


Broadband internet subscription rates and opioid prescribing via telemedicine during the COVID-19 pandemic

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Abstract

Purpose: In response to the COVID-19 pandemic, the US DEA allowed controlled substance prescriptions to be issued following a telemedicine encounter. This study evaluated changes in opioid prescribing in Kentucky counties with low and high rates of broadband subscription before, during, and after a series of statewide emergency declarations that may have affected health care access.

Methods: The study used the prescription drug monitoring program to analyze records of opioid analgesic prescriptions dispensed to opioid-naïve individuals in high (N = 26) and low (N = 94) broadband access counties during 3 periods: before a state of emergency (SOE) and executive order (EO) limiting nonemergent health care services (January 2019-February 2020), while the EO was active (March-April 2020), and after health care services began reopening (May-December 2020). Marginal generalized estimating equations-type negative binomial models were fit to compare prescription counts by broadband access over the 3 periods.

Findings: Rates of opioid dispensing to opioid-naïve individuals decreased significantly during the EO, but increased nearly to pre-SOE levels after health care services began reopening. Dispensing rates in low broadband counties were higher than those in high broadband counties during all time periods, although these differences were negligible after adjusting for potential confounders. During the EO, prescriptions were written for longer days' supply in both county types.

Conclusions: The overall dramatic reduction in opioid prescribing rates should be considered when evaluating annual opioid prescribing trends. However, broadband subscription rate did not appear to influence opioid prescriptions dispensed in Kentucky during the EO.

KEYWORDS

COVID-19, opioid, telemedicine

INTRODUCTION

In response to the extraordinary circumstances surrounding the coronavirus disease 2019 (COVID-19) pandemic and subsequent public health emergency, the US Drug Enforcement Administration (DEA) adopted policies allowing practitioners to prescribe controlled substances without having to interact in-person with the patient.¹ Subsequently, best practices for pain management included use of telemedicine.²⁻⁴ This change removed potential barriers to an individual's ability to obtain an opioid prescription (eg, an in-person encounter and hardcopy), which could increase new opioid prescription rates.

Under this new guidance, effective March 16, 2020, a practitioner could prescribe a controlled substance to a new patient evaluated using a real-time, 2-way, audiovisual communications device (ie, after a telemedicine encounter).^{1,5} However, in addition to provider-level capability and permissions,⁴ patients must also meet specific criteria for a successful telemedicine encounter: access to broadband internet, defined as download speeds of at least 25 megabits per second (Mbps) and upload speeds of at least 3 Mbps;⁶ an internet capable device; and necessary technological literacy to access broadband internet using the device.⁷

While up to 80% of rural Americans have internet access, availability of quality broadband that meets telemedicine requirements is consistently lower in rural households.⁸⁻¹⁰ It is, therefore, possible that decreased ability to meet successful telemedicine encounter criteria may result in a disproportionate reduction in access to pain management, specifically opioid analgesics, in select communities.

In Kentucky, multiple statewide interventions in response to COVID-19¹¹ may have also influenced opioid prescribing, specifically among those without access to necessary technology to facilitate a telemedicine encounter. On March 6, 2020, Kentucky declared a state of emergency (SOE). Hospitals were then asked to cease elective procedures effective March 18; hospitals could resume nonurgent/emergent services (including elective procedures), diagnostic radiology, and lab services on April 27, 2020.

It is unclear whether patients with limited broadband access, specifically in rural or Appalachian areas, were less likely to have received opioid prescriptions during the COVID-19 pandemic. The purpose of this study was to examine trends in new opioid analgesic prescriptions (ie, opioid prescriptions to opioid-naïve patients) in Kentucky counties with high and low rates of broadband internet access before and throughout the COVID-19 pandemic. We hypothesized that counties with lower broadband subscription rates would experience more dramatic reductions in opioid prescriptions related to the introduction of telemedicine prescribing.

METHODS

Data sources

The primary analysis for this study used data from the Kentucky All Schedule Prescription Electronic Recording (KASPER) database, the

state's prescription drug monitoring program, which collects data from dispensers regarding all Schedule II-V prescriptions within 24 hours of dispensing.¹² Opioid analgesic prescriptions dispensed to adults (≥ 18 years old at the time of dispensing) between January 1, 2019 and December 31, 2020 were eligible for inclusion. Opioid analgesic prescriptions were identified using the 2019 CDC National Drug Code list,¹³ updated with information from the Medi-Span Electronic Drug File (MED-File V2) and the Drug Inactive Date File.¹⁴ Buprenorphine products used for treatment of opioid use disorder were excluded. Opioid-naïve status was defined as 45 days of no active opioid analgesic prescription prior to the index prescription.¹⁵ Prescription morphine milligram equivalents (MME) were calculated using established conversion factors available from the Centers for Disease Control and Prevention.¹³

Rural and urban status was assigned using the National Center for Health Statistics (NCHS) rural-urban classification scheme.¹⁶ Appalachian status was assigned to counties served by the Appalachian Regional Commission.¹⁷ Other county-level demographic variables (eg, age, race, gender, broadband access, etc.) were assigned using the United States Census Bureau American Communities Survey 5-Year Estimates Subject Tables (dataset ACSST5Y2019), 2015-2019.¹⁸ Broadband status was assigned based on the variable *Households with a Broadband Internet Subscription, Percent*. This variable reflects the percent of respondents indicating access to cable, fiber optic, or digital subscriber line; cellular data plan; satellite; fixed wireless subscription; or other nondial-up internet subscription.

Analysis

Analyses were performed at the county level. Because there was significant overlap between NCHS designation, Appalachian status, and household broadband subscription rate among counties (Table 1), counties were divided into cohorts based on broadband subscription rate only. As previously described by Patel et al., a binary measure of broadband access was used.¹⁹ Counties where at least the state average percentage (78.4%) of households had broadband access were assigned to the high broadband access (HBBA) cohort; counties with under 78.4% household broadband access were assigned to the low broadband access (LBBA) cohort.

Time periods were defined based on state-level actions taken in response to the COVID-19 pandemic in Kentucky. Time periods were assigned at the beginning of the associated month in which the state-level action was taken. Three time periods for the study were identified: pre-SOE (January 1, 2019-February 28, 2020), executive order (EO) active (March 1, 2020-April 30, 2020), and health care reopening (May 1, 2020-December 31, 2020). The DEA rule authorizing the use of telemedicine for opioid prescribing without first having an in-person evaluation was effective March 16, 2020 and remained in effect throughout both the EO active and health care reopening periods.

Comparisons of LBBA and HBBA counties for community-level factors were in terms of frequency (percent), and *P*-values came from Chi-square tests. Demographics of residents were expressed as the

TABLE 1 Demographics of LBBA and HBBA counties, 2019-2020

Variable	LBBA (N = 94)	HBBA (N = 26)	P value
Households with a broadband internet prescription (mean %, SD)	69.24 (5.76)	83.11 (3.08)	<.0001
Rural (N, %)	76 (80.85%)	9 (34.62%)	<.0001
Appalachian (N, %)	50 (53.19%)	4 (15.38%)	<.0001
Total population (age 18 and up)	1,457,565	2,007,237	
Average population (age ≥18) (mean ± SD)	15,506.0 ± 12,178.53	77,201.4 ± 117,530.24	.013
Age ≥65 (mean %, SD)	18.68% (0.02)	16.63% (0.03)	.0001
Female gender (mean %, SD)	50.02% (0.02)	50.87% (0.01)	.0019
Race, White alone (mean %, SD)	94.23% (0.05)	90.61% (0.06)	.0015
Owner-occupied housing rate (mean %, SD)	72.43% (0.06)	69.70% (0.08)	.1311
Households with a computer (mean %, SD)	79.63% (0.05)	89.72% (0.03)	<.0001
High school degree or higher (mean %, SD)	80.19% (0.06)	88.99% (0.03)	<.0001
Bachelor's degree or higher (mean %, SD)	13.79% (0.03)	26.50% (0.08)	<.0001
Median household income (mean ± SD)	\$41,153.8 ± \$8,414.21	\$58,361.8 ± \$13,382.95	<.0001
Travel time to work, minutes, workers ≥16 (mean ± SD)	27.0 ± 5.5	23.5 ± 3.7	.0004

Abbreviations: HBBA, high broadband access; LBBA, low broadband access.

percentage for each county, and the mean (standard deviation) percentage for LBBA and HBBA counties was provided. Two-sample *t*-tests were used to compare LBBA and HBBA mean percentages.

Unadjusted and adjusted marginal generalized estimating equations (GEE)-type negative binomial models were fit to compare opioid-naïve prescriptions over the 3 time periods (pre-SOE vs EO active vs health care reopening). The adjusted model controlled for several variables that may have influenced the use of telemedicine, including age, race, gender, highest education achieved, and distance traveled to work, measured at the county level.²⁰ Two additional marginal GEE-type negative binomial models were fit to compare opioid-naïve prescription counts by county-level broadband access (HBBA vs LBBA) over the 3 time periods. Unadjusted and adjusted models included these 2 categorical variables and their interaction as predictors.²¹ Models were clustered on county, and the statistical correlations among count outcomes, one per time period, from the same county were modeled using working unstructured covariance matrices. A county's count outcome was defined as the total number of opioid-naïve prescriptions dispensed in the given time period. Due to differing lengths in time periods, as well as varying numbers of residents across counties, the model's offsets were the natural log of the number of residents in the given county multiplied by the number of months in that time period. Therefore, population rates per resident month are directly modeled, and rate ratios are used as the basis of comparisons.

To provide a continuous (opposed to binary) viewpoint of the household broadband subscription rate's association with opioid-naïve prescription rates (per resident per month), scatterplots with corresponding weighted Pearson's correlations were used. Observations were weighted based on the number of residents in the given county. Scatterplots and correlations are presented separately for each time period. Partial correlations are also provided to adjust for the potential confounders.

Analyses were conducted in SAS version 9.4 (SAS Institute, Cary, NC, USA). Statistical significance was defined as $P < .05$.

RESULTS

Of the 120 Kentucky counties, 94 were classified as having LBBA, and 26 were classified as having HBBA. LBBA counties were more likely to be rural (80.85% vs 34.62%, $P < .0001$) and Appalachian (53.19% vs 15.38%, $P < .0001$). LBBA counties also were less likely to have houses with a computer and high school or college graduates. Full demographics are presented in Table 1.

The overall rate of prescriptions per 1,000 population significantly decreased from 19.9 during the pre-SOE phase to 15.0 during the EO active period and returned to 19.2 during the health care reopening phase (Table 2). The number of opioid prescriptions dispensed to an opioid-naïve patient per month was higher in LBBA counties than in HBBA counties across all time periods (Table 2 and Figure 1, $P < .01$), although no significant difference between these 2 groups was observed during any of the 3 time periods after adjusting for potential confounders. There was a significant decrease in prescription opioid dispensing rates among county types between pre-SOE and EO active periods (20.4-15.4 prescriptions per 1,000 adults, in LBBA vs 18.5-13.6 prescriptions per 1,000 adults in HBBA), with corresponding unadjusted (0.76 vs 0.73) and adjusted (0.76 vs 0.74) rate ratios being similar for LBBA and HBBA counties. Opioid prescriptions nearly rose back to pre-SOE levels during the health care reopening phase across both county types (19.6 and 18.0 prescriptions per 1,000 adults in LBBA and HBBA counties, respectively); unadjusted and adjusted rate ratios comparing health care reopening and pre-SOE levels were similar at 0.96 and 0.97 for LBBA and HBBA, respectively ($P < .0001$). These patterns mirrored the overall patterns for the state as a whole,

TABLE 2 Regression results for average monthly opioid-naïve prescriptions by time period and county type, 2019-2020

	Pre-SOE(1/19-2/20)		EO active (3/20-4/20)		Health care reopening (5/20-12/20)	
<i>All 120 counties</i>						
Unadjusted rates ^a	19.9		15.0		19.2	
Unadjusted RR over time ^b	-		0.75 (0.74, 0.76) [*]		0.96 (0.96, 0.97) [*]	
Adjusted ^c RR over time ^b	-		0.75 (0.74, 0.76) [*]		0.96 (0.96, 0.97) [*]	
	<i>LBBA</i>	<i>HBBA</i>	<i>LBBA</i>	<i>HBBA</i>	<i>LBBA</i>	<i>HBBA</i>
Unadjusted rates ^a	20.4	18.5	15.4	13.6	19.6	18.0
Unadjusted RR over time ^b	-	-	0.76 (0.75, 0.77) [*]	0.73 (0.72, 0.75) [*]	0.96(0.95, 0.97) [*]	0.97 (0.96, 0.98) [*]
Adjusted ^c RR over time ^b	-	-	0.76 (0.75, 0.77) [*]	0.74 (0.72, 0.75) [*]	0.96 (0.95, 0.97) [*]	0.97 (0.96, 0.98) [*]
Unadjusted RR: LBBA versus HBBA ^d	1.10 (1.05, 1.16) [*]		1.14 (1.07, 1.21) [*]		1.09 (1.03, 1.15) [*]	
Adjusted ^c RR: LBBA versus HBBA ^d	1.01 (0.95, 1.07)		1.04 (0.97, 1.11)		1.00 (0.94, 1.06)	

Abbreviations: EO, executive order; ER/LA, extended-release or long-acting; HBBA, high broadband access; LBBA, low broadband access; MME, morphine milligram equivalents; RR, rate ratio; SOE, state of emergency.

^aEstimated rate of prescriptions issued to opioid-naïve patients per 1,000 population age ≥ 18 .

^bRate ratios with 95% confidence intervals compare the rate for the given group and time period to the corresponding pre-SOE rate.

^cRate ratios are adjusted for the percent of the county population that is White, 65 years or older, female, and has a bachelor's degree, and mean travel time to work (minutes) for workers ≥ 16 .

^dRate ratios with 95% confidence intervals compare the rates for LBBA and HBBA counties during the given time period.

* $P < .0001$; ** $P < .01$.

which showed a significant reduction in opioid prescriptions during the EO active period with a near return to baseline (but still statistically significant decrease) in prescription in the health care reopening phase.

Scatterplots and unadjusted correlations also showed that opioid-naïve prescription rates tended to be higher in counties with lower household broadband subscription rates and tended to be lower during the EO active period (Figure 2). Across the 3 time periods, opioid-naïve prescription and household broadband subscription rates were similarly and inversely correlated ($P < .0001$). However, after adjusting for potential confounders, partial correlations were not significant.

Examining drugs by DEA schedule, Schedule II opioids (eg, hydrocodone, oxycodone, and morphine) represented the majority of dispensed opioid prescriptions in both cohorts across all time periods (Table 3). Schedule II opioids represented a higher percentage of opioid prescriptions in HBBA counties compared to LBBA counties, which persisted during all time periods.

Average days' supply of dispensed opioid prescriptions was longer in LBBA counties compared to HBBA. As the number of dispensed opioid prescriptions decreased during the EO active period, days' supply of Schedule II prescriptions increased in both cohorts (6.9 ± 8.4 to 7.7 ± 9.2 days in LBBA and 5.9 ± 7.3 to 6.6 ± 8.1 days in HBBA). Days' supply decreased to pre-SOE baseline in both cohorts during the health care reopening phase (6.7 ± 8.2 and 5.7 ± 7.0 days in LBBA and HBBA counties, respectively). Similar trends, albeit with longer overall days' supply, were seen among Schedule III and Schedule IV opioids (Table 3).

Average total MME, daily MME, and rate of extended-release/long-acting prescriptions did not significantly differ between cohorts and did not change between time periods.

DISCUSSION

This study evaluated new opioid analgesic dispensing episodes before and during the initial 9 months of the COVID-19 pandemic in Kentucky, hypothesizing that increasing allowance of telemedicine encounters may disproportionately affect opioid analgesic access in areas with low broadband internet subscription rates. While new opioid dispensing episodes dramatically decreased during the initial statewide EO, the decrease was similar in HBBA and LBBA counties. However, the approximate 25% reduction in opioid prescriptions dispensed over a 2-month period in 2020 must be considered when evaluating annual trends in opioid prescribing and dispensing.

It is noteworthy, but not surprising, that opioid dispensing in LBBA counties was higher at baseline and remained higher throughout all time periods when compared to HBBA counties. Overall opioid prescribing rates are commonly higher in rural counties,²²⁻²⁶ which made up 80.85% of LBBA counties versus 34.62% of HBBA counties in this study. This may be influenced by a higher prevalence of pain, specifically chronic and high-impact chronic pain, in rural communities;²⁷ lower availability of other pain treatment modalities;²⁸ or other factors.²⁹

Perhaps reflecting an overall decrease in access to or hesitance to use health care services,^{30,31} days' supply of opioid prescriptions increased across schedules in both LBBA and HBBA counties during the EO active period. Although days' supply decreased in the health care reopening phase, the acute increase in days' supply is concerning because of associations with long-term opioid use.³² These concerns may be compounded by initial findings that survivors of COVID-19

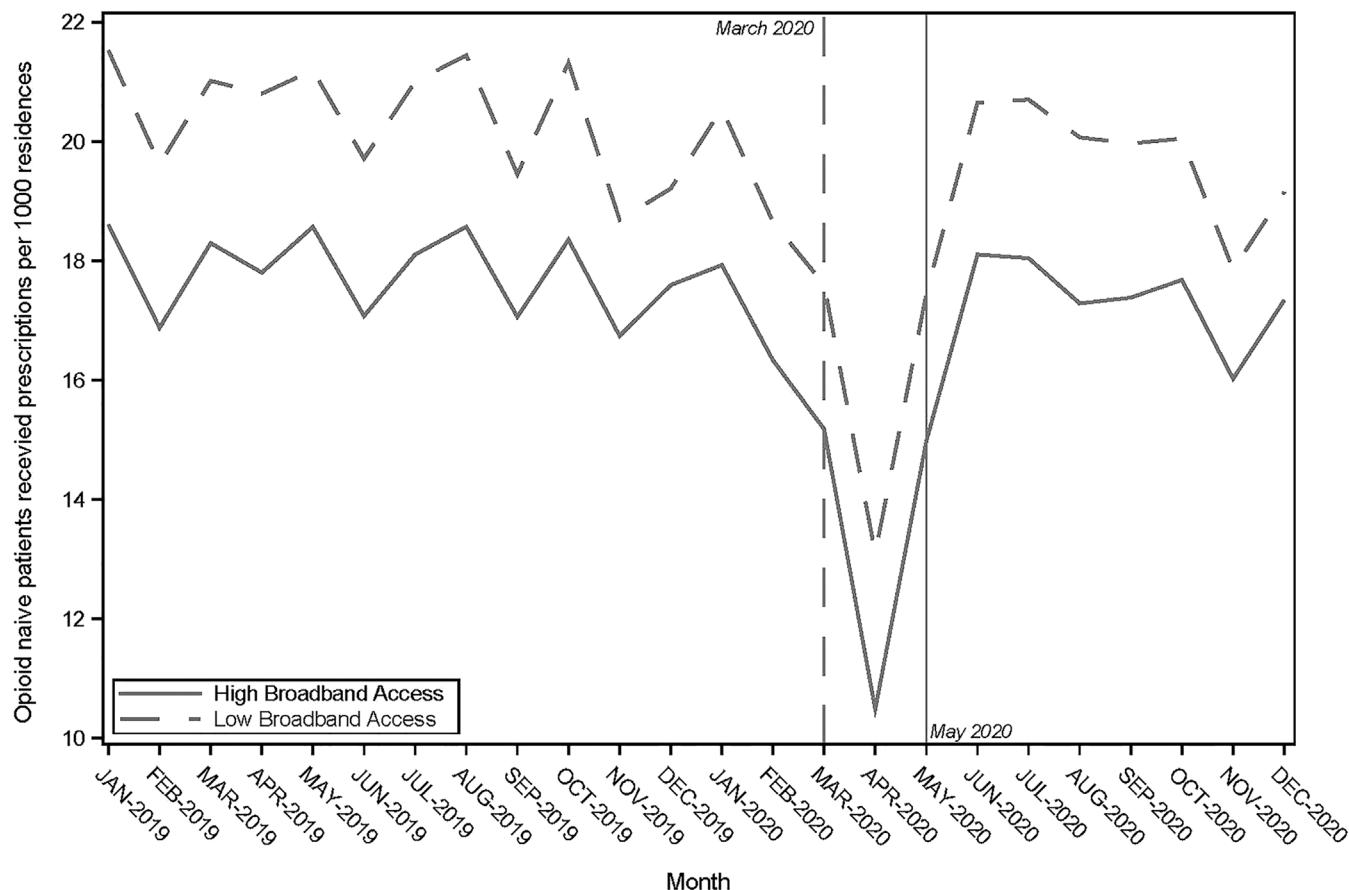


FIGURE 1 Opioid prescriptions to opioid-naïve patients in HBBA and LBBA counties, 2019-2020. Abbreviations: HBBA, high broadband access; LBBA, low broadband access. Note: Dashed and solid vertical lines represent cutoffs for pre-SOE, EO active, and health care reopening phases

TABLE 3 Opioid prescriptions by time period and county type, 2019-2020

Variable	Pre-SOE (1/19-2/20)		EO active (3/20-4/20)		Health care reopening (5/20-12/20)	
	LBBA	HBBA	LBBA	HBBA	LBBA	HBBA
<i>Drug schedule^a</i>						
Schedule II	77.3	80.8	73.8	76.4	76.8	80.4
Schedule III	6.1	4.7	7.0	5.9	5.9	4.7
Schedule IV	16.5	14.5	19.2	17.6	17.2	14.8
<i>Days' supply^b</i>						
Schedule II ^c	6.9 ± 8.4	5.9 ± 7.3	7.7 ± 9.2	6.6 ± 8.1	6.7 ± 8.2	5.7 ± 7.0
Schedule III-IV ^d	12.7 ± 12.4	11.0 ± 11.7	13.6 ± 12.6	11.9 ± 12.3	12.5 ± 12.2	10.8 ± 11.5
Average daily MME ^b	33.6 ± 48.4	35.7 ± 42.7	32.3 ± 49.5	34.4 ± 45.3	33.0 ± 49.2	34.9 ± 41.6
Total MME ^b	231.7 ± 633.2	212.2 ± 619.8	253.4 ± 743.6	227.5 ± 618.9	220.0 ± 573.5	202.4 ± 526.8
ER/LA formulation ^a	0.83	0.68	1.02	0.75	0.77	0.62

Abbreviations: EO, executive order; ER/LA, extended-release or long-acting; HBBA, high broadband access; LBBA, low broadband access; MME, morphine milligram equivalents; SOE, state of emergency.

^aPercent of total opioid prescriptions to opioid-naïve individuals.

^bData presented as mean ± standard deviation.

^cSchedule II opioids include fentanyl, hydrocodone, hydromorphone, methadone, morphine, oxycodone, oxymorphone, and tapentadol.

^dSchedule III opioids include buprenorphine (analgesic preparations) and codeine; Schedule IV opioids include tramadol.

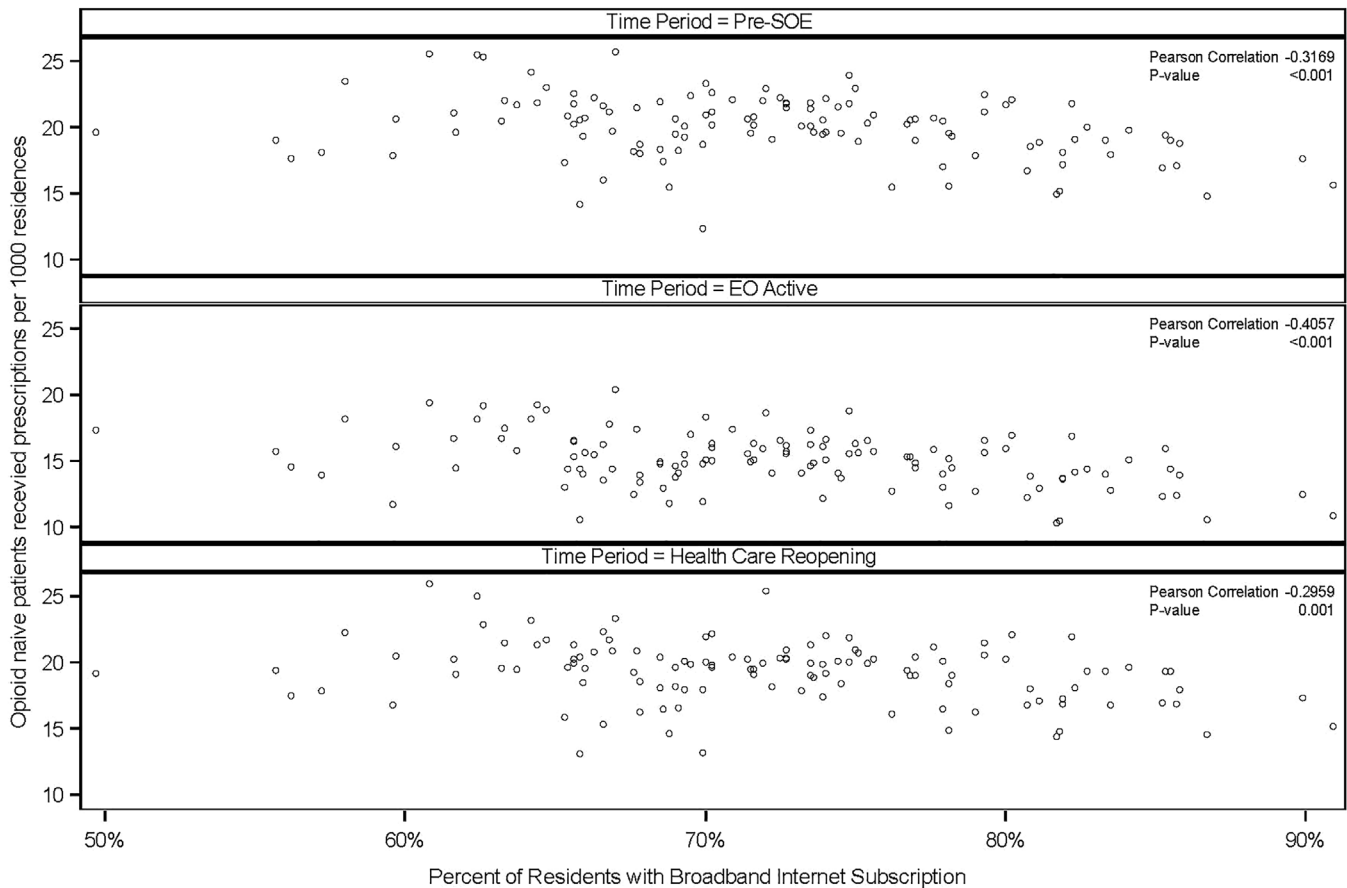


FIGURE 2 Correlation between opioid prescriptions to opioid-naïve patients and internet access by time period, 2019-2020. Correlation and *P*-value in the figure are weighted by community size. Partial correlations are 0.051 ($P = .588$), -0.024 ($P = .800$), and 0.033 ($P = .728$) for the 3 time periods, respectively

have significant excess mental health burden, including incident opioid use.³³ It is particularly interesting to note that even prior to the SOE, the mean days' supply of Schedule II opioid prescriptions was close to 6 in HBBA counties and almost 7 in LBBA, more than double the 3 days' supply limit for mandated by the Kentucky General Assembly in 2017.³⁴ While the law prohibits practitioners from issuing more than a 3-day supply of a Schedule II opioid for acute pain, it contains numerous exceptions, including practitioner professional judgment, that may contribute to the longer average days' supply noted in our study.

Our study has notable limitations. Primarily, the type of encounter resulting in an opioid prescription (eg, telemedicine vs in-person) is not available in the KASPER data set and was not assessed. Additionally, only filled prescriptions were assessed. It is possible that the demand for opioids decreased during the EO active time period, in relation to reductions in ambulatory surgeries or, potentially, fewer acute injuries resulting in a health care encounter; the limited data regarding the impact of COVID-19 restrictions on trauma-related encounters are mixed.^{35,36} We evaluated data at the county level and can, therefore, not assess an individual's likelihood of receiving an opioid prescription during a given time period or based on that specific individual's access to broadband. Broadband access has previously been described as a component of telemedicine access,¹⁹ but other variables (eg, tech-

nological literacy and provider access to telemedicine)^{4,7} may influence telemedicine access and were not assessed in this study. Finally, this study only reports on acute opioid dispensing from a single, relatively rural state with comparatively low rates of broadband access. The defined thresholds for HBBA and LBBA counties were based on the state average rate of 78.4%, which may not be representative of states with higher or lower average rates. Although other analyses have used cutoffs as low as 40% to define low broadband access,³⁷ overall subscription rates have increased over time;³⁸ further, no counties in the state during the time period assessed had broadband subscription rates under 49.7%. While rates of opioid prescribing in Kentucky are higher than many other states, the overall trends in amount and characteristics of dispensed prescriptions are similar.³⁹

CONCLUSION

Access to telemedicine, as measured by broadband access, was not associated with rates of opioid dispensing before and during COVID-19. The changes in opioid prescriptions during Spring 2020 (eg, fewer prescriptions with higher days' supply) should be considered in annual estimates of opioid prescribing.

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CONFLICTS OF INTEREST

The authors have no conflicts of interest.

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