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Early Data on Predictors of COVID-19 Treatment Frequency at Community Health Centers

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Abstract

Introduction: Federally-funded community health centers (CHCs) serve on the front lines of the COVID-19 pandemic, providing essential COVID-19 testing and care for vulnerable patient populations. Overlooked in the scholarly literature is a description of how different characteristics and vulnerabilities shaped COVID-19 care delivery at CHCs in the first year of the pandemic. Our research objective was to identify organization- and state-level factors associated with more or fewer COVID-19 care and testing visits at CHCs in 2020. **Methods:** Multilevel random intercept regression models examined associations among organization and state-level predictor variables and the frequency of COVID-19 care and testing visits at CHCs in 2020. The study sample included 1267 CHCs across the 50 states and the District of Columbia. **Results:** The average CHC provided 932 patient visits for COVID-19-related care in 2020. Yet, the CHC's role in delivering COVID-19 services proved as diverse as the populations and localities CHCs serve. For example, after adjusting for other factors, each percentage-point increase in a CHC's Hispanic patient population size was associated with a 1.3% increase in the frequency of patient visits for COVID-19 care in 2020 ($P < .001$). Serving a predominantly rural patient population was associated with providing significantly fewer COVID-19-related care visits ($P = .002$). Operating in a state that enacted a mask-wearing policy in 2020 was associated with a 26.2% lower frequency of COVID-19 testing visits at CHCs in 2020, compared to CHCs operating in states without mask-wearing policies ($P = .055$). **Conclusions:** In response to the pandemic, the federal government legislated funding to help CHCs address challenges associated with COVID-19 and provide services to medically-underserved patient populations. Policymakers will likely need to provide additional support to help CHCs address population-specific vulnerabilities affecting COVID-19 care and testing delivery, especially as highly contagious COVID-19 variants proliferate (eg, Delta and Omicron).

Keywords
COVID-19, primary care, vulnerable populations, community health

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Introduction

In the US, federally-funded community health centers (CHCs) work to improve access to primary health services and combat health disparities historically experienced by patients living in communities with lower socioeconomic status (SES).[1,2] Like most US health care providers, CHCs faced new operational and financial challenges caused by the COVID-19 pandemic. Despite experiencing an estimated 26% decline in patient visits and an estimated $5.9 billion decline in patient revenue in 2020,[3,4] CHCs assumed a crucial role in providing COVID-19 testing and care in low-SES communities across the US, serving over 29 million patients in 2020.[5]

Although CHCs serve on the front lines of the pandemic, not all CHCs share the same organizational characteristics or provide the same services. Moreover, not all CHC patient populations share similar health care needs and

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vulnerabilities. Overlooked in the scholarly literature is a description of how different characteristics and vulnerabilities may have shaped COVID-19 care delivery at CHCs in the first year of the pandemic. This knowledge gap is concerning. The COVID-19 pandemic imposed new pressures upon CHCs, likely impacting their already fragile balance sheets and their ability to provide high-quality services to different vulnerable patient populations during the pandemic,[6-8] including low-SES and racial and ethnic minority patients. However, little is known about which organizational or contextual factors may have worsened or alleviated the burden of COVID-19 care delivery at CHCs.

To our knowledge, this is one of the first studies to examine COVID-19 care delivery at CHCs and describe predictors of COVID-19 care and testing frequency at CHCs in the first year of the pandemic. Our research objective was to identify organization- and state-level factors associated with more or fewer COVID-19 care and testing visits at CHCs in 2020. Findings from our multilevel regression analyses offer important insights as CHCs continue to navigate the pandemic and as highly contagious COVID-19 variants proliferate (eg, Delta and Omicron).

Methods

Data and Sample

The 2020 Uniform Data System (UDS) (calendar year from January 1 to December 31) was the primary data source for this observational study. The Health Resources and Services Administration (HRSA) collects the UDS data annually on the patient characteristics, service utilization, and organizational features of all CHCs. Beginning in 2020, HRSA collected new data on novel coronavirus (SARS-CoV2) for all CHCs. This study presents one of the first analyses of the most recent and available UDS data, providing systematic insight to the reader about COVID-19 care delivery at CHCs in 2020. For purposes described below, data from the Bureau of Labor Statistics (BLS), Ballotpedia, and the New York Times COVID-19 data repository were also merged into our analytic file.

The CHC was the unit of analysis. To conduct complete case analysis, the final analytic sample included 1267 CHCs, representing 94.4% of CHCs in operation in the 50 states and the District of Columbia in 2020.

Dependent Variables

There were 2 dependent variables. Our first dependent variable measured the natural log of the number of patient visits with COVID-19 diagnoses (ICD-10 U07.1) occurring at each CHC in 2020 (ie, normalized). The second dependent variable measured the natural log of the number of patient visits for COVID-19 testing (CPT 87426 and 87635) occurring at each CHC in 2020.

Predictor Variables

We examined 13 predictor variables using data from the UDS, BLS, Ballotpedia, and the New York Times COVID-19 data repository (Table 1).[5,9,10] UDS data were used to construct 10 organization-level predictor variables. We included measures of the size of each CHC's female and youth populations to account for differences in COVID-19 risk by gender and age. We also included measures of the size of each CHC's Hispanic or Latino/a and black or African American (non-Hispanic) patient populations. Recent studies have shown that black and Hispanic patients may have been predisposed to more significant health risks from COVID-19,[7,8] potentially necessitating greater care and testing needs at CHCs. We included measures of the percentages of uninsured patients, patients diagnosed with obesity, and patients diagnosed with depression or mood disorder to account for differences in insurance coverage and health status between CHC patient populations. Given the negative impacts of COVID-19 on rural well-being,[11] as well as evidence of lower vaccination rates among rural residents,[12] we accounted for CHC rurality by including a binary measure equal to 1 if a CHC served a predominantly rural patient population, and equal to 0 if the CHC served a mostly urban patient population. Finally, our regression models included measures of total patient population size and total supplemental funding received for COVID-19-related support in 2020 (eg, Coronavirus Aid, Relief, and Economic Security [CARES] Act) to account for differences in organizational size and COVID-19 testing and care capacity, respectively.

Data from the BLS, Ballotpedia, and the New York Times COVID-19 data repository were used to construct 3 state-level predictor variables. First, we used state-level data measuring the per capita prevalence of COVID-19 at the end of 2020—aggregated from public sources by the New York Times—to account for differences in COVID-19 severity between the states. Second, we used BLS data to include a measure of the unemployment rate for each state and account for differences in state-level economic circumstances. Third, because recent studies have demonstrated that state-issued mask orders were associated with decreases in county-level daily COVID-19 cases,[13] we included a binary variable equal to 1 if a state enacted a mask-wearing policy in 2020, and equal 0 if the state did not enact a mask-wearing policy. State-level policymakers acted to help reduce the spread of COVID-19 and mitigate the burdens imposed by the pandemic on health care providers in their states in 2020. Before the availability of pharmaceutical interventions, the 2 most common and often contentious policies enacted by the states were mask-wearing and stay-at-home orders. Following the advice of both federal and local health experts,[14] 39 states and the District of Columbia enacted policies requiring individuals to wear masks in

Table 1. Characteristics of the Analytic Sample CHCs (n = 1267): 2020.

CHC-level characteristics	
Patient visits for care with COVID-19 diagnosis (mean)	932 (2703)
Patient visits for COVID-19 testing (mean)	3726 (8052)
Non-Hispanic, black patients (mean)	18.5% (22.6)
Hispanic or Latino/a patients (mean)	26.4% (25.6)
Female patients (mean)	56.6% (5.9)
Patients under 18 years old (mean)	22.2% (12.8)
Uninsured patients (mean)	22.9% (17.5)
Percent of patients diagnosed with obesity (mean)	22.0% (17.3)
Percent of patients diagnosed with depression or mood disorder (mean)	10.6% (6.9)
Total patients; 1000s (mean)	21.4 (27.0)
Total supplemental COVID-19 capacity funding; $10 000s (mean)	$98.2 (125.9)
CHCs by patient population rurality	
Urban	736 (58.1%)
Rural	531 (41.9%)
State-level characteristics	
CHCs operating in states that enacted a mask mandate policy	
No mask-wearing policy	261 (20.6%)
Mask-wearing policy enacted in 2020	1006 (79.4%)
Unemployment rate (mean)	8.0% (1.6)
COVID-19 cases per capita (mean; cumulative by December 2020)	0.060 (0.016)

For each continuous variable, unadjusted mean percentages or totals per CHC in 2020 are shown, and standard deviations are shown in parentheses. Categorical variables as described as counts for each category, as well as percentages for each category in parentheses. The CHC was the unit of analysis.

indoor or outdoor public spaces statewide in 2020.[3] Information about each state's mask-wearing policy status was obtained from Ballotpedia, a nonpartisan encyclopedia that catalogs the timing of state-level policy decisions.

Statistical Analysis

Multilevel random intercept regression models examined associations among the organization- and state-level predictor variables and the frequency of COVID-19 care (Model 1) and testing (Model 2) visits at CHCs in 2020. The multilevel model analysis accounted for variation in our 2 dependent variables attributable to the clustering of CHCs within states. An a priori significance level of .05 was established. All analyses were conducted by using Stata MP version 17.1 (College Station, TX).

Results

The average CHC provided 932 patient visits for COVID-19-related care and 3726 patient visits for COVID-19 testing in 2020 (Table 1). The average CHC in our analytic sample treated 21 417 patients during the study. Nearly half (about 44.9%) of the patients served by the CHCs in our sample identified as being Hispanic or Latino/a or black or African American. About 58.1% of the CHCs treated predominantly urban patient populations, and about 20.6% of the CHCs operated in states that never enacted a mask-wearing policy in 2020.

Table 2 shows the estimates from the multilevel random intercept models. Null models excluding right-hand variables were first estimated to determine the appropriateness of the multilevel modeling approach. Likelihood ratio tests led to the rejection of the null hypothesis that the standard deviation of the random intercept of the state-level grouping variable was equal to zero in each model. Non-trivial intraclass correlation coefficients indicated that 16.0% of the variation in the Model 1 dependent variable and 7.1% of the variation in the Model 2 dependent variable were attributable to differences between states, suggesting a multilevel modeling approach was appropriate.[15,16]

Because the dependent variables were log-transformed, the coefficients shown in Table 2 for continuous predictor variables are interpreted as $100\% \times \beta$ changes. The coefficients for binary predictor variables are interpreted as $100\% \times (e^{\beta}-1)$ changes. Among the organization-level predictors, after adjusting for all other factors, each one-percentage-point increase in a CHC's Hispanic patient population size was associated with a 1.3% increase in the frequency of patient visits for COVID-19 care in 2020 (Model 1; $P < .001$). Each percentage-point increase in the percentage of patients diagnosed with obesity at a CHC was associated with a 1.1% increase in the frequency of patient visits for COVID-19 care in 2020 ($P < .001$). Each

Table 2. Associations Between CHC- and State-Level Characteristics and the Frequency of COVID-19 Care and Testing Visits: 2020.

	1	2
	Outcome: Natural log of patient visits for care with COVID-19 diagnosis	Outcome: Natural log of patient visits for COVID-19 testing
CHC-level characteristics		
Percent of non-Hispanic, black patients	−0.001	0.003
Percent of Hispanic or Latino/a patients	0.013**	0.002
Percent of female patients	0.008	−0.015+
Percent of patients under 18 years old	0.013**	0.015**
Percent of uninsured patients	−0.002	−0.002
Percent of patients diagnosed with obesity	0.011**	0.004
Percent of patients diagnosed with depression or mood disorder	−0.023**	−0.018**
Total patients; 1000s	0.035**	0.032**
Total supplemental COVID-19 capacity funding; $10 000s	−0.001**	−0.001
Patient population rurality		
Urban	Ref	Ref
Rural	−0.292**	0.031
State-level characteristics		
Operating in a state that enacted a mask mandate policy		
No mask-wearing policy	Ref	Ref
Mask-wearing policy enacted in 2020	0.060	−0.304+
Unemployment rate	0.084+	−0.017
COVID-19 cases per capita (cumulative by December 2020)	13.853**	5.018
Intercept	2.259**	6.952**
Observations	1267	1267

Estimates using data from the UDS, Ballotpedia, and the New York Times COVID-19 data repository. $^{+}P < .10$. $^{**}P < .01$. Because the dependent variables were log-transformed, the coefficients for continuous predictors are interpreted as a 100% × β change, and the coefficients for binary predictors are interpreted as a 100% × (e^{β}–1) change. The model fit diagnostic was AIC = 4266.3 for Model 1 and AIC = 4831.2 for Model 2. Null models excluding right-hand variables were estimated to determine the appropriateness of the multilevel modeling approach. Likelihood ratio tests led to the rejection of the null hypothesis that the standard deviation of the random intercept of the state-level grouping variable was equal to zero in each model. The intraclass correlation coefficients indicated that 16.0% of the variation in the Model 1 dependent variable and 7.1% of the variation in the Model 2 dependent variable were attributable to differences between states.

percentage-point increase in the percentage of patients under 18 years old served at a CHC was associated with a 1.3% increase in the frequency of patient visits for COVID-19 care in 2020 ($P < .001$). On its own, serving larger patient populations was associated with providing significantly more COVID-19-related care visits ($P < .001$). However, serving a predominantly rural patient population was associated with providing significantly fewer COVID-19-related care visits ($P = .002$). Among the state-level predictors, greater state-level per capita COVID-19 rates were associated with providing significantly more COVID-19-related care visits at CHCs in 2020 ($P < .001$). Higher state-level unemployment rates were also associated with CHCs providing more COVID-19-related care visits, though this relationship was of borderline statistical significance ($P = .053$).

The Model 2 findings show that each percentage-point increase in the percentage of patients diagnosed with depression or mood disorder at a CHC was associated with a 1.8% decrease in the frequency of patient visits for COVID-19 testing in 2020, after adjusting for all other factors (Model 2; $P = .02$). Each percentage-point increase in the percentage of patients under 18 years old served at a CHC was associated with a 1.5% increase in COVID-19 testing visits, on average ($P < .001$). Similar to the Model 1 results, serving larger patient populations was independently associated with providing more COVID-19 testing visits ($P < .001$). Among the state-level predictors, operating in a state that enacted a mask-wearing policy in 2020 was associated with a 26.2% lower frequency of COVID-19 testing visits at CHCs in 2020, compared to CHCs operating in states without mask-wearing policies. However, this relationship was of borderline statistical significance ($P = .055$).

Discussion

Key findings from this study suggest that both organization- and state-level factors affected the frequency of patient

visits for COVID-19-related care at CHCs during the first year of the pandemic, even after adjusting for differences in practice size and the amount of supplemental COVID-19 funding support received from the federal government. Of note, our results highlight several population-specific vulnerabilities relevant to COVID-19 care delivery at CHCs. First, serving larger Hispanic patient populations was associated with experiencing a greater frequency of COVID-19-related care visits in 2020. Second, and consistent with concerns that rural populations may not be able to receive adequate COVID-19 services,[11] serving a predominantly rural patient population was associated with providing significantly fewer COVID-19-related care visits in 2020. Third, higher state-level unemployment rates were associated with an increase in COVID-19 care visits at CHCs. This may suggest a link between economic instability and the need for COVID-19-related care in the primary care safety net, though this relationship was of borderline statistical significance.

Population-specific vulnerabilities such as these could have troubling implications for promoting health equity during the pandemic. Most CHC patients identify as racial and ethnic minorities, experience low SES, and live in medically-underserved areas.[1] Even among CHCs, serving larger Hispanic patient populations was associated with a higher frequency of COVID-19-related care visits. This finding appears to be consistent with previous research suggesting Hispanic patients were more likely to be infected with and require care for SARS-CoV-2.[7] In turn, this finding may suggest that Hispanic CHC patients were predisposed to greater risks from COVID-19 compared to non-Hispanic patients, portending a greater need for COVID-19-related services by Hispanic patients beyond the scope of CHCs.[17] Additional research is needed to better understand whether Hispanic patients experiencing lower SES were able to adequately access secondary or tertiary COVID-19 care from larger health care providers, or whether their ability to access those services was encumbered by longstanding racial and ethnic inequalities.[18]

In response to these and other pandemic-related challenges, the federal government legislated supplemental funding supporting CHCs' operations.[19] Notable provisions included $1.32 billion in supplemental funding provided through the CARES Act and a short-term funding fix for the Community Health Center Fund in 2020,[19] as well as continued funding provided to CHCs through the American Rescue Plan Act in 2021. However, depending on how long the pandemic persists, additional federal support and technical assistance will likely be needed to help CHCs address and overcome different organizational vulnerabilities affecting their ability to provide adequate COVID-19 services.

In addition to federal financial support, state-level policymakers can also enact public policies to help reduce the spread of COVID-19 and soften the demand for COVID-19 testing imposed upon health care providers. For example, our findings suggest that there were fewer COVID-19 testing—but not care-related—visits at CHCs in states that adopted mask-wearing policies in 2020 compared to states that did not, though the finding was of borderline statistical significance. One explanation for this relationship could be that mask-wearing policies may have slowed COVID-19 transmission or reduced the need for COVID-19 testing among certain patient populations. This finding may be consistent with other studies demonstrating that state-issued mask orders were associated with decreases in county-level daily COVID-19 cases.[13]

Limitations

This study had several limitations. First, this was one of the first studies to use new measures created by HRSA and explore how different factors may have been related to differences in the provision of COVID-19 care and testing at CHCs in 2020. Findings from this study are generalizable at the national level. However, this was a cross-sectional study, and causal analyses were not conducted. For these reasons, the reader must refrain from drawing definitive conclusions about how changes in any particular organization or state-level factor might impact COVID-19-related care delivery at CHCs. Second, UDS data were reported at the CHC grantee level. This was a population-focused investigation. Individual patient outcomes and risks could not be examined. Third, our data predated the availability of COVID-19 vaccines to the public. CHC vaccination rates may impact the relationships identified in this study. CHC vaccination information will be available in UDS data in 2022. Fourth, our multivariable statistical analyses adjusted for the amount of supplemental funding received by each CHC for COVID-19-related support in 2020 in an attempt to account for differences in COVID-19 care capacity between the CHCs. However, this measure is imperfect. The pandemic disrupted care delivery at CHCs and in other settings in idiosyncratic ways.[20] We could not measure or characterize the full extent of those disruptions and treatment capacity differences for the CHCs in our study sample.

Conclusions

This study examined early data on COVID-19 care delivery at CHCs during the first year of the pandemic. The CHC's role in providing COVID-19 testing and care proved as diverse as the populations and localities CHCs serve. We found that different organization- and state-level factors were associated with more or fewer COVID-19 care and testing visits at CHCs in 2020. Of concern were different population-specific vulnerabilities affecting the frequency of COVID-19 care and testing visits at CHCs. Notable

vulnerabilities included serving larger Hispanic patient populations or predominantly rural patient populations. These findings provide important insights as CHCs continue to navigate the pandemic and as highly contagious COVID-19 variants proliferate (eg, Delta and Omicron).

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