Online Resource 1. Summary of Referenced Studies

Referenced study	Location	Sample size	Major finding
[1] Alexander M, Unruh L, Koval A, Belanger W. United States response to the COVID-19 pandemic, January-November 2020. Health Econ Policy Law. 2022;17:62–75. https://doi.org/10.1017/s1744133121000116	United States	~ 340 million from census	Differences in state responses to the pandemic correlated to transmission/positivity rates; for example, states that enforced the use of masks for a longer duration had a smaller positivity rate than states that were more lax about mask policies. Positivity rates were skewed early in the pandemic due to a lack of a COVID-19 tests. Once tests were developed, production and distribution took time to scale to demand, which led to restrictions such as only testing symptomatic patients. Equipment shortages stunted patient care; for example, hospital bed shortages and ventilator shortages. PPE shortages put healthcare workers at higher risk, leading to the reuse of masks, gowns, etc. This then led to an increase in healthcare worker shortages, which the US already had issues with. Multiple bills were passed by Congress in March and April to ensure insurance companies covered COVID-19 testing and subsequent consequences of contracting the virus. Despite these actions, health financing issues still arose. Multiple findings in this paper ultimately identify how the action and inaction of the United States government impacted transmission rates and death rates during the COVID-19 pandemic.
[2] Sparling A, Walls M, Mayfield CA, Priem JS, Durham J, Hetherington T, Taylor YJ. Racial/ethnic disparities in health care setting choice for adults seeking Severe Acute Respiratory Syndrome Coronavirus 2 testing. Med Care. 2022;60:3–12. https://doi.org/10.1097/mlr.0000000000001654	Southeastern United States	105,386	55% patients sought care at an outpatient clinic; 24% at the emergency department; 12% at urgent care; 9% at mobile testing units. 58% were White; 24% Black; 11% Hispanic; 8% other race/identity. Black patients had a higher likelihood of ED testing compared to White patients. Hispanic patients had highest likelihood of being tested at a mobile testing unit. Patients without a primary care physician had a higher relative risk of undergoing testing at the ED or mobile testing unit.
[3] Rane MS, Profeta A, Poehlein E, Kulkarni S, Robertson M, Gainus C, Parikh A, LeBenger K, Frogel D, Nash D. SARS-CoV-2 pandemic in New York	New York City, NY, United States	2.8 million	6.1 million diagnostic and serologic tests were performed on 2.8 million people.

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metropolitan area: The view from a major urgent care provider. Ann Epidemiol. 2022;74:31–40. https://doi.org/10.1016/j.annepidem.2022.05.006			Testing levels were higher among 20-29 year old, non-Hispanic White and female patients compared to other groups. Reverse transcriptase polymerase chain reaction positivity was higher in non-Hispanic Black (7.9%), Hispanic (8.2%), and Native American (8.2%) compared to non-Hispanic White (5.7%) patients. Overall seropositivity was estimated at 22.1%. Highest among 10-14 year olds (27.9%), non-Hispanic Black (26%) and Hispanic (31%) testers.
[4] Brown KM, Lewis JY, Davis SK. An ecological study of the association between neighborhood racial and economic residential segregation with COVID-19 vulnerability in the United States' capital city. Ann Epidemiol. 2021;59:33–6. https://doi.org/10.1016/j.annepidem.2021.04.003	Washington, D.C., United States	~ 750,000, from census tracts	Overall positivity: 4.7% Neighborhoods with a greater concentration of African Americans have higher rates of COVID-19 incidence despite lower testing rates.
[5] Jacobson M, Chang TY, Shah M, Pramanik R, Shah SB. Racial and ethnic disparities in SARS-CoV-2 testing and COVID-19 outcomes in a Medicaid managed care cohort. Am J Prev Med. 2021;61:644–51. https://doi.org/10.1016/j.amepre.2021.05.015	Northern California, United States	Total 84,346: 13,897 Black 21,827 White 24,153 Latino	% tested: Black – 27.7, White – 29.1, Latino – 34.8, % positive: Black – 2.83, White – 2.26, Latino – 8.01
[6] Holden TM, Richardson RAK, Arevalo P, Duffus WA, Runge M, Whitney E, Wise L, Ezike NO, Patrick S, Cobey S, Gerardin J. Geographic and demographic heterogeneity of SARS-CoV-2 diagnostic testing in Illinois, USA, March to December 2020. BMC Public Health. 2021;21:1105. https://doi.org/10.1186/s12889-021-11177-x	Illinois, United States	Entire state 12.7 million	Tested/1000/day: Latino – 1.87, Black – 2.58, White – 2.87
[7] Jefferson C, Watson E, Certa JM, Gordon KS, Park LS, D'Souza G, Benning L, Abraham AG, Agil D, Napravnik S, Silverberg MJ, Leyden WA, Skarbinski J, Williams C, Althoff KN, Horberg MA. Differences in COVID-19 testing and adverse outcomes by race, ethnicity, sex, and health system setting in a large diverse US cohort. PLoS One. 2022;17:e0276742. https://doi.org/10.1371/journal.pone.0276742	6 Cohorts across the United States: Kaiser Permanente Northern California; Kaiser Permanente Mid-Atlantic States;	5,958,908	Hispanic patients had highest rate of testing (16%) and positivity (18%). Asian/Pacific Islander patients had the lowest testing rate (11%). White patients had lowest positivity rates (5%). Men had a lower likelihood of testing and a higher positivity risk compared to women. Men were more likely to be hospitalized as well. Black patients were more likely to have COVID-19 related hospitalizations and deaths when compared to White patients.

Referenced study	Location	Sample size	Major finding
	University of North Carolina at Chapel Hill HIV clinical cohort; Vanderbilt Comprehensive Care Clinic HIV Cohort; and Veterans Aging Cohort Study		Supports evidence of racial, ethnic, and sex disparities during the pandemic, including in healthcare settings with reduced barriers to care.
[8] Bilal U, Tabb LP, Barber S, Diez Roux AV. Spatial inequities in COVID-19 testing, positivity, confirmed cases, and mortality in 3 U.S. cities: An ecological study. Ann Intern Med. 2021;174:936–44. https://doi.org/10.7326/m20-3936	New York City, Philadelphia, & Chicago, United States	Zip code tabulation area level from March 2020 to September 2020	Neighborhoods with high social vulnerability had lower testing rates and higher positivity ratios, confirmed case rates, and mortality rates across the three cities.
[9] Centers for Disease Control and Prevention. 2024. Fast facts: HIV in the US by race and ethnicity. https://www.cdc.gov/hiv/data-research/facts-stats/race-ethnicity.html Accessed 3 Sep 2025.	United States	340 million; 31,800 new HIV cases in 2022	Black and Hispanic people are disproportionately affected by HIV compared to their population size, making up 70% of new cases in 2022.
[10] Rodriguez F, Coquet J, Harrington R, Hernandez-Boussard T. Increases in SARS-CoV-2 test positivity rates among Hispanic people in a Northern California health system. Public Health Rep. 2021;136:543–7. https://doi.org/10.1177/00333549211026778	Stanford Healthcare, Northern California, United States	179,032	282,916 COVID-19 tests were administered to 179,032 individual patients from March 4, 2020 to January 12, 2021. 32,766 of those patients were Hispanic (18.3%). Hispanic patients were 3 times as likely to receive a positive test result than patients in other racial/ethnic groups.
[11] Park LS, McGinnis KA, Gordon KS, Justice AC, Leyden W, Silverberg MJ, Skarbinski J, Jefferson C, Horberg M, Certa J, Napravnik S, Edwards JK, Westreich D, Bastarache L, Gangireddy S, Benning L, D'Souza G, Williams C, Althoff KN. SARS-CoV-2 testing and positivity among persons with and without HIV in 6 US cohorts. J Acquir Immune Defic Syndr. 2022;90:249–55. https://doi.org/10.1097/qai.0000000000002943`	5 Clinical Cohorts and 1 Interval Cohort across the United States: Kaiser Permanente Northern California (Oakland, CA); Kaiser Permanente Mid-Atlantic	Cohorts ranged in size from 1,675 to 31,304 PWH and 1,430 to 3,742,604 PWoH	PWH were tested significantly more for COVID-19 than PWoH, though the proportion of positive tests was comparable by HIV status. The difference in proportion of positive COVID-19 tests ranged from 4.7% lower to 1.4% higher.

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	Sates (Rockville, MD); University of Northern Carolina Health (Chapel Hill, NC); Vanderbilt University Medical Center (Nashville, TN); Veterans Aging Cohort Study		
[12] Spinelli MA, Brown LB, Glidden DV, Hunter K, Martin-Tuite P, Zheng J, Sera C, Havlir D, Buchbinder SP, Gandhi M. SARS-CoV-2 incidence, testing rates, and severe COVID-19 outcomes among people with and without HIV. AIDS. 2021;35:2545–7. https://doi.org/10.1097/qad.0000000000003075	San Francisco, California, United States	22,024 total; 2,690 PWH	The risk of severe COVID-19 was higher among PWH. Positivity rates were lower in PWH, though testing rates were higher.
[13] Flannery S, Schwartz R, Rasul R, Hirschwerk DA, Wallach F, Hirsch B, McGowan J. A comparison of COVID-19 inpatients by HIV status. Int J STD AIDS. 2021;32:1149–56. https://doi.org/10.1177/09564624211023015	New York City metropolitan health system, New York, United States	10,202 inpatients diagnosed with COVID-19; 99 had HIV	Hospitalized patients with HIV and COVID-19 coinfection did not have worse outcomes than the general population. PWH with CD4% < 14 or not on HIV treatment had higher mortality rates. PWH on IL-6 inhibitors had lower mortality rates. PWH given antifungal medications, hydroxychloroquine, antibiotics, steroids, and vasopressors had higher mortality rates.
[14] Van Dyke RB, Chadwick EG, Hazra R, William PL, Seage GR III. The PHACS SMARTT Study: Assessment of the safety of in utero exposure to antiretroviral drugs. Front Immunol. 2016;7:199 https://doi.org/10.3389/fimmu.2016.00199	22 sites across the United States, including Puerto Rico	>3,500 HIV-exposed but uninfected infants and children	The study seeks to determine the safety of in utero exposure to antiretrovirals and to estimate the incidence of adverse events. Overall, the study found little evidence for serious adverse events resulting from in utero exposure to antiretrovirals, though notes that several concerning findings as well as new antiretrovirals should be studied further.
[15] Tassiopoulos K, Patel K, Alperen J, Kacanek D, Ellis A, Berman C, Allison SM, Hazra R, Barr E, Cantos K, Siminski S, Massagli M, Bauermeister J, Siddiqui DQ, Puga A, Van Dyke R, Seage GR III. Following young people with perinatal HIV infection from adolescence into adulthood: the protocol for PHACS AMP Up, a	14 clinical sites across the United States, including Puerto Rico	850 (600 perinatally HIV-infected, 250 for comparison)	Long term follow-up of young adults who were perinatally infected with HIV to determine medical, social, and behavioral outcomes. Examples include malignancies, metabolic complications, substance use, mental health

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prospective cohort study. BMJ Open. 2016 Jun 9;6(6):e011396. https://doi.org/10.1136/bmjopen-2016-011396			
[16] Worldometer. 2022. COVID-19 Coronavirus Pandemic. https://www.worldometers.info/coronavirus/ Accessed 3 Sep 2025.	Global		Last updated April 13, 2024; as of that date—with the limit of the multifactorial difficulties with tracking total global cases—there were 704,753,890 COVID-19 cases and 7,010,681 deaths.
[17] Dong E, Du H, Gardner L. An interactive web-based dashboard to track COVID-19 in real time. Lancet Inf Dis. 2020;20(5):533-534. https://doi.org/10.1016/S1473-3099(20)30120-1	Global		Johns Hopkins developed an interactive web-based dashboard to track COVID-19 cases, deaths, and recoveries in real time for reference.
[18] Lau CSM, Johns J, Merlene S, Kanya S, Taber A, Melander D, Rodgers S, Prichard P, Shukla V. Trends in COVID-19 testing and positivity rates from a mobile testing program in the Phoenix Metropolitan area. J Community Health. 2021;46:1221–5. https://doi.org/10.1007/s10900-021-01011-1	Phoenix, Arizona, United States	32,234 tests performed; 3,654 were positive	Positivity rate of 11.3%; higher positivity rates in December 2020 and January 2021 when compared to February-April 2021 were attributed to the holiday season.
[19] D'Souza G, Tong W, Gustafson D, Alcaide ML, Lahiri CD, Sharma A, French AL, Palella FJ, Kempf MC, Mimiaga MJ, Ramirez C, Kassaye S, Rinaldo CR, Brown TT, Tien PC, Adimora AA. SARS-CoV-2 infection among people living with HIV compared with people without HIV: Survey results from the MACS-WIHS combined cohort study. J Acquir Immune Defic Syndr. 2022;89:1–8. https://doi.org/10.1097/qai.0000000000002822	13 clinical sites across the United States participating in MACS/WIHS Combined Cohort Study	Of 4,330 participants, 3,671 completed at least one survey.	Despite similar COVID-19 testing and physical distancing profiles among HIV serostatus, PLWH were more likely to have a positive result.
[20] Chadha P, Chadha H, Shukla V, Prichard P, Lau CSM. Mobile COVID-19 testing program in Phoenix: A retrospective observational cohort study of results, trends, and positivity rates. Medicine (Baltimore). 2023;102:e35451. https://doi.org/10.1097/md.0000000000035451	Phoenix, Arizona, United States	72,827	Within a mobile testing unit spanning December 2020 – April 2022, 72,827 COVID-19 tests were performed. 8,666 of those tests were positive. Case counts and positivity rates increased over the fall and winter months, peaking in January 2021 (13.96%) and January 2022 (24.84%).
[21] Irons NJ, Raftery AE. Estimating SARS-CoV-2 infections from deaths, confirmed cases, tests, and random surveys. Proc Natl Acad Sci U S A. 2021;118:e2103272118. https://doi.org/10.1073/pnas.2103272118	Indiana and Ohio, United States		Uses a Bayesian framework to estimate COVID-19 prevalence using deaths, confirmed cases, tests, and random surveys.

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[22] Barrera CM, Hazell M, Chamberlain AT, Gandhi NR, Onwubiko U, Liu CY, Prieto J, Khan F, Shah S. Retrospective cohort study of COVID-19 among children in Fulton County, Georgia, March 2020-June 2021. BMJ Paediatr Open. 2021;5:e001223. https://doi.org/10.1136/bmjpo-2021-001223	Fulton County, Georgia, United States	10,437 confirmed COVID-19 cases among children 0-18	The proportion of pediatric cases rose from 1.1% in April 2020 to 21.6% in April 2021. Case rates and test rates were highest among high school aged children. Low COVID-19 testing rates likely skewed early data. When broader community incidence rates increased, pediatric incidence rates increased as well.
[23] Gaglioti AH, Li C, Douglas MD, Baltrus PT, Blount MA, Zahidi R, Caplan LS, Willock RJ, Fasuyi OB, Mack DH. Population-level disparities in COVID-19: Measuring the independent association of the proportion of Black population on COVID-19 cases and deaths in US counties. J Public Health Manag Pract. 2021;27:268–77. https://doi.org/10.1097/phh.0000000000001354	3,044 counties across the United States		The proportion of non-Hispanic Black people in a county was positively associated with county COVID-19 case and death rates.
[24] Bigelow BF, Saxton RE, Flores-Miller A, Mostafa HH, Loss MJ, Phillips KH, Moore AM, Hale WD, Tolson TM, McCann NS, Catlett CL, Golden SH, Clark JM, Page KR. Community testing and SARS-CoV-2 rates for Latinxs in Baltimore. Am J Prev Med. 2021;60:e281–6. https://doi.org/10.1016/j.amepre.2021.01.005	Baltimore, Maryland, United States	1,786	Of 1,786 patients, 57.5% were Latinx, 31.2% were non-Hispanic White, 5.9% were non-Hispanic Black, and 5.3% were non-Hispanic other. The overall COVID-19 positivity rate at this community testing center was 10 times higher among Latinx (31.5%) than among non-Hispanic Whites (3.4%).
[25] Kaufman HW, Niles JK, Nash DB. Disparities in SARS-CoV-2 positivity rates: Associations with race and ethnicity. Popul Health Manag. 2021;24:20–6. https://doi.org/10.1089/pop.2020.0163	Across the United States	2,331,175	Communities with the highest proportion of Black non-Hispanic and Hispanic populations have the highest COVID-19 NAAT positivity rates, even after controlling for other risk factors.
[26] Allan-Blitz LT, Goldbeck C, Hertlein F, Turner I, Klausner JD. Association of lower socioeconomic status and SARS-CoV-2 positivity in Los Angeles, California. J Prev Med Public Health. 2021;54:161–5. https://doi.org/10.3961/jpmph.21.126	Los Angeles, California, United States	2,141,127	Residence in Zip codes with lower average annual household income, lower rates of employment, or lower rates of health insurance was associated with a higher COVID-19 positivity rate.
[27] Chan PY, Greene SK, Lim SW, Fine A, Thompson CN. Persistent disparities in SARS-CoV-2 test percent positivity by neighborhood in New York City, March 1-July 25, 2020. Ann Epidemiol. 2021;63:46–51. https://doi.org/10.1016/j.annepidem.2021.07.032	New York City, New York, United States	177 neighborhoods	COVID-19 percent positivity was positively correlated with neighborhood racial and ethnic characteristics as well as socioeconomic status, including the proportion of the population who were Latino and Black non-Latino, uninsured, Medicaid enrollees, transportation workers, or had low educational attainment.
[28] Oates GR, Juarez LD, Horswell R, Chu S, Miele L, Fouad MN, Curry WA, Fort D, Hillegass WB, Danos DM. The association between neighborhood social vulnerability and COVID-19 testing, positivity, and	Alabama and Louisiana, United States	1160 Alabama and 1105 Louisiana census tracts	In both states, overall vulnerability and vulnerability themes (racial/ethnic minorities and disadvantaged housing conditions without transportation) were associated with higher COVID-19 positivity rates.

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incidence in Alabama and Louisiana. J Community Health. 2021;46:1115–23. https://doi.org/10.1007/s10900-021-00998-x			
[29] Dai CL, Kornilov SA, Roper RT, Cohen-Cline H, Jade K, Smith B, Heath JR, Diaz G, Goldman JD, Magis AT, Hadlock JJ. Characteristics and factors associated with coronavirus disease 2019 infection, hospitalization, and mortality across race and ethnicity. Clin Infect Dis. 2021;73:2193–204. https://doi.org/10.1093/cid/ciab154	A large health system spanning California, Oregon, and Washington, United States	629,953	56,645 individuals tested positive. Major healthcare disparities were evident, especially among Hispanics who tested positive at a higher rate (34.3% of positive tests but only 13.4% of tests), required excess hospitalization and mechanical ventilation, and had higher odds of in-hospital mortality despite younger age.
[30] Elbadawi A, Elgendy IY, Joseph D, Eze-Nliam C, Rampersad P, Ouma G, Bhandari R, Kirksey L, Chaudhury P, Chung MK, Kalra A, Mehta N, Bartholomew JR, Sahai A, Svensson LG, Cameron SJ. Racial differences and in-hospital outcomes among hospitalized patients with COVID-19. J Racial Ethn Health Disparities. 2022;9:2011–8. https://doi.org/10.1007/s40615-021-01140-2	Cleveland Clinic facilities in Northeast Ohio and South Florida, United States.	3,678	866 of the 3,678 patients were hospitalized. 55.4% were Caucasian, 29.5% were Black, 3.3% were Hispanic, and 4.7% other racial groups. Hospitalization rates were highest for Black patients (36.6%), followed by other (28.3%), Caucasian (24.4%), and then Hispanic (10.7%). Patients with COVID-19 did exhibit some racial variations in clinical presentation, laboratory data, and requirements for advanced monitoring and cardiopulmonary support, but these nuances did not dramatically alter in-hospital outcomes.
[31] Gasper MA, Happel AU, Dzanibe S, Slyker J, Jaspan HB. Immunology of infants who are HIV-exposed uninfected in the parental combination antiretroviral therapy era. Lancet HIV. 2025 Nov;12(11):e789-e801. https://doi.org/10.1016/S2352-3018(25)00184-5 Epub 2025 Aug 27. PMID: 40885205.	Kenya, South Africa, Uganda, Belgium		Heightened inflammation, altered gut microbiome, and differences in innate and adaptive immunology in infants who are HEU, despite improved maternal access to ARVs in pregnancy and post-partum, continue to increase infectious morbidity risk in this population.