

Effect of Medicaid Expansions on HIV Diagnoses and Pre-Exposure Prophylaxis Use



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Introduction: Increased insurance coverage and access to health care can increase identification of undiagnosed HIV infection and use of HIV prevention services such as pre-exposure prophylaxis. This study investigates whether the Medicaid expansions facilitated by the Affordable Care Act had these effects.

Methods: A difference-in-differences design was used to estimate the effects of the Medicaid expansions using data on HIV diagnoses per 100,000 population, awareness of HIV status, and pre-exposure prophylaxis use. The analyses involved first calculating differences in new diagnoses and pre-exposure prophylaxis use before and after the expansions and then comparing these differences between treatment counties (i.e., all counties in states that expanded Medicaid) and control counties (i.e., all counties in states that did not expand Medicaid). Further analyses to investigate mechanisms addressed associations with HIV incidence, rates of sexually transmitted infections, and substance use. Analyses were conducted between August 2019 and July 2020.

Results: Medicaid expansions were associated with an increase in HIV diagnoses of 0.508 per 100,000 population, or 13.9% ($p=0.037$), particularly for infections contracted via injection drug use and among low-income, rural counties with a high share of pre-Affordable Care Act uninsured rates that were most likely to be affected by the expansions. In addition, Medicaid expansions were associated with improvements in the knowledge of HIV status and pre-exposure prophylaxis use. There was no impact of the expansions on incident HIV, substance use, or sexually transmitted infection rates with the exception of gonorrhea, which decreased after the expansions. Altogether, these results suggest that the changes in new HIV diagnoses, awareness of HIV status, and pre-exposure prophylaxis were not simply because of a higher incidence or an increase in infection risk.

Conclusions: Medicaid expansions were associated with increases in the percentage of people living with HIV who are aware of their status and pre-exposure prophylaxis use. Expanding public health insurance may be an avenue for curbing the HIV epidemic.

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INTRODUCTION

The Affordable Care Act (ACA) expanded eligibility for the Medicaid program as an unprecedented step to increase access to health care. Through this act, a program that previously covered only low-income children, pregnant women, adults with disabilities, and very low-income parents was expanded to include all adults in families with incomes <138% of the federal poverty level. Although the initial ACA plans were to apply to all states, a 2012 Supreme Court decision made the eligibility expansion optional and, as of

May 2020, only 35 states and the District of Columbia have proceeded with the expansions. This paper considers the impact of the expansions on HIV diagnoses and prevention, starting from the premise that HIV burdens

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populations with significant socioeconomic disadvantages and living in underserved areas of the U.S. That is, above and beyond possible changes in HIV incidence, did the expansions increase diagnoses of HIV among people who were previously unaware of their HIV status? Did they increase access to pre-exposure prophylaxis (PrEP, a daily pill approved by the U.S. Food and Drug Administration in 2012 and highly effective in protecting against HIV)^{1–3} for eligible low-income individuals through Medicaid? Although prior studies have identified a positive impact of Medicaid expansions on HIV testing,^{4,5} answers to these 2 specific research questions can offer important insights for implementing the current national HIV prevention strategy and fulfill the commitment to end the spread of HIV in the U.S. by 2030.

The benefits of an early HIV diagnosis and PrEP are broad and well known. An HIV diagnosis, currently made an average of 3 years after infection,⁶ is the precursor of access to antiretroviral therapy, which also prevents death and morbidity and the spread of the virus.^{6–11} Furthermore, an HIV diagnosis reduces risk behavior among people who were previously undiagnosed,¹² and the Centers for Disease Control and Prevention (CDC) recommend frequent testing for populations with high HIV risk and ≥ 1 test for all individuals at some point in their lives.¹³ PrEP also improves health outcomes by preventing infection and is recommended to men who have sex with men, people who inject drugs, and heterosexually active adults.^{1–3} However, even though access to both HIV screening and PrEP is

facilitated by having health insurance, people living with HIV and the populations that need PrEP are often poor or underserved. These 2 aspects of HIV epidemiology make the ACA a natural intervention to increase both HIV diagnosis and PrEP uptake.

This study capitalizes on the variability across states and years (Appendix Figure A1, available online) by comparing changes in HIV-related outcomes in expansion and nonexpansion states. Although the ACA promoted health insurance coverage in numerous ways, this study examines the expansions in the Medicaid program and their impact on HIV diagnoses and PrEP use. For states that have adopted Medicaid expansion, HIV screening must be covered at no cost for the newly eligible populations under the ACA.^{14–17} Likewise, PrEP is paid for by state Medicaid programs.^{14,15,18} Hence, the Medicaid expansions should increase HIV diagnoses, knowledge of HIV status, and PrEP use in a direct way. In addition, they may also increase HIV diagnoses, knowledge of HIV status, and PrEP use indirectly. First, having health insurance may increase HIV diagnoses and PrEP use by increasing contact with healthcare providers, who are advised to screen and provide counseling for HIV to their patients.^{15,16} Second, having health insurance may increase coverage of substance use treatment. Substance use treatment has been shown to facilitate HIV diagnoses^{19,20} and may also increase awareness of PrEP and thus PrEP use.

A model of the impact of the Medicaid expansions on HIV diagnoses and PrEP use appears in Figure 1. As shown, Medicaid expansions may improve access to care

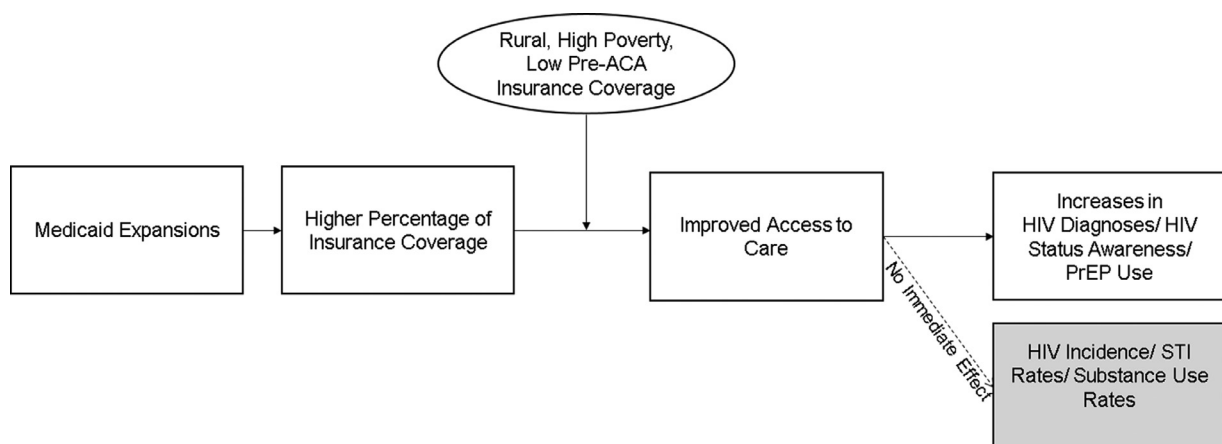


Figure 1. A model of Medicaid expansions and outcomes.

Notes: The figure depicts a model of the impact of Medicaid expansions on HIV diagnoses and PrEP use. Medicaid expansions may improve access to care and therefore increase HIV diagnoses, awareness of HIV status, and PrEP use. The effects of the expansions should be stronger for rural areas, counties with higher levels of poverty, and counties with a higher share of pre-ACA rates of uninsured individuals. In the short run, no direct proximal impact of the expansion on HIV incidence, other STIs, or substance use was predicted. ACA, Affordable Care Act; PrEP, pre-exposure prophylaxis; STI, sexually transmitted infection.

and therefore increase HIV diagnoses, awareness of HIV status, and PrEP use. These increases should be stronger for rural areas, counties with higher levels of poverty, and counties with higher shares of pre-ACA rates of uninsured individuals. The rationale for these predictions is that the policy should have the most impact on the most vulnerable areas. HIV incidence, rates of other sexually transmitted infections (STIs), and substance use also appear in [Figure 1](#). However, these variables are not connected directly to the expansions because they are difficult to specify a priori. First, better access and associated improvements in HIV screening and PrEP may decrease HIV incidence over time. However, this effect may be visible only over a long period. Second, the effects of the expansions on STIs may be similar or different from those for HIV depending on the primary route of HIV transmission. If the HIV diagnoses reflect sexual transmission, then an increase in HIV diagnoses may go hand in hand with an increase in STI rates. By contrast, if the HIV diagnoses reflect drug injection transmission, then an increase in HIV diagnoses may be unrelated to the trend of STIs.

This study examines whether Medicaid expansions affected HIV diagnoses and PrEP use. Although studies have looked at the impact of the Medicaid expansions on HIV testing,^{21,22} this study is the first to estimate the impact of these expansions on diagnoses and PrEP use. Further analyses also investigate whether any changes in the diagnoses were because of infections via (1) heterosexual contact, (2) injection drug use, (3) male-to-male sexual contact, (4) male-to-male sexual contact and injection drug use, and (5) other routes. To describe the potential mechanisms, the effects of expansions on (1) HIV incidence, (2) the rates of STIs, and (3) substance use were also examined.

METHODS

Study Sample

States' status regarding Medicaid expansion was obtained from the Kaiser Family Foundation.²³ [Appendix A](#), available online, provides details on the categorization of states. To measure the effect of these expansions on HIV-related outcomes, data from several sources were used. [Appendix Table F1](#), available online, provides details on the definitions of each variable.

Measures

The HIV diagnoses per 100,000 population for each county-year came from CDC's National Center for HIV/AIDS, Viral Hepatitis, STD (sexually transmitted disease) and TB (tuberculosis) Atlas from 2010 to 2017.²⁴ The data on HIV diagnoses are also classified into 5 transmission categories to which transmission may be attributed: (1) heterosexual contact, (2) injection drug use, (3)

male-to-male sexual contact, (4) male-to-male sexual contact and injection drug use, and (5) other.

One limitation of the CDC Atlas is that HIV data for counties with <5 HIV cases or populations <100 are censored to ensure confidentiality of personally identifiable information. The censored cells were replaced with 0 in the main analyses, although [Appendix D](#), available online, tested the sensitivity of the results to this choice by also imputing with 1, 2.5, and 4 and by using the method proposed by Siegler and colleagues.²⁵

To supplement HIV diagnoses, the study involved analyses of the estimated percentage of people living with HIV who were diagnosed and thus know about their HIV infection. The state-level estimates were obtained from CDC for the years 2010–2017.

To study the effects on PrEP use, the number of people who had ≥ 1 day of prescribed PrEP in a year per 100,000 county residents were obtained from the AIDS Vu for 2012–2017.²⁶

In the short run, the expansions were not expected to proximally and directly affect either HIV incidence or STIs ([Figure 1](#)). However, possible effects were examined using (1) incidence estimates per 100,000 population and (2) rates of other STIs obtained from CDC for the years 2010–2017. Furthermore, supplementary analyses examined the following possible expansion effects on substance use and drug-related overdoses as an indication of unsafe drug use: (1) the number of opioid prescriptions dispensed per state by year from CDC and (2) the number of opioid-related emergency room visits and inpatient stays per state by year from the 2010–2016 Healthcare Cost and Utilization Program.²⁷

The models also included county-level measures of demographics, including the fraction of county population that is male and aged 25–44 years, Black, and Hispanic and data from the Bureau of Labor Statistics on unemployment rates. Finally, as increases in HIV diagnoses may be because of injection drug use, several drug policy indicator variables were constructed using data from Meara et al.²⁸ to ensure that the estimates were not confounded by other simultaneous drug-related policy changes.

Statistical Analysis

A difference-in-differences (DID) framework using longitudinal data from treatment and control groups was employed to estimate the effect of Medicaid expansions. First, differences in the outcomes before and after the expansions were calculated, and then those differences between treatment and control counties were compared. The before period was 2010 through the year before state expansion, and the after period was the expansion year through 2017. The treatment counties are from 32 states plus the District of Columbia, all of which expanded Medicaid to low-income adults by December 2017, and the control counties are from the 18 states that had not yet expanded Medicaid to this population. The validity of this approach depends on parallel trends assumption, namely that changes in HIV outcomes in the nonexpansion counties provide a good counterfactual for the changes that would have been observed in the treated counties in the absence of the expansion.

The DID estimate is the coefficient for the interaction term between the post-expansion period indicator and the indicator variable coded 1 for counties in states that opted to expand Medicaid eligibility by the end of 2017 and 0 otherwise. All models controlled for county characteristics, state, and year indicators. State-specific linear time trends were added to some of the specifications

to additionally control for state-specific unobservables that vary over time. In addition, results from models that included indicator variables for treated counties before the Medicaid expansion and 1-year lag indicator were included. SEs were clustered at the state level.

The timing of the effects was investigated by constructing event studies, in which a single expansion indicator variable was replaced with a series of indicator variables representing the number of years relative to the expansion.²⁹ This analysis was used to verify the validity of the parallel trends assumption. The analyses were conducted between August 2019 and July 2020. [Appendix B](#), available online, provides additional details about the statistical models. [Appendix C](#), available online, tests for the validity of the parallel trends assumption.

RESULTS

Summary statistics for the main variables used in the analysis from 2010 to 2017 appear in [Appendix Table F2](#), available online. As shown, the mean for all HIV cases was lower for the expansion states than non-expansion states. At the same time, the use of PrEP was greater in these areas.

[Table 1](#) presents the DID estimates of how the expansions affected HIV diagnoses. According to the regression result in Column 1, the Medicaid expansions were associated with a statistically significant increase in HIV diagnoses, an average of 0.508 new cases per 100,000 population, which represents a 13.9% ($0.508 \times 100 / 3.659$) increase from pre-expansion levels. [Appendix Table F3](#), available online, presents the analogous estimates from a model that included state-by-year indicators and estimates controlling for a 1-year leading indicator variable.

[Figure 2A](#) plots the DID estimates and their corresponding 95% CIs, comparing HIV diagnoses in counties in expansion states with those in nonexpansion states, relative to the year before treatment. [Figure 2B](#)

adds state-specific linear time trends. Points to the left of the vertical line present the differences in treatment and control counties before the expansion of Medicaid, suggesting that the pre-expansion differences in new diagnoses were not statistically significant. At the time of the Medicaid expansion, the difference in HIV diagnoses between expansion and nonexpansion states increased and remained above the earlier coefficients in Years 2 and 3 ([Figure 2A](#)). Although the DID coefficient estimated in the year following the expansion was robust to the inclusion of state-specific time trends in [Figure 2B](#), the estimated coefficient became smaller in magnitude and not statistically significant beginning in the second year of expansions. It is important to note that state-specific time trends may reflect the effect of the policy and not just pre-existing trends.³⁰ In this sense, the inclusion of these trends may lead to conservative estimates of the effects of expansions. However, the authors chose to be conservative in this set of analyses.

[Table 1](#), Columns 2–6 and [Appendix Figure F1](#) (available online) present estimates for new HIV diagnoses separately by transmission category. Owing to the high number of censored cells in these subgroups at the county level, the estimated coefficients by risk category were conducted at the state level. These results suggest that Medicaid expansions were associated with a statistically significant increase in the rate of infections attributed to injection drug use as well as male-to-male sexual contact and injection drug use. However, there were no detectable effects in other categories.

[Appendix Figure F2](#), available online, considers the extent to which Medicaid expansions affected various county subgroups. These analyses reveal that the increase in new diagnoses was concentrated in rural counties, counties with high poverty rates, and counties with high rates of pre-ACA uninsured. [Appendix Figure F3](#), available online, suggests that increases in HIV

Table 1. Changes in New Diagnoses Among Counties That Expanded Medicaid Relative to Those That Did Not

Variable	All diagnoses (1)	Heterosexual contact (2)	Injection drug use (3)	Male-to-male sexual contact (4)	Male-to-male sexual contact and injection drug use (5)	Other (6)
Expansion	0.508** (0.238)	0.485 (0.405)	0.351*** (0.099)	0.572 (0.636)	0.133* (0.078)	0.006 (0.006)
Pre-2014 mean	3.659	3.116	0.720	6.742	0.440	0.022
Observations	25,064	408	408	408	408	408

Note: The table shows the results of the difference-in-differences regressions using HIV diagnoses from CDC. Column (1) uses new cases per 100,000 individuals by county from 2010 to 2017; Columns (2) through (6) use the new cases per 100,000 individuals by state from 2010 to 2017. The regressions control for unemployment rate, percentage of population that is male, aged 25–44 years, Hispanic, and Black; policy variables that account for opioid prescription limits, prescription drug monitoring programs, and other requirements to prevent illicit opioid-seeking behavior; and state and year fixed effects. SEs in parentheses are clustered at the state level. Boldface indicates statistical significance (

* $p < 0.1$;

** $p < 0.05$;

*** $p < 0.01$).

CDC, Centers for Disease Control and Prevention.

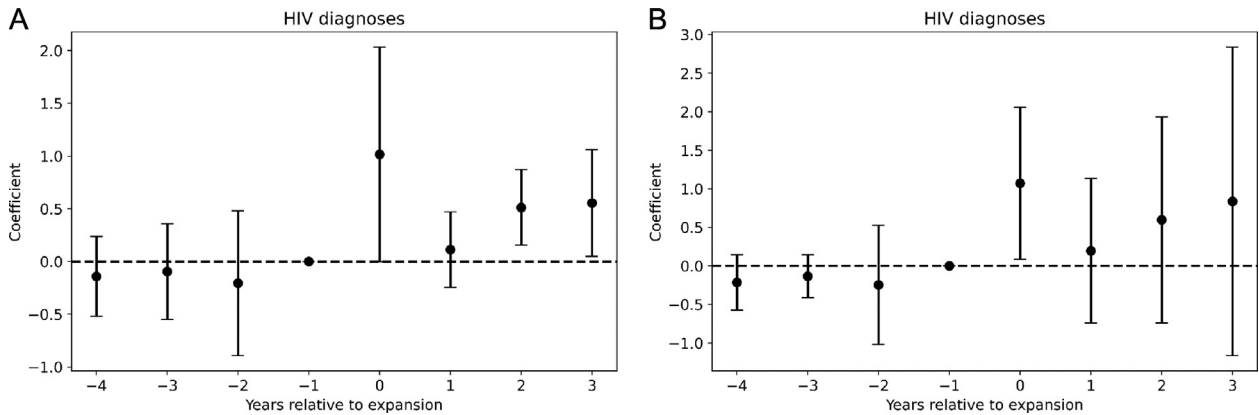


Figure 2. Changes in HIV diagnoses among counties that expanded Medicaid relative to counties that did not, by time period relative to expansion. (A) Without control for state-specific linear time trends. (B) Including state-specific linear time trends.

Notes: The figures show point estimates (and 95% CIs) from regression of HIV diagnoses in each county on a series of indicator variables for time relative to the expansion of Medicaid eligibility. Estimated rates of new diagnoses during the year before expansion were omitted. Data on new HIV cases per 100,000 individuals by county came from CDC for 2010–2017. The regressions control for unemployment rate, percentage of population that is male, aged 25–44 years, Hispanic, and Black; policy variables that account for opioid prescription limits, prescription drug monitoring programs, and other requirements to prevent illicit opioid-seeking behavior; and state and year fixed effects. (B) includes state-specific linear time trends. SEs are clustered at the state level. CDC, Centers for Disease Control and Prevention.

diagnoses were statistically significant only in the Midwest and Southern counties. Although this graph reflects a pre-existing downward trend in the Northeast, this trend disappeared when states that partially expanded their program before 2014 were dropped.

The analysis of the effects of Medicaid expansions on knowledge of status appears in Table 2 and shows a significant increase as a function of the expansions (Table 2, Column 1 and Appendix Figure F4, available online). This increase was more pronounced in states with a high rural population, high poverty rates, and high rates of pre-ACA uninsured (Appendix Figure F5, available online).

Table 2, Column 2 suggests that Medicaid expansions increased the number of PrEP users by 2.643 per 100,000 population ($p < 0.10$). Although this average increase in PrEP use in expansion states compared with nonexpansion states was not significant at $p < 0.05$, Appendix Figure F6, available online, shows a lagged increase in PrEP use starting from the second year of the expansion, which is consistent with the increasing dissemination of PrEP as a new prevention method. These increases were larger in counties with the highest pre-ACA uninsured rates and urban areas, suggesting that there are additional barriers in PrEP uptake in rural areas (Appendix Figure F7, available online).

Consistent with the predictions from Figure 1, the effect of the Medicaid expansions on HIV incidence was not statistically significant (Table 2, Column 3 and Appendix Figure F8, available online). In addition, the rates of chlamydia, gonorrhea, and syphilis were analyzed (Table 2,

Columns 4–7 and Appendix Figure F9, available online). The rates of gonorrhea decreased after Medicaid expansions; however, there was no significant change in the diagnoses of chlamydia or syphilis. Finally, there was no evidence that Medicaid expansions changed any opioid-related outcomes (Table 2, Columns 8–10 and Appendix Figure F10, available online).

DISCUSSION

The National HIV/AIDS Strategy includes the goal of reducing the social health disparities that continue to define the HIV epidemic. Although many social factors contribute to these disparities, health insurance accounts for much of the variation in access to care,³¹ suggesting that insurance expansions should have important implications for HIV prevention. This study examined how the ACA Medicaid expansions affected HIV diagnoses and PrEP use.

Results of DID models indicated that the expansions increased HIV diagnoses. However, only the increase in the first year of the expansion was robust to alternative model specifications. Appendix E, available online, presents the DID estimated coefficient for the likelihood of HIV testing. Consistent with the literature, expansions in Medicaid eligibility were associated with increases in HIV testing.²¹ The increase in HIV diagnoses indicates that improved access to HIV testing resulting from insurance expansions increased the percentage of people living with HIV who are aware of their status.

Table 2. Changes in Outcomes Among Counties That Expanded Medicaid Relative to Those That Did Not

Variable	Awareness of HIV status (1)	PrEP users (2)	HIV incidence (3)	Chlamydia (4)	Gonorrhea (5)	Syphilis (6)	Latent syphilis (7)	Prescription opioids (8)	Opioid-related ER visits (9)	Opioid-related inpatient (10)
Expansion	1.798 ** (0.842)	2.643 * (1.537)	0.703 (0.941)	-8.972 (8.600)	-5.701 ** (2.894)	-0.436 (0.293)	-0.476 (0.286)	-0.061 (0.191)	6.269 (5.218)	1.198 (1.191)
Pre-2014 mean	81.646	4.147	11.458	353.537	75.396	2.296	2.498	7.862	24.170	16.947
Observations	347	18,798	343	25,063	25,062	24,950	24,678	408	98	249

Note: The table shows the results of the difference-in-differences regressions. Column (1) is based on CDC data on the awareness of HIV status by state from 2010 to 2017. Column (2) uses county-level data on the number of PrEP users per 100,000 individuals from the AIDSvu for 2012–2017. Column (3) estimate is based on CDC data on HIV incidence per 100,000 population per state for 2010–2017. Columns (4) to (7) use the CDC data on STI counts per 100,000 individuals by county from 2010 to 2017. Column (8) is based on CDC data on rates of opioid prescriptions dispensed by state from 2010 to 2017, and Columns (9) and (10) use HCUP data on rates of opioid-related hospital visits by state from 2010 to 2016. The regressions control for unemployment rate, percentage of population that is male, aged 25–44 years, Hispanic, and Black; policy variables that account for opioid prescription limits, prescription drug monitoring programs, and other requirements to prevent illicit opioid-seeking behavior; and state and year fixed effects. SEs in parentheses are clustered at the state level. Boldface indicates statistical significance (

* $p < 0.1$;

** $p < 0.05$).

CDC, Centers for Disease Control and Prevention; ER, emergency room; HCUP, Healthcare Cost and Utilization Program; PrEP, pre-exposure prophylaxis; STI, sexually transmitted infection.

Another finding is that although the rate of infections attributed to injection drug use increased, the rates of infections transmitted through male-to-male or heterosexual contact remained stable. This finding is not surprising as the U.S. is in the midst of an opioid crisis, and the increase in injection drug use has led to a greater risk of illness owing to needle sharing. Because there is no evidence that Medicaid expansions affected substance use, the increase in HIV diagnoses attributed to injection is consistent with the improved access to care among those with substance use disorder. Moreover, people with substance use disorders were more likely to be uninsured before the ACA than the general population.³²

In addition, this study suggests that Medicaid expansions were associated with greater use of PrEP and reductions in the prevalence of gonorrhea. The reduction in the rate of gonorrhea is consistent with the improved access to care after the expansions, because detection of gonorrhea typically leads to a rapid resolution of the STI and may decrease its prevalence.³³

This study has important policy implications. Ongoing debates have focused, in part, on the role of access to affordable healthcare plans on disproportionate HIV burden.³⁴ This study was ideally suited to answer this question by providing evidence that Medicaid expansions were associated with improvements in several HIV-related outcomes. Thus, nonexpanding states, especially the Southern states where incidence is currently highest,³⁵ could facilitate HIV prevention by extending insurance coverage to low-income residents.

Limitations

Limitations of these analyses include the lack of access to unsuppressed data on HIV diagnoses. Although the sensitivity analysis suggested that the qualitative conclusions of the study remained robust to alternative imputation methods, the magnitude of the effects was affected. Also, as with any quasi-experimental method, these analyses are subject to potential time-varying confounders, although pre-expansion trends did not differ between expansion and nonexpansion states.

CONCLUSIONS

The study findings suggest that expanding eligibility for Medicaid increased HIV diagnoses. This finding is important because CDC estimates show that a high fraction of new HIV infections in the U.S. in 2016 were transmitted by people who were living with HIV but were not aware of their status.³⁶ This study provides important evidence suggesting that increasing health insurance coverage may play a critical role in eradicating HIV.

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SUPPLEMENTAL MATERIAL

Supplemental materials associated with this article can be found in the online version at <https://doi.org/10.1016/j.amepre.2020.10.021>.

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