Original article

SARS-CoV-2 pandemic in New York metropolitan area: the view from a major urgent care provider

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A B S T R A C T

Purpose: Tracking severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) testing and positivity trends is crucial for understanding the trajectory of the pandemic. We describe demographic and clinical characteristics, testing, and positivity rates for SARS-CoV-2 among 2.8 million patients evaluated at an urgent care provider.
Methods: We conducted a retrospective study of patients receiving a diagnostic or serologic test for SARS-CoV-2 between March 1, 2020 and July 20, 2021 at 115 CityMD locations in the New York metropolitan area. Temporal trends in SARS-CoV-2 positivity by diagnostic and serologic tests stratified by age, sex, race/ethnicity, and borough of residence were assessed.
Results: During the study period, 6.1 million COVID diagnostic and serological tests were performed on 2.8 million individuals. Testing levels were higher among 20–29-year-old, non-Hispanic White, and female patients compared with other groups. About 35% were repeat testers. 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 to be 22.1% (95% confidence interval: 22.0–22.2) and was highest among 10–14 year olds (27.9%), and non-Hispanic Black (26.0%) and Hispanic (31.0%) testers.
Conclusion: Urgent care centers can provide broad access to diagnostic testing and critical evaluation for ambulatory patients during pandemics, especially in population-dense, urban epicenters. Urgent care center electronic medical records data can provide in-depth surveillance during pandemics complementary to citywide health department data sources.

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Introduction

New York City (NYC) was the epicenter of the coronavirus disease 2019 (COVID-19) pandemic during its beginning phases in the United States [1]. On March 7, 2020, NY's governor declared a state of emergency, expanding the testing protocol to cover patients without an identified exposure but experiencing severe symptoms. By June 2, 2020, anyone in NY could be tested regardless of symptoms or exposure. Repeat testing was recommended for those who worked in residential congregate settings or with ongoing concerns of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) exposure [2]. Vaccines became available to high-risk individuals in December 2020 and are now widely available to the general population.

Cumulative incidence and seroprevalence estimates for New York city have been reported using cross-sectional serosurveys [3,4]. Studies have found substantial differences in COVID-19 infection rates during the first wave in NYC by race/ethnicity and geographical regions [1,3,5]. A serosurvey performed after the first wave also found higher seroprevalence in Black and Hispanic populations, suggesting that differential disease burden persisted after the first wave [4]. The New York City Department of Health and Mental Hygiene (NYC DOHMH) reports daily cases diagnosed using polymerase chain reaction (PCR) and rapid antigen tests by Zipcode but does not provide details on sociodemographic differences in trends [6]. Given that persons of color have suffered a higher burden of disease during the pandemic and that their coronavirus vaccination rates are lower compared to non-Hispanic White people [7], tracking differential testing and positivity trends between races/ethnicities is important.

In addition to vaccination, widespread availability of diagnostic tests with fast turnaround times followed by self-isolation is instrumental in limiting transmission [8]. Urgent care providers can play a crucial role in meeting the large demand for COVID-19 clinical evaluation and testing by providing immediate access for symptomatic patients, reducing unnecessary use of hospital emergency departments. Additionally, urgent care centers provide prompt access to patients who have mild symptoms, who are asymptomatic, or who require repeat testing when such access at doctor's offices is limited.

Describing SARS-CoV-2 testing patterns among urgent care patients and demographic and clinical characteristics of those who tested positive can provide key insights into the trajectory of the pandemic. We analyzed these trends in the New York metropolitan area using electronic medical record (EMR) data from a major urgent care provider from the beginning of the pandemic to the vaccine era.

Methods

Study setting and participants

CityMD is the largest walk-in urgent medical care provider in the region and has been a COVID-19 diagnostics and treatment center since the earliest phase of the pandemic. This study includes patients who received a COVID-19 diagnostic or serologic test at CityMD sites in the New York metropolitan area (NYC, Long Island, and Westchester).

Data collection

Two types of COVID-19 diagnostic tests (reverse transcriptase polymerase chain reaction [RT-PCR] and rapid antigen tests) as well as serologic tests were also offered at CityMD. We examined de-identified EMR data and SARS-CoV-2 diagnostic and serological test results between March 1, 2020 and July 20, 2021 from CityMD's 115 locations in the five boroughs of NYC ($n = 76$), Long Island ($n = 32$), and Westchester ($n = 7$). Testing, using assays authorized for emergency use by the Food and Drug Administration, included: 1) RT-PCR tests of respiratory tract specimens for SARS-CoV-2 RNA collected via nasopharyngeal and nasal swabs; 2) serologic tests of serum specimens, and 3) rapid antigen tests of respiratory tract specimens collected via anterior nasal swabs. RT-PCR and serology tests were conducted by commercial laboratories (Quest SARS-CoV-2 rRT-PCR [100% sensitivity and 100% specificity [9], LabCorp COVID-19 RT-PCR test [98.1% sensitivity and 100% specificity [10], Roche Elecsys Anti-SARS-CoV-2 immunoglobulin G and assay [99.5% sensitivity 99.8% specificity [11], Abbot Architect SARS-CoV2 immunoglobulin G Assay [100% sensitivity 99.9% specificity [12]). Rapid antigen tests were conducted on-site (BD Veritor

[67%–93% sensitivity and 98%–100% specificity [13], Quidel Sofia 2 SARS Antigen Fluorescent Immunoassay [65.8% sensitivity and 99.4% specificity [14]). The type of test performed depended on the clinical presentation as well as patient request. CityMD began offering antibody tests against spike protein (anti-S) on March 05, 2021. Antibody tests offered before this date were against the nucleocapsid protein (anti-N).

All patients were evaluated by a licensed clinician. We examined body temperature and oxygen saturation collected at the time of COVID-19 testing. Additionally, we examined history of comorbidities among those tested positive.

Demographic characteristics

Individual-level demographic factors, such as age, gender, race/ethnicity, and region of residence at the time of testing were examined. Age at time of visit was categorized into 5-year intervals up to 20 years, and in 10-year intervals thereafter, going up to >100 years. Self-reported race and ethnicity data were mapped to the US Office of Management and Budget defined categories for race/ethnicity [15] (Appendix).

Definitions

Test-level positivity for RT-PCR and rapid antigen tests was defined as the percent of total tests performed on a given day that were positive. Individual-level percent positivity was defined as the percent of individuals tested on a given day with a positive result. For individuals with RT-PCR and rapid antigen tests on the same day, RT-PCR test result were used to calculate daily test positivity. Only the first positive test result for an individual was used for estimating daily individual-level positivity rate and any further test results were excluded. Repeat testing was defined as having two or more diagnostic tests on separate days.

Statistical analysis

Descriptive statistics were used to summarize COVID-19 testing and positivity by demographic characteristics. We plotted the daily test volume, test-level positivity, and individual-level positivity for PCR and rapid antigen tests to assess temporal trends in SARS-CoV-2 infections. We compared COVID-19 positivity trends in four time periods: March–June 2020 (emergence and wave 1), July–September 2020 (low activity), October 2020–March 2021 (wave 2), and April–July 2021 (vaccine era). We plotted weekly percent positivity by age group to examine age-specific trends in COVID-19 positivity as different age groups became eligible for vaccination at different times during the pandemic.

We used Pearson correlations to compare the daily 7-day average of COVID-19 cases calculated from CityMD EMR data to 7-day average COVID-19 cases reported by the NYC DOHMH. Correlation analysis was restricted to PCR- confirmed cases because NYC DOHMH defines percent positivity using only PCR-confirmed cases. All analyses were conducted in R v4.0.1 [16].

This study was approved by the Institutional Review Board of the City University of New York Graduate School of Public Health and Health Policy.

Results

Between March 1, 2020 and July 20, 2021, CityMD performed 6.1 million diagnostic and serologic tests on 2.8 million individuals living in NYC, Long Island, and Westchester. Most testers were 20–29 years old (24%), while 11% were children and adolescents (Table 1). About 25% of the testers were Hispanic, 33% were non-Hispanic (NH) White, and 10% were NH Black. Most testers were

Table 1
Diagnostic testing patterns among CityMD patient population: March 1, 2020–July 20, 2021

Characteristics	RT-PCR tests (%*)	Rapid antigen tests (%*)
Total	1537,435 (100)	2042,894 (100)
Age (y)		
<5	15,546 (1.0)	37,145 (1.8)
5–9	33,339 (2.2)	65,956 (3.2)
10–14	47,102 (3.1)	80,814 (4.0)
15–19	78,380 (5.1)	124,936 (6.1)
20–29	374,935 (24.4)	517,780 (25.3)
30–39	328,110 (21.3)	419,942 (20.6)
40–49	223,627 (14.6)	283,924 (13.9)
50–59	213,941 (13.9)	265,866 (13.0)
60–69	142,156 (9.2)	164,024 (8.0)
70–79	614,19 (4.0)	63,283 (3.1)
80–89	168,17 (1.1)	169,79 (0.8)
90–99	2029 (0.1)	2205 (0.1)
>100	34 (0)	40 (0)
Sex		
Female	867,276 (56.4)	1108,254 (54.2)
Male	670,126 (43.6)	934,554 (45.7)
Race/ethnicity		
NH White	505,448 (32.9)	666,266 (32.6)
NH Black	157,473 (10.2)	221,981 (10.9)
Hispanic	385,801 (25.1)	552,562 (27.0)
Native American/Alaskan Native/Pacific Islander	11,804 (0.8)	16,939 (0.8)
Asian	126,501 (8.2)	149,974 (7.3)
Other/unknown	350,408 (22.8)	435,172 (21.3)
Region		
Bronx	140,738 (9.1)	209,287 (10.2)
Brooklyn	290,031 (18.9)	350,879 (17.2)
Long Island	378,474 (24.6)	589,242 (28.8)
Manhattan	353,271 (23.0)	447,133 (21.9)
Westchester	79,207 (5.1)	131,634 (6.4)
Queens	252,882 (16.4)	253,552 (12.4)
Staten Island	42,832 (2.8)	61,167 (3.0)

* Col%.

seen in NYC (70%). Overall, 34.9% ($n = 2154,195$) of the total tests performed were RT-PCR tests, 52.5% ($n = 3236,815$) were rapid antigen tests, and 12.6% ($n = 771,111$) were serological tests. Since their introduction in October 2020, 80.5% patients received a rapid antigen test ($n = 2304,381$), and 31.4% ($n = 899,549$) received rapid antigen tests followed by a confirmatory RT-PCR test on the same day using the same specimen (Table 2). The usage of serologic tests decreased as the pandemic progressed. During the study period, CityMD diagnosed 286,922 individuals with SARS-CoV-2 infection, of which 169,618 patients were diagnosed in NYC (Fig. 1).

Repeat testing

A total of 1013,635 (35.4%) patients had two or more diagnostic tests on separate days and were defined as repeat testers (median time interval between first and last test: 144 days, interquartile range: 62–232). Of these, 36,039 testers (1.2%) had multiple positive tests (median interval between first and last positive diagnostic tests: 10 days; interquartile range: 7–14 days). Only 876 of the 36,039 (2.4%) cases had an interval of ≥90 between two positive tests, that is, potential re-infections.

Temporal trends in COVID-19 testing and positivity

Testing increased rapidly after the last week of April 2020. The introduction of rapid antigen tests in October 2020 further increased testing (Fig. 2A). The individual-level positivity rate was high early in the pandemic mainly because SARS-CoV-2 testing in New York was restricted to severe or hospitalized cases (Fig. 2C).
Trends in the number of positive tests and percent positivity started declining in late March 2020 coinciding with the

strict lockdown and physical distancing mandates implemented. The daily individual-level positivity rate remained low (~1%) until September 2020. Starting October 2020, when indoor dining, bars, and schools reopened, cases once again increased rapidly giving way to a second wave of the pandemic (Fig. 2B and C). Daily testing and positivity rates continued to increase through holidays, such as Thanksgiving and Christmas and stayed high at ~10% until April 2021. Both RT-PCR and antigen test positivity started declining after the second week of April and remained low at ~1% until June 2021. RT-PCR and antigen percent positivity started increasing again in July 2021 and overall diagnostic test positivity was 4% as of July 20, 2021 (Fig 2B and C).

Demographic differences in diagnostic testing and positivity

Age-specific PCR test positivity was highest in the 40–69-year age groups followed by those older than 90 years in wave 1 (Table 2). However, in the second wave, PCR (9.4%) as well as antigen test positivity (11.6%) in 15–19 years old was high and comparable to those 40–49 and 50–59 years old (PCR: 9.5%; antigen: 11.9% for both age groups; P-value comparing all age groups <0.001). PCR positivity was higher in Hispanic, NH Black, and Native American testers compared to NH White and Asian testers in the first wave. PCR positivity decreased for NH Black (11.8% in wave 1 vs. 8.8% for RT-PCR and 9.5% for antigen tests in wave 2; *P*-value <.001) but increased for Hispanic and Native American patients. Based on self-reported race and ethnicity groups, testers who identified as Afghan, Bangladeshi, Salvadoran, and central American Indian had high test positivity rates (>10%, Fig. A1). In the vaccine era, test positivity decreased in all age groups compared to earlier periods (Table 2). Particularly for patients 60 years and older, test positivity started to decline 2 weeks earlier than other ages and stayed lower than 15–35 years old and 36–60 years old in July 2021 (Fig. 3).

Patterns in seropositivity: Majority of the serology tests conducted were between March and August 2020, with testing demand reducing significantly after September 2020 (Fig. A3). Since March 5, 2021 when CityMD started offering anti-spike antibody testing following vaccine roll-out, only 1.3% of patients received a serology test. Overall, seropositivity in this time period was estimated to be 22.1% (95% confidence interval [CI]: 22.0%–22.2%) (Table 3). Seropositivity was highest in 5–9 years old (27.2%) and 10–14 years old (27.7%) compared to older age groups. Seropositivity was also high among individuals over the age of 90 (21.8%). Seropositivity estimates were higher among NH Black (26.0%), Hispanic (31.0%), and Native American testers (24.9%). Among Hispanic testers, those who self-identified as Ecuadorian and Mexican had >40% seropositivity rates (Fig. A2). Residents of the Bronx (31.6%) and Queens (30.8%) had higher seropositivity compared to other boroughs.

Correlation between CityMD and routine SARS-CoV-2 surveillance COVID-19 trends

Between March 1, 2020 and July 20, 2021, the NYC DOHMH conducted a daily median of 34,823 RT-PCR tests while CityMD conducted a daily median of 4115 tests. The overall correlation in test positivity rates between the two systems was 0.97 (95% CI: 0.96–0.97). In wave 1, CityMD performed a weekly median of 1935 RT-PCR tests with correlation of 0.96 (95% CI: 0.94–0.97) with daily citywide positivity estimates. During a period of low activity in July–September 2020, CityMD performed a daily median of 6187 tests but correlation in test positivity rates between the two systems dropped to 0.22 (95% CI: 0.02–0.41). During the winter wave and the vaccine era, CityMD performed a daily median of 4332 and 2756 RT-PCR tests respectively, with a correlation of 0.93 (95% CI:
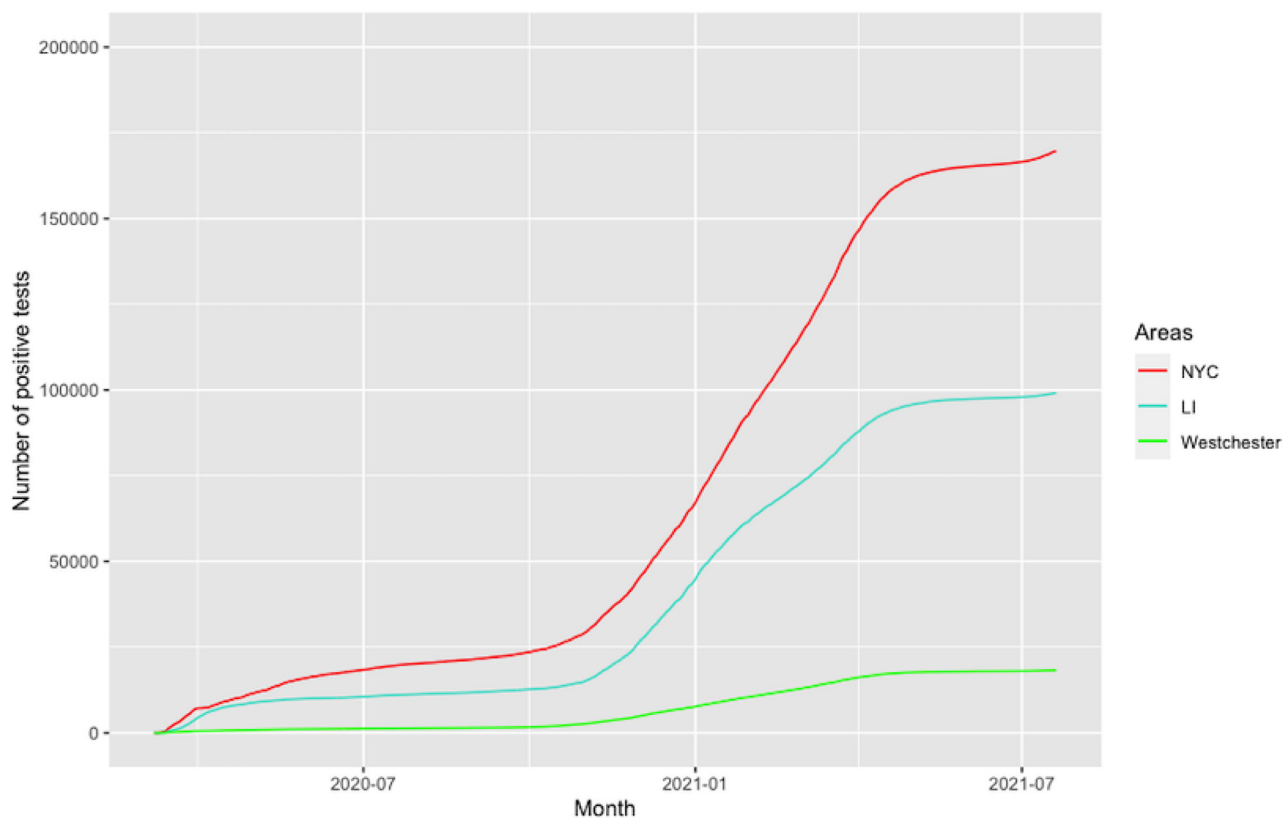
Fig. 1. Cumulative number of positive tests of COVID in among New York Metropolitan area residents testing at CityMD March 2020–July 2021.
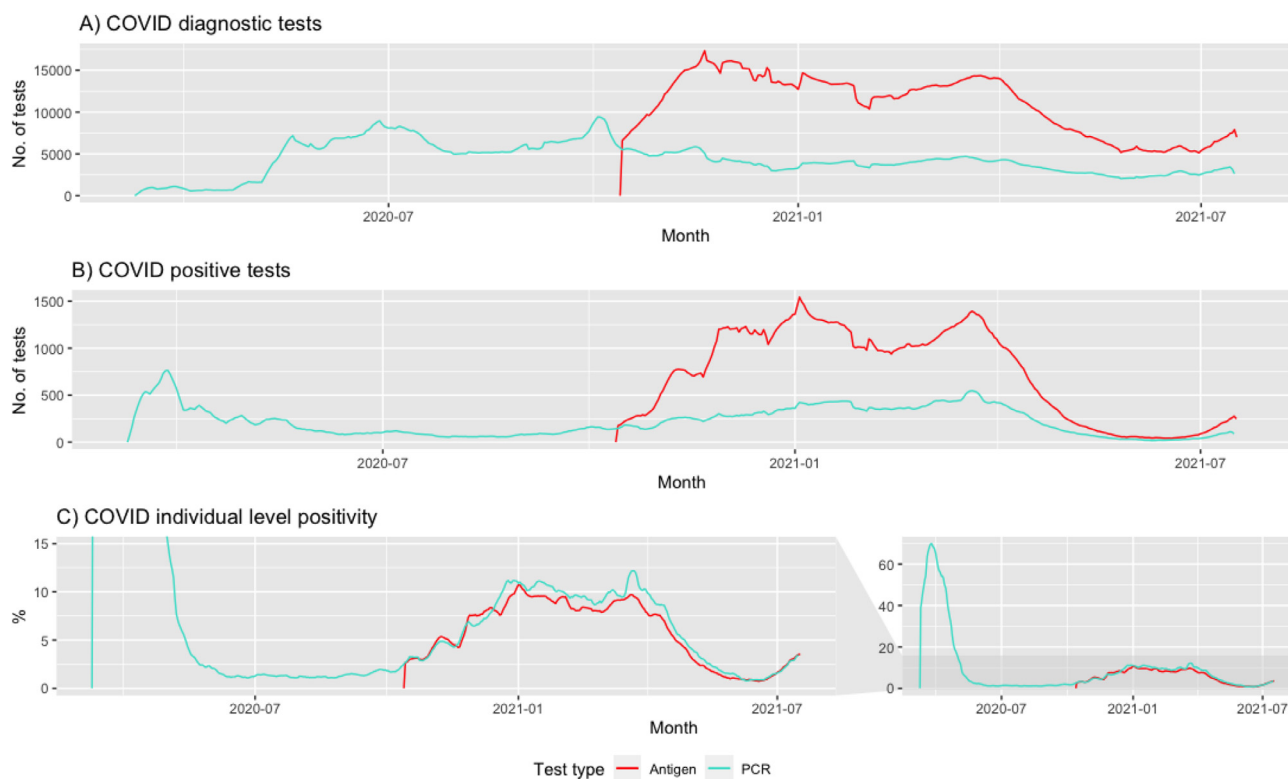
Fig. 2. A) Daily COVID-19 tests performed; B) Number of COVID-19 tests that were positive; C) proportion of individuals who received their first positive PCR or antigen test over time (individual-level daily positivity rate). COVID molecular and rapid antigen testing and positivity trends at CityMD in the New York metropolitan area March 2020–July 2021.

Table 2

Demographic characteristics of persons tested for SARS-CoV-2 by RT-PCR and rapid antigen tests and proportion tested positive at CityMD, March 01 2021–July 20, 2021

|	RT-PCR tests				Antigen tests	
	March–June 2020 (Wave 1) N (%*)	July–September 2020 (Low transmission) N (%)	October 2020–March 2021 (Wave 2) N (%)	April–July 2021 (Vaccine era) N (%)	October 2020–March 2021 (Wave 2) N (%)	April–July 2021 (Vaccine era) N (%)
Total	385,630 (7.8)	498,003 (1.6)	675,053 (8.7)	289,213 (4.3)	1596,440 (10.9)	707,941 (4.3)
Age (y)[†]						
<5	1149 (4.1)	3271 (2.3)	6694 (7.2)	5583 (2.9)	23,537 (10.4)	17,561 (3.9)
5–9	2967 (3.8)	8090 (1.6)	13,812 (7.2)	11,778 (3.2)	42,485 (9.5)	31,219 (3.5)
10–14	5771 (3.9)	12,068 (1.7)	19,280 (8.0)	15,767 (3.4)	52,613 (10.9)	37,708 (4.1)
15–19	11,456 (4.9)	26,201 (2.0)	33,581 (9.4)	18,928 (4.7)	91,016 (11.6)	50,001 (4.8)
20–29	75,353 (5.6)	133,989 (1.7)	180,042 (8.4)	75,292 (4.6)	417,834 (10.1)	183,694 (4.3)
30–39	85,151 (6.6)	110,339 (1.5)	147,510 (8.5)	61,708 (4.7)	334,883 (10.5)	143,491 (4.5)
40–49	62,929 (8.9)	69,493 (1.5)	97,282 (9.5)	38,707 (4.8)	225,364 (11.9)	92,102 (4.6)
50–59	65,068 (9.8)	65,600 (1.6)	91,796 (9.5)	32,710 (4.2)	214,505 (11.9)	79,690 (4.4)
60–69	47,649 (10.2)	43,378 (1.3)	56,942 (8.7)	19,010 (3.6)	131,139 (11.1)	47,362 (3.6)
70–79	21,671 (8.6)	19,486 (1.3)	21,889 (7.8)	7506 (2.8)	48,717 (10.4)	19,186 (2.9)
80–89	5770 (8.5)	5467 (1.3)	5543 (9.0)	1997 (3.5)	12,715 (11.7)	5239 (3.8)
90–99	688 (9.0)	616 (0.8)	663 (9.3)	224 (4.0)	1595 (12.8)	685 (4.8)
>100	8 (37.5)	5 (NA)	19 (10.5)	3 (NA)	37 (10.8)	3 (NA)
Race/ethnicity[†]						
NH White	127,159 (4.9)	173,197 (1.3)	236,476 (7.4)	83,860 (3.9)	546,910 (9.6)	211,626 (4.1)
NH Black	35,270 (11.8)	50,109 (1.5)	64,036 (8.8)	40,092 (4.9)	157,774 (9.5)	97,391 (4.2)
Hispanic	88,331 (9.0)	118,259 (2.1)	172,522 (10.2)	80,550 (4.7)	425,629 (12.6)	198,362 (4.5)
Nat. Am./Alas. Nat./Pac. Is.	2815 (8.7)	3502 (2.0)	54,87 (10.2)	2329 (4.3)	13,433 (12.3)	5554 (4.9)
Asian	28,823 (6.1)	43,550 (1.0)	58,352 (7.7)	22,708 (3.9)	120,754 (9.6)	47,152 (3.9)
Other/unknown	103,232 (9.4)	109,386 (1.7)	138,180 (9.6)	59,674 (4.2)	331,940 (11.9)	147,856 (4.3)
Sex[†]						
Female	216,766 (7.3)	284,690 (1.4)	383,988 (8.0)	168,499 (3.9)	861,106 (10.2)	397,804 (4.0)
Male	168,862 (8.3)	213,306 (1.8)	291,056 (9.7)	120,697 (4.9)	735,295 (11.7)	310,088 (4.7)
Region[†]						
Bronx	35,903 (8.5)	45,927 (2.1)	53,528 (11.2)	29,462 (4.4)	153,308 (11.8)	82,147 (3.8)
Brooklyn	86,117 (6.7)	106,766 (1.2)	113,628 (8.3)	48,520 (4.9)	273,189 (9.6)	126,396 (4.3)
Long Island	73,245 (14.3)	102,707 (2.1)	191,548 (9.4)	74,720 (4.1)	471,400 (13.0)	186,548 (5.0)
Manhattan	98,998 (4.3)	130,169 (1.1)	151,349 (7.5)	604,67 (3.9)	363,870 (7.5)	151,733 (3.1)
Westchester	14,073 (8.7)	24,785 (1.8)	35,216 (8.6)	15,943 (3.3)	101,781 (12.0)	42,538 (4.3)
Queens	66,923 (6.3)	76,293 (1.6)	11,0024 (8.2)	51,163 (4.5)	185,308 (11.9)	97,350 (4.6)
Staten Island	10,371 (9.8)	11,356 (2.4)	19,760 (11.5)	8938 (6.2)	47,584 (14.3)	21,229 (6.4)
Other tests Same day						
Antibody IgG					59,533 (21.7)	5632 (35.0)
RT-PCR					61,0336 (9.4)	289,213 (4.3)
Symptomatic[†]						
No					131,4761 (4.7)	490,373 (1.8)
Yes					390,842 (28.1)	248,125 (8.5)
Missing					59,397 (7.6)	13,711 (3.6)

IgG = immunoglobulin G; Nat Am./Al. Nat./Pac. Is. = Native American, Alaskan Native, Pacific Islanders; RT-PCR = reverse transcriptase polymerase chain reaction; SARS-CoV-2 = severe acute respiratory syndrome coronavirus 2.

* Percent tested positive.
[†] Chi square test comparing PCR and antigen test positivity for different demographic characteristics in each wave separately all had *P* values < .001.

0.91–0.95) and 0.97 (0.96–0.98) between citywide and CityMD test positivity rates.

*Signs, symptoms, and history of comorbidities*

Vital signs information from the EMR was available for 87% of testers. Patients with a positive test were more likely to present with a fever ≥100.1F compared to those with a negative test (8.2% vs. 0.9%). A higher proportion of COVID-19 positive individuals had O_2 levels <95% compared to COVID-19 negative individuals (1.2% vs. 0.3%). Of those who tested positive by any test, 46,062 (13.0%) had a documented history of heart disease, 22,070 (6.2%) high cholesterol, 20,157 (5.7%) asthma or COPD, and 13,350 (3.8%) depression and/or anxiety.

Discussion

Using data from a large ambulatory urgent care provider in the New York metropolitan area, we analyzed COVID-19 diagnostic and serologic testing and positivity trends over the course of the pandemic. Combining RT-PCR and rapid antigen data, CityMD diagnosed roughly 17% of the total SARS-CoV-2 cases in NYC. Test positivity rates from the CityMD patient database were highly correlated with positivity rates reported by the NYC DOHMH during periods of high virus transmission. Cumulative seropositivity over the study period among CityMD testers in NYC was found to be 22.1%, lower than that of all testers citywide (33.3%) [17], which includes severe cases tested in hospitals and emergency departments. Testing and positivity patterns differed by age, sex, race/ethnicity, and geography, and about 35% of testers were repeat testers. These data highlight the essential role that urgent care providers play in testing and evaluating symptomatic and asymptomatic cases in large numbers and epidemic tracking to control disease spread.

After months of sustained high transmission, the decline in case positivity rates since April 2021 might be because of steadily increasing vaccination coverage. Older adults were prioritized for vaccination in December 2020 and had higher vaccination coverage by May 2021 compared to younger adults who became vaccine-eligible only in April 2021. This may have led to a slightly earlier
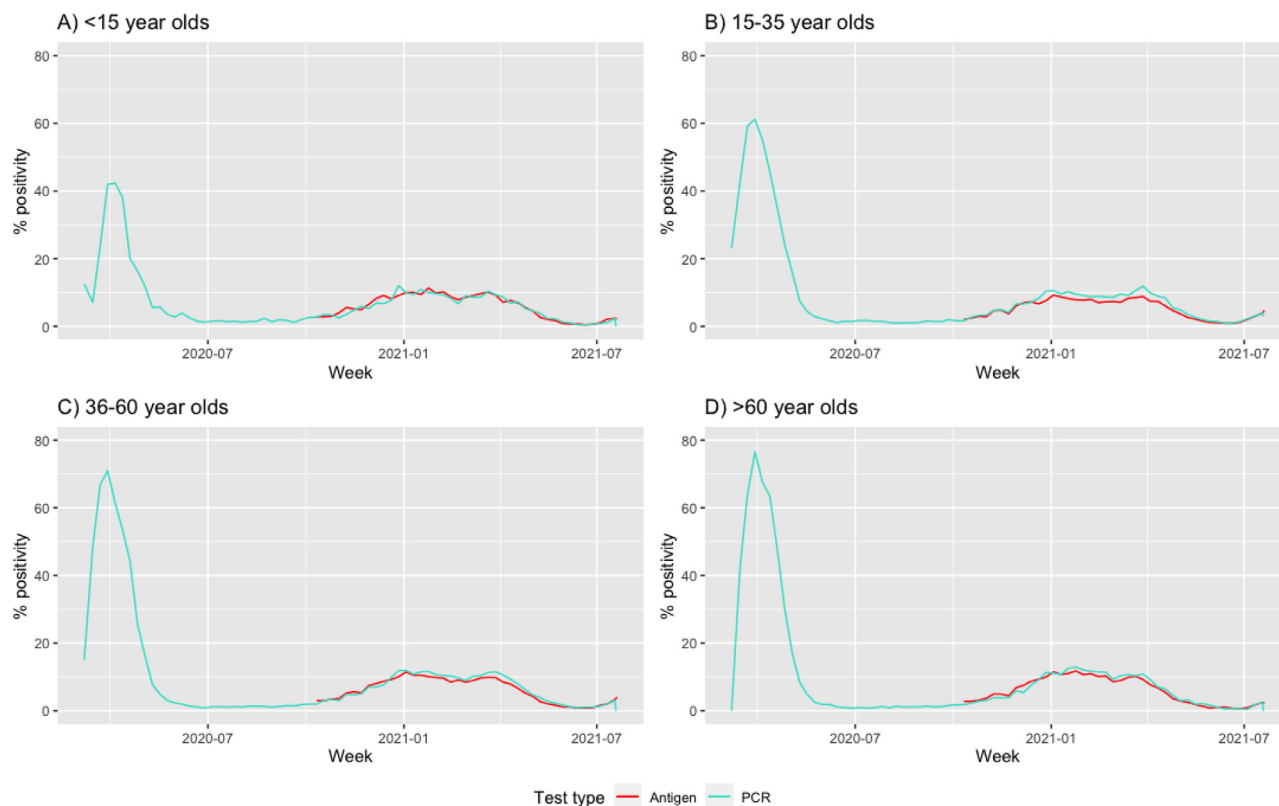
Fig. 3. A) <15 year olds, B) 15–35 year olds, C) 36–60 year olds, D) >>60 year olds. COVID molecular and rapid antigen percent positivity by age groups—March 2020–July 2021.

decline and relatively low positivity rates in July 2021 among older testers [18]. Vaccine efficacy against infection might be reduced for the Delta variant, which could have led to the late summer 2021 wave [19], but test positivity rates were still lower than the second wave.

We observed higher infection rates and seropositivity among non-Hispanic Black and Hispanic testers, similar to trends in NYC overall [1] and elsewhere [20,21]. Longstanding barriers and structural inequities in healthcare access might explain these trends [22,23]. Hispanic and non-Hispanic Black New Yorkers also form a large proportion of essential workers and healthcare workers, further increasing their risk of infection with SARS-CoV-2 [24,25]. People of color are more likely to live in multi-generational homes which could have resulted in rapid transmission of the virus to household members due to household crowding [26]. It is critical that testing and vaccinations are accessible and without cost barriers among communities with the greatest burden of SARS-CoV-2.

Seropositivity was higher in children and adolescent testers compared to adults. Other US studies found lower estimates of seropositivity among children, but their sample size was small [27,28]. Low diagnostic testing rates but high seropositivity among children and adolescents suggest probable exposure during the first pandemic wave (e.g., while in school during high levels of community spread prior to lockdown) but fewer testing opportunities because of test availability, or due to having milder symptoms or being asymptomatic [29]. This finding could have implications for transmission from younger children to older, more vulnerable age groups, and should be explored further [30]. As the pandemic progressed, we found that test positivity among children was comparable to adults, which challenges earlier findings that COVID-19 burden is lower among children. Indeed, COVID-19 incidence among children is currently increasing nationwide [31]. As schools have reopened, it is crucial to vacci-

nate children over five and routinely test them to prevent school outbreaks.

The overall prevalence of antibodies in this cohort of SARS-CoV-2 testers was 22.1% for the entire study period. However, most antibody tests were performed during the early phases of the pandemic and population-level immunity might have increased since April 2021 as vaccination rates steadily increased. Because serology testing decreased dramatically over time in this study, we were unable to reliably assess temporal trends in seropositivity in different demographic groups. Moreover, for the small number of patients tested after March 5, presence of anti-spike antibodies might be due to vaccination or infection. Periodic population representative surveys can provide better estimates of the true SARS-CoV-2 seropositivity at a given time [32].

There is a high demand for rapid antigen tests in urgent care centers such as CityMD. Rapid tests can quickly confirm active symptomatic infection as well as screen for asymptomatic and presymptomatic infections [33]. They are more useful for identifying infectious persons compared to RT-PCR tests, which can have longer turnaround times and be positive well after the end of the infectious period [8]. Rapid tests are also less invasive than RT-PCR tests, which makes them more popular among testers, and have the potential to increase testing uptake broadly [34,35]. Widespread availability of rapid tests followed by self-isolation has potential to greatly mitigate transmission.

The SARS-CoV-2 positivity trends over time in our study population were highly correlated with NYC population-level trends reported by the NYC DOHMH, when the number of daily reported cases was sufficiently high. Thus, alternative data sources, such as EMRs from urgent care clinics systems have the potential to complement traditional surveillance systems used by government agencies during pandemics [36]. An advantage of EMR-based surveillance is the detailed self-reported information on de-

Table 3
Demographic characteristics of persons tested for SARS-CoV-2 antibodies and proportion seropositive at CityMD, March 1, 2020–July 20, 2021

Characteristics	March 1, 2020–March 4, 2021[*] N (%[§])	March 5, 2021–July 20, 2021[†] N (%[§])	Overall N (%[§])	P-value[‡] (Overall)
Total	699,792 (21.88)	9367 (34.67)	706,126 (22.1)	
Age (y)				<.001
<5	87 (18.39)	4 (0)	91 (17.6)	
5–9	2596 (27.04)	35 (40)	2626 (27.2)	
10–14	10,743 (27.7)	179 (38.55)	10,890 (27.9)	
15–19	23,757 (24)	431 (32.95)	24,094 (24.2)	
20–29	147,242 (18.41)	1901 (29.25)	148,522 (18.6)	
30–39	161,087 (19.36)	2124 (29.71)	162,499 (19.6)	
40–49	118,004 (23.77)	1669 (34.45)	119,099 (24.0)	
50–59	118,224 (25.21)	1690 (38.4)	119,334 (25.4)	
60–69	78,170 (24.56)	884 (45.36)	78,761 (24.8)	
70–79	31,946 (21.15)	361 (49.03)	32,200 (21.5)	
80–89	7271 (20.66)	81 (37.04)	7338 (20.8)	
90–99	664 (21.54)	8 (50)	671 (21.8)	
>100	1 (100)	0 (0)	1 (100)	
Race				<0.001
NH White	256,657 (13.65)	3692 (35.24)	259,975 (13.8)	
NH Black	55,223 (25.9)	884 (27.94)	56,763 (26.0)	
Hispanic	164,269 (30.73)	2148 (33.19)	170,842 (31.0)	
Nat Am./Al. Nat./Pac. Is.	5005 (24.9)	73 (49.32)1	5159 (24.9)	
Asian	52,497 (15.97)	562 (37.9)	53,794 (16.2)	
Other/unknown	166,141 (26.3)	2008 (36.75)	157,985 (26.3)	
Sex				<.001
Female	392,488 (21.36)	5756 (34.42)	395,433 (14.0)	
Male	307,297 (22.56)	3611 (35.09)	309,077 (16.3)	
Region				<.001
Bronx	62,789 (31.45)	839 (33.85)	63,378 (31.6)	
Brooklyn	146,988 (19.99)	1821 (29.82)	148,211 (20.2)	
Long Island	135,781 (18.88)	3006 (40.79)	137,889 (19.4)	
Manhattan	181,869 (17.27)	1857 (30.48)	183,046 (17.4)	
Westchester	30,977 (18.07)	522 (34.1)	313,77 (18.4)	
Queens	122,112 (30.72)	1150 (32.78)	122,837 (30.8)	
Staten Island	19,276 (19.93)	172 (43.02)	19,388 (20.2)	

Nat Am./Al. Nat./Pac. Is. = Native American, Alaskan Native, Pacific Islanders; SARS-CoV-2 = severe acute respiratory syndrome coronavirus 2.

[*] Serology tests performed against anti-nucleocapsid (anti-N) protein only (pre-vaccine period).

[†] Serology tests against anti-nucleocapsid (anti-N) protein and anti-spike (anti-S) protein (vaccine period) started after March 5, 2021.

[‡] Chi-squared P-value.

[§] % tested positive for antibodies.

mographic characteristics and clinical symptomatology and history that allows us to examine COVID-19 positivity rates by categories not reported by government agencies. US Office of Management and Budget categories for race/ethnicity can mask wide variability in SARS-CoV-2 prevalence in some groups. For example, the overall diagnostic positivity and seroprevalence among Hispanic testers was 8% and 29.4%, respectively. However, within Hispanic ethnic groups, these proportions ranged from 4%−16% and 14%−52%, respectively (Fig. A1, Fig. A2). Public health jurisdictions should endeavor to collect complete data on race/ethnicity to improve our understanding of disease risk inequities within the community [22].

Our study has limitations. Our data only includes individuals who sought a COVID-19 test. Patients who seek care at CityMD are not representative of all persons testing for SARS-CoV-2 in the NY metropolitan area or the general population. Because CityMD is an ambulatory care provider, we did not have information on clinical evaluation and testing outside of CityMD, subsequent development of severe disease, hospitalization, or death after the visit. Typical COVID-19 symptoms were not captured in a standardized form in the EMR. As at-home testing become more prevalent, testing and positivity trends estimated from urgent care data might become less reliable.

In summary, our results highlight the vital role that urgent care providers play in diagnosing substantial numbers of patients for COVID-19, potentially triggering self-isolation and contact tracing to help limit transmission in population-dense, urban epicenters. Urgent care providers can limit the flow of less severe patients to emergency departments of hospitals, which was of critical importance during periods of surge. Future pandemic preparedness plans should leverage urgent care providers for a multitude of critical implementation roles with the potential to improve individual and public health outcomes.

Acknowledgments

Appendix

Diagnostic test positivity and seropositivity by self-reported race and ethnicity

Self-reported race in the CityMD EMR included specific Native American tribes and country-level nationalities. First, we categorized reported races into White, Black, Asian, Native American/Pacific Islander/Alaska Native, and Other/Unknown based on the values reported in the "Race" variable using OMB guidelines. For patients missing a value for race, their responses recorded for the "Ethnicity" variable were used to assign ethnicity. Any patient who reported "Hispanic" race was classified as having "Hispanic" OMB race/ethnicity category, resulting

in the following categories: non-Hispanic White, non-Hispanic Black, Asian, Native American/Pacific Islander/Alaska Native, Hispanic, and other/unknown. Patients who had both race and ethnicity missing were classified as having "other/unknown" race/ethnicity.

Patients reported 896 different drop-down categories for race, and 60 of these categories were listed by more than 1000 individuals. Patients reported 44 different categories for ethnicity, of which 36 were listed by more than 1000 persons. We present here estimates of SARS-CoV-2 seropositivity and diagnostic test positivity for the different self-reported racial and ethnic groups with more than 1000 people in them.

Serologic testing over time

A large proportion of the antibody tests were conducting during the initial period of the pandemic between March 2020 and August 2020. Demand for antibody testing dropped significantly thereafter. CityMD conducted only anti-nucleocapsid antibody testing until March 5, 2021. Thereafter, once vaccine roll-out began, CityMD started offering anti-spike protein antibody testing as well, but uptake was low.
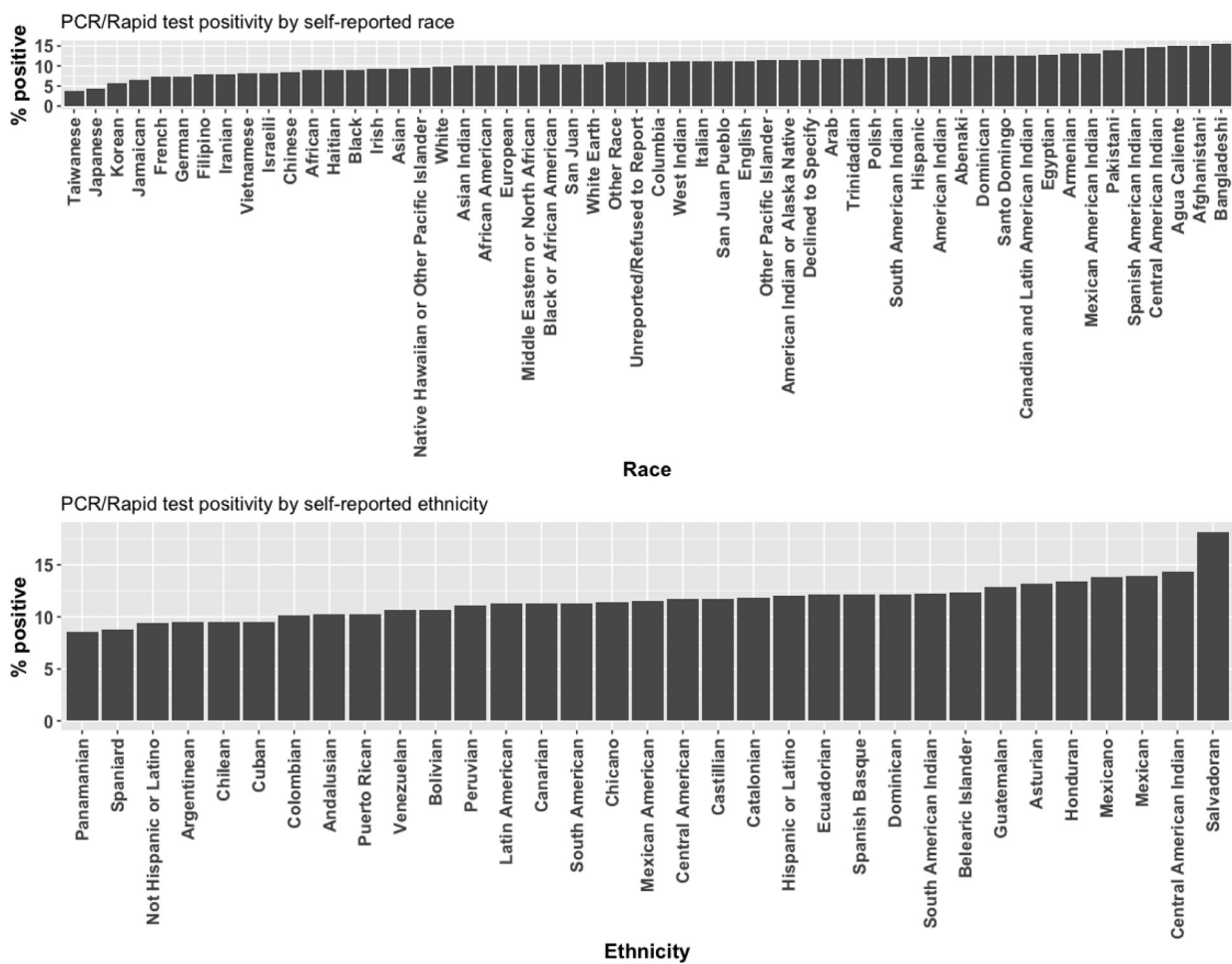

Fig A1. Percent positivity of diagnostic tests by self-reported race and ethnicity.
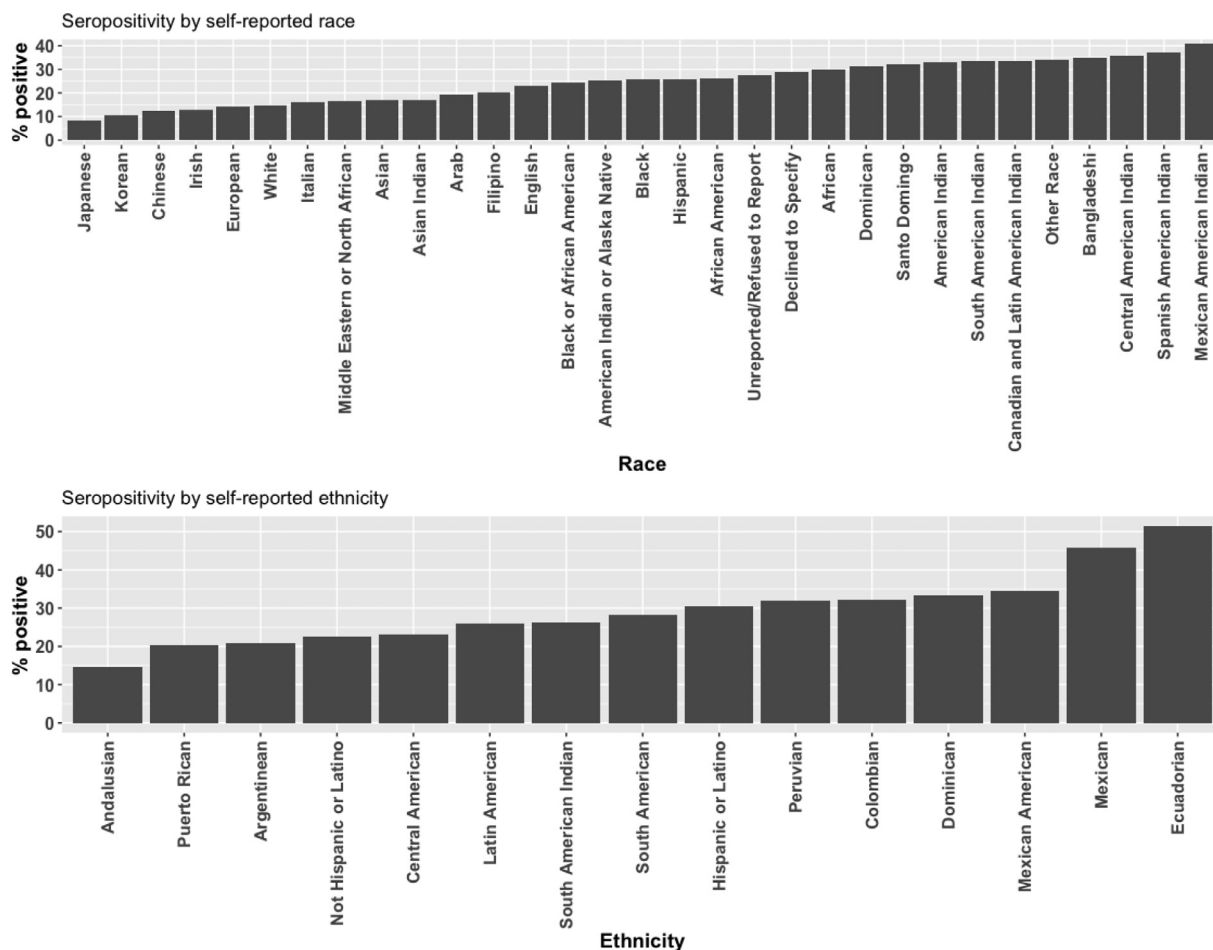
Fig A2. Seropositivity by self-reported race and ethnicity.

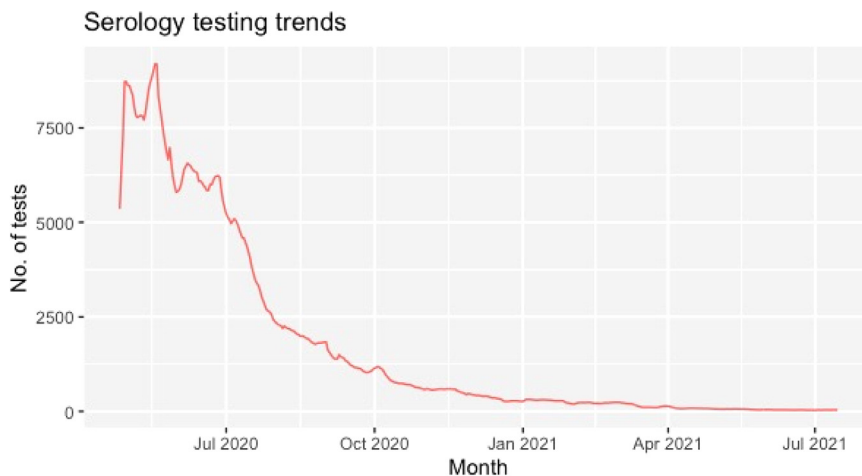**Fig A3.** COVID antibody testing at CityMD in the New York metropolitan area March 2020–July 2021.

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