UNITED STATES DISTRICT COURT
NORTHERN DISTRICT OF GEORGIA
ATLANTA DIVISION

L.E., by and through their parent and next friend, SARA CAVORLEY; B.B., a minor, by and through their parent and next friend, ELIZABETH BAIRD; A.Z., a minor, by and through their parent and next friend, JESSICA ZEIGLER; and C.S., a minor, by and through their parent and next friend, TARASHA SHIRLEY,

Plaintiffs,

v.

CHRIS RAGSDALE, in his official capacity as Superintendent of Cobb County School District; RANDY SCAMIHORN, in his official capacity, a member of the Cobb County Board of Education; DAVID BANKS, in his official capacity as member of the Cobb County School Board; DAVID CHASTAIN, in his official capacity as member of the Cobb County School Board; BRAD WHEELER, in his official capacity as member of the Cobb County School Board; JAHA HOWARD, in his official capacity as member of the Cobb County School Board; CHARISSE DAVIS, in her official capacity as member of the Cobb County School Board; LEROY TRE' HUTCHINS, in his official capacity as member of the Cobb County School

Civil Action No. 1:21-cv-04076-TCB

Board; and COBB COUNTY SCHOOL DISTRICT,

Defendants.

DECLARATION OF JAYANTA BHATTACHARYA, MD, PhD

This Declaration is given by Jayanta Bhattacharya, MD, PhD, who, under penalty of perjury pursuant to 28 U.S.C. § 1746, states that the following is true and correct:

1.

My name is Dr. Jayanta Bhattacharya. I am over twenty-one (21) years of age, legally competent to make this Declaration, and have personal knowledge of the statements made herein. I make this affidavit on my own personal knowledge for use in supporting Defendants in the above-styled matter and for all other purposes permitted by law.

2.

I hold a Doctor of Medicine from Stanford University, and a PhD in Economics, also from Stanford University.

EXHIBIT 4

3.

I am a former Professor of Medicine (20 years) and current Professor of Health Policy at Stanford University School of Medicine. I am Director of Stanford's Center for Demography and Economics of Health and Aging. I have published 154 scholarly articles in peer-reviewed journals in the fields of medicine, economics, health policy, epidemiology, statistics, law, and public health, among others. My research has been cited in the peer-reviewed scientific literature more than 11,700 times. I am also a research associate at the National Bureau of Economics Research and a research associate at Acumen, LLC.

4.

I hold a courtesy appointment as a Professor of Economics at a senior fellow at the Stanford Institute for Economic Policy Research.

5.

I have not and will not receive any financial or other compensation to prepare this Declaration or to testify in this case. Nor have I received compensation for preparing declarations or reports or for testifying in any other case related to the COVID-19 pandemic, or any personal or research funding from any pharmaceutical company.

6.

My recent research focuses on the epidemiology of COVID, including the lethality of COVID infection and the effects of lockdown policies. Before COVID, I studied the health and well-being of vulnerable populations, emphasizing the role of government programs, biomedical innovation, and health policy. I have published many articles in top peer-reviewed scientific journals in medicine, economics, health policy, epidemiology, statistics, law, and public health, among other fields. I have published to date six peer-reviewed publications on COVID, including some of the most highly cited pieces published during the pandemic.

7.

A true and correct copy of my curriculum vitae, updated as of June 2021, is attached hereto as **Exhibit A**.

8.

I authored the report, "Scientific Evidence on COVID, Children, and Mask Mandates" dated October 10, 2021. A true and correct copy of this report is attached hereto as **Exhibit B**. This report reflects my expert opinion on the scientific evidence surrounding the efficacy and side-effects of a school mask mandate.

So sworn this 10th day of October, 2021.

Jayanta Bhattacharya, MD, PhD

JAY BHATTACHARYA, M.D., Ph.D. **June 2021**

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RESEARCH INTERESTS

Health economics, health policy, and outcomes research

A. ACADEMIC HISTORY:

Stanford University	A.M., A.B.	1990
Stanford University School of Medicine	M.D.	1997
Stanford University Department of Economics	Ph.D.	2000

B. EMPLOYMENT HISTORY:

2001 – present	Professor (Assistant to Full), Stanford University Department of Medicine, Department of Economics (by courtesy)
2013 – present	Senior Fellow, Stanford Institute for Economic Policy Research
2014 – present	Senior Fellow Stanford Freeman Spogli Institute
2007 – present	Research Associate, Sphere Institute / Acumen LLC
2002 – present	FRF to Research Associate, National Bureau of Economic Research
2001 – 2020	Professor (Assistant to Full) Department of Health Research and Policy (by courtesy)
2006 – 2008	Research Fellow, Hoover Institution
1998 – 2001	Economist (Associate to Full), RAND Corporation
1998 – 2001	Visiting Assistant Professor, UCLA Department of Economics

C. SCHOLARLY PUBLICATIONS:

PEER-REVIEWED ARTICLES (152 total)

1. Yoshikawa A, Vogt W.B., Hahn J., **Bhattacharya J.**, "Toward the Establishment and Promotion of Health Economics Research in Japan," *Japanese Journal of Health Economics and Policy* 1(1):29-45, (1994).
2. Vogt WB, **Bhattacharya J**, Kupor S, Yoshikawa A, Nakahara T, "The Role of Diagnostic Technology in Competition among Japanese Hospitals," *International Journal of Technology Management, Series on Management of Technology in Health Care*, 11(1):93-105 (1995).
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EXHIBIT 4-A

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11. DeLeire T, **Bhattacharya J**, and MaCurdy T. "Comparing Measures of Overtime Across BLS Surveys." *Industrial Relations* 41(2):362-369 (2002).
12. Studdert D, **Bhattacharya J**, Warren B, Schoenbaum M, Escarce JJ. "Personal Choices of Health Plans by Managed Care Experts." *Medical Care* 40(5):375-86 (2002).
13. **Bhattacharya J**, Schoenbaum M, and Sood N. "Optimal Contributions to Flexible Spending Accounts for Medical Care." *Economics Letters* 76(1):129-135 (2002).
14. Reville R, Neuhauser F, **Bhattacharya J**, and Martin C, "Comparing Severity of Impairment for Different Permanent Upper Extremity Musculo-Skeletal Injuries" *Journal of Occupational Rehabilitation* 12(3):205-21 (2002).
15. Lakdawalla D., Goldman D, **Bhattacharya J**, Hurd M, Joyce G, and Panis C., "Forecasting the Nursing Home Population", *Medical Care* 41(1):8-20 (2003) See comments "Forecasting the Nursing Home Population," *Medical Care* 41(1):28-31 (2003).
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Insurance and HIV-Related Mortality," *Journal of Health Economics* 22:1105-1122 (2003).

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23. **Bhattacharya J**. "Specialty Selection and Lifetime Returns to Specialization Within Medicine" *Journal of Human Resources* 40(1):115-143 (2005).
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25. **Bhattacharya J,** Shang B, Su CK, Goldman D "Technological Advance in Cancer and the Future of Medical Care Expenditures by the Elderly," *Health Affairs.* [Web Exclusive 10.1377/hlthaff.w5.r5-r17] 26 September (2005).
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27. **Bhattacharya J** and Lakdawalla D, "The Labor Market Value of Health Improvements" *The Forum for Health Economics and Health Policy.* Forum: Biomedical Research and the Economy: Article 2 http://www..bepress.fhep/biomedical_research/2 (2005).
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33. **Bhattacharya J** and Shang B, "Model Based Survey Design Using Logits:

Estimating Lost Statistical Power from Random Alternative Sampling" *Survey Research Methods* 1(3):145-154 (2007).ea

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52. **Bhattacharya J** and Giubilini A. "Immunity Passports: A Debate Between Jay Bhattacharya and Alberto Giubilini" Lockdown Sceptics. May 7, 2021.
53. **Bhattacharya J**. "Editor's Note: Children Are A Casualty of Lockdown." *Collateral Global*. May 11, 2021.
54. Kopinska JA, Atella V, **Bhattacharya J**, Miller G (2021) The Changing Relationship between Bodyweight and Longevity in High- and Low- Income Countries.

National Bureau of Economic Research Working Paper #28813. https://www.nber.org/papers/w28813

55. Toubat O, Berg AH, Sobhani K, Mulligan K, Hori AM, **Bhattacharya J**, Sood N (2021) Manufacturer Signal-to-Cutoff Threshold Underestimates Cumulative Incidence of SARS-CoV-2 Infection: Evidence from the Los Angeles Firefighters Study. *medRxiv*. **doi:** https://doi.org/10.1101/2021.04.20.21255829.
56. Bendavid E, Oh C, **Bhattacharya J**, Ioannidis JPA. Response to Letters Re: 'Assessing mandatory stay- At- Home and business closure effects on the spread of COVID- 19'. *European Journal of Clinical Investigation*. 2021 Mar:e13553. DOI: 10.1111/eci.13553.
57. **Bhattacharya J**. "What Does Lockdown and Focused Protection Mean in Nursing Homes?" Collateral Global. May 18, 2021.
58. **Bhattacharya J**. "Cancer and Lockdown" Collateral Global. May 25, 2021.
59. Kulldorff M and **Bhattacharya J** "It's mad that 'herd immunity' was ever a taboo phrase" The Telegraph, May 27, 2021
60. **Bhattacharya J**, Gupta S, Kulldorff M, "The Beauty of Vaccines and Natural Immunity" Smerconish. June 4, 2021
61. **Bhattacharya J** "Stanford professor challenges SJ Merc's "Coronavirus Lessons Learned" assertions" Opportunity Now. June 4, 2021
62. **Bhattacharya J** "On the Catastrophic Misapplication of the Precautionary Principle" Collateral Global. June 14, 2021
63. Kulldorff M and **Bhattacharya J** "The Ill-Advised Push to Vaccinate the Young" The Hill, June 17, 2021

BOOKS AND REPORTS (8 total)

1. Yoshikawa A, **Bhattacharya J**, Vogt WB eds. Health Economics of Japan: Patients, Doctors, and Hospitals Under a Universal Health Insurance System, Tokyo: University of Tokyo Press, (1996).
2. Goldman DP, Hurd M, Shekelle PG, Newberry SJ, Panis CWA, Shang B, **Bhattacharya J**, Joyce GF, Lakdawalla D. Health Status and Medical Treatment of the Future Elderly: Final Report, TR-169-CMS, Santa Monica, CA: RAND (2004).
3. **Bhattacharya J**, Currie J, Haider SJ, Variyam J. Evaluating the Impact of School Nutrition Programs: Final Report. E-FAN-04-008, Washington D.C.: Economic Research Service, USDA (2004).
4. **Bhattacharya J**, Hyde T, Tu P. Health Economics, London: Palgrave-MacMillan, (2013).
5. MaCurdy T, **Bhattacharya J**, Perlroth D, Shafrin J, Au-Yeung A, Bashour H, Chicklis C, Cronen K, Lipton B, Saneinejad S, Shrestha E, Zaidi S. Geographic Variation in Spending, Utilization, and Quality: Medicare and Medicaid Beneficiaries. Acumen Report to the Institute of Medicine Committee Study of Geographic Variation in Health Care Spending and Promotion of High-Value Health Care, Washington, DC: Institute of Medicine (2013)

6. MaCurdy T, **Bhattacharya J**, Shafrin J, Chicklis C, Cronen K, Friley J, Lipton B, Rogers D, Zaidi S. IOM Study of Geographic Variation: Growth Analysis. Acumen Report to the Institute of Medicine Committee Study of Geographic Variation in Health Care Spending and Promotion of High-Value Health Care, Washington, DC: Institute of Medicine (2013)
7. **Bhattacharya J**, Chandra A, Chernew M, Goldman D, Jena A, Lakdawalla D, Malani A, Philipson T. Best of Both Worlds: Uniting Universal Coverage and Personal Choice in Health Care, American Enterprise Institute (AEI) White Paper, Washington DC: AEI Press (2013)
8. **Bhattacharya J**, Vail D, Moore D, Vogt W, Choradia N, Do R, Erickson K, Feinberg L, Isara F, Lin E, Narayanan V, Vaikath M, MaCurdy T. Medicare Current State and Future Trends Environment Scan. Center for Medicare and Medicaid Services (CMS) White Paper (2019)

BOOK CHAPTERS (15 total)

1. **Bhattacharya J**, Garber AM, MaCurdy T. "Cause-Specific Mortality Among Medicare Enrollees," in Inquires in the Economics of Aging, D Wise (ed.), Chicago, IL: University of Chicago Press. (1997).
2. MaCurdy T, Nechyba T, **Bhattacharya J**. "Ch. 2: An Economic Model of the Fiscal Impacts of Immigration," The Immigration Debate: Studies on the Economic, Demographic, and Fiscal Effects of Immigration, J Smith (ed.), National Academy of Sciences Commission on Behavioral and Social Sciences and Education: Washington D.C., (1998).
3. **Bhattacharya J**, Currie J. "Youths and Nutritional Risk: Malnourished or Misnourished?" in Risky Behavior Among Youths, J Gruber (ed.), (2001).
4. Yoshikawa A. and **Bhattacharya J**. "Japanese Health Care" in World Health Systems: Challenges and Perspectives, Bruce Fried and Laura M. Gaydos (eds.), Chicago, IL: Health Administration Press (2002).
5. **Bhattacharya J**, Cutler D, Goldman DP, Hurd MD, Joyce GF, Lakdawalla DN, Panis CWA, and Shang B, "Disability Forecasts and Future Medicare Costs" Frontiers in Health Policy Research, Vol. 6, Alan Garber and David Cutler (eds.) Boston, MA: MIT Press (2003).
6. **Bhattacharya J**, Choudhry K, and Lakdawalla D. (2007) "Chronic Disease and Trends in Severe Disability in Working Age Populations" Proceedings from the Institute of Medicine workshop, 'Disability in America: An Update,' Institute of Medicine: Washington, D.C.
7. **Bhattacharya J**, Garber AM, MaCurdy T. "Trends in Prescription Drug Use by the Disabled Elderly" in Developments in the Economics of Aging, D. Wise (ed), Chicago, IL, University of Chicago Press (2009).
8. **Bhattacharya J** and Richmond P "On Work and Health Among the American Poor" in Pathways to Self-Sufficiency: Getting Ahead in an Era Beyond Welfare

Reform John Karl Scholz and Carolyn Heinrich (eds), New York, NY, Russell Sage Foundation (2009).

9. **Bhattacharya J**, Garber A, MaCurdy T "The Narrowing Dispersion of Medicare Expenditures 1997-2005" in Research Findings in the Economics of Aging, D. Wise (ed.), Chicago, IL, University of Chicago Press (2010)
10. **Bhattacharya J**, Bundorf MK, Pace N, and Sood N "Does Health Insurance Make You Fat?" in Economic Aspects of Obesity Michael Grossman and Naci Mocan (eds.), Chicago, IL, University of Chicago Press (2010)
11. **Bhattacharya J**, Garber A, Miller M, and Perlroth D "The Value of Progress against Cancer in the Elderly" Investigations in the Economics of Aging, David Wise (ed), Chicago, IL, University of Chicago Press (2012)
12. Yoshikawa A. and **Bhattacharya J**. "Japanese Health Care" in World Health Systems: Challenges and Perspectives, 2nd edition, Bruce Fried and Laura M. Gaydos (eds.), Chicago, IL: Health Administration Press (2012).
13. Hanson, J., Chandra, A., Moss, E., **Bhattacharya, J.** Wolfe, B., Pollak, S.D.. Brain Development and Poverty: Preliminary Findings. In Biological Consequences of Socioeconomic Inequalities. B. Wolfe, T. Seeman, and W. Evans (Eds). NY: Sage. (2012)
14. **Bhattacharya J** "The Diffusion of New Medical Technologies: The Case of Drug-Eluting Stents (A Discussion of Chandra, Malenka, and Skinner)" In Explorations in the Economics of Aging, David Wise (ed.), Chicago, IL, University of Chicago Press (2014).
15. MaCurdy T and **Bhattacharya J** "Challenges in Controlling Medicare Spending: Treating Highly Complex Patients" in Insights in the Economics of Aging, David Wise (ed.) Chicago, IL, University of Chicago Press (2015).

ABSTRACTS (3)

1. Su CK and **Bhattacharya J**. Longitudinal Hospitalization Costs and Outcomes in the Treatment of the Medicare Breast Cancer Patient. *International Journal of Radiation Oncology Biology Physics* (1996); 36(S1): 282. [abstract]
2. Nguyen C, Hernandez-Boussard T., Davies S, **Bhattacharya J**, Khosla R, Curtin C. *Cleft Palate Surgery: Variables of Quality and Patient Safety*. Presented at the 69th Annual American Cleft-Palate Craniofacial Association (2012). [abstract]
3. Patel MI, Ramirez D, Agajanian R, Bhattacharya J, Milstein A, Bundorf MK. "The effect of a lay health worker-led symptom assessment intervention for patients on patient-reported outcomes, healthcare use, and total costs." Journal of Clinical Oncology 36(15 Suppl):6502 [abstract]

D. PUBLIC AND PROFESSIONAL SERVICE:

JOURNAL EDITING

Journal of Human Capital, Associate Editor (2015-present)
American Journal of Managed Care, Guest Editor (2016)
Journal of Human Resources, Associate Editor (2011-13)
Forum for Health Economics & Policy, Editorial Board Member (2001-2012)
Economics Bulletin, Associate Editor (2004-2009)

SERVICE ON SCIENTIFIC REVIEW AND ADVISORY COMMITTEES (Selected)

- Standing member of the Health Services Organization and Delivery (HSOD) NIH review panel, 2012-2016
- NIH reviewer (various panels, too numerous to list) 2003-present
- NIH Review Panel Chair: 2018 (P01 review), 2020 (DP1 review).
- Invited Reviewer for the European Research Council, ERC Advanced Grant 2015 RFP
- NIH Stage 2 Challenge Grant Review Panel, July 2009
- Appointed a member of an Institute of Medicine (IOM) panel on the regulation of work hours by resident physicians, 2007-8.
- Standing member of the NIH Social Science and Population Studies Review Panel, Fall 2004-Fall 2008
- Invited Reviewer for National Academy of Sciences report on Food Insecurity and Hunger, November 2005.
- Invited Reviewer for the National Academy of Sciences report on the Nutrition Data Infrastructure, December 2004
- Invited Reviewer for the National Institute on Health (NIH) Health Services Organization and Delivery Review Panel, June 2004, Alexandria, VA.
- Invited Reviewer for the Food Assistance and Nutrition Research Program US Department of Agriculture Economic Research Service Research Proposal Review Panel, June 2004, Stanford, CA.
- Invited Reviewer for the National Institute on Health (NIH) Social Science and Population Studies Review Panel, February 2004, Alexandria, VA.
- Invited Reviewer for the National Institute on Health (NIH) Social Sciences and Population Studies Review Panel, November 2003, Bethesda, MD.
- Invited Reviewer for the National Institute on Health (NIH) Social Science, Nursing, Epidemiology, and Methods (3) Review Panel, June 2003, Bethesda, MD.
- Invited Reviewer for the Food Assistance and Nutrition Research Program US Department of Agriculture Economic Research Service Research Proposal Review Panel, August 2002.
- Research Advisory Panel on Canadian Disability Measurement, Canadian Human Resources Development Applied Research Branch, June 2001 in Ottowa, Canada.
- Invited Reviewer for the National Institute of Occupational Safety and Health R18 Demonstration Project Grants Review panel in July 2000, Washington D.C.
- Research Advisory Panel on Japanese Health Policy Research. May 1997 at the Center for Global Partnership, New York, NY.

TESTIMONY TO GOVERNMENTAL PANELS AND AGENCIES (9)

- US Senate Dec. 2020 hearing of the Subcommittee on Homeland Security and Governmental Affairs. Testimony provided on COVID-19 mortality risk, collateral harms from lockdown policies, and the incentives of private corporations and the government to invest in research on low-cost treatments for COVID-19 disease
- "Roundtable on Safe Reopening of Florida" led by Florida Gov. Ron DeSantis. September 2020.
- "Evaluation of the Safety and Efficacy of COVID-19 Vaccine Candidates" July 2020 hearing of the House Oversight Briefing to the Economic and Consumer Policy Subcommittee.
- US Senate May 2020 virtual roundtable. Safely Restarting Youth Baseball and Softball Leagues, invited testimony
- "Population Aging and Financing Long Term Care in Japan" March 2013 seminar at the Japanese Ministry of Health.
- "Implementing the ACA in California" March 2011 testimony to California Legislature Select Committee on Health Care Costs.
- "Designing an Optimal Data Infrastructure for Nutrition Research" June 2004 testimony to the National Academy of Sciences commission on "Enhancing the Data Infrastructure in Support of Food and Nutrition Programs, Research, and Decision Making," Washington D.C.
- "Measuring the Effect of Overtime Reform" October 1998 testimony to the California Assembly Select Committee on the Middle Class, Los Angeles, CA.
- "Switching to Weekly Overtime in California." April 1997 testimony to the California Industrial Welfare Commission, Los Angeles, CA.

REFEREE FOR RESEARCH JOURNALS

American Economic Review; American Journal of Health Promotion; American Journal of Managed Care; Education Next; Health Economics Letters; Health Services Research; Health Services and Outcomes Research Methodology; Industrial and Labor Relations Review; Journal of Agricultural Economics; Journal of the American Medical Association; Journal of Health Economics; Journal of Health Policy, Politics, and Law; Journal of Human Resources; Journal of Political Economy; Labour Economics; Medical Care; Medical Decision Making; Review of Economics and Statistics; Scandinavian Journal of Economics; Social Science and Medicine; Forum for Health Economics and Policy; Pediatrics; British Medical Journal

Trainee	**Current Position**
Peter Groeneveld, MD, MS	Associate Professor of Medicine, University of Pennsylvania
Jessica Haberer, MD, MS	Assistant Professor of Medicine, Harvard Medical School
Melinda Henne, MD, MS	Director of Health Services Research, Bethesda Naval Hospital
Byung-Kwang Yoo, MD, PhD	Associate Professor, Public Health, UC Davis
Hau Liu, MD, MS, MBA	Chief Medical Officer at Shanghai United Family Hospital
Eran Bendavid, MD, MS	Assistant Professor, General Medicine Disciplines, Stanford University
Kaleb Michaud, MS, PhD	Associate Professor of Medicine, Rheumatology and Immunology, University of Nebraska Medical Center
Kanaka Shetty, MD	Natural Scientist, RAND Corporation
Christine Pal Chee, PhD	Associate Director of the Health Economics Resource Center, Palo Alto VA
Matthew Miller, MD	VP Clinical Strategy and Head of Innovation, Landmark Health

Vincent Liu, MD	Research Scientist, Kaiser Permanente Northern California Division of Research
Daniella Perlroth, MD	Chief Data Scientist, Lyra Health
Crystal Smith-Spangler, MD	Internist, Palo Alto Medical Foundation
Barrett Levesque, MD MS	Assistant Professor of Clinical Medicine, UC San Diego Health System
Torrey Simons, MD	Clinical Instructor, Department of Medicine, Stanford University
Nayer Khazeni, MD	Assistant Professor of Medicine (Pulmonary and Critical Care Medicine), Stanford University
Monica Bhargava, MD MS	Assistant Clinical Professor, UCSF School of Medicineilan
Dhruv Kazi, MD	Assistant Professor, UCSF School of Medicine
Zach Kastenberg, MD	Resident, Department of Surgery, Stanford University
Kit Delgado, MD	Assistant Professor, Department of Emergency Medicine and Faculty Fellow, University of Pennsylvania
Suzann Pershing, MD	Chief of Ophtalmology for the VA Palo Alto Health Care System
KT Park, MD	Assistant Professor, Department of Medicine, Stanford University
Jeremy Goldhaber-Fiebert, PhD	Associate Professor, Department of Medicine, Stanford University
Sanjay Basu, MD	Assistant Professor, Department of Medicine, Stanford University
Marcella Alsan, MD, PhD	Assistant Professor, Department of Medicine (CHP/PCOR), Stanford Univ.
David Chan, MD, PhD	Assistant Professor, Department of Medicine (CHP/PCOR), Stanford Univ.
Karen Eggleston, PhD	Senior Fellow, Freeman Spogli Institute, Stanford University
Kevin Erickson, MD	Assistant Professor, Department of Nephrology, Baylor College of Medicine
Ilana Richman, MD	VA Fellow at CHP/PCOR, Stanford University
Alexander Sandhu, MD	VA Fellow at CHP/PCOR, Stanford University
Michael Hurley	Medical Student, Stanford University
Manali Patel, MD	Instructor, Department of Medicine (Oncology), Stanford University
Dan Austin, MD	Resident Physician, Department of Anesthesia, UCSF School of Medicine
Anna Luan, MD	Resident Physician, Department of Medicine, Stanford University
Louse Wang	Medical Student, Stanford University
Christine Nguyen, MD	Resident Physician, Department of Medicine, Harvard Medical School
Josh Mooney, MD	Instructor, Department of Medicine (Pulmonary and Critical Care Medicine), Stanford University
Eugene Lin, MD	Fellow, Department of Medicine (Nephrology), Stanford University
Eric Sun, MD	Assistant Professor, Department of Anesthesia, Stanford University
Sejal Hathi	Medical Student, Stanford University
Ibrahim Hakim	Medical Student, Stanford University
Archana Nair	Medical Student, Stanford University
Trishna Narula	Medical Student, Stanford University
Daniel Vail	Medical Student, Stanford University
Tej Azad	Medical Student, Stanford University
Jessica Yu, MD	Fellow, Department of Medicine (Gastroenterology), Stanford University
Daniel Vail	Medical Student, Stanford University
Alex Sandhu, MD	Fellow, Department of Medicine (Cardiology), Stanford University
Matthew Muffly, MD	Clinical Assistant Professor, Dept. of Anesthesia, Stanford University

Dissertation Committee Memberships

Ron Borzekowski	Ph.D. in Economics	Stanford University	2002
Jason Brown	Ph.D. in Economics	Stanford University	2002
Dana Rapaport	Ph.D. in Economics	Stanford University	2003
Ed Johnson	Ph.D. in Economics	Stanford University	2003
Joanna Campbell	Ph.D. in Economics	Stanford University	2003
Neeraj Sood*	Ph.D. in Public Policy	RAND Graduate School	2003
James Pearce	Ph.D. in Economics	Stanford University	2004
Mikko Packalen	Ph.D. in Economics	Stanford University	2005
Kaleb Michaud*	Ph.D. in Physics	Stanford University	2006
Kyna Fong	Ph.D. in Economics	Stanford University	2007

Natalie Chun	Ph.D. in Economics	Stanford University	2008
Sriniketh Nagavarapu	Ph.D in Economics	Stanford University	2008
Sean Young	Ph.D. in Psychology	Stanford University	2008
Andrew Jaciw	Ph.D. in Education	Stanford University	2010
Chirag Patel	Ph.D. in Bioinformatics	Stanford University	2010
Raphael Godefroy	Ph.D. in Economics	Stanford University	2010
Neal Mahoney	Ph.D. in Economics	Stanford University	2011
Alex Wong	Ph.D. in Economics	Stanford University	2012
Kelvin Tan	Ph.D. in Management Science	Stanford University	2012
Animesh Mukherjee	Masters in Liberal Arts Program	Stanford University	2012
Jeanne Hurley	Masters in Liberal Arts Program	Stanford University	2012
Patricia Foo	Ph.D. in Economics	Stanford University	2013
Michael Dworsky	Ph.D. in Economics	Stanford University	2013
Allison Holliday King	Masters in Liberal Arts Program	Stanford University	2013
Vilsa Curto	Ph.D. in Economics	Stanford University	2015
Rita Hamad	Ph.D. in Epidemiology	Stanford University	2016
Atul Gupta	Ph.D. in Economics	Stanford University	2017
Yiwei Chen	Ph.D. in Economics	Stanford University	2019
Yiqun Chen	Ph.D. in Health Policy	Stanford University	2020
Min Kim	Ph.D. in Economics	Iowa State Univ.	2021
Bryan Tysinger	Ph.D. in Public Policy	RAND Graduate School	2021

E. GRANTS AND PATENTS

PATENT (2)

1. "Environmental Biomarkers for the Diagnosis and Prognosis for Type 2 Diabetes Mellitus" with Atul Butte and Chirag Patel (2011), US Patent (pending).
2. "Health Cost and Flexible Spending Account Calculator" with Schoenbaum M, Spranca M, and Sood N (2008), U.S. Patent No. 7,426,474.

GRANTS AND SUBCONTRACTS (42)

CURRENT (6)

2019-2020 Funder: Acumen, LLC.
Title: Quality Reporting Program Support for the Long-Term Care Hospital, Inpatient Rehabilitation Facility, Skilled Nursing Facility QRPs and Nursing Home Compare
Role: PI

2018-2020 Funder: Acumen, LLC.
Title: Surveillance Activities of Biologics
Role: PI

2018-2020 Funder: France-Stanford Center for Interdisciplinary Studies
Title: A Nutritional Account of Global Trade: Determinants and Health Implications
Role: PI

2017-2023 Funder: National Institutes of Health

	Title: The Epidemiology and Economics of Chronic Back Pain Role: Investigator (PI: Sun)
2017-2021	Funder: National Institutes of Health Title: Big Data Analysis of HIV Risk and Epidemiology in Sub-Saharan Africa Role: Investigator (PI: Bendavid)
2016-2020	Funder: Acumen, LLC. Title: MACRA Episode Groups and Resource Use Measures II Role: PI

PREVIOUS (36)

2016-2018	Funder: University of Kentucky Title: Food acquisition and health outcomes among new SNAP recipients since the Great Recession Role: PI
2015-2019	Funder: Alfred P. Sloan Foundation Title: Public versus Private Provision of Health Insurance Role: PI
2015-2019	Funder: Natural Science Foundation Title: Health Insurance Competition and Healthcare Costs Role: Investigator (PI: Levin)
2014-2015	Funder: The Centers for Medicare and Medicaid Services Title: Effect of Social Isolation and Loneliness on Healthcare Utilization Role: PI
2014-2015	Funder: AARP Title: The Effect of Social Isolation and Loneliness on Healthcare Utilization and Spending among Medicare Beneficiaries Role: PI
2013-2019	Funder: National Bureau of Economic Research Title: Innovations in an Aging Society Role: PI
2013-2014	Funder: Robert Wood Johnson Foundation Title: Improving Health eating among Children through Changes in Supplemental Nutrition Assistance Program (SNAP) Role: Investigator (PI: Basu)
2011-2016	Funder: National Institutes of Health (R37) Title: Estimating the Potential Medicare Savings from Comparative Effectiveness Research Role: PI Subaward (PI: Garber)
2011-2016	Funder: National Institute of Aging (P01) Title: Improving Health and Health Care for Minority and Aging Populations Role: PI Subcontract (PI: Wise)

2010-2018	Funder: National Institutes of Health Title: Clinic, Family & Community Collaboration to Treat Overweight and Obese Children Role: Investigator (PI: Robinson)
2010-2014	Funder: Agency for Health, Research and Quality (R01) Title: The Effects of Private Health Insurance in Publicly Funded Programs Role: Investigator (PI: Bundorf)
2010-2013	Funder: Agency for Healthcare Research and Quality Title: G-code" Reimbursement and Outcomes in Hemodialysis Role: Investigator (PI: Erickson)
2010-2013	Funder: University of Southern California Title: The California Medicare Research and Policy Center Role: PI
2010-2012	Funder: University of Georgia Title: Natural Experiments and RCT Generalizability: The Woman's Health Initiative Role: PI
2010-2011	Funder: National Bureau of Economic Research Title: Racial Disparities in Health Care and Health Among the Elderly Role: PI
2009-2020	Funder: National Institute of Aging (P30) Title: Center on the Demography and Economics of Health and Aging Role: PI (2011-2020)
2009-2011	Funder: Rand Corporation Title: Natural Experiments and RCT Generalizability: The Woman's Health Initiative Role: PI
2008-2013	Funder: American Heart Association Title: AHA-PRT Outcomes Research Center Role: Investigator (PI: Hlatky)
2007-2009	Funder: National Institute of Aging (R01) Title: The Economics of Obesity Role: PI
2007-2009	Funder: Veterans Administration, Health Services Research and Development Service Title: Quality of Practices for Lung Cancer Diagnosis and Staging Role: Investigator
2007-2008	Funder: Stanford Center for Demography and Economics of Health and Aging Title: The HIV Epidemic in Africa and the Orphaned Elderly

	Role: PI
2007	Funder: University of Southern California Title: The Changes in Health Care Financing and Organization Initiative Role: PI
2006-2010	Funder: National Institute of Aging (K02) Title: Health Insurance Provision for Vulnerable Populations Role: PI
2006-2010	Funder: Columbia University/Yale University Title: Dummy Endogenous Variables in Threshold Crossing Models, with Applications to Health Economics Role: PI
2006-2007	Funder: Stanford Center for Demography and Economics of Health and Aging Title: Obesity, Wages, and Health Insurance Role: PI
2005-2009	Funder: National Institute of Aging (P01 Subproject) Title: Medical Care for the Disabled Elderly Role: Investigator (PI: Garber)
2005-2008	Funder: National Institute of Aging (R01) Title: Whom Does Medicare Benefit? Role: PI Subcontract (PI: Lakdawalla)
2002	Funder: Stanford Center for Demography and Economics of Health and Aging Title: Explaining Changes in Disability Prevalence Among Younger and Older American Populations Role: PI
2001-2003	Funder: Agency for Healthcare Research and Quality (R01) Title: State and Federal Policy and Outcomes for HIV+ Adults Role: PI Subcontract (PI: Goldman)
2001-2002	Funder: National Institute of Aging (R03) Title: The Economics of Viatical Settlements Role: PI
2001-2002	Funder: Robert Woods Johnson Foundation Title: The Effects of Medicare Eligibility on Participation in Social Security Disability Insurance Role: PI Subcontract (PI: Schoenbaum)
2001-2002	Funder: USDA Title: Evaluating the Impact of School Breakfast and Lunch Role: Investigator
2001-2002	Funder: Northwestern/Univ. of Chicago Joint Center on Poverty Title: The Allocation of Nutrition with Poor American Families Role: PI Subcontract (PI: Haider)
2000-2002	Funder: National Institute on Alcohol Abuse & Alcoholism (R03) Title: The Demand for Alcohol Treatment Services Role: PI
2000-2001	Funder: USDA Title: How Should We Measure Hunger?

Role: PI Subcontract (PI: Haider)

F. SCHOLARSHIPS AND HONORS

- Phi Beta Kappa Honor Society, 1988
- Distinction and Departmental Honors in Economics, Stanford University, 1990
- Michael Forman Fellowship in Economics, Stanford University, 1991-1992
- Agency for Health Care Policy and Research Fellowship 1993-1995
- Outstanding Teaching Assistant Award, Stanford University, Economics, 1994
- Center for Economic Policy Research, Olin Dissertation Fellowship, 1997-1998
- Distinguished Award for Exceptional Contributions to Education in Medicine, Stanford University, 2005, 2007, and 2013.
- Dennis Aigner Award for the best applied paper published in the *Journal of Econometrics*, 2013

Scientific Evidence on COVID, Children, and Mask Mandates

October 10, 2021

Jay Bhattacharya, MD, PhD

Professor, Stanford University School of Medicine

EXHIBIT
4-B

Table of Contents

Executive Summary

This report aims to assess the scientific evidence regarding the benefits and harms of mandating that children wear masks to attend school. I adopt an approach that contrasts the marginal benefits of required masking against the marginal harms. This stands in contrast to the approach that has characterized much decision-making during the pandemic, which typically ignores harms from interventions while at the same time assuming – even in the absence of high-quality scientific evidence – that the interventions will succeed in slowing disease spread. The primary findings I report in each section are as follows.

In "Public Health Decision-Making Principles," I outline some key and uncontroversial principles that public health ought to follow if it is to claim that it has a reasonable basis for the policies it is implementing, including the consideration of both costs and benefits of the policy in both short and long run, the strength and quality of scientific evidence underlying the policy, whether the policy is consistent with democratic norms and ethical principles, and a requirement that the policy treat all members of society equitably. The imposition of mandatory childhood masking fails on several grounds because the balance of harms outweighs the benefits, and the strength of scientific evidence on benefits is weak.

In "COVID-19 Infection Fatality Risk", I discuss the evidence on the risk of mortality posed by SARS-CoV-2 infection. For children, the mortality risk posed by infection is vanishingly low, with infection survival probabilities surpassing 99.99% in many studies. The risk of mortality after infection grows sharply with age. For elderly adults over 70, the survival probability after infection is 95%. The vaccination of the adult population has dramatically lowered the mortality risk faced by vaccinated individuals.

In "Children are unlikely to suffer serious side effects from COVID-19", I present further evidence on the low likelihood that children face lasting harm from COVID infection, including evidence that severe inflammatory outcomes, such as MIS-C, are rare.

In "Children are Inefficient Transmitters of the Virus," I present evidence from studies conducted worldwide that children are less efficient at spreading the disease than adults. Based on this evidence, which was available early in the epidemic, many countries opened their schools for in-

person instruction during the 2020-21 academic year, in many places with no masks required for children or staff. The results from this natural experiment yielded very low COVID-related mortality for children and COVID-infection rates for teachers and staff at lower rates than in the population at large.

In "No Randomized Evidence of Efficacy of Masking in Limiting Disease Spread," I present evidence of structured reviews of the literature on the effect of masking on slowing the spread of COVID and other respiratory viruses. The primary conclusion is that there are no high-quality randomized evaluations that establish that masks on children are particularly effective in slowing disease spread. The highest quality observational evidence from the U.S. suggests no correlation between mandating that children wear masks and disease outcomes.

Finally, in "Harms to Children from Mask Wearing in Schools," I present evidence from the scientific literature that masks can pose some harm to the emotional and social development of some children.

Overall, the evidence I present in this report shows that permitting parents to opt out of a mandated mask policy is unlikely to have a significant effect on COVID disease spread and may relieve some children from the harms of masking.

Biography

I am a Professor of Medicine at Stanford University and a research associate at the National Bureau of Economic Research. I direct Stanford's Center for Demography and Economics of Health and Aging. My recent research focuses on the epidemiology of COVID, including the lethality of COVID infection and the effects of lockdown policies. Before COVID, I studied the health and well-being of vulnerable populations, emphasizing the role of government programs, biomedical innovation, and health policy. I have published many articles in top peer-reviewed scientific journals in medicine, economics, health policy, epidemiology, statistics, law, and public health, among other fields. I have published to date six peer-reviewed publications on COVID, including some of the most highly cited pieces published during the pandemic. I hold an M.D. and Ph.D. in economics, both earned at Stanford University.

Public Health Decision-Making Principles

The justification for a benefit-harm approach is that it is consistent with the principles of good public health[1] and health policy[2] practice that predates the epidemic and is more likely to produce good decisions and better pandemic outcomes. Within the context of public health decisions, "decisions about which actions should be considered [during a pandemic] should take into account numerous factors, such as virus transmission parameters, severity of disease among different age and risk groups, availability and effectiveness of control measures and treatment options, and impact on health care, schools, business, and the community."[3] That is because mitigation policies—especially severe ones—have "potential social, economic, and political consequences that need to be fully considered by political leaders as well as health officials" before their implementation.[4] Those consequences are evident and well-illustrated by the economic, physical, and psychological harms that extreme COVID-19 mitigation measures inflicted and, in many places, continue to inflict.

While the topic is voluminous, there are a few principles that are particularly relevant to COVID-19 policy making, including the following guidelines for decision-makers:

- Consider both the costs *and* benefits of alternative policies, choosing policies that appropriately balance the two.
- Appropriately account for uncertainty in the projected costs and benefits of policy options.
- Account for the strength of the scientific evidence.
- Be constrained in policy making by democratic norms and ethical principles.
- Choose policies that treat people in society equitably, and in particular, eschew policies that disproportionately favor more affluent members of society over poorer members.

Sound health policy decision-making requires a careful evaluation of both the costs and benefits over both the long and short term. It is striking that public health officials rarely discuss the collateral harms or, in the case of masks, often assume that there are none. The costs considered should include medical and psychological harms as well as economic damage.

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[1] Public Health Leadership Society (2002) Principles of the Ethical Practice of Public Health. American Public Health Association. https://www.apha.org/-/media/files/pdf/membergroups/ethics/ethics_brochure.ashx

[2] Bhattacharya J, Hyde T, Tu P. Health Economics, London: Palgrave-MacMillan, (2013).

[3] Rachel Holloway et al., *Updated Preparedness and Response Framework for Influenza Pandemics*, MORBIDITY & MORTALITY WEEKLY REP., Sept. 26, 2014, at 6.

[4] Thomas V. Inglesby et al., *Disease Mitigation Measures in the Control of Pandemic Influenza*, 4 BIOSECURITY & BIOTERRORISM: BIODEFENSE STRATEGY, PRACTICE, & SCIENCE 366, 369 (2006).

The costs and benefits of every potential policy involve some degree of uncertainty, including lockdowns and masking. Weighing the costs and benefits of a particular mitigation policy is, to be sure, a difficult task in the context of a pandemic. "[D]ata needed to make decisions might be limited," especially early in a pandemic, but "delaying action might weaken the effectiveness of the response."[5] But that does not justify taking blanket prophylactic action that may, in the end, cause significant harm with little benefit, which is precisely what occurred in the COVID-19 pandemic.

In the face of uncertainty, public health decision-making should be based on the best available evidence regarding the most likely outcomes from the imposition of the policy. Medicine and public health require the highest quality evidence – placebo-controlled randomized trials – for a good reason; too often, lower-quality evidence produces misleading conclusions. Public health decision-making should eschew decision-making based on worst-case or best-case assumptions about the outcomes that may happen if alternate policies are adopted. It is particularly bad practice to make decisions that assume worst-case scenarios regarding the costs of a policy and best-case assumptions regarding the benefits of a policy, or vice versa. So, for instance, it is poor public health practice to assume in the absence of high-quality evidence that masks, if mandated, will have a dramatic effect on disease transmission and mortality with no consideration of the harms associated with masking children.

In addition to the costs and benefits, public health policy must consider the strength of the scientific evidence regarding the measure in achieving the aims it proposes. Of course, without solid scientific evidence in favor of a policy – especially one with enormous costs – its imposition by a government on a population would be unethical. The greater the potential harms from the policy on some part of the population, the greater the evidentiary standard required to establish its necessity.

Finally, equity is a key principle of public health. Public health officials must consider whether the harms of a policy like lockdowns fall disproportionately on the poor, minority populations, or others of low socioeconomic status. Similarly, policies that accrue benefits disproportionately to

[5] Rachel Holloway et al., *Updated Preparedness and Response Framework for Influenza Pandemics*, MORBIDITY & MORTALITY WEEKLY REP., Sept. 26, 2014, at 6.

the affluent, majority populations, and people of high socioeconomic status should be redesigned to comport with the requirement for equity in public health decision-making.

In summary, sound public-health practice adheres to key principles aimed at grounding policy in sound science, respecting human rights and democratic norms, appropriately accounting for costs and benefits of policies and uncertainty in outcomes, treating people equitably, as well as other principles not discussed here. Public health officials must make decisions within that framework to engage in non-arbitrary and non-capricious decision-making. That includes current decisions about COVID-19-related health policy, such as whether or not to mandate non-pharmaceutical interventions ("NPI's") like mask wearing for schoolchildren—the subject of this report. Instead, public health authorities should focus their resources on protecting the population of older, vulnerable people who have not yet been vaccinated and still face a high risk of death if infected. Direct protection through extended vaccination efforts for the vulnerable would more effectively reduce the direct harms from COVID, without some of the adverse effects – both social and personal – induced by mask mandates for children.

COVID-19 Infection Fatality Risk

SARS-CoV-2, the virus that causes COVID-19 infection, entered human circulation some time in 2019 in China. The virus itself is a member of the coronavirus family of viruses, several of which cause typically mild respiratory symptoms upon infection. The SARS-CoV-2 virus, by contrast, induces a wide range of clinical responses upon infection. These presentations range from entirely asymptomatic infection to mild upper respiratory disease with unusual symptoms like loss of sense of taste and smell, hypoxia, or a deadly viral pneumonia that is the primary cause of death due to SARS-CoV-2 infection.

The mortality danger from COVID-19 infection varies substantially by age and a few chronic disease indicators.[6] For most of the population, including the vast majority of children and young adults, COVID-19 infection poses less of a mortality risk than seasonal influenza. By contrast, for older people – especially those with severe comorbid chronic conditions – COVID-19 infection poses a high risk of mortality, on the order of a 5% infection fatality rate.

The best evidence on the infection fatality rate from SARS-CoV-12 infection (that is, the fraction of infected people who die due to the infection) comes from seroprevalence studies. The definition of seroprevalence of COVID-19 is the fraction of people in a population who have specific antibodies against SARS-CoV-2 in their bloodstream. A seroprevalence study measures the fraction of a population who have antibodies that are produced specifically by people infected by the SARS-CoV-2 virus. The presence of specific antibodies in blood provides excellent evidence that an individual was previously infected.

Seroprevalence studies provide better evidence on the total number of people who have been infected than do case reports or positive reverse transcriptase-polymerase chain reaction (RT-PCR) test counts. PCR tests are the most common type of test used to check whether a person currently has the virus or viral fragments in their body (typically in the nasopharynx). The PCR test should

[6] Public Health England (2020) Disparities in the Risk and Outcomes of COVID-19. August 2020. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/908434/Disparities_in_the_risk_and_outcomes_of_COVID_August_2020_update.pdf

not be used to count the total number of people who have been infected to date in a population. Case reports and PCR test counts both miss infected people who are not identified by the public health authorities or who do not volunteer for RT-PCR testing. That is, they miss people who were infected but recovered from the condition without coming to the attention of public health authorities. Because they ignore unreported, fatality rate estimates based on case reports or positive test counts are substantially biased toward reporting a higher fatality rate.

According to a meta-analysis[7] by Dr. John Ioannidis of every seroprevalence study conducted to date of publication with a supporting scientific paper (74 estimates from 61 studies and 51 different localities worldwide), the median infection survival rate—the inverse of the infection fatality rate—from COVID-19 infection is 99.77%. For COVID-19 patients under 70, the meta-analysis finds an infection survival rate of 99.95%. A separate meta-analysis[8] by other scientists independent of Dr. Ioannidis' group reaches qualitatively similar conclusions.

A study of the seroprevalence of COVID-19 in Geneva, Switzerland (published in *The Lancet*)[9] provides a detailed age breakdown of the infection survival rate in a preprint companion paper[10] 99.9984% for patients 5 to 9 years old; 99.99968% for patients 10 to 19 years old; 99.991% for patients 20 to 49 years old; 99.86% for patients 50 to 64 years old; and 94.6% for patients above 65.

I estimated the age-specific infection fatality rates from the Santa Clara County seroprevalence study[11] data (for which I am the senior investigator). The infection survival rate is 100% among people between 0 and 19 years (there were no deaths in Santa Clara in that age range up to that date); 99.987% for people between 20 and 39 years; 99.84% for people between 40 and 69 years; and 98.7% for people above 70 years.

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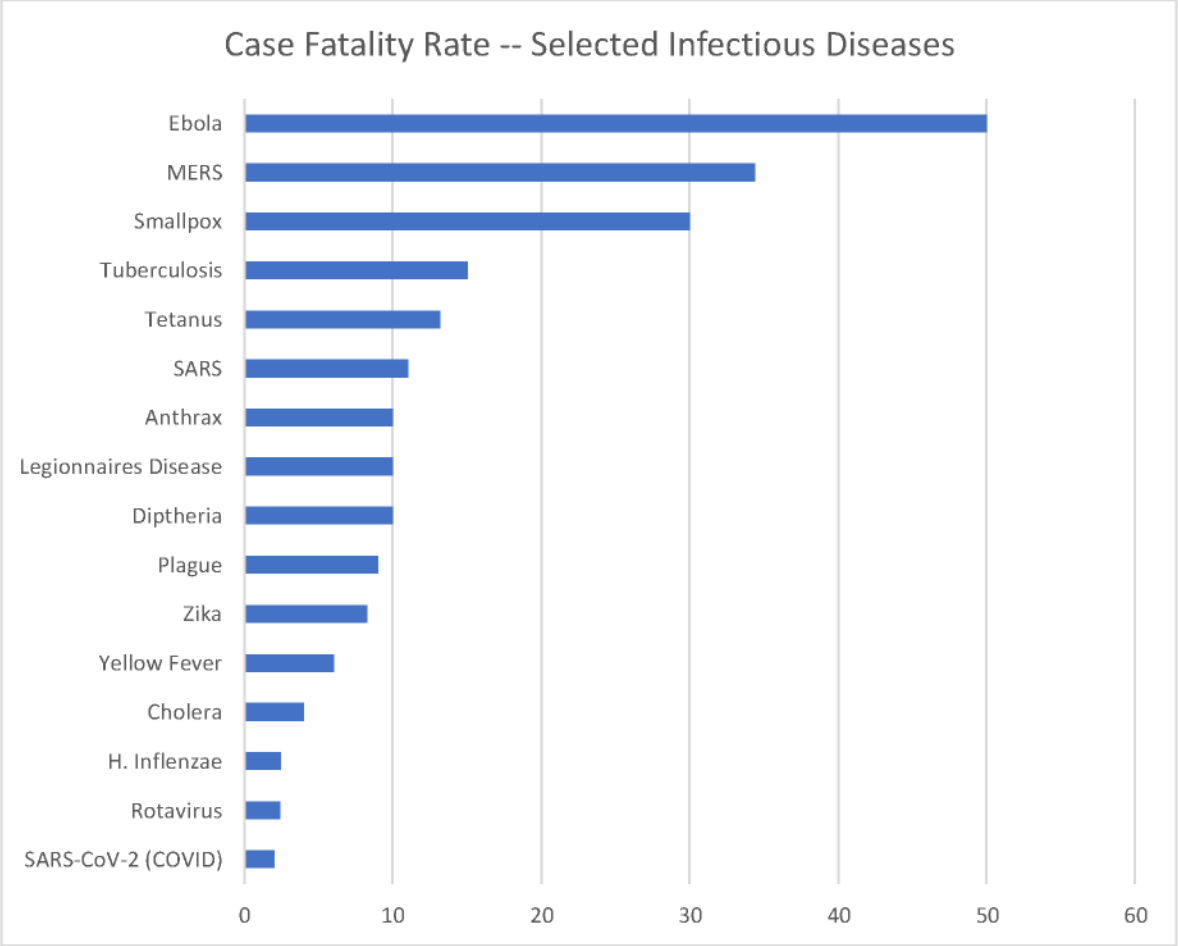
[7] John P.A. Ioannidis , *The Infection Fatality Rate of COVID- 19 Inferred from Seroprevalence Data*, Bulletin of the World Health Organization BLT 20.265892.
[8] Andrew T. Levin, et al., *Assessing the Age Specificity of Infection Fatality Rate for COVID- 19: Meta-Analysis & Public Policy Implications* (Aug. 14,2020)MEDRXIV, http://bit.ly/3gplolV.
[9] Silvia Stringhini, et al., *Seroprevalence of Anti-SARS-CoV-2 lgG Antibodies in Geneva, Switzerland (SEROCoV-POP): A Population Based Study* (June 11, 2020) THE LANCET, https://bit.ly/3187S13.
[10] Francisco Perez-Saez, et al. *Serology- Informed Estimates of SARS-COV-2 Infection Fatality Risk in Geneva, Switzerland* (June 15,2020) OSF PREPRINTS, http://osf.io/wdbpe/.
[11] Eran Bendavid, et al., *COVID- 19 Antibody Seroprevalence in Santa Clara County, California* (April 30,2020) MEDRXIV, https://bit.ly/2EuLIFK.

Those numbers are consistent with what the US CDC has reported. A US CDC report[12] found between 6 and 24 times more SARS-CoV-2 infections than cases reported between March and May 2020. Correspondingly, the CDC's estimate of the infection fatality rate for people ages 0-19 years is 0.003%, meaning infected children have a 99.997% survivability rate. For people ages 20-49 years, it was 0.02%, meaning that young adults have a 99.98% survivability rate. For people age 50-69 years, it was 0.5%, meaning this age group has a 99.5% survivability rate. Finally, for people ages 70+ years, it was 5.4%, meaning seniors have a 94.6% survivability rate. [13] There is thus no substantial qualitative disagreement about the infection fatality rate reported by the CDC and other sources in the scientific literature. This should come as no surprise since they all rely on seroprevalence studies to estimate infection fatality rates.

It is helpful to provide some context for how large the mortality risk is posed by COVID infection relative to the risk posed by other infectious diseases. Since seroprevalence-based mortality estimates are not readily available for every disease, in the figure immediately below, I plot case fatality rates, defined as the number of deaths due to the disease divided by the number of identified or diagnosed cases of that disease. The case fatality rate for SARS-CoV-2 is ~2% (though that number has decreased with the availability of vaccines and effective treatments). By contrast, the case fatality rate for SARS is over five times higher than that, and for MERS, it is 16 times higher than that.

[12] Fiona P. Havers, et al., *Seroprevalence of Antibodies to SARS-CoV-2 in 10 Sites in the United States, March 23-May 12, 2020* (Jul. 21, 2020) JAMA INTERN MED., https://bit.ly/3goZUgy.
[13] COVID- 19 Pandemic Planning Scenarios, Centers for Disease Control and Prevention, https://www.cdc.gov/coronavirus/2019-ncov/hcp/planning-scenarios.html.



Perhaps the most important implication of these estimates is that they identify two distinct populations of people who face a very different risk from COVID infection. One segment – the elderly and others with severe chronic disease – faces a higher risk of mortality if infected (especially if unvaccinated). A second segment – typically non-elderly people – face a very low risk of mortality if infected and instead face much greater harm from lockdowns, school closures, and other non-pharmaceutical interventions than from COVID infection itself. The right strategy, then, is focused protection of the vulnerable population by prioritizing them for vaccination while lifting lockdowns and other restrictions on activities for the rest since they cause harm without corresponding benefit for the non-vulnerable. The Great Barrington Declaration, of which I am a primary co-author, describes an alternate policy of focused protection. This policy would lead to fewer COVID-related deaths and fewer non-COVID-related deaths than universal lockdowns or a strategy that lets the virus rip through the population. My co-authors of this Declaration include Prof. Martin Kulldorff of Harvard University and Prof. Sunetra Gupta of Oxford University. Over

12,000 epidemiologists and public health professionals and 35,000 medical professionals have co-signed the Declaration.[14]

These infection fatality rate estimates presented in this section are drawn from data before widespread vaccination in the U.S. and elsewhere. The COVID-19 vaccines approved for use in the U.S. are very effective in substantially reducing the infection fatality rate. According to the US Centers for Disease Control, the mRNA vaccines were 94% effective against COVID-19 hospitalization for patients 65 and older.[15] So infection fatality rates that I provide above are overestimated by at least one order of magnitude. Fully vaccinated, non-elderly teachers in classrooms face a vanishingly small risk of mortality even if the SARS-CoV-2 virus infects them.

[14] Bhattacharya J, Gupta S, Kulldorff M (2020) Great Barrington Declaration. https://gbdeclaration.org

[15] Tenforde MW, Olson SM, Self WH, et al. Effectiveness of Pfizer-BioNTech and Moderna Vaccines Against COVID-19 Among Hospitalized Adults Aged ≥65 Years — United States, January–March 2021. MMWR Morb Mortal Wkly Rep 2021;70:674–679. DOI: http://dx.doi.org/10.15585/mmwr.mm7018e1external icon

Children are unlikely to suffer serious side effects from COVID-19 despite the delta variant

As the previous section indicates, COVID-19 is not a severe threat to schoolchildren, especially younger children—even if they contract the disease.[16] To begin, COVID-19 is almost never fatal for schoolchildren. According to Bravata et al., 2021 "[t]he CDC estimates that compared to adults 40 to 49 years of age, children 5 to 17 years of age have 160 times lower risk of death from COVID-19 and 27 times lower risk of hospitalization from COVID-19."[17] Since the start of the pandemic in the U.S. in January 2020 through Sept. 15, 2021, 439 children under 18 have died with a COVID-19 diagnosis code in their record. This is fewer children than die during a typical five-month influenza season each year.[18]

And in Georgia, there have been few COVID-19 linked deaths among those under 18 years old.[19] The figure, taken from the Georgia Department of Public Health Daily Status Report, plots a histogram of confirmed deaths by age in Georgia using data from the pandemic's start through October 8, 2021. It should not be surprising, given the evidence shown in the previous section, how uncommon mortality is for children relative to older people, especially those over the age of 70, where the bulk of the COVID-19 deaths have occurred.

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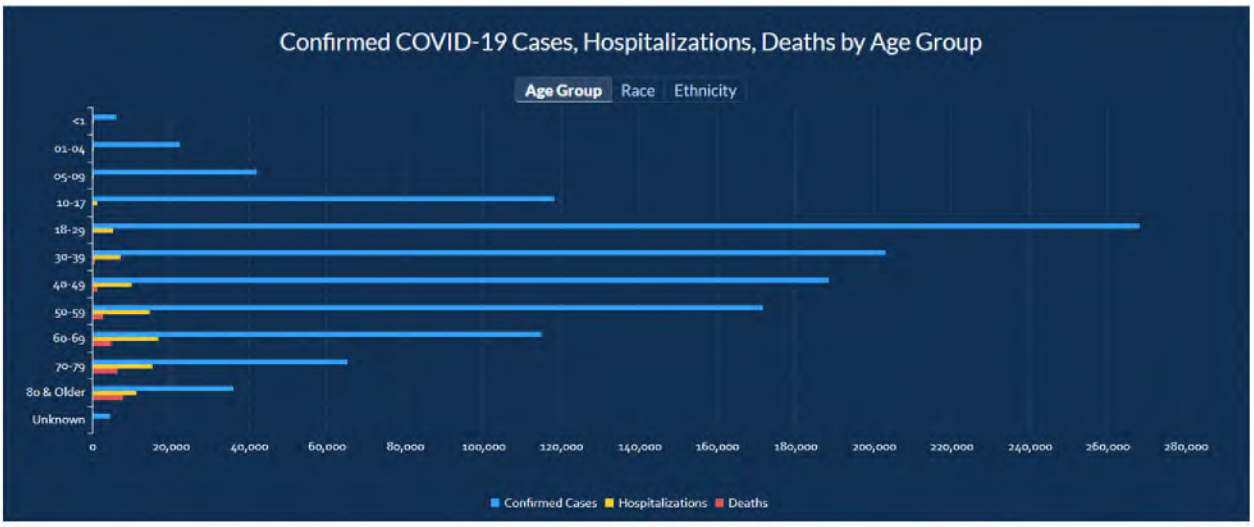
[16] Especially children without preexisting conditions—"[i]t appears that children who become severely ill with acute Covid-19 often have one or more underlying conditions, including medical complexity, obesity, asthma, sickle cell disease, and immunosuppression." Jessica H. Rubens et al., *Acute COVID-19 and Multisystem Inflammatory Syndrome in Children*, BMJ: CLINICAL UPDATES, Mar. 1, 2021, at 2.

[17] Dena Bravata, et al. *Back to School: The Effect of School Visits During COVID-19 on COVID-19 Transmission* 9 (Nat'l Bureau of Econ. Research, Working Paper No. 28645, Apr. 2021).

[18] Marty Makary, Opinion, *The Flimsy Evidence Behind the CDC's Push to Vaccinate Children*, WALL ST. J. (July 19, 2021), https://on.wsj.com/2VYqit1. See also National Center for Health Statistics, "COVID-19 Data from the NCHS". Table 1. Table 1. Deaths involving coronavirus disease 2019 (COVID-19), pneumonia, and influenza reported to NCHS by sex and age group. United States. Accessed September 24, 2021. https://www.cdc.gov/nchs/covid19/index.htm

[19] Georgia Department of Public Health Daily Status Report. COVID-19 Case Demographics. https://ga-covid19.ondemand.sas.com/. Data accessed October 10, 2021 and current through October 8, 2021.



Indeed, data from the U.K. regarding fatality rates from the Delta variant show the case fatality rate from delta is lower than other variants. It is near 0.0% for those under fifty years old.[20] Given the death rate from COVID-19 is positively related to age, and the data from the U.K. indicate that the relationship still holds despite the new variant, the U.K. data show that the delta variant is *not* particularly lethal for schoolchildren.

The incidence of school-age children requiring hospitalizations due to COVID-19 is also rare. The latest data from the CDC, shown immediately below, plots hospitalization rates per 100,000 population for different age groups from September 2020 through Sept. 22, 2021. The rate of hospitalization for the 0-17 age group, even at the peak of the epidemic this past summer, was below five children per million population on any given date. Children make up by far the smallest share of the total hospitalized population at any given time, while the elderly make up the bulk of the hospitalized.[21]

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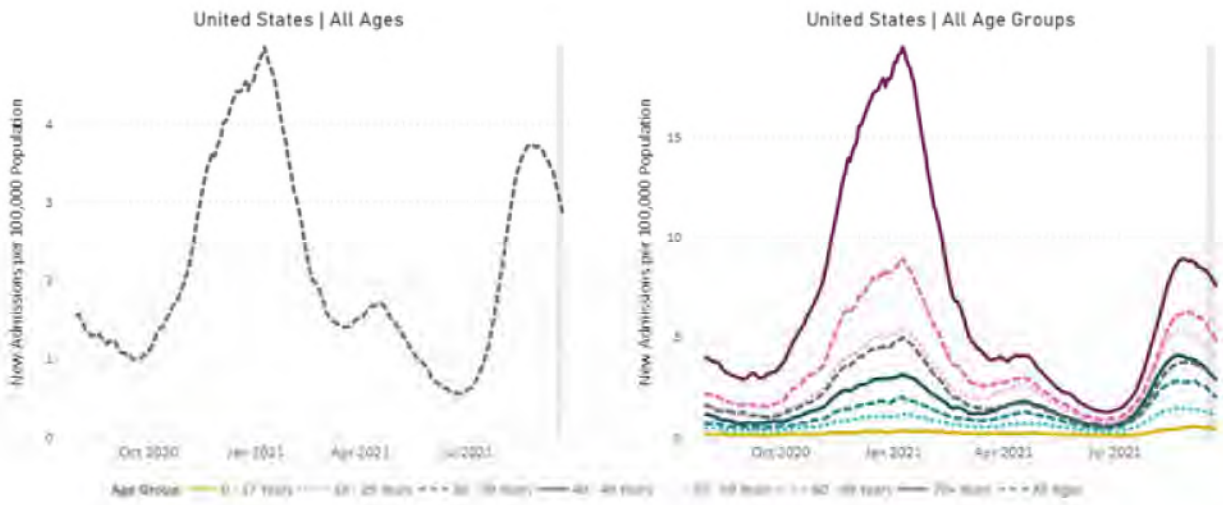
[20] *See* Public Health England (2021) SARS-CoV-2 variants of concern and variants under investigation in England. Technical Briefiing 20. August 6, 2021. (showing that only 48 of the 147,612 unvaccinated people under 50 who were infected with the Delta variant died, or 0.03%). https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1009243/Technical_Briefing_20.pdf.

[21] CDC COVID Data Tracker. United States at a Glance. https://covid.cdc.gov/covid-data-tracker/#new-hospital-admissions. Accessed September 24, 2021



Even those advocating for stricter non-pharmaceutical interventions in school settings acknowledge that COVID-19 "infection in children is generally characterized by mild illness. Only a minority of children require hospitalization…." [22] The public health agency in the Netherlands similarly concludes, "Worldwide, relatively few children have been reported with COVID-19… Children become less seriously ill and almost never need to be hospitalized because of" COVID-19."[23]

Experience over the last year and a half bears this out. For example, in Sweden, "[f]rom March through June 2020, a total of 15 children with Covid-19 were admitted to an ICU (0.77 per 100,000 children in this age group)."[24] Furthermore, data published by Public Health England shows that hospitalization rates and case fatality rates from delta variant infections are lower than hospitalization and case fatality rates from the previously common alpha variant for the younger population.[25]

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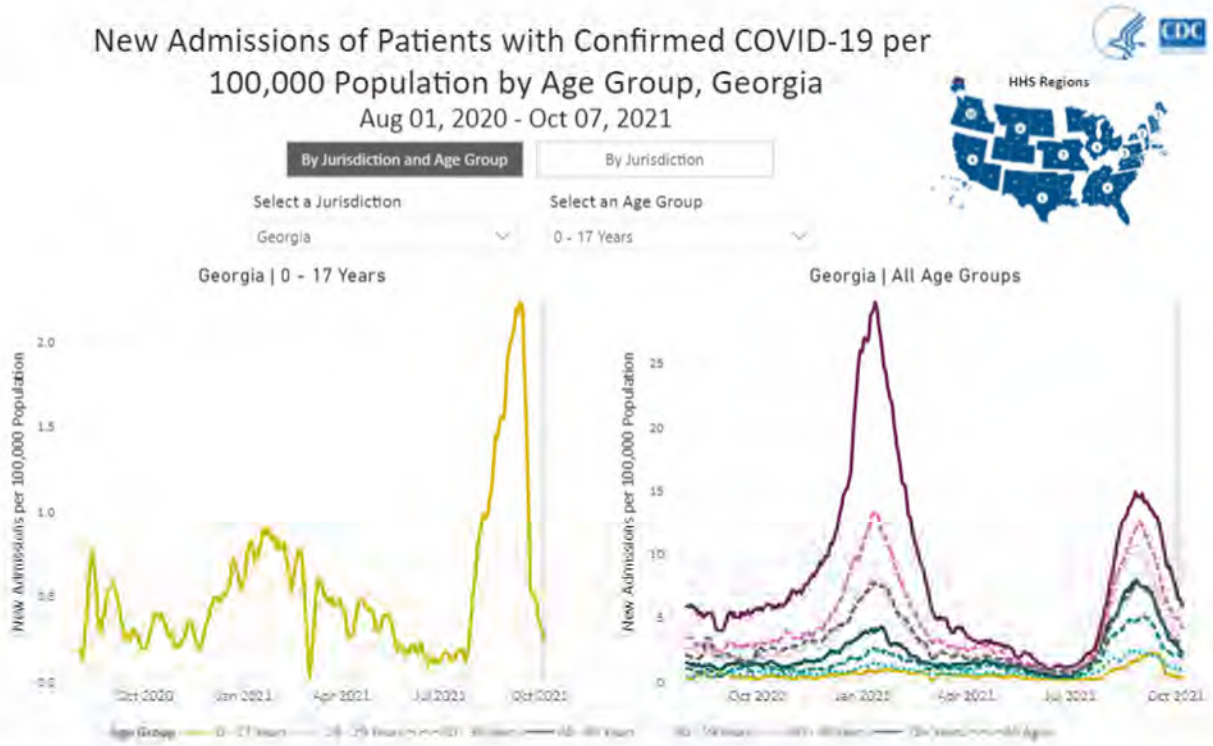
[22] Zoe Hyde, Perspective, *COVID-19, Children and Schools: Overlooked and at Risk*, 213 MED. J. AUSTL. 444, 444 (2020)

[23] *See Children, School and COVID-19*, NAT'L INST. PUB. HEALTH & ENV'T (last updated July 14, 2021), https://www.rivm.nl/en/coronavirus-covid-19/children-and-covid-19).

[24] Jonas F. Ludvigsson, Letter to the Editor, *Open Schools, Covid-19, and Child and Teacher Morbidity in Sweden*, 384 NEW ENG. J. MED. 669, 669 (2021)

[25] Public Health England. SARS-CoV-2 variants of concern and variants under investigation in England Technical briefing 23. 17 September 2021. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1018547/Technical_Briefing_23_21_09_16.pdf

And the data from the CDC shows that, in Georgia, children age 0-17 made up a minuscule fraction of new admissions over the whole epidemic and over the past three months:[26]



The chart on the left above does show a spike in hospitalizations that correspond to the prevalence of the Delta variant—but even that is low, a little over 2 admissions per 100,000 population. At least some part of the more recent spike is due to coinfection with Respiratory Syntical Virus (RSV), which had an out-of-season surge this summer in the U.S.[27] As the right-hand chart above reflects, it is still a tiny percentage of all hospital admissions. These data suggest outcomes for children infected with the delta variant are similar to outcomes from prior variants. Data from across the country (shown in the chart below) confirm that conclusion, with the weekly admission rate for those under 18 years old much lower than those over 18.[28]

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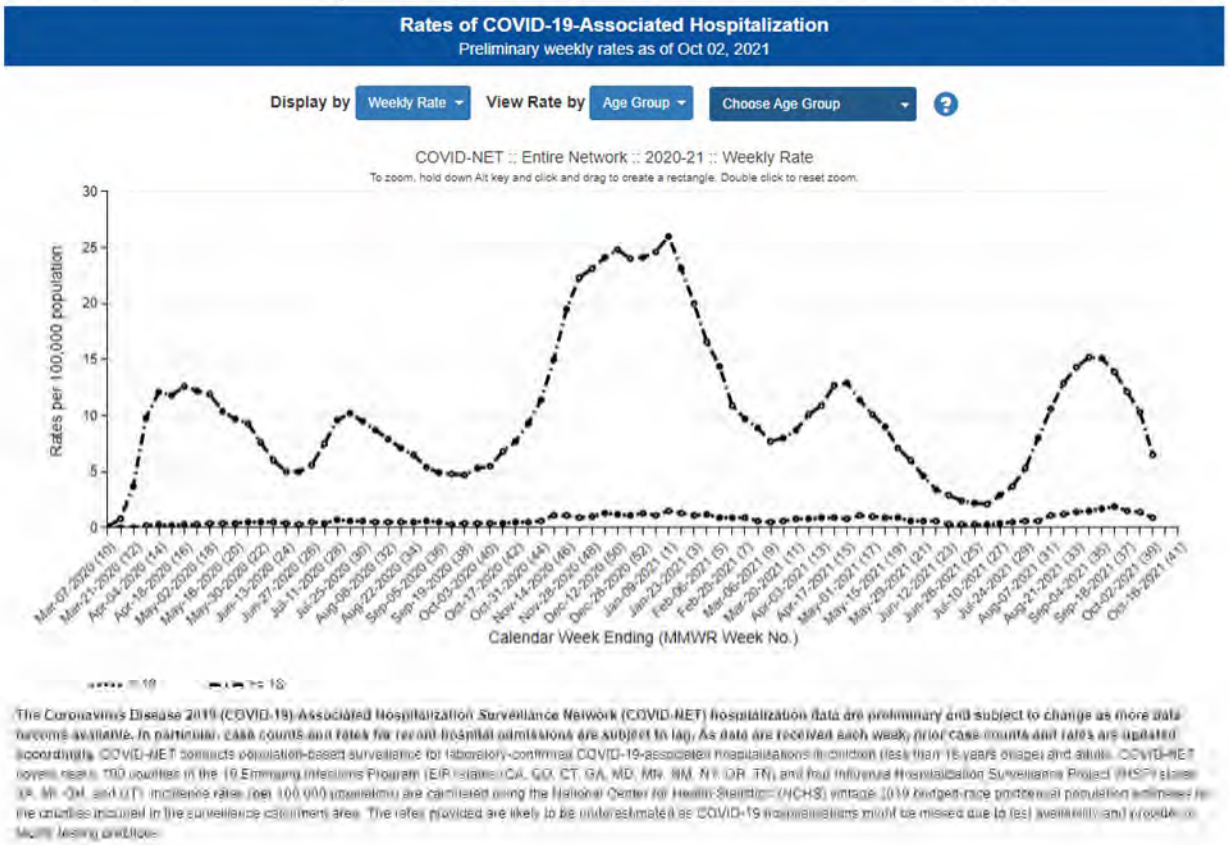
[26] *CDC. COVID Data Tracker.* https://covid.cdc.gov/covid-data-tracker/#new-hospital-admissions

[27] James Ducharme. Why the Respiratory Disease RSV is Having an Off-Season Surge. Time. July 22, 2021. https://time.com/6082836/rsv-spike-summer-2021/

[28] *COVID Data Tracker*, CDC (last visited October 10, 2021), https://covid.cdc.gov/covid-data-tracker/#covidnet-hospitalization-network.



The U.K. has seen a similar pattern, with hospital admission rates for school-age children near their prior peak for each age cohort, though still much smaller compared to other age cohorts[29]. Two possible explanations for this include age prioritization of vaccination—which prioritized older individuals and hence protected them differentially— and a surge in RSV, rather than increasing virulence of the delta variant against children.

In addition to hospitalizations, severe health complications from COVID-19 are also rare. Long-lasting symptoms that persist after recovery from COVID-19 infections ("long COVID") and Multisystem Inflammatory Syndrome (MIS-C) are also rare among children. As to the latter, "a small fraction of children can experience a severe post-infectious multisystem inflammatory syndrome."[30] The data from the CDC bears this out: in total, there have been 4,404 cases of MIS-

[29] *See Coronavirus (COVID-19) Latest Insights: Hospitals*, OFF. NAT'L STAT. (Aug. 13, 2021), https://bit.ly/3ALzikG.

[30] Hyde, *supra*, at 444; *see also* Ludvigsson, *Open Schools*, *supra*, at 669 ("[A] total of 15 children [between the ages of 1 and 16] with Covid-19 (*including those with MIS-C*) were admitted to an ICU (0.77 per 100,000 children in this age group).") (emphasis added).

C in children between the ages of 0 and 20 in the country since mid-May 2020.[31] That is roughly 0.1% of children identified as COVID-19 cases in that age group.[32] Rubens et al. confirm that MIS-C is rare: "Overall, MIS-C is a rare complication of SARS-CoV-2. A May 2020 systematic review from 26 countries reported an MIS-C incidence of 0.14% among all children with SARS-CoV-2 infection, but this estimated incidence may be imprecise because of potential underestimation of overall SARS-CoV-2 infections in children."[33]

As for long COVID, the evidence "suggests a very low prevalence of [it]" in children.[34] Indeed, "[s]eropositive children, all with a history of pauci-symptomatic SARS-CoV-2 infection, did not report long COVID more frequently than seronegative children."[35] Another study found that symptomatic COVID-19 infection in schoolchildren (5 to 17 years old) "is usually of short duration (6 days vs. 11 days in adults), with low symptom burden."[36] Further, the authors note that "[o]nly a small proportion of children had illness duration beyond four weeks, and their symptom burden decreased over time. Almost all children had symptom resolution by eight weeks."[37] This result is consistent with other studies showing that long COVID is rare among the general population. [38]

The most reliable study was recently published by the Office of National Statistics in the U.K.[39] It is the most reliable study because of its large sample size and, notably, a control group of children

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[31] *Multisystem Inflammatory Syndrome*, CDC (last updated July 30, 2021), https://bit.ly/3xMxdTC.

[32] For data for total COVID-19 cases broken out by age, see *Demographic Trends of COVID-19 Cases and Deaths in the US Reported to CDC*, CDC (last updated Aug. 14, 2021), https://bit.ly/3iPfCpW. The number is a rough approximation due to the difference in reporting periods and because the CDC's age breakdown does not allow for totaling of cases in people aged 0 to 20. To approximate this number, the analysis totals cases for people aged 0 to 17, which would tend to increase the percentage presenting with MIS-C.

[33] Jessica H. Rubens et al., *Acute COVID-19 and Multisystem Inflammatory Syndrome in Children*, BMJ: CLINICAL UPDATES, Mar. 1, 2021, at 3

[34] Thomas Radtke et al., *Long-Term Symptoms After SARS-CoV-2 Infection in School Children: Population-Based Cohort with 6-Months Follow-Up* 6 (MedRxiv, Preprint, May 18, 2021)

[35] *Id.* at 6.

[36] Erika Molteni et al., *Illness Duration and Symptom Profile in Symptomatic UK School-Aged Children Tested for SARS-CoV-2*, LANCET ADOLESCENT HEALTH, Aug. 3, 2021, at 7.

[37] *Id.* at 2.

[38] *See* Alex J. Walker, *Clinical Coding of Long COVID in English Primary Care: A Federated Analysis of 58 Million Patient Records* In Situ *Using OpenSAFELY*, BRIT. J. GEN. PRAC., 2021, at 3 ("Up to 25 April 2021, there were 23,273 (*0.04%*) patients with a recorded code indicative of a long-COVID diagnosis.") (emphasis added).

[39] Office of National Statistics, UK. Technical article: Updated estimates of the prevalence of post-acute symptoms among people with coronavirus (COVID-19) in the UK: 26 April 2020 to 1 August 2021. https://www.ons.gov.uk/peoplepopulationandcommunity/healthandsocialcare/conditionsanddiseases/articles/technic

who had no history of COVID-19 infection. Strikingly, among children age 2 – 11 years, the children in the control group (who had never previously had COVID) had a higher rate of "long-COVID" symptoms (4.1%) than the kids who had previously had COVID (3.2%) four months after recovery from infection. Among children 12-16, the rates of long-COVID symptoms at four months were similar and low in the control (1.3%) and COVID-recovered groups (3.0%). Among young adults age 17-24, the rates of "long-COVID" were identical in the control and COVID-recovered groups (3.6%).

To be sure, there is a chance that COVID-19 results in severe, adverse outcomes among children—as there is with any disease. But the evidence, thankfully, shows children infected with COVID-19 are overwhelmingly likely to recover fully with only mild illness while sick and no lingering effects.

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alarticleupdatedestimatesoftheprevalenceofpostacutesymptomsamongpeoplewithcoronaviruscovid19intheuk/26april2020to1august2021

Children are Inefficient Transmitters of the Virus

Even without masks, the overwhelming weight of scientific data suggests that the risk of transmission of the virus from children aged six and below to older people is negligible and from children between 7 and 12 to older people is small relative to the risk of transmission from people older than 18 to others. Data also show that the risk of child-to-child transmission in school settings is low.

The most important evidence on the childhood spread of the disease comes from a study conducted in Iceland and published in the New England Journal of Medicine[40]. The data for this study come from Iceland's systematic screening of its population to check for the virus. This is the most important study on this topic because it is the only study that definitively establishes the direction of the spread of the virus from contact to contact. The study reports on a population-representative sample and a sample of people who were tested because of the presence of symptoms consistent with COVID-19 infection. The study team isolated SARS-CoV-2 virus samples from every positive case, sequenced the virus's genome for every patient, and tracked the mutation patterns in the virus. This analysis, along with contact tracing data, allowed the study team to identify definitively who passed the virus to whom. There have been hundreds of minor mutations of the virus identified, which typically do not alter the function of the virus much, but which provide a unique fingerprint, of sorts, that makes it possible to tell whether two patients could possibly have passed the virus to one another. From this analysis, the senior author of the study, Dr. Kari Stefansson, concluded[41] that "even if children do get infected, they are less likely to transmit the disease to others than adults. We have not found a single instance of a child infecting parents. There is amazing diversity in the way in which we react to the virus."

Though the Iceland study is the only definitive study, many other studies use contact tracing methods to investigate the role of children in disease spread. The bulk of such studies conclude that children play a small role in disease spread, consistent with the Iceland data.

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[40] Daniel F. Gudbjartsson, Ph.D., Agnar Helgason, Ph.D., et al., *Spread of SARS-CoV-2 in the Icelandic Population,* The New England Journal of Medicine, https://www.nejm.org/doi/full/10.1056/NEJMoa2006100 (June 11, 2020).
[41] Roger Highfield, *Coronavirus: Hunting Down COVID-10,* Science Museum Group, https://www.sciencemuseumgroup.org.uk/blog/hunting-down-covid-19/ (April 27, 2020).

A French study[42], conducted by scientists at the L'Institut Pasteur, examined data from late April 2020 on schoolteachers, students, and their parents in Crepy-en-Valois in France. The schools in France were closed from the end of January on, at first because of the February holiday and then the late February lockdown. During this period, French schools implemented no restrictions on students – neither social distancing nor mask requirements. The authors found three cases among kids in January using antibody tests but found no evidence of virus spread to other kids or teachers from those early cases. Any spread between the end of January and April (when the authors collected samples) must have occurred during the lockdown. The authors' main conclusion[43] from these facts is that parents were the source of infections in school children; children were not the source. Those kids who tested antibody positive at the end of April, because of the circumstances of the lockdown, must have become positive from a source other than their school. The primary contacts of the young children were their parents, of whom 61% were positive, which is consistent with parent-to-child spread. This is also consistent with the results showing that only 6.9% of parents tested positive for the virus among antibody-negative kids in April. The authors' main conclusion mirrors the one reached in the Icelandic study showing that the disease spreads less easily from children to adults than from adults to adults, *even in the absence of masking requirements*.

Researchers in Ireland conducted a similar study[44] which analyzed 1,160 children and adults in Ireland who were physically present in a school at some time between March 1st and March 13th, where a COVID-19 case was identified. (Schools were closed in Ireland on March 12th). The authors found three children (between 10 and 15 years old) and three adults with COVID-19 infections. Their study followed students and families after the school closures to see if there was any evidence of disease spread from these identified cases. While the study authors mention

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[42] Arnaud Fontanet, MD, DrPH, Rebecca Grant, et al., *SARS-CoV-2 Infection in Primary Schools in Northern France: A Retrospective Cohort Study in an Area of High Transmission,* Institut Pasteur, https://www.pasteur.fr/fr/file/35404/download (last visited July 9, 2020).

[43] *COVID-19 In Primary Schools: No Significant Transmission among Children or From Students to Teachers,* Institut Pasteur, https://www.pasteur.fr/en/press-area/press-documents/covid-19-primary-schools-no-significant-transmission-among-children-students-teachers (June 23, 2020).

[44] Laura Heavey, Geraldine Casey, et al., *No Evidence of Secondary Transmission of COVID-19 from Children Attending School in Ireland, 2020,* Eurosurveillance, https://www.eurosurveillance.org/content/10.2807/1560-7917.ES.2020.25.21.2000903#html_fulltext (May 28, 2020).

physical distancing, hand hygiene, and cough etiquette as interventions implemented in Irish schools at the time, they do not mention required masking. All six patients had PCR confirmed COVID-19 disease but contracted the virus from contacts outside of school. Despite identifying 722 contacts, the study authors reported finding no instance of an infected child infecting another child. The infected adults, by contrast, had many fewer contacts – 102 – but did pass on the infection to a few adult contacts. This, even though the infected children engaged in "music lessons (woodwind instruments) and choir practice, both of which are reportedly high-risk activities for transmission." *Ibid.* As with the French study mentioned above, the Irish schools did not mandate masking at the time of the study, and they still do not require them for children under 13.[45]

Based on contact tracing data, a report[46] by the ministry of health in the Netherlands finds almost no disease spread by infected patients 20 and under at all, and only limited spread by adults 20-25 to others outside their own age category. The authors of the study concluded: "Data from the Netherlands also confirms the current understanding: that children play a minor role in the spread of the novel coronavirus. The virus is mainly spread between adults and from adult family members to children. The spread of COVID-19 among children or from children to adults is less common." Hygiene standards in the Netherlands promulgated by its National Institute for Public Health and the Environment make no recommendation of masking for either primary school or secondary school students.[47]

A German[48] study reports a strikingly similar finding on the likelihood of pediatric disease spread. The German Society for Pediatric Infectious Diseases collected data on all children and adolescents admitted to a hospital for COVID-19 treatment between mid-March and early May 2020 – 128 patients were admitted to 66 different hospitals. The authors sourced the infection for

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[45] Citizens Information Ireland. Face Coverings During COVID-19. https://www.citizensinformation.ie/en/health/covid19/face_coverings_during_covid19.html# (Sept. 25, 2021)

[46] *Children and COVID-19,* National Institute for Public Health and the Environment, https://www.rivm.nl/en/novel-coronavirus-covid-19/children-and-covid-19 (July 2, 2020).

[47] Hygiene Guideline for Primary Schools, National Institute for Public Health and the Environment. https://www.rivm.nl/hygienerichtlijnen/basisscholen (September 25, 2021); and General Hygiene Guideline. National Institute for Public Health and the Environment. https://www.rivm.nl/hygienerichtlijnen/algemeen (Sept. 25, 2021).

[48] Armann, J. P., Diffloth, N., Simon, A., Doenhardt, M., Hufnagel, M., Trotter, A., Schneider, D., Hübner, J., & Berner, R. (2020). Hospital Admission in Children and Adolescents With COVID-19. Deutsches Arzteblatt international, 117(21), 373–374. https://doi.org/10.3238/arztebl.2020.0373

38% of these patients, which turned out to be a parent 85% of the time. Though the authors document a limitation of small sample size, they conclude that "In contrast to other epidemic viral respiratory infections, the primary source of infection with SARS-CoV-2 appears not to be other children." The authors reported a single death among these 128 pediatric patients.

A study of 23 family disease clusters in Greece, published on August 7, 2020, in the *Journal of Medical Virology*, found that in 91% of the clusters, an adult was the first person to be infected. Their contact tracing effort attempted to clarify the direction of disease spread by careful questioning about the relative timing of the development of symptoms. They found no evidence of either child to adult spread or even child to child spread. They concluded that "[w]hile children become infected by SARS-CoV-2, they do not appear to transmit the virus to others. Furthermore, children more frequently have an asymptomatic or mild course compared to adults."[49]

A study by the Federal Office of Public Health of Switzerland analyzed 793 cases reported by Swiss doctors in late July 2020.[50] The reports included the place where each patient most likely contracted the infection. The most common source of infection was at home, with 27.2% tracing their disease there. School, by contrast, consisted of only 0.3% of the infections; exactly two of the 793 cases could be tracked to a school. This study has some limitations: first, it is a contact tracing study without genetic sequencing verification, so it is impossible to judge the direction of diseases spread with certainty (i.e., from adult to child or child to adult). Second, the report provides no details about the age of the cases, so it is not possible to separately glean the disease acquisition frequencies for children and adults; and third, only summer schools were in session during this period. Nevertheless, the results strongly suggest that schools are a minor source of community spread of the infection.

A large study of 1,900 children attending an urban summer school in Barcelona, Spain, found only

[49] Helena C. Maltezou Rengina Vorou Kalliopi Papadima, et al. (2020) "Transmission dynamics of SARS-CoV-2 within families with children in Greece: a study of 23 clusters" Journal of Medical Virology, https://doi.org/10.1002/jmv.26394 (accessed August 12, 2020).
[50] Office fédéral de la santé publique OFSP (2020) "Rectificatif : les lieux de contamination sont les contextes familiaux et non les boîtes de nuit" Aug. 2, 2020. available at https://www.bag.admin.ch/bag/fr/home/das-bag/aktuell/news/news-02-08-2020.html

39 new index cases (30 pediatric) over five weeks.[51] (An index case is an initial person identified by a positive test for the virus, from whom close contacts are identified). The investigators chose this setting because they viewed it as a model for what to expect from school openings in the fall. Those 39 index cases interacted with another 253 children within their "cohabitation groups," of whom only 12 developed an infection"– a secondary attack rate of 4.7%. The low secondary attack rate was similar for children of all ages attending the programs, ranging up to 17 years old. The report does not mention masks as a disease prevention method. Rather, the investigators attributed the success in controlling the spread of the disease to frequent handwashing by the children and organizing the children into "bubbles" so that the kids interacted with the same group of children all day long.

A comprehensive official report by Public Health England of the role of English schools, which were reopened on June 1, 2020, despite high community case numbers, in spreading the pandemic.[52] The author of this report found that cases and outbreaks were "uncommon across all educational settings" and that "[s]taff members had an increased risk of SARS-CoV-2 infections compared to students in any educational setting, and the majority of cases linked to outbreaks were in staff." In response to this study, U.K. education minister Gavin Williamson said: "The latest research, which is expected to be published later this year – one of the largest studies on the coronavirus in schools in the world – makes it clear there is little evidence that the virus is transmitted at school."[53]

Perhaps the best observational evidence (outside of the Iceland study) on the risk children pose to teachers comes from Sweden's COVID-19 policy. Swedish primary schools have been open for in-person instruction throughout the epidemic (high schools were closed briefly at the height of the epidemic), even when cases ran high in the community at large, with no masking required of

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[51] Oriel Guell (2020) *Major coronavirus study in Spanish summer camps shows low transmission among children.* El Pais. (Aug. 26, 2020) available at https://english.elpais.com/society/2020-08-26/major-coronavirus-study-in-spanish-summer-camps-shows-low-transmission-among-children.html

[52] Sharif Ismail et al. (2020) "SARS-CoV-2 infection and transmission in educational settings: cross-sectional analysis of clusters and outbreaks in England" Public Health England, Aug. 12, 2020 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/911267/School_Outbreaks_Analysis.pdf

[53] Peter Walker (2020) "Little Evidence COVID Spreads in Schools, says Gavin Williamson" *The Guardian*, Aug. 10, 2020. https://www.theguardian.com/world/2020/aug/10/little-evidence-covid-spreads-in-schools-says-gavin-williamson

its children.[54] In spring 2020, of the 1.8 million kids in school, ages 1-15, zero died from COVID.[55] Furthermore, there is no evidence the teachers were at greater risk of COVID infections than others, despite their pupils not wearing masks. On the contrary, the rate of COVID-19 infection among teachers was lower than the average rate of COVID-19 infection among other Swedish essential workers. This result is confirmed by studies of the effect of school closures in the U.S. and elsewhere on overall excess mortality, which finds that school closures – much less mask mandates – on COVID risk were at best minimal.[56, 57]

The overwhelming bulk of scientific studies that have examined the topic – including the best studies, which take pains to distinguish correlation from causation – find that children play a limited role in spreading COVID-19 infection to adults. It is striking that this conclusion holds even in situations where children were not required to wear masks.

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[54] Ludvigsson JF, Engerström L, Nordenhäll C, Larsson E. Open Schools, Covid-19, and Child and Teacher Morbidity in Sweden. N Engl J Med. 2021 Feb 18;384(7):669-671. doi: 10.1056/NEJMc2026670. Epub 2021 Jan 6. PMID: 33406327; PMCID: PMC7821981.

[55] Public Health Agency of Sweden (2020) "COVID-19 in Schoolchildren: A Comparison between Finland and Sweden" https://www.folkhalsomyndigheten.se/contentassets/c1b78bffbfde4a7899eb0d8ffdb57b09/covid-19-school-aged-children.pdf

[56] Dena Bravata, Jonathan H. Cantor, Neeraj Sood & Christopher M. Whaley (2021) Back to School: The Effect of School Visits During COVID-19 on COVID-19 Transmission. NBER Working Paper # 28645. April 2021. https://www.nber.org/papers/w28645 DOI 10.3386/w28645

[57] Walsh S, Chowdhury A, Braithwaite V, et alDo school closures and school reopenings affect community transmission of COVID-19? A systematic review of observational studiesBMJ Open 2021;11:e053371. doi: 10.1136/bmjopen-2021-053371

No Randomized Evidence of Efficacy of Masking in Limiting Disease Spread

There is by now a vast empirical literature purporting to evaluate the effectiveness of mask-wearing in limiting the spread of the SARS-CoV-2 virus. The question is complicated because it is unlikely that there is a single answer. The effectiveness of masks differ based on the type of mask (cloth vs. surgical vs. N95), protocols for replacing contaminated masks, how well trained the mask-wearer is in maintaining good mask fit, and a large number of other factors, including other non-pharmaceutical interventions such as hand washing, social distancing, and ventilation upgrades. The effectiveness of masks in protecting the wearer against infection (self-protection) will also differ from the effectiveness of masks in protecting people near the wearer from becoming infected (source control). Studies conducted in laboratories on mannequins, for instance, are unlikely to translate well into real-world settings, where conditions differ sharply from the laboratory. Many ecological studies also estimate the correlation between the imposition of mask mandates and the subsequent spread of COVID-19 disease in various locations rather than at the individual level. However, it is notoriously difficult to adjust for bias caused by factors that researchers do not observe in such studies.

The best guide to the effectiveness of masks – the highest quality evidence – are randomized controlled trials that reduce bias from many sources on the effectiveness estimates. Though some have argued that randomized evaluations of the effectiveness of masking are impossible in the context of respiratory virus spread, there were more than a dozen randomized evaluations of masking in the context of the flu published before the pandemic in peer-reviewed journals. It has been more than 18 months since the beginning of the pandemic and the imposition of lockdown orders, and the efficacy of masking has been of intense policy interest. Nevertheless, there is to date only a single peer-reviewed randomized study published on the effectiveness of masks in self-protection against COVID-19. The study, which did not enroll children, found no statistically significant difference between the treatment group and control group regarding the probability of infection.[58]

[58] Bundgaard H, Bundgaard JS, Raaschou-Pedersen DET, von Buchwald C, Todsen T, Norsk JB, Pries-Heje MM, Vissing CR, Nielsen PB, Winsløw UC, Fogh K, Hasselbalch R, Kristensen JH, Ringgaard A, Porsborg Andersen M, Goecke NB, Trebbien R, Skovgaard K, Benfield T, Ullum H, Torp-Pedersen C, Iversen K. Effectiveness of Adding

Shockingly, there are no randomized evaluations of the effectiveness of masks on children in source control for COVID-19 (that is, the effectiveness of masks in protecting others in the context of schools or children). In the context of adults, there is a preprint (not yet peer-reviewed) randomized study on the efficacy masking as source control. The study, conducted in Bangladesh, randomly assigned villages in that country to cloth masks, surgical masks, and control villages. In the villages chosen for masking, residents were offered masks for free, and various measures were implemented to encourage masking. Ultimately, about 40% of villagers in the villages chosen for masking wore masks, while about 10% wore masks in the control villages. Despite the sharp increase in masking, there was no statistically significant difference in the symptomatic seroprevalence of COVID-19 disease in the villages with cloth masks and the control villages. The villages assigned surgical masks had a slightly lower symptomatic seroprevalence rate than the control villages (0.76% vs. 0.69%), with a 95% statistical confidence bound that included zero effect and no measured difference in hospitalization or mortality. The study did not include children.

So in the context of COVID-19, there is no high-quality evidence supporting the notion that masks on children work to control disease spread, either self-protection or source control. By contrast, in the context of the flu, there is considerable randomized evidence that masks are not effective in reducing disease spread for both source control and self-protection.[59]

The literature on the efficacy of masks to control respiratory viruses is vast, so it is fortunate that four prominent groups have conducted comprehensive literature reviews. I will reproduce here the key conclusions conducted by teams of researchers at the Cochrane Collaborative, at the European CDC, at the Oxford University Centre for Evidence-Based Medicine, and at the US Centers for Disease Control. All of the reviews acknowledge the lack of randomized evidence in this area.

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a Mask Recommendation to Other Public Health Measures to Prevent SARS-CoV-2 Infection in Danish Mask Wearers : A Randomized Controlled Trial. Ann Intern Med. 2021 Mar;174(3):335-343. doi: 10.7326/M20-6817. Epub 2020 Nov 18. PMID: 33205991; PMCID: PMC7707213.

[59] Jefferson T, Del Mar CB, Dooley L, Ferroni E, Al-Ansary LA, Bawazeer GA, van Driel ML, Jones MA, Thorning S, Beller EM, Clark J, Hoffmann TC, Glasziou PP, Conly JM. Physical interventions to interrupt or reduce the spread of respiratory viruses. Cochrane Database of Systematic Reviews 2020, Issue 11. Art. No.: CD006207. DOI: 10.1002/14651858.CD006207.pub5.

Each differs in their conclusions about the effectiveness of masks, but those conclusions rest on the relative weight each research group put on randomized studies showing no benefit in masking versus poor quality correlational evidence that provided mixed results on mask effectiveness based on the setting.

The Cochrane Collaborative is an organization of academics with a reputation for writing high-quality evidence summaries on a full range of important topics within medicine using a standardized approach to evidence evaluation. The Cochrane review of the mask literature separately evaluates the effectiveness of medical/surgical masks and N95 respirator masks.[60] Because there were no randomized studies in the context of COVID-19 when the study was published, the review focuses on the randomized studies in the influenza context. The authors conclude:

> "**Medical/Surgical Masks:** Seven studies took place in the community, and two studies in healthcare workers. Compared with wearing no mask, wearing a mask may make little to no difference in how many people caught a flu-like illness (9 studies; 3507 people); and probably makes no difference in how many people have flu confirmed by a laboratory test (6 studies; 3005 people). Unwanted effects were rarely reported, but included discomfort.
> **N95/P2 respirators:** Four studies were in healthcare workers, and one small study was in the community. Compared with wearing medical or surgical masks, wearing N95/P2 respirators probably makes little to no difference in how many people have confirmed flu (5 studies; 8407 people); and may make little to no difference in how many people catch a flu-like illness (5 studies; 8407 people) or respiratory illness (3 studies; 7799 people). Unwanted effects were not well reported; discomfort was mentioned."

In other words, according to a comprehensive evidence summary of mask effectiveness in the context of the flu – a virus that shares many physical properties with the SARS-CoV-2 virus and is transmitted similarly to SARS-CoV-2 – high-quality evidence finds no effect of masks on the spread of disease, even when the masks are employed by health care workers who are trained to use them properly.

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[60] *Ibid.*

The US CDC review, conducted last year, evaluates the randomized studies on the effectiveness of various personal protective measures, including face masks to protect against the spread of influenza.[61] The review's conclusion is straightforward:

> "In this review, we did not find evidence to support a protective effect of personal protective measures or environmental measures in reducing influenza transmission. Although these measures have mechanistic support based on our knowledge of how influenza is transmitted from person to person, randomized trials of hand hygiene and face masks have not demonstrated protection against laboratory-confirmed influenza, with one exception."

The one exception they note is a randomized study that found that regular hand washing may slow influenza spread in health care settings. The CDC review – conducted in mid-2020 – emphasizes the need for high-quality studies on masks and COVID-19. It is striking that there has only been two randomized evaluation published since this call for high-quality evidence last year (that is, the Danish and Bangladeshi mask studies I cite above) since the publication of this review by the CDC.

The review by the team at the Oxford University Centre for Evidence-Based Medicine – a group that (like the Cochrane Collaborative) is famous for its careful evidence summaries on a wide variety of health care topics – makes the same observations as the other groups.[62] Namely, they lament the lack of high-quality evidence evaluating the effectiveness of masks in the context of COVID-19. Unlike the other groups, the CEBM review documents several randomized studies in progress (including the Danish mask study referenced above). Though the CEBM study was published in July 2020, to my knowledge, none of these planned randomized studies have been completed or published beside the Danish and Bangladeshi mask studies referenced above.[63] The

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[61] Xiao J, Shiu E, Gao H, et al. Nonpharmaceutical Measures for Pandemic Influenza in Nonhealthcare Settings—Personal Protective and Environmental Measures. Emerging Infectious Diseases. 2020;26(5):967-975. doi:10.3201/eid2605.190994.

[62] Tom Jefferson, Carl Heneghan (2020) Masking Lack of Evidence with Politics. Centre for Evidence Based Medicine working paper. Oxford University. https://www.cebm.net/covid-19/masking-lack-of-evidence-with-politics/

[63] During a person conversation on August 14, 2021, Prof. Carl Heneghan (Oxford University) confirmed to me that none of the planned randomized studies listed in the CEBM review (except for the Danish mask study cited here) had been completed, released as a working paper, or published to date.

CEBM summary emphasizes the danger of making policy decisions (such as making masks mandatory) when the scientific evidence on the topic is so inadequate.

> "What do scientists do in the face of uncertainty on the value of global interventions? Usually, they seek an answer with adequately designed and swiftly implemented clinical studies as has been partly achieved with pharmaceuticals. We consider it is unwise to infer causation based on regional geographical observations as several proponents of masks have done. Spikes in cases can easily refute correlations, compliance with masks and other measures is often variable, and confounders cannot be accounted for in such observational research…The small number of trials and lateness in the pandemic cycle is unlikely to give us reasonably clear answers and guide decision-makers. This abandonment of the scientific modus operandi and lack of foresight has left the field wide open for the play of opinions, radical views, and political influence."

The literature review by the European CDC covers both the randomized evidence on masks and influenza spread that the other teams' review and the early observational evidence on masks and COVID-19.[64] The team evaluating this evidence places more weight on the low-quality observational studies than do some of the other teams. For this reason, I place less importance on the conclusions of this review than I do on the others. Still, they emphasize in their conclusions the need for more high-quality (i.e., randomized) evidence on the topic.

> "The evidence regarding the effectiveness of medical face masks for the prevention of COVID-19 in the community is compatible with a small to moderate protective effect, but there are still significant uncertainties about the size of this effect. Evidence for the effectiveness of non-medical face masks, face shields/visors and respirators in the community is scarce and of very low certainty. Additional high-quality studies are needed to assess the relevance of the use of medical face masks in the COVID-19 pandemic."

Since there is so little randomized data available to answer whether masks effectively protect the user or slow disease spread, it is natural to look to observational evidence. Observational data are most important when randomized evaluations are impossible for logistical or ethical reasons. However, this is not true for masks since there have been randomized studies on their effect on reducing transmission of respiratory viruses conducted – including one in the context of COVID-19. The problem with observational studies is that the adoption of a mask mandate (either in schools or in the community) is not a random decision and may be induced by the perceived threat

[64] European Centre for Disease Prevention and Control. Using face masks in the community: first update. 15 February 2021. ECDC: Stockholm; 2021.

of COVID cases near the time of adoption. Therefore, the correlation observed in observational data does not necessarily imply a causal relationship between a mask mandate and COVID outcomes.

That said, a comprehensive analysis of the correlation between COVID spread in the U.S. in the fall/winter wave of late 2020/early 2001, and the imposition of mask mandates found no correlation between them.[65] The authors of this peer-reviewed study concluded that "Earlier mask mandates were not associated with lower total cases or lower maximum growth rates. Growth rates and total growth were comparable between U.S. states in the first and last mask use quintiles during the Fall-Winter wave…We did not observe an association between mask mandates or use and reduced COVID-19 spread in U.S. states." If there is no correlation between mask mandates and COVID case growth, it seems unlikely that there is a causal relationship.

For mask mandates in schools, the observational evidence is mixed, with some studies finding correlations between mask requirements and cases and others finding no correlation.[66] No randomized studies have been conducted. Some studies given prominence by the CDC have been of particularly poor quality. For instance, the CDC cited one study conducted by Duke researchers in North Carolina as showing that masks on children reduced disease spread.[67] However, the study includes only 11 school districts that required masks and *no* control districts that did not require masks. Writing in the *Wall Street Journal* about the study, Duke University researcher Tom Nicholson wrote:

> In an inversion of logic, the report concluded that the only nonvariable in the data set [masks] must be the cause of low transmission rates in North Carolina schools. It should be obvious that proving some components of a strategy as useless doesn't demonstrate that others are effective. Such a claim requires a control group or appropriate statistical methods. The researchers might as well have attributed the low Covid rate in schools to wearing shoes.

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[65] Damian D.Guerra, Daniel J.Guerra. Mask mandate and use efficacy for COVID-19 containment in US States.International Research Journal of Public Health, 2021; 5:55. DOI: 10.28933/irjph-2021-08-1005

[66] Gettings J, Czarnik M, Morris E, et al. Mask Use and Ventilation Improvements to Reduce COVID-19 Incidence in Elementary Schools — Georgia, November 16–December 11, 2020. MMWR Morb Mortal Wkly Rep 2021;70:779–784. DOI: http://dx.doi.org/10.15585/mmwr.mm7021e1external icon

[67] US CDC. Science Brief: Transmission of SARS-CoV-2 in K-12 Schools and Early Care and Education Programs – Updated July 9, 2021. Accessed Sept. 25, 2021. https://www.cdc.gov/coronavirus/2019-ncov/science/science-briefs/transmission_k_12_schools.html#in-person

Another recent study of mandated masking in two counties in Arizona published by the CDC presents evidence that mask mandates in schools correlate with fewer COVID "outbreaks" during the first two weeks of school.[68] Besides the obvious problem with the study – that it does not adopt a randomized design and should thus not be interpreted as providing causal evidence of the efficacy of mask mandates – there is another important problem with it. The study presents data on "outbreaks" rather than cases, hospitalizations or deaths among children or staff members. An outbreak is defined by two or more COVID cases at a school within a 14 day period. From the data presented in the paper, it is not possible to rule out the possibility that schools with mask mandates actually had more cases than schools without mask mandates. In any case, the title of the paper emphasizes that it presents an "association" (as opposed to causal evidence), and should be treated as such.

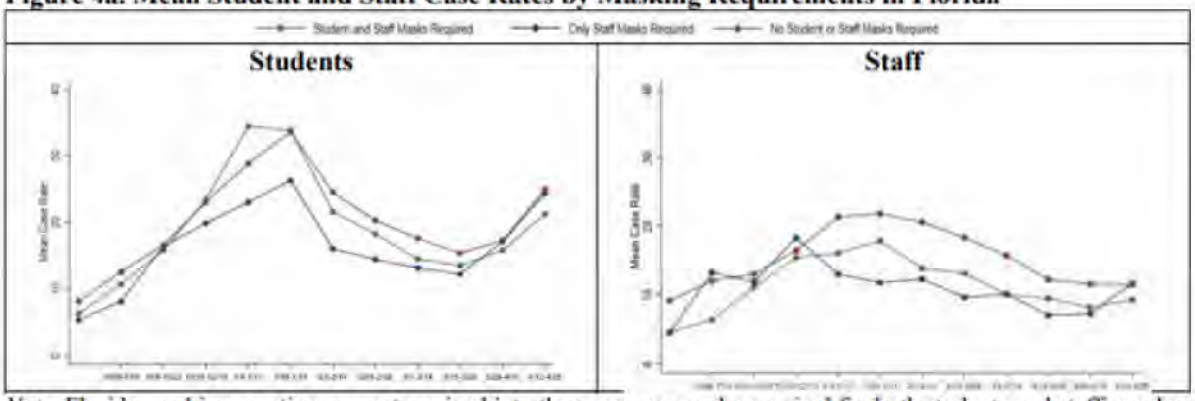
One particularly notable observational study—notable for its detailed measurement of masking policies at the school and district level, for its accounting for other factors such as school-level ventilation upgrades, and its consideration of outcomes throughout the 2020/21 school year – reported on the correlation between masking and COVID-19 case rates in Florida, New York, and Massachusetts.[69] In Florida, school mask policies fell into one of three categories: masks required for both staff and students; masks required only for staff; and no masks required. The figure (Figure 4, reproduced exactly from the paper) shows how case rates evolved over the school year (between October 2020 and April 2021) for each of the three groups. Through much of the school year,

[68] Jehn M, McCullough JM, Dale AP, et al. Association Between K–12 School Mask Policies and School-Associated COVID-19 Outbreaks — Maricopa and Pima Counties, Arizona, July–August 2021. MMWR Morb Mortal Wkly Rep 2021;70:1372–1373. DOI: http://dx.doi.org/10.15585/mmwr.mm7039e1

[69] Emily Oster, Rebecca Jack, Clare Halloran, John Schoof, Diana McLeod (2021) "COVID-19 Mitigation Practices and COVID-19 Rates in Schools: Report on Data from Florida, New York and Massachusetts" medRxiv, May 21, 2021, doi: https://doi.org/10.1101/2021.05.19.21257467

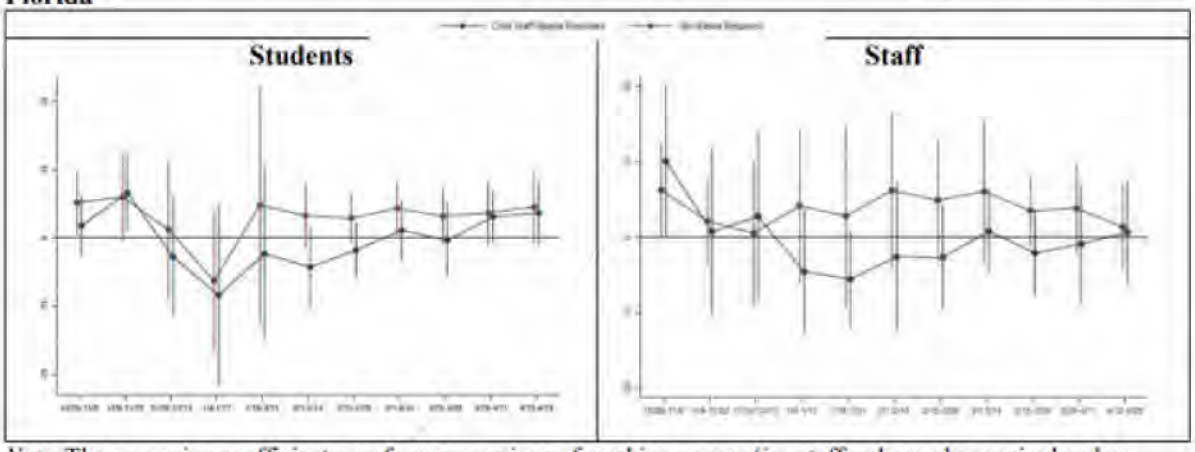
COVID case rates were lowest among both staff and children for locations that required only staff to mask (top panel). In fact, there were no statistically significant differences in the case rates among the three groups; that is, locations with mask mandates on either staff or students did no better in case rates relative to locations with no mandates (bottom panel). The primary finding for Florida extends to the other states the authors analyzed: mask mandates for students are effectively uncorrelated with COVID-19 infection rates in either students or teachers.

Figure 4a. Mean Student and Staff Case Rates by Masking Requirements in Florida



Note. Florida masking practices are categorized into three groups: masks required for both students and staff, masks required for staff only, and no masks required for either students or staff. Case rates are reported as daily COVID-19 case rates per 100,000. Mean daily case rate is calculated by group per biweekly wave in the data. Means do not control for community case rates or population demographics.

Figure 4b. Regression Coefficients of Student and Staff Case Rates on Masking Requirements in Florida



Note. The regression coefficients are from regressions of masking groups (i.e. staff-only masks required and no masks required) interacted with each biweekly wave group on student and staff case rates. The comparison is masks required for both students and staff. Regressions control for community case rates, time fixed effects, racial demographics, density groups, ventilation upgrades, and school level. Regressions are weighted by total student enrollment and standard errors are clustered by school districts.

Given the negative evidence from high-quality randomized studies on the efficacy of masking in

the context of the flu, the fact that the only two randomized trials on the efficacy of masking in adults both found minimal and statistically insignificant (Danish study) or barely statistically significant (Bangladeshi study) effects of masking on self-protection and source control, that there are no randomized trials in the contexts of masking children in schools, and that there is mixed evidence from observational studies, it is not correct to conclude that masking children in schools has limited the spread of COVID-19. The correct conclusion is that there is no established correlation, and hence no scientific basis for mandating the children be masked.

Harms to Children from Mask Wearing in Schools

In contrast with the poor quality evidence that masking children in schools has any effect whatsoever on COVID-19 disease spread, there is ample evidence of some physical and developmental harms to children that accrue from wearing masks.

The World Health Organization's guidance document on child masking says that up to age five, masking children may harm the achievement of "childhood developmental milestones."[70] For children between six and eleven, the same document says that mask guidance should consider the "potential impact of mask-wearing on learning and psychosocial development." The WHO explicitly recommends against masks during exercise because masks make breathing more difficult. The US CDC, which recommends masking toddlers as young as two years old, has not explained why its guidance departs from the WHO on this point.

A study surveying parents and pediatricians documents that a substantial fraction of children required to wear masks experience immediate physical side-effects, including speaking difficulties, changes in mood, discomfort breathing, headache, and cutaneous disorders (i.e., face rashes).[71] In addition to these physical problems, masking children causes psychological stress in children and disrupts learning.

Covering the lower half of the face of both teacher and pupil reduces the ability to communicate.[72] In particular, children lose the experience of mimicking expressions, an essential tool of nonverbal communication. Positive emotions such as laughing and smiling become less recognizable, and negative emotions get amplified. Bonding between teachers and students is significantly and

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[70] World Health Organziation. Advice on the use of masks for children in the context of COVID-19. Annex to the Advice on the use of masks in the context of COVID-19. Geneva, 2020. https://www.who.int/publications/i/item/WHO-2019-nCoV-IPC_Masks-Children-2020.1

[71] Assathiany R, Salinier C, Béchet S, Dolard C, Kochert F, Bocquet A, Levy C. Face Masks in Young Children During the COVID-19 Pandemic: Parents' and Pediatricians' Point of View. Front Pediatr. 2021 Jun 23;9:676718. doi: 10.3389/fped.2021.676718. PMID: 34249814; PMCID: PMC8260829.

[72] Carbon CC, Serrano M. The Impact of Face Masks on the Emotional Reading Abilities of Children-A Lesson From a Joint School-University Project. Iperception. 2021 Aug 19;12(4):20416695211038265. doi: 10.1177/20416695211038265. PMID: 34447567; PMCID: PMC8383324.

negatively affected. Masking exacerbates the chances that a child will experience anxiety and depression, which are already at pandemic levels themselves. Another review concludes: [73]

> "[C]overing the lower half of the face reduces the ability to communicate, interpret, and mimic the expressions of those with whom we interact. Positive emotions become less recognizable, and negative emotions are amplified. Emotional mimicry, contagion, and emotionality in general are reduced and (thereby) bonding between teachers and learners, group cohesion, and learning – of which emotions are a major driver."

One interesting study compares the hemoglobin content of blood collected before the pandemic led to lockdown versus blood collected during the pandemic through December 2020. The study analyzes a large sample size of over 19,500 blood donors.[74] The study's basic premise is that if masking creates hypoxia (sometimes experienced as difficulty breathing when masked), a donor's body will respond by making a larger quantity of hemoglobin to compensate. This is precisely what the researchers observe. They conclude that "prolonged use of face mask by blood donors may lead to intermittent hypoxia and consequent increase in hemoglobin mass." Of course, if this conclusion is true for blood donors, it is likely to be true for school children.

Finally, a perspective piece by the first author of the New England Journal of Medicine article on the Swedish experience with open schools (cited above) raises the likely possibility that children are less likely to comply with optimal mask-wearing protocols than adults.[75] The author's reasoning against the wisdom of masking children is worth quoting in full:

> "Face masks also have potential disadvantages, such as hindering verbal and non-verbal communication. There is a risk that children will keep touching their masks and actually increase the viral load on their hands. Using face masks also risks replacing social distancing, as some parents may be tempted to send their children to school or daycare wearing a mask if they have minor symptoms rather than keeping them at home. Finally, the commercially made masks that are currently available, especially the N95 masks that are said to offer greater protection, rarely fit children. Hence the

[73] Spitzer M. Masked education? The benefits and burdens of wearing face masks in schools during the current Corona pandemic. Trends Neurosci Educ. 2020;20:100138. doi:10.1016/j.tine.2020.100138 /

[74] Setia R, Dogra M, Handoo A, Yadav R, Thangavel GP, Rahman AE. Use of face mask by blood donors during the COVID-19 pandemic: Impact on donor hemoglobin concentration: A bane or a boon. Transfus Apher Sci. 2021 May 26:103160. doi: 10.1016/j.transci.2021.103160. Epub ahead of print. PMID: 34217601; PMCID: PMC8152240.

[75] Ludvigsson JF. Little evidence for facemask use in children against COVID-19. Acta Paediatr. 2021 Mar;110(3):742-743. doi: 10.1111/apa.15729. Epub 2021 Jan 3. PMID: 33393117.

> use of such masks might lead to a false sense of safety, despite leaking viruses due to their poor fit. However, the most important drawback of face masks in children may well be that their use could reduce the focus from other measures that may be more important, such as hand washing, social distancing and staying at home when they are sick."

Good medicine is conservative about intervening when there is the possibility of harm. In the case of child masking, though some have asserted that it is proven that masking children never cause harm, that is clearly incorrect. The burden is not simply to prove that there exist children for whom masks never cause harm. Rather, the burden for someone advocating for mandated universal masking of children is to prove that no children are ever harmed. This is an impossible burden given the weight of the scientific evidence.

Conclusion

To summarize, the medical and epidemiological literature has documented conclusively that children face a vanishingly small risk of mortality from COVID-19 infection relative to other risks that children routinely face. Furthermore, the evidence also indicates that – even without masks – children are less efficient at spreading the disease to adults than adults are at spreading the infection to children or each other. There is no high-quality evidence that requiring children to wear masks has any appreciable effect on the likelihood that teachers or other school staff will acquire COVID-19 disease. On the contrary, empirical evidence from Sweden and elsewhere where masks were not required shows that schools are low-risk environments of disease spread. Finally, there is considerable evidence that requiring children to wear masks all day at school correlates with harms to their learning and development and with both physical and psychological harms.

Today, adult teachers and staff have no reason to put their safety ahead of the well-being of school kids. Vaccinations are highly effective at keeping adults out of the hospital and at preventing death. A healthy, fully vaccinated teacher is strongly protected by threats posed by COVID spread in the classroom. By now, every teacher in America has been offered the vaccine; many were in the first priority group, even above vulnerable older people. Given these facts, there is no scientific or medical reason to require masking school children.