Variations in state-level SARS-COV-2 testing recommendations in the United States, March-July 2020

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Abstract

Testing recommendations for COVID-19 in the United States have varied by state and over time in the spring and summer of 2020. As of July 2020, 16 states recommended testing asymptomatic members of the general public. The rate of COVID-19 tests reported in each state correlates with more permissive testing recommendations and with higher epidemic intensity. Higher per capita testing was associated with more complete reporting of COVID-19 deaths, which is a fundamental requirement for analyzing the pandemic. Coordinated, consistent guidelines for COVID-19 testing should be a high priority for state and national health systems.
Introduction

SARS-CoV-2, the virus that causes COVID-19, was declared a global pandemic by the World Health Organization in March 2020. Worldwide, responses to the pandemic have varied and had varying success. In the United States, each state determined testing guidelines, lockdown procedures, and reopening procedures individually. The Centers for Disease Control and Prevention also maintained testing recommendations and guidelines, but states and localities were largely responsible for their own policies. The COVID-19 pandemic in the United States is ongoing, costing around 150,000 lives by the end of July 2020.

Testing for COVID-19 has been a continual hurdle in the United States. Supply chain issues, doubts about testing accuracy and methodology, and conflicting guidance from federal, state and local officials about testing have all interfered with testing efforts. State governments and health departments established testing guidelines in March 2020, which were sometimes augmented by local governmental health departments. The turnaround time for test results has been strained, and resources for individuals to sustain their household resources while remaining isolated or quarantined while awaiting the result of a test have not been widely available.

Here we describe the changing recommendations for COVID-19 testing to the general public in the United States in the spring and summer of 2020 and the consequences of these changes for obtaining accurate statistics about the pandemic.

Methods

The objective of this analysis was to establish whether varying the state-level COVID-19 testing guidelines had any impact on the actual number of tests performed, and whether the number of tests performed was related to the rate of recognizing COVID-19 deaths as a cause of excess mortality (reported COVID-19 deaths/excess pneumonia + influenza + COVID-19 deaths). COVID-19 testing guidelines were documented from the websites of the departments of health in each of the 50 states and the District of Columbia once monthly from March-July 2020 (Supplemental Table 1). We ranked recommendations to tests by the general public (as opposed to members of specific named risk groups) by assigning 0= criterion not specified, 1= accessible to people with a negative influenza test, 2= accessible to people with symptoms consistent with COVID-19 illness, 3= accessible to anyone, including asymptomatic people.

Univariate correlations between testing recommendation score, tests per capita, and percentage of positive tests were analyzed with Spearman correlation tests. We evaluated relationships between the number of COVID-19 tests performed per capita, testing recommendations score, and epidemic intensity (defined as excess pneumonia+influenza+COVID-19 deaths per capita) with a Poisson regression model. Total COVID-19 tests performed in each state was the outcome variable, offset by the log of the total population of each state, with the testing recommendations score and the log of epidemic intensity as the independent variables.
The number of excess PIC deaths per state and the reported number of COVID-19 deaths were obtained from the open-access data repository describing excess deaths during the COVID-19 outbreak (https://github.com/weinbergerlab/excess_pi_covid). Final data were obtained August 15, 2020.

Positive tests and the overall number of tests in each state were collected from the website of The COVID Tracking Project (https://covidtracking.com/). Population data were taken from the United States Census Bureau’s 2019 estimates. R (R: A language and environment for statistical computing, version 3.6.1. R Foundation for Statistical Computing, Vienna, Austria, https://www.R-project.org/.) was used for statistical analyses.

Results

State Testing Guidelines

From March to July 2020, recommendations of COVID-19 testing for the general public varied between states and over time (Figure 1), as did testing prioritization for identified risk groups (Supplemental Figure 1).

The earliest available state-level data ranged from March 1 (in Michigan, Rhode Island, and Washington) to March 12 (in Massachusetts), while the remaining 47 states began reporting COVID-19 data between March 4 and March 7. March data included all March dates – April 4; April data included April 5 – May 2; May data included May 3 – June 6; June data included June 7 – July 4; July data included records from July 5 – 31.

As of July, 16 states recommended that asymptomatic members of the general public be tested for COVID-19. 9 states actively recommended against the testing of asymptomatic people; 3 of which then reversed this recommendation in July. South Dakota also recommended against seeking a test if people were experiencing symptoms, citing the
lack of effective COVID-19 therapy as a contraindication for testing. Most states (35/51) changed their testing recommendations twice between March and July. Only Oklahoma did not change their testing criteria, though the state health department website specifies that private testing facilities have their own criteria.

**Testing per capita, testing recommendations, and epidemic intensity**

Reported COVID-19 tests per capita increased steadily, though unevenly, while the percentage of positive tests varied widely between states (Figure 2) from March to June. The minimum percentage of positive tests for a single month was 0.8% in May in Alaska; the maximum was 47% in April in New Jersey. Overall, testing per capita increased, as did the number of states recommending COVID-19 tests to the general public (Figure 3).

More permissive testing recommendations correlated independently with a higher number of tests reported *per capita* and with a lower percentage of positive tests. In the Poisson model, both more permissive testing recommendations and higher epidemic intensity were associated with higher rates of testing.
Finally, testing *per capita* was weakly correlated with the completeness of death reporting (COVID-19 deaths out of excess pneumonia+influenza+COVID-19 deaths) from March-May, 2020 (Figure 4). As testing increased within a state, there was a smaller gap between reported COVID-19 deaths and the completeness of death reporting. The relationship became more muddled when the analysis was expanded to March-July (Supplemental Figure 2), indicating that there may be several factors influencing the completeness of death reporting.

Discussion

COVID-19 testing policies changed frequently, and unevenly, in the spring and summer of 2020 in the United States. Tests per 1000 population reported each month increased across the board. Testing recommendations to the general public also increased, with 16 states allowing for asymptomatic members of the general public to be tested as of July 2020. The rate of COVID-19 testing was associated with both testing recommendations and epidemic intensity, indicating that both are important measures for improving data completeness during the pandemic. In the early course of the pandemic, March-May, testing per capita and completeness of mortality data both increase, though afterwards this apparent relationship becomes less clear. It is possible that other characteristics of healthcare systems in each state could influence both the testing rates and completeness of reporting (i.e. supply chain or personnel issues). The variation in data completeness seen in July may be due to reporting delays, and thus might decrease as mortality data are updated.

States with a high percentage of positive tests and broad testing recommendations may be experiencing a high burden of COVID-19. Coupling this with an increase in epidemic intensity may indicate perturbations in the healthcare system, i.e. shortages in material or personnel needed to complete a test. Several new testing protocols \(^{13-15}\) aimed at alleviating these shortfalls have been developed, and their widespread use could decrease the likelihood of a COVID-19 death remaining undetected.
Improving surveillance and data quality during the first months of the COVID-19 pandemic has been challenging for state health departments, many of which have struggled with staffing, funding, and even threats to public-facing employees. However, messaging around the utility of testing has been inconsistent at both the federal and state level, with three states actively recommending against testing asymptomatic people and then reversing this policy to encourage all residents to get tested. Consistent messaging from public health authorities would be beneficial, particularly in light of the continuing problem of misinformation during the COVID-19 pandemic.

There are several limitations to these data and this analysis. The criteria established by state health departments are not the single, definitive authority for determining COVID-19 testing recommendations and prioritization. Additional rules established by local governments, private clinics and laboratories have augmented or superseded these guidelines. Several states include vague, catch-all terms such as “clinician judgement” which also likely affect how many individuals are able to be tested. Further complicating the relationship between state-level testing policy and data on reported COVID-19 tests and cases, the number of reported tests is not differentiated between individuals who are tested once and individuals who are tested multiple times (e.g. as part of a screening program at their place of employment), which may inflate the number of tests when comparing tests per 1000 residents. Establishing a comprehensive set of COVID-19 testing guidelines has thus far proved a challenge for state health departments. Despite frequent changes and inconsistent application of these guidelines, COVID-19 testing recommendations scores still correlated with the number of tests performed, demonstrating that these guidelines are reflective of on-the-ground testing practices. The correlation between testing intensity and the completeness of death reporting could be influenced by other time varying factors, such as changes in the guidelines for coding deaths as due to COVID-19.

When there is a high percentage of positive tests, testing recommendations and testing per capita should be expanded, so that chains of transmission can be identified, and infectious individuals can be isolated. Similarly, when there is high epidemic intensity, testing per capita and testing recommendations should be increased. Both a high number of excess deaths and a high percentage of positive COVID-19 tests can be used as indicators of high COVID-19 disease burden and provide evidence of epidemic intensity. Testing asymptomatic people is crucial to preventing outbreaks, since recent reports have shown that up to 88% of infected people do not have any symptoms at the time of testing. Novel methods of testing, and their potential to improve epidemic tracking and to relieve supply chain pressure should be further explored. Controlling COVID-19 outbreaks is possible, as evidenced by the pandemic responses in, among others, South Korea, Vietnam, Germany, and New Zealand, and necessary. Serious, consistent effort and financial support are needed to enable public health agencies and health care workers to find, isolate, and treat infected people. Delaying the expansion of public health resources will prolong viral transmission and result in unacceptable increases in morbidity and mortality.

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Supplementary Materials

Supplemental Table 1. State health department websites, used as the source to determine state-level COVID-19 testing guidelines.
| State | Source(s) |
|-------|-----------|
| AL    | https://www.alabamapublichealth.gov/covid19/patients.html |
| AK    | http://dhss.alaska.gov/dph/Epi/SiteAssets/Pages/HumanCoV/AKCOVIDTestingGuidance.pdf |
| AZ    | https://www.azdhs.gov/documents/preparedness/epidemiology-disease-control/infectious-diseases-services/coronavirus/arizona-state-public-health-laboratory-testing-matrix.pdf |
| AR    | https://www.healthy.arkansas.gov/programs-services/topics/covid-19-guidance-for-getting-tested |
| CA    | https://www.cdph.ca.gov/Programs/CID/DCDC/Pages/COVID-19/Expanding-Access-to-Testing-Updated-Interim-Guidance-on-Prioritization-for-COVID-19-Laboratory-Testing-0501.aspx |
| CO    | https://covid19.colorado.gov/covid-19-in-colorado/about-covid-19/testing-for-covid-19 |
| CT    | https://portal.ct.gov/Coronavirus/Covid-19-Knowledge-Base/COVID-19-Testing |
| DE    | https://coronavirus.delaware.gov/testing/testing-frequently-asked-questions/ |
| DC    | https://coronavirus.dc.gov/testing |
| FL    | https://floridahealthcovid19.gov/health-care-providers/ |
| GA    | https://dph.georgia.gov/covid-19-testingdirect-patient-lines |
| HI    | https://health.hawaii.gov/coronavirusdisease2019/for-clinicians/evaluating-puis/ |
| ID    | https://rebound.idaho.gov/wp-content/uploads/testing-recommendations.pdf |
| IL    | https://www.dph.illinois.gov/topics-services/diseases-and-conditions/diseases-a-z-list/coronavirus/health-care-providers |
| IN    | https://www.coronavirus.in.gov/files/IN-COVID-19_FAQforPublic%207.3.20.pdf |
| IA    | https://covidtesting.shl.uiowa.edu/ |
| KS    | https://www.coronavirus.kdheks.gov/DocumentCenter/View/393/COVID-19-Testing-Approval-Form-fillable-PDF---4-21-20 |
| KY    | https://chfs.ky.gov/Pages/search.aspx?terms=covid+test&affiliateld=CHFS |
| LA    | http://ldh.la.gov/assets/oph/Coronavirus/resources/TestingIsolationGuidelines.pdf |
| ME    | https://www.maine.gov/tools/whatsnew/index.php?topic=DHS+Press+Releases&id=2657874&v=dhhs_article_2020 |
| MD    | https://phpa.health.maryland.gov/Documents/coronavirus_testing_FAQ.pdf |
| MA    | https://www.mass.gov/info-details/about-covid-19-testing#should-i-be-tested? |
| MI    | https://www.michigan.gov/coronavirus/0,9753,7-406-98163-530157--,00.html |
| MN    | https://www.health.state.mn.us/diseases/coronavirus/symptoms.html#test |
| MS    | https://msdh.ms.gov/msdhsite/_static/14.21866.420.html |
| MO    | https://health.mo.gov/emergencies/ert/alertsadvisories/pdf/update42220.pdf |
| MT    | https://dphhs.mt.gov/publichealth/cdepi/diseases/coronavirusmt |
| NE    | http://dhhs.ne.gov/Documents/COVID-19%20Guidance%20To%20Public%20And%20Testing.pdf |
| NH    | https://covid19testingne.co1.qualtrics.com/jfe/form/SV_cJa8ezYVRQfZRCI |
| State | Testing Website |
|-------|-----------------|
| NV    | https://nvhealthresponse.nv.gov/find-covid-19-testing-in-nevada/ |
| NH    | https://business.nh.gov/DOS_COVID19Testing/ |
| NJ    | https://covid19.nj.gov/pages/testing |
| NM    | https://cv.nmhealth.org/public-health-screening-and-testing/location-details/ |
| NY    | https://coronavirus.health.ny.gov/covid-19-testing |
| NC    | https://covid19.ncdhhs.gov/about-covid-19/testing |
| ND    | https://www.health.nd.gov/sites/www/files/documents/Files/MSS/coronavirus/2020_6_16_COVID_PCR_Guidance.pdf |
| OH    | https://coronavirus.ohio.gov/wps/portal/gov/covid-19/families-and-individuals/MHSF/ |
| OK    | https://coronavirus.health.ok.gov/articles/criteria-guide-evaluation-and-laboratory-testing-covid-19-clinicians-and-laboratories |
| OR    | https://sharedsystems.dhsoha.state.or.us/DHSForms/Served/le2267.pdf |
| PA    | https://www.health.pa.gov/topics/disease/coronavirus/Pages/Guidance/Testing-Factsheet.aspx |
| RI    | https://health.ri.gov/covid/testing/ |
| SC    | https://www.scdhec.gov/sites/default/files/media/document/10466-DHU-06-19-2020-COVID-19.pdf |
| SD    | https://doh.sd.gov/documents/COVID19/COVID_TestingFacts.pdf |
| TN    | https://www.tn.gov/governor/covid-19/get-tested.html |
| TX    | https://dshs.texas.gov/coronavirus/public-health.aspx |
| UT    | https://coronavirus-download.utah.gov/Health/UDOH%20HAN%20COVID_04142020_Statewide_Guidance%20%281%29.pdf |
| VT    | https://www.healthvermont.gov/response/coronavirus-covid-19/testing-covid-19 |
| VA    | https://www.vdh.virginia.gov/coronavirus/health-professionals/vdh-updated-guidance-on-testing-for-covid-19/ |
| WA    | https://www.doh.wa.gov/Emergencies/NovelCoronavirusOutbreak2020COVID19/TestingforCOVID19 |
| WV    | https://dhhr.wv.gov/COVID-19/pages/testing.aspx |
| WI    | https://www.dhs.wisconsin.gov/covid-19/testing.htm |
| WY    | https://health.wyo.gov/department-offers-testing-update-advice-for-wyoming/ |
Supplemental Figure 1. State-level COVID-19 testing recommendations for selected risk groups, March-July 2020. Criteria for (A) Healthcare/Essential Workers, (B) High-Risk Populations, (C) Long-term Care Facility Residents or Workers, (D) Associates of Known COVID-19 Case, (E) Travelers to High-Risk Areas, and (F) Hospitalized Patients were scaled as follows: 0 = Criterion not listed, 1 = Negative influenza test required, 2 = Symptomatic individual, 3 = Any individual.

### A. Healthcare/Essential Workers

| State | Mar | Apr | May | Jun | Jul |
|-------|-----|-----|-----|-----|-----|
| AL    | 0   | 3   | 3   | 3   | 3   |
| AZ    | 0   | 3   | 3   | 3   | 3   |
| CA    | 0   | 3   | 3   | 3   | 3   |
| CO    | 0   | 3   | 3   | 3   | 3   |
| CT    | 0   | 3   | 3   | 3   | 3   |
| DC    | 0   | 3   | 3   | 3   | 3   |
| FL    | 0   | 3   | 3   | 3   | 3   |
| GA    | 0   | 3   | 3   | 3   | 3   |
| HI    | 0   | 3   | 3   | 3   | 3   |
| IL    | 0   | 3   | 3   | 3   | 3   |
| IN    | 0   | 3   | 3   | 3   | 3   |
| IA    | 0   | 3   | 3   | 3   | 3   |
| KY    | 0   | 3   | 3   | 3   | 3   |
| LA    | 0   | 3   | 3   | 3   | 3   |
| MI    | 0   | 3   | 3   | 3   | 3   |
| MN    | 0   | 3   | 3   | 3   | 3   |
| MS    | 0   | 3   | 3   | 3   | 3   |

### B. High-Risk Populations

| State | Mar | Apr | May | Jun | Jul |
|-------|-----|-----|-----|-----|-----|
| AL    | 0   | 3   | 3   | 3   | 3   |
| AZ    | 0   | 3   | 3   | 3   | 3   |
| CA    | 0   | 3   | 3   | 3   | 3   |
| CO    | 0   | 3   | 3   | 3   | 3   |
| CT    | 0   | 3   | 3   | 3   | 3   |
| DC    | 0   | 3   | 3   | 3   | 3   |
| FL    | 0   | 3   | 3   | 3   | 3   |
| GA    | 0   | 3   | 3   | 3   | 3   |
| HI    | 0   | 3   | 3   | 3   | 3   |
| IL    | 0   | 3   | 3   | 3   | 3   |
| IN    | 0   | 3   | 3   | 3   | 3   |
| IA    | 0   | 3   | 3   | 3   | 3   |
| KY    | 0   | 3   | 3   | 3   | 3   |
| LA    | 0   | 3   | 3   | 3   | 3   |
| MI    | 0   | 3   | 3   | 3   | 3   |
| MN    | 0   | 3   | 3   | 3   | 3   |
| MS    | 0   | 3   | 3   | 3   | 3   |

### C. Long-term Care Facility Work/Reside

| State | Mar | Apr | May | Jun | Jul |
|-------|-----|-----|-----|-----|-----|
| AL    | 0   | 3   | 3   | 3   | 3   |
| AZ    | 0   | 3   | 3   | 3   | 3   |
| CA    | 0   | 3   | 3   | 3   | 3   |
| CO    | 0   | 3   | 3   | 3   | 3   |
| CT    | 0   | 3   | 3   | 3   | 3   |
| DC    | 0   | 3   | 3   | 3   | 3   |
| FL    | 0   | 3   | 3   | 3   | 3   |
| GA    | 0   | 3   | 3   | 3   | 3   |
| HI    | 0   | 3   | 3   | 3   | 3   |
| IL    | 0   | 3   | 3   | 3   | 3   |
| IN    | 0   | 3   | 3   | 3   | 3   |
| IA    | 0   | 3   | 3   | 3   | 3   |
| KY    | 0   | 3   | 3   | 3   | 3   |
| LA    | 0   | 3   | 3   | 3   | 3   |
| MI    | 0   | 3   | 3   | 3   | 3   |
| MN    | 0   | 3   | 3   | 3   | 3   |
| MS    | 0   | 3   | 3   | 3   | 3   |

### D. Assoc. with Known COVID-19 Case

| State | Mar | Apr | May | Jun | Jul |
|-------|-----|-----|-----|-----|-----|
| AL    | 0   | 3   | 3   | 3   | 3   |
| AZ    | 0   | 3   | 3   | 3   | 3   |
| CA    | 0   | 3   | 3   | 3   | 3   |
| CO    | 0   | 3   | 3   | 3   | 3   |
| CT    | 0   | 3   | 3   | 3   | 3   |
| DC    | 0   | 3   | 3   | 3   | 3   |
| FL    | 0   | 3   | 3   | 3   | 3   |
| GA    | 0   | 3   | 3   | 3   | 3   |
| HI    | 0   | 3   | 3   | 3   | 3   |
| IL    | 0   | 3   | 3   | 3   | 3   |
| IN    | 0   | 3   | 3   | 3   | 3   |
| IA    | 0   | 3   | 3   | 3   | 3   |
| KY    | 0   | 3   | 3   | 3   | 3   |
| LA    | 0   | 3   | 3   | 3   | 3   |
| MI    | 0   | 3   | 3   | 3   | 3   |
| MN    | 0   | 3   | 3   | 3   | 3   |
| MS    | 0   | 3   | 3   | 3   | 3   |

### E. Traveler to High-Risk Area

| State | Mar | Apr | May | Jun | Jul |
|-------|-----|-----|-----|-----|-----|
| AL    | 0   | 3   | 3   | 3   | 3   |
| AZ    | 0   | 3   | 3   | 3   | 3   |
| CA    | 0   | 3   | 3   | 3   | 3   |
| CO    | 0   | 3   | 3   | 3   | 3   |
| CT    | 0   | 3   | 3   | 3   | 3   |
| DC    | 0   | 3   | 3   | 3   | 3   |
| FL    | 0   | 3   | 3   | 3   | 3   |
| GA    | 0   | 3   | 3   | 3   | 3   |
| HI    | 0   | 3   | 3   | 3   | 3   |
| IL    | 0   | 3   | 3   | 3   | 3   |
| IN    | 0   | 3   | 3   | 3   | 3   |
| IA    | 0   | 3   | 3   | 3   | 3   |
| KY    | 0   | 3   | 3   | 3   | 3   |
| LA    | 0   | 3   | 3   | 3   | 3   |
| MI    | 0   | 3   | 3   | 3   | 3   |
| MN    | 0   | 3   | 3   | 3   | 3   |
| MS    | 0   | 3   | 3   | 3   | 3   |

### F. Hospitalized Patients

| State | Mar | Apr | May | Jun | Jul |
|-------|-----|-----|-----|-----|-----|
| AL    | 0   | 3   | 3   | 3   | 3   |
| AZ    | 0   | 3   | 3   | 3   | 3   |
| CA    | 0   | 3   | 3   | 3   | 3   |
| CO    | 0   | 3   | 3   | 3   | 3   |
| CT    | 0   | 3   | 3   | 3   | 3   |
| DC    | 0   | 3   | 3   | 3   | 3   |
| FL    | 0   | 3   | 3   | 3   | 3   |
| GA    | 0   | 3   | 3   | 3   | 3   |
| HI    | 0   | 3   | 3   | 3   | 3   |
| IL    | 0   | 3   | 3   | 3   | 3   |
| IN    | 0   | 3   | 3   | 3   | 3   |
| IA    | 0   | 3   | 3   | 3   | 3   |
| KY    | 0   | 3   | 3   | 3   | 3   |
| LA    | 0   | 3   | 3   | 3   | 3   |
| MI    | 0   | 3   | 3   | 3   | 3   |
| MN    | 0   | 3   | 3   | 3   | 3   |
| MS    | 0   | 3   | 3   | 3   | 3   |
Supplemental Figure 2: Monthly COVID-19 tests per capita and completeness of death reporting (COVID-19 deaths/excess pneumonia + influenza + COVID-19 deaths) by state, March-July, 2020. Size of bubble is scaled to COVID-19 deaths per 100,000 people. States from March-July are shaded yellow-dark red. Lines connect individual states over time and are shaded corresponding to COVID-19 cases per capita.