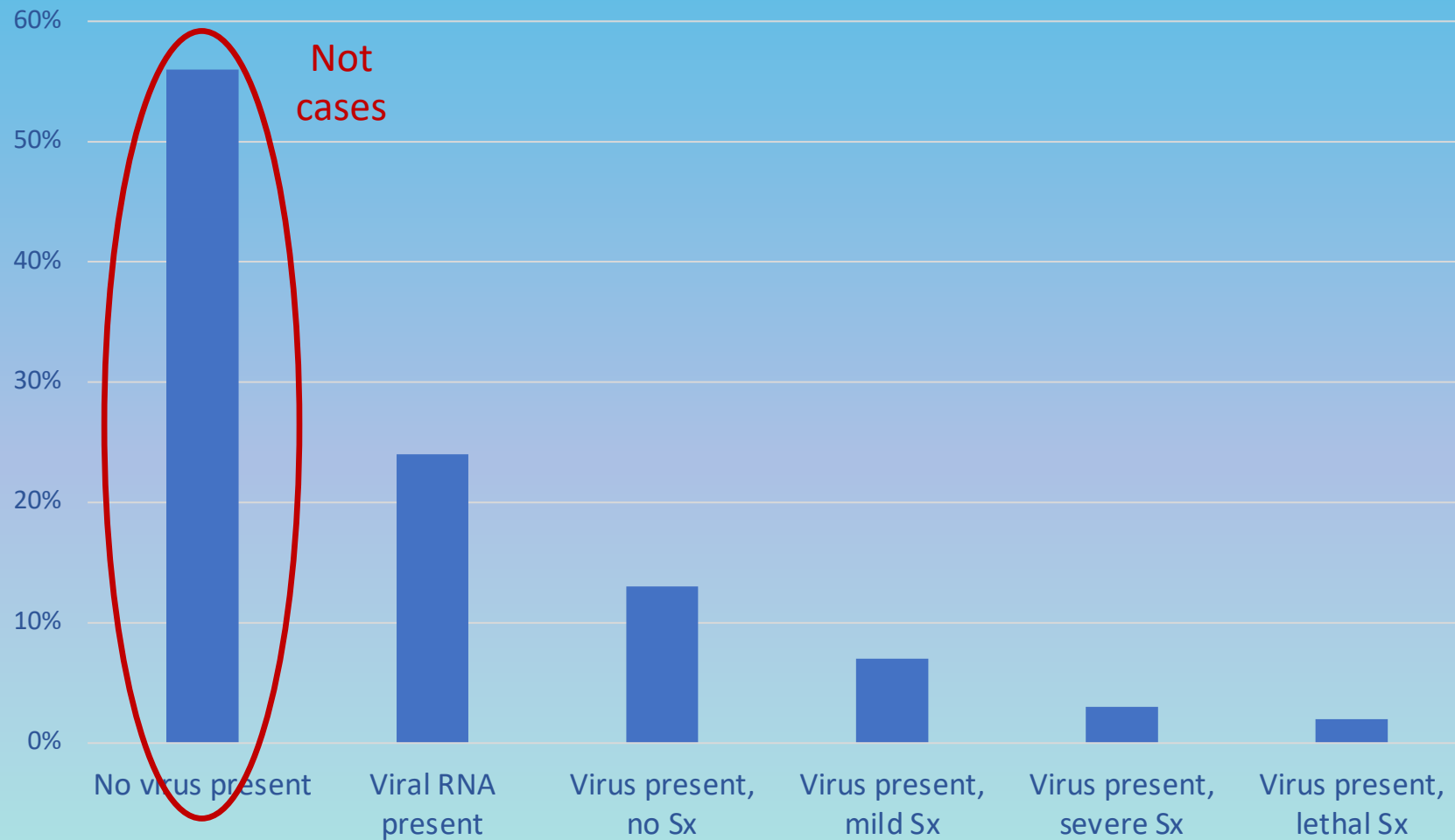
- QUESTION: What is the definition of a case of Covid-19
- ANSWER: Anyone who has a positive PCR test for SARS-CoV-2
- No signs and symptoms are necessary – asymptomatic cases qualify

Tested Population by the Presence of Virus and Symptoms



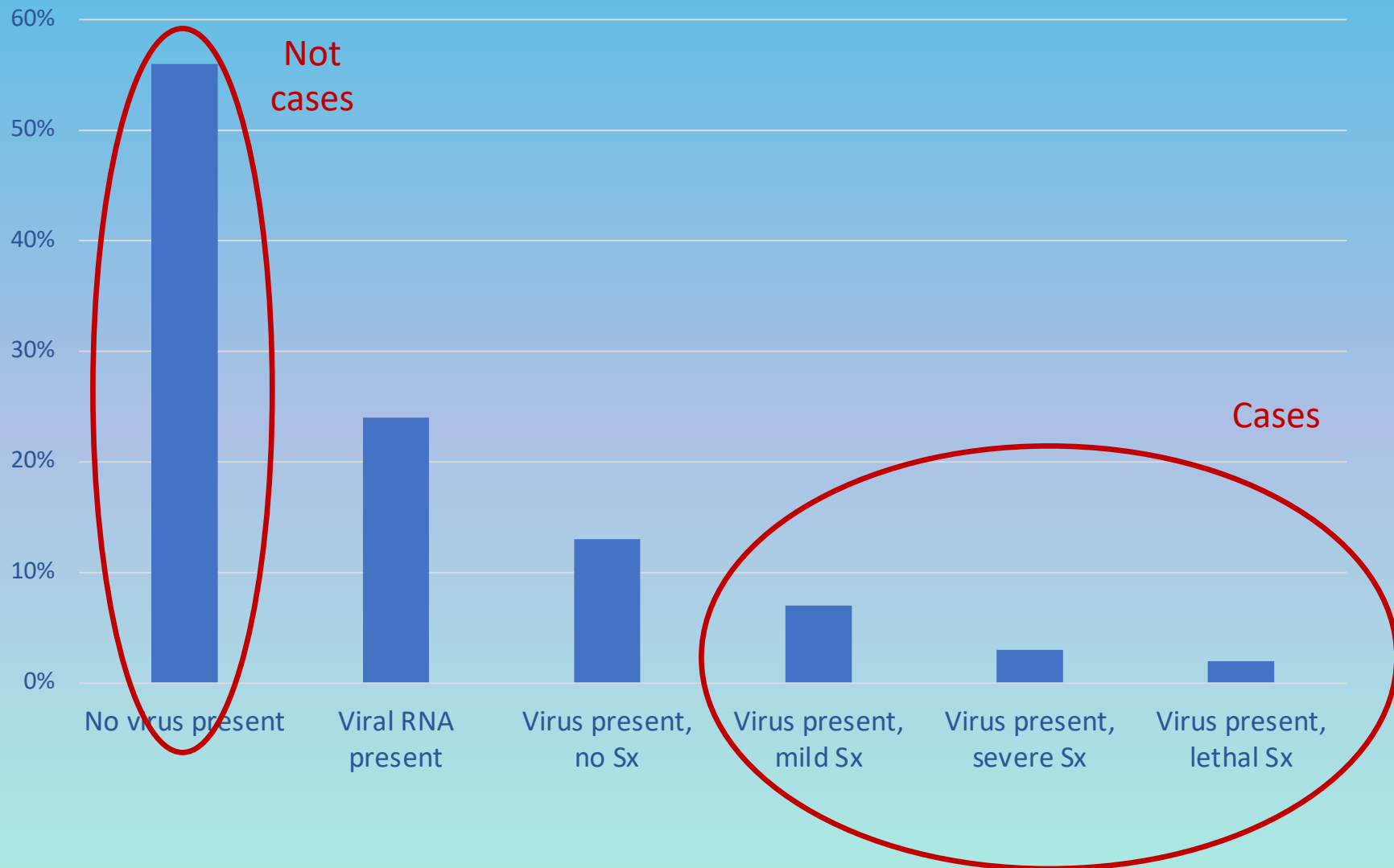
(Hypothetical data)

Tested Population by the Presence of Virus, Shedding, and Symptoms



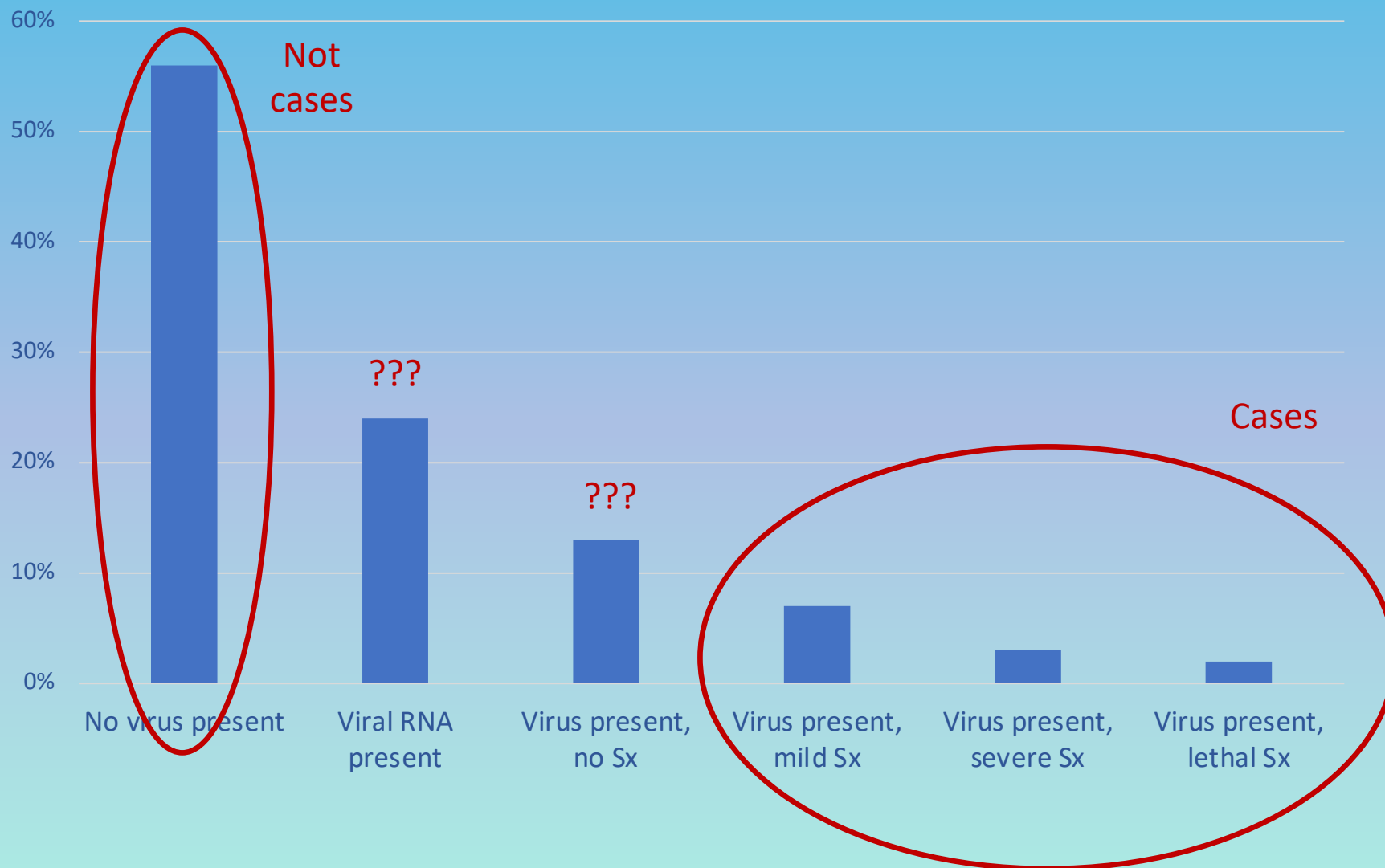
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Tested Population by the Presence of Virus, Shedding, and Symptoms



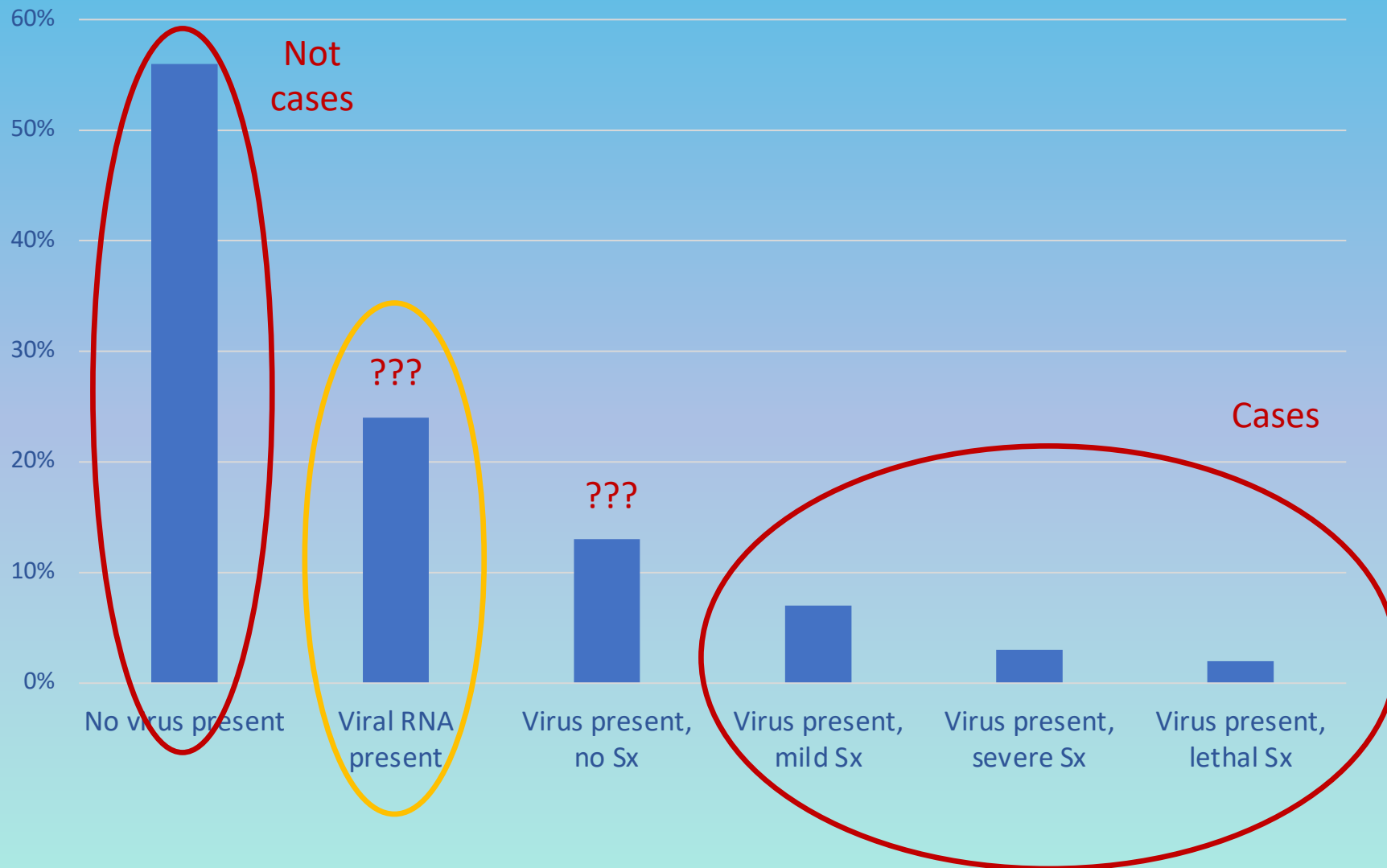
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Tested Population by the Presence of Virus, Shedding, and Symptoms



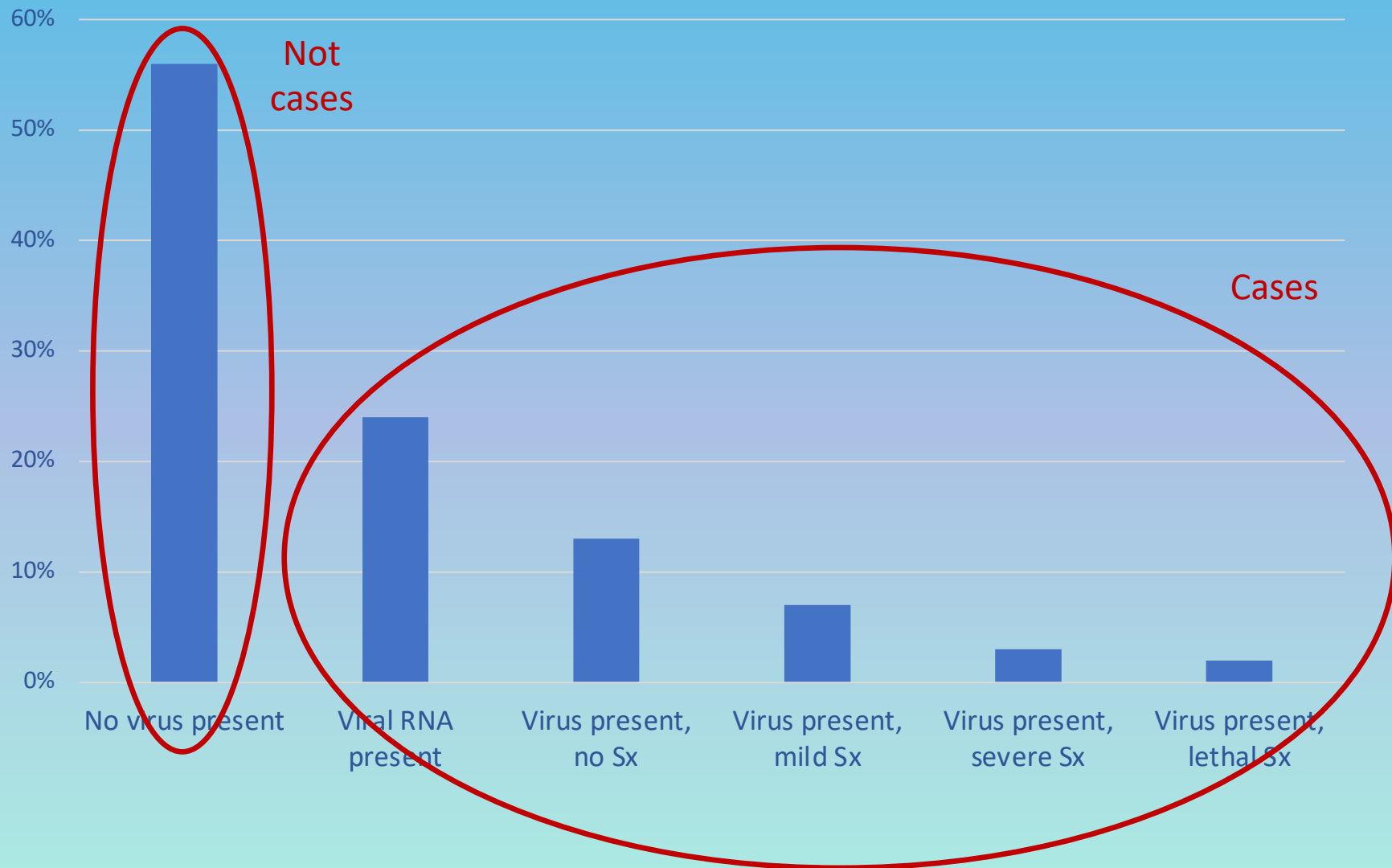
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Tested Population by the Presence of Virus, Shedding, and Symptoms



(Hypothetical data)

Why do we Use This Case Definition for Covid-19?

- Because Covid-19 is not like most other infectious diseases
- Asymptomatic infections are known to play a clear role in SARS-Cov-2 transmission
- Asymptomatic cases can become symptomatic cases
- The disease is both highly infectious and can be lethal, so we don't want false negative cases to lead to further cases

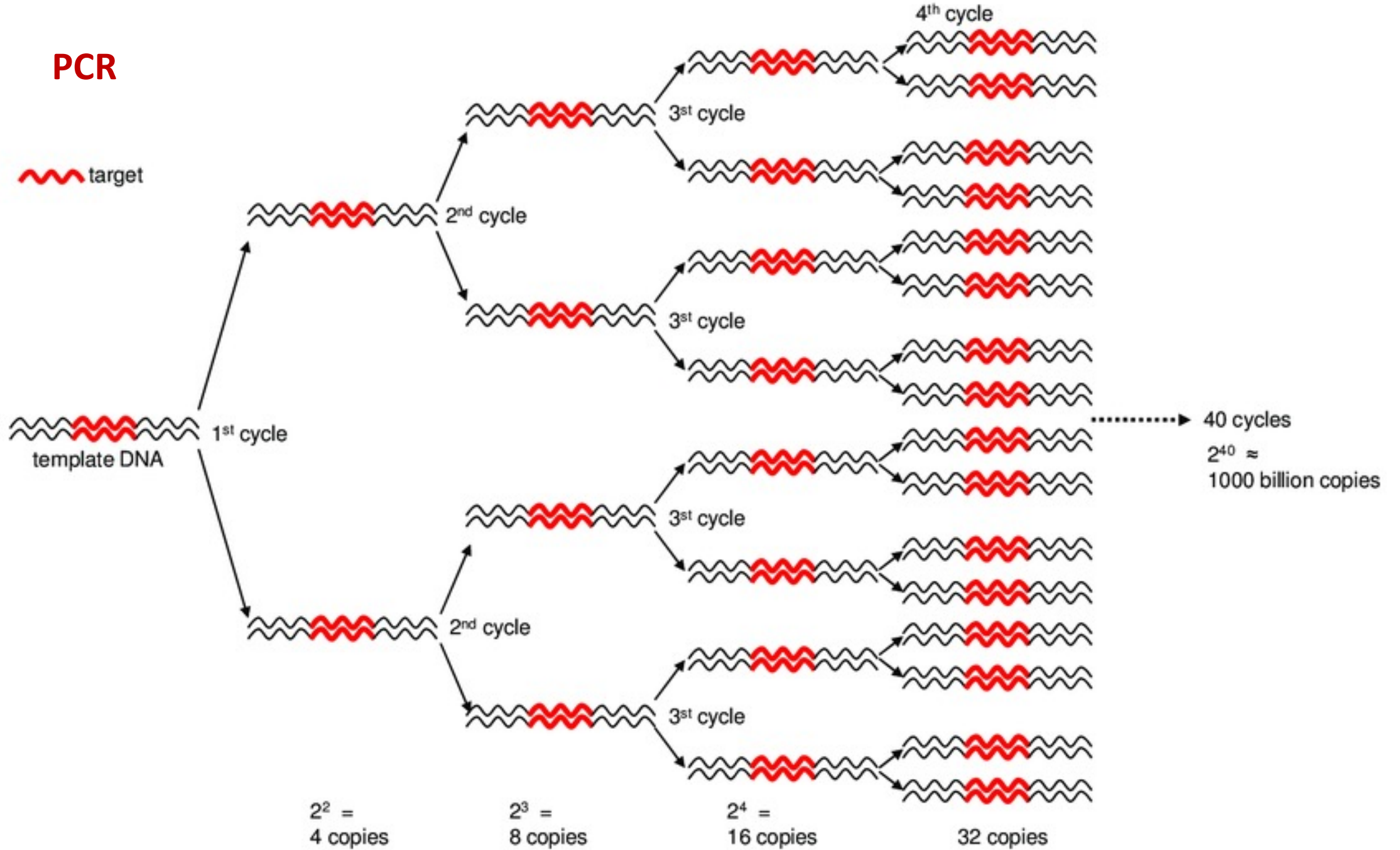
How Vaccines Actually Work

- Vaccines are designed to stop viruses AFTER they have entered the body
- There is an array of bodily defenses that take part in this, including mucus membranes
- Now, imagine that we live in a sea of pathogens that are always trying to infect our bodies
- Once inside the body, though, the pathogens are usually quickly destroyed our immune system

So, Why is this a problem?

- If SARS-CoV-2 is able to enter a body, it will try to infect its target cells
- Even if it is successful, a well-vaccinated immune system will destroy any new viruses and destroy all of the cells that have been infected.
- With all of this activity, minute amounts of viral RNA can still be present in a body
- Using PCR, this RNA can be detected and voilà! We have a new case of Covid-19!

PCR



Alarming Headline in A Local Newspaper

“HALF OF COVID-19 CASES IN ICUs ARE
FULLY VACCINATED”

- Wait...what? How can that be true?
- To understand why this is basically meaningless, we just need to employ a simple equation

$$\begin{aligned}\phi(k) &= 2 \frac{A}{\sqrt{2\pi}} \int_0^{\infty} e^{-ax} \cos kx \, dx = \frac{A}{\sqrt{2\pi}} \int_0^{\infty} e^{-ax} (e^{ikx} + e^{-ikx}) \, dx \\ &= \frac{A}{\sqrt{2\pi}} \int_0^{\infty} (e^{(ik-a)x} + e^{-(ik+a)x}) \, dx = \frac{A}{\sqrt{2\pi}} \left[\frac{e^{(ik-a)x}}{ik-a} + \frac{e^{-(ik+a)x}}{-(ik+a)} \right] \Big|_0^{\infty} \\ &= \frac{A}{\sqrt{2\pi}} \left(\frac{-1}{ik-a} + \frac{1}{ik+a} \right) = \frac{A}{\sqrt{2\pi}} \frac{-ik-a+ik-a}{-k^2-a^2} = \boxed{\sqrt{\frac{a}{2\pi}} \frac{2a}{k^2+a^2}}.\end{aligned}$$

Estimated Severe Breakthrough Cases in U.S. Population ≥ 12 years

$$\text{Really big number} \times \text{Really really tiny number} = \text{Really tiny number}$$

$$90\% \times 0.05\% = .045\%$$

$$253.3 \text{ million} \times 0.05\% = 126,650 \text{ breakthrough cases}$$

74% has received at least one dose of vaccine

$\approx 16\%$ have been infected

U.S. Population ≥ 12 years ≈ 281.5 million

Estimated Severe Breakthrough Cases in U.S. Population ≥ 12 years

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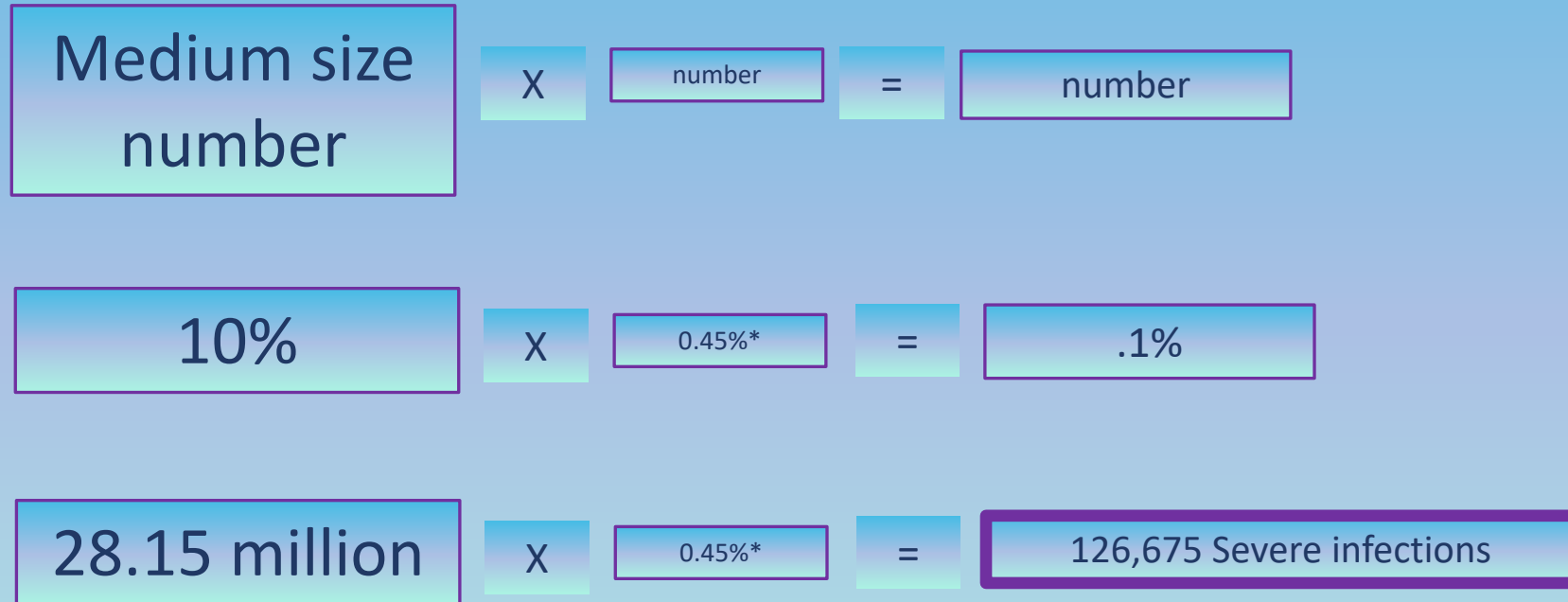
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$\approx 16\%$ have been infected

U.S. Population ≥ 12 years ≈ 281.5 million

Estimated Severe Covid-19 Cases in Unvaccinated U.S. Population ≥ 12 years



10% unvaccinated with
no prior infection

U.S. Population ≥ 12 years
 \approx 281.5 million

Estimated Severe Covid-19 Cases in Vaccinated and **Unvaccinated** U.S. Population ≥ 12 years

Breakthrough
cases

=

126,650

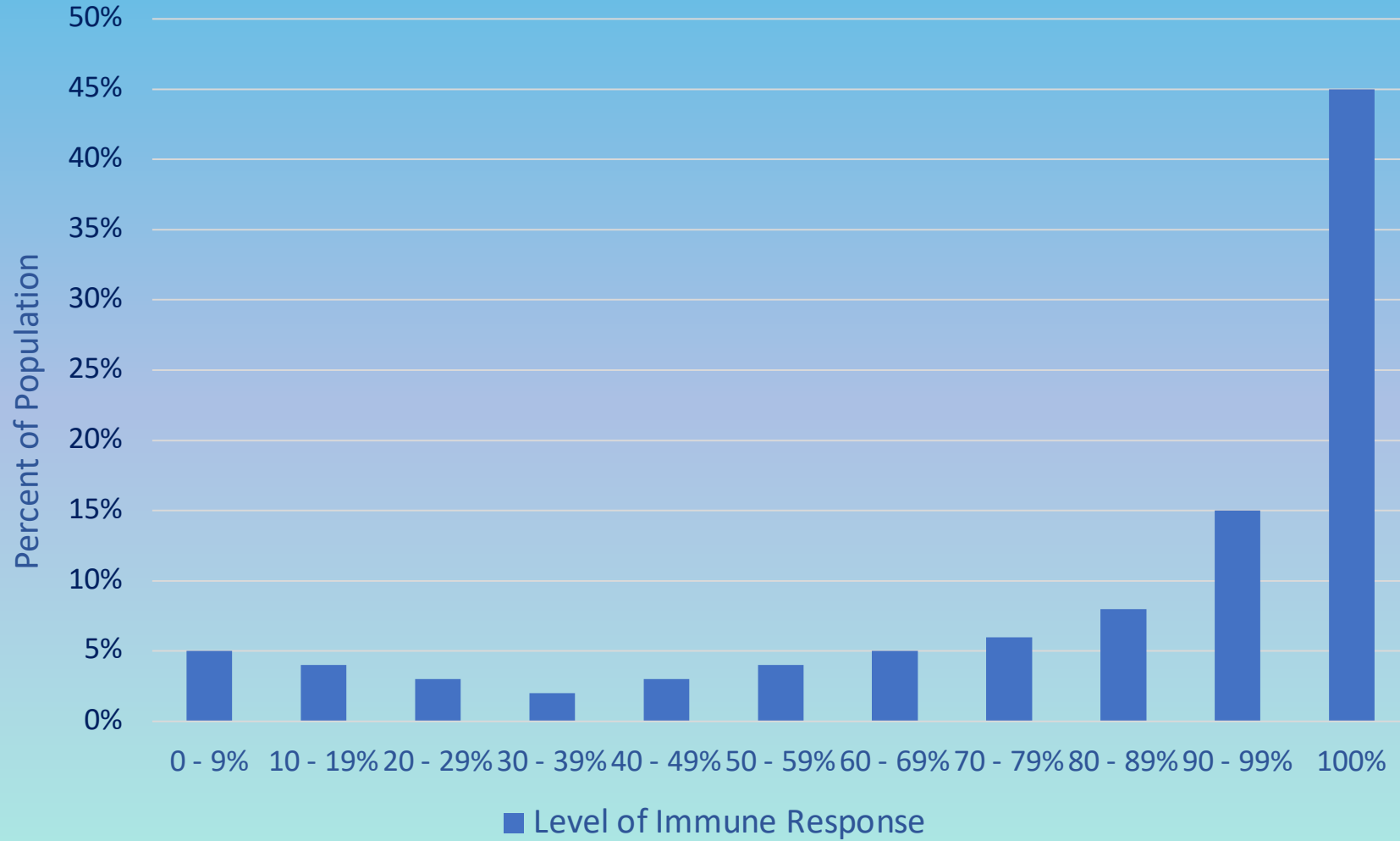
Unvaccinated
Cases

=

126,675

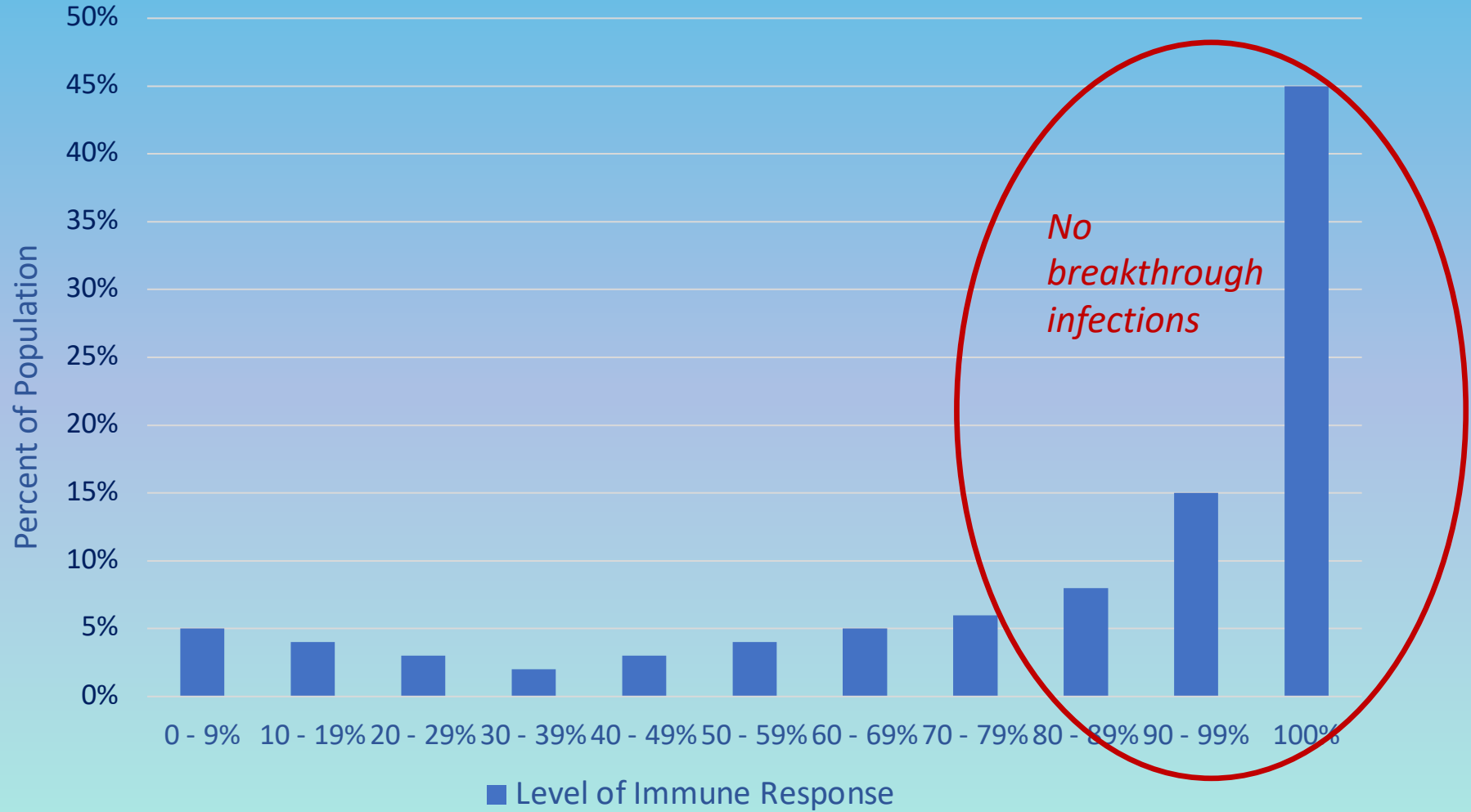
Breakthrough Infections

Percent of Population by Level of Immune Response



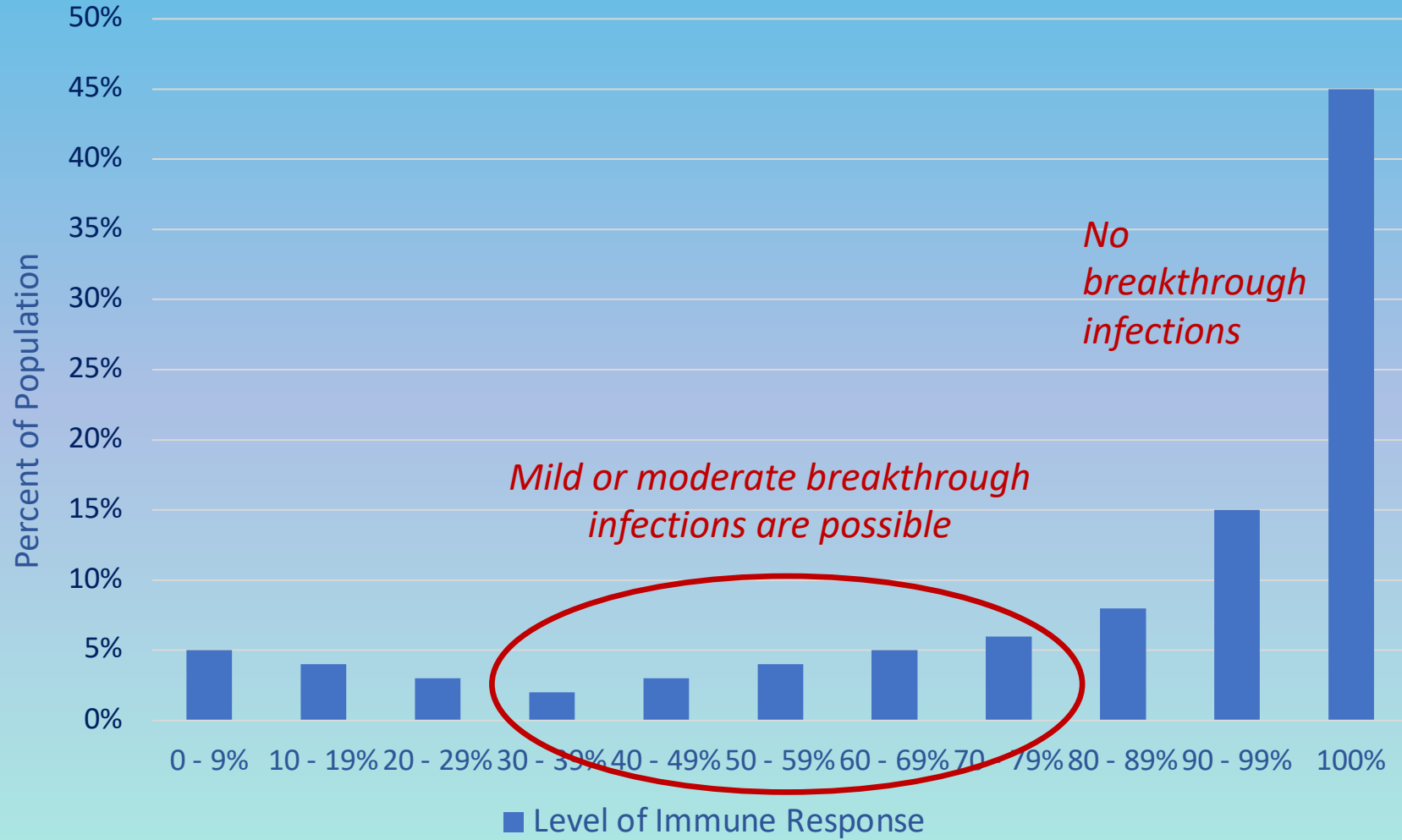
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Percent of Population by Level of Immune Response



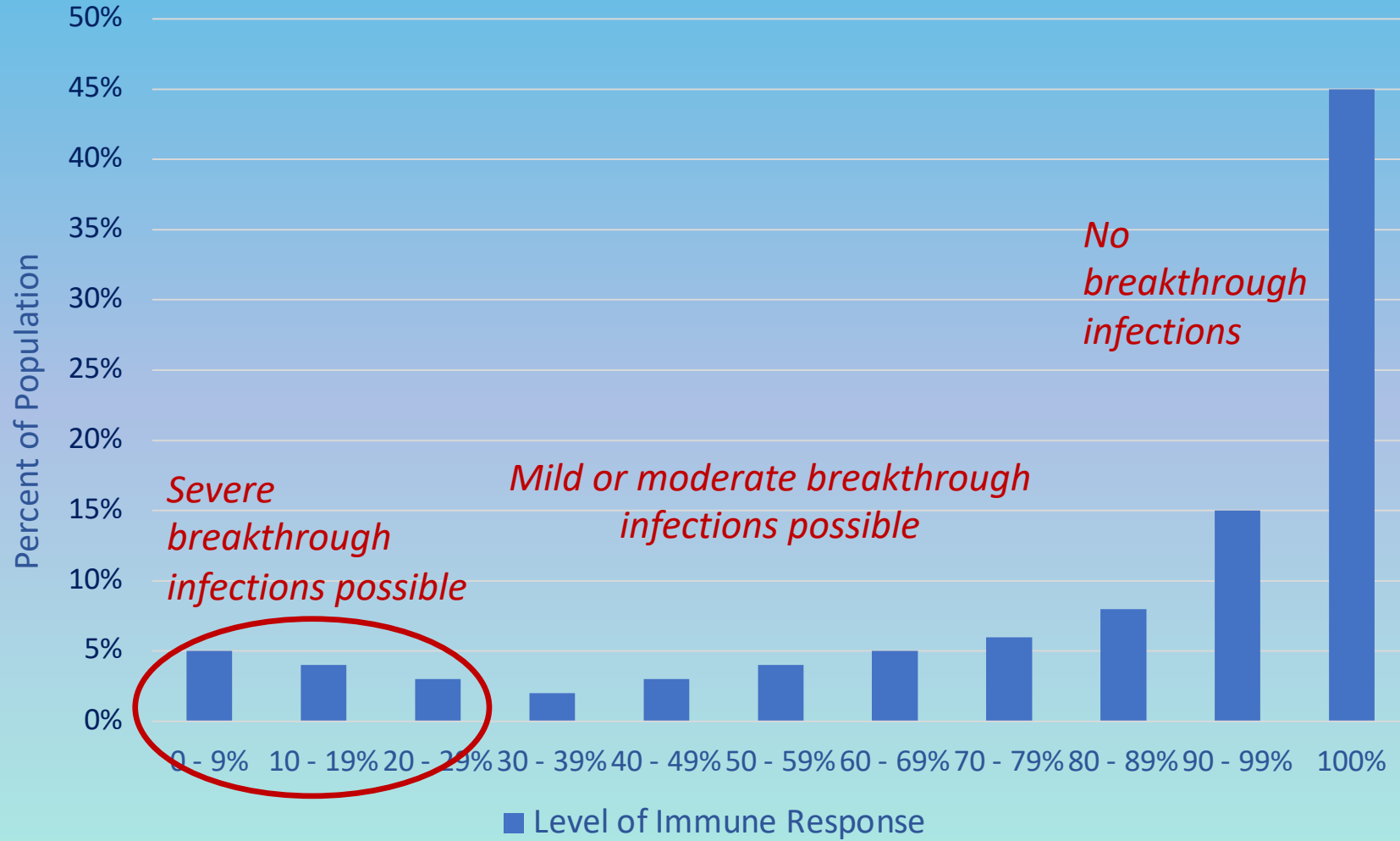
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Percent of Population by Level of Immune Response



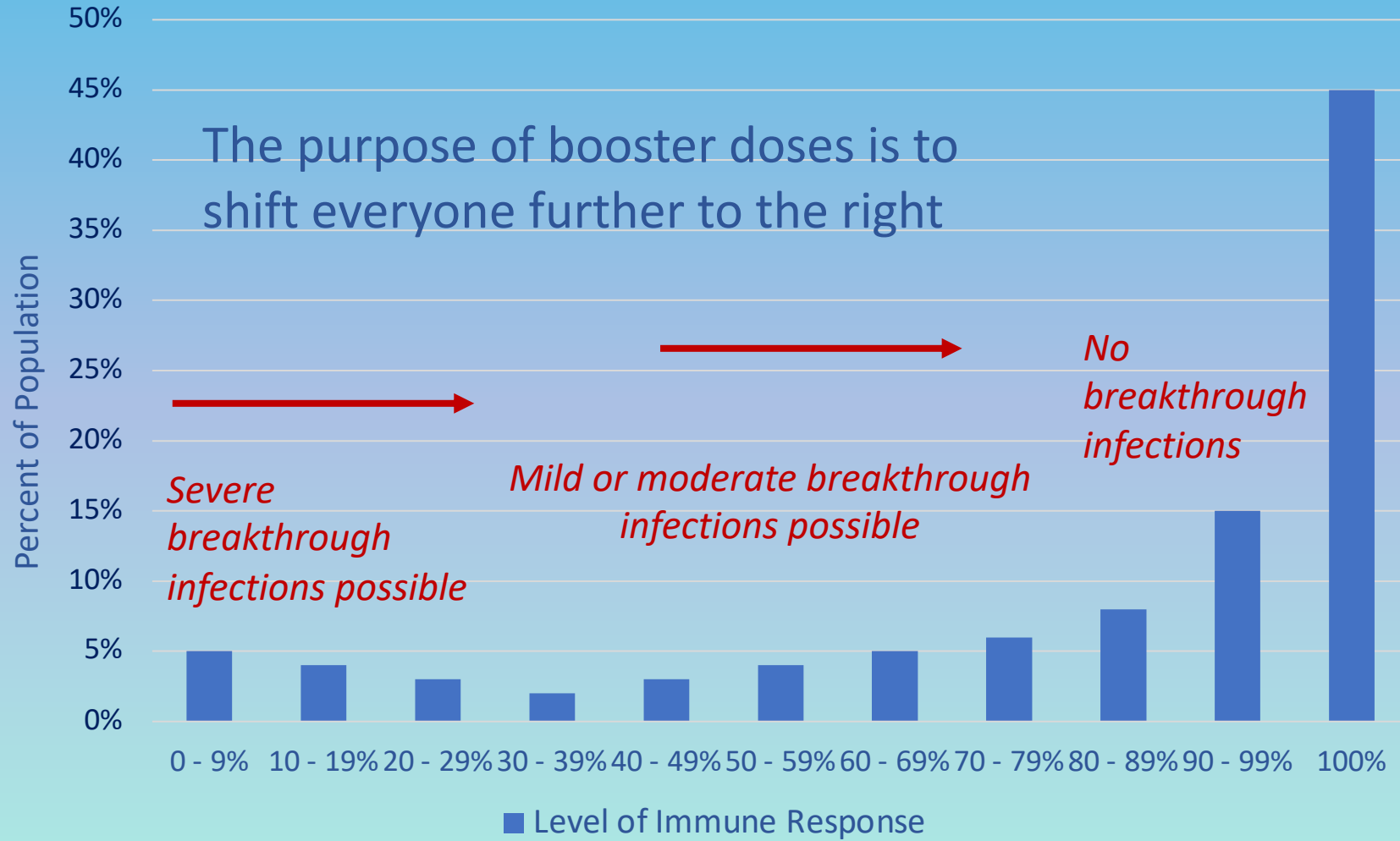
(Hypothetical data)

Percent of Population by Level of Immune Response



(Hypothetical data)

Percent of Population by Level of Immune Response



(Hypothetical data)

How do You Know Your Level of Response?

- You usually don't know for sure
- If you're at the low end of the graph, then you do know
- If you're in the middle of the graph, then you have probably had problems with other viral infections
- If you aren't clearly in either of these two groups, then you're probably in the high-response group, except...
- ...if you're over age 65, in which case you're pretty much totally screwed

Immune Response and Age

 . . . Just kidding!!!

- But our immune responses do diminish slowly with age beginning around age 70
- For example, an outbreak at a French nursing home infected a quarter of the residents in spite of 95% vaccine coverage (but only 33% coverage for the staff)
- One resident, who was unvaccinated, died
- At this time, there is no high-dose version of any Covid-19 vaccine, but I would expect that boosters will be authorized soon for people over age 65



You Bet Your Life

Booster Doses

So, let's Talk About Boosters...

- As of now, booster doses of mRNA vaccines are only approved by FDA and CDC for a very restricted group of people who are immunocompromised:
 - Receiving active cancer treatment
 - Received a transplant or are taking medication to suppress the immune system
 - Received a stem cell transplant
 - Were diagnosed with either DiGeorge syndrome¹ or Wiskott-Aldrich syndrome²
 - Were diagnosed with HIV with a high viral load
 - Taking high-dose steroids

^{1,2}Genetic disorders that can cause poor immune system function

So, let's Keep Talking About Boosters...

- The proposed recommendation for a booster dose is to receive the same mRNA vaccine as your primary doses
- This may change in the near future when NIH completes a clinical trial using the opposite mRNA vaccine
- Studies in England and Israel suggest that receiving the opposite vaccine can lead to a higher boost and a broader coverage in the immune response
- But again, although boosters for those over 65 or the general population have been proposed, they have NOT been approved by CDC or FDA, nor is there enough evidence that they are necessary for the general population

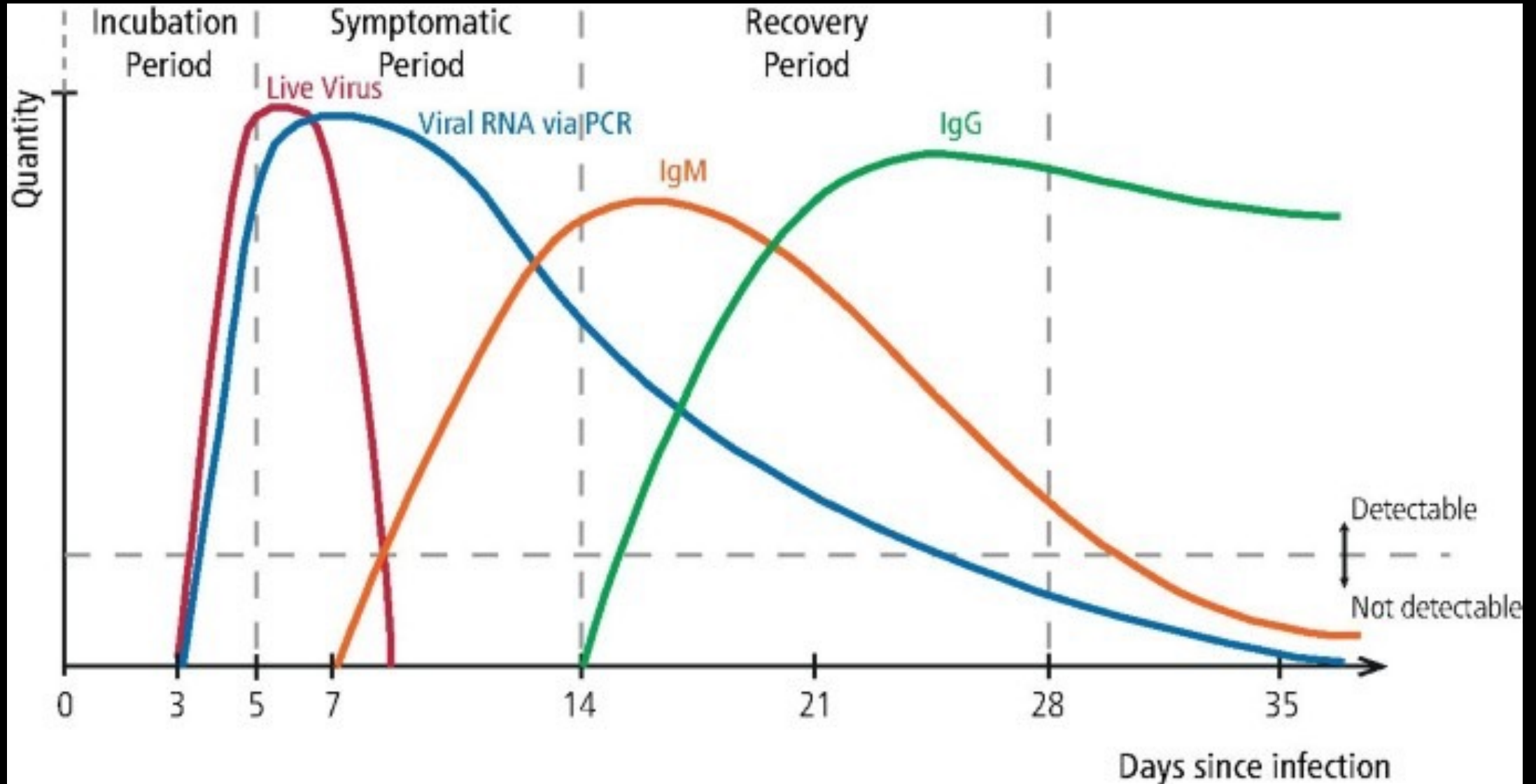
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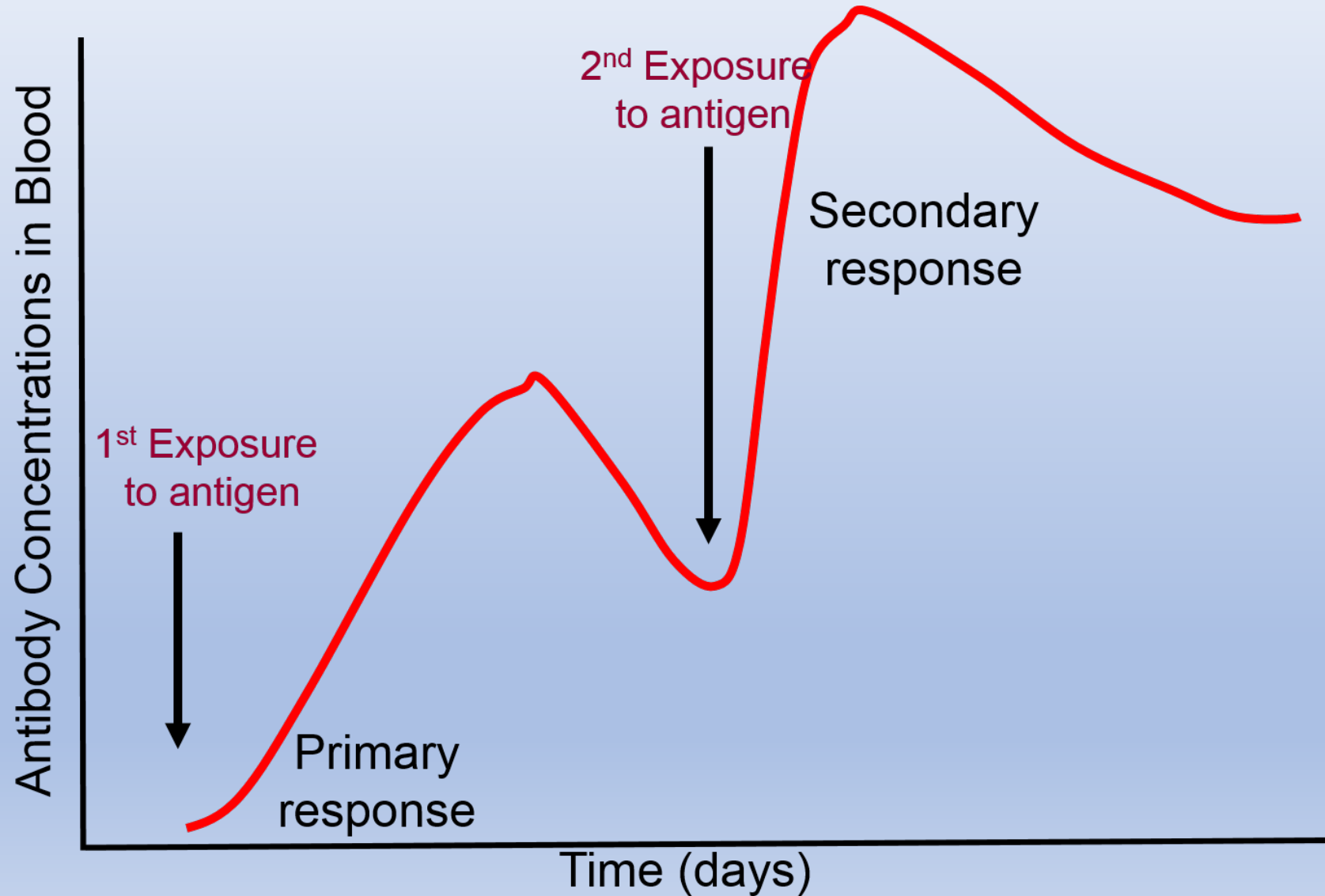
Still More About Boosters...

- While it's true that vaccine-induced antibodies are beginning to wane, so what?
- Antibodies always wane....why hang around when there's nothing to do?
- The important thing is how fast they can come roaring back when there actually is something to do, like the presence of SARS-CoV-2

Antigen – Antibody Interaction Over Time



Antibody Response After Immunization



Blah, Blah, Blah...Boosters...

- As we've discussed before, antibodies are not the only game in town, they are just the easiest game to measure
- Cellular immunity is equally important or possibly more important in stopping an infection
- And for both humoral and cellular immunity, how much is enough?
- Finally, for those of you from Urbana, there's the ethical problem of boosting our probably already-sufficient protection by using a dose of vaccine that could be going into the arm of someone who hasn't yet received a single dose

The Approval Process for Boosters

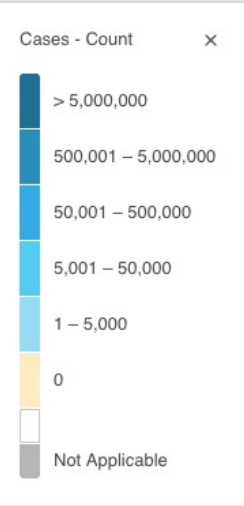
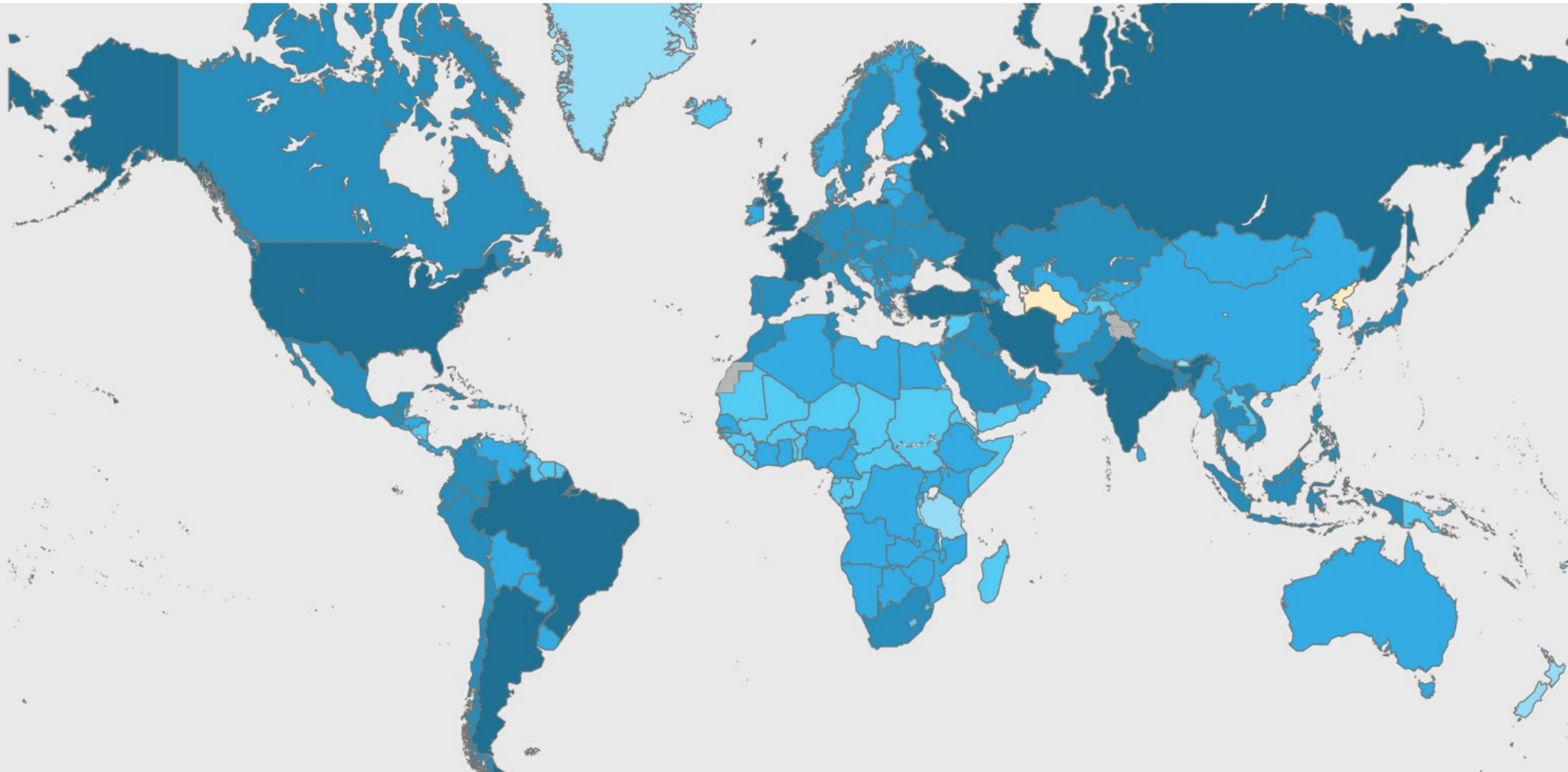
- Four steps are necessary for Covid-19 boosters to be approved for additional populations:
 - Approval from the FDA advisory committee of external experts (meeting today!)
 - Final approval by FDA itself
 - Approval by the CDC Advisory Committee on Immunization practices (ACIP)
 - Approval by CDC itself
- My guess? Approval for people >65 and healthcare workers

Current Covid-19 Situation

Current Covid-19 Situation

- Global
- U.S.A.
- Illinois
- Champaign county

WHO Coronavirus (COVID-19) Dashboard

[Overview](#)[Measures](#)[Data Table](#)[Explore](#)[Download Map Data](#)

Cases

Total

330,815
new cases**224,511,226**
confirmed cases**4,627,540**
deaths**5,534,977,637**
vaccine doses administered

Globally, as of **5:36pm CEST, 13 September 2021**, there have been **224,511,226 confirmed cases** of COVID-19, including **4,627,540 deaths**, reported to WHO. As of **13 September 2021**, a total of **5,534,977,637 vaccine doses** have been administered.

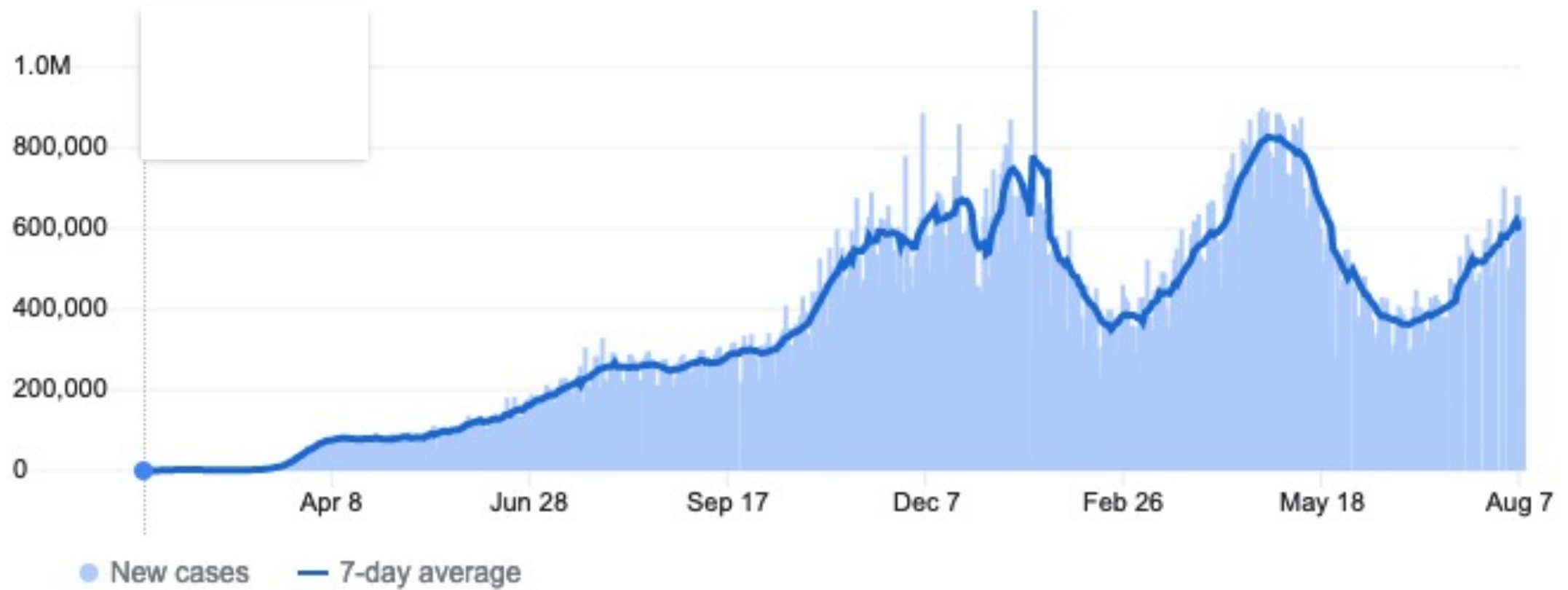
Global

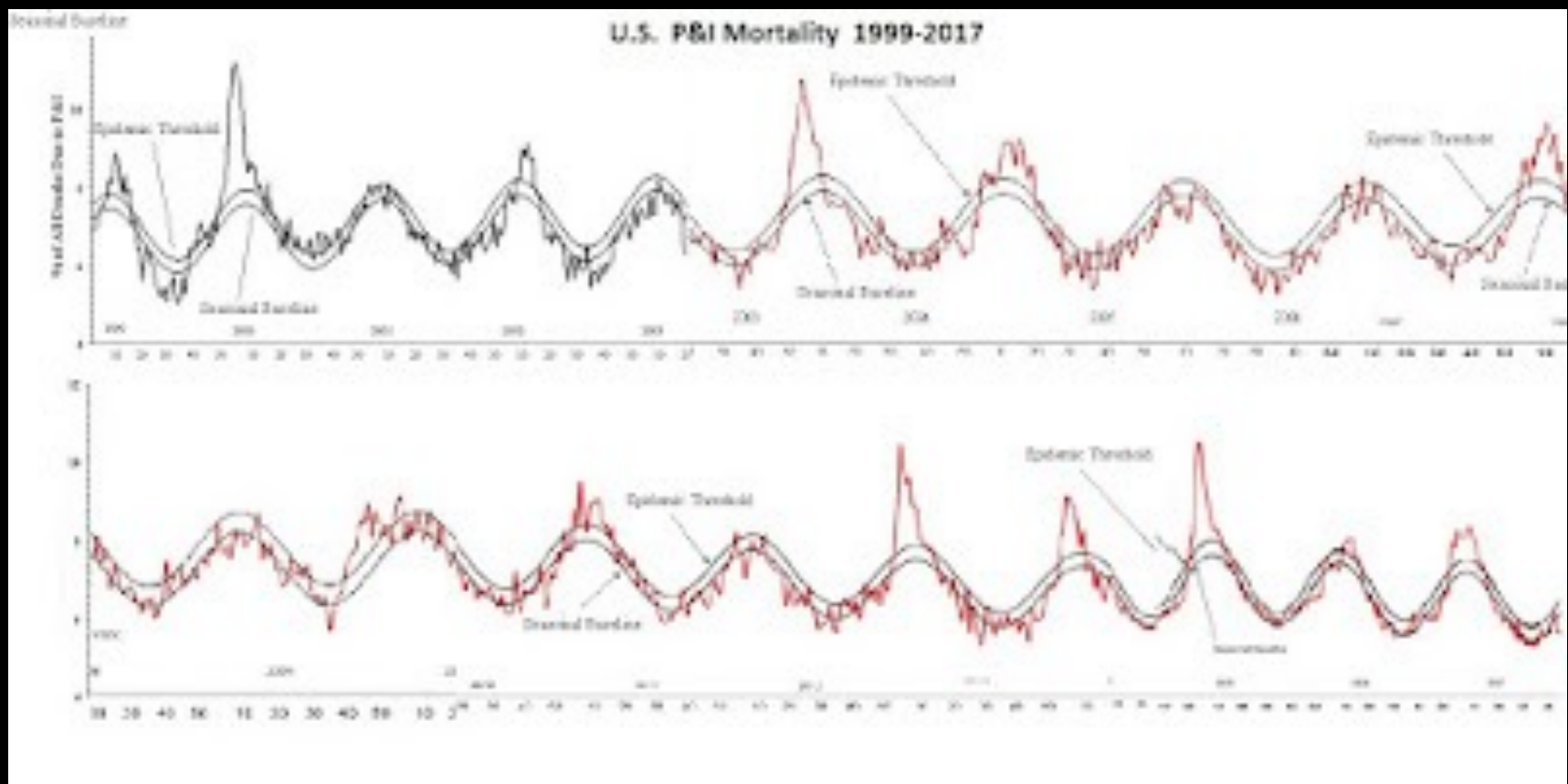
New cases ▾



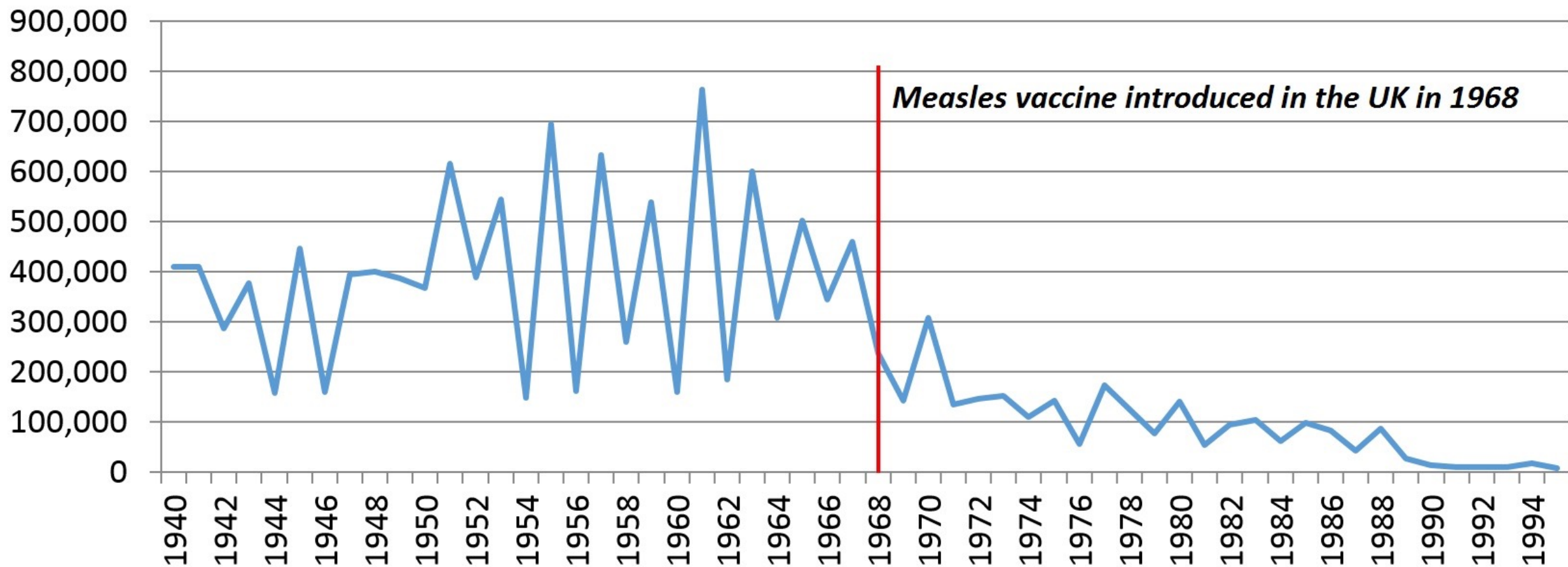
Worldwide ▾

All time ▾





Measles: annual number of notified cases in England and Wales, 1940 - 1995



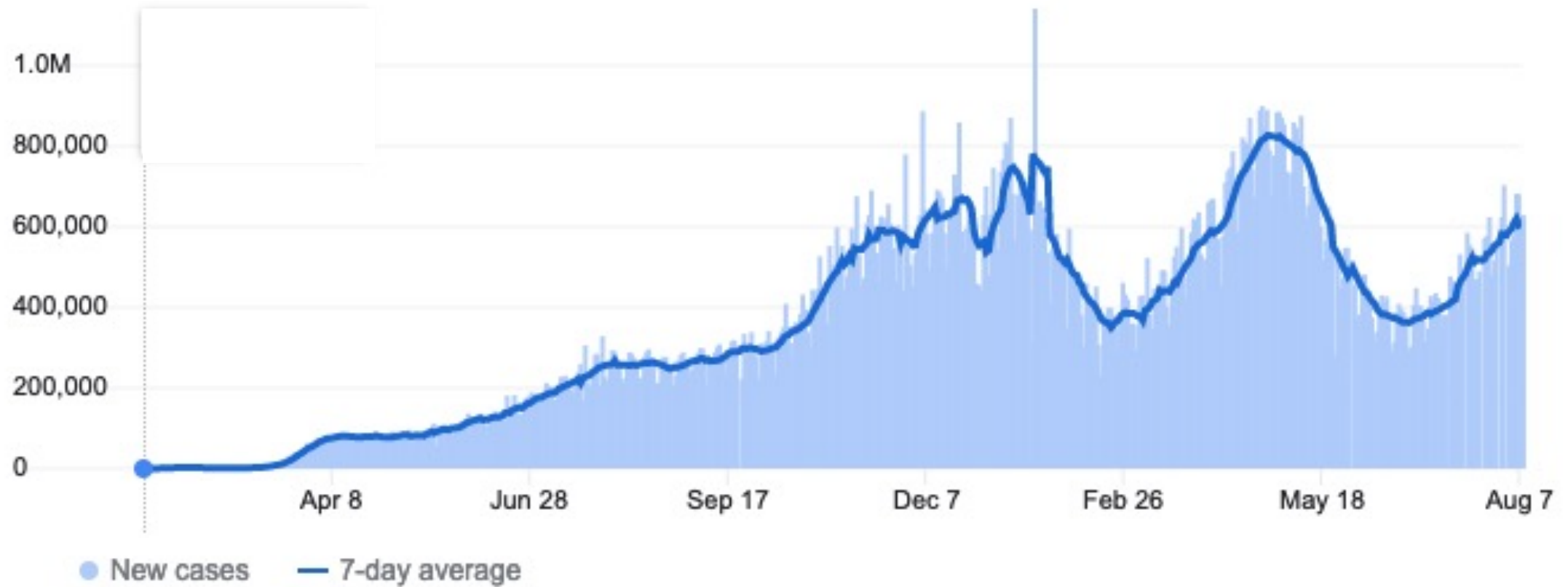
Global

New cases ▾



Worldwide ▾

All time ▾



Situation by WHO Region

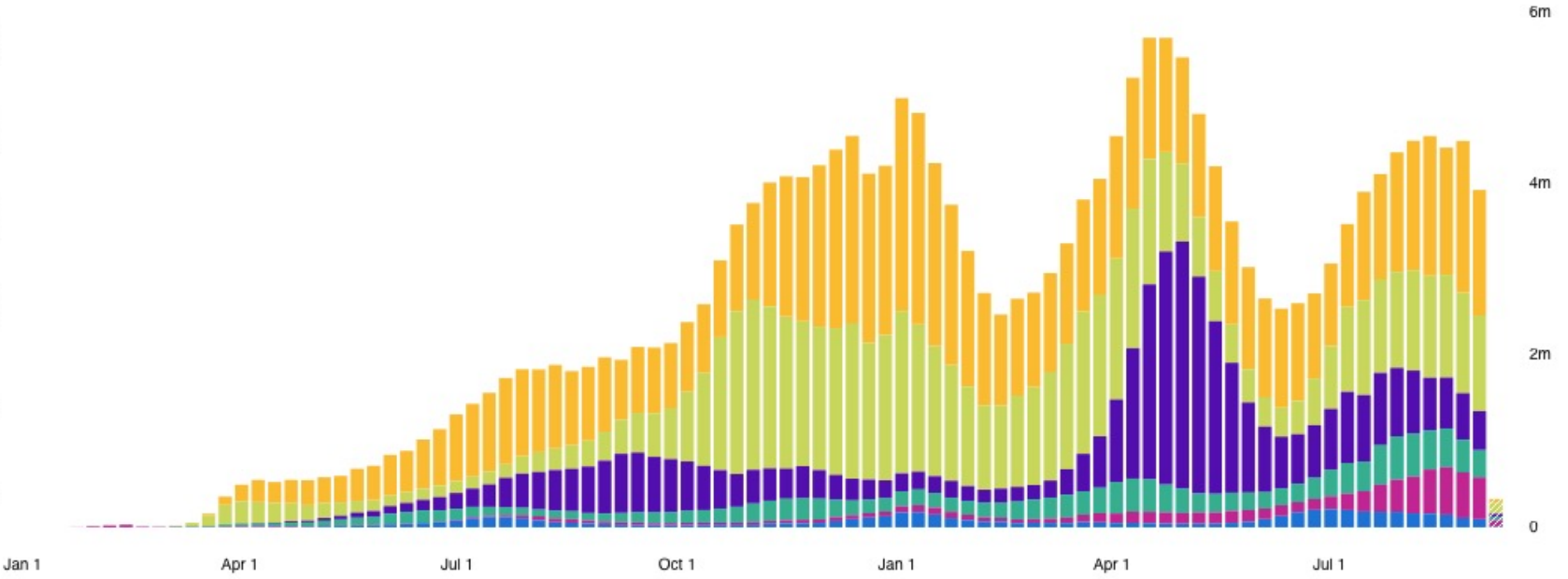


Daily Weekly

Cases Deaths

Count

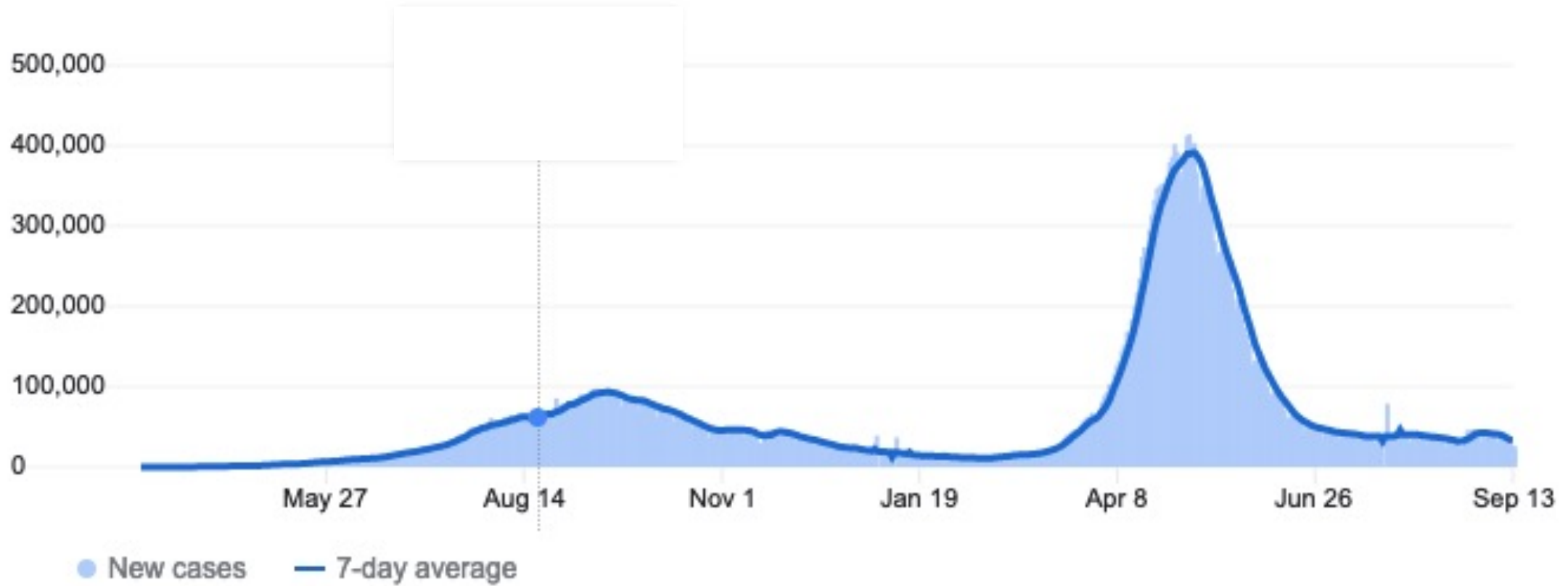
Americas	86,505,509 confirmed
Europe	67,300,263 confirmed
South-East Asia	42,155,706 confirmed
Eastern Mediterranean	15,235,802 confirmed
Western Pacific	7,492,971 confirmed
Africa	5,820,211 confirmed



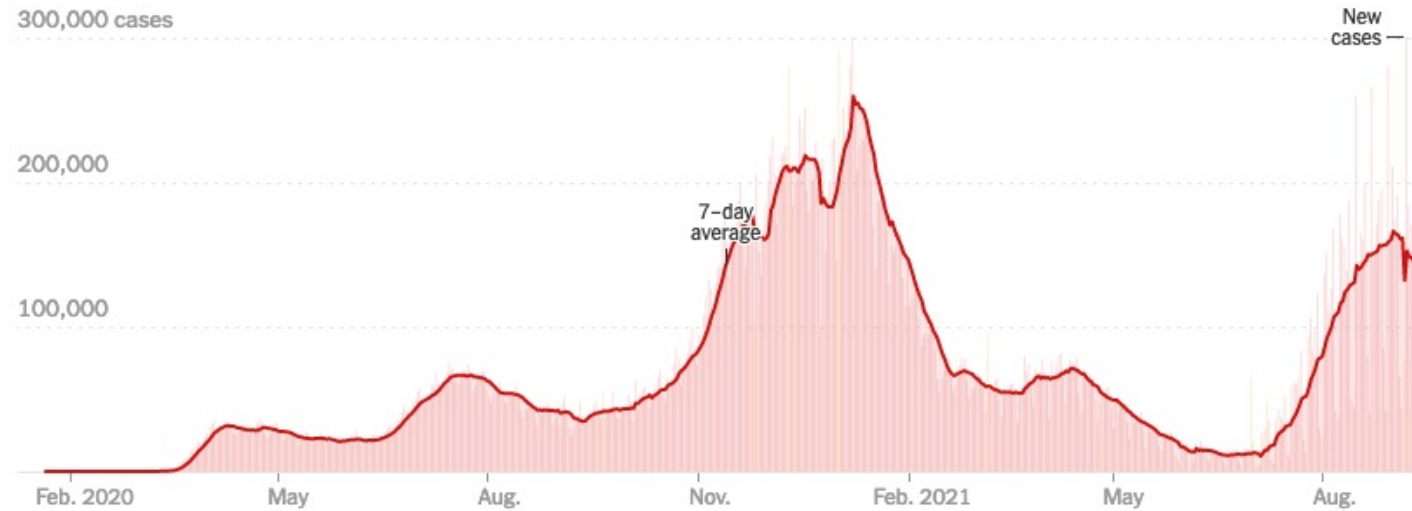
Source: World Health Organization
 Data may be incomplete for the current day or week.

India

New cases ▾ India ▾ All regions ▾ All time ▾

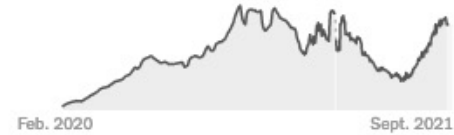


New reported cases

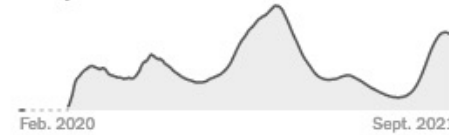


These are days with a reporting anomaly. Read more [here](#).

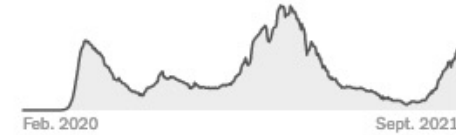
Tests



Hospitalized



Deaths

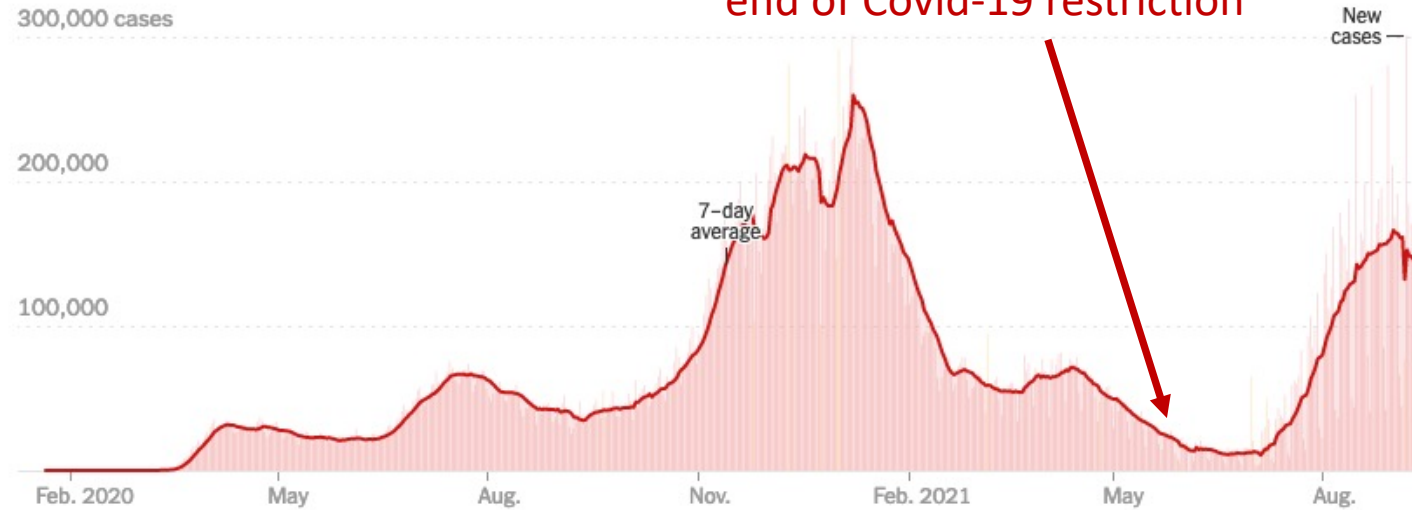


	DAILY AVG. ON SEPT. 16	14-DAY CHANGE	TOTAL REPORTED
Cases	150,366	-9%	41,790,700
Tests	1,520,339	+4%	—
Hospitalized	97,424	-5%	—
Deaths	1,969	+29%	670,231

[About this data](#)

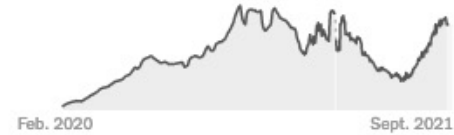
New reported cases

Dr. Walensky announces the end of Covid-19 restriction

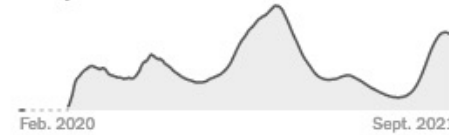


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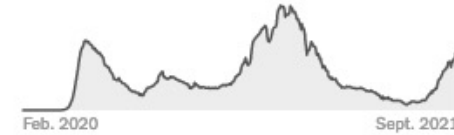
Tests



Hospitalized



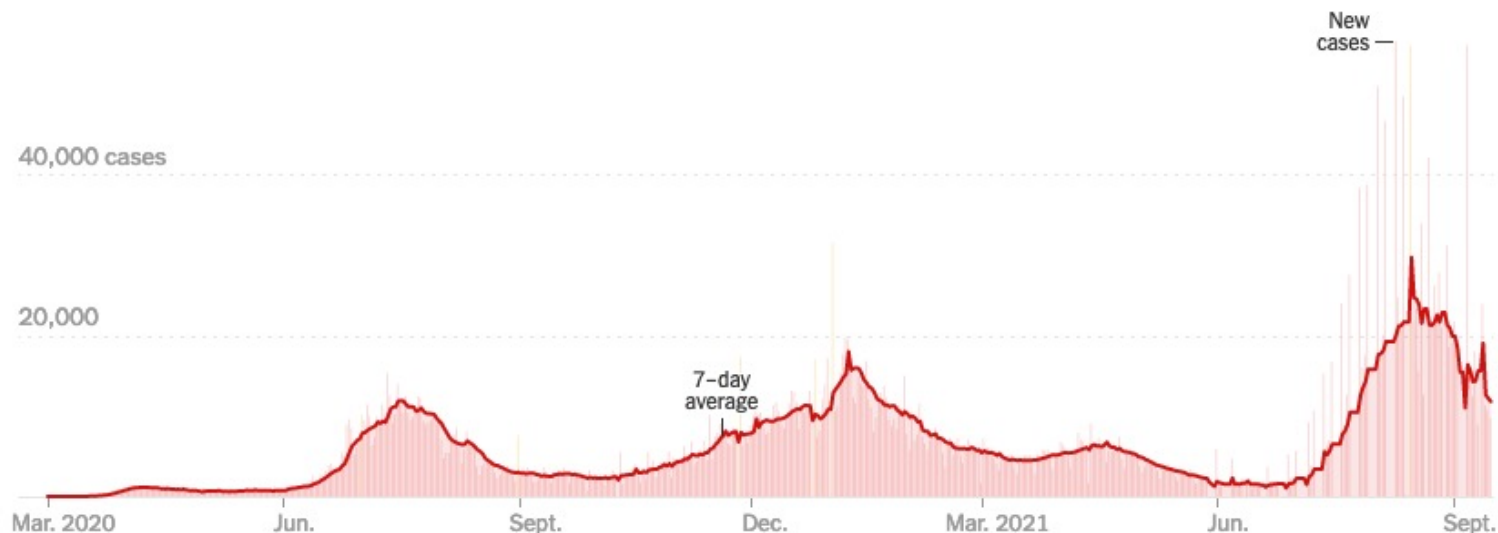
Deaths



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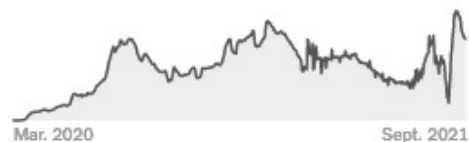
New reported cases

Florida



These are days with a reporting anomaly. Read more [here](#).

Tests



Hospitalized



Deaths

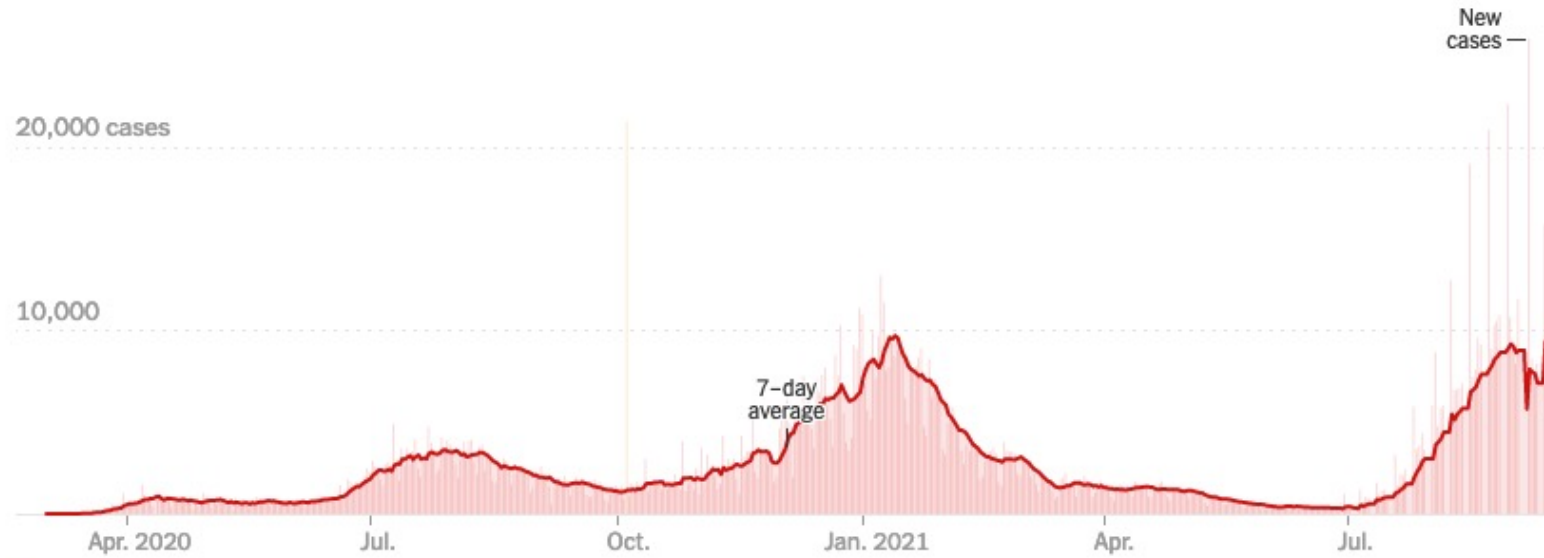


	DAILY AVG. ON SEPT. 16	14-DAY CHANGE	TOTAL REPORTED
Cases	11,816	-41%	3,473,873
Tests	102,347	-11%	—
Hospitalized	11,206	-28%	—
Deaths	363	+11%	50,811

[About this data](#)

New reported cases

Georgia



These are days with a reporting anomaly. Read more [here](#).

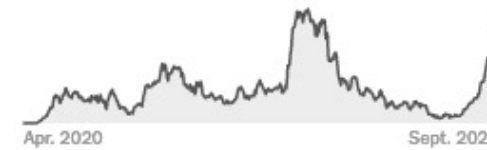
Tests



Hospitalized



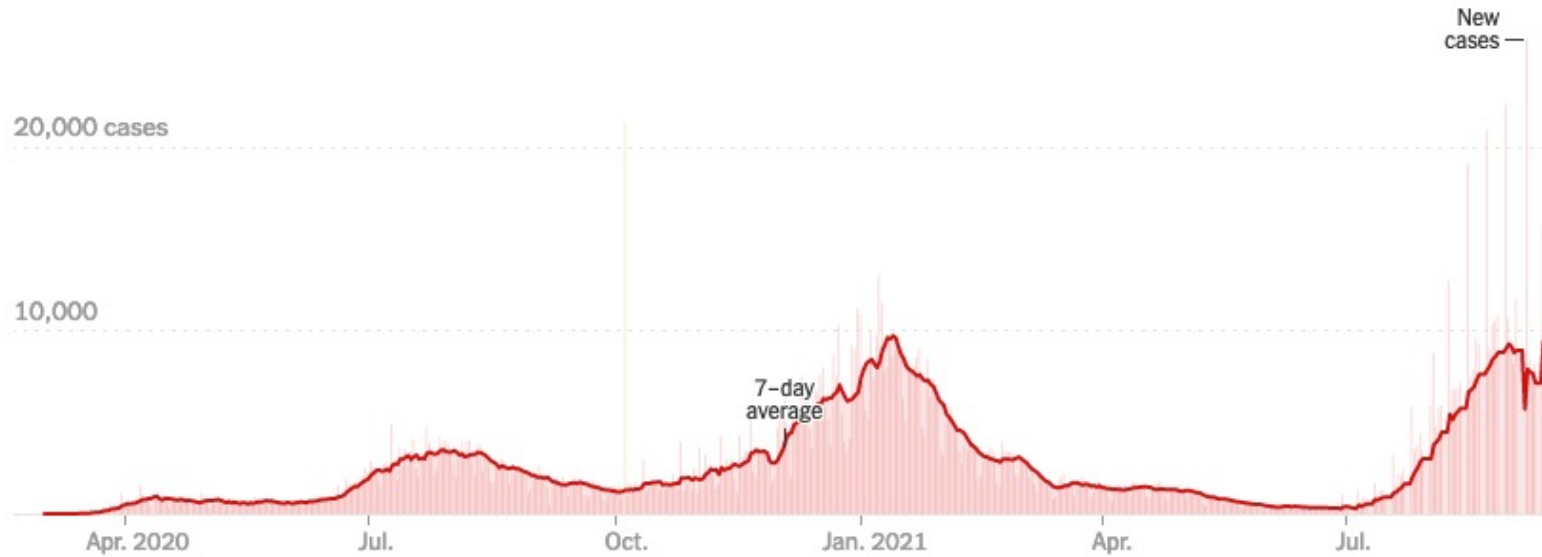
Deaths



	DAILY AVG. ON SEPT. 16	14-DAY CHANGE	TOTAL REPORTED
Cases	6,103	-30%	1,486,285
Tests	36,538	-10%	—
Hospitalized	5,982	-6%	—
Deaths	120	+69%	23,657

New reported cases

Georgia



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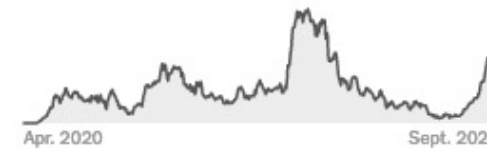
Tests



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Deaths



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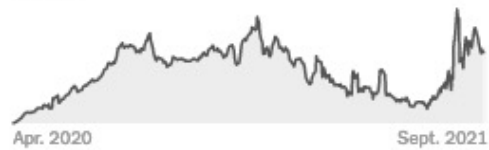
New reported cases

Alabama

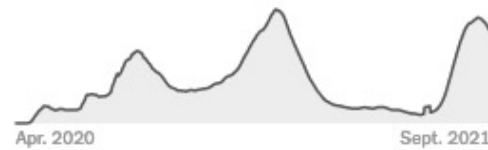


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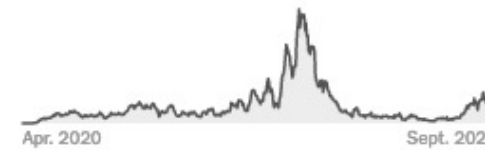
Tests



Hospitalized



Deaths



DAILY AVG. ON SEPT. 16

14-DAY CHANGE

TOTAL REPORTED

Cases

3,621

-23%

761,865

Tests

13,947

-12%

—

Hospitalized

2,720

-12%

—

Deaths

43

+34%

12,856

New reported cases

Alabama

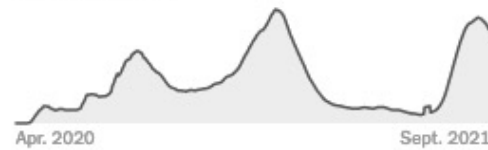


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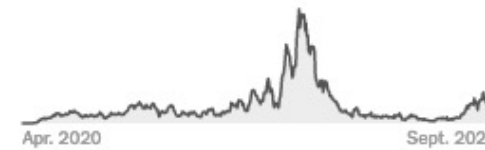
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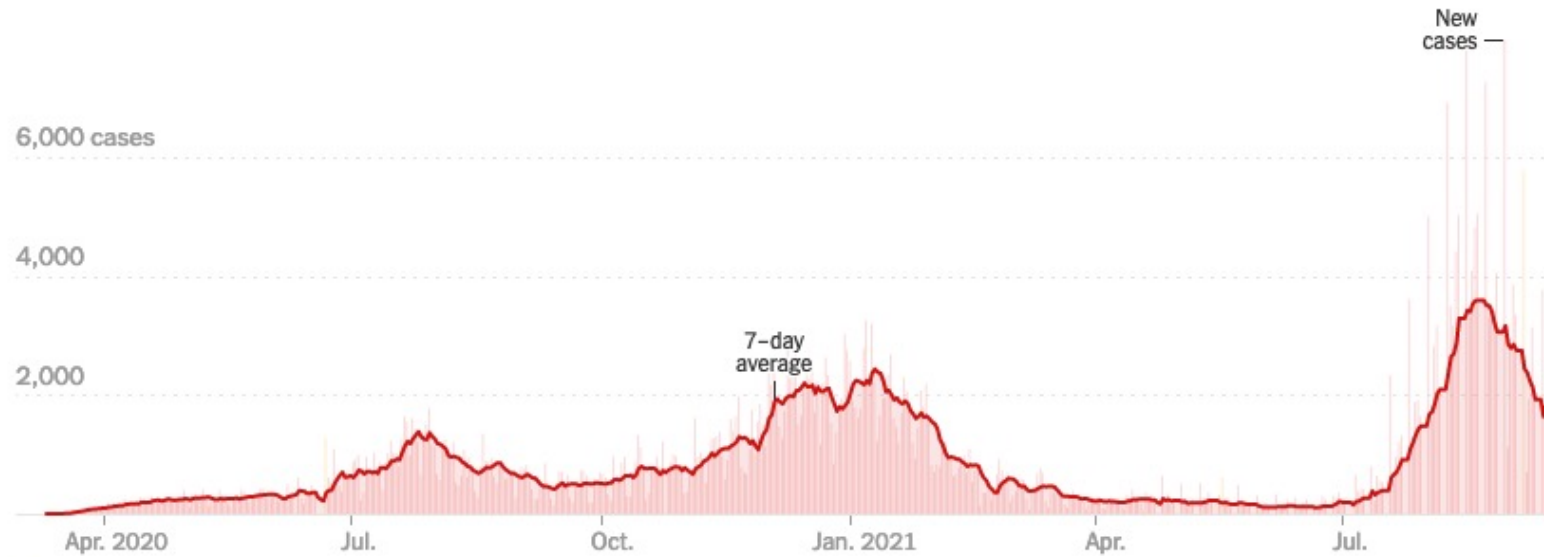
43

+34%

12,856

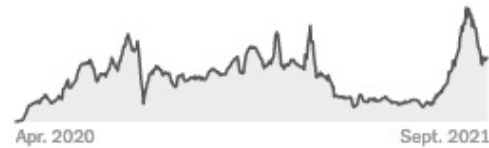
New reported cases

Mississippi

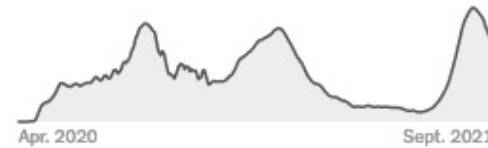


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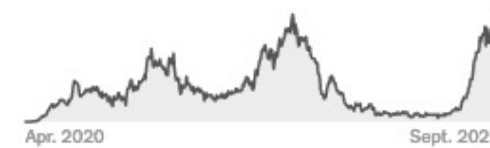
Tests



Hospitalized



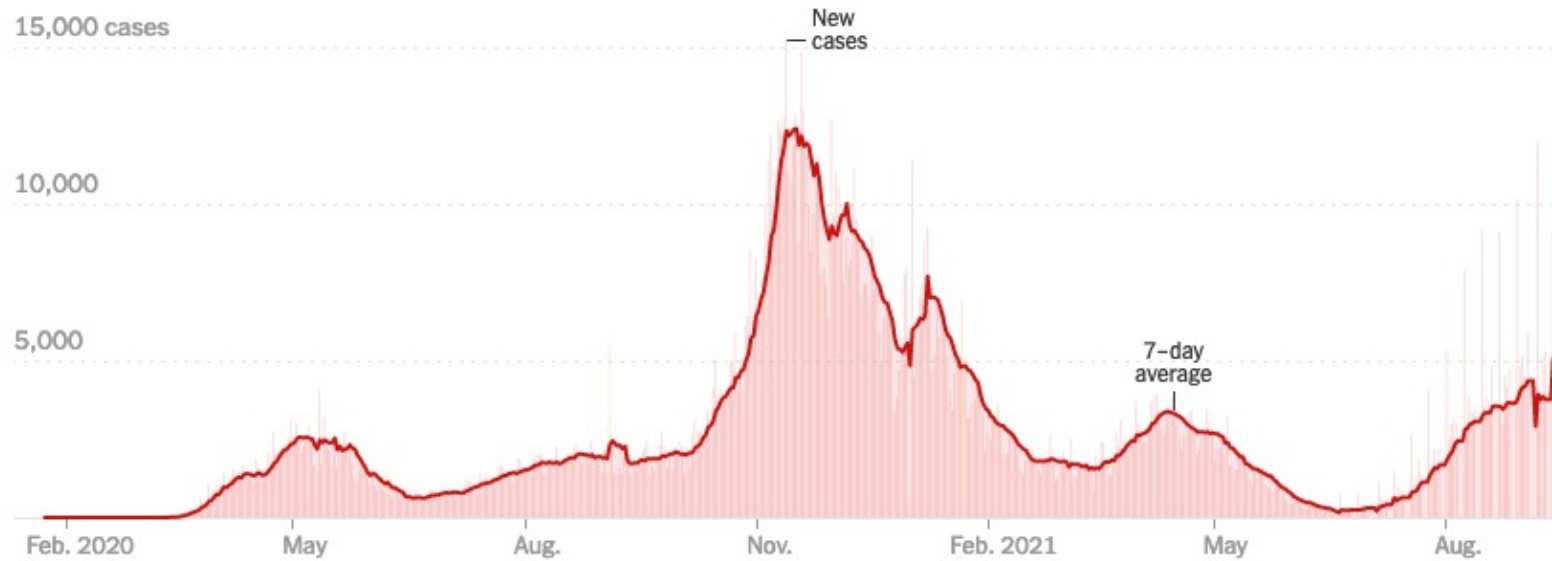
Deaths



	DAILY AVG. ON SEPT. 16	14-DAY CHANGE	TOTAL REPORTED
Cases	1,810	-36%	471,092
Tests	4,556	-32%	—
Hospitalized	1,259	-25%	—
Deaths	42	+1%	9,165

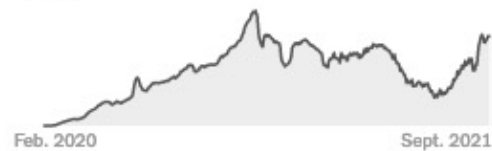
New reported cases

Illinois



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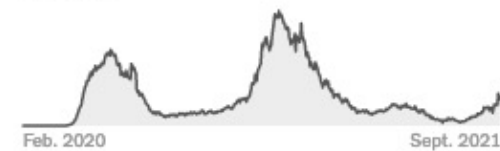
Tests



Hospitalized



Deaths



DAILY AVG. ON SEPT. 16

14-DAY CHANGE

TOTAL REPORTED

Cases

3,957

-6%

1,591,607

Tests

70,490

+41%

—

Hospitalized

2,264

+1%

—

Deaths

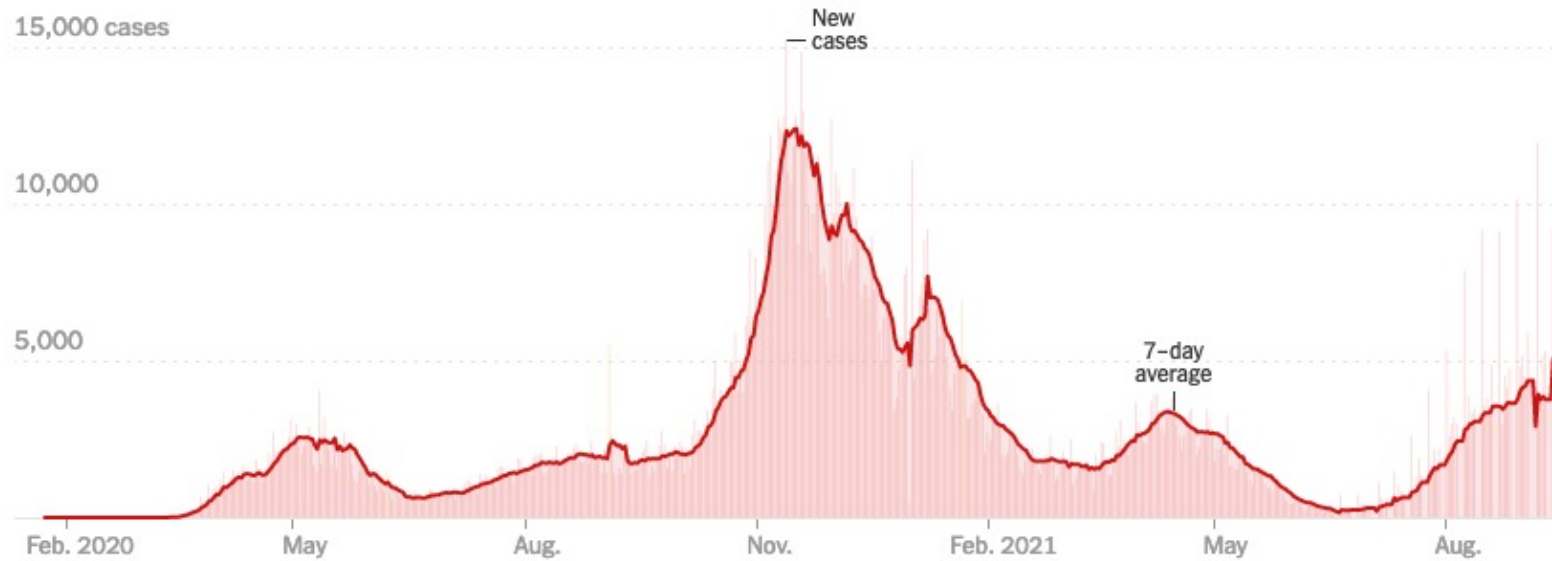
46

+87%

27,113

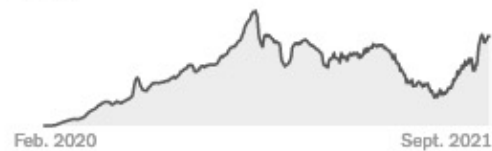
New reported cases

Illinois



These are days with a reporting anomaly. Read more [here](#).

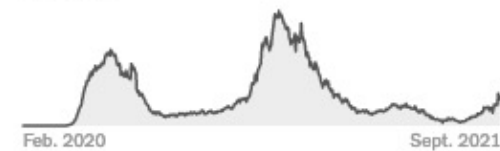
Tests



Hospitalized



Deaths

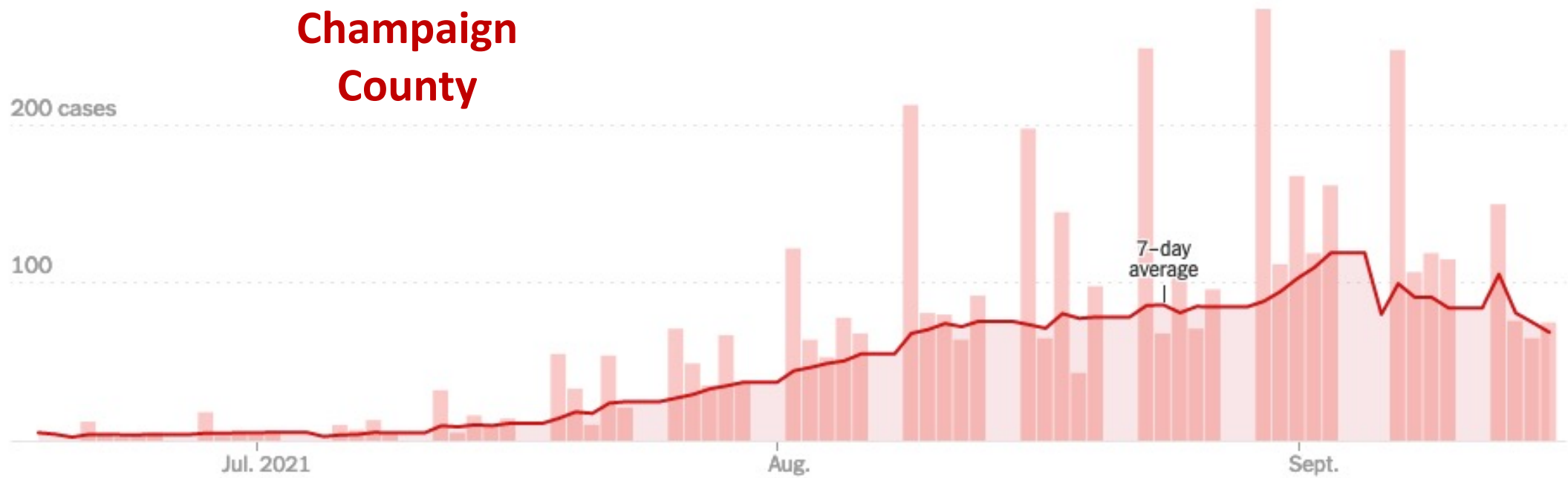


	DAILY AVG. ON SEPT. 16	14-DAY CHANGE	TOTAL REPORTED
Cases	3,957	-6%	1,591,607
Tests	70,490	+41%	—
Hospitalized	2,264	+1%	—
Deaths	46	+87%	27,113

New reported cases by day

DAILY AVG. ON SEPT. 16 **69** 14-DAY CHANGE **-37%**

Champaign County



Hospitalized

14-DAY CHANGE

+2%



Deaths

LAST TWO WEEKS

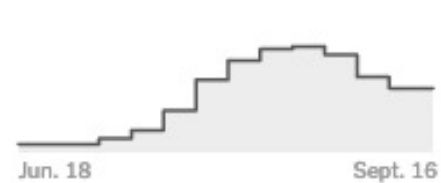
10



Test positivity

14-DAY AVG.

2%



ALL AGES

12 AND UP

65 AND UP

Fully vaccinated

52%



59%



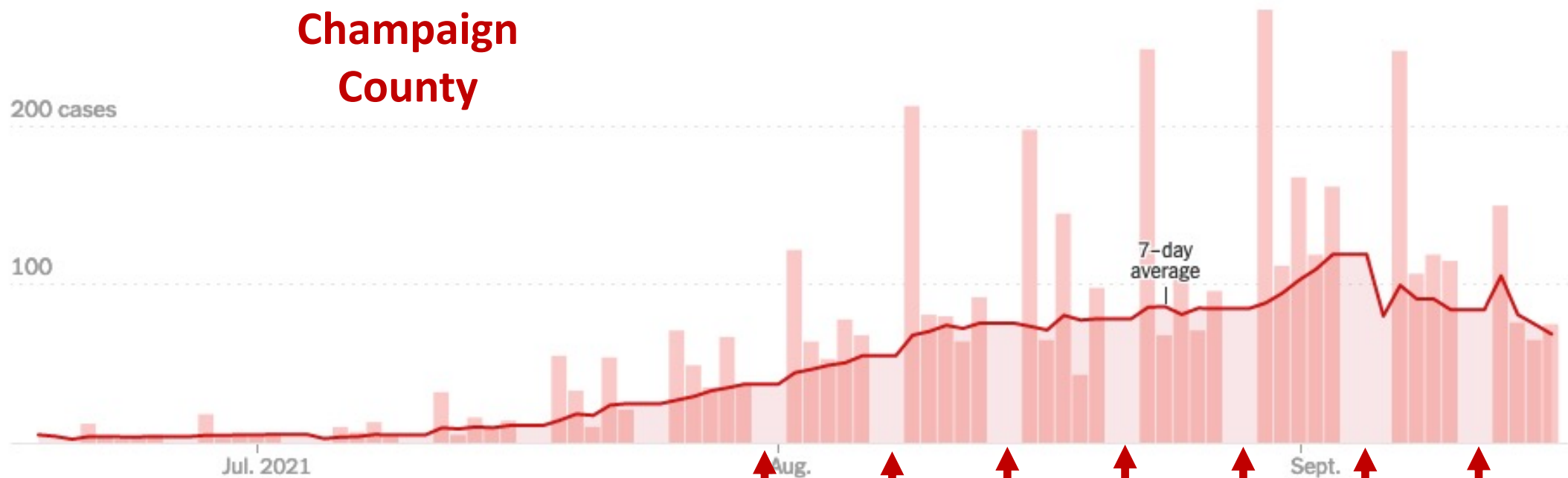
82%



New reported cases by day

DAILY AVG. ON SEPT. 16 **69** 14-DAY CHANGE **-37%**

Champaign County



Hospitalized

14-DAY CHANGE

+2%



Deaths

LAST TWO WEEKS

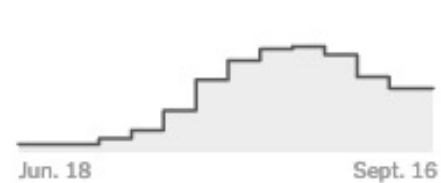
10



Test positivity

14-DAY AVG.

2%



ALL AGES

12 AND UP

65 AND UP

Fully vaccinated

52%



59%



82%



Additional Information on The Origin of SARS-Cov-2



Two New Bits of Information Have Recently Emerged

- Field notes from Dr. Shi (of “Bat Lady” fame) regarding the conditions in the Yunnan Caves where she and her team collected specimens of bats
- An email from Dr. Shi to a foreign colleague expressing concern that her lab might have caused the outbreak in Wuhan

Connection to the Yunnan Caves

- You will hopefully recall that there are two main hypotheses for the origin of SARS-CoV-2: the lab-leak hypothesis and the natural evolution hypothesis
- We also discussed a third, unifying hypothesis concerning the possible infection a lab worker while collecting bat specimens in the Yunnan Caves
- Under this hypothesis, one or more of the laboratory technicians collecting specimens in caves could have brought the virus back to Wuhan where they then introduced it into the local population and wet markets

Conditions in the Yunnan Caves

- Based on Dr. Shi's published field notes, conditions in the caves could easily have led to exposure and infection to a number of bat viruses, including SARS-CoV-2
- In most of the caves, the team had to crawl on their stomachs through narrow openings into the cave and then move through hot, airless chambers that became narrower and narrower
- I recall reading field notes from similar CDC missions to caves in southwest Texas to study bat rabies
- On those missions, some staff were infected with rabies, either from scratches from the limestone or from inhaling air that was contaminated with bat guano that contained virus

Dr. Shi's Email

- This email, which was obviously written prior to the censoring of all outside contact, expressed concern that the virus might have been introduced into Wuhan from her lab
- There was nothing in the email about the virus being created in her lab, but rather that viruses with nearly identical genetic sequences were being studied in the lab
- The tone of the email was more of wondering if it was possible, not a real fear that it might have happened

Update on Influenza

Will we Even Have Influenza This Year?

- Last year, the 2020 – 2021 flu season was a non-event
- For the second year in a row, Australia has not experienced an influenza outbreak
- We can't look at data yet for the 2021 – 2022 season because it doesn't officially begin until October 1st
- Nonetheless, judging by the ending of the current season, it looks likely that we could have a significant number of influenza cases in the coming season

Australia Influenza, 2021

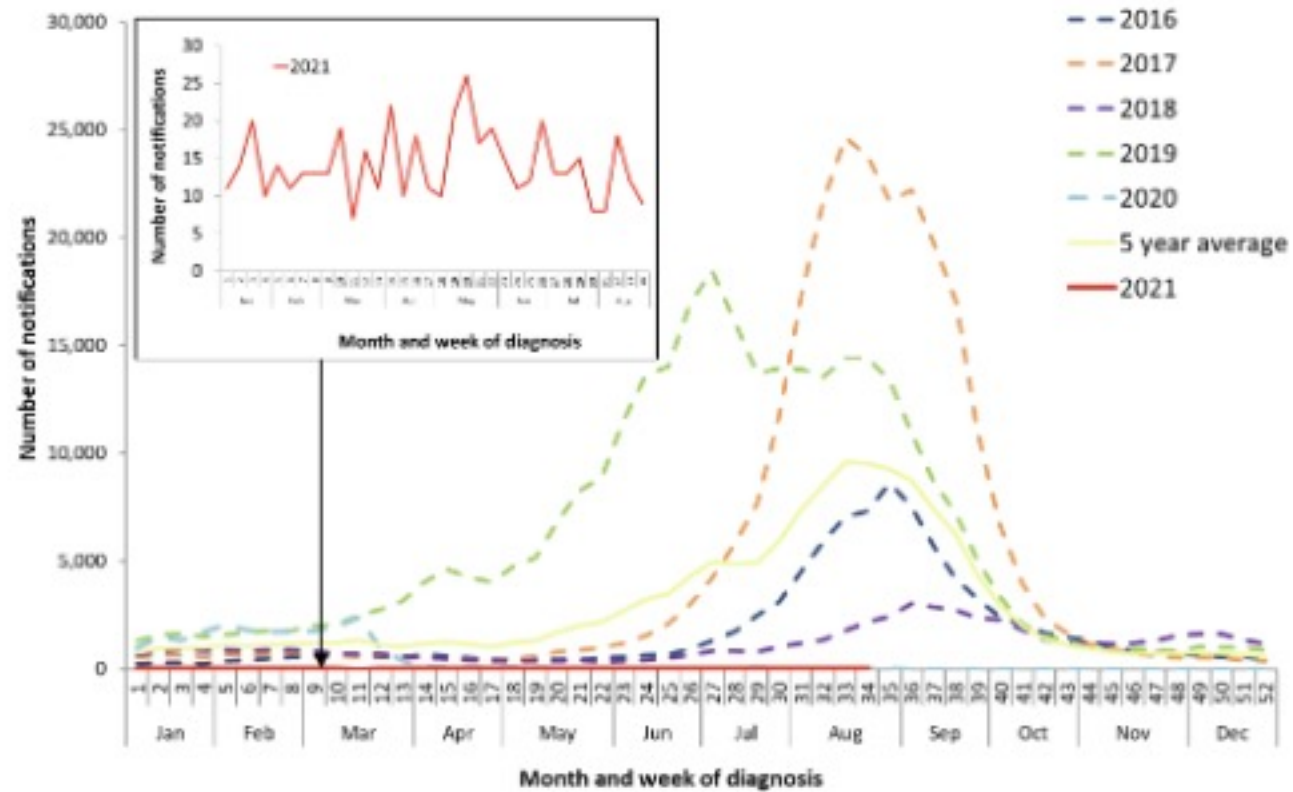
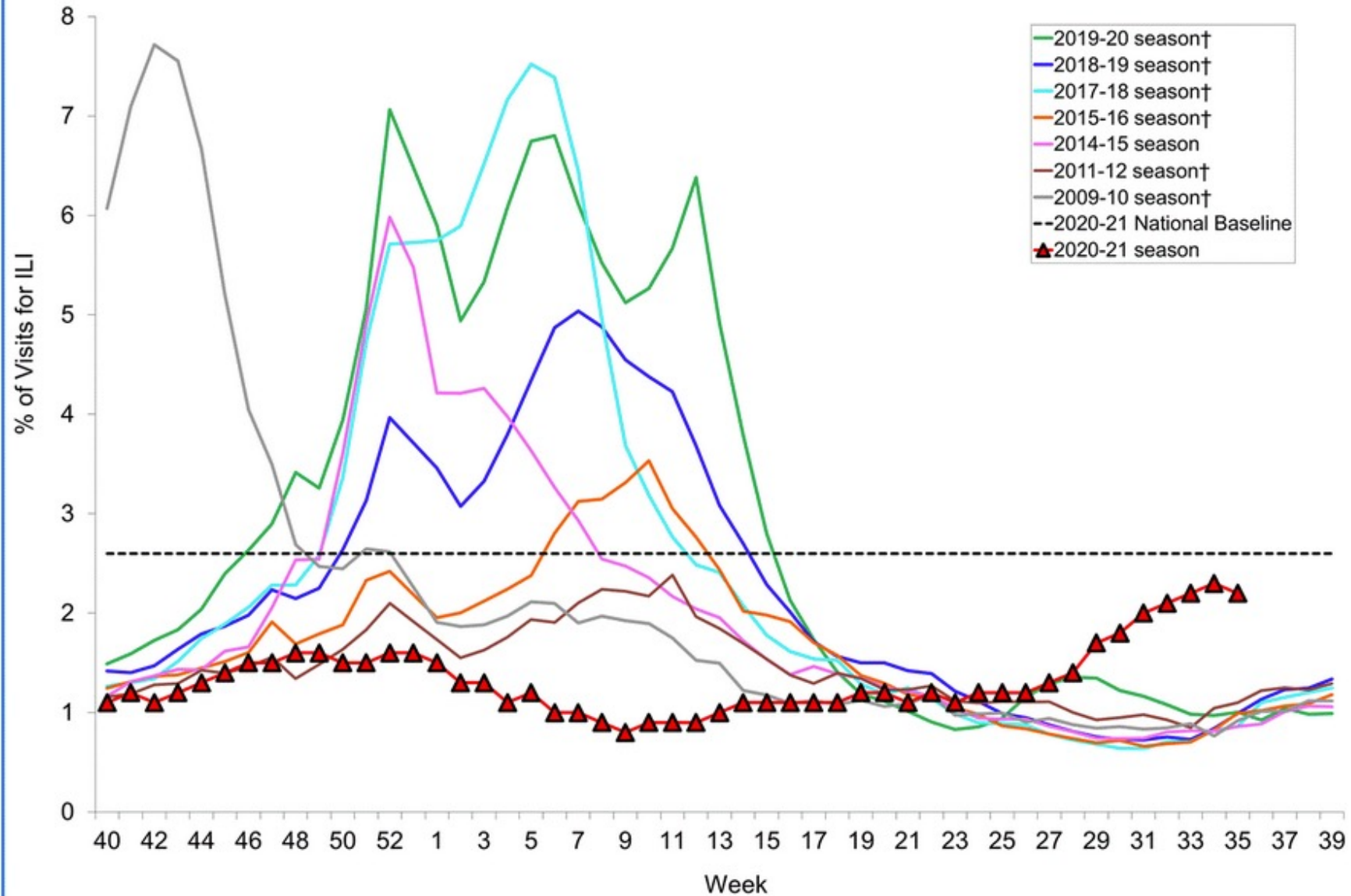


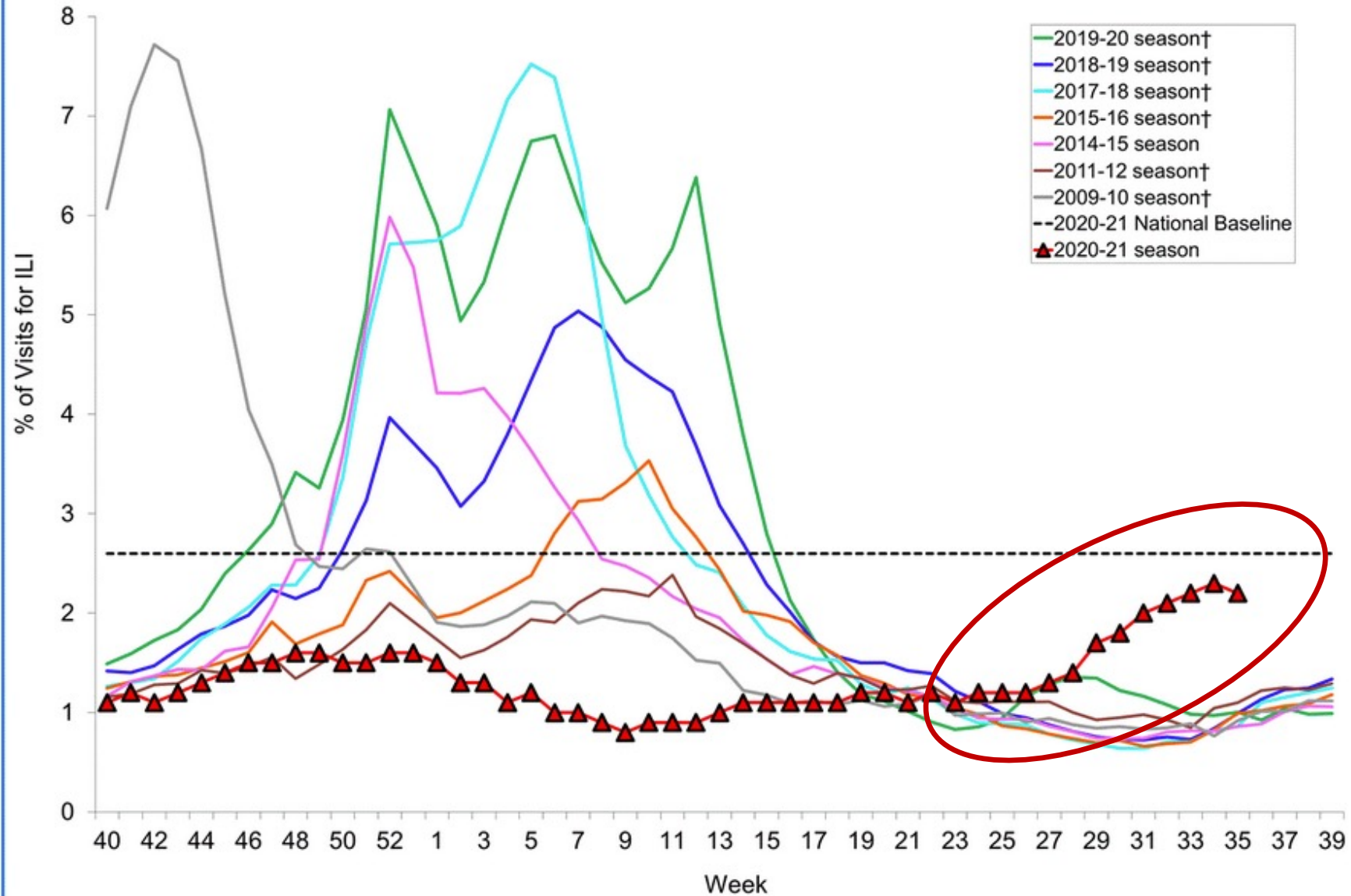
Figure 14: Notifications of laboratory-confirmed influenza by month and week from 2016 to 2021 in Australia ([Source](#): National Notifiable Diseases Surveillance System, Australian Department of Health)

Percentage of Visits for Influenza-like Illness (ILI) Reported by the U.S. Outpatient Influenza-like Illness Surveillance Network (ILINet), Weekly National Summary, 2020-2021 and Selected Previous Seasons



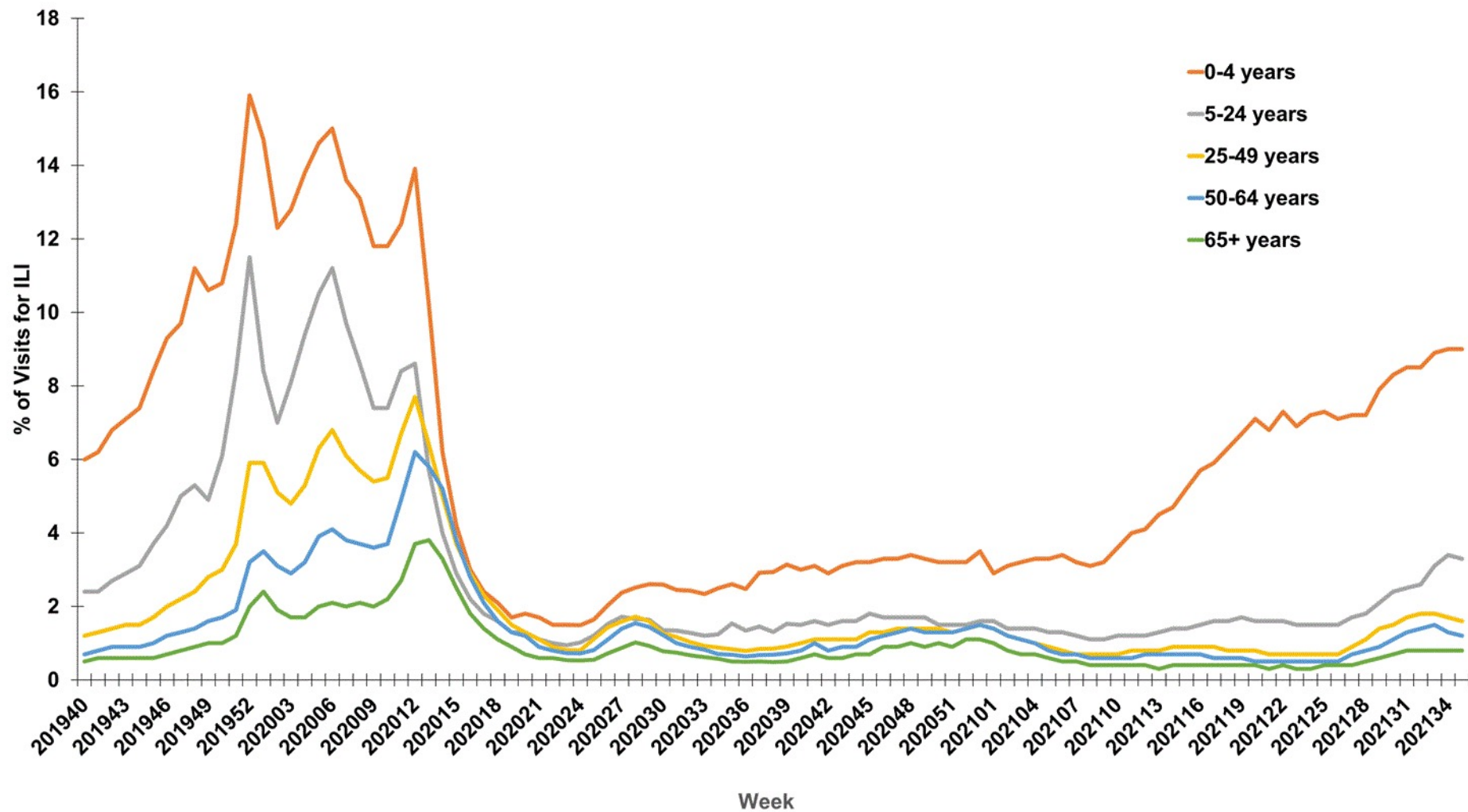
†These seasons did not have a week 53, so the week 53 value is an average of week 52 and week 1.

Percentage of Visits for Influenza-like Illness (ILI) Reported by the U.S. Outpatient Influenza-like Illness Surveillance Network (ILINet), Weekly National Summary, 2020-2021 and Selected Previous Seasons

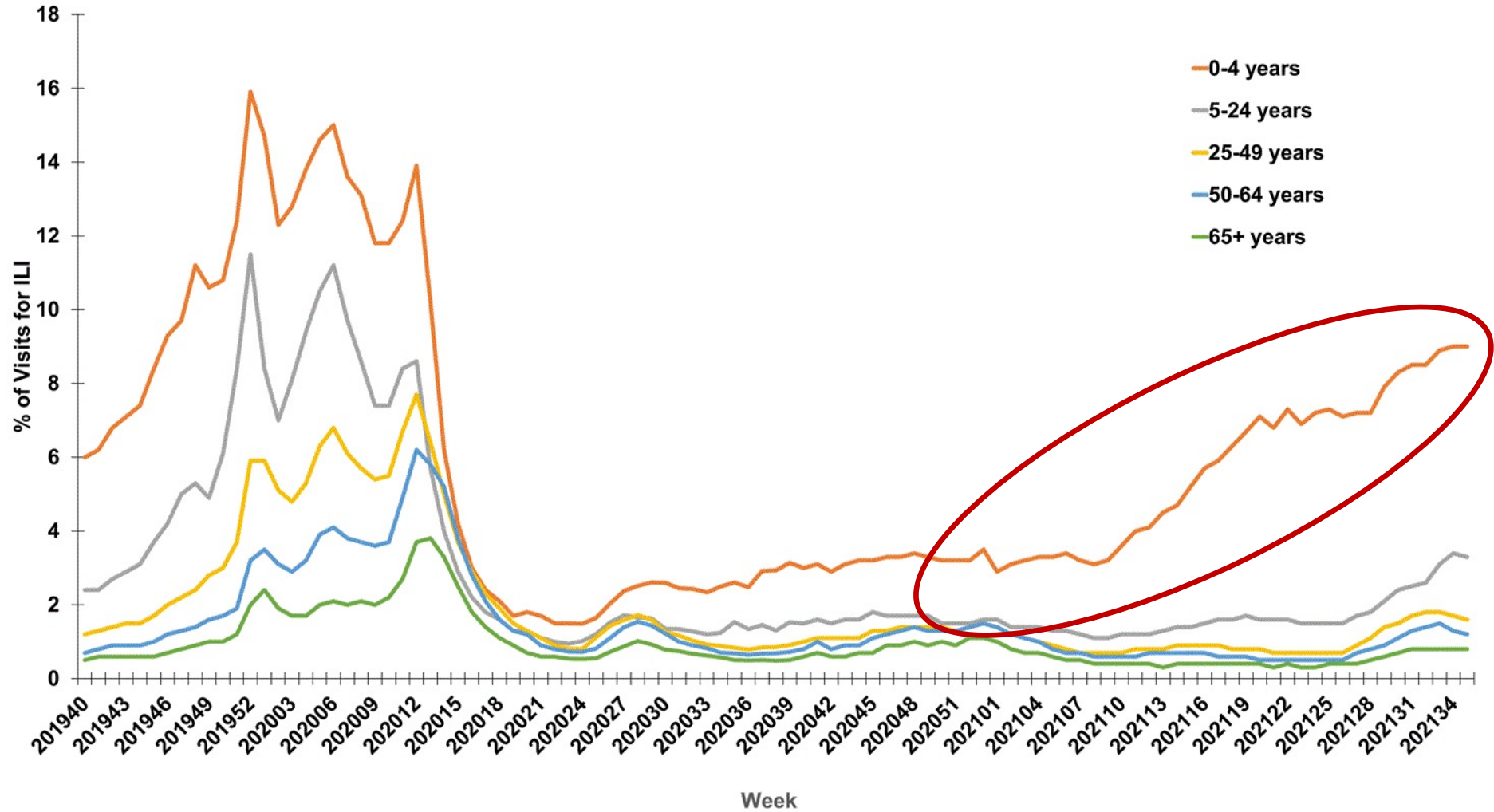


†These seasons did not have a week 53, so the week 53 value is an average of week 52 and week 1.

Percentage of Visits for Influenza-Like Illness (ILI) by Age Group
Reported by the U.S. Outpatient Influenza-like Illness Surveillance Network (ILINet),
Weekly National Summary, 2019-2020 and 2020-2021 Seasons



Percentage of Visits for Influenza-Like Illness (ILI) by Age Group
Reported by the U.S. Outpatient Influenza-like Illness Surveillance Network (ILINet),
Weekly National Summary, 2019-2020 and 2020-2021 Seasons



My Thoughts on Influenza Vaccines

- Nothing has really changed from my previous recommendations
- Wait until the end of October or the beginning of November to receive your vaccine
- My top four choices: Flublok, Flucelvax, Fluad, and Fluzone high-dose
- You will need to call around to locate Flublok; the others are available now at a number of pharmacies

Changes in the Vaccine Components

- The A(H1N1) component has changed
- The A(H3N2) component has changed
- The B/Victoria component has changed
- The B/Yamagata component remains the same

THANK YOU!!!

