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A Tale of 3 Pandemics: Severe Acute Respiratory Syndrome Coronavirus 2, Hepatitis C Virus, and Human Immunodeficiency Virus in an Urban Emergency Department in Baltimore, Maryland

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Background. We sought to determine the prevalence and sociodemographic and clinical correlates of acute and convalescent severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), hepatitis C virus (HCV), and human immunodeficiency virus (HIV) infections among emergency department (ED) patients in Baltimore.

Methods. Remnant blood samples from 7450 unique patients were collected over 4 months in 2020 for SARS-CoV-2 antibody (Ab), HCV Ab, and HIV-1/2 antigen and Ab. Among them, 5012 patients were tested by polymerase chain reaction for SARS-CoV-2 based on clinical suspicion. Sociodemographics, ED clinical presentations, and outcomes associated with coinfections were assessed.

Results. Overall, 729 (9.8%) patients had SARS-CoV-2 (acute or convalescent), 934 (12.5%) HCV, 372 (5.0%) HIV infection, and 211 patients (2.8%) had evidence of any coinfection (HCV/HIV, 1.5%; SARS-CoV-2/HCV, 0.7%; SARS-CoV-2/HIV, 0.3%; SARS-CoV-2/HCV/HIV, 0.3%). The prevalence of SARS-CoV-2 (acute or convalescent) was significantly higher in those with HCV or HIV vs those without (13.6% vs 9.1%, $P < .001$). Key sociodemographic disparities (race, ethnicity, and poverty) and specific ED clinical characteristics were significantly correlated with having any coinfections vs no infection or individual monoinfection. Among those with HCV or HIV, aged 18–34 years, Black race, Hispanic ethnicity, and a cardiovascular-related chief complaint had a significantly higher odds of having SARS-CoV-2 (prevalence ratios: 2.02, 2.37, 5.81, and 2.07, respectively).

Conclusions. The burden of SARS-CoV-2, HCV, and HIV co-pandemics and their associations with specific sociodemographic disparities, clinical presentations, and outcomes suggest that urban EDs should consider implementing integrated screening and linkage-to-care programs for these 3 infections.

Keywords. coinfection; emergency department; HCV; HIV; SARS-CoV-2.

The severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) pandemic has infected >235 million people globally, of whom >4.8 million died by the end of September 2021 [1, 2]. In addition to the massive impact on life and livelihood, the coronavirus disease 2019 (COVID-19) pandemic has placed a major strain on the overall healthcare infrastructure, with an unintended adverse impact on access to diagnostic testing and care for those with other common transmissible, but more indolent infectious diseases such as hepatitis C virus (HCV) and human immunodeficiency virus (HIV) [3–6]. Decline in rates of screening have resulted in decreases in the number of newly diagnosed and treated HIV- and HCV-infected individuals, and a deterioration in the care continuum for each [7, 8]. Unfortunately, these changes in healthcare resource delivery during the pandemic have disproportionately impacted underserved communities and other vulnerable populations who have been most severely affected by HCV and HIV, and now by SARS-CoV-2 [9, 10].

Emergency departments (EDs) serve as the frontline of healthcare infrastructure in the United States (US) [11, 12]. Given that, as well as the current model and challenges with healthcare delivery during the current pandemic, EDs are the de facto

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site where patients with emerging and reemerging infectious diseases most commonly present [13]. Historically, EDs have served as a window for understanding emerging infectious disease epidemics in local communities, in large part through the conduct of clinical and laboratory-based observational studies, including those for HIV [14–16], HCV [17–19], and now SARS-CoV-2 [20–23]. EDs have also played a major role in broad infectious disease public health initiatives, implementing varied HCV and HIV testing and linkage-to-care programs [24, 25].

Given the importance of EDs as a sentinel surveillance site for indolent and emerging infections, coupled with knowledge gaps with regard to the impact that SARS-CoV-2 has had on HCV and HIV in the community, we sought to (1) provide a descriptive snapshot of these 3 diseases from the ED perspective; (2) conduct a deeper exploration of the sociodemographic and clinical features of patients with either monoinfection or coinfections; and (3) perform a subgroup analysis to explore the impact of acute and/or convalescent SARS-CoV-2 infection on those with HCV and/or HIV. Understanding the magnitude, epidemiology, and initial clinical presentation of these 3 infections may be important in designing effective interventions, including future comprehensive and integrated ED-based testing, referral, and linkage-to-care strategies.

METHODS

Study Setting and Population

The Johns Hopkins Hospital ED (JHHED) is an urban academic adult ED that provides services to approximately 66 000 patients annually prior to the COVID-19 pandemic, primarily from the neighborhoods surrounding the JHHED and the Baltimore metropolitan area. The ED (patient population including 65% Black and 8% Hispanic) treats mainly underserved and minority populations [20]. Seroprevalence studies have demonstrated high HIV and HCV prevalence (6% and 14%, respectively) among patients attending this ED [15, 17, 26]. There is an established screening and linkage-to-care program for HIV (since 2005) and HCV (since 2015) in place at the JHHED.

An identity-unlinked SARS-CoV-2, HCV, and HIV seroprevalence study was conducted at JHHED using all available stored remnant blood specimens from patients attending the ED from 2 time periods, between 1 May 2020 and 4 July 2020 (study period 1), and from 30 August 2020 to 9 November 2020 (study period 2), prior to Emergency Use Authorizations issued by the US Food and Drug Administration for the use of the Pfizer-BioNTech COVID-19 vaccine on 11 December 2020 [27] and for the use of the Moderna COVID-19 vaccine on 18 December 2020 [28]. Specimens were fully de-identified to remove all protected health information prior to data analysis. For all samples, sociodemographic characteristics (age, sex, race, ethnicity, residential zip code, primary care physician [PCP] status, and healthcare insurance status), clinical information (chief complaint; triage acuity; ED primary, secondary, and tertiary diagnosis; and ED disposition) were available from the ED administrative database. Details of the study methodology have been described elsewhere [20, 29]. This study was approved by the Johns Hopkins University School of Medicine Institutional Review Board (IRB00083646).

Laboratory Testing

Emergency department patients with suspected SARS-CoV-2 infection based on their symptoms and signs, and/or under the ED physician's clinical discretion, were tested for active SARS-CoV-2 infection using reverse-transcription polymerase chain reaction (RT-PCR) Xpert Xpress SARS-CoV-2 test (Cepheid, Sunnyvale, California) [30].

Plasma from remnant samples was tested for antibodies to SARS-CoV-2, HCV, and HIV using Abbott ARCHITECT anti-HCV, HIV Combo Ag/Ab, and SARS-CoV-2 immunoglobulin G (IgG) assay, which detects IgG against the SARS-CoV-2 nucleocapsid protein. All samples were tested on an Abbott ARCHITECT *i*2000SR (Abbott Laboratories, Abbott Park, Illinois) instrument. Samples that were positive for HCV Ab and HIV Ag/Ab were further tested using the Abbott RealTi*m*e HCV and HIV-1 viral load assays (Abbott Laboratories, Des Plaines, Illinois). Detailed information is presented in the Supplementary Materials.

Data Analysis

Point estimates of each viral infection (SARS-CoV-2 overall [acute and convalescent], HCV, and HIV) and their corresponding 95% confidence intervals (CIs) were calculated as well as point estimates and their CIs of SARS-CoV-2 acute and convalescent infection, chronic HCV infection, and unsuppressed HIV viral load. The poverty level of each zip code that was linked to data from the 2018 American Community Survey [31, 32] was operationally categorized based on proportion of people living below the poverty level into <10%, 10% to <20%, 20% to <30%, ≥30%, or missing. Chief complaint was classified into 14 categories using reason for visit classification [33] based on Centers for Disease Control and Prevention categories [34], including a category "nonsymptomatic visit according to purpose of the patient visit" (which includes physical, radiological, and other examinations; laboratory and other testing; medication instructions/request) for those patients without a symptomatic chief complaint. ED diagnosis was classified into 22 disease categories in accordance with the *International Classification of Diseases, Tenth Revision* (*ICD-10*) codes [35].

We initially compared sociodemographic and clinical correlates of each viral infection using the χ^2 or Fisher exact test for categorical variables and the Kruskal-Wallis test for continuous variables. We next repeated the analyses exclusively for those with evidence of any active infection (acute SARS-CoV-2 infection, detectable HCV, and/or HIV RNA). Subgroup analyses

on sociodemographics characteristics by study period were performed.

To determine the sociodemographic factors and clinical correlates associated with coinfection with SARS-CoV-2 (acute or convalescent infection) among ED patients with HIV and/or HCV infection (presence of HIV-1/-2 and/or HCV antibodies), we estimated prevalence ratios (PRs) of SARS-CoV-2 coinfection using bivariate modified Poisson regression analysis. For ED chief complaint and diagnosis, the PR of each unique chief complaint or diagnostic category was determined by comparing those with the specific chief complaint diagnosis vs those without. All PRs were presented with their corresponding 95% CIs. All data analyses were performed using SAS version 9.4 software (SAS Institute Inc, Cary, North Carolina) and a 2-sided P value < .05 was considered statistically significant.

RESULTS

There were 19 289 ED visits by 14 325 unique patients during the study period, of which remnant samples were available for 7461 unique patients. Among these, 7450 patients had SARS-CoV-2, HCV, and HIV antibody testing performed and were included for analysis. Additionally, 5012 of the 7450 patients were also tested in the ED for acute SARS-CoV-2 infection by RT-PCR, based on presenting signs and symptoms and/or at the discretion of the treating ED clinician. Sociodemographic and clinical characteristics of their ED visits are summarized in Table 1. There were some differences observed among those patients included in the analysis vs those not included (Supplementary Table 1).

Overall, there were a total of 1804 patients (24.2% [95% CI, 23.3%–25.2%]) with evidence of at least 1 of the 3 infection types (Figure 1). Specific positive test findings were as follows: 549 (7.4% [95% CI, 6.8%–8.0%]) SARS-CoV-2 IgG antibody; 277 (3.7% [95% CI, 3.3%–4.2%]) SARS-CoV-2 RT-PCR; 934 (12.5% [95% CI, 11.8%–13.3%]) HCV antibody; and 372 (5.0% [95% CI, 4.5%–5.5%]) HIV 1/2 antigen/antibody (Figure 2). Regarding SARS-CoV-2, there were 729 (9.8% [95% CI, 9.1%–10.5%]) patients with evidence of SARS-CoV-2 infection (either acute or convalescent). Regarding HCV, of 934 HCV antibody-positive patients, 388 (41.5%) had detectable RNA, giving an overall viremic HCV prevalence of 5.2% (95% CI, 4.7%–5.7%). Regarding HIV, of 372 HIV-infected patients, 103 (27.7%) had detectable HIV RNA, giving an HIV viremic prevalence of 1.4% (95% CI, 1.1%–1.7%). Regarding coinfections, there were 211 patients (2.8% [95% CI, 2.5%–3.2%]) with evidence of any coinfections of the 3 viruses. Patterns of coinfections are shown in Figure 1 and Supplementary Table 2. HIV plus HCV was the leading coinfection identified (n = 113, 1.5% [95% CI, 1.3%–1.8%]), followed by SARS-CoV-2 and HCV (n = 55, 0.7% [95% CI, .6%–1.0%]) and SARS-CoV-2 and HIV (n = 23, 0.3% [95% CI, .2%–.5%]). Twenty patients (0.3% [95% CI, .2%–.4%]) had coinfection with all 3 viruses. The prevalence of SARS-CoV-2 infection (acute or convalescent) was significantly higher in those with HCV or HIV infection compared to those without both HCV and HIV (13.6% vs 9.1%, P < .001).

Sociodemographic Factors and Clinical Correlates of Monoinfection or Coinfections With SARS-CoV-2, HCV, and HIV

Table 1 compares sociodemographic and clinical factors by infection status (no infection, individual monoinfection with each virus, coinfection with any 2–3 viruses) (Table 1). Description of key significant sociodemographic factors, including age, sex, race/ethnicity, poverty level, having a PCP, self-pay or no medical insurance, and clinical correlates (including triage acuity, chief complaint, specific ED diagnoses, and ED disposition), is summarized in the Supplementary Materials. Subgroup analysis by study period is also summarized in the Supplementary Materials and Supplementary Table 3.

Sociodemographic Factors and Clinical Correlates of "Active" Monoinfection and/or Coinfections: Acute SARS-CoV-2 Infection, Chronic HCV, and Unsuppressed HIV Infection

With respect to acute or uncontrolled active infections, we observed that there were 270 (3.6% [95% CI, 3.2%–4.1%]) patients with active SARS-CoV-2 infection (ie, RT-PCR positive) only, 361 (4.9% [95% CI, 4.4%–5.4%]) with HCV RNA only, 79 (1.1% [95% CI, .8%, 1.3%]) with HIV RNA only, and 29 (0.4% [95% CI, .3%–.6%]) with at least 2 different viral RNA detected. There were 6711 (90.1% [95% CI, 89.4%–90.8%]) patients without detection of any of these 3 viral RNA (Table 2).

Significant differences across a variety of sociodemographic and clinical characteristics were observed when comparing groups based on infection status (ie, no infection, individual monoinfection with each virus, coinfection with any 2–3 viruses). Comparisons made included age, sex, race/ethnicity, poverty level, having a PCP, self-pay or no medical insurance, triage acuity, chief complaint, specific ED diagnoses, and ED disposition (Table 2). Detailed descriptions of the significant associations observed are summarized in the Supplementary Materials. Subgroup analysis by study period is also summarized in the Supplementary Materials and Supplementary Table 4.

Sociodemographic Factors and Clinical Correlates of SARS-CoV-2 Infections Among ED Patients With HCV and/or HIV Infection

For 1173 ED patients with HCV and/or HIV infection, factors positively associated with SARS-CoV-2 infection in bivariate analysis (Table 3) included age 18–34 years (PR compared to those 65 and older, 2.02 [95% CI, 1.18–3.46]), the second period of the study period (1.40 [95% CI, 1.01–1.94]), non-Hispanic Black race (2.37 [95% CI, 1.52–3.69] vs non-Hispanic White), and Hispanic ethnicity (5.81 [95% CI, 2.94–11.46] vs non-Hispanic White).

Table 1. Demographic and Clinical Characteristics by Coinfection Status of Severe Acute Respiratory Syndrome Coronavirus 2 (Immunoglobulin G and/or Reverse-Transcription Polymerase Chain Reaction), Anti–Hepatitis C Virus, and Human Immunodeficiency Virus Antigen/Antibody Positivity

Characteristic	Overall (N = 7450)	Absence of Any Infection (n = 5646)	SARS-CoV-2 Ab$^+$ or PCR$^+$ Only (n = 631)	HCV Ab$^+$ Only (n = 746)	HIV Ag/Ab$^+$ Only (n = 216)	Any Coinfection[a] (n = 211)
Sociodemographic characteristics						
Age[b], y, median (IQR)	47 (32–61)	45 (31–61)	43 (31–58)	55 (40–63)	47 (35.5–58.5)	57 (49–62)
18–24	708 (9.5)	606 (10.7)	78 (12.4)	16 (2.1)	7 (3.2)	1 (0.5)
25–34	1507 (20.2)	1220 (21.6)	129 (20.4)	99 (13.3)	43 (19.9)	16 (7.6)
35–44	1275 (17.1)	959 (17.0)	121 (19.2)	117 (15.7)	50 (23.2)	28 (13.3)
45–54	1156 (15.5)	827 (14.7)	106 (16.8)	135 (18.1)	46 (21.3)	42 (19.9)
55–64	1355 (18.2)	895 (15.9)	98 (15.5)	227 (30.4)	49 (22.7)	86 (40.8)
≥65	1440 (19.3)	1133 (20.1)	98 (15.5)	150 (20.1)	21 (9.7)	38 (18.0)
Missing	9 (0.1)	6 (0.1)	1 (0.2)	2 (0.3)	0 (0.0)	0 (0.0)
Sex observed at birth[b]						
Male	3664 (49.2)	2623 (46.5)	302 (47.9)	480 (64.3)	126 (58.3)	133 (63.0)
Female	3784 (50.8)	3023 (53.5)	329 (52.1)	265 (35.5)	89 (41.2)	78 (37.0)
Unknown	2 (0.0)	0 (0.0)	0 (0.0)	1 (0.1)	1 (0.5)	0 (0.0)
Race/ethnicity[b]						
White, Non-Hispanic	2177 (29.2)	1767 (31.3)	71 (11.3)	283 (37.9)	21 (9.7)	35 (15.6)
Black, Non-Hispanic	4241 (56.9)	3142 (55.7)	339 (53.7)	421 (56.4)	181 (83.8)	158 (74.9)
Other race, Non-Hispanic	482 (6.5)	404 (7.2)	37 (5.9)	25 (3.4)	8 (3.7)	8 (3.8)
Hispanic, any race	550 (7.4)	333 (5.9)	184 (29.2)	17 (2.3)	6 (2.8)	10 (4.7)
ZTCA poverty level[b]						
<10%	1939 (26.0)	1654 (29.3)	134 (21.2)	100 (13.4)	31 (14.4)	20 (9.5)
10% to <20%	2326 (31.2)	1727 (30.6)	229 (36.3)	236 (31.6)	67 (31.0)	67 (31.8)
20% to <30%	1858 (24.9)	1327 (23.5)	159 (25.2)	240 (32.2)	62 (28.7)	70 (33.2)
≥30%	1163 (15.6)	823 (14.6)	98 (15.5)	141 (18.9)	52 (24.1)	49 (23.2)
Unavailable	164 (2.2)	115 (2.0)	11 (1.7)	29 (3.9)	4 (1.9)	5 (2.4)
Has a PCP[b]						
Yes	4689 (62.9)	3589 (63.6)	355 (56.3)	427 (57.2)	160 (74.1)	158 (74.9)
No	2761 (37.1)	2057 (36.4)	276 (43.7)	319 (42.8)	56 (25.9)	53 (25.1)
Self-pay or no primary payor[b]						
Yes	733 (9.8)	543 (9.6)	127 (20.1)	42 (5.6)	9 (4.2)	12 (5.7)
No	6717 (90.2)	5103 (90.4)	504 (79.9)	704 (94.4)	207 (95.8)	199 (94.3)
Clinical characteristics						
Chief complaint[b]						
General symptoms	472 (6.3)	321 (5.7)	71 (11.3)	51 (6.8)	14 (6.5)	15 (7.1)
Nervous system	754 (10.1)	611 (10.8)	46 (7.3)	65 (8.7)	10 (4.6)	22 (10.4)
Skin, hair, and nails	192 (2.6)	146 (2.6)	5 (0.8)	30 (4.0)	7 (3.2)	4 (1.9)
Cardiac, vascular, and lymphatic systems	301 (4.0)	240 (4.3)	28 (4.4)	17 (2.3)	8 (3.7)	8 (3.8)
Respiratory system	1299 (17.4)	921 (16.3)	170 (26.9)	125 (16.8)	37 (17.1)	46 (21.8)
Musculoskeletal system	1069 (14.4)	779 (13.8)	67 (10.6)	154 (20.6)	30 (13.9)	39 (18.5)
Digestive system	1331 (17.9)	1050 (18.6)	108 (17.1)	100 (13.4)	43 (19.9)	30 (14.2)
Endocrine system	50 (0.7)	42 (0.7)	4 (0.6)	2 (0.3)	2 (0.9)	0 (0.0)
Urinary system	268 (3.6)	212 (3.8)	22 (3.5)	19 (2.6)	8 (3.7)	7 (3.3)
Male reproductive system	24 (0.3)	17 (0.3)	3 (0.5)	2 (0.3)	2 (0.9)	0 (0.0)
Female reproductive system and breast	144 (1.9)	122 (2.2)	12 (1.9)	5 (0.7)	4 (1.9)	1 (0.5)
Eyes and ears	188 (2.5)	157 (2.8)	11 (1.7)	13 (1.7)	5 (2.3)	2 (1.0)
Mental health	595 (8.0)	441 (7.8)	30 (4.8)	85 (11.4)	23 (10.7)	16 (7.6)
Nonsymptomatic visit	607 (8.2)	476 (8.4)	34 (5.4)	60 (8.0)	20 (9.3)	17 (8.1)
Missing	156 (2.1)	111 (2.0)	20 (3.2)	18 (2.4)	3 (1.4)	4 (1.9)
Triage acuity[b]						
1	789 (10.6)	594 (10.5)	58 (9.2)	93 (12.5)	24 (11.1)	20 (9.5)
2	1099 (14.8)	808 (14.3)	96 (15.2)	136 (18.2)	33 (15.3)	26 (12.3)
3	4304 (57.8)	3288 (58.2)	346 (54.8)	408 (54.7)	125 (57.9)	137 (64.9)

Table 1. Continued

Characteristic	Overall (N = 7450)	Absence of Any Infection (n = 5646)	SARS-CoV-2 Ab$^+$ or PCR$^+$ Only (n = 631)	HCV Ab$^+$ Only (n = 746)	HIV Ag/ Ab$^+$ Only (n = 216)	Any Coinfection[a] (n = 211)
4	1073 (14.4)	814 (14.4)	114 (18.1)	89 (11.9)	32 (14.8)	24 (11.4)
5	150 (2.0)	115 (2.0)	15 (2.4)	16 (2.1)	2 (0.9)	2 (1.0)
Missing	35 (0.5)	27 (0.5)	2 (0.3)	4 (0.5)	0 (0.0)	2 (1.0)
ED diagnosis						
Certain infectious and parasitic diseases[b]	188 (2.5)	127 (2.3)	13 (2.1)	22 (3.0)	13 (6.0)	13 (6.2)
Neoplasms[b]	119 (1.6)	108 (1.9)	3 (0.5)	6 (0.8)	0 (0.0)	2 (1.0)
Diseases of the blood/blood disorders	192 (2.6)	156 (2.8)	10 (1.6)	18 (2.4)	6 (2.8)	2 (1.0)
Endocrine, nutritional, and metabolic diseases[b]	267 (3.6)	197 (3.5)	16 (2.5)	28 (3.8)	10 (4.6)	16 (7.6)
Mental, behavioral, and neurodevelopmental disease[b]	602 (8.1)	438 (7.8)	39 (6.2)	95 (12.7)	20 (9.3)	10 (4.7)
Diseases of the nervous system[b]	193 (2.6)	171 (3.0)	11 (1.7)	4 (0.5)	3 (1.6)	4 (1.9)
Diseases of the eye and adnexa	140 (1.9)	115 (2.0)	10 (1.6)	10 (1.3)	3 (1.4)	2 (1.0)
Diseases of the ear and mastoid process	20 (0.3)	17 (0.3)	2 (0.3)	1 (0.1)	0 (0.0)	0 (0.0)
Diseases of the circulatory system	490 (6.6)	372 (6.6)	32 (5.1)	58 (7.8)	14 (6.5)	14 (6.6)
Diseases of the respiratory system	310 (4.2)	228 (4.0)	35 (5.6)	33 (4.4)	7 (3.2)	7 (3.3)
Diseases of the digestive system	541 (7.3)	423 (7.5)	38 (6.0)	42 (5.6)	22 (10.2)	16 (7.6)
Diseases of the skin and subcutaneous tissue[b]	255 (3.4)	161 (2.9)	10 (1.6)	66 (8.9)	5 (2.3)	13 (6.2)
Musculoskeletal system and connective tissue[b]	372 (5.0)	279 (4.9)	12 (1.9)	53 (7.1)	14 (6.5)	14 (6.6)
Diseases of the genitourinary system	551 (7.4)	430 (7.6)	49 (7.8)	45 (6.0)	15 (6.9)	12 (5.7)
Pregnancy, childbirth and the puerperium	71 (1.0)	58 (1.0)	7 (1.1)	4 (0.5)	2 (0.9)	0 (0.0)
Congenital malformations or deformations	9 (0.1)	9 (0.2)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Symptoms, signs, abnormal clinical lab finding[b]	2726 (36.6)	2119 (37.5)	193 (30.6)	262 (35.1)	74 (34.3)	78 (37.0)
Injury, poisoning of external causes[b]	602 (8.1)	471 (8.3)	28 (4.4)	79 (10.6)	12 (5.6)	12 (5.7)
Codes for special purposes (eg, COVID-19)[b]	232 (3.1)	48 (0.5)	165 (26.2)	2 (0.3)	1 (0.5)	16 (7.6)
External causes of morbidity	272 (3.7)	206 (3.7)	24 (3.8)	24 (3.2)	8 (3.7)	10 (4.7)
Factors influencing health status and service	301 (4.0)	230 (4.1)	29 (4.6)	38 (5.1)	2 (0.9)	2 (1.0)
None or missing[b]	468 (6.3)	362 (6.4)	36 (5.7)	39 (5.2)	23 (10.7)	8 (3.8)
ED disposition[b]						
Discharge or screened and left	4064 (54.6)	3130 (55.4)	350 (55.5)	357 (47.9)	123 (56.9)	104 (49.3)
Transfer to other facilities, clinics, or L&D	56 (0.8)	43 (0.8)	5 (0.8)	5 (0.7)	2 (0.9)	1 (0.5)
Admit, hospital observation, OR, or died	3103 (41.7)	2314 (41.0)	259 (41.1)	344 (46.1)	86 (39.8)	100 (47.4)
Other	227 (3.1)	159 (2.8)	17 (2.7)	40 (5.4)	5 (2.3)	6 (2.8)

Data are presented as No. (%) unless otherwise indicated.

Abbreviations: Ab, antibody; Ag, antigen; COVID-19, coronavirus disease 2019; ED, emergency department; HCV, hepatitis C virus; HIV, human immunodeficiency virus; IQR, interquartile range; L&D, Labor and Delivery; OR, operating room; PCP, primary care physician; PCR, polymerase chain reaction; SARS-CoV-2, severe acute respiratory syndrome coronavirus 2; ZTCA, zip code tabulation areas.

[a]At least 2 positive laboratory test results of SARS-CoV-2 (immunoglobulin G or reverse-transcription PCR), anti-HCV, and anti–HIV-1/2.

[b]$P < .05$ across the groups under that particular characteristic except for ED diagnosis or $P < .05$ for that specific ED diagnosis.

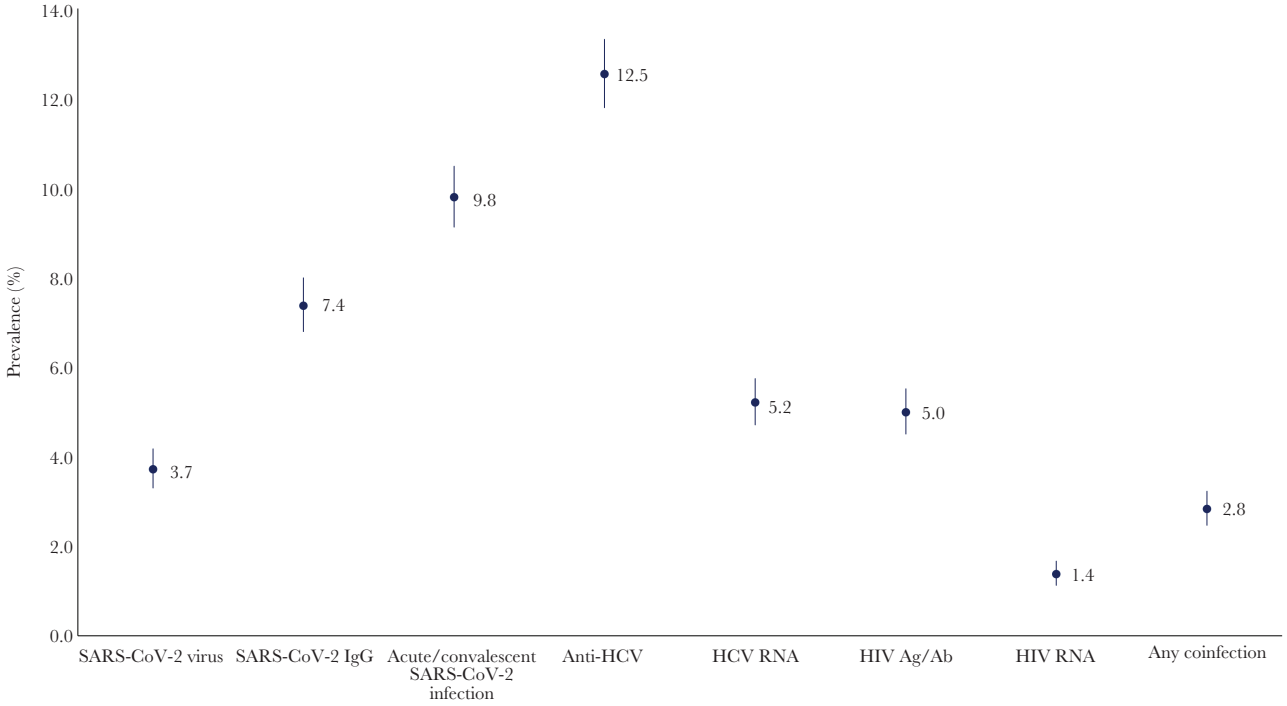

Figure 1. Results of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) immunoglobulin G, SARS-CoV-2 reverse-transcription polymerase chain reaction, human immunodeficiency virus (HIV)–1/2 antigen/antibody, HIV RNA load, hepatitis C virus (HCV) antibody, and HCV RNA load in 7450 patients of an urban emergency department in Baltimore, Maryland, 1 May 2020—9 November 2020. Abbreviations: Ab, antibody; Ag, antigen; ED, emergency department; HCV, hepatitis C virus; HIV, human immunodeficiency virus; SARS-CoV-2, severe acute respiratory syndrome coronavirus 2.

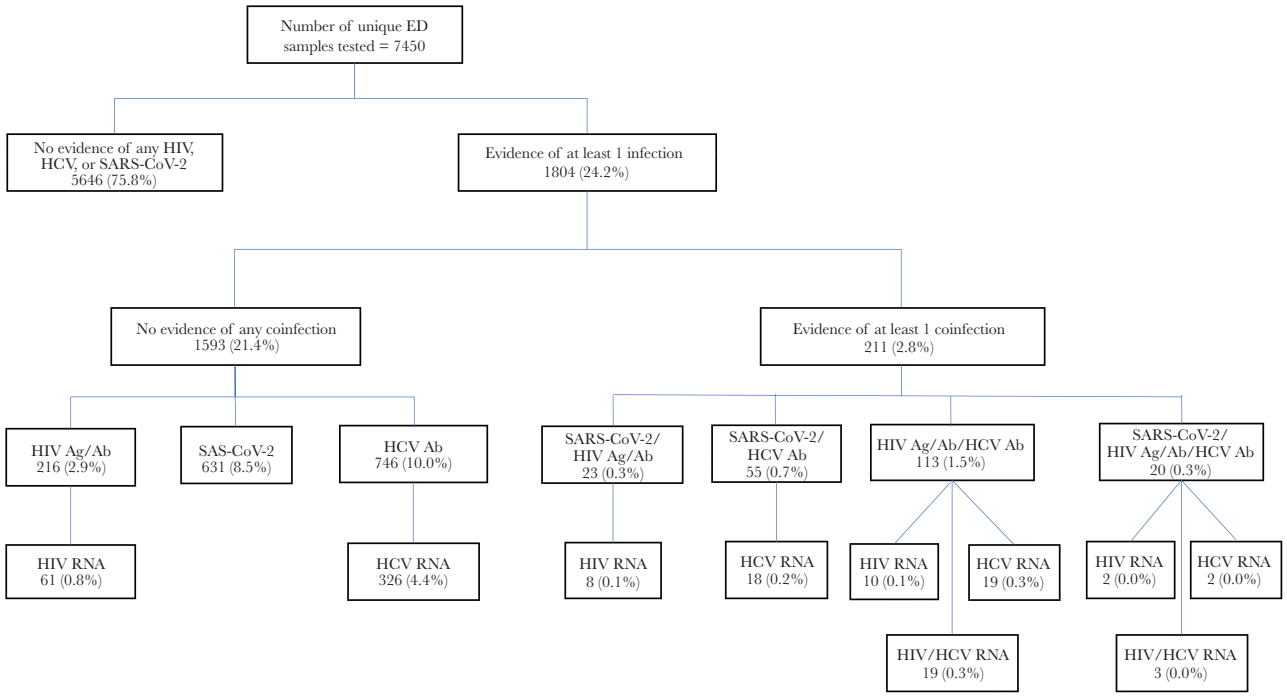

Figure 2. Prevalence of severe acute respiratory syndrome coronavirus 2, hepatitis C virus, and human immunodeficiency virus infection among 7450 patients who presented to an urban emergency department in Baltimore, Maryland, 1 May 2020–9 November 2020. Abbreviations: Ab, antibody; Ag, antigen; HCV, hepatitis C virus; HIV, human immunodeficiency virus; IgG, immunoglobulin G; SARS-CoV-2, severe acute respiratory syndrome coronavirus 2.

Table 2. Demographic and Clinical Characteristics by Active Coinfection Status of Severe Acute Respiratory Syndrome Coronavirus 2 Reverse-Transcription Polymerase Chain Reaction Positive, Detectable Hepatitis C Virus RNA, or Detectable Human Immunodeficiency Virus RNA

Characteristic	Overall (N = 7450)	No Active Coinfection (n = 6711)	SARS-CoV-2 PCR$^+$ Only (n = 270)	HCV VL$^+$ Only (n = 361)	HIV VL$^+$ Only (n = 79)	Any Coactive Infection[a] (n = 29)
Sociodemographic characteristics						
Age[b], y, median (IQR)	47 (32–61)	47 (32–61)	44.5 (32–61)	51 (37–60)	40 (33–53)	55 (40–59)
<25	708 (9.5)	671 (10.0)	26 (9.6)	7 (1.9)	4 (5.1)	0 (0.0)
25–34	1507 (20.2)	1367 (20.4)	54 (20.0)	62 (17.2)	21 (26.6)	3 (10.3)
35–44	1275 (17.1)	1126 (16.7)	55 (20.4)	68 (18.8)	21 (26.6)	5 (17.2)
45–54	1156 (15.5)	1026 (15.3)	32 (11.9)	75 (20.8)	17 (21.5)	6 (20.7)
55–64	1355 (18.2)	1185 (17.7)	54 (20.0)	93 (25.8)	12 (15.2)	11 (37.9)
≥65	1440 (19.3)	1328 (19.8)	49 (18.2)	55 (15.2)	4 (5.1)	4 (13.8)
Missing	9 (0.1)	8 (0.1)	0 (0.0)	1 (0.3)	0 (0.0)	0 (0.0)
Sex observed at birth[b]						
Male	3664 (49.2)	3235 (48.2)	124 (45.9)	231 (64.0)	53 (67.1)	21 (72.4)
Female	3784 (50.8)	3476 (51.8)	146 (54.1)	129 (35.7)	25 (31.7)	8 (27.6)
Unknown	2 (0.0)	0 (0.0)	0 (0.0)	1 (0.3)	1 (1.3)	0 (0.0)
Race/ethnicity[b]						
White, non-Hispanic	2177 (29.2)	1976 (29.4)	36 (13.3)	154 (42.7)	5 (6.3)	6 (20.7)
Black, non-Hispanic	4241 (56.9)	3819 (56.9)	138 (51.1)	194 (53.7)	70 (88.6)	20 (69.0)
Other race, non-Hispanic	482 (6.5)	462 (6.9)	10 (3.7)	8 (2.2)	0 (0.0)	2 (6.9)
Hispanic, any race	550 (7.4)	454 (6.8)	86 (31.9)	5 (1.4)	4 (5.1)	1 (3.5)
ZTCA poverty level[b]						
<10%	1939 (26.0)	1821 (27.1)	61 (22.6)	47 (13.0)	9 (11.4)	1 (3.5)
10% to <20%	2326 (31.2)	2071 (30.9)	106 (39.3)	121 (33.5)	19 (24.1)	9 (31.0)
20% to <30%	1858 (24.9)	1649 (24.6)	55 (20.4)	114 (31.6)	27 (34.2)	13 (44.8)
≥30%	1163 (15.6)	1030 (15.4)	43 (15.9)	62 (17.2)	23 (29.1)	5 (17.2)
Unavailable	164 (2.2)	140 (2.1)	5 (1.9)	17 (4.7)	1 (1.3)	1 (3.5)
Has a PCP[b]						
Yes	4689 (62.9)	4286 (63.9)	159 (58.9)	176 (48.8)	49 (62.0)	19 (65.5)
No	2761 (37.1)	2425 (36.1)	111 (41.1)	185 (51.3)	30 (38.0)	10 (34.5)
Self-pay or no primary payor						
Yes	733 (9.8)	675 (10.1)	29 (10.7)	19 (5.3)	7 (8.9)	3 (10.3)
No	6717 (90.2)	6036 (89.9)	241 (89.3)	342 (94.7)	72 (91.1)	26 (89.7)
Clinical characteristics						
Chief complaint[b]						
General symptoms	472 (6.3)	387 (5.8)	56 (20.7)	19 (5.3)	7 (8.9)	3 (10.3)
Nervous system	754 (10.1)	690 (10.3)	22 (8.2)	35 (9.7)	3 (3.8)	4 (13.8)
Skin, hair, and nails	192 (2.6)	174 (2.6)	0 (0.0)	14 (3.9)	3 (3.8)	1 (3.5)
Cardiac, vascular, and lymphatic systems	301 (4.0)	287 (4.3)	3 (1.1)	7 (1.9)	3 (3.8)	1 (3.5)
Respiratory system	1299 (17.4)	1132 (16.9)	96 (35.6)	52 (14.4)	14 (17.7)	5 (17.2)
Musculoskeletal system	1069 (14.4)	944 (14.1)	17 (6.3)	90 (24.9)	12 (15.2)	6 (20.7)
Digestive system	1331 (17.9)	1237 (18.4)	36 (13.3)	41 (11.4)	15 (19.0)	2 (6.9)
Endocrine system	50 (0.7)	47 (0.7)	0 (0.0)	2 (0.6)	1 (1.3)	0 (0.0)
Urinary system	268 (3.6)	252 (3.8)	5 (1.9)	9 (2.5)	2 (2.5)	0 (0.0)
Male reproductive system	24 (0.3)	24 (0.4)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Female reproductive system and breast	144 (1.9)	139 (2.1)	3 (1.1)	2 (0.6)	0 (0.0)	0 (0.0)
Eyes and ears	188 (2.5)	179 (2.7)	2 (0.7)	7 (1.9)	0 (0.0)	0 (0.0)
Mental health	595 (8.0)	521 (7.8)	9 (3.3)	49 (13.6)	13 (16.5)	3 (10.3)
Nonsymptomatic visit	607 (8.2)	562 (8.4)	11 (4.1)	26 (7.2)	6 (7.6)	2 (6.9)
Missing	156 (2.1)	136 (2.0)	10 (3.7)	8 (2.2)	0 (0.0)	2 (6.9)
Triage acuity[b]						
1	789 (10.6)	693 (10.3)	25 (9.3)	53 (14.7)	15 (19.0)	3 (10.3)
2	1099 (14.8)	977 (14.6)	49 (18.2)	53 (14.7)	12 (15.2)	8 (27.6)
3	4304 (57.8)	3906 (58.2)	156 (57.8)	191 (52.9)	35 (44.3)	16 (55.2)
4	1073 (14.4)	967 (14.4)	35 (13.0)	54 (15.0)	16 (20.3)	1 (3.5)

Table 2. Continued

Characteristic	Overall (N = 7450)	No Active Coinfection (n = 6711)	SARS-CoV-2 PCR+ Only (n = 270)	HCV VL+ Only (n = 361)	HIV VL+ Only (n = 79)	Any Coactive Infection[a] (n = 29)
5	150 (2.0)	137 (2.0)	3 (1.1)	9 (2.5)	1 (1.3)	0 (0.0)
Missing	35 (0.5)	31 (0.5)	2 (0.7)	1 (0.3)	0 (0.0)	1 (3.5)
ED diagnosis						
Certain infectious and parasitic diseases[b]	188 (2.5)	152 (2.3)	9 (3.3)	13 (3.6)	12 (15.2)	2 (6.9)
Neoplasms	119 (1.6)	115 (1.7)	0 (0.0)	4 (1.1)	0 (0.0)	0 (0.0)
Diseases of the blood/blood disorders	192 (2.6)	178 (2.7)	3 (1.1)	8 (2.2)	2 (2.5)	1 (3.5)
Endocrine, nutritional, and metabolic diseases[b]	267 (3.6)	237 (3.5)	5 (1.9)	19 (5.3)	3 (3.8)	3 (10.3)
Mental, behavioral, or neurodevelopmental disease[b]	602 (8.1)	525 (7.8)	9 (3.3)	57 (15.8)	8 (10.1)	3 (10.3)
Diseases of the nervous system	193 (2.6)	182 (2.7)	5 (1.9)	5 (1.4)	1 (1.3)	0 (0.0)
Diseases of the eye and adnexa	140 (1.9)	134 (2.0)	1 (0.4)	5 (1.4)	0 (0.0)	0 (0.0)
Diseases of the ear and mastoid process	20 (0.3)	18 (0.3)	1 (0.4)	1 (0.3)	0 (0.0)	0 (0.0)
Diseases of the circulatory system	490 (6.6)	444 (6.6)	18 (6.7)	22 (6.1)	3 (3.8)	3 (10.3)
Diseases of the respiratory system	310 (4.2)	276 (4.1)	14 (5.2)	15 (4.2)	3 (3.8)	2 (6.9)
Diseases of the digestive system[b]	541 (7.3)	503 (7.5)	11 (4.1)	19 (5.3)	8 (10.1)	0 (0.0)
Diseases of the skin and subcutaneous tissue[b]	255 (3.4)	213 (3.2)	0 (0.0)	37 (10.3)	4 (5.1)	1 (3.5)
Musculoskeletal system and connective tissue[b]	372 (5.0)	338 (5.0)	0 (0.0)	26 (7.2)	7 (8.9)	1 (3.5)
Diseases of the genitourinary system	551 (7.4)	516 (7.7)	14 (5.2)	17 (4.7)	2 (2.5)	2 (6.9)
Pregnancy, childbirth, and the puerperium	71 (1.0)	68 (1.0)	2 (0.7)	1 (0.3)	0 (0.0)	0 (0.0)
Congenital malformations or deformations	9 (0.1)	9 (0.1)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Symptoms, signs, abnormal clinical lab finding[b]	2726 (36.6)	2502 (37.3)	67 (24.8)	119 (33.0)	30 (38.0)	8 (27.6)
Injury, poisoning of external causes[b]	602 (8.1)	556 (8.3)	6 (2.2)	34 (9.4)	4 (5.1)	2 (6.9)
Codes for special purposes (eg, COVID-19)[b]	232 (3.1)	77 (1.2)	152 (56.3)	0 (0.0)	0 (0.3)	3 (10.3)
External causes of morbidity	272 (3.7)	251 (3.7)	6 (2.2)	12 (3.3)	2 (2.5)	1 (3.5)
Factors influencing health status and service[b]	301 (4.0)	275 (4.1)	11 (4.1)	13 (3.6)	1 (1.3)	1 (3.5)
None or missing[b]	468 (6.3)	439 (6.5)	3 (1.1)	20 (5.5)	5 (6.3)	1 (3.5)
ED disposition[b]						
Discharge or screened and left	4064 (54.6)	3731 (55.6)	110 (40.7)	173 (47.9)	38 (48.1)	12 (41.4)
Transfer to other facilities, clinics, or L&D	56 (0.8)	51 (0.8)	3 (1.1)	2 (0.6)	0 (0.0)	0 (0.0)
Admit, hospital observation, OR, or died	3103 (41.7)	2732 (40.7)	150 (55.6)	165 (45.7)	39 (49.4)	17 (58.6)
Other	227 (3.1)	197 (2.9)	7 (2.6)	21 (5.8)	2 (2.5)	0 (0.0)

Data are presented as No. (%) unless otherwise indicated.

Abbreviations: COVID-19, coronavirus disease 2019; ED, emergency department; HCV, hepatitis C virus; HIV, human immunodeficiency virus; IQR, interquartile range; L&D, Labor and Delivery; OR, operating room; PCP, primary care physician; PCR, polymerase chain reaction; SARS-CoV-2, severe acute respiratory syndrome coronavirus 2; VL, viral load; ZTCA, zip code tabulation areas.

[a]At least 2 positive laboratory test results of SARS-CoV-2 reverse-transcription PCR, HCV RNA load testing, and HIV RNA load testing.

[b]$P < .05$ across the groups under that particular characteristic except for ED diagnosis or $P < .05$ for that specific ED diagnosis.

HCV- and/or HIV-infected patients with a cardiovascular-related chief complaint had a higher odds of having SARS-CoV-2 coinfection compared to those with a chief complaint without cardiovascular symptoms/signs (PR, 2.07 [95% CI, 1.06–4.06]). In addition, HCV- and/or HIV-infected patients with an ED diagnosis coded in *ICD-10* as "certain infectious and parasitic diseases," "diseases of the digestive system," and "codes for special purposes" (eg, COVID-19) each had a significantly higher odds of having SARS-CoV-2 coinfection than those without these ED diagnoses (PR: 2.26 [95% CI, 1.31–3.92], 1.74 [95% CI, 1.07–2.85], and 6.80 [95% CI, 4.05–11.39], respectively) (Table 3).

DISCUSSION

Since the beginning of the COVID-19 pandemic, EDs have served as the frontline of the healthcare system for diagnosis and initiation of treatment for SARS-CoV-2–infected individuals [20–23]. EDs also continue to be responsible for treatment of varied emergent and urgent conditions, including HCV and/or HIV [8]. This study is one of the first comprehensive analyses of the burden of SARS-CoV-2 coinfections in HCV- or HIV-infected individuals.

We found that approximately one-quarter of patients in our urban ED had at least 1 of these 3 infections. Furthermore, 12% of those with either past or current infection with any of these 3 viruses were coinfected with at least 1 other virus. We also found that approximately 10% of ED patients had an active and/or uncontrolled infection and 4% were coinfected with at least 2 viruses, translating to approximately 750 and 30 unique viremic ED patients over the 4.5-month study period, respectively. These findings create a "call for action" for urban EDs to develop and implement systematic and integrated testing/

Table 3. Demographic and Clinical Factors Associated With Severe Acute Respiratory Syndrome Coronavirus 2 Coinfection Among Urban Emergency Department Patients Who Had Human Immunodeficiency Virus and/or Hepatitis C Virus Infection

Characteristic	HIV or HCV Infection (n = 1173)	Coinfection With SARS-CoV-2 (n = 159)	No Coinfection With SARS-CoV-2 (n = 1014)	Prevalence Ratio (95% CI)
Sociodemographic characteristics				
Age, y, median (IQR)	47 (32–61)	50 (35–59)	55 (41–62)	NC
18–34[a]	182 (15.6)	37 (23.3)	145 (14.3)	**2.02 (1.18–3.46)**
35–44	195 (16.6)	32 (20.1)	163 (16.1)	1.63 (.94–2.83)
45–54	223 (19.0)	30 (18.9)	193 (19.0)	1.34 (.77–2.34)
55–64	362 (30.9)	39 (24.5)	323 (31.9)	1.07 (.63–1.82)
≥65	209 (17.8)	21 (13.2)	188 (18.5)	1.00
Missing	2 (0.2)	0 (0.0)	2 (0.1)	NC
Sex observed at birth				
Male	739 (63.0)	103 (64.8)	636 (62.7)	1.08 (.78–1.50)
Female	432 (36.8)	55 (34.6)	377 (37.2)	1.00
Unknown	2 (0.2)	1 (0.6)	1 (0.1)	NC
Race/ethnicity				
White, non-Hispanic	339 (28.9)	23 (14.5)	316 (31.2)	1.00
Black, non-Hispanic[a]	760 (64.8)	122 (76.7)	638 (62.9)	**2.37 (1.52–3.69)**
Other race, non-Hispanic	41 (3.5)	1 (0.6)	40 (3.9)	0.36 (.05–2.66)
Hispanic, any race[a]	33 (2.8)	13 (8.2)	20 (2.0)	**5.81 (2.94–11.46)**
Period				
1 May–4 Jul 2020	523 (44.6)	58 (36.5)	465 (45.9)	1.00
30 Aug–9 Nov 2020[a]	650 (55.4)	101 (63.5)	549 (54.1)	**1.40 (1.01–1.94)**
ZTCA poverty level				
<10%	151 (12.9)	18 (11.3)	133 (13.1)	1.00
10% to <20%	370 (31.5)	47 (29.6)	323 (31.9)	1.07 (.62–1.83)
20% to <30%	372 (31.7)	51 (32.1)	321 (31.7)	1.15 (.67–1.97)
≥30%	242 (20.6)	40 (25.2)	202 (19.9)	1.39 (.80–2.42)
Unavailable	38 (3.2)	3 (1.9)	35 (3.5)	NC
Has a PCP				
Yes	745 (63.5)	104 (65.4)	641 (63.2)	1.00
No	428 (36.5)	55 (34.6)	373 (36.8)	0.92 (.66–1.28)
Self-pay or no primary payor				
Yes	63 (5.4)	12 (7.6)	51 (10.7)	1.44 (.80–2.59)
No	1110 (94.6)	147 (92.5)	963 (89.3)	1.00
Clinical characteristics				
Chief complaint				
General symptoms	80 (6.8)	12 (7.6)	68 (6.7)	1.12 (.62–2.01)
Nervous system	97 (8.3)	12 (7.6)	85 (8.4)	0.91 (.50–1.63)
Skin, hair, and nails	41 (3.5)	3 (1.9)	38 (3.8)	0.53 (.17–1.66)
Cardiac, vascular, and lymphatic systems[a]	33 (2.8)	9 (5.7)	24 (2.4)	**2.07 (1.06–4.06)**
Respiratory system	208 (17.7)	34 (21.4)	174 (17.2)	1.26 (.86–1.84)
Musculoskeletal system	223 (19.0)	27 (17.0)	196 (19.3)	0.87 (.58–1.32)
Digestive system	173 (14.8)	26 (16.4)	147 (14.5)	1.13 (.74–1.72)
Endocrine system	4 (0.3)	1 (0.6)	3 (0.3)	1.85 (.26–13.21)
Urinary system	34 (2.9)	4 (2.5)	30 (3.0)	0.86 (.32–2.33)
Male reproductive system	4 (0.3)	0 (0.0)	4 (0.4)	NC
Female reproductive system and breast	10 (0.9)	0 (0.0)	10 (1.0)	NC
Eyes and ears	20 (1.7)	1 (0.6)	19 (1.9)	0.36 (.05–2.61)
Mental health	124 (10.6)	18 (11.3)	106 (10.5)	1.08 (.66–1.76)
Nonsymptomatic visit	97 (8.3)	10 (6.3)	87 (8.6)	0.74 (.39–1.41)
Missing	25 (2.1)	2 (1.3)	23 (2.3)	NC
Triage acuity				
1	137 (11.7)	21 (13.2)	116 (11.4)	0.87 (.50–1.53)
2	195 (16.6)	26 (16.4)	169 (16.7)	0.76 (.45–1.29)

Table 3. Continued

Characteristic	HIV or HCV Infection (n = 1173)	Coinfection With SARS-CoV-2 (n = 159)	No Coinfection With SARS-CoV-2 (n = 1014)	Prevalence Ratio (95% CI)
3	670 (57.1)	82 (51.6)	588 (58.0)	0.70 (.46–1.06)
4 or 5	165 (14.1)	29 (18.3)	136 (13.4)	1.00
Missing	6 (0.5)	1 (0.6)	5 (0.5)	NC
ED diagnosis				
Certain infectious and parasitic diseases[a]	48 (2.5)	14 (8.8)	34 (3.4)	**2.26 (1.31–3.92)**
Neoplasms	8 (0.7)	0 (0.0)	8 (0.8)	NC
Diseases of the blood/blood disorders	26 (2.2)	2 (1.3)	24 (2.4)	0.56 (.14–2.27)
Endocrine, nutritional, and metabolic diseases	54 (4.6)	12 (7.6)	42 (4.1)	1.69 (.94–3.05)
Mental, behavioral, and neurodevelopmental diseases	125 (10.7)	14 (8.8)	111 (11.0)	0.81 (.47–1.40)
Diseases of the nervous system	11 (0.9)	3 (1.9)	8 (0.8)	NC
Diseases of the eye and adnexa	15 (1.3)	1 (0.6)	14 (1.4)	NC
Diseases of the ear and mastoid process	1 (0.1)	0 (0.0)	1 (0.1)	NC
Diseases of the circulatory system	86 (7.3)	8 (5.0)	78 (7.7)	0.67 (.33–1.36)
Diseases of the respiratory system	47 (4.0)	4 (2.5)	43 (4.2)	0.62 (.23–1.67)
Diseases of the digestive system[a]	80 (6.8)	18 (11.3)	62 (6.1)	**1.74 (1.07–2.85)**
Diseases of the skin and subcutaneous tissue	84 (7.2)	8 (5.0)	76 (7.5)	0.69 (.34–1.40)
Musculoskeletal system and connective tissue	81 (6.9)	9 (5.7)	72 (7.1)	0.81 (.41–1.58)
Diseases of the genitourinary system	72 (6.1)	7 (4.4)	65 (6.4)	0.70 (.33–1.50)
Pregnancy, childbirth, and the puerperium	6 (0.5)	0 (0.0)	6 (0.6)	NC
Congenital malformations or deformations	0 (0.0)	0 (0.0)	0 (0.0)	NC
Symptoms, signs, abnormal clinical lab finding	414 (35.3)	50 (31.5)	364 (35.9)	0.84 (.60–1.18)
Injury, poisoning of external causes	103 (8.8)	7 (4.4)	96 (9.5)	0.48 (.22–1.02)
Codes for special purposes (eg, COVID-19)[a]	19 (1.6)	16 (10.1)	3 (0.3)	**6.80 (4.05–11.39)**
External causes of morbidity	42 (3.6)	7 (4.4)	35 (3.5)	1.24 (.58–2.65)
Factors influencing health status and service	42 (3.6)	1 (0.6)	41 (4.0)	0.17 (.02–1.22)
None or missing	70 (6.0)	8 (5.0)	62 (6.1)	NC
ED disposition				
Discharge or screened and left	584 (49.8)	80 (50.3)	504 (49.7)	1.00
Transfer to other facilities, clinics, or L&D	8 (0.7)	0 (0.0)	8 (0.8)	NC
Admit, hospital observation, OR, or died	530 (45.2)	74 (46.5)	456 (45.0)	1.02 (.74–1.40)
Other	51 (4.4)	5 (3.1)	46 (4.5)	0.72 (.29–1.77)

Values in bold font indicated there was a statistical significance for that particular prevalence ratio..

Abbreviations: CI, confidence interval; COVID-19, coronavirus disease 2019; ED, emergency department; HCV, hepatitis C virus; HIV, human immunodeficiency virus; IQR, interquartile range; L&D, Labor and Delivery; NC, not calculated; OR, operating room; PCP, primary care physician; SARS-CoV-2, severe acute respiratory syndrome coronavirus 2; ZTCA, zip code tabulation areas.

[a] $P < .05$ for that particular group as compared to the reference group.

screening strategies that improve the identification and care of patients harboring infections who come through our doors, including those with previously undiagnosed and previously diagnosed HCV, HIV, and SARS-CoV-2 (given potential long-term sequalae and/or complications of each infection) [36]. Finding appropriate methods and resources to implement these strategies will require thoughtful collaboration between engaged clinicians, hospitals, and government agencies.

Despite the importance and impact of these coinfections in ED patients, there are no consistent integrated rapid testing/screening strategies and/or platforms for detecting all 3 viruses when an individual seeks for medical care in an ED. Some US academic EDs, including the study ED, have developed integrated ED-based rapid HIV and HCV testing programs prior to the COVID-19 pandemic [19, 37–39]. Identifying the optimal approaches for EDs to adopt for screening, detection, and linkage for these 3 viruses should include consideration of a variety of factors including patients' sociodemographics, clinical presentation, ED workflow, and currently available testing platforms, but the challenge will be balancing these with what is practical. The vision is to advance screening strategies that easily allow ED clinicians to effectively link patients with care, which would also align with the public health infrastructure to support population health.

Our study revealed significant sociodemographic disparities associated with patients' infection status. Hispanic patients were overwhelmingly stricken by SARS-CoV-2, but not by HCV or HIV. Non-Hispanic White patients were overly impacted by HCV with much fewer affected by SARS-CoV-2 or HIV. On the other hand, the non-Hispanic Black patients were severely

impacted by HIV, but not by HCV. Unexpectedly, we found that coinfection was overrepresented in non-Hispanic Blacks, but that group was not as impacted by monoinfections with either SARS-CoV-2 or HCV. Most notably, there were significant racial/ethnic disparities observed in patients infected with HCV and/or HIV; we found that non-Hispanic Black and Hispanic patients infected with HCV and/or HIV had an approximately 2.5 and 6 times higher rate of coinfection, respectively, with SARS-CoV-2 (acute or convalescent infection) as compared to non-Hispanic White patients. Interestingly, it appeared that the 3 viruses we studied have followed separate epidemic pathways in Baltimore, being mainly confined within racial/ethnicity and geographical community clusters. Our findings suggest that a local differential "precision medicine"–based approach to public health, testing, care, and treatment strategies for testing and linkage may be warranted for ED patients who are at different levels of risks for each of these lethal infections.

Consistent with the literature, we also observed a correlation between these 3 infections and zip code–level poverty, healthcare inaccessibility, and lack of healthcare insurance [40, 41]. Approximately 60% of patients with coinfections resided in zip codes with >20% people living below the poverty level. There was also a trend upward in PRs of SARS-CoV-2 coinfections among HCV/HIV-positive ED patients by the level of poverty in their residential zip codes, even though they were not statistically significant. This correlation might be more contributed by cultural factors (eg, multigenerational housing status, especially among Hispanics) rather than purely by poverty. Our data also revealed that a significant number of patients with SARS-CoV-2 did not have a PCP and/or health insurance, likely rooted in underlying health inequities in the Hispanic population in this city [42]. Of note, a relatively high proportion of patients who only had HCV infection also did not have a PCP, highlighting ongoing challenges related to HCV elimination and control locally.

A substantial number of individuals who survived COVID-19 acute infections presented to the ED with signs or symptoms that could be attributed to postacute sequalae of SARS-CoV-2 infection [43–46]. More than 20% of patients with any coinfections presented with a chief complaint involving the respiratory system, consistent with findings from other reports [43, 45, 46] as well as our own [20]. Notably, for patients with HCV or HIV, those with a cardiovascular-related chief complaint had a 2.1 times higher chance to have current or recent SARS-CoV-2 infection than those without. Previous studies have reported significant rates of cardiovascular-related complications among patients following acute COVID-19 [43, 47–49]. Further research is needed to explore the potential synergic effect of SARS-CoV-2 (acute or postacute) coinfection with HCV and/or HIV on cardiovascular-related complications.

Our ED disposition data found that approximately 60% of patients with coactive infections were admitted to hospital observation units or hospitals, which was significantly higher than all other groups. In addition, high levels of HCV and HIV viremia (5.2% and 1.4%, respectively), which could be controlled or cured with therapeutics, continue to drive these pandemics. Mitigation is possible in those infected if diagnosed early and appropriately managed.

Several limitations in our study should be noted. First, similar to previous seroprevalence studies in EDs or other venues, patients with insufficient amounts of remnant specimens or without blood drawn for clinical care were not included. ED patients included in the data analysis were older and had more severe illness vs those excluded. Additionally, the study ED is an academic ED serving an urban area with high seroprevalence of HCV and HIV. Generalizing our findings to all other US EDs is thus not appropriate; however, there are many urban EDs that serve large sectors of the population in the US, which are similar populations to ours. Second, not all of the ED patients included in this study had SARS-CoV-2 RT-PCR testing as it was ordered based on clinical manifestations or by the ED physician's discretion. As substantial numbers of individuals with SARS-CoV-2 infection are asymptomatic, it is likely that we underestimated the prevalence of acute SARS-CoV-2 infections, as well as coactive infection in our study. Third, some sociodemographic information that might be associated with coinfections and was not systematically collected in the study ED (eg, multigenerational, congregate, or unstable housing and individual/household income) was not available to be included for investigation. Fourth, the practice of ED disposition has significantly changed due to the COVID-19 pandemic. Many patients, especially those suspected to have COVID-19, were admitted to hospital observation unit for social preventive or infection prevention reason rather than sole medical reason. Interpretation on admission to hospital observation unit should be cautious if no detailed disposition information is available. Finally, information regarding known (vs unaware) status of infection with HCV or HIV, as well as whether patients were currently receiving or had completed antiviral therapy for HCV or were receiving ongoing antiretroviral therapy, was not available for this data analysis.

CONCLUSIONS

In conclusion, we observed that a substantial number of ED patients have been affected by the SARS-CoV-2, HCV, and HIV co-epidemics within urban communities in Baltimore. We observed that sociodemographic disparities exist with regard to rate of acquiring either monoinfection or coinfections with any these 3 life-altering viruses. Among those living with HCV and/or HIV, observed disparities in race and ethnicity associated with acquisition of SARS-CoV-2 infection, in addition to the increased rates of cardiovascular-related complaints, raise the imperative to improve education and/or access to COVID-19

vaccination. Furthermore, developing an integrated testing strategy for ED clinicians to identify patients with acute or uncontrolled infections with any of these 3 viruses should help clinicians provide better patient care, including referral and linkage to care after the ED visit for essential medical services, which is particularly important for those who have no and/or inadequate access to the healthcare system.

Supplementary Data

Supplementary materials are available at *Open Forum Infectious Diseases* online. Consisting of data provided by the authors to benefit the reader, the posted materials are not copyedited and are the sole responsibility of the authors, so questions or comments should be addressed to the corresponding author.

Notes

Author contributions. Y.-H. H., R. E. R., S. S. S., M. A., O. L., G. D. K., S. H. M., G. A. C., T. C. Q. designed the study. G. D., R. E. F., I. V. L., E. J. B., S. S., O. R. B., R. W., D. A., and J. H. had primary responsibility for the remnant blood specimen and data collection. M. A. and M. S. performed laboratory testing. T. K., G. D., R. M., and E. P. R. supervised data collection. M. A. and G. A. C. supervised laboratory testing. Y.-H. H. performed data analyses. Y.-H. H., R. E. R., S. S. S., M. A., O. L., S. H. M., G. A. C., and T. C. Q. primarily interpreted results. Y.-H. H., R. E. R., S. S. S., and T. C. Q. primarily drafted the manuscript. M. A., G. A. C., T. K., and S. H. M. performed critical editing of the manuscript. M. S., G. D., R. E. F., I. V. L., R. M., G. D. K., E. J. B., S. S., O. R. B., R. W., E. P. R., D. A., and J. H. reviewed and approved the manuscript.

Patient consent. This identity-unlinked seroprevalence study was reviewed by the Johns Hopkins University School of Medicine Institutional Review Board and was approved as an informed consent–waived research protocol (IRB00083646) due to the identity-unlinked methodology.

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