Selection and Surveillance: The Impact of Abortion Funding Cuts on Safety Net Access and STI Detection*

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Abstract

Federal and state funding cuts have targeted publicly funded family planning providers that perform or refer for abortion, with potential impacts on non-abortion services like testing and treatment for sexually transmitted infections (STIs). This paper studies a 2019 shock (the 2019 Title X Final Rule) that made receipt of funds through the federal Title X family planning program contingent on refusing to offer, refer to, or support abortion services resulting in providers exiting the network. Leveraging county-level variation in exposure to Title X-funded clinics facing new funding cuts, this paper investigates the impact on chlamydia case detection. Counties that experienced funding cuts had a subsequent 6.7% reduction in chlamydia case detection. Treatment effects were robust across levels of COVID-19 exposure. Calibrating a model of chlamydia transmission to my empirical estimates and pre-period epidemiological data, I estimate the population-level health impacts resulting from reduced chlamydia detection. Assuming that all of the estimated decrease in case detection was attributed to decreased asymptomatic screening coverage, I find that screening among women decreased by 3.0 percentage points, translating into 48,467 new infections and 4,394 additional cases of pelvic inflammatory disease.

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1 Introduction

Millions of low-income, underinsured, and uninsured individuals access free or low-cost health services from a complex network of over 10,000 publicly funded "safety net" clinics. A subset of these facilities receive state and federal grants to provide family planning services, such as contraceptive care and counseling, breast and cervical cancer screenings, and testing and treatment services for sexually transmitted infections (STIs). As of 2016, over 6 million women received publicly funded family planning services, including 1.2 million adolescent women (Guttmacher Institute, 2019).

Among clinics that provide publicly funded family planning services, a subset specialize in sexual and reproductive health. Since 2010, federal and state policies targeting providers affiliated with or referring to abortion services have threatened the ability of many of these clinics to operate. Clinics have reduced hours, staff, and available service offerings and have even shut down altogether impeding access to non-abortion services– such as STI testing and treatment – for population served by these clinics (Gounder, 2025; Ollstein and Roubein, 2019; White et al., 2012, 2015). These impacts are likely to be large given that STI testing accounts for a meaningful share of these clinics' activity: among Planned Parenthood affiliates, who are often targeted by these policies, STI testing and treatment accounted for 50% of all medical services provided in 2018. This is more than contraception services (26%) and cancer screenings and prevention (6%)(Planned Parenthood, 2019a).

Across the United States, annual notifications for gonorrhea, chlamydia, and syphilis have risen 13% since 2014 (Centers for Disease Control and Prevention, 2024). Much of the increase in STI rates has occurred among adolescents and young adults. Of the approximately 25 million new infections that are estimated to occur each year, about half are among people aged 15-24 (Kreisel et al., 2021). Young women aged 15-24 account for the highest reported rates of chlamydia and gonorrhea—the two most common STIs in the US (Centers for Disease Control and Prevention, 2024). This same population is also most exposed to shocks to family planning, accounting for 36% ($\sim$ 1.5 million) of federal family planning users in 2018 (Fowler et al., 2019). Untreated STIs among women can cause pelvic inflammatory disease, infertility, and increase risk for other STIs, like HIV, and can also be transmitted to infants during pregnancy.

Politically motivated funding cuts to family planning providers that affect non-abortion service provision offer an opportunity to study whether, and how, reduced access to publicly funded family planning care affects STI case detection. The impact of reduced access is a priori ambiguous. Reported cases are the product of underlying incidence and screening intensity. If reduced access lowers screening intensity, reported STI cases may decline even if underlying STI prevalence is unchanged. At the same time, if undetected infections go untreated, declines in screening may lead to lagged increases in transmission. The net effect on detected cases thus depends on the relative speed of these channels and on the extent to which patients substitute towards other providers.

I study the 2019 Title X Final Rule ("domestic gag rule"), which imposed new requirements on recipients of the federal Title X Family Planning Grant program and prompted over 1,000 clinics to withdraw from the network. The rule generated variation in access to publicly funded family care across counties and over time. Identification comes from comparing counties that lost Title X access following the 2019 Final Rule to counties whose access remained stable. I use a doubly-robust differences-in-differences design that matches on a set of pre-period covariates to address imbalances between treated and control counties could result in differential trends in STI growth rates. Given that 2020 was the first full year of treatment and that parallel pre-trends do not guarantee that treated and control counties weren't differentially affected by COVID-19, I perform additional robustness checks — re-estimating the ATT without the main pandemic years and exploring heterogeneity by COVID-19 severity — that suggest results are not attributable to differential COVID-19 disruptions.

I first show that the 2019 Final Rule displaced a large number of clients and chlamydia tests. The number of Title X funded chlamydia tests dropped by nearly 500,000 tests between 2018 and 2019, when the rule took effect, and by nearly 1 million more between 2019–2020. In states that were highly exposed to Title X exits, testing declined by 50% in 2019. While these declines are mechanical — providers who exit the network no longer perform Title X-funded services, their magnitude establishes the scale of the displacement: a large number of clients would have had to rely on alternative sources of financial coverage, seek alternative providers with Title X funding, or forgo care.

Consistent with descriptive declines in testing, I find an overall significant negative effect on chlamydia case detection between 2019–2023. Counties that lost all within-county Title X access experienced significant reductions in reported chlamydia case detection relative to counties whose access remained stable. These effects appear even in partially treated 2019: reported case detection declined by 2.3% relative to 2018 though were insignificant. Further, these estimates are consistent when using an alternative measure of treatment that defined treatment based on proximity to nearest Title X-funded clinic. I find significant declines between of up to 5.0% beginning in 2019. Given that data on testing volumes and test positivity are not available nationally or at the county-level, I benchmark these estimates against the share of testing performed at Title X facilities for a subset of states that lost all Title X providers and chlamydia positivity rates reported in the literature, which suggest that the estimated treatment effects are plausible.

I also explore the extent to which patients can substitute to other providers. Other publicly funded family planning providers that predominantly provide primary care services (e.g., Federally Qualified Health Centers, FQHCs) as opposed to specialized reproductive and sexual health services, have largely been insulated from abortion-targeted funding cuts and nearly all offer chlamydia, gonorrhea, and HIV testing (VandeVusse et al., 2024). If patients view these providers as close substitutes, a funding shock might reallocate testing across providers rather than reduce overall demand for testing. However, substitution may be incomplete if alternative providers are not viewed as substitutes, face constraints in absorbing displaced patients, are less geographically accessible, or charge higher fees. I develop a county-level panel of publicly funded clinic locations that distinguishes Title X-funded facilities from other safety net providers, specifically FQHCs and 340B-funded STI clinics. Nearly 70% of counties with a Title X clinic had access to an alternate safety-net provider. I find that declines in case detections were largest in counties that did not have access to alternate publicly funded provider, but that case detection still declined in counties with access to alternate care. This is consistent with existing evidence that safety-net family planning providers are not perfectly substitutable (Hasstedt, 2017; Stevenson et al., 2016) for family planning services. Contraceptive users value specialized family planning clinics as confidential, trusted, and expert sources of care, even when 40% of clients also have a primary care provider (Frost et al., 2021). Further, between 2010-2018, female visitors to a subset of STD clinics declined by half, with pronounced reductions among women less than 25 (Llata et al., 2021). This raises the possibility that STI services, despite being more widely offered, may also exhibit imperfect substitution.

To determine the impact of the Title X shock on population health outcomes not reported by surveillance data, I developed a model of chlamydia transmission using a transmission-dynamic compartmental model. I calibrate the model to empirical estimates of decrease in chlamydia case detection to estimate changes in new infections, prevalence, and the number of women experiencing severe sequelae, such as pelvic inflammatory disease (PID). Assuming that all decline in chlamydia case detection was due to declines in asymptomatic screening coverage, I estimate that the shock generated 48,467 new infections and 4,394 additional cases of PID between 2019–2021.

This paper makes three contributions. First, it provides causal evidence on how changes in access to care affect STI outcomes. This extends earlier work by Lu and Slusky (2016), Packham (2017), and Fischer et al. (2018) looking at the impacts of state-level Title X shocks on fertility and contraceptives in Texas. In addition to extending this work to a new outcome, STIs, this paper leverages national county-level variation nearly a decade after the state-level shocks evaluated in prior papers. Second, I construct a novel county-level panel of publicly funded clinic locations to explore substitution effects. Third, I combine reduced-form estimates with a transmission model to recover population health impacts that surveillance data do not capture.

This paper relates to several literatures. This paper is most closely related to nascent work that descriptively documents the impact of reduced access to family planning services on STIs (Srinivas et al., 2022; Sherwood et al., 2025). Srinivas et al (2022) find an association between the closure of four Planned Parenthood clinics and STI rates in Iowa, and Sherwood et al. (2025) study the effect of the 2019 Title X rule on HIV testing through the Title X program and regional HIV diagnoses. Exploiting this same national shock, I leverage variation in access to the federal Title X family planning program across counties and over time to construct a plausible counterfactual. This paper also related to work on the spillovers of family planning clinic closures on non-abortion services (Lu and Slusky, 2016; Packham, 2017; Fischer et al., 2018). Lu and Slusky (2016) show that demand for preventive screenings, such as annual breast exams, cervical cancer screenings and pap smears, decreased as distance to nearest family planning clinic increased following a closure. Given that most chlamydia and gonorrhea infections among women are asymptomatic, and thus identified through routine screening rather than symptom-driven visits, changes in STI case detection may similarly decrease with reduced access.

The rest of the paper is organized as follows. Section 2 details the Title X family planning program and the 2019 Title X Final Rule. Section 3 presents the data and descriptive statistics. Sections 4 and 5 outlines the empirical strategy and associated results. Section 7 outlines the setup of the transmission-dynamic model and model results. Finally, Section 8 concludes.

2 Background: 2019 Title X Final Rule

Established in 1970, Title X is the only federal grant program dedicated to family planning. It supports access to an array of confidential, free and low-cost family planning services for low-income women and men, including contraception and counseling, breast and cervical cancer screening, and STI services.

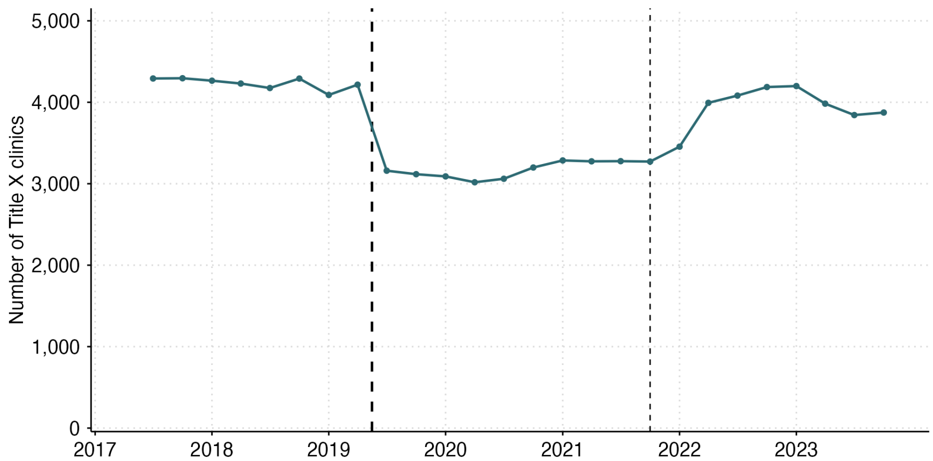
Title X funding both subsidizes access to family planning services and supports clinics' capacity to deliver them (Gold, 2007). Funds are distributed to grantees, who then determine how funding is allocated. Whereas Medicaid or Section 1115 family planning waivers reimburse providers for enrolled patients, Title X subsidizes care for individuals who do not meet Medicaid eligibility requirements (e.g., immigrants, those above the 250% poverty line) and where covered services are incomplete or confidentiality is a concern. Although 40% of Title X users were uninsured in 2018, over half had public (38%) or private insurance (20%) (Fowler et al., 2019). A variety of clinic types receive Title X funds. Roughly half are health departments and the remainder include Planned Parenthood affiliates, Federally Qualified Health Centers (FQHCs), hospital outpatient departments, correctional facilities, schools, and other private clinics.

STI testing is a core part of Title X clinics' services. In 2018, Title X providers performed 2.1 million chlamydia tests, 2.4 million gonorrhea tests, 750,000 syphilis tests, and 1.2 million HIV tests (Fowler et al., 2019). Eighty-five percent of chlamydia testing through Title X is among women (Fowler et al., 2019). Most STI testing is integrated opportunistically into routine visits, though nearly 25% of patients report STI screening as their primary reason for seeking care (Frost et al., 2021). Title X providers are expected to offer STI testing services to clients in accordance with CDC guidelines. This entails offering annual chlamydia and gonorrhea screenings for all sexually active women under 25 and women older than 25 at increased risk of infection. In 2018, Title X sites tested 53% of all female users (1.8 million) and 61% of women under 25 for chlamydia (Fowler et al., 2019).

In March 2019, the Trump Administration announced the Title X Final Rule, which prohibited Title X providers from promoting, referring for, or supporting abortion services, among other restrictions (HHS Office of Population Affairs, 2019). Because Title X had always prohibited the use of program funds for abortion services, the new restrictions were widely understood as an effort to target providers with any affiliation to abortion care.

Figure 1 plots the trend in the number of clinics participating in Title X between 2017 and 2025. Over 1,000 clinics withdrew from the network in 2019 forfeiting all Title X funding. These included providers offering both abortion and non-abortion services and those that viewed the restrictions as incompatible with comprehensive family planning services. Exiting grantees referred to the rule

Figure 1: Quarterly counts of participating Title X clinics (2017-2025)



Notes: Extracted Title X clinic counts (defined as sub-recipients and service sites) from 2017–2025 based on Office of Population Affairs' (OPA) monthly Title X grantee directories. Monthly counts for January, April, July, October are shown. Validation of extracted counts are located in Appendix Figure 7. The dashed line shows when the 2019 Final Rule went into effect. The dotted line shows when the rule was reversed in 2021.

as "unethical and dangerous" and that it would require "replacing our services with inadequate and incomplete health care" (Planned Parenthood, 2019b; PHS Solutions, 2019). Planned Parenthood, which served nearly 40% of Title X patients through over 400 affiliate clinics, withdrew entirely from the network. Planned Parenthood's outsized role in Title X amplified the disruption. Though affiliates accounted for only 10% of Title X clinics, they served roughly one third of contraceptive clients nationally (Hasstedt, 2017). Six states—Hawaii, Maine, Oregon, Utah, Vermont, and Washington—lost all Title X providers for nearly two years (Frederiksen et al., 2025). Health departments (52%) and FQHCs (33%) made up the majority of clinics that remained (Frost et al., 2025).

Exiting the Title X network does not guarantee that a clinic decreased or terminated operations, but anecdotally, it removed a meaningful share of funding. In 2019, Title X accounted for over 20% of participating providers' revenue (Fowler et al., 2019). Participating clinics also qualify for the 340B Drug Pricing program, which lets them purchase contraceptives and other medications at reduced prices. Losing these sources of funding forced clinics to adjust in ways relevant for STI screening. In surveys of clinics in four states (Arizona, Iowa, New Jersey and Wisconsin), clinics that left Title X reported serving fewer contraceptive patients, changing their sliding-fee scale, encouraging patients to use private insurance, and increasing fees for specific services (VandeVusse et al., 2023). Some clinics reported suspending walk-in STI testing services and charging for STI testing (Ollstein and Roubein, 2019). Several states, including Hawaii, Illinois, Maryland, Vermont, Washington, Massachusetts, Oregon, and California, attempted to backstop a portion of Title X funding as a short-term measure, though many could not sustain it beyond 2019. While this period overlaps the height of the COVID-19 pandemic, an estimated 63% of the decline in Title X users has been attributed to the Final Rule rather than to the pandemic (Fowler et al., 2021).

In 2021, the Biden Administration reversed the 2019 Final Rule. Nearly 62% of counties that lost clinics in 2019 had returned to their baseline clinic count by 2023. This was driven largely by previously exited clinics that rejoined the network beginning in 2022.

3 Data and Descriptive Statistics

3.1 Treatment Data: County-level Title X Access

I define county-level Title X access in two ways: 1) whether the county contains any Title X clinic within its borders and 2) the distance to the nearest Title X-funded clinic, irrespective of whether that clinic is located within the county.

The location of clinics receiving Title X funding comes from monthly grantee directories from the Office of Population Affairs' (OPA) between 2017-2025 (HHS Office of Population Affairs, 2026). These directories list the names, addresses, and zip codes of all grantees receiving Title X funds as well as their sub-recipients and service sites. I extract clinic names and addresses to construct a national panel of Title X-funded service sites and sub-recipients (hereafter "Title X clinics"). Sub-recipients may deliver services directly in addition to distributing funding to service sites, and their inclusion as clinics is consistent with prior work (Krass et al., 2022; Frederiksen et al., 2025). I restrict to clinics located in the 50 states and DC and exclude 6% of Title X clinics with limited availability to the general population, including K-12 schools, correctional or detention facilities, and shelters.

Quarterly counts were validated against annual FPAR reports of service sites and sub-recipients and 2020 Guttmacher Census (Figure 7). To assign clinics to counties, I match clinic zip codes to 5-digit county FIPS codes using the Department of Housing and Urban Development's 2010 United States Postal Service ZIP code crosswalk file. I then calculate the straight-line distance between the Census's 2020 population-weighted county centroid for each county in the United States and the centroid of the zip code in which each clinic is located.

I determine treatment status based on whether a county experienced a change in Title X access between the first and last quarter of 2019, and that the loss persisted through Q1 2020. I consider two definitions of a change in access to Title X-funded care. The first definition defines treatment based on whether a county went from having at least one Title X clinic to containing no clinics between the first and last quarter of 2019 (hereafter "county-based"). Counterfactual counties are those that retained their Title X access throughout 2019. This captures the aggregate shock to within-county Title X access.

To account for measurement error from clinic churn, for each county, I determine the maximum number of clinics in January-March 2019 (best access) and the minimum number of clinics between October-December 2019 (worst access). Control counties were defined as those whose count of clinics did not change between Q1 and Q4 2019. Complete-loss counties are counties who lost all of their clinics in Q4 2019, and where the loss persisted into each month of Q1 2020. This definition is stable over time – 99% of counties that lost access between Q1 and Q4 2019 still had 0 clinics beginning in Q1 2020, and 96% had 0 clinics by Q4 2020 and 88% by Q4 2021. I exclude 7 counties that were classified as controls, but whose access declined in Q1 2020.

However, this measure of treatment does not account for the fact that residents may access care in a neighboring county. Thus, I define a second definition of treatment that measures the change in distance to the county's nearest Title X clinic regardless of county boundaries (hereafter "distance-based"). It combines the change in distance to the nearest Title X-funded clinic following the 2019 Rule with the baseline pre-treatment distance. Following a construction similar to that of Fischer et al. (2018), I create binned distances based on whether a county lost a Title X-funded clinic within 5, 5-10, and 10-20 miles from its population-weighted county centroid (i.e., a county went from having its nearest Title X clinic with 5-10 miles of its population-weighted centroid, to having its nearest Title X-funded clinic be over 10 miles away post-treatment). Treatment is thus binary within each mutually exclusive distance bin. This addresses potential non-linearities in the effect of distance and accommodates heterogeneity in treatment effects by baseline access.

I calculate the monthly distance to the nearest Title X clinic from each county's population-weighted centroid. I determine each county's baseline distance bin by taking the minimum distance to the county's nearest Title X clinic between January-March 2019. Treatment status is then determined if the nearest clinic crossed the bin's upper bound in Q4, where an increase in distance between Q1 and Q4 persisted into Q1 2020. Counties whose distance to their nearest Title X clinic was in the same distance bin between Q1-Q4 2019 were considered controls. Treatment is binding: The median distance to the nearest Title X clinic after the Final Rule is 38–50 miles for each distance bin.

3.2 Outcome data: Case detection for sexually transmitted infections

My main outcome is chlamydia case detection, which is the most common STI in the US. Chlamydia is a notifiable condition meaning that providers or laboratories are required to report detected cases to local health departments for case management. While time trends in the number of cases detected reflects both changes in testing and transmission, few data sources exist at-scale on STI testing volume, positivity rates of tests or characteristics patients who test.[1] My main outcome is annual counts of diagnosed and reported STI cases at the county-level between 2014-2023 from the CDC's National Center for HIV, Viral Hepatitis, STD and Tuberculosis Prevention AtlasPlus. Data are reported as the number of annual reported diagnoses per 100,000 county population, where the attributed county is based on the patient's location of residence, rather than the location of testing. This captures whether a resident was detected, regardless of where testing occurred.

Among the subset of treated and control counties, 34 county-years are missing. A majority of the missingness is in Maryland, which did not report STI case notification data in 2021 (Centers for Disease Control and Prevention, 2023), and Connecticut revised their county-level designations in

[1] Additionally detection may be impacted by changes in test technology, guideline-recommended populations, and reporting systems. Test technology and screening recommendations have largely been consistent during this study period. Expansion of more sensitive tests, such as nucleic acid amplification tests (NAATs), took place between 2000-2008 and CDC cemented NAATs as the preferred diagnostic method in 2014.

2022 and 2023 (Centers for Disease Control and Prevention, 2024). I exclude 0.2% (38) of chlamydia county-years in which 0 cases were reported. Less than 4% of county-years had < 10 cases.

While gonorrhea is often tested in tandem with chlamydia among women, I exclude it from this analysis. I am limited to total cases at the county-level. Since gonorrhea cases reflect a more diverse population, such as men who have sex with men (MSM), changes in case detection are likely to be a more diffuse signal of Title X shocks, especially given changes in screening guidelines and diagnostics for MSM over the study period.

3.3 Covariates

I include covariates that might plausibly affect differential trends in STI growth rates between treated and control counties due to transmission or detection. This includes county population, the racial and ethnic composition and the share of the population of reproductive age (15-44) (Surveillance, Epidemiology, and End Results (SEER) Program), the unemployment rate (Bureau of Labor Statistics Local Area Unemployment Statistics), and whether the county was located in a state that expanded Medicaid prior to 2019.

I also compute the straight-line distance to the nearest alternative safety-net provider offering STI testing, specifically Federally Qualified Health Centers (FQHCs) and Section 318 STD clinics, which are predominantly state and local health departments.

I identify addresses for FQHCs from HRSA's Annual Uniform Data System and identify the subset of Section 318 STD clinics that are registered as part of the 340B Drug Discount Program and appear in the Office of Pharmacy Affairs' 340B Covered Entity database. Because FQHCs and Section 318 STD clinics may themselves receive Title X funding, I exclude clinics that appear in both the Title X directories and HRSA UDS data or 340B data based on name and zip code, so that the access to alternate providers measure only reflects access to non-Title X providers.

3.4 Descriptive Statistics

Table 1 provides a summary of the nearly 2,000 counties that contained at least one Title X funded clinic in January 2019. Most of these counties were located in the South and Midwest, were rural, and had a predominantly non-Hispanic White population. The average distance to the nearest Title X clinic from the county's population-weighted centroid was around 5 miles. Based on estimates from the Guttmacher Institute, Title X clinics accounted for the majority of publicly funded family planning care in these counties as of 2015, though over 70% of counties with a Title X clinic also had access to an alternate provider.

Figure 3 maps the location of treated counties using the county-based definition of access. Unlike control counties, treated counties tended to be located outside of South. They were less rural, more populated, and wealthier. Treated counties tend to be in states that expanded Medicaid prior to 2019 with a much lower share of women under 25 who were uninsured. While baseline chlamydia rates were lower in treated counties, the average pre-period growth rates were similar across counties. Among distance-based treated counties, counties in < 5 mile or 5-10 mile distance bins are more urban (Appendix Table 11) than their controls. On average, residents of treated counties in the < 5 mile to 5-10 mile bin had to travel over 65 miles to their nearest Title X clinic post-exit. Over 75% of counties have access to alternative safety-net providers regardless of treatment status or distance bin.

Table 2 provides details on clinic exits across treatment regimes. Nearly 500 counties experienced the exit at least one Title X clinic within their county's borders. Most counties that experienced any exit lost all Title X clinics within their county, losing 2.7 clinics on average. Average distance to the nearest Title X clinic following the exit increased between 48 and 74 miles, depending on treatment group. Nearly 60% of counties that lost all of their clinics had returned to their baseline clinic counts in the post-period. Most of this recovery occurred in 2022. A majority of this clinic return was driven by the return of Planned Parenthood affiliates and other clinics that had previously received Title X funding.

4 Empirical Strategy

I leverage national variation in access to Title X-funded clinics across counties and over time to estimate the relationship between losing Title X access and STI case detection. Using a difference-in-differences design, I compare changes in STI case detection between counties where access to publicly funded family planning decreased following the 2019 Title X Final Rule and counties whose Title X access remained stable. The target parameter is the average treatment effect on the treated (ATT) – the average causal effect of reduced access to Title X care on chlamydia case detection among counties that experienced a decrease in Title X clinics in 2019, which reflects the county-level policy impact of changes in Title X access. The Title X Final Rule was announced in March 2019 and went into effect in July 2019 after court delays. Because I only have annual variation in outcome data, I define treatment based on a single treatment cohort (2019).

I estimate changes in chlamydia case detection on the log scale. This addresses wide variation in baseline STI rates across counties and that treatment effects are likely to vary based on baseline rates. I fail to reject the null that parallel trends are not sensitive to functional form (p-value = 0.97) (Roth and Sant'Anna, 2023).

The preferred specification uses the doubly-robust estimator developed by Callaway and Sant'Anna (2021) to estimate the change in log chlamydia case detection applying equal weights to all counties. By combining outcome regression and inverse probability weighting (IPW), this estimator remains consistent under model misspecification in either the outcome regression or the IPW model. I prefer this for its ability to flexibly include covariates via IPW, which is important given the imbalance between treated and control counties. Covariates are set to their pre-treatment 2018 levels. I define 2019 as the first year of treatment, though it is partially treated. For event study results, I estimate changes in chlamydia case detection relative to 2018, which is the year prior to when the Title X Final Rule went into effect. Standard errors are bootstrapped over 1,000 iterations and clustered at the county-level.

Identification of the ATT relies on a parallel trends assumption: trends in STI growth rates among counties that experienced decreased access to a Title X-funded care in 2019 would have continued on the same trajectory as counties where access remained stable in absence of the 2019 Gag Rule. Because treated and control counties are imbalanced on covariates that plausibly predict differential trends in STI growth rates (e.g., urbanicity, demographics, Medicaid expansion status), the unconditional parallel trends assumption is unlikely to hold. Instead I invoke a conditional parallel trends assumption that holds if, within levels of observed pre-treatment covariates, trends in untreated potential outcomes would have been parallel. These include levels of demographic characteristics (log county population, share of the population that is non-Hispanic White, share of the population that is Hispanic, and share of county between 15-44 years of age), economic characteristics (unemployment rate), and safety-net infrastructure (distance to nearest FQHC or STI clinic from population-weighted centroid, whether county was in state that expanded Medicaid before 2019).

While the parallel trends assumption is fundamentally untestable, I argue whether a given clinic exits the Title X network is likely unanticipated and unrelated to unobserved time-varying factors that would differentially affect STI growth rates. First, providers exiting the network cited clinical and ethical objections to Final Rule restrictions on abortion referrals, rather than underlying changes in STI rates or factors that might affect STI rates. Further, these decisions were largely made at the organization level and applied uniformly across affiliated clinics (e.g. Planned Parenthood) independent of local STI dynamics, county conditions, or clinic financial viability. If clinics were independently exiting the network, this might raise concerns about selection.

5 Results

5.1 Descriptive trends in Title X-funded services

Figure 2 Panels A and B depicts trends in all users and chlamydia tests by sex. Between 2014–2018, Title X served an average of 3.99 million clients per year. Women accounted for the majority of Title X users (89%) and chlamydia tests. Total clients and STI testing services declined in the post-period beginning in 2019. In 2019, there were 758,000 fewer female users and 89,000 fewer male users relative to 2018, a 25% decrease for both groups. The number of chlamydia tests decreased by 0.5 million tests among women between 2018–2019, with a subsequent decrease of nearly 1 million tests between 2019-2020.

Figure 2 Panels C-F provides trends in testing and visits by level of state-exposure to the 2019 Final Rule. The finest geographic unit reported by FPAR is the state-level. "High exposure" refers to 13 states that lost $> 75\%$ of their Title X providers. This includes 6 states (OR, WA, HI, VT, UT, ME) that lost all of their Title X-funded providers. Consistent with Title X exits in 2019, high-exposure states experienced a nearly 50% decline in all female clients, and all clients and chlamydia testing among women aged < 25. Low-exposure states experience a drop in 2020 which plateaus for the remainder of the post-period, while high-exposure states rebound in 2022, consistent with the 2021 Title X rule reversal.

While these trends are a mechanical result following from the withdrawal of Title X providers (rather than a decline in testing at the county-level), they suggest that a large number of clients were displaced from free or low-cost family planning services and either needed to substitute to other sources of care or drop out of care-seeking altogether.

5.2 Chlamydia case detection

Table 3 presents difference-in-difference and event study estimates of the effect of losing Title X access on county chlamydia case detection. Column 1 presents the results for the county-based definition of treatment. Columns 2–4 present the results for the distance-based definition of treatment. Each column is a separate model estimated on the subset of treated and control counties in each mutually exclusive distance bin. Panel A presents the overall ATT estimate aggregated over the entire post-period. Panel B reports the event study coefficients, which are also plotted in Figures 4 and 5.

Under the county-based definition of treatment, Figure 4 shows flat and insignificant pre-trends. Beginning in 2019, chlamydia case detection declined by an insignificant 2.3%, with significant reductions of 7.1% and 11.5% in 2020 and 2021, respectively. Case detection partially rebounded in 2022 and 2023, though remained below pre-period and pre-pandemic levels, potentially consistent with partial recovery of Title X clinics following the 2021 rule reversal (221 of 360 treated counties regained a clinic by 2022). Panel A, Column 1 shows that over the entire post-period, chlamydia case detection declined by 6.7% among treated counties.

Table 4 presents the average marginal effect implied by the estimated event study coefficients following Feng and Bilinski (2024) in terms of the differences in the number of cases and cases per 100,000 population relative to 2018. The decline in case detection translated to a decrease of a 9.34 cases per 100,000, or 9,500 cases in partially treated 2019, and upwards of 26.26 to 43.39 cases per 100,000 lost in 2020 and 2021.

The estimated effects on chlamydia case detection are consistent when looking at the results using the distance-based definition of treatment. Again, pre-period event study coefficients are flat and insignificant across all three distance bins (Figure 5). Table 3, Panel A shows that the magnitude of the impact is largest for counties that lost a clinic within 5–10 miles of their population-weighted centroid (a 9.2% decrease), relative to counties that lost a clinic within 5 miles (a 7.1% decrease). Among counties whose nearest clinic was now more than 20 miles away, we find an insignificant decrease of 3.5% in the post-period. While less precise and likely underpowered, this may suggest that baseline access to Title X-funded care was already limited, such that traveling even further for care may have had no impact on care-seeking.

Are the estimated coefficients reasonable given the share of STI testing performed by Title X providers? Using the 6 states that lost all providers and for which annual chlamydia test volumes were available, I perform a rough benchmarking exercise to determine whether the magnitude of estimated coefficients are reasonable given the number of tests performed via Title X (Table 5). This assumes that Title X exits accounted for all of the decline in chlamydia case detection and that displaced clients did not substitute to other providers for testing. Required positivity ranged from 6.5% in 2019 to 12.6% in 2022, and was 8.1% during COVID-19 beginning in 2020. Early estimates for 2019 and 2020 are in line with existing estimates of positivity at publicly funded clinics. A 2011 study reported 7.2% positivity among family planning patients aged 15–24 in 2008 using data from the Infertility Prevention Project (Satterwhite et al., 2011). Required positivity rates are well-below estimates from a higher-risk population of individuals attending STD clinics that found positivity among women aged 15–24 to be 19.9% in 2018 (Llata et al., 2021).

5.3 Substitution

Although clients may not have been able to receive Title X-funded services at a subset of clinics, they could substitute to other publicly funded providers, such as FQHC or Section 318 STD Clinics. If Title X users could have substituted to alternate providers, detection should have been largely unaffected. Table 6 provides evidence of potential substitution effects when subsetting the sample to counties with and without access to alternate providers. Sample sizes were small for distance-based $>$ 5 mi, so event study estimates are only presented for counties within the $<$ 5 mi distance-band. Counties that "had an alternate provider" had access to an FQHC or 340B STD clinic as close as or closer than the Title X clinic a county lost.

I find that the decline in case detection is larger in counties where no alternate publicly funded provider was available. This decline begins in 2019 (a significant 8.3% decline), whereas there is no evidence that counties with access to alternate provider experienced a change in case detection beginning in 2019 (-0.4%). Counties had access to an alternate provider still experienced a decline in case detection, but to a lesser extent. This suggests that substitution might be occurring but is incomplete: nearby alternate providers dampen the impact of a Title X loss, but don't fully offset it.

6 Robustness Checks

COVID-19 Pandemic Given that treatment occurs in 2019 and outcomes are observed annually, one concern is that the 2020-2021 decline reflects COVID-19 disruptions to screening and care-seeking rather than the loss of Title X access. While pre-treatment trends may appear parallel, post-treatment trends might diverge if the pandemic affected treated and control counties differently in ways that conditioning on pre-treatment covariates cannot account for. If differential COVID-19 disruption drives the effect, estimates should be largest where COVID-19-induced disruptions were the greatest. I find the opposite – reductions in chlamydia case detection are largest in the lowest-burden tercile of COVID-19 morbidity and mortality (Table 7). I also find that estimating the ATT just for 2019 produces consistent estimates (declines of 3.7-5.0%) across all terciles. Additionally, excluding the most affected years of the COVID-19 pandemic—2020 and 2021—from the aggregated ATT estimates attenuates the chlamydia effect, but the direction and significance of the estimate are retained (Table 8).

7 Compartmental Model

To estimate the impact of Title X provider exits on unobserved population health outcomes, I develop a compartmental model of chlamydia transmission, which is then fit to the empirical estimates of Title X exits on chlamydia case detection.

I first calibrate model parameters to pre-period data on chlamydia case detection, prevalence, and screening coverage from 2008-2018. I then construct a treated scenario which allows symptomatic testing and asymptomatic screening to vary and which is fit to empirical estimates of changes in case detection for the period 2019–2021, which is prior to when the Title X rule was reversed. Comparing the treated scenario to a counterfactual scenario in which parameters are fixed at their 2018 values, I estimate the change in: (1) chlamydia testing and screening, (2) the number of missed detections, (3) additional new infections, (3) prevalence, and (4) the additional number of women with chlamydia infection who progress to having severe sequelae, specifically pelvic inflammatory disease (PID).

7.1 Model

I develop a Susceptible-Infected-Susceptible model of chlamydia infections among a closed population of heterosexual 15–39 year-old men and women. I exclude communities that contribute to chlamydia transmission, specifically men who have sex with men, but for whom transmission dynamics (Cornelisse et al., 2017) and recommended frequency and type of screening (urogenital vs. extragenital) differ (Centers for Disease Control and Prevention, 2025).

The model uses difference equations accounting for competing risks to model infections on a monthly time step. It is stratified by sex ($k \in$ F = Female, M = Male) and sexual activity ($l \in$ H = High, L = Low). To start the model, I seed the model with a prevalence of 0.05 per sex-activity group and let it burn-in for 40 years prior to 2008.

7.1.1 Force of Infection

Mixing is assortative across sexual activity groups. The force of infection ($\lambda_{k,l}(t)$), which is the rate at which susceptible individuals of sex k and activity-group l acquire infection is defined as:

$$\lambda_{k,l}(t) = \beta(t) \sum_{m=1}^{2} \left[c^{*}_{k,l\to m} \times \rho_{k,l\to m} \times \frac{I^{\text{sym}}_{k'm}(t) + I^{\text{asym}}_{k'm}(t)}{N_{k'm}} \right] \tag{1}$$

where arrows in subscripts ($\to$) indicate the direction of partner selection across activity groups whereby l chooses m throughout, β is the per partnership probability of transmission which reflects the number of sex acts per partnerships and probability of transmission per act, $c^{*}_{k,l\to m}$ is the balanced rate of partnership acquisition with partners of activity group l mixing with members of activity group m from the opposite sex (k'), and $\rho_{k,l\to m}$ is the probability that members of sex k and activity group l mix with members of activity group m. The final term denotes chlamydia prevalence in the opposite sex group of activity m. Transmissibility is assumed to be the same across individuals with symptomatic and asymptomatic infections (Althaus et al., 2010). The force of infection can vary linearly over time to account for any time-varying changes in sexual behavior, such as number of partners, and transmission via β.

The supply and demand for partners between the sexes are balanced following Garnett and Anderson (1994). Partner acquisition rates are adjusted for each sex by $B_{l\to m}$, which captures the imbalance between supply and demand for partners across risk groups l and m for each sex, and by θ which controls the extent to which a given sex dominates sexual demand. $B_{k,l\to m}$ is defined for sex k. Since the inverse of $B_{k,l\to m}$ is equivalent for k', only a single B is defined. I fix $\theta = 0.5$, such that each sex is equally demanding of partnerships.

$$c^*_{k,l\to m} = c_{kl} \times B^{\theta}_{k,l\to m} \tag{2}$$

If $B_{k,l\to m} = 1$, then the supply and demand of partnerships balances:

$$B_{k,l\to m} = \frac{c_{k'm} \times \rho_{k',m\to l} \times N_{k'm}}{c_{kl} \times \rho_{k,l\to m} \times N_{kl}} \tag{3}$$

For each sex k, the share of partnerships formed between individuals in risk group l and m:

$$\rho_{k,l\to m} = \epsilon \times \delta_{lm} + (1-\epsilon)\frac{c_{k'm} \times N_{k',m}}{\sum\limits_{n\in\{H,L\}} [c_{k'n} \times N_{k'n}]} \tag{4}$$

$\delta_{lm} = 1$ if $l = m$ (within-group mixing) and 0 otherwise. ϵ is the assortativeness level in the population, such that individuals pick a partner from their own group with probability ϵ and at random otherwise. If $\epsilon = 0$, then mixing is entirely random. If $\epsilon = 1$, then mixing is entirely assortative.

7.1.2 Infections

Infected individuals are either symptomatic ($I^{\text{sym}}_{k,l}(t)$) or asymptomatic ($I^{\text{asym}}_{k,l}(t)$) with some probability that is allowed to vary by sex (σ_k) (Price et al., 2016). Infected individuals return to susceptible either through successful treatment or natural recovery (γ).

Symptomatic infections

$$\begin{aligned} I^{\text{sym}}_{k,l}(t) = I^{\text{sym}}_{k,l}(t-1) & \\ & + \sigma_k \times \big(1 - \exp(-\lambda_{k,l}(t))\big) S_{k,l}(t-1) \\ & - \big(1 - \exp(-(\tau_k * \delta * \omega_{sympt} * \phi + \gamma))\big) I^{\text{sym}}_{k,l}(t-1) \end{aligned} \tag{5}$$

Asymptomatic infections

$$
\begin{aligned}
I^{\text{asym}}_{k,l}(t) = I^{\text{asym}}_{k,l}(t-1) \\
&+ (1-\sigma_k)\big(1-\exp(-\lambda_{k,l}(t))\big)S_{k,l}(t-1) \\
&- \big(1-\exp(-(\alpha_k * \delta * \omega_{screen} * \phi + \gamma))\big)I^{\text{asym}}_{k,l}(t-1)
\end{aligned} \tag{6}
$$

Symptomatic individuals seek testing at the rate at which their symptoms develop (Davies et al., 2014; Althaus et al., 2010), and asymptomatic individual are screened according to the rate at which they seek care (Davies et al., 2014), all of which vary by sex. Asymptomatic screening is allowed to vary linearly overtime for women only, which tracks continued expansion of recommended routine annual screening for sexually active women < 25 (LeFevre, 2014). Given that no screening guidelines exist for men and that much of the expansion in screening among men has occurred among MSM, screening among men is assumed to be constant over time (LeFevre, 2014). Testing and screening are assumed to be done using nucleic acid amplification tests (NAATs), which had already achieved over 85% coverage among women in family planning clinics by 2008 (Satterwhite et al., 2011) and were recommended by the CDC beginning in 2010 (Centers for Disease Control and Prevention, 2010).

Individuals who are tested or screened are detected using a fixed sensitivity rate (ϕ). A subset of detected individuals are lost to follow-up, which differs based on symptom presentation (ω). A fraction of individuals who initiate treatment are assumed to cure instantaneously, based on a fixed probability of the effectiveness of antibiotic regimens (δ). CDC recommends a 7-day treatment regimen for uncomplicated chlamydia infections (Centers for Disease Control and Prevention, 2022). The model assumes that all detected cases are reported – meaning there is no under-reporting of cases. While reporting is likely not perfectly complete, completeness has increased with the expansion of electronic laboratory reporting over the last decade, with over 90% of cases being reported electronically in some states (Mishra et al., 2023; Danforth et al., 2023).

7.1.3 Susceptible

Infected individuals who are either successfully treated or naturally clear infection return to the susceptible compartment where they can be infected again.

$$
\begin{aligned}
S_{k,l}(t) = S_{k,l}(t-1) \\
&- \big(1-\exp(-\lambda_{k,l}(t))\big)S_{k,l}(t-1) \\
&+ \big(1-\exp(-(\tau_k * \delta * \omega_{sympt} * \phi + \gamma))\big)I^{\text{sym}}_{k,l}(t-1) \\
&+ \big(1-\exp(-(\alpha_k * \delta * \omega_{screen} * \phi + \gamma))\big)I^{\text{asym}}_{k,l}(t-1)
\end{aligned} \tag{7}
$$

7.2 Calibration

I calibrate the model to national annual estimates of prevalence, case detection, and screening coverage between 2008-2018. Parameters and their prior distributions are provided in Appendix

Table 10.

Prevalence Sex-specific estimates of chlamydia prevalence come from the National Health and Nutrition Examination Survey (NHANES), which is performed biennially. Data are publicly available for individuals aged 18-39 and available through 2016. Results are reported for urine specimens undergoing lab-based NAAT chlamydia testing. Estimates are weighted using their survey weights to reflect the US population aged 18-39. Since the model population in 15-39, estimates likely underestimate overall prevalence given that prevalence is highest among individuals < 20. Monthly modeled estimates of prevalence are averaged to get an estimate of annual prevalence.

$$Prev_k(t) = \frac{\sum_{l \in \{H,L\}} \left[\frac{I^{\text{asym}}_{k,l} + I^{\text{sym}}_{k,l}}{N_k} \right]}{12} \tag{8}$$

$$NHANES - Prev_k(t) \sim Normal(Prev_k(t), se_k^{NHANES}(t)) \tag{9}$$

Reported case detection Annual case detection is calibrated to data from the CDC for women aged 15–39 using a negative binomial likelihood to account for data dispersion and reporting completeness. I only calibrate the model to case detection among women, since this group is most likely to capture heterosexual partnerships, whereas a subset of chlamydia infections among men originate in the MSM population and trends in infections may reflect changes in transmission dynamics and specific screening practices for this population.

$$\begin{aligned} D_k(t) = \sum_{l \in \{H,L\}} \Bigg[& \frac{s\,\alpha_k(t)}{\alpha_k * \delta * \omega_{screen} * \phi + \gamma} \big(1 - \exp(-\alpha_k * \delta * \omega_{screen} * \phi + \gamma)\big)\, I^{\text{asym}}_{k,l}(t-1) \\ & + \frac{s\,\tau_k}{\tau_k * \delta * \omega_{sympt} * \phi + \gamma} \big(1 - \exp(-\delta * \omega_{sympt} * \phi * \tau_k + \gamma)\big)\, I^{\text{sym}}_{k,l}(t-1) \Bigg] \end{aligned} \tag{10}$$

$$CDC_F(t) \sim NegBin(D_f(t), 500) \tag{11}$$

Screening coverage Finally, asymptomatic screening coverage is calibrated to annual estimates of chlamydia screening from the National Survey for Family Growth using a normal likelihood. I use estimates of screening coverage from Katz et al. (2023), which determined the share of female survey respondents that received a chlamydia test in the last 12 months between 2008-2019.

$$NSFG - Coverage_F(t) \sim Normal(screen_cov, se^{NSFG}(t)) \tag{12}$$

7.3 Estimating population health impacts

Using the calibrated parameters, I reconstruct the difference-in-differences estimates by running the model to create treated and counterfactual scenarios. The population is set to 26.9 million 15–39 year olds living in treated counties. Under the counterfactual scenario, the model deterministically uses the 2018 calibrated parameter values through 2021, assuming no shock to testing. Under the treated scenario, screening and testing are allowed to vary, which assumes that all of the estimated change in case detection is happening through this channel. I calculate the change in case detection between the treated and counterfactual models on the log scale between period t and 2018, which are fit to the ATT. The assumption being that all of the difference between treatment and counterfactual scenarios due to Title X exits is attributable to a change in detection among women.

My main results only calibrate the change in asymptomatic screening coverage among women to difference-in-difference estimates, assuming that all of the detection is attributable to a decline in asymptomatic screening.

Using the modeled change in screening coverage, I then generate estimates of population health outcomes as if screening was held fixed at that level for 2019–2021, which aligns with the period prior to when Title X provider returned to the network. I do this for two different ATT windows – 2019 only, and 2019–2020.

The model generates five quantities of interest, relative to the counterfactual in which 2018 testing coverage continued through 2021 unchanged. First, I defined missed detections as the number of infections among women that pre-shock level of asymptomatic screening would have detected. Second, I define the additional time an asymptomatic infection in women persists prior to detection, given the change in the expected time spent in the asymptomatic state. Third, the additional new infections generated between 2019–2021, relative to under counterfactual screening. Fourth, the additional cases of pelvic inflammatory disease, obtained by multiplying the annual rate of PID, informed by a prior, times the average number of women infected in a given year. For now, this assumes that all women – regardless of prior infection – face the same risk of PID.

Using the calibrated parameters from the pre-period requires two assumptions: (1) that parameters which are calibrated to national data are reflective of treated counties, and (2) that the estimated ATT coefficients which are estimated among all-age case counts are representative of the effects among individuals aged 15–39 years old.

7.4 Results

Under the counterfactual scenario, asymptomatic screening coverage was estimated to be 34.9%. When calibrating the treated scenario to empirical estimates of the change in case detection in 2019, I estimated that asymptomatic screening coverage among women declined by 3.0 percentage points. This translated to an increase of 41,246 infections that would have otherwise been detected under the counterfactual scenario between 2019-2021, 48,467 new infections, and an increase in total population prevalence by 0.06 percentage points to 2.74%. We take these as a lower bound given that 2019 estimates on case detection only reflect partial treatment. Calibrating to ATT estimates over 2019–2020 resulted in an 8.0 percentage point decline in asymptomatic screening coverage, and a resulting increase of 112,265 missed detections, 129,383 new chlamydia infections, and an increase in total population prevalence by 0.15 percentage points to 2.83%. Reduced screening extended infection duration among women by between 11.3–31 days (3.5–9.6% increase) and generated between 4,394–12,152 additional cases of pelvic inflammatory disease.

8 Conclusion

In summary, the 2019 Title X Final Rule reduced access to Title X-funded services across a large number of counties. I find that this loss of access reduced chlamydia case detection among counties that lost all within-county access to a Title X clinic. These effects are concentrated among counties that lost a clinic within 10 miles of their county centroid. I present preliminary evidence that these declines are not solely attributable to differential COVID-19 responses, and that substitution to alternate safety-net providers offering STI testing might be occurring but is incomplete.

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9 Tables and Figures

Table 1: Balance statistics (2018) — Counties with a Title X clinic

	National	Treated	Control
Demographic			
Population size	144,491 (407,618)	217,742 (355,174)	75,291 (183,284)
% Rural	56.3%	43.9%	62.9%
% Region			
% Northeast	9.4%	32.2%	2.9%
% Midwest	23.1%	28.3%	20.7%
% South	54.0%	9.7%	67.6%
% West	13.6%	29.7%	8.8%
% Race/Ethnicity			
% NH White	75.4 (19.7)	79.3 (17.0)	75.7 (19.6)
% NH Black	12.2 (16.2)	5.7 (7.9)	14.0 (17.6)
% Hispanic	8.7 (11.8)	9.7 (11.3)	7.3 (9.8)
% NH API	2.0 (4.0)	3.9 (7.6)	1.2 (1.5)
% NH AIAN	1.7 (5.6)	1.3 (3.4)	1.8 (6.0)
Economic			
Median household income ($)	52,129 (14,332)	61,114 (15,462)	49,029 (12,328)
Unemployment rate (%)	4.29 (1.36)	4.37 (1.51)	4.28 (1.33)
% female 19–25 uninsured	15.9 (10.2)	9.5 (5.6)	17.5 (10.4)
STI rates (per 100k)			
Chlamydia rate, 2018	445 (271)	390 (194)	450 (286)
% change in chlamydia, 2016–2018	12.8 (41.6)	11.2 (35.2)	13.5 (44.0)
Safety-net infrastructure			
Distance to nearest Title X clinic (mi), 2019 Q1	5.2 (5.6)	5.8 (9.4)	5.1 (4.4)
% with any alternate provider in county	77.1%	78.9%	75.6%
N counties	2029	360	1485

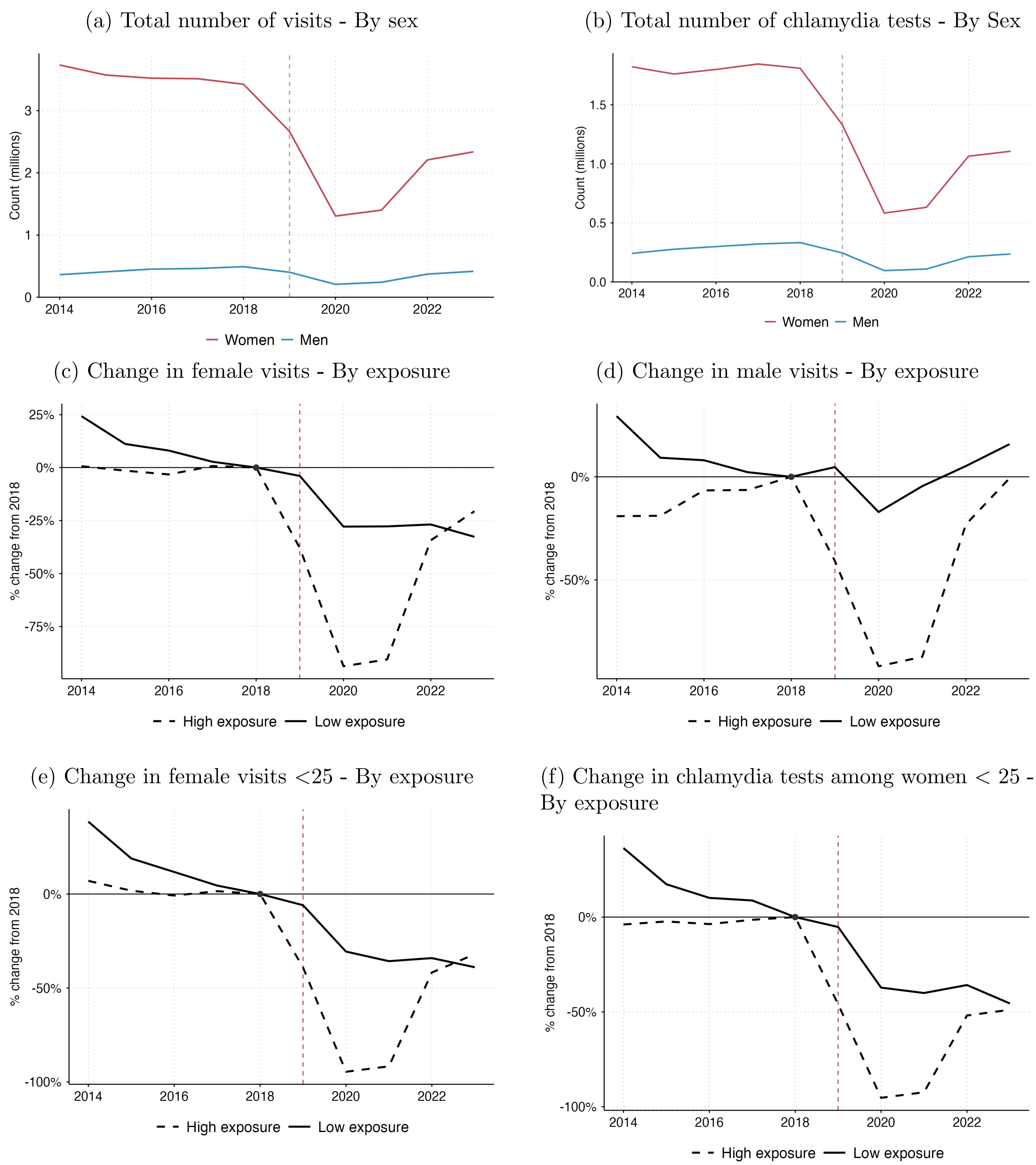
Notes: Sample restricted to counties in the 50 states and the District of Columbia with at least one Title X clinic in the first quarter of 2019 (pre-treatment baseline). National refers to all of these counties. Treated refers to counties that experienced a persistent loss of all Title X clinics in 2019. Control counties are those whose Title X access remained stable. 123 counties that only partially lost providers not included in either treated or control. All data based on 2018 unless otherwise noted. Unweighted county-level means with standard deviations in parentheses, except % Rural, % Region and % with any alternate provider, which are shares. Distance to the nearest Title X clinic is the minimum monthly distance from the population-weighted county centroid in Q1 2019. "Alternate provider" refers to a Federally Qualified Health Center or a 340B-registered STI clinic in the county. STI rates use SEER total county population as the denominator.

Table 2: 2019 Title X shock characteristics by group

	County-based		Distance-based		
	Complete loss	Partial loss	<5 mi	5–10 mi	10–20 mi
N counties	360	123	208	140	90
Avg Title X clinics per 100k, 2019 Q1	4.78	6.29	3.64	5.19	2.80
Avg clinics lost in 2019	2.76	2.99	3.39	2.11	0.86
Change in distance to nearest Title X (mi), 2019 Q1–Q4	73.71	1.58	68.95	74.31	48.20
% returned to baseline Title X count post-2019	59.7%	42.3%	63.0%	52.1%	17.8%
% previous Title X clinics	68.1%	45.1%	67.3%	69.8%	59.0%

Notes: Sample includes counties in the 50 states and the District of Columbia with at least one Title X clinic in 2019 Q1. "County-based" defines treatment at the county-level. Complete loss refers to counties that lost all within-county Title X access. Partial loss counties are those that experienced a loss of a Title X provider, but who retained access to some Title X services within the county. "Distance-based" defines treatment based on proximity of Title X providers to a county's population-weighted centroid and allocates counties to one of three mutually exclusive distance bins. For instance, counties in the < 5 mi distance bin went from having its nearest Title X provider within 5 miles of its population-weighted county centroid to having its nearest provider be over 10 miles away post-treatment.

Figure 2: Trends in Title X clients and chlamydia testing (2014–2023)



Notes: Panels (a) and (b) report the number of visits and chlamydia tests (in millions) by sex among Title X clients for all 50 states and DC from the Family Planning Annual Report (FPAR) annual reports. The dashed vertical line marks 2019 (the Title X Final Rule). Panels (c) - (f) report the average percent change relative to 2018 for 13 high exposure and 28 low exposure states, based on the share of counties with Title X providers that are treated in 2019. Over 75% of counties in high-exposure states are treated (lose all providers) and < 5% in low exposure states have counties that are treated. FPAR only reports a subset of outcomes by state. Chlamydia tests are only reported for women < 25 at the state-level. *High exposure* = New York, Oregon, Washington, Maine, Vermont, Utah, Hawaii, Minnesota, Maryland, Massachusetts, Connecticut, Illinois, and Alaska. textitLow exposure = Alabama, Arizona, Arkansas, Colorado, Delaware, DC, Florida, Georgia, Kansas, Kentucky, Louisiana, Mississippi, Missouri, Nebraska, Nevada, New Mexico, North Carolina, North Dakota, Oklahoma, Rhode Island, South Carolina, South Dakota, Tennessee, Texas, Virginia, West Virginia, Wyoming.

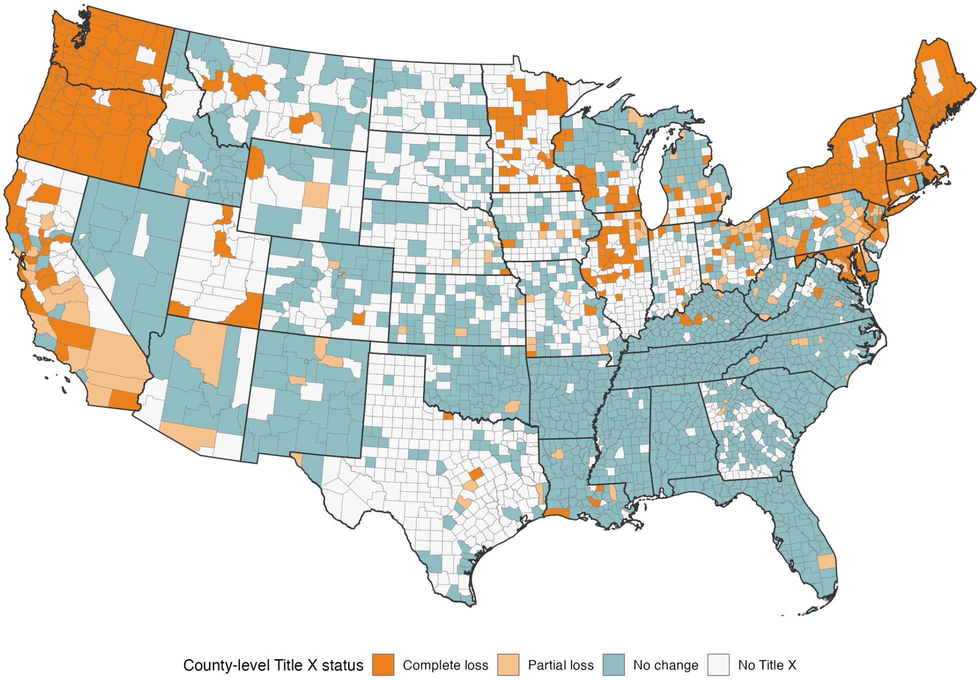


Figure 3: Location of treated and control counties, by county-based treatment definition

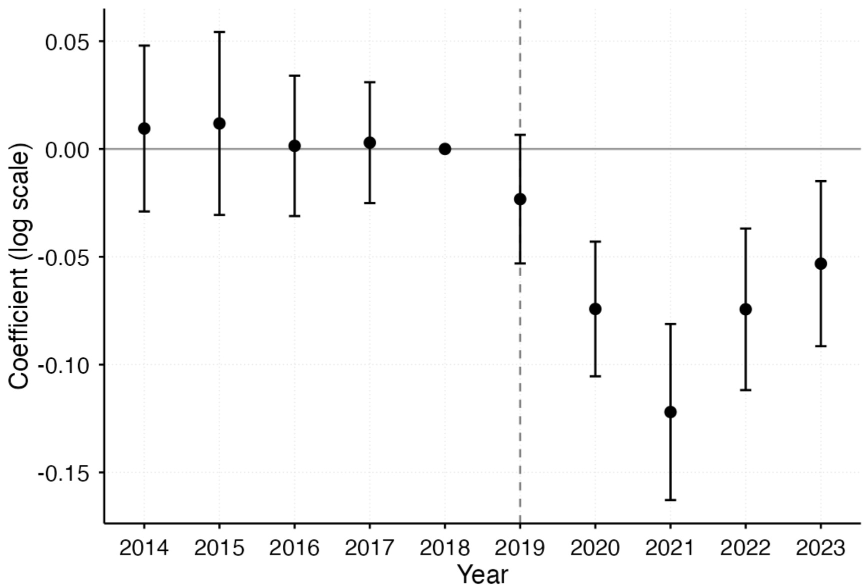
Notes: Map plots county treatment status based on whether the county experienced a Title X loss in 2019. Counties shaded in orange lost all Title X clinics (complete loss). Counties shaded in yellow lost at least one, but not all, clinics (partial loss). Counties shaded in gray did not experience any loss (control, stable). Counties in white did not have any Title X clinics as of 2018.

Table 3: Impact of Title X clinic loss on chlamydia case detection (log)

	County-based	Distance-based		
	Complete loss	<5 mi	5–10 mi	10–20 mi
Panel A: Difference-in-differences model				
ATT	-0.069***	-0.074***	-0.096***	-0.036
	(0.014)	(0.015)	(0.024)	(0.033)
Panel B: Event study model				
2014	0.009 (0.020)	-0.027 (0.027)	0.031 (0.033)	0.001 (0.057)
2015	0.012 (0.022)	-0.015 (0.028)	-0.013 (0.030)	0.027 (0.065)
2016	0.001 (0.017)	-0.022 (0.022)	-0.009 (0.027)	-0.026 (0.048)
2017	0.003 (0.014)	-0.009 (0.018)	-0.009 (0.022)	0.006 (0.042)
2018 (reference)	—	—	—	—
2019	-0.023 (0.015)	-0.028* (0.017)	-0.050* (0.027)	-0.020 (0.036)
2020	-0.074*** (0.016)	-0.075*** (0.018)	-0.102*** (0.032)	-0.078** (0.040)
2021	-0.122*** (0.021)	-0.123*** (0.024)	-0.149*** (0.034)	-0.041 (0.049)
2022	-0.074*** (0.019)	-0.081*** (0.021)	-0.096*** (0.031)	-0.012 (0.039)
2023	-0.053*** (0.020)	-0.065*** (0.020)	-0.081** (0.034)	-0.031 (0.042)
N (county-years)	18,318	12,079	6,545	4,479

Notes: Panel A reports the aggregated ATT from a doubly-robust DiD specification; Panel B reports dynamic ATT coefficients by year from the same model, with 2018 as the reference period.
* $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$.

Figure 4: Changes in chlamydia case detection (log) - County-based (DR-DID)



Notes: Figure reports coefficients estimated from the event study specification for changes in the county-level chlamydia rate on the log scale. Coefficients represent the change in log STI case detection among counties that lost all within-county Title X clinics (treated) relative to counties whose Title X access remained stable, compared to 2018—the year prior to the 2019 Final Rule. The Title X Final Rule went into effect in July 2019, so 2019 is partially treated. Vertical bars represent 95% confidence intervals. Bootstrapped standard errors are computed over 1,000 iterations and clustered at the county level. Excludes Maryland, which did not report cases in 2021, and Connecticut in all periods.

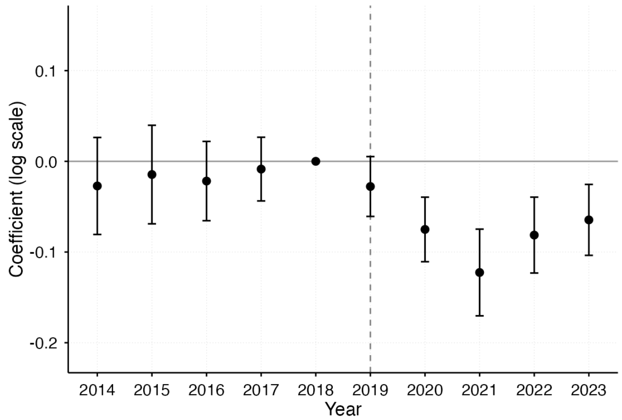
Table 4: Average marginal effect of Title X exits in treated counties (county-based)

	2019	2020	2021	2022	2023	Overall
Case difference	-9,497	-25,630	-41,417	-26,214	-18,662	-24,960
	(6,281)	(5,709)	(7,512)	(6,991)	(7,034)	(5,071)
AME (per 100,000)	-9.34	-26.26	-43.39	-26.22	-18.00	-25.04
	(6.18)	(5.85)	(7.87)	(6.99)	(6.79)	(5.09)
ATT (log scale)	-0.023	-0.074	-0.122	-0.074	-0.053	-0.069
Observed cases	403,352	332,725	319,214	339,560	341,585	347,287
Treated counties	354	354	332	354	354	354

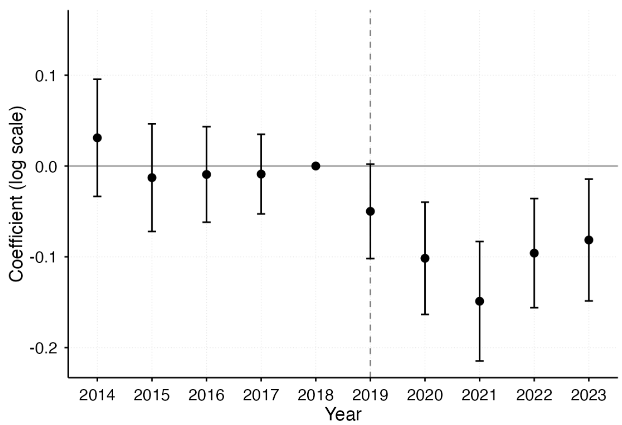
Notes: Average marginal effect calculated according to Feng and Bilinski (2024). ATT refers to coefficients estimated from the event study specification for changes in the county-level chlamydia rate (per 100,000 population) on the log scale. Observed cases are the number of chlamydia cases reported to the CDC for each year among treated counties. Treated counties are all counties in the 50 states and DC who lost all within-county Title X clinics in 2019, excluding Connecticut in all periods and Maryland in 2021.

Figure 5: Changes in chlamydia case detection (log) - Distance-based (DR-DID)

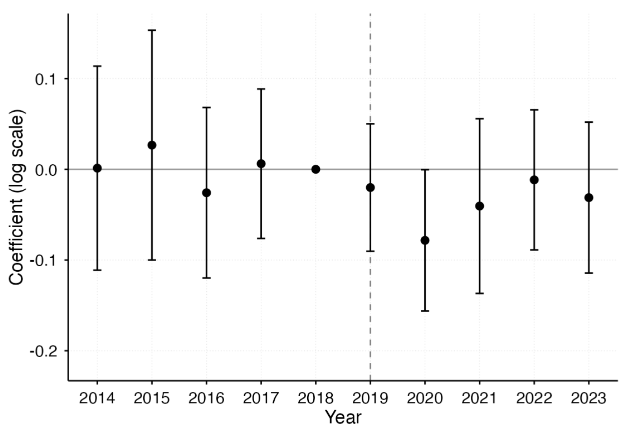
(a) Less than 5 miles



(b) 5–10 miles



(c) 10–20 miles



Notes: Figure reports coefficients estimated from the event study specification for changes in the county-level chlamydia rate (per 100,000 population) on the log scale. Coefficients represent the change in log STI case detection among counties that lost all within-county Title X clinics (treated) relative to counties whose Title X access remained stable, compared to 2018—the year prior to the 2019 Final Rule. The Title X Final Rule went into effect in July 2019, so 2019 is partially treated. Vertical bars represent 95% confidence intervals. Bootstrapped standard errors are computed over 1,000 iterations and clustered at the county level. Excludes Maryland, which did not report cases in 2021, and Connecticut in all periods.

Table 5: Benchmark Exercise: Positivity among lost tests to account for detected effects in 6 states that lost all providers

	2019	2020	2021
Estimated case difference	-4,129	-11,717	-18,163
Tests lost	63,984	144,478	144,478
Required positivity (%)	6.5	8.1	12.6

Notes: Estimated case difference from event study model using preferred specification subset to treated counties in 6 states that lost all Title X providers in 2019 (HI, ME, OR, UT, VT and WA). State-level FPAR reports chlamydia tests for females under 25 only. Test lost compare number of tests reported by state in a given year relative to the number of tests reported in 2018. Tests are inflated to estimate the overall number of tests lost accounting for the share of total tests performed on women under 25. Required positivity is the positivity the lost tests would have needed, assuming that Title X exits were solely responsible for the estimated effect and that displaced Title X patients did not substitute elsewhere. Only 2019–2021 is shown before most providers returned to the network in 2022.

Table 6: Effect of Title X clinic loss by access to an alternate provider, <5 mi band

	Has alternate	No alternate
Panel A: Difference-in-Differences model		
ATT	-0.067***	-0.090***
	(0.018)	(0.033)
Panel B: Event study model		
2014	-0.027	-0.030
	(0.024)	(0.065)
2015	-0.000	-0.036
	(0.026)	(0.064)
2016	-0.001	-0.060
	(0.024)	(0.060)
2017	-0.005	-0.009
	(0.018)	(0.045)
2018 (reference)	0.000	0.000
2019	-0.004	-0.083**
	(0.018)	(0.038)
2020	-0.058***	-0.109***
	(0.019)	(0.042)
2021	-0.125***	-0.112**
	(0.032)	(0.053)
2022	-0.083***	-0.083*
	(0.023)	(0.047)
2023	-0.067***	-0.062
	(0.023)	(0.044)

Notes: Sample is counties whose 2019 Q1 distance to the nearest Title X clinic was under 5 miles. 144 treated counties have alternate providers while 64 treated counties do not have access to an alternate provider. I only present the < 5 mi results here as only 37 and 22 counties in the 5–10 mi and 10–20 mi distance bin did not have access to alternate provider.
* $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$.

Table 7: ATT by tercile of COVID-19 severity — Chlamydia

	Lowest third	Middle third	Highest third
Panel A: COVID-19 cases per 100k			
Full (2019–2023)	-0.1593***	-0.0848***	-0.0600***
	(0.0305)	(0.0187)	(0.0207)
2019 only	-0.0374	-0.0470***	-0.0371*
	(0.0380)	(0.0175)	(0.0221)
2019 + 2022–2023	-0.1194***	-0.0686***	-0.0456**
	(0.0335)	(0.0204)	(0.0216)
Panel B: COVID-19 deaths per 100k			
Full (2019–2023)	-0.1144***	-0.0923***	-0.0704***
	(0.0315)	(0.0251)	(0.0200)
2019 only	-0.0483	-0.0499**	-0.0491**
	(0.0325)	(0.0242)	(0.0209)
2019 + 2022–2023	-0.0908***	-0.0707**	-0.0622***
	(0.0321)	(0.0282)	(0.0217)

Notes: Results on log chlamydia case detection from doubly-robust DiD (Callaway and Sant'Anna 2021) estimation with county-clustered standard errors without covariates. County-level COVID-19 case counts and deaths are from Johns Hopkins. Terciles were computed using treated county cut-offs and using the following cut-offs: Panel A (COVID-19 cases per 100k): lowest $<$ 24,286 per 100k, middle 24,286–30,440 per 100k, highest $>$ 30,440 per 100k. Panel B (COVID-19 deaths per 100k): lowest $<$ 222 per 100k, middle 222–328 per 100k, highest $>$ 328 per 100k per 100k.

* $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$.

Table 8: ATT with the COVID-19 years dropped from the post-period — Chlamydia

	Main (2019–2023)	Excl. 2020	Excl. 2020 + 2021
Panel A: No covariates			
ATT	-0.1039***	-0.1023***	-0.0822***
	(0.0130)	(0.0135)	(0.0137)
N (county-years)	18,318	16,483	14,669
Panel B: Baseline covariates			
ATT	-0.0694***	-0.0682***	-0.0503***
	(0.0153)	(0.0146)	(0.0147)
N (county-years)	18,318	16,483	14,669
N (treated counties)	354	354	354
N (control counties)	1482	1482	1482

Notes: Results on log chlamydia rate from doubly-robust DiD (Callaway and Sant'Anna 2021) estimation with county-clustered standard errors. The Main column reports the ATT over the full 2019–2023 post-period. Excl. 2020 drops 2020 entirely; Excl. 2020 + 2021 drops both, leaving 2019, 2022 and 2023. Panel A presents unconditional estimates. Panel B conditions on the set of covariates used in the main model (share of population aged 15–44, non-Hispanic White and Hispanic population shares, log total population, Medicaid expansion status, the unemployment rate, and distance to the nearest alternate safety-net provider (FQHC or 340B-registered STI clinic), all measured in 2018.

* $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$.

Table 9: Modeled impacts of Title X provider exits on population health outcomes for 2019–2021, by ATT window

	ATT window used for calibration	
	2019	2019–2020
DiD estimate - Change in case detection (log)	-0.023 (0.014)	-0.049 (0.013)
Asymptomatic screening coverage, women		
Difference	-3.0 [-6.6, 0.5]	-8.0 [-12.3, -3.5]
Counterfactual	34.9%	34.9%
Percent change	-8.5% [-18.9, 1.6]	-22.9% [-35.3, -10.1]
Missed detections (total)		
Difference	41,246 [-7,525, 92,102]	112,265 [48,687, 174,410]
Counterfactual	1,426,638	1,471,839
Percent change	2.9% [-0.5, 6.3]	7.6% [3.4, 11.5]
New infections (total)		
Difference	48,467 [-9,024, 107,058]	129,383 [57,350, 197,897]
Counterfactual	2,841,027	2,841,027
Percent change	1.7% [-0.3, 3.8]	4.6% [2.0, 7.0]
Annual chlamydia prevalence (average)		
Difference	0.06 [-0.01, 0.12]	0.15 [0.07, 0.23]
Counterfactual	2.68%	2.68%
Percent change	2.1% [-0.4, 4.7]	5.6% [2.5, 8.7]
Length of infection, women (average)		
Difference	11.3 days [-2.0, 25.3]	31.0 days [13.3, 48.5]
Counterfactual	324 days	324 days
Percent change	3.5% [-0.6, 7.8]	9.6% [4.1, 15.0]
Pelvic inflammatory disease (total)		
Difference	4,394 cases [-682, 11,548]	12,152 cases [3,781, 23,083]
Counterfactual	155,913 cases	159,818 cases
Percent change	2.8% [-0.5, 6.3]	7.6% [3.3, 11.7]

Notes: Posterior means with 95% credible intervals. The first row reports the aggregate DiD estimate each column is calibrated to, with its standard error in parentheses. Each column is calibrated to difference-in-difference estimates of the county-based Title X provider exits on chlamydia case detection over two different aggregation windows. Column A is calibrated to the 2019 estimates only, excluding any potential differential COVID-19 shock. Column B is calibrated to the estimate for 2019-2020. Women's asymptomatic screening is the only free parameter. All other parameters are held fixed at their pre-period posterior means. Population health outcomes are then simulated under each estimate of the screening coverage for the period 2019–2021. Providers began returning to the Title X network in 2022 following the reversal of the 2019 Final Rule.

A Appendix

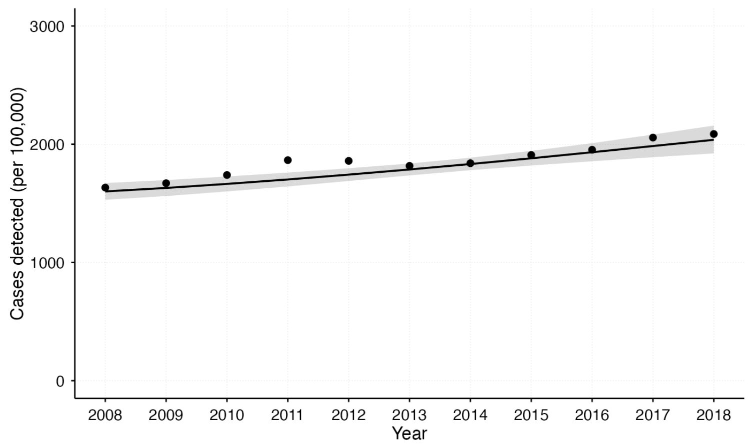
Table 10: Model parameters, prior distributions, posterior distribution, and sources

Description	Parameter	Distribution	Prior	Posterior	Source
Demographics					
National population (15–39)	N_{tot}	—	106,928,959	—	CDC (average 2008–2018)
Share of national population 15–39, female	N_{F}	—	0.492	—	CDC (average 2008–2018)
Sexual behavior					
Share of population that is high-risk	π	Fixed	0.10	—	Assumed - Rönn et al. (2019)
Partner change rate, high-risk group (per month)	c_H	Gamma	0.33 [0.25, 0.42]	0.30 [0.23, 0.39]	National Center for Health Statistic
Partner change rate, low-risk group (per month)	c_L	Gamma	0.08 [0.02, 0.07]	0.07 [0.23, 0.39]	National Center for Health Statistic
Assortative mixing in population	ϵ	Beta	0.60 [0.35, 0.74]	0.60 [0.40, 0.79]	Assumed
Partnership-balancing exponent	θ	Fixed	0.5	—	Garnett and Anderson (1994)
Natural history of chlamydia					
Transmission probability per partnership	β	Beta	0.78 [0.44, 0.92]	0.66 [0.41, 0.71]	Davies et al. (2014); Rönn et al. (20
Annual log-linear trend in β	$\beta(t)$	Normal	0 [−0.05, 0.05]	0.01 [0.00, 0.01]	Assumed
Share of new infections that are symptomatic, female	σ_F	Fixed	0.30	—	Price et al. (2016); Davies et al. (20
Share of new infections that are symptomatic, male	σ_M	Beta	0.29 [0.25, 0.34]		Rönn et al. (2019); Davies et al. (20
Natural recovery rate (per month)	γ	Fixed	0.06	—	Price et al. (2016)
Testing & Screening					
Symptomatic care-seeking detection rate (per month), women	τ_F	Gamma	0.78 [0.69, 0.87]	0.81 [0.73, 0.91]	Davies et al. (2014)
Symptomatic care-seeking detection rate (per month), men	τ_M	Gamma	0.74 [0.65, 0.83]	0.74 [0.66, 0.83]	Davies et al. (2014)
Asymptomatic screening rate, female, 2008 (per month)	α_F	Gamma	0.02 [0.02, 0.03]	0.03 [0.02, 0.03]	Katz et al. (2023)
Annual log-linear trend on asymptomatic screening, female	$\alpha_F(t)$	Normal	0.03 [0.00, 0.05]	0.03 [0.01, 0.05]	Assumed, Hamilton et al. (2023)
Asymptomatic screening rate, male, 2008 (per month)	α_M	Gamma	0.005 [0.0006, 0.014]	0.01 [0.01, 0.01]	Katz et al. (2023)
NAAT sensitivity	ϕ	Fixed	0.98	—	Price et al. (2016); Watson et al. (2
Treatment					
Share completing treatment after a positive test, with symptoms	ω_{sympt}	Fixed	0.95	—	Wong et al. (2005); G Foglia et al. (
Share completing treatment after a positive test, without symptoms	ω_{screen}	Fixed	0.85	—	Wong et al. (2005); G Foglia et al. (
Treatment efficacy, given treatment completion	δ	Fixed	0.96	—	Geisler et al. (2015)

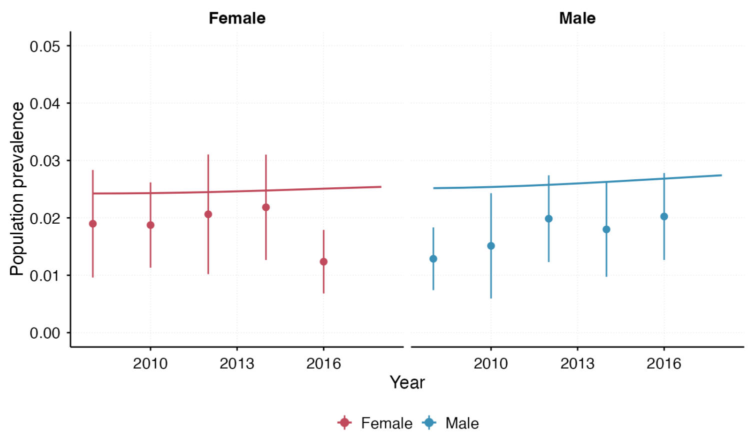
Notes: Prior includes values of parameters if they are fixed as well as prior means with 95% CIs in parentheses. Posterior, where calibrated, refers to posterior means and 95% marked "Fixed" are not estimated.

Figure 6: Model Calibration: Fitted vs. Observed

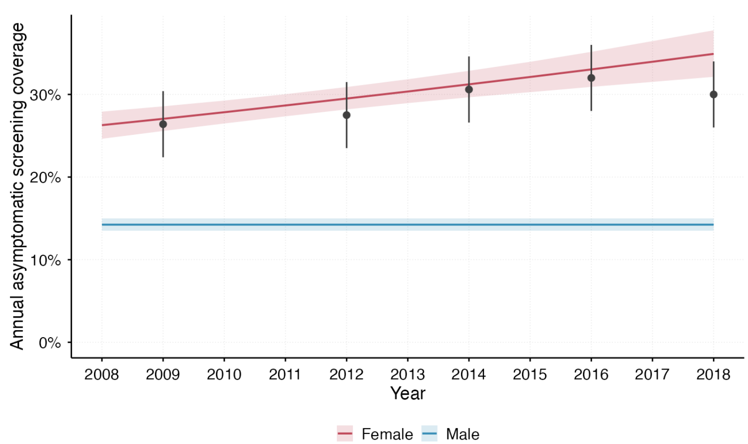
(a) CDC cases per 100,000 population



(b) NHANES Prevalence

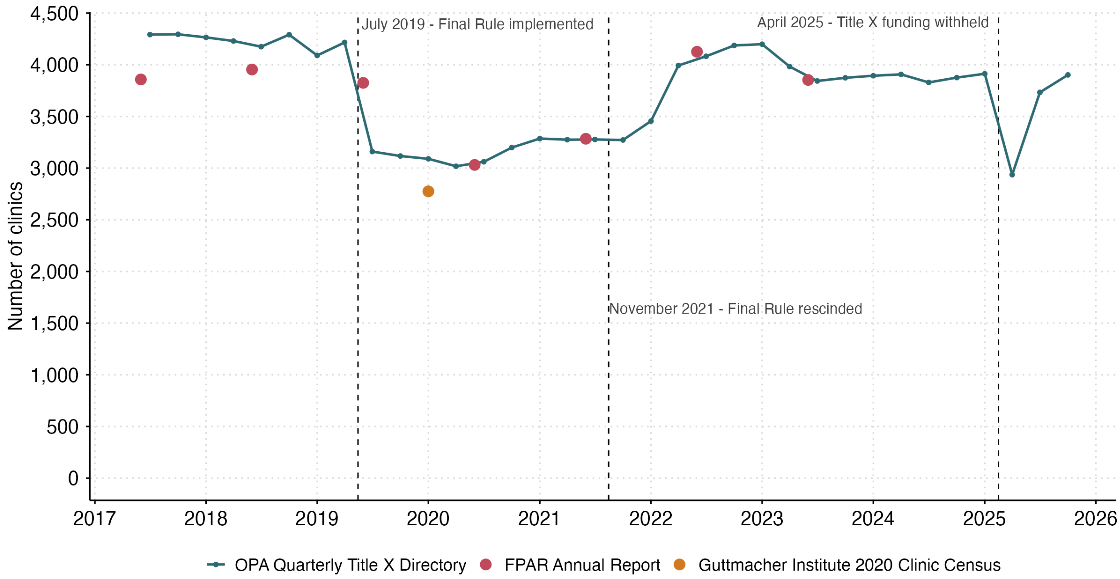


(c) Fitted trends in screening coverage (2008-2018)



B Appendix B

Figure 7: Validation of Title X clinic extraction (2017-2025)



Notes: Validation of extracted Title X clinic counts (defined as sub-recipients and service sites) from 2017–2025 based on Office of Population Affairs' (OPA) monthly Title X grantee directories. Quarterly counts are shown. Directory counts were compared to other annual Title X clinic counts: 1) Counts of service sites submitted by Title X grantees as part of the annual Family Planning Annual Reports (FPAR) to OPA (pink dots), and 2) The Guttmacher Institute's 2020 census of Title X-funded clinics providing publicly funded contraceptive services (orange dots).

Table 11: County characteristics by treatment status – Distance-based

	<5 mi		5–10 mi		10–20 mi	
	T	C	T	C	T	C
Demographic						
Population size	338,241 (602,872)	136,732 (465,482)	146,341 (225,850)	95,664 (196,825)	61,687 (82,058)	63,569 (164,697)
% Rural	35.6%	59.6%	47.9%	53.4%	53.3%	61.2%
% Region						
% Northeast	33.7%	3.9%	30.7%	5.7%	14.4%	3.6%
% Midwest	28.8%	21.8%	30.0%	23.3%	51.1%	42.4%
% South	13.9%	69.2%	5.7%	60.7%	4.4%	40.4%
% West	23.6%	5.1%	33.6%	10.3%	30.0%	13.6%
% Race/Ethnicity						
% NH White	77.0 (17.9)	74.5 (20.9)	81.3 (16.6)	76.2 (18.4)	85.6 (14.2)	78.0 (19.2)
% NH Black	7.7 (8.9)	14.8 (18.2)	3.8 (5.9)	12.5 (15.8)	2.5 (3.1)	9.0 (13.4)
% Hispanic	9.6 (10.1)	7.8 (11.2)	10.2 (13.0)	7.9 (10.6)	8.3 (10.8)	9.4 (13.6)
% NH API	5.0 (7.9)	1.6 (2.5)	2.9 (7.3)	1.5 (2.2)	2.2 (6.2)	1.3 (2.1)
% NH AIAN	0.8 (1.2)	1.3 (4.5)	1.8 (4.9)	1.8 (5.5)	1.4 (3.6)	2.2 (7.7)
Economic						
Unemployment rate (%)	4.09 (1.17)	4.28 (1.35)	4.61 (1.83)	4.27 (1.32)	4.19 (1.41)	3.95 (1.18)
% female 19–25 uninsured	9.0 (5.2)	17.1 (10.6)	10.1 (6.2)	17.0 (9.5)	10.5 (8.3)	17.9 (12.4)
STI rates (per 100k)						
Chlamydia rate, 2018	430 (226)	470 (295)	360 (293)	422 (243)	291 (119)	370 (266)
% change in chlamydia, 2016–2018	13.0 (38.7)	12.1 (39.8)	9.4 (29.1)	12.6 (38.7)	18.2 (38.7)	18.0 (65.5)
Gonorrhea rate, 2018	120 (107)	155 (135)	86 (114)	137 (126)	61 (52)	109 (135)
% change in gonorrhea, 2016–2018	79.7 (196.1)	88.7 (209.4)	71.3 (169.9)	70.5 (130.6)	82.9 (207.0)	84.5 (186.1)
Safety-net infrastructure						
Distance to nearest Title X clinic (mi), 2019 Q1	2.9 (1.3)	2.8 (1.3)	7.0 (1.4)	6.8 (1.4)	14.6 (2.8)	14.9 (3.1)
Δ Distance to nearest Title X (mi), 2019 Q1–Q4	68.95 (88.53)	–	74.31 (84.69)	–	48.20 (52.84)	–
% with alternate provider within band or closer	69.2%	69.0%	73.6%	75.8%	75.6%	80.9%
N counties	208	1007	140	524	90	361

Notes: Table reports baseline covariate distributions across treated and control counties as of 2018. Means with standard deviations in parentheses, except % Rural, % Region and % with an alternate provider, which are shares. Sample includes all 50 states and DC. Counties are grouped by the band containing their 2019 Q1 minimum distance to the nearest Title X clinic. The change in distance excludes Alaska and Hawaii. % with an alternate provider refers to whether the county has at least one FQHC delivery site or 340B-registered STI clinic within the corresponding distance band or closer.