Title

San Francisco's Citywide COVID-19 Response: Strategies to Reduce COVID-19 Severity and Health Disparities, March 2020 Through May 2022

Authors

Sachdev, Darpun D
Petersen, Maya
Havlir, Diane V
et al.

Publication Date

2023-07-05

DOI

10.1177/00333549231181353

Peer reviewed

PUBLIC HEALTH REPORTS

Public Health Reports
1–9

DOI: 10.1177/00333549231181353
journals.sagepub.com/home/phr
Sage

San Francisco's Citywide COVID-19 Response: Strategies to Reduce COVID-19 Severity and Health Disparities, March 2020 Through May 2022

Darpun D. Sachdev, MD[1]; Maya Petersen, MD, PhD[2]; Diane V. Havlir, MD[3]; Joshua Schwab, MS[2]; Wayne T.A. Enanoria, PhD[1]; Trang Q. Nguyen, PhD[1]; Mary P. Mercer, MD[4]; Susan Scheer, PhD[1]; Ayanna Bennett, MD[1]; Andrea G. Tenner, MD[1]; James D. Marks, MD, PhD[5]; Naveena Bobba, MD[1]; Susan Philip, MD[1]; and Grant Colfax, MD[1]

Abstract

San Francisco implemented one of the most intensive, comprehensive, multipronged COVID-19 pandemic responses in the United States using 4 core strategies: (1) aggressive mitigation measures to protect populations at risk for severe disease, (2) prioritization of resources in neighborhoods highly affected by COVID-19, (3) timely and adaptive data-driven policy making, and (4) leveraging of partnerships and public trust. We collected data to describe programmatic and population-level outcomes. The excess all-cause mortality rate in 2020 in San Francisco was half that seen in 2019 in California as a whole (8% vs 16%). In almost all age and race and ethnicity groups, excess mortality from COVID-19 was lower in San Francisco than in California overall, with markedly diminished excess mortality among people aged >65 years. The COVID-19 response in San Francisco highlights crucial lessons, particularly the importance of community responsiveness, joint planning, and collective action, to inform future pandemic response and advance health equity.

Keywords

COVID-19, San Francisco, excess mortality, public health response

By May 2022, SARS-CoV-2 had resulted in nearly 78 million known COVID-19 cases and >1 million deaths in the United States.[1,2] As of 2022, the number of COVID-19 deaths was 301 per 100 000 US population. California, where 12% of the US population resides, reported 229 COVID-19 deaths per 100 000 people.[1] Notably, San Francisco, with one of the highest population densities in the United States and >800 000 residents, experienced a mortality rate of 98 COVID-19 deaths per 100 000 residents, one of the lowest among large metropolitan cities in the United States.[1]

Swift action informed by experience and data in San Francisco was critical to success. In collaboration with other Bay Area counties, San Francisco initiated one of the first stay-at-home orders in the United States, on March 16, 2020, when only 43 cases had been diagnosed.[3] Most residents in San Francisco transitioned to telecommuting, with essential workers in health care, emergency, food, and other core infrastructure services continuing in-person work. By the time the order was lifted on June 15, 2020, <50 COVID-19–associated deaths in San Francisco had been reported.[4]

However, stark disparities among racial and ethnic groups had emerged.[5] In April 2020, a population-based study conducted in the San Francisco Mission District (where 39% of

[1] San Francisco Department of Public Health, San Francisco, CA, USA
[2] Divisions of Biostatistics and Epidemiology, School of Public Health, University of California, Berkeley, Berkeley, CA, USA
[3] Department of Medicine, University of California, San Francisco, San Francisco, CA, USA
[4] Department of Emergency Medicine, University of California, San Francisco, San Francisco, CA, USA
[5] Department of Anesthesia, University of California, San Francisco, San Francisco, CA, USA

Corresponding Author:
Darpun D. Sachdev, MD, San Francisco Department of Public Health, 356 7th St, San Francisco, CA 94102, USA.
Email: darpun.sachdev@cdph.ca.gov

residents are Latinx) reported markedly higher COVID-19 risk among Latinx front-line essential workers than among non-Latinx participants, with most living in crowded, multigenerational households.[6]

Building on early lessons learned and marshalling human and financial resources for robust response, by June 2020, San Francisco had implemented 4 strategies designed to mitigate pandemic-related effects and reduce disparities: (1) conducting aggressive mitigation measures to protect populations at risk for severe disease, (2) prioritizing resources in neighborhoods highly affected by COVID-19, (3) designing timely and adaptive data-driven policies, and (4) leveraging partnerships and public trust. Understanding the impact of these strategies is critical to inform future public health responses.

Purpose

The purpose of this case study was to describe programmatic and implementation outcomes of San Francisco's COVID-19 pandemic response strategy and population-level public health outcomes, including the effective reproductive number (the average number of secondary infections from a primary COVID-19 case in a population) and hospital census (the number of beds in hospitals occupied by COVID-19 patients), from March 2020 through May 2022. Because comparisons of reported COVID-19 deaths may fail to capture the full effects of pandemic control measures,[5] we also compared the excess mortality in 2020 in San Francisco with the state of California, stratified by age and race and ethnicity.

Methods

We calculated program- and population-level metrics by using public health surveillance data routinely collected and analyzed by the San Francisco Department of Public Health (SFDPH) and the California Department of Public Health (CDPH). This work was conducted as part of SFDPH COVID-19 surveillance; per SFDPH guidelines, institutional review board approval was not required (45 CFR §46.102[l][2]).

Estimation of Time-Varying Reproductive Number

The effective reproductive number is an estimate of the average number of secondary COVID-19 infections that arise from a primary COVID-19 case in a population. We estimated time-varying effective reproductive numbers by using the open-source LEMMA (Local Epidemic Modeling for Management & Action) model version 2.1.2,[7,8] which has been used in San Francisco and California COVID-19 responses since early 2020. We fit unknown county-level model parameters by using a Bayesian framework that incorporates county-level COVID-19 cases (identified by laboratory-confirmed polymerase chain reaction tests), hospital census, intensive care unit (ICU) census, and the number of deaths obtained from public health surveillance data.

Monitoring Vaccination Uptake

We calculated vaccination rates by race and ethnicity over time by dividing the number of San Francisco residents who had completed their primary vaccine series (2 doses of the Moderna mRNA-1273 or the Pfizer-BioNTech BNT162b2 COVID-19 vaccine or a single dose of the Ad26.COV2.S vaccine) or who had received a booster on that day by the estimated population size. We obtained immunization data from the California Immunization Registry and only included records of people who had vaccines that were authorized or approved for use in the United States.

Excess Deaths From COVID-19

We used 2019 all-cause mortality data to estimate excess deaths in 2020, stratified by age and race and ethnicity. Excess mortality measures reflect a range of reasons affecting health outcomes, including increases in mortality because of deferred health care, decreases in mortality because of reduced transmission of other respiratory viruses, or reductions in accidents and other important trends (eg, drug overdose deaths). We obtained data on excess mortality in California and in San Francisco from the Fusion Center at CDPH; methods are detailed elsewhere.[9]

Outcomes

The timeline for implementation of key strategies, reproductive number, and hospital census is depicted in Figure 1.

Strategy 1: Aggressive Mitigation Measures to Protect Populations at Risk for Severe COVID-19

Asymptomatic testing programs in congregate settings. In April 2020, SFDPH proactively worked with skilled nursing facilities (SNFs) and prioritized testing for SNF residents to detect emerging outbreaks given limited citywide testing resources. Initially, SNFs were reluctant to test residents and staff because of concerns that facilities would be stigmatized and staff would not report to work. SFDPH trained SNF staff on-site on personal protective equipment, cohort strategies, and surveillance testing. The universal implementation of mass testing in San Francisco SNFs resulted in reports of 4% to 41% of health care workers and 20% to 75% of SNF residents with asymptomatic infections; outbreaks were averted through early detection and isolation of these asymptomatic cases.[10,11] SFDPH also used address-matched geocoding to rapidly detect new COVID-19 cases in SNFs and other congregate housing settings with shared spaces, which triggered response testing events.[12] By May 2022, SNF residents composed 1% of all COVID-19 cases and 18% of all COVID-19–related deaths in San Francisco.

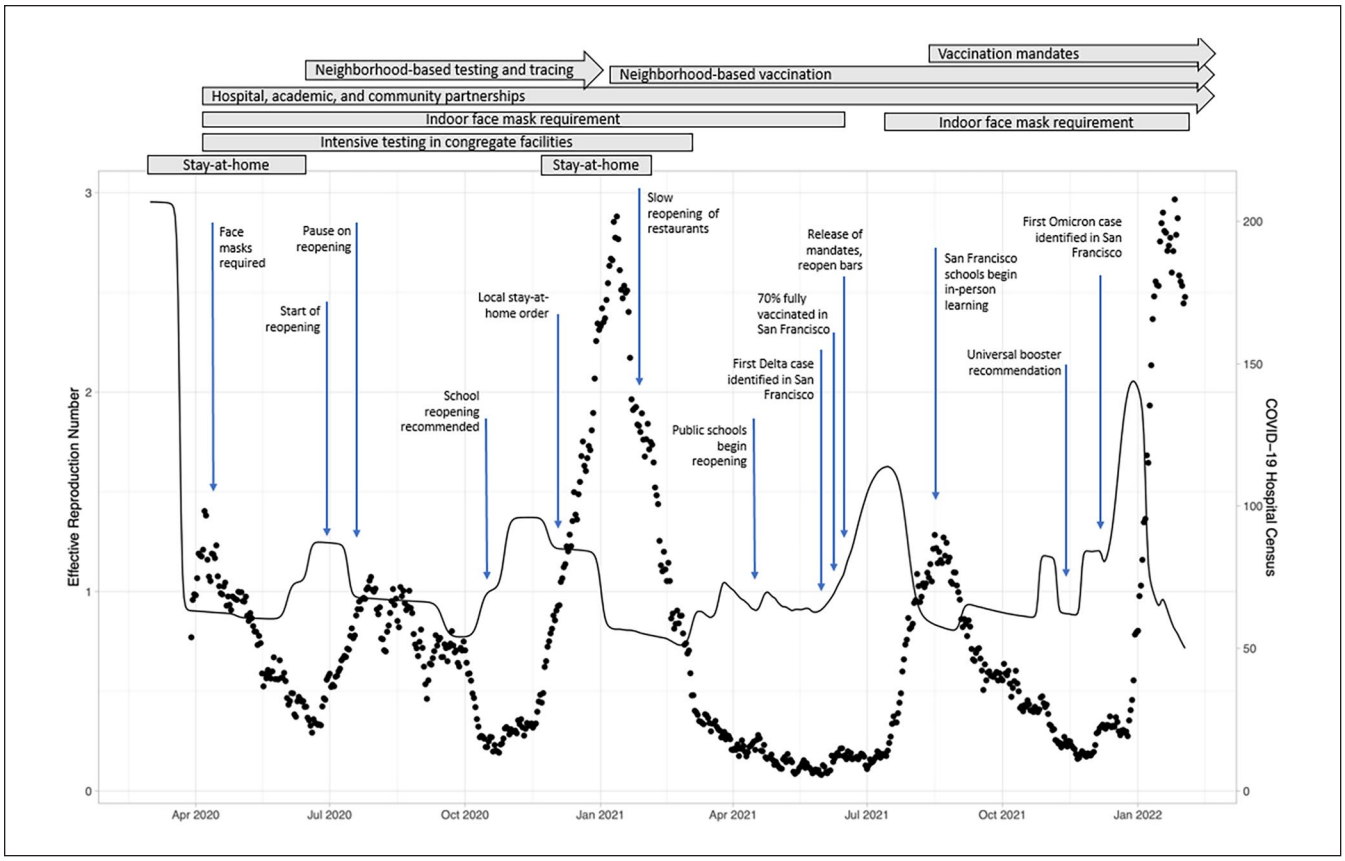

Figure 1. Timeline of policies that focused on preventing COVID-19 disease severity in San Francisco, March 2020 through March 2022. Solid line indicates the effective reproductive number, estimated by using the open-source LEMMA (Local Epidemic Modeling for Management & Action) model version 2.1.2 based on COVID-19 hospital census by day (solid dots), as well as reported COVID-19 cases, intensive care unit census, and COVID-19–related deaths.

Following a COVID-19 outbreak of more than 100 people in a homeless shelter in April 2020, shelter occupancy was reduced to a capacity level of 30% to 40%, beds were spaced >6-feet apart, and people with COVID-19 comorbidities were transferred to hotels.[13-15] Overall, 13 known COVID-19 deaths occurred among people experiencing homelessness through May 2022.

San Francisco's local jail, with an average daily pre–COVID-19 census of 1200 people, experienced no COVID-19–associated deaths among people who were incarcerated or among jail staff. Rigorous testing protocols were implemented at jail entry throughout the COVID-19 pandemic, including serial COVID-19 testing, quarantine for all new entrants, surveillance testing in long-term–stay units, and mandatory testing for all jail staff. In addition, the jail population was reduced in collaboration with San Francisco justice partners, including law enforcement, the district attorney, and the public defender. An in-depth review of the jail population by collaborators helped to identify people who could be released, including those with ≤60 days remaining in their sentences, people charged with misdemeanors or nonviolent felonies, and people who could be placed in housing or released on probation.

Face mask mandates. Given the initial lack of a vaccine or therapy for COVID-19, San Francisco issued an indoor face mask mandate on April 17, 2020, which expanded in July 2020 to require face coverings for all residents aged ≥10 years when outside their residence. In alignment with the Centers for Disease Control and Prevention (CDC) and CDPH, outdoor and indoor face mask requirements were lifted on May 3, 2021, and June 15, 2021, respectively. When cases surged due to the Delta variant, the indoor face mask mandate was reinstated on July 23, 2021; lifted with some exceptions on February 15, 2022; and fully lifted on April 15, 2022. Self-reported face mask adherence throughout this entire period was high in San Francisco compared with other parts of California and the United States.[16]

Stay-at-home orders. As a result of rising COVID-19 cases and model-based hospital projections suggesting that there was a risk of developing a shortage of critical care beds if hospitalizations continued to increase, a second stay-at-home order and a mandatory quarantine for people who had traveled outside the Bay Area went into effect in San Francisco from December 6, 2020, through January 28, 2021.

Strategy 2: Prioritizing Resources in Neighborhoods Highly Affected by COVID-19

Test and respond. In July 2020, SFDPH partnered with academia and community-based organizations (CBOs) to implement a testing strategy modeled after the prototype of the San Francisco Mission District testing event. The "test and respond" strategy emphasized access to decentralized, walk-up, neighborhood-based COVID-19 testing sites and linkage to resources.[17] Testing services were linked with delivery of food and cleaning supplies provided by SFDPH and CBOs to support isolation and quarantine.[18] "Equity officers," appointed in March 2020 by SFDPH, were public health leaders who met with community members weekly to review testing data. To address gaps in sick leave coverage among populations highly affected by COVID-19, San Francisco funded the Right to Recover program from June 2020 through June 2022, which offered financial stipends to people diagnosed with COVID-19 to cover essential costs during isolation. The program was funded through philanthropy and direct allocation of unspent city funds.

Contact tracing. In addition to experienced public health staff, a new cadre of city and state workers without prior public health experience was deployed to serve as COVID-19 contact tracers.[19-21] Over time, deployed staff returned to their original positions, and contract staff representing diverse linguistic and cultural backgrounds were newly hired. By fall 2020, nearly 500 workers were supporting or conducting case investigations as contact tracers, 40% of whom were bilingual speakers of Spanish and English. From April 2020 through March 2021, 80% of people diagnosed with COVID-19 in San Francisco were reached by the contact tracing team.[22]

Asymptomatic COVID-19 transmission and a short incubation period made it difficult to notify contacts fast enough to prevent transmission.[22] To prevent delayed outreach during surges, a new chatbot technology developed by CDPH was implemented to immediately reach out to people newly diagnosed with COVID-19 by text message.[23] Despite the operational challenges of contact tracing, reported data informed the local understanding of transmission networks and guided policies for schools and face masks for people who were fully vaccinated.[24]

Vaccine rollout. Immediately after the Emergency Use Authorization of COVID-19 vaccines in December 2020, a collaborative network of health care systems and pharmacies worked together to rapidly distribute vaccines. In accordance with CDC and CDPH guidelines, vaccine eligibility in San Francisco followed a tiered approach, prioritizing local health care workers and then other residents based on age and comorbidities. Five high-volume vaccination sites, including at health system campuses and the major conference center in San Francisco, were launched between December 2020 and January 2021, with a centralized website for scheduling appointments. From January 15 through April 30, 2021, in San Francisco, 786 978 vaccines were administered; on a single high-volume day, >15 000 vaccinations were administered. Alongside CBO staff, neighborhood COVID-19 vaccination hubs conducted mobile events.[25-28] By mid-June 2021, San Francisco was the second major metropolitan city in the United States to have 70% of the vaccine-eligible population fully vaccinated. Notably, COVID-19 vaccination coverage among Black or African American (68%) and Latinx (79%) residents in San Francisco was higher than among the general population in California (66% and 65%, respectively) and nationally (57% and 65%, respectively) (Figure 2A).[29] In August 2021, San Francisco was the first US city to implement COVID-19 vaccination requirements for patrons of certain indoor establishments.[30] By April 2022, 83% of the vaccine-eligible population had completed a primary vaccine series.

In recognition of the role of widespread COVID-19 vaccine uptake to reduce transmission, San Francisco made COVID-19 booster doses available to groups at risk for severe COVID-19 starting in September 2021. In November 2021, San Francisco was one of the first US cities to endorse booster vaccinations regardless of age (ahead of CDC recommendations), at a time when the need for booster vaccinations was still being debated nationally. Administration of booster vaccines occurred primarily through partnerships between SFDPH and citywide pharmacies, health systems, and neighborhood-based sites. By April 2022, 70% of vaccine-eligible people in San Francisco had received an initial booster dose, compared with 50% of vaccine-eligible people in California and 45% nationally, although with continued disparities by race and ethnicity (Figure 2B).[29]

Strategy 3: Timely and Adaptive Data-Driven Policies

SFDPH's partnerships with the University of California, San Francisco, and the University of California, Berkeley (developed during decades of collective efforts to address HIV), helped to generate knowledge, identify trends, and translate data into policy and strategies throughout San Francisco's COVID-19 response.[28] In particular, local academic and policy experts used the LEMMA model to project hospitalizations and cases and quantify the potential effects of policy decisions. The model was updated over time to simultaneously fit to data of COVID-19 cases, hospitalizations, ICU census, deaths, vaccine uptake (types, timing, and doses), waning immunity from vaccines over time, and circulating virus variants. The model supported timely public health decision-making, particularly related to the December 2020 stay-at-home order and the universal COVID-19 booster recommendations made in fall 2021.[31]

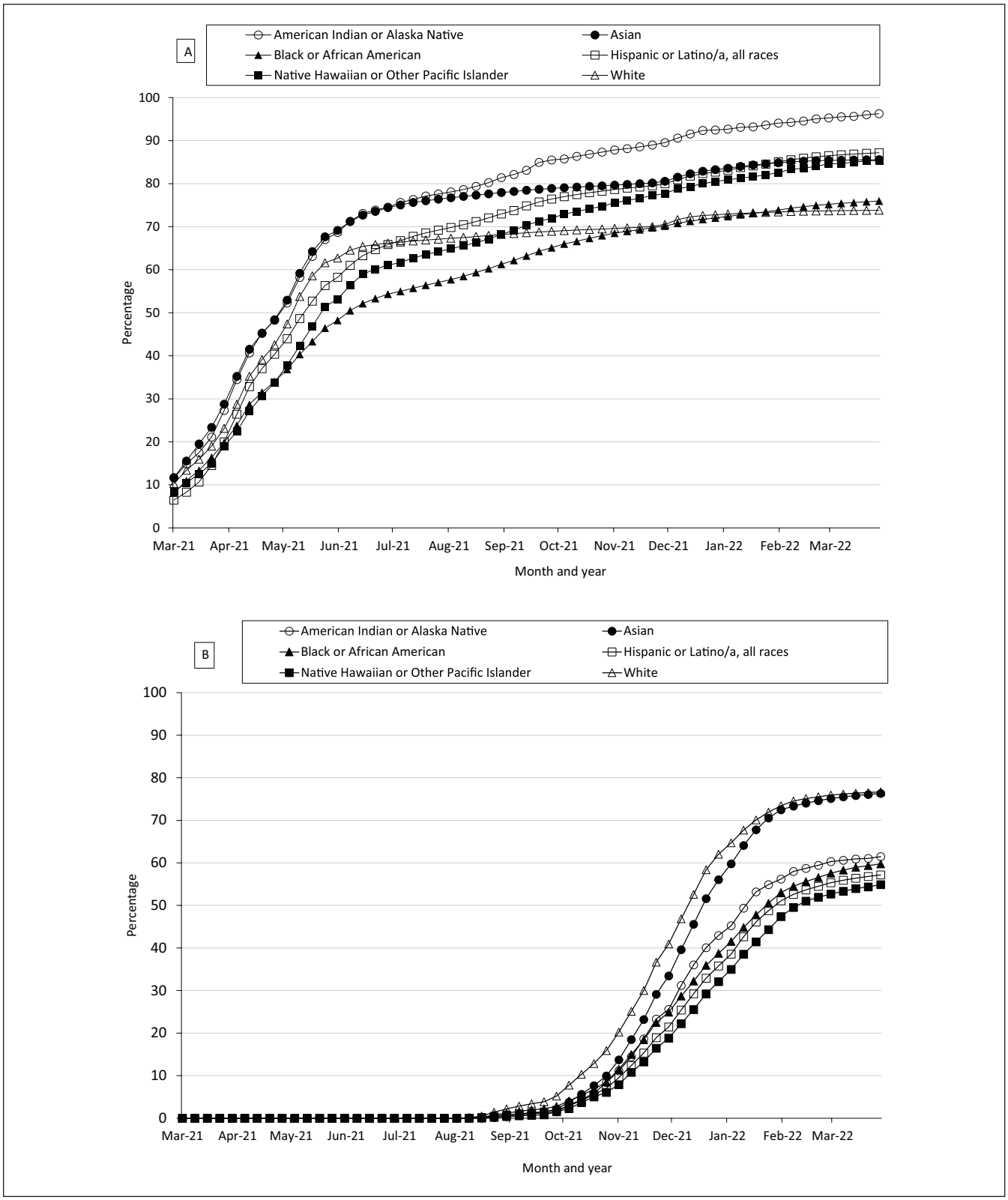

Figure 2. Percentage of residents who were vaccinated (A) and received a booster vaccine (B) for COVID-19 over time, stratified by race and ethnicity, San Francisco, March 2021 through March 2022. Vaccination rates by race and ethnicity were calculated by dividing the number of San Francisco residents who had completed their primary series (2 doses of the mRNA vaccines or the single-dose vaccine) or booster on that day by the estimated population size. The denominator for booster vaccination results was the number of people who completed the 1- or 2-dose series. Data source: California Immunization Registry.

Strategy 4: Leveraging Partnerships and Public Trust

By early 2020, SFDPH had a long history of engaging with CBOs to address the HIV epidemic and, more recently, had made investments to address mental health and substance use treatment. Public acceptance of COVID-19 mitigation strategies (wearing face masks and social distancing) was high, in part reflecting public trust that had been built through successes seen through prior public health policies and ongoing communication between SFDPH staff and community leaders, leading to active outreach and education by CBOs to community members. Direct funding to CBOs in December 2020 allowed for the expansion of programs serving neighborhoods with the highest case rates of COVID-19.

Regular press conferences by the San Francisco mayor and the SFDPH director of health and the provision of accessible data through COVID-19 dashboards were critical tools to communicate with the public. With support from the San Francisco mayor's Office of Economic and Workforce Development, coalitions with businesses helped maintain community partner support of evolving public health orders related to group gathering sizes, indoor dining, face masks, and vaccination. Consistent communication between public health officers across Bay Area counties helped to enact region-wide policies, which further normalized public health recommendations and enabled consistency in messaging across the counties that residents travel through for work and other activities.

Hospital partnerships allowed for centralized resource allocation for patients who had severe COVID-19 disease and for daily assessments of ICU bed availability. Although San Francisco maintains one of the highest ICU capacities per capita in the Bay Area, a low-acuity continuing care site was erected in July 2020 to support up to 93 COVID-19–negative patients discharged from hospitals.

Differences in Excess Mortality in San Francisco and California

The excess all-cause mortality rate in 2020 in San Francisco was half that seen in 2019 in California as a whole (8% vs 16%) (Figure 3). Disparities in excess mortality in San Francisco were attenuated compared with California overall, with markedly diminished excess mortality rates among people aged >65 years across all races and ethnicities (eFigure 1 in Supplemental Material). Nonetheless, high rates of excess mortality in San Francisco persisted among people who were Latinx (16.7%), Asian (5.8%), or Black (4.1%), with the highest rates of excess mortality relative to White populations of the same age occurring among Latinx people aged ≥85 years (eFigure 2 in Supplemental Material).

Lessons Learned

The success of San Francisco's COVID-19 response relied on the application of public health principles through the lens of health equity to mitigate COVID-19 morbidity and mortality. Community responsiveness, joint planning, and public trust in public health are the foundations of disease preparedness—the prerequisite for effective mandates, guidance, and collective action. Public health data systems in San Francisco were designed to proactively detect inequities in transmission, testing, and vaccination, allowing adaptive and improved response strategies.

Although the COVID-19 response in San Francisco was swift and successful, unintended consequences occurred. SFDPH's safety-net hospital faced many strains related to the disproportionate incidence of COVID-19 cases in populations served by the public health system (eg, Latinx) and staff shortages fueled by factors such as illness, burnout, childcare responsibilities, and COVID-19 deployment. Length of hospital stays increased, and transitions across the acute care system were delayed, leading to backlogs in emergency departments for patients experiencing psychiatric emergencies or those requiring isolation and quarantine support.[32,33] Some pre–COVID-19 public health gains slipped; for example, the number of people taking antiretroviral medications to prevent or treat HIV declined, hampering the local Get to Zero efforts for new HIV infections.[34,35] People aged >65 years experienced increased loneliness and social isolation.[36]

Although the role of children in COVID-19 transmission was initially unclear, accumulating local and national data showed that children were at low risk for severe disease and that in-school transmission was rare when mitigation measures were in place.[37] Schools in San Francisco were closed in March 2020; however, by June 2020, SFDPH allowed childcare programs to reopen, with instructions to create stable cohorts, conduct health screenings, and require face coverings. In fall 2020, SFDPH developed a path for school reopening that included on-site inspection of facilities to ensure proper distancing and ventilation and careful epidemiologic tracking of in-school transmission.[38] Private and parochial schools reopened by the end of 2020, but the public school district continued to rely primarily on virtual learning through the 2020-2021 school year and then fully reopened in fall 2021. When CDPH lifted face mask mandates in schools in March 2022, San Francisco allowed for optional face masks for school-aged children. The long-term effects of prolonged school closure on learning attainment and the mental and physical health of children and adolescents are not yet fully understood.[39,40]

On December 1, 2021, San Francisco was the first jurisdiction in the United States to identify a person infected with the Omicron variant.[41] To respond to this highly transmissible and vaccine-evasive variant, hospital systems in San Francisco collaborated to streamline the availability of new treatments

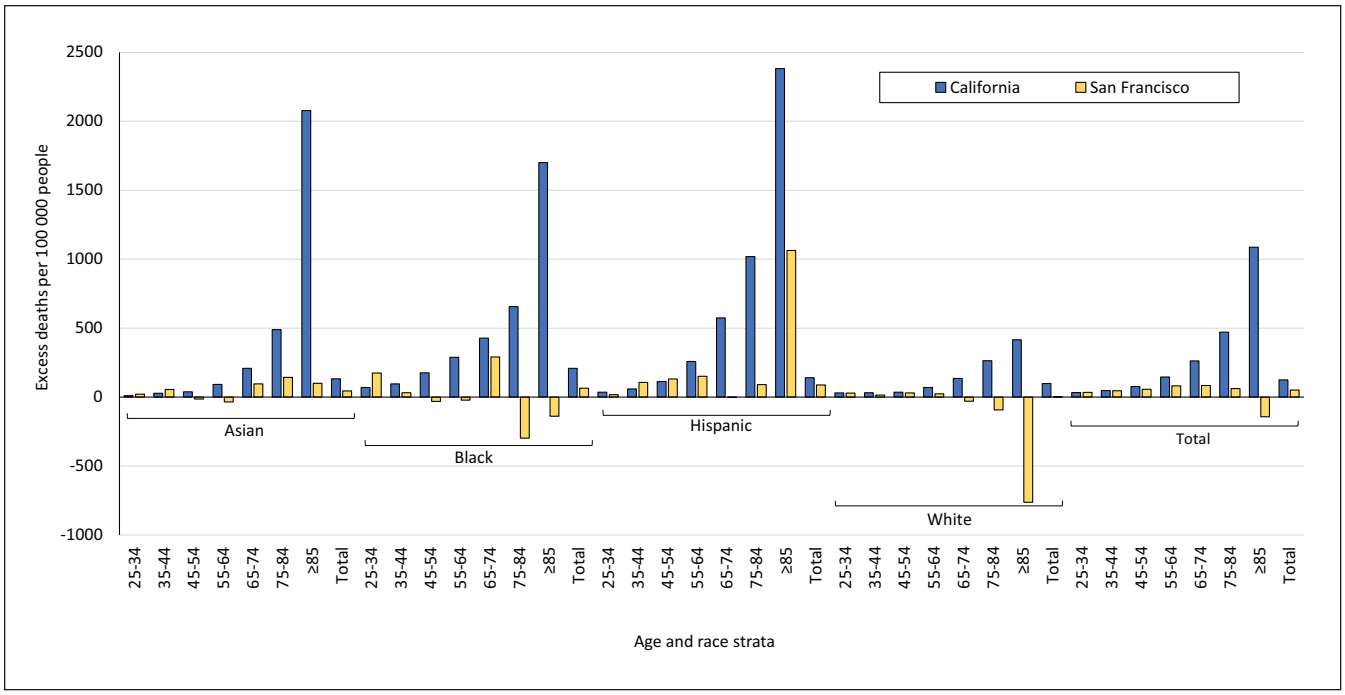

Figure 3. Excess mortality in 2020-2021 compared with 2019, by age group and race and ethnicity, in San Francisco and California. Cases of all-cause mortality in 2019 were used to estimate excess deaths in 2020, both overall and stratified by age and race and ethnicity. Data source: California Department of Public Health, Fusion Center.[9]

to prevent severe outcomes of COVID-19. Although case numbers reached new peaks, the death rate in San Francisco remained low (12 deaths per 100 000 population).

Public health approaches and priorities will continue to evolve as new COVID-19 variants emerge. Sustaining partnerships will be critical to respond to dynamic changes and recalibrate responses. Trust and transparency within communities, adaptive infrastructure and robust data systems, and resilience will be needed to respond to future outbreaks.

Acknowledgments

The authors acknowledge the staff of the SFDPH COVID Command Center who developed and implemented COVID-19 strategies. For this, from the City and County of San Francisco and SFDPH, we acknowledge Tomas Aragon, MD, DrPH; Adrienne Bechelli, MPA; Deborah Borne, MD; MaryEllen Carroll, BA; Stephanie Cohen, MD; Jeff Critchfield, MD; Patricia Erwin, MPH; Charles Fann, BA; Jonathan Fuchs, MD; Lisa Golden, MD; Hali Hammer, MD; Katherine Hernandez, RN; Mivic Hirose, MSN; Claire Horton, MD; Amy Lockwood, PhD; Janice Louie, MD; Jacque McCright, MPH; Willi McFarland, MD; Tracey Packer, MPH; Roland Pickens, MD; Lisa Pratt, MD; Baljeet Sangha, MPH; Jonathan Sears, MPH; Shakirah Simley, BA; Tobi Skotnes, MPH; David Stier, MD; Julie Stoltey, MD; Katy Tang, BA; Troy Williams, MSN; Aaron Yen, BA; Linda Yeung, BA; and Albert Yu, MD. From UCSF, we acknowledge Jessica Bloome, MD; Lillian Brown, MD; Jessica Celentano, MPH; Elizabeth Imbert, MD; and Michael Reid, MD. Staff who supported data and analysis include Lizzy Connelly, MPH; Michelle Kirian, MPH; Bob Kohn, MPH; Christopher Lee, MPH; Tina Lee, MPH; Wendy Lu, MPH; Devan Morris, BS; Jackvin Ng, MPH; Melissa Ongpin, MPH; Amy Ovadia, MPH; Seth Pardo, PhD; Melissa Sanchez, PhD; Maddie Sankaran, MPH; Lena Tran, MPH, MSW; and Iris Tsui, MPH.

Declaration of Conflicting Interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The authors received no financial support for the research, authorship, and/or publication of this article.

ORCID iD

Darpun D. Sachdev, MD https://orcid.org/0000-0002-7309-8091

Supplemental Material

Supplemental material for this article is available online. The authors have provided these supplemental materials to give readers additional information about their work. These materials have not been edited or formatted by *Public Health Reports*'s scientific editors and, thus, may not conform to the guidelines of the *AMA Manual of Style,* 11th Edition.

References

1. Johns Hopkins University and Medicine Coronavirus Resource Center. COVID-19 dashboard. Updated March 10, 2023. Accessed September 28, 2022. https://coronavirus.jhu.edu/map.html
2. Centers for Disease Control and Prevention. COVID data tracker. Accessed September 28, 2022. https://covid.cdc.gov/covid-data-tracker/#datatracker-home
3. Aragón TJ, Cody SH, Farnitano C, et al. Crisis decision-making at the speed of COVID-19: field report on issuing the first regional shelter-in-place orders in the United States. *J Public Health Manag Pract*. 2021;27(suppl 1):S19-S28. doi:10.1097/PHH.0000000000001292
4. City and County of San Francisco. COVID-19 cases and deaths. Accessed March 14, 2023. https://sf.gov/data/covid-19-cases-and-deaths#deaths-by-month
5. Chen YH, Glymour MM, Catalano R, et al. Excess mortality in California during the coronavirus disease 2019 pandemic, March to August 2020. *JAMA Intern Med*. 2021;181(5):705-707. doi:10.1001/jamainternmed.2020.7578
6. Chamie G, Marquez C, Crawford E, et al. Community transmission of severe acute respiratory syndrome coronavirus 2 disproportionately affects the Latinx population during shelter-in-place in San Francisco. *Clin Infect Dis*. 2021;73(suppl 2):S127-S135. doi:10.1093/cid/ciaa1234
7. Tolles J, Luong T. Modeling epidemics with compartmental models. *JAMA*. 2020;323(24):2515-2516. doi:10.1001/jama.2020.8420
8. Geng EH, Schwab J, Foraker R, et al. Outcomes associated with social distancing policies in St. Louis, Missouri, during the early phase of the COVID-19 pandemic. *JAMA Netw Open*. 2021;4(9):e2123374. doi:10.1001/jamanetworkopen.2021.23374
9. California Department of Public Health, Office of Strategic Development and External Relations, Fusion Center. Data brief: 2020 increases in deaths in California. Updated November 30, 2021. Accessed September 28, 2022. https://skylab.cdph.ca.gov/communityBurden/_w_32c9f80f/xMDA/2020_Excess_Mortality.html
10. Louie JK, Scott HM, DuBois A, et al. Lessons from mass-testing for coronavirus disease 2019 in long-term care facilities for the elderly in San Francisco. *Clin Infect Dis*. 2021;72(11):2018-2020. doi:10.1093/cid/ciaa1020
11. Karmarkar EN, Blanco I, Amornkul PN, et al. Timely intervention and control of a novel coronavirus (COVID-19) outbreak at a large skilled nursing facility—San Francisco, California, 2020. *Infect Control Hosp Epidemiol*. 2021;42(10):1173-1180. doi:10.1017/ice.2020.1375
12. Cohen SE, Stookey J, Anderson N, et al. Using geocoding to identify COVID-19 outbreaks in congregate residential settings: San Francisco's outbreak response in single-room occupancy hotels. *Public Health Rep*. 2023;138(1):7-13. doi:10.1177/00333549221128301
13. Imbert E, Kinley PM, Scarborough A, et al. Coronavirus disease 2019 outbreak in a San Francisco homeless shelter. *Clin Infect Dis*. 2021;73(2):324-327. doi:10.1093/cid/ciaa1071
14. Fuchs JD, Carter HC, Evans J, et al. Assessment of a hotel-based COVID-19 isolation and quarantine strategy for persons experiencing homelessness. *JAMA Netw Open*. 2021;4(3):e210490. doi:10.1001/jamanetworkopen.2021.0490
15. Self JL, Montgomery MP, Toews KA, et al. Shelter characteristics, infection prevention practices, and universal testing for SARS-CoV-2 at homeless shelters in 7 US urban areas. *Am J Public Health*. 2021;111(5):854-859. doi:10.2105/AJPH.2021.306198
16. Carnegie Mellon University, Delphi Group. COVIDcast. San Francisco County, CA. Accessed September 28, 2022. https://delphi.cmu.edu/covidcast/?region=06075
17. Rubio LA, Peng J, Rojas S, et al. The COVID-19 symptom to isolation cascade in a Latinx community: a call to action. *Open Forum Infect Dis*. 2021;8(2):ofab023. doi:10.1093/ofid/ofab023
18. Kerkhoff AD, Sachdev D, Mizany S, et al. Evaluation of a novel community-based COVID-19 "test-to-care" model for low-income populations. *PLoS One*. 2020;15(10):e0239400. doi:10.1371/journal.pone.0239400
19. Reid M, Enanoria W, Stoltey J, et al. The SARS-CoV-2 pandemic: the race to trace: contact tracing scale-up in San Francisco—early lessons learned. *J Public Health Policy*. 2021;42(2):211-221. doi:10.1057/s41271-021-00285-y
20. Celentano J, Sachdev D, Hirose M, Ernst A, Reid M. Mobilizing a COVID-19 contact tracing workforce at warp speed: a framework for successful program implementation. *Am J Trop Med Hyg*. 2021;104(5):1616-1619. doi:10.4269/ajtmh.20-1665
21. Eliaz A, Blair AH, Chen YH, et al. Evaluating the impact of language concordance on coronavirus disease 2019 contact tracing outcomes among Spanish-speaking adults in San Francisco between June and November 2020. *Open Forum Infect Dis*. 2021;9(1):ofab612. doi:10.1093/ofid/ofab612
22. Sachdev DD, Brosnan HK, Reid MJA, et al. Outcomes of contact tracing in San Francisco, California—test and trace during shelter-in-place. *JAMA Intern Med*. 2021;181(3):381-383. doi:10.1001/jamainternmed.2020.5670
23. Johnson BD, Shui MW, Said K, Chavez A, Sachdev DD. Prioritizing COVID-19 contact tracing during a surge using chatbot technology. *Am J Public Health*. 2022;112(1):43-47. doi:10.2105/AJPH.2021.306563
24. Sachdev DD, Chew Ng R, Sankaran M, et al. Contact-tracing outcomes among household contacts of fully vaccinated coronavirus disease 2019 (COVID-19) patients: San Francisco, California, 29 January–2 July 2021. *Clin Infect Dis*. 2022;75(1):e267-e275. doi:10.1093/cid/ciab1042
25. Marquez C, Kerkhoff AD, Naso J, et al. A multi-component, community-based strategy to facilitate COVID-19 vaccine uptake among Latinx populations: from theory to practice. *PLoS One*. 2021;16(9):e0257111. doi:10.1371/journal.pone.0257111
26. Peng J, Marquez C, Rubio L, et al. High likelihood of accepting COVID-19 vaccine in a Latinx community at high SARS-CoV-2 risk in San Francisco. *Open Forum Infect Dis*. 2021;8(10):ofab202. doi:10.1093/ofid/ofab202
27. Bibbins-Domingo K, Petersen M, Havlir D. Taking vaccine to where the virus is—equity and effectiveness in coronavirus vaccinations. *JAMA Health Forum*. 2021;2(2):e210213. doi:10.1001/jamahealthforum.2021.0213
28. Fields J, Gutierrez JR, Marquez C, et al. Community-academic partnerships to address COVID-19 inequities: lessons from the San Francisco Bay area. *NEJM Catalyst*. June 23, 2021. Accessed February 14, 2023. https://catalyst.nejm.org/doi/pdf/10.1056/CAT.21.0135

29. Ndugga N, Hill L, Artiga S, Haldar W; Kaiser Family Foundation. Latest data on COVID-19 vaccinations by race/ethnicity. July 14, 2022. Accessed September 27, 2022. https://www.kff.org/coronavirus-covid-19/issue-brief/latest-data-on-covid-19-vaccinations-by-race-ethnicity
30. Vera A, Mossburg C. First major US city announces it will mandate proof of full vaccinations for certain indoor activities. *CNN Travel*. August 12, 2021. Accessed March 12, 2023. https://www.cnn.com/2021/08/12/us/san-francisco-vaccine-requirement/index.html
31. Petersen M, Schwab J, Havlir DV. SARS-CoV-2 vaccine boosters: the time to act is now. *PLoS Med*. 2021;18(12):e1003882. doi:10.1371/journal.pmed.1003882
32. Cawley C, Kanzaria HK, Zevin B, Doran KM, Kushel M, Raven MC. Mortality among people experiencing homelessness in San Francisco during the COVID-19 pandemic. *JAMA Netw Open*. 2022;5(3):e221870. doi:10.1001/jamanetworkopen.2022.1870
33. Appa A, Rodda LN, Cawley C, et al. Drug overdose deaths before and after shelter-in-place orders during the COVID-19 pandemic in San Francisco. *JAMA Netw Open*. 2021;4(5):e2110452. doi:10.1001/jamanetworkopen.2021.10452
34. Chan CT, Ming K, Camp C, Saberi P. Sexual behaviors, substance use, and quality of life among individuals using PrEP in San Francisco during the COVID-19 pandemic shelter-in-place orders: a cross-sectional survey. *J Acquir Immune Defic Syndr*. 2022;89(4):e39-e42. doi:10.1097/QAI.0000000000002900
35. Spinelli MA, Hickey MD, Glidden DV, et al. Viral suppression rates in a safety-net HIV clinic in San Francisco destabilized during COVID-19. *AIDS*. 2020;34(15):2328-2331. doi:10.1097/QAD.0000000000002677
36. Kotwal AA, Holt-Lunstad J, Newmark RL, et al. Social isolation and loneliness among San Francisco Bay area older adults during the COVID-19 shelter-in-place orders. *J Am Geriatr Soc*. 2021;69(1):20-29. doi:10.1111/jgs.16865
37. Honein MA, Barrios LC, Brooks JT. Data and policy to guide opening schools safely to limit the spread of SARS-CoV-2 infection. *JAMA*. 2021;325(9):823-824. doi:10.1001/jama.2021.0374
38. Kaiser SV, Watson A, Dogan B, et al. Preventing COVID- 19 transmission in education settings. *Pediatrics*. 2021;148(3):e2021051438. doi:10.1542/peds.2021-051438
39. Leeb RT, Bitsko RH, Radhakrishnan L, Martinez P, Njai R, Holland KM. Mental health–related emergency department visits among children aged <18 years during the COVID-19 pandemic—United States, January 1–October 17, 2020. *MMWR Morb Mortal Wkly Rep*. 2020;69(45):1675-1680. doi:10.15585/mmwr.mm6945a3
40. Goldhaber D, Kane TJ, McEachin A, Morton E, Patterson T, Staiger DO. The consequences of remote and hybrid instruction during the pandemic. NBER Working Paper Series. May 9, 2022. Accessed September 27, 2022. https://www.nber.org/papers/w30010
41. Centers for Disease Control and Prevention. First confirmed case of Omicron variant detected in the United States. December 1, 2021. Accessed September 27, 2022. https://www.cdc.gov/media/releases/2021/s1201-omicron-variant.html