

Misinformation vs Disinformation

The fifth Horseman of the modern Apocalypse



- Misinformation: your wrong and you don't know it
- Disinformation: you're wrong and you know it
- Biased: Your wrong and you should know it

Misinformation vs Credibility

Misinformation – getting it wrong-
implies this is a binary issue

Disinformation – Focuses on
Intent

Credibility

- Relevance of Expertise
- Potential for Bias

Credibility Case Study

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COVID-19 Antibody Seroprevalence in Santa Clara County, California

Eran Bendavid, Bianca Mulaney, Neeraj Sood, Soleil Shah, Emilia Ling, Rebecca Bromley-Dulfano, Cara Lai, Zoe Weissberg, Rodrigo Saavedra-Walker, Jim Tedrow, Dona Tversky, Andrew Bogan, Thomas Kupiec, Daniel Eichner, Ribhav Gupta, John P.A. Ioannidis, Jay Bhattacharya

doi: <https://doi.org/10.1101/2020.04.14.20062463>

Now published in *International Journal of Epidemiology* doi: 10.1093/ije/dyab010

Abstract

Full Text

Info/History

Metrics

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Abstract

Background Addressing COVID-19 is a pressing health and social concern. To date, many epidemic projections and policies addressing COVID-19 have been designed without seroprevalence data to inform epidemic parameters. We measured the seroprevalence of antibodies to SARS-CoV-2 in a community sample drawn from Santa Clara County.

Methods On April 3-4, 2020, we tested county residents for antibodies to SARS-CoV-2 using a lateral flow immunoassay. Participants were recruited using Facebook ads targeting a sample of individuals living within the county by demographic and geographic characteristics. We estimate weights to adjust our sample to match the zip code, sex, and race/ethnicity distribution within the county. We report both the weighted and unweighted prevalence of antibodies to SARS-CoV-2. We also adjust for test performance characteristics by combining data from 16 independent samples obtained from manufacturer's data, regulatory submissions, and independent evaluations: 13 samples for specificity (3,324 specimens) and 3 samples for sensitivity (157 specimens).

Posted April 30, 2020.

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Credibility Red Flags

Lack of Expertise

1. Relevance of previous publications
2. Training
3. First and Senior authors vs. add on authors

Bias (Independent of content)

1. Conclusions precede research
2. Ignoring feedback from experts
3. Conflict of interest
4. Lack of transparency
5. Close connection to publishing journal
6. Post publication promotional campaign

Bias (assessment requires some understanding)

1. Cherry Picking
2. Post hoc analysis, especially biased post hoc analysis (data torture)
3. Failure to use standard methods to minimize bias
4. Lack of self skepticism
5. Unidirectional concern about bias





Relevance of Experience/Expertise

medRxiv

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BMJ Yale

The Team

- 2 Health Economists
- 1 Hedge Fund Manager
- 1 Infectious Disease Physician
- 1 Epidemiologist (meta-analyst and critic)
- No one who had ever done a seroprevalence study

COVID-19 Antibody Seroprevalence in Santa Clara County, California

Eran Bendavid, Bianca Mulaney, Neeraj Sood, Soleil Shah, Emilia Ling, Rebecca Bromley-Dufano, Cara Lai, Zoe Weissberg, Rodrigo Saavedra-Walker, Jim Tedrow, Dona Tversky, Andrew Bogen, Thomas Kupiec, Daniel Eichner, Ribhav Gupta, John P.A. Ioannidis, Jay Bhattacharya

doi: <https://doi.org/10.1101/2020.04.14.20062463>

Now published in *International Journal of Epidemiology* doi: 10.1093/ije/dyab010

ESSAY

Why Most Published Research Findings Are False

John P. A. Ioannidis

Published: August 30, 2005 • <https://doi.org/10.1371/journal.pmed.0020124>

Article	Authors	Metrics	Comments	Media Coverage
▼				

Correction

Abstract

Modeling the Framework for False Positive Findings

Correction

25 Aug 2022: Ioannidis JPA (2022) Correction: Why Most Published Research Findings Are False. PLOS Medicine 19(8): e1004085. <https://doi.org/10.1371/journal.pmed.1004085> | [View correction](#)



Conclusions Precede Research

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OPINION COMMENTARY

It's Dangerous to Test Only the

Random sampling is essential to learn the truth about the deadliness.

By Neeraj Sood

March 15, 2020 12:08 pm ET

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“Scientists in a given field may be prejudiced purely because of their belief in a scientific theory or commitment to their own findings.” -John Ioannidis



A nurse holds swabs and a test tube to test people for Covid-19 at a drive-through station set up in the parking lot of the

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FIRST OPINION

A fiasco in the making? As the coronavirus pandemic takes hold, we are making decisions without reliable data

By John P.A. Ioannidis March 17, 2020

Reprints



Selectively Ignoring Subject Matter Experts



Taia T. Wang, MD, PhD, MSCI

ASSOCIATE PROFESSOR OF MEDICINE (INFECTIOUS DISEASES) AND
OF MICROBIOLOGY AND IMMUNOLOGY



Scott D. Boyd, MD PhD

STANFORD PROFESSOR OF FOOD ALLERGY AND IMMUNOLOGY AND
PROFESSOR OF PATHOLOGY

Practices at Stanford Health Care, Stanford Medicine Children's Health,
Stanford Health Care Tri-Valley

- Wang’s experiments on the test left her “alarmed,”
- The test “performed very poorly on samples with lower antibody” levels that are more representative of people with mild or asymptomatic infections.
- In her email to the group of faculty, Wang was clear: She did not want her name on the paper and did not trust the test.
- According to the whistleblower complaint, the researchers did not wait to hear what Boyd thought. They had gone ahead and submitted their paper to MedRxiv.
- Ioannidis also pointed out that it was a preprint, not a published study, and therefore subject to further revision



Conflict of Interest

JetBlue's Founder Helped Fund A Stanford Study That Said The Coronavirus Wasn't That Deadly

A Stanford whistleblower complaint alleges that the controversial John Ioannidis study failed to disclose important financial ties and ignored scientists' concerns that their antibody test was inaccurate.



Stephanie M. Lee
BuzzFeed News Reporter

Posted on May 15, 2020 at 2:13 pm



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BuzzFeed News; Michael Nagle/Bloomberg via Getty Images; Getty Images; vetenskapsfestivalen via YouTube

Whistleblower Account

- One email, without a visible timestamp or sender that was sent to Bogan's and Neeleman's addresses, read: "David, I think you should write Taia a note and tell her you'll support her lab if she validates this kit." Bendavid confirmed that he put Neeleman and Wang in touch.
- "If you are willing to do a 5,000 test in New York, just tell me the cost and I will raise the money immediately,"
- "Conversations with Mr. Neeleman helped me understand how vital the Santa Clara results would be for millions of people. He mentioned, for example, that Elon Musk was interested in funding a nationwide study." – Jay Bhattacharya



Lack of Transparency

"David Neeleman has a particular perspective and some ideas and some thoughts. I don't know exactly who were the people who funded the study eventually. But whoever they were, none of them really told us it should be designed in a given way or done in a given way or find a particular type of result or report a particular type of result."

- Ioannidis



Volume 50, Issue 2
April 2021

Conflict of interest

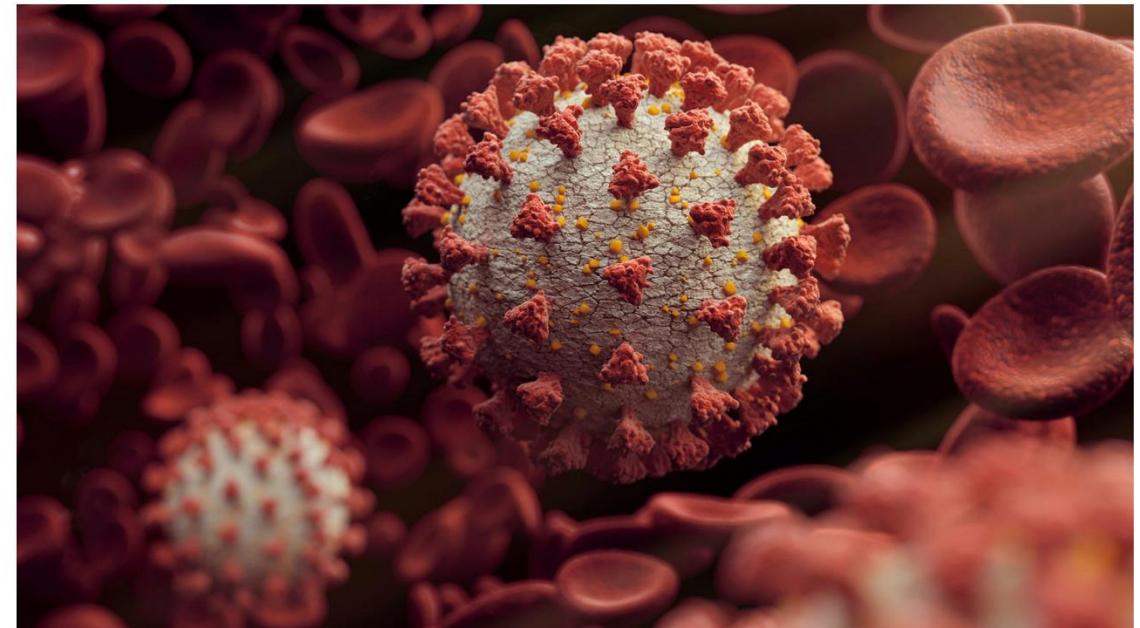
None declared. Of note, test kits were purchased from [redacted] and none of the authors has a relationship to the test manufacturer (other than the tests).

References

– NEWS AND COMMENTARY –

NEELEMAN: Stanford Professors' Coronavirus Study Could Be Game Changer

By David Neeleman • Apr 7, 2020 DailyWire.com • [f](#) [X](#) [g](#)

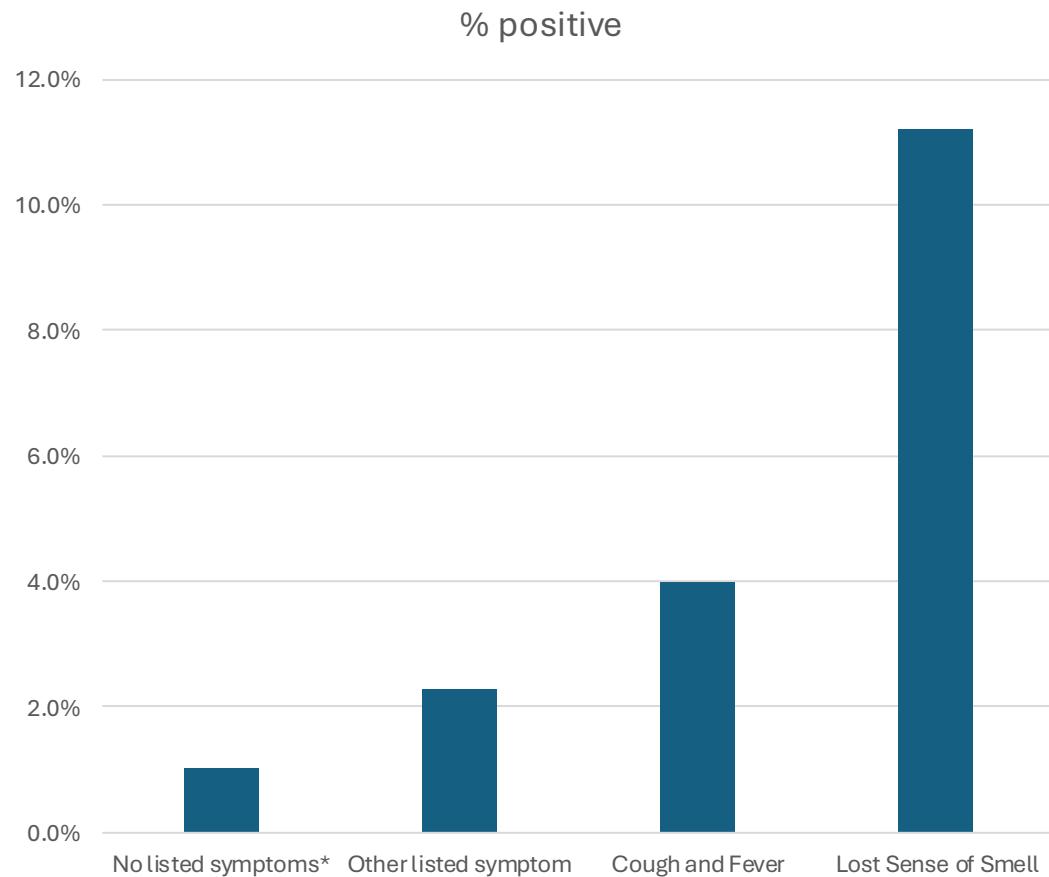


Radoslav Zilinsky via Getty Images

"My search for a solution has led me to three amazing and dedicated professors and scientists from Stanford University School of Medicine with impeccable credentials. I have come to know them personally. Drs. John Ioannidis, Jay Bhattacharya and Eran Bendavid" - Neeleman



Design Failure and Lack of Transparency



- CFR in Santa Clara at the time was 5-8% (underassessment even worse than for WHO)
- Failed to ask about 3 of the top 6 symptoms of COVID (fatigue, myalgia, headaches)
- Did not note that 40% of positives had lost sense of smell
- Did not simply ask about motivation for participating.



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Volume 50, Issue 2

April 2021

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COVID-19 antibody seroprevalence in Santa Clara County, California

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International Journal of Epidemiology, Volume 50, Issue 2, April 2021, Pages 410–419,
<https://doi.org/10.1093/ije/dyab010>

Published: 22 February 2021 Article history ▾

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Abstract

Background

Measuring the seroprevalence of antibodies to Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) is central to understanding infection risk and fatality rates. We studied Coronavirus Disease 2019 (COVID-19)-

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New Data Suggest the Coronavirus Isn't as Deadly as We Thought

A study finds 50 to 85 times as many infections as known cases—meaning a far lower fatality rate.

By Andrew Bogan

April 17, 2020 at 4:28 pm ET

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1343



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- 59 blogs
- 3 policy sources
- 20889 tweeters
- 22 Facebook pages
- 1 Wikipedia page
- 3 video uploaders



The Dirty Truth (Josh) @AKA_RealDirty · Apr 20, 2020

This Stanford doctor did the antibody study in **Santa Clara** county and it shows the **#CoronaVirus** has a fatality rate close to the influenza fatality rate each year.

🔗 ...



Alex Berenson @AlexBerenson · Apr 17, 2020

The **@stanford** antibody testing is out - it estimates ~3% of people in **Santa Clara** County (CA) have been infected and recovered, 50-plus times the estimate of confirmed active cases. More evidence **#SARSCoV2** is far more widespread and thus less dangerous than expected.

🔗 ...



Fareed Zakaria @FareedZakaria · Apr 17, 2020

First US random sampling of a population was done in **Santa Clara** County, CA last week to find out how many people have **Covid** and thus the actual fatality rate.

🔗 ...

20

88

225

...

...



Ben Shapiro @benshapiro · Apr 17, 2020

New study: seroprevalence testing for coronavirus antibodies in **Santa Clara** county in CA (sample size: 3,300 people) finds prevalence 50 TO 85 TIMES the confirmed cases reported medrxiv.org/content/10.1101/2020.04.16.20204433.full.pdf

...

137

815

18K

...

...

The Problem with a Seroprevalence Study

- Requires a true random sample.
- People need motivation to give their blood.
- If that motivation is related to the outcome you are measuring, you have self selection bias.
- That's why seroprevalence study often use blood leftover from other tests such as routine physical exams.



Was it a random sample?

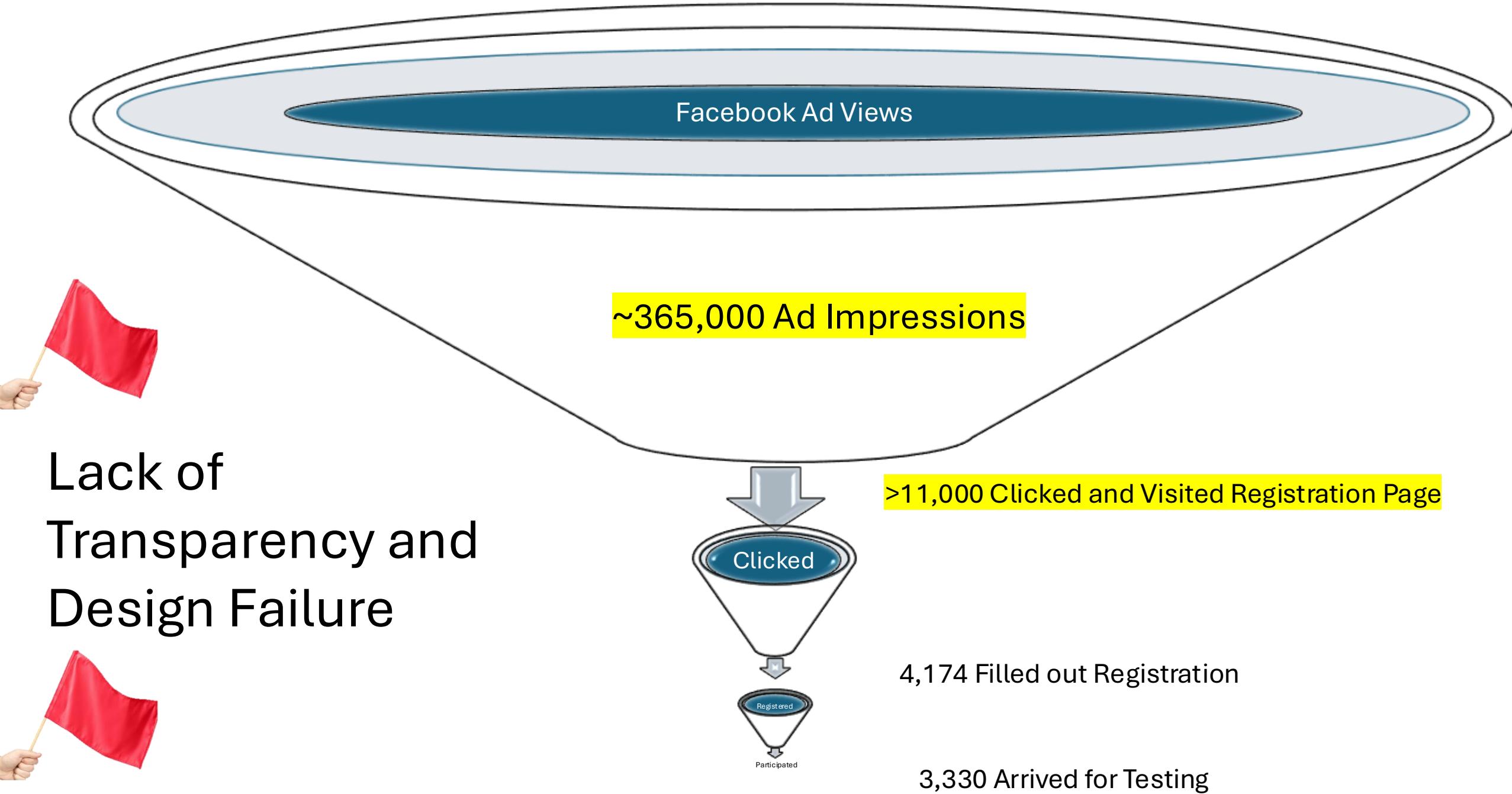


Santa Clara County Covid-19 Seroprevalence Study

Sponsored •

Stanford researchers, with support from Santa Clara County, are conducting a study to determine how many people in our county have had COVID-19. We are looking for participants to get tested for antibodies to COVID-19. Any resident of Santa Clara County is encouraged to participate, including healthy adults and children. Please complete a survey and visit one of three sites in the county to provide a fingerstick blood sample this week. This study is designed to guide public health in our county, not personal health status. Click the link to find out more.

April 3-4, 2020





Lack of Self Skepticism

From: "Catherine Su [REDACTED]"
Date: April 2, 2020 at 4:34:15 PM PDT
To: [REDACTED]
Subject: [egan_community] COVID-19 antibody testing - FREE - this Fri/Sat -ONE per household
Reply-To: Catherine Su [REDACTED]

Free COVID-19 Testing -- needed to calculate prevalence of disease in Santa Clara County

What? Get tested.. FDA approved antibody test for Coronavirus. To test the prevalence of disease in our county, we need 2500 residents. The antibody test differs from the swab test that measures infectious patients actively carrying the COVID-19 RNA in their nasal passages. The serum antibody test

“Why get tested?

(1) Knowledge – Peace of mind. You will know if you are immune. If you have antibodies against the virus, you are FREE from the danger of a) getting sick or b) spreading the virus.”

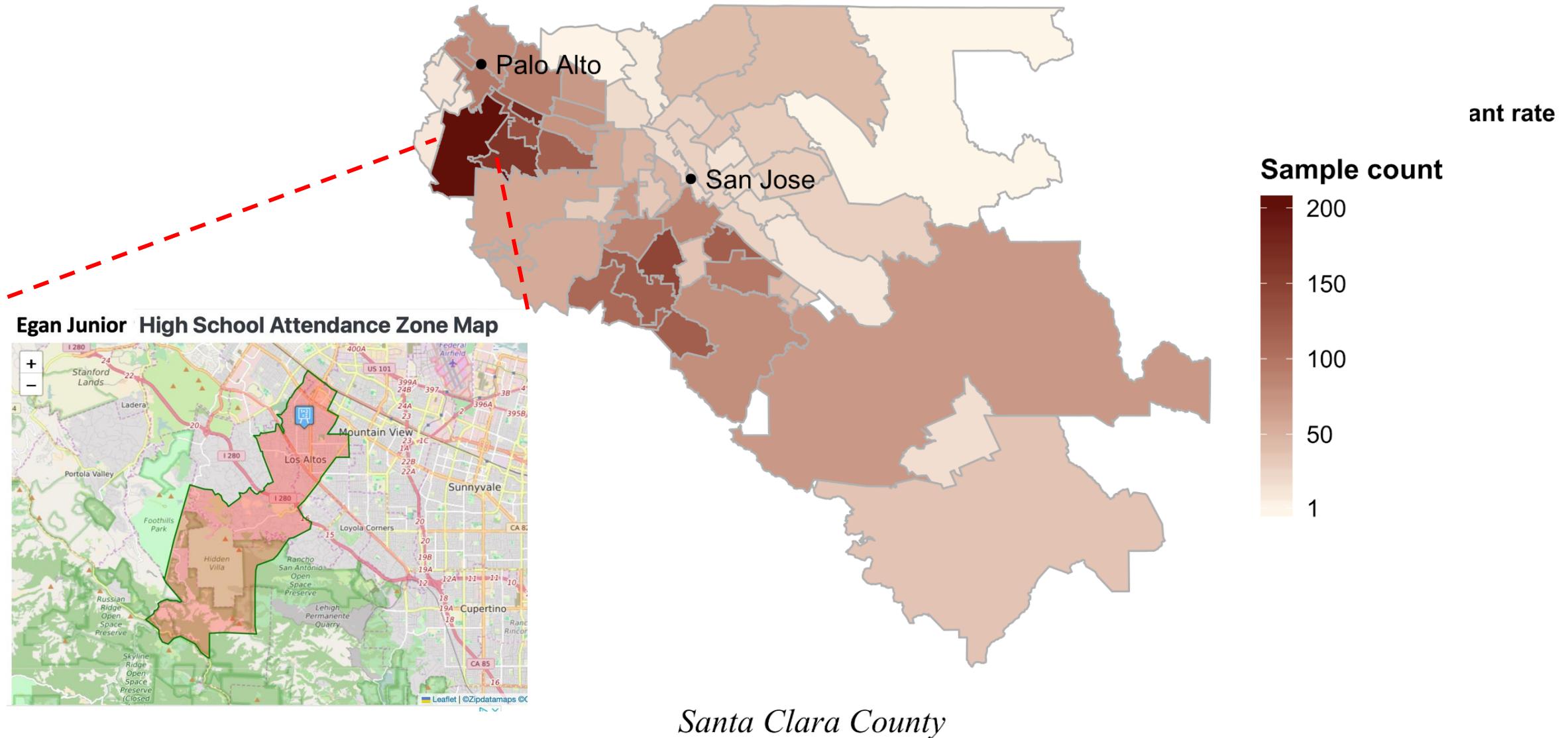
You will ”no longer need to quarantine and can return to work without fear”

employees that have been laid off, let them know -- they no longer need to quarantine and can return to work without fear. If you don't want to know the results, we don't need to send you the results.

(2) Research - Contribute to knowledge of the prevalence of virus spread in Santa Clara County. This allows researchers to plan hospital bed needs and forecasting where to allocate public health resources. This will help your neighbors and family members. More information here:

<https://www.wsj.com/articles/is-the-coronavirus-as-deadly-as-they-say-11585088464>

Sample count by zip code





Lack of Transparency and Lack of Self Skepticism

From the supplement to the published article (not mentioned in preprint)

- These registrations appear to have been driven by sharing of the Facebook ad and registration links in local social media and listservs amongst residents of relatively wealthy zip codes. We learned of at least one incident where the survey link from the Facebook ad, as well as inaccurate information about the study purpose, were shared to a listserv without our knowledge or consent. During the study, when we realized that our registrations were heavily skewed towards those zip codes, we moved to preferentially accept registrations from under-represented zip codes of the county into the sample.
- $225/3330 = 6.8\%$ of study sample comes from ZIP code area for Egan Jr. High School
- 1.1% of Santa Clara County lives in that ZIP code
- Oversampled by a factor of 6.2



Unidirectional Concern About Bias

I later learned that my wife, Dr. Su, sent an email through my son's middle school parent's listserv telling people about the study.

Unauthorized recruiting efforts were well-intentioned (they seemed aimed to ensure we had enough people sign up for the study) but also unhelpful. They skewed our study population toward oversampling the relatively affluent people who live in the county's northern half and undersampling less affluent people who tend to live in the county's southern half. Since covid incidence in those days showed the same economic inequality as many other health conditions in America, this sampling biased our prevalence estimate downward relative to the truth. This problem is unavoidable, and we employed statistical reweighting techniques to help solve them.

- Jay Bhattacharya



Biased Post-hoc Analysis

	Sample	County	Multiplier	Eagan School Ethnicity	Weighted adjustment
White	64%	33%	X 55%	39.4%	22%
Hispanic	8%	26%	X 311%	19.5%	61%
Asian	19%	28%	X 155%	39.9%	62%
Other	9%	13%	x 117%	1.2%	1%
					146%

- Seropositivity rates for this ZIP code are never provided
- Adjustments **increased** impact of rates in this ZIP Code by 46%



Biased Post Hoc Analysis

Ethnic Group	Sample proportion	County proportion	Ratio County/Sample	Antibody prevalence in group relative to overall sample positivity	Relative rate of COVID deaths in California through April 2020
White	64.1%	33.1%	0.52	67%	0.99
Asian	18.7%	27.8%	1.49	127%	1.13
Hispanic	8%	26.3%	3.29	327%	0.9

- Emails “skewed our study population toward oversampling the relatively affluent people”
- “COVID incidence in those days showed the same economic inequality as many other health conditions in America”
- “This problem is unavoidable”
- “We employed statistical reweighting techniques to help solve them”

Scientists shred study on Twitter



Natalie E. Dean, PhD

@nataliexdean

A rapid, unsolicited peer review on emerging serosurvey data from Santa Clara County, ai remain skeptical of claims that we are identi out of every 50 to 85 confirmed cases.

1/10



Trevor Bedford @trvrb · Apr 17, 2020

Very interesting new preprint by Eran Bendavid and colleagues reports seroprevalence estimates from Santa Clara county. Great to have seroprevalence work start to emerge, but I'd be skeptical of the 2-4% seroprevalence result. 1/8

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medrxiv.org
COVID-19 Antibody Seroprevalence in Santa Clara ...
Background Addressing COVID-19 is a pressing health and social concern. To date, many epidemi...

63

712

1,234



A Marm Kilpatrick
@DiseaseEcology

...



Bob Wachter @Bob_Wachter · Apr 23, 2020

Stanford Serology study preprint just posted that is certain to mislead many people:
[medrxiv.org/content/10.110...](https://medrxiv.org/content/10.1101)

It's a serological study which is fantastic. We need these kinds of papers to help us understand what's going on. This paper is rposeful?

05 PM · Apr 17,

7 Retweets 1

1

19

61



Bayes' theorem as applied to Santa Clara County data

Manufacturer's values

Sens=91.8%, Spec=99.5%, prevalence=1-2%

Test results	Infection present	Infection absent	Total
Positive	9.18	4.9	14.08
Negative	0.82	985.1	985.92
Total	10	990	1000

Positive predictive value = 9.18/14.08 = 65.2%
If 25 positive tests, 16 true positives, 9 false positives

Test results	Infection present	Infection absent	Total
Positive	18.36	4.9	23.26
Negative	1.64	975.1	976.74
Total	20	980	1000

Positive predictive value = 18.36/23.26 = 78.6%
If 25 positive tests, 20 true positive, 5 false positives

Blended values

Sens=80.3%, Spec=99.5%, prevalence=1-2%

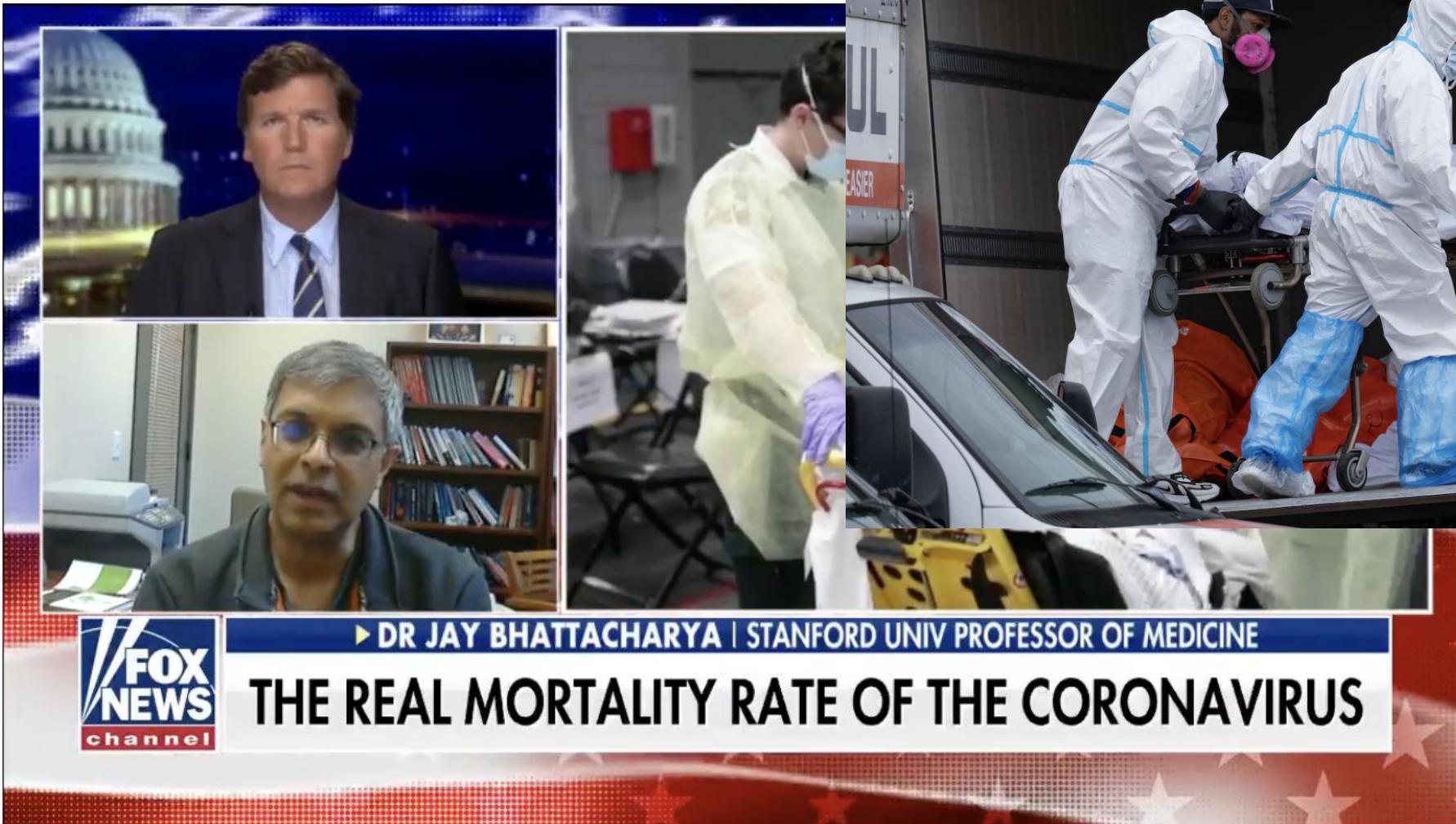
Test results	Infection present	Infection absent	Total
Positive	8.03	4.9	12.93
Negative	1.97	985.1	987.07
Total	10	990	1000

Positive predictive value = 8.03/13.03 = 62.1%
If 25 positive tests, 15 true positives, 10 false positives

Test results	Infection present	Infection absent	Total
Positive	16.06	4.9	20.96
Negative	3.94	975.1	979.04
Total	20	980	1000

Positive predictive value = 16.06/20.96 = 76.6%
If 25 positive cases, 19 true positives, 6 false positives

Was it Misinformation?



Tucker: What is the actual death rate of COVID-19?

If coronavirus infection is more widespread than we thought, by definition that means the virus is less deadly; insight from Dr. Jay Bhattacharya, Stanford University professor of medicine.

Key Conclusions



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Is the Coronavirus as Deadly as They Say?

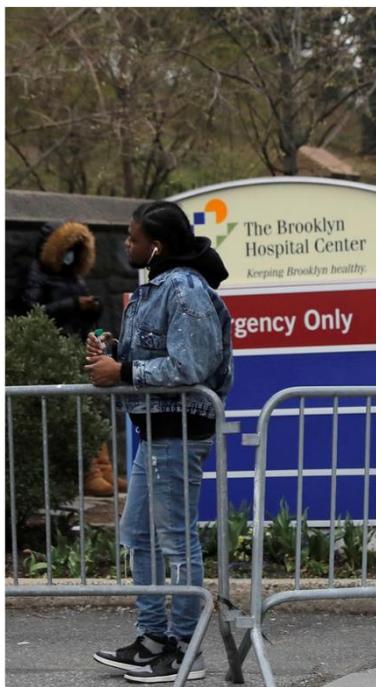
Current estimates about the Covid-19 fatality rate may be too high by orders of magnitude.

By Eran Bendavid and Jay Bhattacharya

March 24, 2020 6:21 pm ET



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- This study estimated one death corresponds 588 cases
- Influenza CFR is about one death per thousand
- Implying COVID is not much worse than the flu
- Exactly as predicted



At the time of the preprint release

- CDC had reported 22,637 deaths
- Their CFR would imply 13 million cases
- CDC had only reported 1.5 million cases
- Despite the flaws, there was no way to PROVE them wrong

Cumulative confirmed COVID-19 deaths

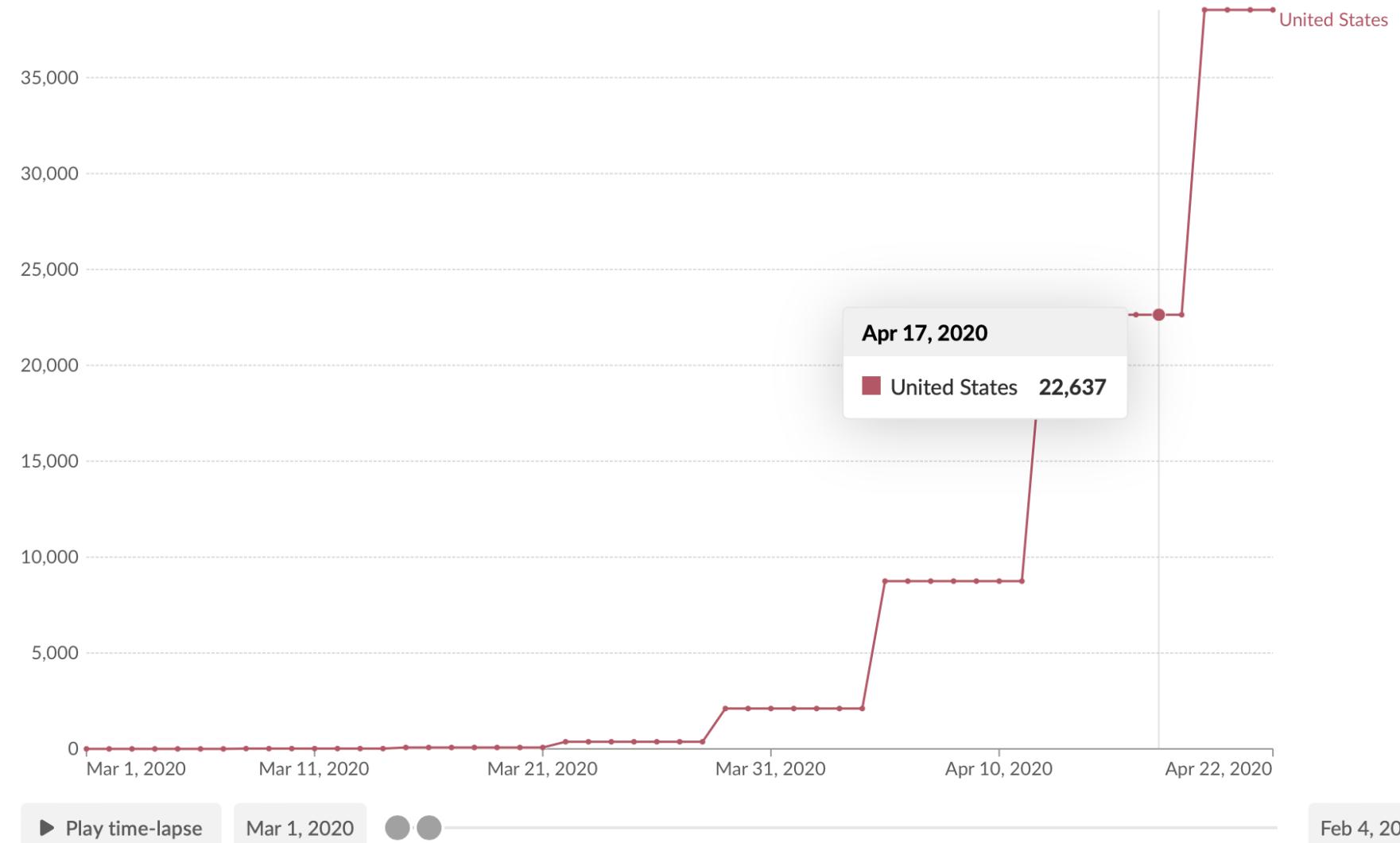
Due to varying protocols and challenges in the attribution of the cause of death, the number of confirmed deaths may not accurately represent the true number of deaths caused by COVID-19.

Table

Map

Chart

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Volume 50, Issue 2
April 2021

JOURNAL ARTICLE COVID-19 antibody seroprevalence in Santa Clara County, California

Eran Bendavid , Bianca Mulaney, Neeraj Sood, Soleil Shah, Rebecca Bromley-Dufano, Cara Lai, Zoe Weissberg, Rodrigo Saavedra-Walker, Jim Tedrow, Andrew Bogan, Thomas Kupiec, Daniel Eichner, Ribhav Gupta, John P A Ioannidis, Jay Bhattacharya

International Journal of Epidemiology, Volume 50, Issue 2, April 2021, Pages 410–419,
<https://doi.org/10.1093/ije/dyab010>

> Int J Epidemiol. 2021 May 17;50(2):410-419. doi: 10.1093/ije/dyab010.

COVID-19 antibody seroprevalence in Santa Clara County, California

Author contributions

Funding

Acknowledgements

References

Supplementary data

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sample drawn from Santa Clara County.

Methods

On 3 and 4 April 2020, we tested 3328 county residents for immunoglobulin G (IgG) and immunoglobulin M (IgM) antibodies to SARS-CoV-2 using a rapid lateral-flow assay (Premier Biotech). Participants were recruited using advertisements that were targeted to reach county residents that matched the county population by gender, race/ethnicity and zip code of residence. We estimate weights to match our sample to the county by zip, age, sex and race/ethnicity. We report the weighted and unweighted prevalence of antibodies to SARS-CoV-2. We adjust for test-performance characteristics by combining data from 18 independent test-kit assessments: 14 for specificity and 4 for sensitivity.

Results

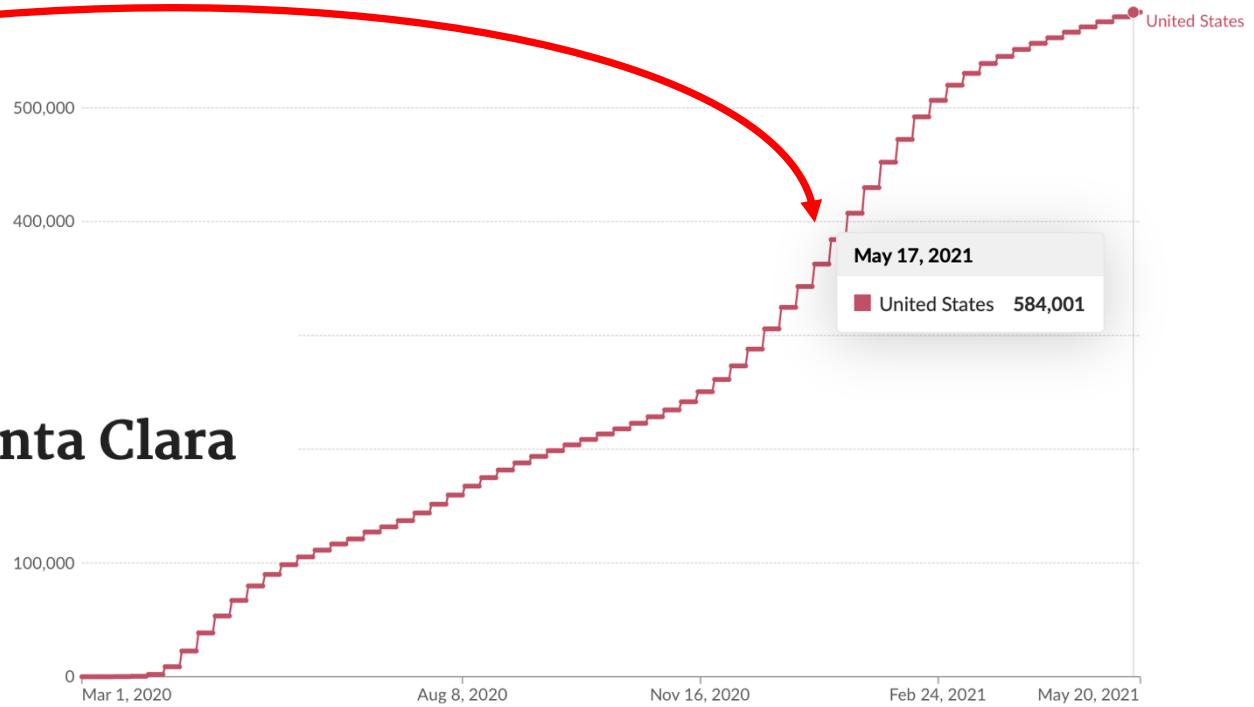
The raw prevalence of antibodies in our sample was 1.5% [exact binomial 95% confidence interval (CI) 1.1–2.0%]. Test-performance specificity in our data was 99.5% (95% CI 99.2–99.7%) and sensitivity was 82.8% (95% CI 76.0–88.4%). The unweighted prevalence adjusted for test-performance characteristics was 1.2% (95% CI 0.7–1.8%). After weighting for population demographics, the prevalence was 2.8% (95% CI 1.3–4.2%), using bootstrap to estimate confidence bounds. These prevalence point estimates imply that 53 000 [95% CI 26

Cumulative confirmed COVID-19 deaths

Due to varying protocols and challenges in the attribution of the cause of death, the number of confirmed deaths may not accurately represent the true number of deaths caused by COVID-19.

Table Map Chart

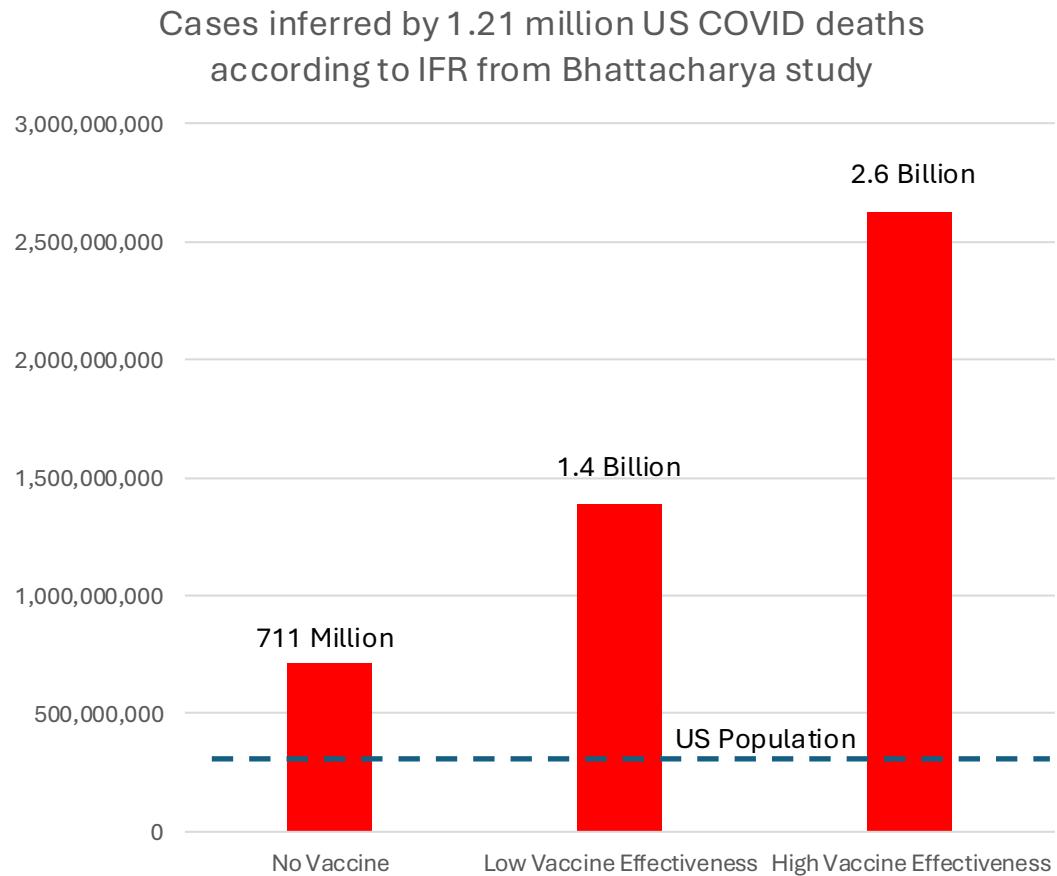
Our World
in Data



- The paper was already demonstrably wrong when it was published
- If the IFR was truly 0.17%, 584,000 deaths would have required 344 million cases

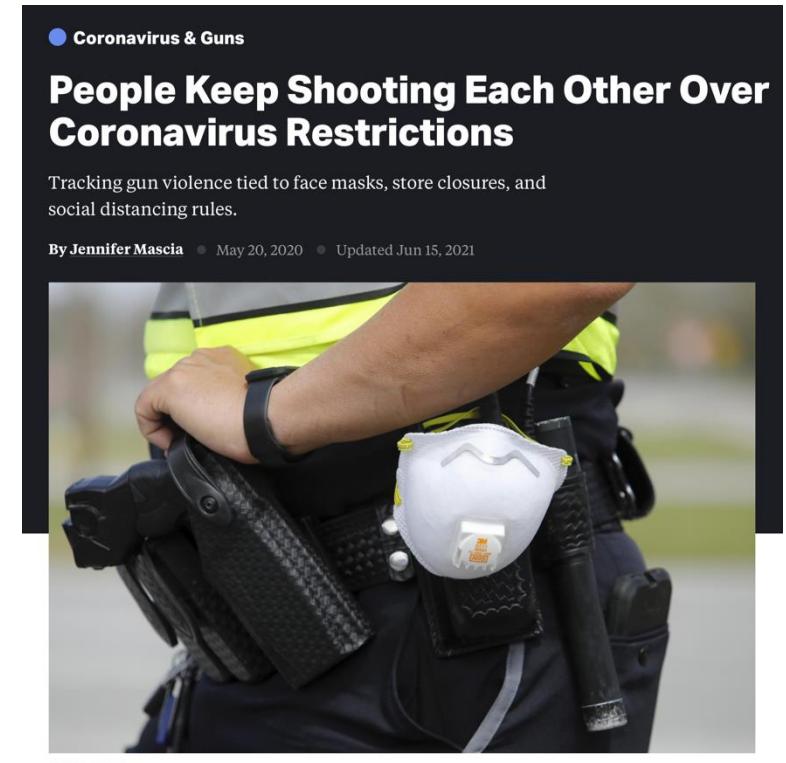
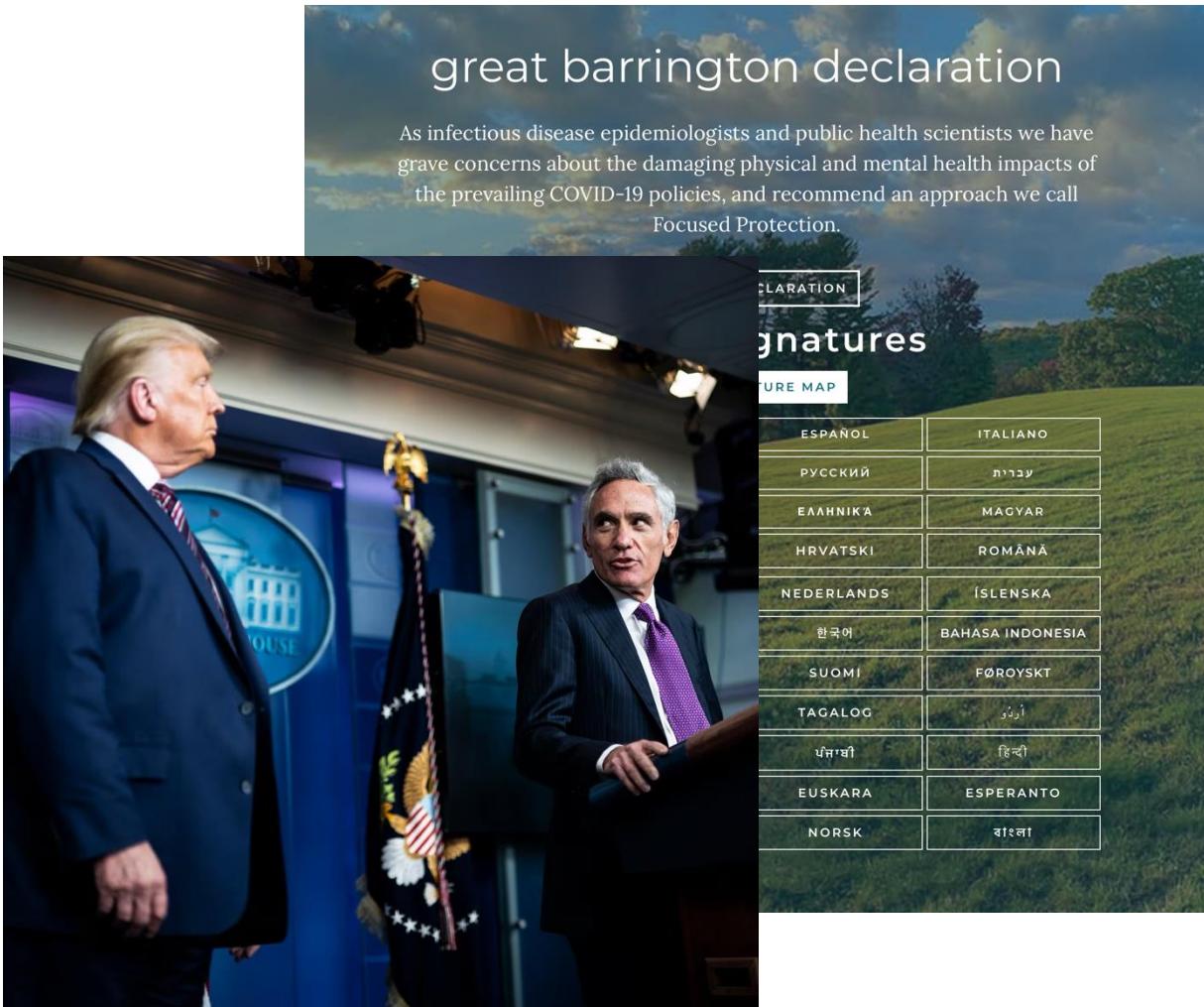


Lack of Self Skepticism



- In the summer of 2024, I asked Jay Bhattacharya what he thought of their findings in light of the results at right.
- He insisted they had gotten it right.

Impact of the Study



Beginning in March of 2020, state and local governments across the country instituted a slew of public closures and mask mandates to prevent the spread of the coronavirus. The policies shuttered businesses and prevented public gatherings — and also engendered a new category of gun violence.

The Rewards of Bad Science

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Trump hits NIH with ‘devastating’ freezes on meetings, travel, communications, and hiring

Researchers facing “a lot of uncertainty, fear, and panic”

22 JAN 2025 • 5:45 PM ET • BY MEREDITH WADMAN, JOCELYN KAISER

LYDIA POLIMENI/NATIONAL INSTITUTES OF HEALTH

