Impact of COVID-19 on HIV Preexposure Prophylaxis Prescriptions in the United States
– A Time Series Analysis

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Summary: This study assessed the impact of the COVID-19 pandemic on PrEP prescriptions in the
United States from March 2020 through March 2021 and found a 22% reduction in PrEP
prescriptions and a 25% reduction in number of new PrEP users.
Abstract

Background: Uptake of HIV preexposure prophylaxis (PrEP) has been increasing in the United States since its FDA approval in 2012; however, the COVID-19 pandemic may have affected this trend. Our objective was to assess the impact of the COVID-19 pandemic on PrEP prescriptions in the United States.

Methods: We analyzed data from a national pharmacy database from January 2017 through March 2021 to fit an interrupted time-series model that predicted PrEP prescriptions and new PrEP users had the pandemic not occurred. Observed PrEP prescriptions and new users were compared with those predicted by the model. Main outcomes were weekly numbers of PrEP prescriptions and new PrEP users based on a previously developed algorithm. The impact of the COVID-19 pandemic was quantified by computing rate ratios and percent decreases between the observed and predicted counts during 3/15/2020 – 3/31/2021.

Results: In the absence of the pandemic, our model predicted that there would have been 1,058,162 PrEP prescriptions during 3/15/2020 – 3/31/2021. We observed 825,239 PrEP prescriptions, a 22.0% reduction (95% CI: 19.1%-24.8%) after the emergency declaration. The model predicted 167,720 new PrEP users during the same period; we observed 125,793 new PrEP users, a 25.0% reduction (95% CI: 20.9%-28.9%). The COVID-19 impact was greater among younger persons and those with commercial insurance. The impact of the pandemic varied markedly across states.

Conclusion: The COVID-19 pandemic disrupted an increasing trend in PrEP prescriptions in the United States, highlighting the need for innovative interventions to maintain access to HIV prevention services during similar emergencies.

Keywords: PrEP, preexposure prophylaxis, COVID-19
BACKGROUND

On March 13, 2020, the President of the United States declared a national emergency in response to the outbreak of coronavirus disease 2019 (COVID-19) in the United States caused by the novel severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) [1]. Many states and localities issued mandatory “stay-at-home” or “shelter-in-place” orders and other protective measures in an effort to reduce the spread of SARS-CoV-2 [2-4]. The Centers for Disease Control and Prevention (CDC) also recommended individuals and groups practice social distancing to reduce exposure to SARS-CoV-2 [5]. These policies, as well as individuals’ fear of COVID-19 exposure, resulted in decreased use of health services, especially preventive and elective health care [6, 7].

HIV preexposure prophylaxis (PrEP) with daily oral antiretroviral medications is a safe and effective intervention that reduces the risk of HIV acquisition among men who have sex with men (MSM), heterosexual men and women, and persons who inject drugs [8, 9]. In 2012, the U.S. Food and Drug Administration (FDA) approved tenofovir disoproxil fumarate combined with emtricitabine (FTC/TDF) as PrEP [10]. The CDC published clinical PrEP practice guidelines in 2014 and updated guidelines in 2017 and in 2021 [11-13]. Nondaily event-driven PrEP (also called “2-1-1” PrEP), while not an FDA-approved regimen, has been prescribed and used among selected patients, as two clinical trials have demonstrated its HIV prevention efficacy among MSM [13]. The number of persons prescribed PrEP had been increasing since its approval. Compared with the estimated 1.1 million persons with indications for PrEP in the United States, approximately 280,000 (23%) were prescribed PrEP in 2019 [14]. In October 2019, the FDA approved a second drug for PrEP – tenofovir alafenamide combined with emtricitabine (FTC/TAF) [15]. About one third of existing PrEP users switched to the newer formulation within 12 months of its approval [16]. Several generic formulations of FTC/TDF were also approved by FDA in the fall of 2020.

In the absence of the COVID-19 pandemic, the trend in national PrEP prescriptions was expected to
continue to increase. However, when shelter-in-place and social distancing orders were issued, many healthcare providers temporarily closed their practice, limited it to providing urgent care, or provided telemedicine services [17, 18]. The COVID-related closures as well as individuals’ concerns about potential exposure to SARS CoV-2 likely affected the use of PrEP services. Persons who choose to initiate PrEP need to be assessed by a clinician for existing HIV, sexually transmitted infections (STIs), hepatitis B, hepatitis C, and their renal function. Persons who have been taking PrEP are recommended to have monitoring health care visits every 3 months for assessment of ongoing risk of HIV acquisition, PrEP adherence and persistence counseling, and laboratory testing for HIV, STIs, and renal function [12]. The pandemic also likely affected adherence to these recommended clinical guidelines. The objective of this study was to quantify the impact of the COVID-19 pandemic on PrEP prescriptions and new PrEP users in the United States by analyzing a national pharmacy database.

METHODS

Data Source

We analyzed data from the IQVIA Real World Data—Longitudinal Prescriptions Database (hereafter, IQVIA database) from January 2017 to March 2021. The IQVIA database captures prescriptions from all payers and represents approximately 92% of all prescriptions dispensed from retail pharmacies and 60-86% from mail order outlets in the United States [19]. The database does not include prescriptions from closed healthcare systems such as health maintenance organizations or the Veterans Administration. Prescriptions in the IQVIA database are linked to medical claims to identify associated diagnoses, and to the Experian consumer database to identify patient demographic characteristics. Race/ethnicity data were available for <40% of persons prescribed PrEP.

Measures

We identified PrEP prescriptions in the IQVIA database from January 1, 2017 to March 31, 2021 using a previously developed and validated algorithm [20-22]. We identified all FTC/TDF, FTC/TAF (included since 2019), and generic FTC/TDF (included since October 2020) prescriptions among
persons aged ≥16 years in the database and excluded prescriptions for HIV treatment, hepatitis B treatment, or HIV post-exposure prophylaxis using coexisting diagnosis codes or other prescribed antiretroviral drugs indicating non-PrEP uses. The remaining prescriptions not excluded by the algorithm were defined as PrEP prescriptions.

We defined two outcome measures in this study and analyzed separately: (1) the number of PrEP prescriptions and (2) the number of new PrEP users. We estimated the weekly cumulative numbers of prescriptions and new users throughout the study period. To estimate the number of PrEP prescriptions, we captured non-refilled PrEP prescriptions provided by a prescriber for new or ongoing users. In other words, we included new or renewed PrEP prescriptions and did not count refilled prescriptions. We then aggregated all PrEP prescriptions at the person-level and identified new PrEP users each week if that user had no prior PrEP prescriptions in the IQVIA database.

The outcome measures were reported by patient sex, age group, geographic region, payer type, and race/ethnicity. Payer type at the person-level was calculated based on a hierarchical variable, constructed using a payer hierarchy of public insurance (Medicaid/CHIP and Medicare), commercial insurance, cash, and other. The other payer type category included coupon/voucher programs, discount card programs, and state or manufacturer medication assistance programs (MAPs). We also stratified the outcomes by state. A state was identified using 3-digit ZIP codes of patients’ residential location in the IQVIA database.

Analysis

Weekly PrEP prescription data before and after the start of the COVID-19 pandemic were modeled as an interrupted time series using a generalized linear quasi-Poisson model adjusted for seasonality. This approach models the sequence of repeated weekly observations which is interrupted by an event, in this case the start of the COVID-19 pandemic, occurring at a known timepoint. The impact
of the COVID-19 pandemic interruption can be evaluated by comparing the expected trend had the interruption not taken place against the observed change in the time period after the interruption. The time series model was used to predict the number of PrEP prescriptions and new PrEP users for the period of March 15, 2020 through March 31, 2021, assuming the COVID-19 pandemic did not occur. The impact of COVID-19 was measured by comparing predicted PrEP prescriptions and observed PrEP prescription counts during March 15, 2020 – March 31, 2021 using rate ratios and the percent reduction with 95% confidence intervals (CIs). The estimated effect of COVID-19 was also stratified by patient demographic characteristics and by state. All analyses were performed using R version 3.6.1 (R Foundation for Statistical Computing, Vienna, Austria).

RESULTS

National Trends

The observed weekly number of PrEP prescriptions and modeled trends from 2017-2021 are shown in Figures 1a and 2a. The trend steadily increased from January 2017 until March 14, 2020. The interrupted time series model predicted that there would have been 1,058,162 PrEP prescriptions during March 15, 2020 to March 31, 2021 in the absence of the pandemic. We observed 825,239 PrEP prescriptions in the IQVIA database during the same time period. The rate ratio for the observed and predicted trends was 0.78, indicating a 22.0% reduction (95% CI: 19.1%-24.8%) during that period. Similarly, the observed weekly number of new PrEP users increased from January 2017 until March 14, 2020 (Figures 1b and 2b). The model predicted 167,720 new PrEP users during the evaluation period, and we observed 125,793 new PrEP users in the IQVIA database, a rate ratio of 0.75, indicating a 25.0% reduction (95% CI: 20.9%-28.9%) after the emergency declaration (Table 1).

The observed and expected numbers and percent decreases are broken down by month (Table 1). The monthly percent reduction in the number of PrEP prescriptions was mostly around 20% throughout the observation period, compared to the expected number. We observed a 17.4%
reduction in the number of PrEP prescriptions in June 2020, and decreases greater than 25% in December 2020, and February and March 2021. We observed a 39.5% and 34.2% reduction in the number of new PrEP users in April and May 2020, compared to the expected number of new PrEP users. New PrEP users rebounded in June 2020 with only a 16.5% reduction, then we observed wider gaps until October 2020. In December 2020, we observed a 30.9% reduction in the number of new PrEP users, but after then the gaps were around 20%.

Trends by Demographic characteristics

When stratified by demographic characteristics, the percent reduction in PrEP prescriptions and PrEP users did not vary substantially between men and women or by race/ethnicity during the COVID-19 pandemic (Table 2). We observed larger decreases in new PrEP users for persons aged 16-29 years (27.6% reduction (95% CI, 22.6%-32.2%), compared with persons aged >50 years (18.5% reduction (95% CI, 13.7%-23.1%). Both the number of PrEP prescriptions and new PrEP users in the South decreased to a lesser extent [17.4% reduction (95% CI, 14.1%-20.6%) in PrEP prescriptions; 14.4 reduction (95% CI, 9.5%-19.1%) in new PrEP users] than in other regions.

When we stratified by payer type, larger reductions in PrEP prescriptions were observed for persons who had commercial insurance (23.5% reduction (95% CI, 20.7%-26.3%)) compared with persons with public health insurance (15.0% reduction (95% CI, 11.5%-18.4%)) and persons who paid with cash (12.7% reduction (95% CI, 6.8%-18.3%)). Among new PrEP users, greater decreases were found among those who paid with other type of payer (10.7% reduction (95% CI, 5.0%-16.1%)) compared with persons with commercial insurance (29.1% reduction (95% CI, 25.0%-33.1%)), public insurance (28.2% reduction (95% CI, 23.5%-32.6%)), or those who paid with cash (22.3% reduction (95% CI, 15.8%-28.3%)).
Trends by State

The COVID-19 impact on the number of PrEP prescriptions varied markedly among states, ranging from a 9.9% increase (95% CI, -20.3% - 0.4%) in Delaware to a 84.1% reduction (95% CI, 77.4% - 88.8%) in South Dakota. The impact on the number of new PrEP users ranged from a 26.4% increase (95% CI, -57.1% - 1.7%) in Delaware to a 61.8% reduction (95% CI, 44.9% - 73.4%) in South Dakota, although confidence intervals were frequently wide in states with low numbers of PrEP prescriptions before the pandemic. In states with the largest number of PrEP prescriptions prior to the pandemic, such as California, Georgia, Illinois, Massachusetts, and New York, reductions of >35% were observed in new PrEP users after the emergency declaration. In some states, such as Delaware, Florida, Nebraska, and Oklahoma, smaller reductions were observed in PrEP prescriptions and new PrEP users after the emergency declaration (Table 3).

DISCUSSION

We found a 22% decrease in the total number of PrEP prescriptions and a 25% decrease in the total number of new PrEP users between March 2020 and March 2021 compared to predicted numbers assuming the COVID-19 pandemic shutdown had never occurred. We observed a partial rebound in the number of new users in June 2020, but then followed by declining numbers towards the end of 2020. We observed another rebound in the number of new users after December 2020, when the COVID-19 vaccines became available.

Our finding of reductions in PrEP prescriptions was consistent with other studies that found declines in the use of preventive and elective healthcare services [6, 7]. PrEP requires adherent and persistent use for its effectiveness as a biomedical tool for HIV prevention. Persons who stopped taking PrEP but had ongoing risk behaviors during the pandemic might have acquired and subsequently transmitted HIV infection. At least one study found that HIV testing rates decreased substantially during the COVID-19 pandemic [23], which may be partially due to decreases in PrEP
prescriptions. HIV testing is an important part of integrated PrEP services, that is, PrEP users are required to have a negative HIV test result prior to initiating PrEP, and testing is recommended every 3 months at follow-up visits before a new prescription is provided for PrEP continuation. Decreases in PrEP initiation and ongoing PrEP prescriptions resulted in fewer HIV tests, as well as fewer opportunities to diagnose HIV.

The pandemic caused more disruption in new PrEP prescriptions among younger persons. PrEP coverage was lower among persons in younger age groups prior to the COVID pandemic, and it decreased even more during the pandemic shutdown [14]. Young persons are typically less likely to adhere to and persist with daily medications [24-26]. In addition, young persons might have had less access to care during the pandemic compared to older persons [27, 28], likely because older persons had established relationships with health care providers prior to the shutdown. Decreased PrEP uptake and persistence due to lack of access to care, along with lack of perceived HIV risk, might have resulted in increased HIV transmission risk among persons in younger populations [29]. Innovative interventions such as risk assessment tools, educational messages, PrEP provider locator tools, and other resources linked to social media apps could help reach this population to improve their PrEP initiation, adherence, and persistence.

We also observed larger reductions in PrEP use among persons with commercial health insurance. A study that reported on an analysis of the IQVIA database found that out-of-pocket payments for PrEP were lower among persons with Medicaid or Medicare than among those with commercial insurance [30]. With loss of employment and health insurance coverage during the COVID-19 shutdown, high copayments might have been a barrier to PrEP use among persons with commercial insurance or those who paid with cash. Starting January 2021, most health plans were required to offer PrEP to their beneficiaries without copays under the Affordable Care Act (ACA), which can increase access to PrEP by removing financial barriers.
The South had the least changes in PrEP prescriptions compared to other regions, which might be attributed to individual states’ variation in COVID-19 policies as well as their pre-COVID-19 PrEP use. Increases in new PrEP users were observed in some Southern states like Delaware and Florida during the study period. Most state governments declared a state of emergency and required shutdowns, resulting in increased time spent at home in the first half of 2020 [31, 32]. These shutdowns affected non-essential businesses, most schools, and non-emergent/urgent health care venues. Timing of enacting and lifting of stay-at-home and closure orders as well as type of the restrictions varied by state and might have affected both access to health care and a person’s comfort level to seek it. We observed that the magnitude of decreased PrEP prescriptions and new PrEP users during the COVID-19 pandemic varied across states, possibly related to the timing or severity of each state’s COVID-related policy enactments [3, 4]. The variation in the size of the decreases might have also depended on the number of persons using PrEP prior to the COVID-19 pandemic. Further research is needed to better understand state-level variation and the factors that affected it.

Our study has some limitations. We did not capture PrEP prescriptions from closed health systems such as health maintenance organizations. We might have over- or under-estimated the COVID-19 impact on PrEP prescriptions in some states due to low precision in the measurement of some state-level numbers. Decreased PrEP prescriptions could be due to lack of access to care or decreased risk behavior during the pandemic [33]; we were unable to distinguish between these factors. Additionally, some users might take event-driven (or 2-1-1) PrEP regimens, even if their refill patterns changed, which could not be observed in this analysis. Race/ethnicity data were available for fewer than 40% of persons prescribed PrEP. The race/ethnicity data that were available in the IQVIA database were from the linked Experian consumer database that likely included larger proportions of persons who were white, older, and with higher incomes. Because of the lack of
race/ethnicity data in the IQVIA database for most PrEP users, our finding of no significant
differences by race/ethnicity should be interpreted with caution.

In conclusion, our analysis of a national pharmacy database found that the COVID-19 pandemic
disrupted an increasing trend in PrEP use in the United States, highlighting the need for innovative
interventions to maintain access to HIV prevention services during similar emergencies. Strategies
like the expansion of telemedicine and HIV self-testing or self-sample collection can provide access
to PrEP care during such emergencies or as a convenient health service option for some PrEP users.
Ongoing monitoring of trends in PrEP prescriptions and PrEP users is needed to assess whether the
impact of the COVID-19 pandemic abated after shutdown orders were lifted and as the vaccination
rate among the population increased. Further studies are needed to understand the population-level
implications of decreased PrEP use during the COVID-19 pandemic on HIV transmission.
NOTES

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FIGURE LEGENDS

Figure 1a. Observed weekly number of PrEP prescriptions and modeled trend* from January 1, 2017 through March 31, 2021, IQVIA Real World Data—Longitudinal Prescriptions Database

Figure 1b. Observed weekly number of new PrEP users and modeled trend* from January 1, 2017 through March 31, 2020, IQVIA Real World Data—Longitudinal Prescriptions Database

* The observed weekly numbers were identified in analyses of the IQVIA Real World Data—Longitudinal Prescriptions Database (circles). The modeled trend was fitted using an interrupted time series model adjusted for seasonality (solid line).

Figure 2a. Modeled trends in weekly number of PrEP prescriptions with and without the COVID-19 pandemic from March 15, 2020 through March 31, 2021, IQVIA Real World Data—Longitudinal Prescriptions Database

Figure 2b. Modeled trends in weekly number of new PrEP users with and without the COVID-19 pandemic from March 15, 2020 through March 31, 2021, IQVIA Real World Data—Longitudinal Prescriptions Database

Note: The trends in number of PrEP prescriptions and new PrEP users from January 1, 2017 through March 31, 2020 (solid line) was fitted using an interrupted time series model adjusted for seasonality of the observed numbers identified in analyses of the IQVIA Real World Data—Longitudinal Prescriptions Database. The expected trends in PrEP prescriptions and new PrEP users from March 15, 2020 through March 31, 2021 were predicted by the same model assuming the COVID-19 pandemic did not occur (dashed line). The shade represents 95% confidence intervals.
Table 1: Observed and expected number of PrEP prescriptions and new PrEP users and predicted percent reduction* by month from March 15, 2020 through March 31, 2021, IQVIA Real World Data—Longitudinal Prescriptions Database

| Month                  | PrEP Prescriptions          | New PrEP Users              |
|------------------------|-----------------------------|-----------------------------|
|                        | Observed No. | Expected No. | % Reduction | 95% CI   | Observed No. | Expected No. | % Reduction | 95% CI   |
| Total                  | 825,239       | 1,058,162    | 22.0        | 19.1 – 24.8 | 125,793      | 167,720      | 25.0        | 20.9 – 28.9 |
| March 15-31, 2020      | 31,151        | 32,545       | 4.3         | -0.8 – 8.8   | 4,550        | 5,668        | 19.7        | 13.6 – 25.1  |
| April 2020             | 68,502        | 85,587       | 20.0        | 15.5 – 24.0   | 8,452        | 13,960       | 39.5        | 34.5 – 43.7  |
| May 2020               | 53,878        | 69,344       | 22.3        | 17.9 – 26.3   | 7,062        | 10,740       | 34.2        | 28.8 – 38.9  |
| June 2020              | 58,442        | 70,747       | 17.4        | 12.7 – 21.6   | 9,266        | 11,098       | 16.5        | 9.6 – 22.4   |
| July 2020              | 70,520        | 91,338       | 22.8        | 18.4 – 26.7   | 11,291       | 15,434       | 26.8        | 20.9 – 32.0  |
| August 2020            | 58,477        | 74,572       | 21.6        | 17.2 – 25.5   | 9,859        | 12,778       | 22.8        | 16.7 – 28.2  |
| September 2020         | 58,971        | 76,951       | 23.4        | 19.1 – 27.2   | 9,588        | 12,622       | 24.0        | 18.0 – 29.3  |
| October 2020           | 80,256        | 99,207       | 19.1        | 14.5 – 23.2   | 12,790       | 15,344       | 16.6        | 9.8 – 22.5   |
| November 2020          | 63,448        | 79,510       | 20.2        | 15.7 – 24.2   | 8,499        | 11,669       | 27.2        | 21.2 – 32.3  |
| December 2020          | 74,199        | 99,625       | 25.5        | 21.4 – 29.2   | 10,161       | 14,697       | 30.9        | 25.2 – 35.7  |
| January 2021           | 64,991        | 82,923       | 21.6        | 17.2 – 25.6   | 10,209       | 12,935       | 21.1        | 14.6 – 26.6  |
| February 2021          | 63,782        | 86,357       | 26.1        | 21.9 – 29.9   | 11,115       | 13,919       | 20.1        | 13.6 – 25.8  |
| March 2021             | 78,622        | 109,457      | 28.2        | 23.9 – 32.0   | 12,951       | 16,857       | 23.2        | 16.5 – 28.9  |

*The expected numbers of PrEP prescriptions and new PrEP users were predicted using interrupted time series models fit using a generalized linear quasi-Poisson model adjusted for seasonality.
Table 2: Observed and expected number of PrEP prescriptions and new PrEP users and predicted percent reduction* from March 15, 2020 through March 31, 2021, stratified by demographic characteristics, IQVIA Real World Data—Longitudinal Prescriptions Database

*Expected number and predicted percent reduction during March 15, 2020–March 31, 2021 were estimated from interrupted time series models fit using a generalized linear quasi-Poisson model adjusted for seasonality.

| Characteristics | PrEP Prescriptions | | | | New PrEP Users | | |
|-----------------|---------------------|----------------|------------------|-----------------|---------------------|-----------------|------------------|
|                 | Observed No. | Expected No. | % Reduction | 95% CI | Observed No. | Expected No. | % Reduction | 95% CI |
| **Total**       | 825,239 | 1,058,162 | 22.0 | 19.1 – 24.8 | 125,793 | 167,720 | 25.0 | 20.9 – 28.9 |
| **Sex**         | | | | | | | | |
| Male            | 777,508 | 997,928 | 22.1 | 19.2 – 24.9 | 110,327 | 146,369 | 24.6 | 20.4 – 28.6 |
| Female          | 47,412 | 59,958 | 20.9 | 17.2 – 24.5 | 15,202 | 21,599 | 29.6 | 25.2 – 33.8 |
| **Age Group (years)** | | | | | | | | |
| 16–29           | 228,206 | 294,897 | 22.6 | 18.0 – 27.0 | 51,145 | 70,623 | 27.6 | 22.6 – 32.2 |
| 30–39           | 297,576 | 387,818 | 23.3 | 20.5 – 26.0 | 40,113 | 54,126 | 25.9 | 21.5 – 30.0 |
| 40–49           | 152,494 | 188,931 | 19.3 | 16.3 – 22.2 | 17,199 | 21,945 | 21.6 | 17.0 – 26.0 |
| 50+             | 146,963 | 186,800 | 21.3 | 18.2 – 24.3 | 17,336 | 21,279 | 18.5 | 13.7 – 23.1 |
| **Race/Ethnicity** | | | | | | | | |
| White           | 202,283 | 253,142 | 20.1 | 17.3 – 22.8 | 21,724 | 30,418 | 28.6 | 24.9 – 32.1 |
| Black           | 40,074 | 47,967 | 16.5 | 13.1 – 19.7 | 6,383 | 8,274 | 22.9 | 17.7 – 27.6 |
| Hispanic        | 48,115 | 59,726 | 19.4 | 16.1 – 22.6 | 6,665 | 8,775 | 24.0 | 19.2 – 28.6 |
| Other           | 12,195 | 15,738 | 22.5 | 18.7 – 26.2 | 1,352 | 1,916 | 29.4 | 22.3 – 36.0 |
| Unknown         | 522,572 | 681,756 | 23.3 | 20.3 – 26.2 | 89,669 | 118,455 | 24.3 | 19.8 – 28.6 |
| **Payer Type**  | | | | | | | | |
| Commercial      | 456,859 | 597,358 | 23.5 | 20.7 – 26.3 | 52,494 | 74,090 | 29.1 | 25.0 – 33.1 |
| Public          | 106,426 | 125,232 | 15.0 | 11.5 – 18.4 | 19,048 | 26,534 | 28.2 | 23.5 – 32.6 |
| Cash            | 13,876 | 15,900 | 12.7 | 6.8 – 18.3 | 4,923 | 6,336 | 22.3 | 15.8 – 28.3 |
| Other           | 110,287 | 137,718 | 19.9 | 15.7 – 23.9 | 28,213 | 31,606 | 10.7 | 5.0 – 16.1 |
| **Region**      | | | | | | | | |
| Northwest       | 177,115 | 245,188 | 27.8 | 25.1 – 30.3 | 22,188 | 33,579 | 33.9 | 29.5 – 38.0 |
| Midwest         | 124,985 | 160,258 | 22.0 | 18.8 – 25.1 | 15,533 | 23,925 | 35.1 | 30.7 – 39.2 |
| South           | 298,094 | 360,993 | 17.4 | 14.1 – 20.6 | 57,032 | 66,619 | 14.4 | 9.5 – 19.1 |
| West            | 223,347 | 295,562 | 24.4 | 21.4 – 27.4 | 30,787 | 44,556 | 30.9 | 26.6 – 34.9 |
Table 3: Observed and expected number of PrEP prescriptions and new PrEP users and predicted percent reduction* from March 15, 2020 through March 31, 2021, stratified by states, IQVIA Real World Data—Longitudinal Prescriptions Database

| State          | PrEP Prescriptions |                                                                 | New PrEP Users |                                                                 |
|----------------|--------------------|-----------------------------------------------------------------|----------------|-----------------------------------------------------------------|
|                | Observed No.      | Expected No. | % Reduction | 95% CI | Observed No. | Expected No. | % Reduction | 95% CI |
| Alabama        | 2,741             | 3,568        | 20.6        | 13.9 - 26.7 | 337           | 581          | 21.2        | 5.1 - 34.7 |
| Alaska         | 424               | 649          | 33.8        | 21.4 - 44.2 | 79            | 132          | 38.5        | 13.1 - 56.4 |
| Arizona        | 13,960            | 17,220       | 20.9        | 16.8 - 24.8 | 1,729         | 2,454        | 30.1        | 23.6 - 35.9 |
| Arkansas       | 1,450             | 1,588        | 7.9         | -2.2 - 16.9 | 289           | 348          | 13.7        | -5.8 - 29.6 |
| California     | 104,300           | 137,000      | 26.6        | 23.3 - 29.7 | 13,140        | 20,080       | 34.9        | 30.2 - 39.2 |
| Colorado       | 8,670             | 10,620       | 19.4        | 14.9 - 23.6 | 1,427         | 1,869        | 22.8        | 15.7 - 29.3 |
| Connecticut    | 4,380             | 5,623        | 22.6        | 17.8 - 27.1 | 612           | 1,097        | 40.0        | 32.0 - 47.1 |
| Delaware       | 2,731             | 2,469        | -9.9        | -20.3 - -0.4 | 262           | 224          | -26.4       | -57.1 - -1.7 |
| District of Columbia | 13,380     | 18,240       | 27.7        | 23.8 - 31.5 | 1,198         | 2,142        | 42.6        | 36.0 - 48.5 |
| Florida        | 62,420            | 67,790       | 10.2        | 5.4 - 14.8  | 17,220        | 15,580       | -6.9        | -17.0 - 2.4  |
| Georgia        | 19,120            | 22,680       | 17.4        | 13.4 - 21.2 | 2,814         | 4,312        | 35.4        | 29.9 - 40.4 |
| Hawaii         | 1,604             | 1,853        | 14.0        | 5.9 - 21.3  | 252           | 367          | 28.1        | 13.3 - 40.4 |
| Idaho          | 1,322             | 1,289        | 2.1         | -10.8 - 13.6 | 239           | 290          | 25.8        | 4.8 - 42.1  |
| Illinois       | 37,570            | 49,780       | 25.9        | 22.2 - 29.4 | 3,565         | 5,940        | 38.4        | 32.4 - 44.0 |
| Indiana        | 6,911             | 7,429        | 7.7         | 2.3 - 12.8  | 886           | 1,330        | 28.1        | 19.1 - 36.0 |
| Iowa           | 2,746             | 3,361        | 19.1        | 12.4 - 25.3 | 414           | 624          | 33.6        | 22.8 - 42.8 |
| Kansas         | 2,925             | 3,274        | 11.8        | -1.0 - 23.0 | 408           | 491          | 17.5        | 1.3 - 30.9  |
| Kentucky       | 2,667             | 3,560        | 26.5        | 20.4 - 32.0 | 430           | 778          | 43.6        | 34.9 - 51.0 |
| Louisiana      | 14,380            | 14,600       | 2.9         | -2.9 - 8.4  | 3,120         | 3,681        | 16.2        | 6.3 - 25.0  |
| Maine          | 1,274             | 1,715        | 27.1        | 18.0 - 35.2 | 187           | 288          | 32.3        | 15.2 - 46.0 |
| Maryland       | 7,660             | 10,720       | 29.6        | 25.8 - 33.3 | 1,026         | 2,063        | 47.1        | 41.2 - 52.3 |
| Massachusetts  | 17,260            | 26,950       | 38.2        | 34.6 - 41.6 | 2,129         | 4,037        | 46.5        | 41.5 - 51.0 |
| Michigan       | 9,747             | 13,110       | 27.2        | 22.9 - 31.2 | 1,374         | 2,213        | 35.5        | 28.3 - 42.1 |
| Minnesota      | 8,365             | 9,897        | 16.8        | 12.4 - 20.9 | 929           | 1,543        | 39.2        | 32.2 - 45.5 |
| Mississippi    | 1,541             | 1,963        | 21.0        | 12.1 - 29.1 | 349           | 482          | 22.6        | 6.5 - 35.9  |
| Missouri       | 6,777             | 9,139        | 28.0        | 23.6 - 32.1 | 876           | 1,543        | 43.1        | 36.1 - 49.4 |
| Montana        | 505               | 640          | 21.9        | 9.1 - 33.0  | 104           | 163          | 36.2        | 10.7 - 54.5 |

*The percent reduction and 95% CI were calculated using the New PrEP Users and Observed PrEP Prescriptions columns.
| State         | Expected Cases | Predicted Cases | Percent Reduction | Cases | Predicted Cases | Percent Reduction |
|--------------|----------------|-----------------|-------------------|-------|-----------------|-------------------|
| Nebraska     | 1,508          | 1,564           | 2.3               | -7.9  | 11.6            | 237               | 262               | 8.5               | -13.8 - 26.4      |
| Nevada       | 5,059          | 6,037           | 15.5              | 9.9   | 20.9            | 879               | 1,360             | 32.5              | 22.7 - 41.1       |
| New Hampshire| 1,073          | 1,226           | 3.9               | -8.2  | 14.7            | 231               | 313               | 29.1              | 12.9 - 42.3       |
| New Jersey   | 16,570         | 30,220          | 47.1              | 43.0  | 51.0            | 1,598             | 2,760             | 39.7              | 33.2 - 45.6       |
| New Mexico   | 2,316          | 2,998           | 23.5              | 17.3  | 29.3            | 359               | 502               | 27.4              | 11.7 - 40.3       |
| New York     | 65,650         | 94,400          | 31.0              | 28.3  | 33.7            | 7,662             | 13,000            | 36.1              | 31.0 - 40.8       |
| North Carolina| 11,060       | 15,110          | 28.3              | 24.0  | 32.2            | 1,948             | 2,795             | 29.3              | 22.2 - 35.8       |
| North Dakota | 348            | 402             | 17.3              | -0.2  | 31.8            | 70                | 95                | 30.1              | -1.8 - 52.0       |
| Ohio         | 12,650         | 14,410          | 13.3              | 9.6   | 16.9            | 1,983             | 2,668             | 26.4              | 20.0 - 32.3       |
| Oklahoma     | 2,602          | 2,828           | 9.3               | 1.1   | 16.8            | 582               | 668               | 15.2              | 0.1 - 28.0        |
| Oregon       | 6,966          | 8,247           | 16.3              | 11.7  | 20.7            | 1,213             | 1,499             | 19.3              | 9.9 - 27.8        |
| Pennsylvania | 24,790         | 23,890          | -5.0              | -13.4 | -2.7            | 3,432             | 10.7              | 1.7               | 18.8             |
| Puerto Rico  | 834            | 1,042           | 24.2              | 12.6  | 34.3            | 113               | 153               | 33.3              | 10.5 - 50.3       |
| Rhode Island | 2,226          | 2,752           | 22.1              | 15.3  | 28.3            | 276               | 495               | 38.7              | 26.3 - 49.0       |
| South Carolina| 3,105         | 3,940           | 12.8              | 4.8   | 20.1            | 600               | 897               | 6.0               | -15.2 - 23.3      |
| South Dakota | 217            | 1,475           | 84.1              | 77.4  | 88.8            | 41                | 130               | 61.8              | 44.9 - 73.4       |
| Tennessee    | 8,829          | 12,460          | 28.0              | 22.4  | 33.2            | 1,052             | 1,572             | 27.2              | 17.1 - 36.1       |
| Texas        | 57,870         | 73,040          | 22.0              | 18.0  | 25.7            | 8,717             | 10,820            | 18.4              | 12.1 - 24.2       |
| Utah         | 4,635          | 5,561           | 17.2              | 12.1  | 21.9            | 657               | 837               | 19.9              | 8.0 - 30.2        |
| Vermont      | 526            | 661             | 22.8              | 10.9  | 33.1            | 74                | 144               | 43.7              | 23.4 - 58.6       |
| Virginia     | 7,770          | 9,740           | 22.7              | 18.2  | 26.8            | 1,297             | 2,221             | 42.7              | 36.9 - 48.0       |
| Washington   | 19,150         | 25,660          | 27.2              | 24.1  | 30.3            | 2,854             | 3,640             | 23.1              | 12.7 - 32.3       |
| West Virginia| 679            | 1,036           | 34.1              | 25.0  | 42.1            | 139               | 364               | 60.9              | 49.5 - 69.8       |
| Wisconsin    | 4,173          | 5,649           | 28.8              | 24.3  | 33.2            | 564               | 1,099             | 48.9              | 41.8 - 55.0       |
| Wyoming      | 160            | 184             | 11.6              | -18.2 | 33.9            | 25                | 44                | 39.8              | -4.8 - 65.4       |

*Expected number and predicted percent reduction during March 15, 2020–March 31, 2021 were estimated from interrupted time series models fit using a generalized linear quasi-Poisson model adjusted for seasonality.
Figure 1a. Observed weekly number of PrEP prescriptions and modeled trend* from January 1, 2017 through March 31, 2021, IQVIA Real World Data—Longitudinal Prescriptions Database

Figure 1b. Observed weekly number of new PrEP users and modeled trend* from January 1, 2017 through March 31, 2020, IQVIA Real World Data—Longitudinal Prescriptions Database

* The observed weekly numbers were identified in analyses of the IQVIA Real World Data—Longitudinal Prescriptions Database (circles). The modeled trend was fitted using an interrupted time series model adjusted for seasonality (solid line).
Figure 2a. Modeled trends in weekly number of PrEP prescriptions with and without the COVID-19 pandemic from March 15, 2020 through March 31, 2021, IQVIA Real World Data—Longitudinal Prescriptions Database

Figure 2b. Modeled trends in weekly number of new PrEP users with and without the COVID-19 pandemic from March 15, 2020 through March 31, 2021, IQVIA Real World Data—Longitudinal Prescriptions Database

Note: The trends in number of PrEP prescriptions and new PrEP users from January 1, 2017 through March 31, 2020 (solid line) was fitted using an interrupted time series model adjusted for seasonality of the observed numbers identified in analyses of the IQVIA Real World Data—Longitudinal Prescriptions Database. The expected trends in PrEP prescriptions and new PrEP users from March 15, 2020 through March 31, 2021 were predicted by the same model assuming the COVID-19 pandemic did not occur (dashed line). The shade represents 95% confidence intervals.