Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

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RESEARCH ARTICLE

Dispensing of HIV and Hepatitis C Antivirals During COVID-19: An Interrupted Time-Series Analysis of U.S. National Data

Timothy W. Levengood, MPH,[1] Andrew I. Aronsohn, MD,[2] Kao-Ping Chua, MD, PhD,[3,4] Rena M. Conti, PhD[5]

Introduction: Little is known about the potential changes in the dispensation of life-saving hepatitis C virus (HCV) and HIV antivirals after the initial U.S. outbreak of COVID-19. The objective of this study was to describe the immediate and 1-year impacts of the U.S. outbreak of COVID-19 on monthly dispensing of HIV and HCV antivirals, specifically direct-acting antivirals (DAA) to treat HCV, antiretroviral therapy (ART) to treat HIV, and pre-exposure prophylaxis (PrEP) to prevent HIV.

Methods: Authors used interrupted time-series analysis, examining IQVIA National Prescription Audit (includes 92% of U.S. retail pharmacies and 70% of U.S. mail order and long-term care pharmacies) for changes in monthly dispensed prescriptions, 2 years before and 1 year after the initial U.S. COVID-19 outbreak. Fitted linear segmented regression models were used to assess immediate level and slope changes, excluding data from April 2020 as a washout period. Authors stratified analyses by new/refill, age group, payer type, and delivery channel.

Results: After the initial outbreak, DAA prescription dispensing declined by almost one third. The COVID-19 outbreak was associated with an immediate-level decrease in total DAA prescriptions, followed by a slope increase in monthly dispensing. However, by April 2021, monthly DAA dispensing had not recovered to prepandemic levels. In contrast, ART and PrEP dispensing changed little over the same time period.

Conclusions: U.S. dispensing of DAAs to treat HCV fell at the start of the U.S. COVID-19 outbreak and has yet to fully recover to prepandemic levels. Addressing barriers to care is crucial to reaching national HIV and hepatitis C elimination goals.

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INTRODUCTION

HIV and hepatitis C virus (HCV) impact millions of people and disproportionately burden socially marginalized groups.[1,2] Left untreated, each can lead to advanced disease, worsened quality of life, and premature death. The current U.S. and WHO initiatives call for the elimination of HIV and HCV by 2030.[3,4] Life-saving pharmaceutical advancements in the past decade—direct-acting antivirals (DAAs) to cure HCV, antiretroviral therapy (ART) for HIV management, and pre-exposure prophylaxis (PrEP) for HIV prevention—have transformed these calls into tangible goals.[5]

From the [1]Department of Health, Law, Policy & Management, Boston University School of Public Health, Boston, Massachusetts; [2]Section of Gastroenterology, Hepatology & Nutrition, Department of Medicine, The University of Chicago, Chicago, Illinois; [3]Susan B. Meister Child Health Evaluation and Research Center (CHEAR), Department of Pediatrics, University of Michigan Medical School, Ann Arbor, Michigan; [4]Department of Health Management and Policy, University of Michigan School of Public Health, Ann Arbor, Michigan; and [5]Department of Markets, Public Policy & Law, Boston University Questrom School of Business, Boston University, Boston, Massachusetts

Address correspondence to: Timothy W. Levengood, MPH, Department of Health, Law, Policy & Management, Boston University School of Public Health, 715 Albany Street, Talbot Building, T2W, Boston MA 02118. E-mail: tleven@bu.edu.

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The coronavirus disease 2019 (COVID-19) pandemic likely impeded progress toward treating and eliminating HCV and HIV. Using data from a large clinical laboratory test provider with sites across the U.S., 1 study observed a 59% reduction in HCV antibody testing during April 2020.[6] Moreover, several reports document reduced HIV testing and delayed HIV care appointments after the initial outbreak. In a case study from New York, community-based organizations reported disruptions in all HIV care continuum services during April 2020, including testing, PrEP, and primary care.[7] Another case study from an academic medical center in Chicago documented a shift to telemedicine after shelter in place orders in late March 2020. During the next month, 45 of 98 scheduled HIV care visits were not attended nor were rescheduled.[8] These studies suggest that the outbreak was associated with fewer opportunities to diagnose HCV and HIV; however, they did not directly examine U.S. dispensing of DAAs, ART, and PrEP. Documenting national changes in the dispensing of these drugs is essential to motivating action by clinicians and policymakers to ensure access to life-saving treatments for patients with HIV and HCV.

This study analyzed the dispensing of DAAs, ART, and PrEP from May 2018 through April 2021 using a national data set that reports 92% of U.S. prescriptions. To the authors' knowledge, this study provides the most complete and recent data on the national dispensing of these drugs.

METHODS

Study Sample

In September 2021, the authors analyzed the IQVIA National Prescription Audit, which reports monthly dispensing counts from 92% of U.S. retail pharmacies and 70% of U.S. mail order and long-term care pharmacies.[9] The study period encompassed 3 years of data, from May 2018 to April 2021. In the data set, dispensing counts are projected to national totals using IQVIA's proprietary methodology. These counts are reported overall and according to patient age group, method of payment for prescriptions, and whether prescriptions are new prescriptions or refills of a new prescription. In this context, new does not necessarily imply that the patient had no previous use of the drug; rather, it implies that the prescription was not a refill. The data set lacks individual patient identifiers or information on prescription indication. Because data were deidentified, the Boston University IRB exempted this study from review.

DAAs were defined as products listed in Uniform System of Classification Level 5 category 82212 (hepatitis C antivirals), excluding all ribavirin products. *ART prescriptions* were defined as products listed in Uniform System of Classification Level 3 category 82100 (HIV antivirals), excluding drugs defined as PrEP. *PrEP prescriptions* were defined as those for branded emtricitabine/tenofovir disproxil fumarate (Truvada), which was approved for ART in 2004 and PrEP in 2012[10]; generic emtricitabine/tenofovir disproxil fumarate, which became available September 2020[11]; and branded emticitabine/tenofovir alafenamide (Descovy), which was approved for ART in April 2016 and PrEP in October 2019.[11] Authors distinguished between these medications using variables for product name, combined molecule name, and branded versus generic status.

Measures

For each medication class, authors calculated the number of dispensed prescriptions per 100,000 Americans per month. Monthly population estimates were obtained from the U.S. Census Bureau.[12] Because monthly population estimates for 2021 were not available at the time of writing, the authors used linear regression to calculate the rate of change per month in population estimates between May 2018 and December 2020, then extrapolated predictions to January 2021–April 2021. Results were similar when subtracting the estimated number of COVID-19 decedents during January 2021–April 2021 from projected population denominators.

Statistical Analysis

To describe prepandemic dispensing of DAAs and ARTs, the authors calculated the number of dispensed prescriptions in 2019 per 100,000 Americans. The authors did not describe the prepandemic dispensing of PrEP in 2019. In October 2019, the month in which Descovy gained Food and Drug Administration approval for PrEP, there was an abrupt jump in aggregate dispensing of Descovy and Truvada. Because including data before this month would have distorted preintervention trends, analyses of PrEP dispensing began in October 2019.

To assess changes in dispensing of DAAs and ARTs after the outbreak, the authors calculated the unadjusted year-over-year change in dispensing between March 2019–February 2020 and March 2020–February 2021. Authors did not calculate this change for PrEP for similar reasons as stated earlier. In addition, for all 3 medication classes, the authors assessed changes in monthly dispensing associated with the outbreak using an interrupted time-series analysis. The time period of this analysis was May 2018–April 2021. The *outbreak* was defined as April 2020. Linear segmented regression models were used to assess immediate level and slope changes during April 2020, excluding data from this month as a washout period. Models used Newey-West robust SEs with a 1-month lag to account for first-order autocorrelation. In these models, the intercept is the predicted value of the outcome at baseline, the *level change* refers to any abrupt increase or decrease in the fitted line after the outbreak, and the *slope change* refers to any abrupt change in the slope of the fitted line after the outbreak compared with that of the preoutbreak slope.

In subgroup analyses, authors repeated segmented regression models by age group, method of payment, and delivery channel. Age-group categories were 0–19 years, 20–39 years, 40–64 years, and ≥65 years. Authors used IQVIA's categorizations for payer type: (1) third-party (a category that mostly includes prescriptions paid through private insurance but also includes prescriptions paid by Medicaid managed care), (2) fee-for-service Medicaid, (3) Medicare, and (4) cash (i.e., self-pay) payment. Delivery channels included (1) retail pharmacies (including chain pharmacies, food store pharmacies, and independent pharmacies), (2) mail-order

pharmacies, and (3) long-term care pharmacies. For DAAs only, the authors repeated segmented regression models according to whether the prescription was a new prescription or a refill. Unlike chronic medications such as ART and PrEP, DAAs are typically given as a one-time curative treatment, meaning that new DAA prescriptions may be an indicator of treatment initiation, whereas refill prescriptions may be an indicator of treatment disruption or discontinuation.

The authors conducted 3 sensitivity analyses. First, because the 3 PrEP drugs are also approved for ART, the authors reanalyzed ART dispensing when including these drugs in the definition of ART. Second, rather than define the outbreak as April 2020, the authors defined the *outbreak* as March 2020 and excluded data from this month as a washout period. Third, the authors repeated segmented regression models when modeling the number of dispensed prescriptions instead of the number of dispensed prescriptions per 100,000 Americans. Analyses used 2-sided hypothesis tests (α=0.05) and Stata 16.1 SE.

RESULTS

Table 1 shows prepandemic dispensing counts and year-over-year changes in dispensed prescriptions for DAAs and ARTs as well as coefficients from segmented regression models for all the 3 medication classes. In 2019, 276,326 DAA prescriptions were dispensed (84.1 per 100,000 Americans). The number of DAA prescriptions dispensed in March 2020−February 2021 was 25.8% lower than that in March 2019−February 2020. Before the COVID-19 outbreak, DAA dispensing decreased by −0.04 prescriptions per 100,000 Americans per month (95% CI= −0.07, −0.01). The outbreak was associated with an immediate-level decrease (−2.04 prescriptions per 100,000 Americans, 95% CI= −2.49, −1.59) in total DAA prescriptions and a slope increase (+0.13 prescriptions per 100,000 Americans per month, 95% CI= 0.06, 0.19) in the months after. By April 2021, monthly DAA dispensing had not recovered to prepandemic levels. Figure 1 graphically displays these trends in DAA dispensing.

In 2019, 10,101,007 ART prescriptions were dispensed (3,077.5 per 100,000 Americans). The number of ART prescriptions dispensed in March 2020−February 2021 was 2.1% lower than that in March 2019−February 2020. Before the outbreak, ART dispensing decreased by 0.58 prescriptions per 100,000 Americans per month (95% CI= −1.04, −0.12). The outbreak was not associated with either a level or slope change in ART dispensing.

Between October 2019 and February 2020, the monthly rate of PrEP dispensing did not change. The outbreak was not associated with an immediate-level or slope change in dispensing. Figure 2 displays the trends in ART and PrEP dispensing.

Table 2 shows the coefficients from segmented regression models when stratifying by age group, payer type, and channel. For DAAs only, Table 2 also shows the coefficients when stratifying by whether prescriptions were new or were refills of previous prescriptions. Immediate-level decreases occurred in April 2020 both for new and refill prescriptions, with modest upticks in the slopes. The immediate-level decrease in DAA prescription dispensing was −0.52 prescriptions per 100,000 Americans (95% CI= −0.66, −0.38) for patients aged 20−39 years. Immediate-level decreases also occurred for patients aged 40−64 years and those aged ≥65 years. Unlike in patients aged 40−64 years and those aged ≥65 years, there was no slope change in the months after the outbreak in DAA dispensing for patients aged 20−39 years. Level decreases in DAA prescription dispensing occurred for all methods of payment except cash payment and also occurred for both the retail pharmacy and mail-order pharmacy channels.

As in the overall analysis of ART and PrEP dispensing, the outbreak was not associated with level changes for most subgroups. However, in contrast to the overall analysis, there was an immediate slope increase in the dispensing of ARTs paid by Medicaid or by cash. Unlike dispensing in other age groups, PrEP dispensing to patients aged 0−19 years was decreasing before April 2020 (−0.06 prescriptions per 100,000 patients per month, 95% CI= −0.08, −0.04). After the outbreak, there was an abrupt level increase and a slope increase of 0.05 prescriptions per 100,000 patients per month, implying that the trend in PrEP dispensing in this age group was essentially flat after the outbreak.

The Appendix (available online) shows the results of sensitivity analyses. Conclusions regarding ART dispensing were substantively unchanged when including the 3 PrEP drugs in the definition of ART, when defining the outbreak as March 2020 rather than as April 2020, and when modeling total dispensed prescriptions.

DISCUSSION

This study is, to the authors' knowledge, the first to examine the national dispensing of life-saving HCV and HIV drugs in the U.S. through the first year after the COVID-19 outbreak.[13] We find that the COVID-19 outbreak in April 2020 was associated with a sharp decrease in DAA prescription dispensing and that the levels of dispensing remained below their prepandemic baseline in April 2021. In contrast, the outbreak was associated with minimal changes in dispensing of ART or PrEP drugs.

The study's findings on DAA dispensing are consistent with those of a previous Canadian analysis of drugs

Table 1. U.S. Dispensing of Prescriptions for DAAs, ART, and PrEP, May 2018–April 2021

Medications	Total Rx in 2019 (number of Rx/100,000 Americans)	Percent change in total Rx between March 2019–February 2020 and March 2020–February 2021 (% change in number of Rx/100,000 Americans)	Coefficients from segmented regression models, total Rx/100,000 Americans (95% CI)			
			Intercept	Change per month before April 2020	Level change during April 2020	Slope change after April 2020
DAA prescriptions	276,326 (84.1)	−25.8% (−26.1%)	7.52 (7.05, 7.98)	**−0.04 (−0.07, −0.01) ***	**−2.04 (−2.49, −1.59) *****	**0.13 (0.06, 0.19) *****
ART prescriptions	10,101,007 (3,077.5)	−2.1% (−2.6%)	199.33 (194.17, 204.49)	**−0.58 (−1.04, −0.12) ***	2.66 (−6.54, 11.86)	−0.38 (−1.55, 0.79)
PrEP prescriptions[a]	NA	NA	66.1 (63.06, 69.14)	0.23 (−1.05, 1.50)	−4.95 (−11.27, 1.36)	−0.06 (−1.39, 1.26)

Source: IQVIA National Prescription Audit; timeframe, May 2018–April 2021. *DAAs* were defined as products listed in Uniform System of Classification Level 5 category 82212 (hepatitis C antivirals), excluding all ribavirin products. *ARTs* were defined as products listed in Uniform System of Classification Level 3 category 82100 (HIV antivirals), excluding the *3 PrEP drugs*, which were defined as Descovy, Truvada, and generic combination emtricitabine/tenofovir disproxil fumarate. Monthly population denominators through 2020 were from the U.S. Census Bureau and were imputed for January 2021–April 2021.

Note: Boldface indicates statistical significance (*$p<0.05$, **$p<0.01$, ***$p<0.001$).

All coefficients for intercept are also significant at ***$p<0.001$. Interpretation: the intercept is the estimated baseline level of the outcome variable, change per month before April 2020 is the slope or trajectory of the outcome (dispensed prescriptions per 100,000 Americans) until the start of the U.S. COVID-19 outbreak, level change during April 2020 represents the change in the level of the outcome that occurs in the period immediately after the outbreak, and slope change after April 2020 represents the immediate change in slope that occurs after the outbreak compared with that in the preoutbreak slope.

[a]Analyses of PrEP begin in October 2019, the month Descovy gained FDA approval for use as PrEP. Therefore, the authors do not display the total PrEP prescriptions for 2019 or calculate PrEP percent changes between March 2019–February 2020 and March 2020–February 2021.

ART, antiretroviral therapy; DAA, direct-acting antiviral; FDA, Food and Drug Administration; PrEP, pre-exposure prophylaxis; Rx, prescription.

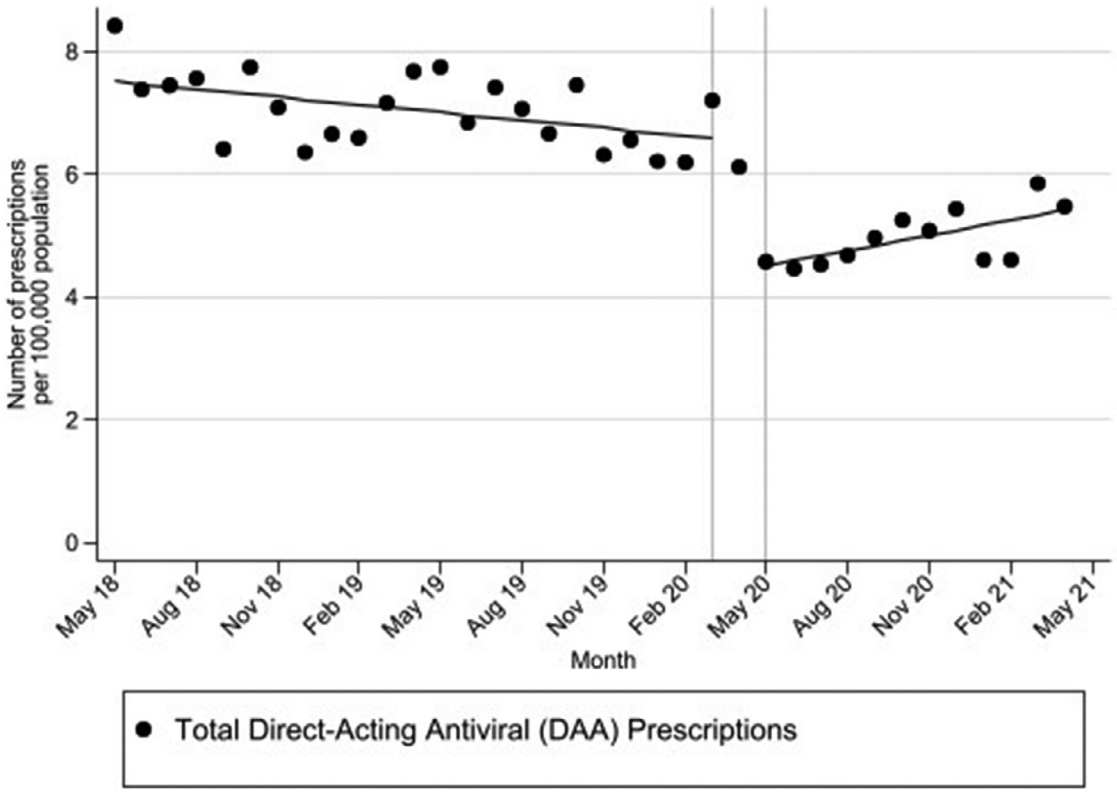

Figure 1. Dispensed prescriptions for DAAs per 100,000 Americans, May 2018–April 2021.
Aug, August; DAA, direct-acting antiviral; Feb, February, Nov, November.

Source: IQVIA National Prescription Audit; timeframe: May 2018–April 2021. *DAA*s were defined as products listed in Uniform System of Classification Level 5 category 82212 (hepatitis C antivirals), excluding all ribavirin products. Monthly population denominators through 2020 were from the U.S. Census Bureau and were imputed for January 2021–April 2021.

reimbursed by the Ontario Drug Benefit. That analysis observed a sharp decline (49.3%) in the number of DAA prescriptions dispensed in the quarter after the introduction of COVID-19 restrictions. This study builds on the Canadian analysis using U.S. data and examining dispensing patterns over a longer period.

The study's findings raise concerns that the pandemic has substantially disrupted efforts to eliminate HCV using DAAs. One explanation for the decreased DAA dispensing in this study may be that fewer patients were newly diagnosed with HCV, a possibility supported by a previous study showing that HCV testing decreased after the COVID-19 outbreak.[6] Another explanation is that patients with HCV already connected to care received DAA treatment before April 2020, meaning that patients eligible for treatment during the pandemic were those with poor care access. Detecting HCV in these hard-to-reach patients and initiating treatment may have been particularly difficult after the COVID-19 outbreak.

In subgroup analyses, there were large decreases in DAA dispensing in patients aged 20–39 years. This is a particularly important group from the perspective of public health because it disproportionately accounts for people who inject drugs and have HCV, a highly marginalized population with substantial barriers to care.[14] In addition, this study found that dispensing of both new and refill prescriptions for DAAs decreased after the outbreak. This finding raises the possibility that both initiation and completion of DAA therapy were disrupted by the pandemic. Notably, because the study data set does not report days supplied of prescriptions, it could not be determined whether the decrease in DAA refills reflected a shift toward the provision of larger new prescriptions, obviating the need for refills. Future research should assess the reasons for the observed decreases in new and refill DAA prescriptions using data sets with individual patient identifiers and prescription duration.

Because of cost and previous authorization requirements, many DAA prescriptions are filled through specialty pharmacies that route through mail-order channels. This study found that DAA dispensing for both retail and mail-order channels dropped substantially in April 2020. The drop in mail-order dispensing occurred even though social distancing measures would not have impeded dispensing through this channel,

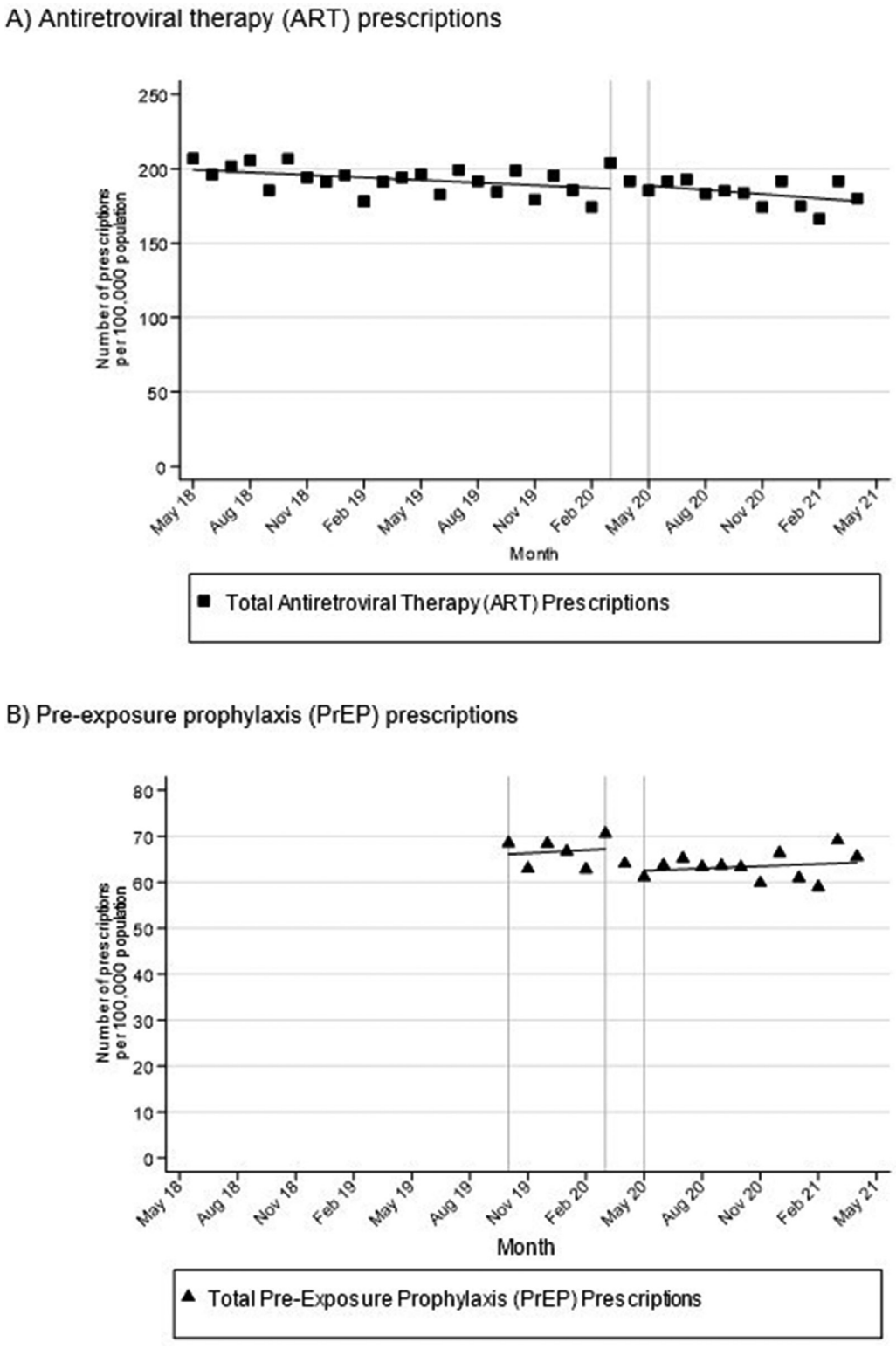

Figure 2. Dispensed prescriptions for HIV ART and PrEP per 100,000 Americans, May 2018–April 2021.

ART, antiretroviral therapy; Aug, August; FDA, Food and Drug Administration; Feb, February; Nov, November; PrEP, pre-exposure prophylaxis.

Source: IQVIA National Prescription Audit; timeframe: May 2018–April 2021. *ART* was defined as products listed in Uniform System of Classification Level 3 category 82100 (HIV antiviral combination), excluding the 3 PrEP drugs, which were defined as Truvada, Descovy, or generic combination emtricitabine/tenofovir disproxil fumarate. Analyses of PrEP began in October 2019, the month in which Descovy was FDA-approved for PrEP. Monthly population denominators through 2020 were from the U.S. Census Bureau and were imputed for January 2021–April 2021.

Table 2. U.S. Dispensing of Prescriptions for DAAs, ART, and PrEP by Subgroup, May 2018–April 2021

Variables	Coefficients from segmented regression models, total Rx/100,000 Americans (95% CI)			
	Intercept	Change per month before March 2020	Level change during April 2020	Level change divided by intercept, %	Slope change after April 2020
(A) DAA prescriptions					
Prescription type					
New	3.32 (3.13, 3.51)	**−0.02 (−0.03, −0.01)****	**−0.98 (−1.25, −0.72)*****	**−29.5**	**0.07 (0.04, 0.10)*****
Refill	4.19 (3.87, 4.51)	−0.02 (−0.05, 0.00)	**−1.06 (−1.39, −0.72)*****	**−25.3**	**0.05 (0.00, 0.11)***
Age[a]					
0–19 years	0.01 (0.01, 0.02)	0.00 (0.00, 0.00)	0.01 (−0.01, 0.02)	100.0	0.00 (0.00, 0.00)
20–39 years	1.11 (1.02, 1.21)	**0.02 (0.02, 0.03)*****	**−0.52 (−0.66, −0.38)*****	**−46.8**	0.01 (−0.01, 0.03)
40–64 years	4.66 (4.38, 4.95)	**−0.05 (−0.07, −0.03)*****	**−1.06 (−1.30, −0.81)*****	**−22.7**	**0.07 (0.04, 0.11)*****
≥65 years	1.73 (1.63, 1.82)	**−0.02 (−0.03, −0.01)*****	**−0.47 (−0.56, −0.38)*****	**−27.2**	**0.04 (0.03, 0.06)*****
Payer type					
Third-party	5.28 (4.94, 5.62)	−0.02 (−0.04, 0.01)	**−1.54 (−1.91, −1.16)*****	**−29.2**	**0.08 (0.03, 0.12)****
Medicaid	0.92 (0.83, 1.01)	0.00 (−0.01, 0.01)	**−0.27 (−0.34, −0.20)*****	**−29.3**	**0.01 (0.00, 0.02)****
Medicare part D	1.22 (1.15, 1.28)	**−0.02 (−0.02, −0.01)*****	**−0.22 (−0.30, −0.15)*****	**−18.0**	**0.03 (0.02, 0.04)*****
Cash	0.10 (0.09, 0.11)	**0.00 (0.00, 0.00)*****	−0.01 (−0.02, 0.00)	−10.0	**0.01 (0.01, 0.01)*****
Channel					
Combined retail	2.48 (2.31, 2.65)	**−0.01 (−0.03, 0.00)***	**−0.71 (−0.89, −0.53)*****	**−28.6**	**0.04 (0.01, 0.06)****
Mail	4.64 (4.34, 4.93)	−0.02 (−0.04, 0.00)	**−1.29 (−1.61, −0.98)*****	**−27.8**	**0.07 (0.03, 0.11)****
Long-term care	0.40 (0.33, 0.47)	**−0.01 (−0.01, 0.00)****	−0.04 (−0.09, 0.02)	−10.0	**0.02 (0.01, 0.02)*****
(B) ART prescriptions					
Age[a]					
0–19 years	2.14 (2.02, 2.26)	**−0.03 (−0.04, −0.02)*****	0.09 (−0.06, 0.23)	4.2	0.01 (−0.01, 0.02)
20–39 years	40.2 (38.94, 41.45)	−0.02 (−0.13, 0.09)	1.03 (−1.31, 3.37)	2.6	**−0.28 (−0.55, −0.01)***
40–64 years	131.96 (128.54, 135.38)	**−0.60 (−0.90, −0.30)*****	2.31 (−3.63, 8.26)	1.8	−0.25 (−0.98, 0.48)
≥65 years	24.83 (23.92, 25.73)	0.08 (0.00, 0.17)	−0.71 (−2.52, 1.10)	−2.9	0.12 (−0.14, 0.37)
Payer type					
Third-party	133.04 (129.26, 136.83)	−0.13 (−0.48, 0.21)	2.38 (−4.43, 9.18)	1.8	−0.65 (−1.44, 0.14)
Medicaid	17.63 (17.21, 18.04)	**−0.17 (−0.21, −0.14)*****	−0.41 (−1.05, 0.22)	−2.3	**0.16 (0.09, 0.23)*****
Medicare part D	46.44 (45.18, 47.69)	**−0.22 (−0.32, −0.12)*****	0.73 (−1.25, 2.71)	1.6	0.04 (−0.28, 0.37)
Cash	2.22 (2.05, 2.40)	**−0.05 (−0.07, −0.04)*****	−0.03 (−0.26, 0.20)	−1.4	**0.07 (0.06, 0.09)*****

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Table 2. U.S. Dispensing of Prescriptions for DAAs, ART, and PrEP by Subgroup, May 2018–April 2021 (*continued*)

Variables	Coefficients from segmented regression models, total Rx/100,000 Americans (95% CI)				
	Intercept	Change per month before March 2020	Level change during April 2020	Level change divided by intercept, %	Slope change after April 2020
Channel					
Combined retail	145.04 (141.56, 148.52)	**−0.49 (−0.81, −0.17)****	0.97 (−5.17, 7.11)	0.7	−0.01 (−0.88, 0.85)
Mail	42.36 (40.71, 44.01)	0.01 (−0.14, 0.15)	2.16 (−0.82, 5.15)	5.1	**−0.43 (−0.72, −0.13)****
Long-term care	11.93 (11.69, 12.18)	**−0.10 (−0.12, −0.08)*****	**−0.47 (−0.84, −0.10)***	**−3.9**	**0.06 (0.02, 0.11)****
(C) PrEP prescriptions					
Age[a]					
0–19 years	0.69 (0.63, 0.75)	**−0.06 (−0.08, −0.04)*****	**0.18 (0.01, 0.36)***	**26.1**	**0.05 (0.03, 0.08)*****
20–39 years	31.26 (30.09, 32.43)	0.12 (−0.41, 0.64)	−2.84 (−5.75, 0.07)	−9.1	0.12 (−0.44, 0.68)
40–64 years	30.67 (29.00, 32.35)	0.08 (−0.59, 0.76)	−1.82 (−4.92, 1.28)	−5.9	−0.18 (−0.88, 0.51)
≥65 years	3.45 (3.19, 3.70)	**0.09 (0.01, 0.16)***	**−0.47 (−0.81, −0.13)***	**−13.6**	−0.06 (−0.15, 0.03)
Payer type					
Third-party	56.02 (53.41, 58.62)	0.40 (−0.68, 1.48)	−4.88 (−10.20, 0.45)	−8.7	−0.21 (−1.32, 0.91)
Medicaid	3.42 (3.28, 3.55)	**−0.10 (−0.15, −0.04)****	−0.04 (−0.31, 0.23)	−1.2	**0.10 (0.04, 0.16)****
Medicare part D	6.46 (6.16, 6.77)	−0.08 (−0.23, 0.07)	0.06 (−0.69, 0.82)	0.9	0.04 (−0.11, 0.20)
Cash	0.21 (0.18, 0.23)	0.01 (0.00, 0.01)	**−0.10 (−0.14, −0.06)*****	**−47.6**	0.00 (−0.01, 0.01)
Channel					
Combined retail	51.45 (49.24, 53.67)	0.30 (−0.59, 1.19)	**−5.13 (−9.42, −0.84)***	**−10.0**	−0.07 (−1.04, 0.89)
Mail	12.65 (11.86, 13.44)	−0.07 (−0.43, 0.3)	−0.02 (−1.85, 1.81)	−0.2	0.01 (−0.34, 0.37)
Long-term care	2.00 (1.94, 2.06)	−0.01 (−0.04, 0.03)	0.20 (−0.13, 0.52)	10.0	0.00 (−0.03, 0.03)

Source: IQVIA National Prescription Audit; timeframe is May 2018–April 2021. *DAAs* were defined as products listed in Uniform System of Classification Level 5 category 82212 (hepatitis C antivirals), excluding all ribavirin products. *ART* were defined as products listed in Uniform System of Classification Level 3 category 82100 (HIV antivirals), excluding the *3 PrEP drugs*, which were defined as Descovy, Truvada, and generic combination emtricitabine/tenofovir disproxil fumarate. Monthly population denominators through 2020 were from the U.S. Census Bureau and were imputed for January 2021–April 2021.

Note: Boldface indicates statistical significance (*$p<0.05$, **$p<0.01$, ***$p<0.001$).

All coefficients for intercept are also significant at ***$p<0.001$. Interpretation: the intercept is the estimated baseline level of the outcome variable, change per month before April 2020 is the slope or trajectory of the outcome (dispensed prescriptions per 100,000 Americans) until the start of the U.S. COVID-19 outbreak, level change during April 2020 represents the change in the level of the outcome that occurs in the period immediately after the outbreak, and slope change after April 2020 represents the immediate change in slope that occurs after the outbreak compared with the preoutbreak slope.

[a]Results for a small number of prescriptions with unknown age are not displayed.

ART, antiretroviral therapy; DAA, direct-acting antivirals; PrEP, pre-exposure prophylaxis; Rx, prescriptions.

unlike dispensing in retail pharmacies. This finding is consistent with potentially decreased demand for DAAs, perhaps owing to disruptions in healthcare visits and HCV screening.

The study's findings on DAA dispensing have important implications for policymakers and clinicians because they suggest that the pandemic has further disrupted a hepatitis C treatment system that was already challenged by poor patient access, high treatment costs, and inadequate provider capacity.[1,2] Other work has suggested that COVID-19 exacerbated existing U.S. disparities, with disproportionately negative health

consequences for socially marginalized groups.[15,16] Barocas et al. modeled how far HCV elimination goals could be delayed or derailed if immediate action is not taken to address COVID-19–related disruptions to the HCV care continuum.

Despite early reports fearing disruption to HIV treatment services,[7,8] ART dispensing did not change substantially after the COVID-19 outbreak. The authors speculate that a potential reason is the unprecedented shift toward delivering care for chronic diseases using telehealth during the pandemic.[17] Notably, patients living with HIV who receive ART include those who know their status and have consistent access to care. In 2019, an estimated 13% of Americans living with HIV did not know that they have the virus; moreover, of all patients diagnosed with HIV in 2019, 24% did not receive any HIV medical care.[18] Thus, although the apparent lack of decrease in the dispensing of ART is reassuring, gaps in identifying patients with undiagnosed HIV and initiating ART in these patients remain.

PrEP dispensing did not change substantially after the outbreak overall and for most age groups. This is potentially surprising given that other studies of PrEP use during the pandemic have shown decreased use.[19] Small studies with self-reported data conducted outside the U. S. observed a decline in PrEP use coinciding with decreased sexual activity. In an analysis of a cohort of gay and bisexual men aged 20−64 years in Australia, 41.8% reported discontinuing PrEP in April 2020, coinciding with a reported reduction in sexual activity.[20] In a qualitative analysis of 25 gay and bisexual men in Toronto from March 2020 to July 2020, several participants discontinued PrEP, with 1 PrEP-experienced individual noting "I mean there's no point in me taking a pill daily if I don't see myself having sex within three weeks, you know what I mean?'[21]

One potential explanation for the discrepancy is the use of national medication dispensing data from the U.S. Another potential explanation is the mismeasurement of PrEP dispensing. This analysis assumed that every use of the 3 PrEP drugs was for PrEP as opposed to ART. If it could have differentiated between dispensing of these drugs by indication, it is possible that it would have similarly found decreased PrEP use. Future studies should assess PrEP use during the pandemic using data sources that have information on indication, such as insurance claims and electronic health records. If PrEP dispensing was indeed stable during the pandemic, studies should explore why use did not decrease. Possibilities include the local roll out of the federal program *Ready, Set, PrEP* starting in December 2019,[22] the introduction of generic PrEP in September 2020,[23] and the growing availability of online prescribing and dispensing of PrEP.[24]

The 1 age group for which PrEP dispensing changed was patients aged 0−19 years. In this age group, the preexisting decline in the rate of dispensing attenuated after the COVID-19 outbreak, resulting in an essentially flat trend. Although the reasons for these findings are unclear, this is of clinical and public policy concern in light of evidence suggesting the underuse of PrEP in adolescents with the greatest risk for HIV.[25]

The authors' ability to capture recent national data on dispensing of DAAs, ART, and PrEP stands in stark contrast to the 2-year lag for national statistics reporting the incidence, prevalence, and treated prevalence for HIV and HCV. Data on disease incidence and prevalence are critical aspects of efforts to reduce and even eliminate HCV and HIV. Policymakers should invest the resources needed to obtain these data in a timelier fashion. The authors join Barocas et al. call for recommitting resources to screening, linking, and treating people with HCV[26] and HIV.

Limitations

This study has limitations. First, the data set lacked clinical details, individual patient identifiers, or information on prescription indication. Consequently, it could not be determined whether declines in dispensing particularly affected vulnerable patient populations, such as people who inject drugs, or identify the precise reason for changes in dispensing patterns. Second, the method for counting PrEP prescriptions is imprecise, and consequently, estimates of levels and changes in PrEP use may be prone to errors. Third, the data set does not include information on individuals who are not receiving treatment for HIV or HCV. This is particularly relevant for this study's findings on HIV medications because many Americans who should be taking these medications are not doing so. Fourth, the authors could not assess changes in dispensing by geographic units such as states.

CONCLUSIONS

After the U.S. outbreak of COVID-19, dispensing of DAAs to treat HCV fell sharply and has yet to fully recover to prepandemic levels. Dispensing of ART to treat HIV and PrEP to prevent HIV remained stable. Future work should monitor changes in dispensing of the study drugs, assess the reasons for treatment declines if detected, and identify evidence-based solutions to overcome barriers to disease detection and treatment.

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CREDIT AUTHOR STATEMENT

Timothy W. Levengood: Conceptualization, Data curation, Formal analysis, Methodology, Project administration, Software, Visualization, Writing - original draft, Writing - review and editing. Andrew Aronsohn: Conceptualization, Methodology, Writing - review and editing. Kao-Ping Chua: Conceptualization, Data curation, Formal analysis, Methodology, Software, Supervision, Writing - review and editing. Rena Conti: Conceptualization, Data curation, Methodology, Supervision, Writing - review and editing.

SUPPLEMENTAL MATERIAL

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