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The seroprevalence of COVID-19 in patients living with HIV in metropolitan Detroit

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Abstract

Background: COVID-19, a novel respiratory illness caused by SARS-CoV-2, has become a global pandemic. As of December 2020, 4.8% of the 941 people living with HIV in our Ryan White clinic have tested polymerase chain reaction positive for SARS-CoV-2. The aim of our study was to estimate the seroprevalence of COVID-19 in our Ryan White people living with HIV, irrespective of known past infection.

Methods: We conducted a cross-sectional study that recruited people living with HIV in the Ryan White program at Henry Ford Hospital in Detroit, Michigan, from September 2020 through May 2021. All Ryan White patients were offered participation during clinic visits. After informed consent, patients completed a survey, and had blood sampled for SARS-CoV-2 antibody testing.

Results: Of the 529 individuals who completed the written survey, 504 participants were tested for SARS-CoV-2 antibody and 52 people living with HIV were COVID-19 immunoglobulin (Ig) G positive resulting in a seroprevalence of 10.3%. Among 36 persons with PCR-confirmed COVID-19, 52.8% were IgG negative. Inclusion of PCR positive but IgG-negative people living with HIV yields a COVID-19 infection prevalence of 14.1%.

Conclusions: These findings suggest that passive public health-based antibody surveillance in people living with HIV significantly underestimates past infection.

Keywords

HIV, seroprevalence, COVID-19, SARS-CoV-2, antibodies

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Introduction

COVID-19, a novel respiratory illness caused by SARS-CoV-2, was first reported in December 2019 among patients with pneumonia in Wuhan, Hubei Province, China, and has now become a global pandemic.[1] The risk of acquisition of COVID-19 and outcome of infection for people living with HIV is not precisely known (personal communication from Jim Kent).[2–5] As of December 2020, 4.8% of the 941 people living with HIV in our Ryan White clinic have tested polymerase chain reaction (PCR) positive for SARS-CoV-2 and 6/45 persons have died (13.3%). However, reported cases do not account for all SARS-CoV-2 infections, as an unknown proportion is not ascertained through passive public health reporting. Detection of SARS-CoV-2 antibodies can be used to estimate SARS-CoV-2 infection in asymptomatic or mildly symptomatic individuals and as a tool to estimate prevalence in populations.[2,3] The aim of our study was to estimate the seroprevalence of COVID-19 in our Ryan White people living with HIV, irrespective of known past infection.

Methods

We conducted a cross-sectional study that recruited people living with HIV in the Ryan White program at Henry Ford Hospital in Detroit, Michigan. A survey and antibody testing were performed from September 2020 through May 2021. All Ryan White patients were offered participation during

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Henry Ford Seroprevalence Survey

Thank you for participating in this survey. Your answers will be used for research purposes only and will be confidential.

1) Current age in years: _____
2) Please specify how you identify yourself
   a. Female
   b. Male
   c. Other
3) Do you consider yourself to be (Please check all that apply)
   a. Black/African American
   b. White/European American
   c. American Indian or Alaskan Native
   d. Asian or Pacific Islander
   e. Hispanic or Latino
   f. Middle Eastern
   g. Other
   h. Prefer not to answer
4) What is the zip code of your home (residence, place where you live)? _____
5) On a typical day, how many other people live in your household? _____
6) Do you, or others in your household smoke?
   a.Yes
   b. No
7) Are you required to leave the home to do your work, care giving, or volunteer activities?
   a. Yes.
   b. No
8) Do you think you have or have had COVID-19
   a. Yes, confirmed with testing
   b. Yes, but not tested
   c. No, confirmed with testing
   d. No, have not been sick
9) Any known exposures to COVID-19 (i.e., first responder, nursing homes, being around someone with COVID-19, etc.)
   a. Yes
   b. No
10) Is your occupation any of the following? (please check all that apply)
   a. Healthcare worker
   b. First responder
   c. Nursing home assistance
   d. Restaurant industry
   e. Grocery store

Figure 1. COVID-19 seroprevalence survey.

clinic visits if they had not already received a dosage of any COVID-19 vaccine. After informed consent, patients completed a survey (Figure 1), and had blood sampled for SARS-CoV-2 antibody testing using the Beckman Coulter Access SARS-CoV-2 Immunoglobulin (Ig) G assay (Brea, CA), an FDA-approved qualitative assay which detects IgG antibodies to the receptor-binding domain of the spike protein.[6] Patients' electronic medical records were reviewed for demographic and clinical information. Continuous variables were analyzed using a two-sample Wilcoxon test. A

Table 1. Comparison of the baseline characteristics of people living with HIV with positive and negative IgG COVID-19 determination.

	Total patients (*N* = 504)	Patients COVID-19 IgG negative (*N* = 452)	Patients COVID-19 IgG positive (*N* = 52)	*p* value
Mean age (IQR)	47 (35–58)	46 (35–58)	52 (44–60)	.009
Sex, *N* (%)				.366
Female	103 (20%)	96 (21%)	7 (13%)	
Male	399 (79%)	354 (78%)	45 (87%)	
Transgender	2 (0.4%)	2 (0.4%)	0	
Race/Ethnicity, *N* (%)				.610
Black/African American	397 (79%)	353 (78%)	44 (85%)	
White/European American	52 (10%)	49 (11%)	3 (6%)	
American Indian or Alaskan Native	4 (0.8%)	4 (0.9%)	0	
Asian or Pacific Islander	1 (0.2%)	1 (0.2%)	0	
Hispanic or Latino	24 (5%)	22 (5%)	2 (4%)	
Middle Eastern	2 (0.4)	2 (0.4%)	0	
Other/declined	13 (2.6%)	10 (2%)	3 (6%)	
Occupation, *N* (%)				.706
Healthcare worker	26 (5%)	24 (5%)	2 (4%)	
First responder	2 (0.4%)	2 (0.4%)	0	
Nursing home assistant	8 (1.6%)	8 (1.8%)	0	
Restaurant industry	24 (5%)	21 (4.6)	3 (6%)	
Grocery store	15 (3%)	12 (2.7%)	3 (6%)	
Other/unemployed	425 (84%)	381 (84%)	44 (85%)	
Other residents in the household, *N* (%)				.625
0–3 people	442 (87%)	394 (87%)	48 (92%)	
4–9 people	53 (11%)	49 (11%)	4 (8%)	
> 10 people	3 (0.6)	3 (0.7%)	0	
Basal metabolic index, *N* (%)				.578
< 18.5	16 (3%)	15 (3%)	1 (2%)	
18.5–24.9	126 (25%)	115 (25%)	11 (21%)	
25–29.0	153 (30%)	134 (30%)	19 (37%)	
> 30	159 (32%)	138 (31%)	21 (40%)	
Past medical history, *N* (%)				
Smoking history	252 (50%)	231 (51%)	21 (40%)	.142
Asthma	72 (14%)	60 (13%)	12 (23%)	.056
COPD	15 (3%)	13 (3%)	2 (3.8%)	.661
End-stage renal disease	13 (2.5%)	11 (2%)	2 (3.8%)	.634
Hypertension	164 (33%)	150 (33%)	14 (27%)	.361
Cardiac condition	34 (7%)	29 (6%)	5 (10%)	.384
Diabetes mellitus type II	80 (16%)	64 (14%)	16 (31%)	.002
Mean CD4 (cell/μl, IQR)	647 (390–846)	642 (392–831)	655 (390–847)	.790
Median HIV-1 viral load (copies/mL, IQR)	Under limit of detection (0–28)	Under limit of detection (0–27)	Under limit of detection (0–28)	.896
Known exposure to COVID-19, *N* (%)	71 (14%)	61 (13%)	10 (19%)	.260
COVID-19 status, *N* (%)				0.001
Yes, confirmed positive by PCR testing	36 (7%)	19 (0.2%)	17 (33%)	
Yes, only by self-report	59 (12%)	52 (12%)	7 (13%)	
No, confirmed negative by PCR testing	51 (10%)	43 (10%)	8 (15%)	
No, only by self-report	335 (66%)	315 (70%)	20 (38%)	

COPD: chronic obstructive pulmonary disease; Ig: immunoglobulin; IQR: interquartile range; PCR: polymerase chain reaction.

nonparametric test was used as the data was not normally distributed. Count variables were analyzed using chi-squared tests of Fisher's exact tests if the sample size was low. Past medical histories were analyzed as the condition versus all others. A *p*-value less than .05 was considered to indicate significance. The study was approved by the Henry Ford Health System Institutional Review Board IRB approval number 14190-01. Written consent was

obtained for all participants prior to blood drawn. All procedures were in accordance with the Helsinki Declaration

Results

From September 2020 to May 2021, 529 people living with HIV in our Ryan White clinic were enrolled in the study (Table 1). Participant median age was 47 years (interquartile range: 35–58 years old); 423 identified as male and 411 were black; 28 were healthcare workers with three first responders; and 77 reported a previous COVID-19 exposure. One hundred sixty-three participants had a body mass index of 30 kg/m^2 or greater. Mean CD4 count was 647 cell/µl (interquartile range: 390–846 cell/µl), and all individuals were virally suppressed. Of the 529 individuals who completed the written survey, 504 participants were tested for SARS-CoV-2 antibody and 52 people living with HIV were COVID-19 IgG positive, resulting in a seroprevalence of 10.3%. There were 35 participants with PCR-confirmed COVID-19, and 59 reported symptoms consistent with COVID-19 but not confirmed. Additionally, 19 of the 35 people living with HIV who were PCR positive for COVID-19 tested COVID-19 IgG negative at a mean of 203 days (standard deviation: 82 days; range: 41–325 days), while nine persons who were PCR positive tested IgG positive at a mean of 139 days (standard deviation: 72 days; range: 62–231 days) from the initial positive SARS-CoV-2 PCR. Age and diabetes mellitus type II were associated with acquisition of COVID-19 IgG. There was no difference upon sex, race/ethnicity, occupation, residents in household, body mass index, co-morbidities other than diabetes mellitus type II, CD4 cell count, HIV-1 viral load, or known exposure to COVID-19 (Table 1).

Discussion

The seroprevalence of 10.3% that we report in our study of SARS-CoV-2 in people living with HIV in our Ryan White program was about 2-fold higher than the number of reported cases by positive SARS-CoV-2 PCR in the same population. Estimating past infection by serology would have underestimated infection, given the absence of antibodies at the time of the serological testing in those with documented PCR-positive infection and those with possible infection who were never tested. The inclusion of PCR-positive but IgG-negative people living with HIV yields an infection prevalence of 14.1%. In comparison, a study among healthcare workers and first responders in Detroit found a seroprevalence of 6.9%.[7]

The seroprevalence of SARS-CoV-2 in people living with HIV is an emerging topic. One study from San Francisco found that the seroprevalence of SARS-CoV-2 among people living with HIV was about 2 times lower compared to the population without HIV. This finding was attributed to a greater caution and sheltering in place among people living with HIV.[4] Another small study in Italy attempted to estimate the seroprevalence of people living with HIV in Umbria. They screened 270 asymptomatic people living with HIV, and found 5.4% had SARS-CoV-2 IgG antibodies.[8] Another study from Thailand revealed that there were no cases of COVID-19 in people living with HIV despite a high prevalence of HIV infection in this area.[9] The seroprevalence appears to be low in people living with HIV compared to our people living with HIV population; this suggests that the impact of health disparities on the Ryan White patients likely increases the chance of acquisition of COVID-19.[10]

It is of interest that 19 participants, previously diagnosed with COVID-19 by PCR, either lost their antibodies or never made antibodies; thus, nearly 53% of people living with HIV were IgG-negative at a mean of 203 days after PCR diagnosis, while 47% were IgG positive at a mean of 139 days. This bespeaks of antibody loss over time from infection. Although other studies have shown that persistent immunity lasts for at least 6–8 months,[5,11,12] the duration of protection from reinfection and adverse outcome remains unknown. Although there has been a rapid decline in SARS-CoV-2 antibodies reported in the immunocompromised population,[5,13,14] all participants in our study had CD4 cell counts above 200 cell/µl and had suppressed HIV viral loads, suggesting some degree of immune competence. Age and diabetes mellitus type II were found to be associated with acquisition of COVID-19 IgG. Older age and co-morbidities have been previously reported to be associated with an increased risk of hospitalization and mortality in patients infected with SARS-CoV-2.[15,16] Nevertheless, the absence of SARS-CoV-2 antibodies in the majority of people living with HIV less than 1 year post-infection supports the potential for reinfection and the potential need for a sequential immunization strategy.[17]

Our study had a few limitations. We were unable to determine IgG status on 25 patients who completed our survey due to indeterminate test results or failure to have testing performed. Additionally, surveys were answered subjectively, and the number of confirmed SARS-CoV-2 cases was relatively low.

In conclusion, our findings illustrate that the seroprevalence of 10.3% in our Ryan White people living with HIV population is consistent with what has been reported in the literature but significantly underestimates past infection. In order to better understand the penetration of COVID-19 into the people living with HIV community, a greater understanding of the dynamics of the antibody response to COVID-19 and the duration of protective immunity is needed.

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