Trends in *Chlamydia trachomatis* Treatment Prescribing Practices in King County, Washington, 2010 - 2018

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Abstract

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Chlamydia trachomatis (CT) is the most commonly reported bacterial sexually transmitted infection in the United States. In 2021, the CDC updated its CT treatment guidelines from equally recommending either azithromycin (1 gram as a single dose) or doxycycline (100mg twice daily for 7 days) to only recommending doxycycline as first line treatment after 2021.

We conducted a trends analysis using the Washington STD surveillance database to understand which patients and providers may be most impacted by the guideline change. We included all female cases of urogenital CT aged ≥15 years who resided in King County and were diagnosed from 2010-2018. Our dataset contained information on demographic factors, sexual history, clinical features, diagnosing facility, year, and treatment regimen. We conducted descriptive analyses and Poisson regression analyses to examine the distribution of azithromycin use and associated risk factors.

There were 36,830 cases of female urogenital CT during the study period; over 90% of cases received azithromycin, with the proportion of azithromycin use increasing in all facilities from 2010 to 2018. Five of the eight facility type groups were prescribing azithromycin to more than 95% of their cases in 2018. Cases who were younger or cases of color were more likely to receive azithromycin (versus doxycycline) compared to older and white cases respectively.

These findings suggest that a substantial shift in prescribing practices will be needed to change from the observed azithromycin use to the newly recommended doxycycline regime. Patients who continue to receive azithromycin may be at higher risk for CT reinfection and subsequent severe outcomes. The differences in prescribing practices by facility and patient characteristics highlight the need for targeted and multifaceted educational campaigns to encourage a transition to doxycycline use.

Background

Chlamydia trachomatis (CT) is the most commonly reported bacterial sexually transmitted infection in the United States. There were over 1.8 million CT cases reported in 2019, with the highest rates among young women aged 15-24.[1] Although CT is typically asymptomatic, it can cause severe reproductive health outcomes, such as pelvic inflammatory disease, ectopic pregnancy and infertility.[1]

Prior to 2021, the US Centers for Disease Control and Prevention (CDC) recommended either azithromycin (1 gram as a single dose) or doxycycline (100mg twice daily for 7 days) as first-line treatments for CT, based on evidence that the two therapies were similarly efficacious in the treatment of urogenital CT.[2,3] In 2021, the CDC updated its guidelines to recommend only doxycycline as the preferred treatment for CT, except for pregnant women and "persons for whom adherence with multi day dosing is a considerable concern."[4]

The extent to which the change to the CT treatment guidelines will be translated into practice remains to be seen. Although it is unknown how often azithromycin was used (instead of doxycycline) for CT treatment prior to 2021, many clinicians likely preferred to use azithromycin due to the relative ease of a single dose of treatment and the possibility for directly observed therapy in some settings.[3] Examining prescribing practices prior to the 2021 guidelines change is crucial to better understand what facility types may be more impacted by the change to CT treatment guidelines. Further, describing prior prescribing patterns can identify the characteristics of patients who have been more likely to receive azithromycin instead of doxycycline for CT treatment, which may help portend which patients may be more likely to continue to receive azithromycin despite the treatment guidelines change.

The objectives of our study were to examine trends in CT prescribing practices in a large urban county from 2010 to 2018, determine whether prescribing practices differed by facility type, and examine factors associated with receipt of azithromycin or doxycycline for CT.

Methods

Study design and population

We conducted a trends analysis to examine CT treatment prescribing practices from 2010 to 2018 in King County, Washington. We also examined the relationships between patient and facility factors and CT treatment during the same period. Our study included all cases of urogenital CT among individuals who were female sex at birth, diagnosed between 2010 and 2018, aged 15 or older, were residents of King County at the time of diagnosis and had available treatment data.

Data collection and measures

All data for this study was obtained from Washington State Department of Health's (WA DOH) electronic STD surveillance database (PHIMS-STD), which includes data from laboratories, medical providers (via case report forms), and partner services interviews. WA laws require laboratories and medical providers report all CT cases to local health authorities, who subsequently provide case report and interview data to WA DOH via PHIMS-STD. Public health staff in King County have access to CT data in PHIMS-STD only for those individuals who reside in King County. PHIMS-STD includes all cases of CT but it is a person-based system which allows the identification of repeat infections for the same individual.

During the study period, information on CT treatment (doxycycline, azithromycin, levofloxacin and other) was recorded by providers on the STD case report form. Staff at Public Health – Seattle & King County systematically reviewed all case report forms for treatment data, and contacted providers to obtain treatment information when it was missing. For this analysis, all free text for the 'other' category were reviewed to ensure appropriate classification of treatment (e.g. cases where "Zithromax" or "Z-pack" were recorded as "Other" were re-categorized to azithromycin).

Additional variables of interest for this analysis included demographic factors, sexual history, clinical features, diagnosing facility type, and year of diagnosis. Demographic, sexual history, and clinical data were obtained from the case report form. Our demographic variables included: age (categorized into 5-year age groups for analysis), race (White, Black, American Indian/Alaska Native, Asian, Native Hawaiian/other Pacific islander, other, multiracial), ethnicity (Hispanic/Latinx, not Hispanic/Latinx), and gender identity. Prior to 2020 the STD case report form did not have a separate field for gender identity. Beginning in 2009, the STD case report form included categories of female, male, transgender male to female and transgender female to male. We acknowledge that language used on the STD case report form is no longer appropriate.

The sexual history and clinical variables included: gender of sex partners (male, female, both), reason for testing (symptomatic, asymptomatic screening, exposed), pregnancy status (yes, no), HIV status (yes, no), CT diagnosis, anatomic infection site, and CT infection in past year. Pregnancy status was added to the case report form in October 2014; there is no available pregnancy information for cases prior to this date. For this analysis, we collapsed CT diagnosis into: uncomplicated infection (includes both asymptomatic and symptomatic [uncomplicated] from case report form), pelvic inflammatory disease (PID), ophthalmia and other complications. Cases included in the analysis had a positive test at a urogenital site (cervix, urethra, urine or vagina); some cases had additional rectal or pharyngeal testing performed. Because only positive tests are reported to PHIMS-STD, missing data on rectal or pharyngeal tests could indicate that an individual was not tested at these anatomic sites or that they were tested but tested negative. Unfortunately, we were unable to differentiate between negative test results and no testing performed at the rectum and pharynx. CT infection in the past year was a calculated variable using the surveillance data in the year prior the current diagnosis within our dataset.

Facility data from PHIMS-STD was obtained from the laboratory report or case report form. The specific name and location of a diagnosing facility are recorded on the laboratory form or case report form and those facilities are assigned a facility type by Department of Health staff. Specifically, as a new facility is entered into PHIMS-STD for the first time it is assigned a facility type. The specific facilities, and their associated facility type, are then selected from a drop-down for each new CT case during data entry. The initial dataset included 20 facility types which were then collapsed into 8 categories for all analyses. Facilities that accounted for more than 5% of CT cases across the study period were included as individual categories. These facilities included: family planning, private physician/HMO, hospital ER/urgent care facility, prenatal care, women's health clinic and FQHC/CHC facilities. We collapsed HIV counseling and testing facilities, STD clinic and other health department facilities into a new 'HIV, STD and Other Health Dept.' category. Facilities that represented fewer than 5% of CT cases across the study period were collapsed into an 'Other' category, which included: drug treatment facility, correctional facility, lab, labor and delivery, school-based clinic, mental health facility, non-ER hospital, Indian Health Services, military and non-specified other facilities.

Statistical analyses

First, we conducted descriptive analyses to examine the distribution of CT cases across treatment groups (doxycycline, azithromycin, levofloxacin, other, total) for all variables including demographic factors, sexual history, clinical features, diagnosing facility, and year. We also present the distribution of CT cases stratified by treatment groups over time. Second, we calculated the distribution of CT prescribing facilities by treatment groups and present the proportion of CT cases receiving azithromycin within each specific facility type over the study period. Finally, we examined the association between patient characteristics (demographic, clinical, sexual history, and facility) and receipt of azithromycin (versus doxycycline). We used Poisson regression models with robust standard errors to estimate unadjusted and adjusted

prevalence ratios and associated confidence intervals to quantify the relationship between all variables of interest and the receipt of azithromycin. The fully adjusted model included all variables of interest. This analysis was limited to cases who only received azithromycin or doxycycline (i.e., for this analysis we dropped cases who received a treatment other than azithromycin or doxycycline). All analyses were conducted in R (v.4.1.1).

All data for this analysis were de-identified; therefore, this study was thus not considered to be human subjects research and was exempt from IRB review.

Results

Our initial dataset included 40,648 cases of CT in King County diagnosed from 2010 to 2018 among individuals who were female sex at birth and aged 15 or older. After limiting to individuals with complete treatment data and those diagnosed with urogenital infection, the analytic sample included 36,830 cases. The cases tended to be ages 20-24, white, non-Hispanic/Latinx, female identifying and with male sex partners (Table 1). Over half of the cases were tested during an asymptomatic screening and over 80% had an uncomplicated CT infection. Over 10% of cases had a previous CT infection in the past year. There were few cases who were also diagnosed with rectal or pharyngeal CT.

On average during the study period, over 90% of cases received azithromycin for CT treatment. This proportion increased over the course of the study period, from 86% in 2010 to 94% from 2015-2018 (Figure 1). Antibiotics other than doxycycline or azithromycin were not commonly prescribed.

The family planning and private physician/HMO facilities accounted for over half of the CT diagnoses from 2010-2018 with 24% and 31% of total cases respectively (Table 1). The proportion of cases diagnosed in each facility type did not dramatically change over the course of the study period (data not shown). The proportion of azithromycin prescribed within each facility type increased over time for all facility types; the steepest increases occurred in women's

health clinics and hospital ERs/urgent care facilities (Figure 2). Five facility types were prescribing azithromycin to 95% or more of CT cases in 2018: family planning, prenatal care, women's health clinics, FQHC/CHC and HIV/STD/other health department clinics (Figure 2). Private physicians, hospital ERs and facilities in the 'other' category were prescribing less azithromycin; however, all facilities were prescribing azithromycin to at least 80% of their cases by the end of the study period in 2018 (Figure 2).

To examine factors associated with receipt of azithromycin, we limited our analytic sample to include cases that received either azithromycin or doxycycline (N= 36,644). Table 2 displays the association between case characteristics and facility type and the receipt of azithromycin (versus doxycycline). In the fully adjusted model, cases who were older were less likely to be prescribed azithromycin compared to those ages 15-19. Cases who were Black, American Indian/Alaska Native or Native Hawaiian/other Pacific Islander had a slightly increased likelihood of being prescribed azithromycin compared to cases who were white (aPR (95% CI) = 1.03 (1.02, 1.03); 1.03 (1.01, 1.05); 1.03 (1.02, 1.05) respectively). Symptomatic cases were less likely to be prescribed azithromycin compared to those being tested during an asymptomatic screening (aPR (95% CI) = 0.97 (0.96, 0.98)). Individuals with a rectal infection were less likely to be prescribed azithromycin compared to those with negative or missing rectal results (aPR (95% CI) = 0.84 (0.71, 0.99)), and cases with a CT infection in the previous year were slightly less likely to be prescribed azithromycin compared to those without a prior infection (aPR (95% CI) = 0.98 (0.97, 0.99)).

Discussion

In this study examining trends in treatment prescribing practices for women with genital CT in King County, WA, we found that the proportion of CT cases prescribed azithromycin increased substantially from 2010 to 2018, with over 90% of CT cases receiving azithromycin by 2018. We also noted differences in prescribing practices by facility type and observed that

younger CT cases and CT cases of color were more likely to receive azithromycin. Given that – as of 2021 – azithromycin is no longer recommended as front-line therapy for CT treatment, our findings suggest that a substantial shift in practice will be required to meet the new CDC CT treatment guidelines.

The overall goal of our analysis was to determine the current state of CT prescribing in our jurisdiction to better understand the potential impact of the new 2021 CT treatment guidelines. Several studies have found that doxycycline and azithromycin are similarly efficacious for the treatment of urogenital CT.[2,3,5] However, recent evidence demonstrated that doxycycline is more effective in the treatment of rectal CT compared to azithromycin.[6,7] The majority of women (~70%) with a urogenital CT infection have an undiagnosed rectal infection at the same time, and these women may have a higher risk of reinfection if treated with azithromycin due to re-inoculation from the rectal site.[8,9] This cycle of potential reinfection continues to place women at higher risk of severe outcomes such as pelvic inflammatory disease, ectopic pregnancy, and infertility.[1]

We hypothesized that there may be differences in prescribing practices by facility type, which may help predict which facilities may have more difficultly transitioning to doxycycline treatment. Indeed, we observed clear differences in prescribing practices across facility types. Out of the eight facility types, there were five that were prescribing azithromycin to 95% or more of their CT cases in 2018. Family planning clinics, which were responsible for diagnosing 24% of all female CT cases during the study period, prescribed azithromycin to 99% of their cases in 2018. Private physicians were responsible for diagnosing the most CT cases during the study period (31%), and although providers within this facility type prescribed less azithromycin within their facility compared to some other facility types, the vast majority of cases (92%) still received azithromycin in 2018. Interestingly, we observed a steep increase in azithromycin use during the study period among hospital ERs and urgent care facilities, from 73% of CT cases receiving azithromycin in 2010 to 89% in 2018; it is unclear what drove the steep increase within these

facilities. While their proportion of azithromycin use was the lowest in 2018 compared to other facilities, the steep increase may indicate a more difficult transition to reverse this trend of increasing azithromycin treatment.

These distinct patterns in prescribing practices across diagnosing facilities highlight the necessity of tailoring training and communication practices to reach different types of providers and facilities across King County. Implementation science studies to examine changes in healthcare practice provide an opportunity to understand evidence-based approaches to change practice. A recent systematic review found that a multifaceted intervention approach was found to be effective in influencing prescribing practices in primary care providers.[10] The combined usage of audit/feedback systems, reminders, educational outreach visits, and patient mediated interventions was highlighted as an effective method for changing primary care provider prescribing practices.[10] This review also highlighted intervention strategies across the education, enablement, environmental restructuring, incentivization, modelling, persuasion and training domains to influence health professionals' practices.[10] Of these domains, the education and enablement based interventions may be the most relevant for changing prescribing practices by increasing knowledge and increasing capability to change.[10]

Although we observed clear patterns in prescribing practices across facilities, the differences in prescribing practices across patient demographics were subtler. Younger cases and patients of color were significantly more likely to receive azithromycin compared to their respective peers, though these associations were of relatively small magnitude. It is possible that providers may feel more comfortable providing younger patients with a single dose of therapy (azithromycin) rather than a 7-day course of therapy (doxycycline) to alleviate adherence concerns. Adolescents may be less likely to adhere to multi-day doxycycline treatments due to a lack of appropriate counseling and follow up appointments due to a lack of transportation or consistent medical provider.[11] The relationship between race and medication adherence is heavily impacted by multiple factors such as low socioeconomic status, increased

stress, discrimination and distrust of the medical system.[12] Providers may have implicit racial biases which unintentionally impact their clinical recommendations, especially when placed under time pressure as seen in many medical facilities.[12]

Although our findings suggest that a substantial change in practice is required to adhere to the new CDC CT treatment guidelines, two studies offer a promising outlook. First, data from gonorrhea treatment suggests that shifts in prescribing practice are possible. The CDC treatment guidelines for gonorrhea were revised in both 2012 and 2015 based on changes in antimicrobial resistance.[13] In 2016, the CDC reviewed gonorrhea cases from the STD Surveillance Network (SSuN) and estimated that over 80% of cases were receiving the newly recommended regimen,[13] and that there were no differences in gonorrhea treatment regimen based on patient age or race/ethnicity.[13] However, they did observe differences in prescribing practices based on facility type, with family planning/reproductive health clinics and STD clinics more likely to prescribe the recommended treatment compared to other facility types.[13] It is difficult to know if this high adherence to updated gonorrhea guidelines seen in 2016 will translate into changed CT prescribing practices, as providers may feel a greater need to quickly shift gonorrhea practices based on risks of antimicrobial resistance.

Second, a recent study conducted in mid-Atlantic pediatric primary care clinics suggests that there have been some shifts in CT prescribing practices already. In that study, the authors analyzed the impact of the 2021 guideline change on CT prescribing practices using electronic health records in two years prior to the guidelines change and the six months following the guideline change.[14] They found that the proportion of CT cases prescribed doxycycline increased substantially from 6% and 9% in 2019 and 2020 respectively, to 54% in 2021 following the implementation of the updated CDC treatment guidelines.[14] This study highlights the potential for a rapid shift in prescribing practices among clinics that were predominately prescribing azithromycin prior to the guidelines change. More analyses, such as this one, are needed to evaluate the impact of the guidelines change and to better understand what facility

types are less likely to adhere to the new guidelines or what are the characteristics of cases that continue to receive doxycycline. Unfortunately, we are unable to do such an analysis in King County and we will not be able to in the foreseeable future. In 2019, our local public health department ceased the systematic collection of CT treatment data due to changes in public health funding and priorities. As a result, we will be unable to measure the true impact of the change in the 2021 CDC CT treatment guidelines on prescribing practices in the region. This is especially concerning due to the substantial rise in azithromycin usage we observed in the decade prior to the guideline change. We hope that other jurisdictions, facilities, or public health entities can perform such analyses using surveillance data, electronic health records, or claims or prescription databases.

There are several limitations to our study. First, there are some variables with high missingness such as pregnancy, HIV status, and infection status at the rectal and pharyngeal sites. We were also limited to data available from the lab records and case report forms which may not capture all relevant variables. In particular, we are using race and ethnicity as a proxy for racism, acknowledging that race is a social construct and that these racialized categories do not encompass the structural or social determinants of health experience by oppressed and marginalized groups. The available facility information only captures the diagnosing site, we are unable to determine if cases were treated at an alternate site. Additionally, as previously noted we were unable to compare prescribing practices before and after the change to the CDC CT treatment guidelines. A final limitation of this study is the geographical limitations of the dataset. The findings of this study may not be generalizable to populations residing outside of King County or Washington. However, despite these limitations our study utilized population-level CT treatment data for almost 10 years that was systematically collected and recorded, to obtain a complete picture of CT prescribing practices.

In conclusion, our study found that azithromycin use for the treatment of urogenital CT among women increased in King County from 2010 to 2018. We observed differential

prescribing trends across facility types which highlights the need for targeted and multifaceted educational programs. We also observed that younger patients and patients of color were more like to be prescribed azithromycin, which may place them at higher risk of CT reinfection and complications. Previous studies have shown that providers can quickly adapt their CT and gonorrhea treatment patterns following a new guideline release; nonetheless, monitoring of CT treatment trends at the local and national level can shed light on how to better support providers and facilities to make this substantial and important shift in CT treatment.

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Table 1. Characteristics of CT cases by treatment type, 2010-2018 (N = 36830)

	Doxycycline (N=2895)	Azithromycin (N=33749)	Levofloxacin (N=77)	Other (N=109)	Total (N=36830)
Age					
15-19	713 (24.6%)	9295 (27.5%)	18 (23.4%)	28 (25.7%)	10054 (27.3%)
20-24	1095 (37.8%)	12886 (38.2%)	26 (33.8%)	41 (37.6%)	14048 (38.1%)
25-29	521 (18.0%)	6255 (18.5%)	21 (27.3%)	16 (14.7%)	6813 (18.5%)
30-34	260 (9.0%)	2760 (8.2%)	8 (10.4%)	13 (11.9%)	3041 (8.3%)
35-39	140 (4.8%)	1314 (3.9%)	1 (1.3%)	3 (2.8%)	1458 (4.0%)
40-44	79 (2.7%)	648 (1.9%)	0 (0%)	3 (2.8%)	730 (2.0%)
45-49	50 (1.7%)	314 (0.9%)	1 (1.3%)	4 (3.7%)	369 (1.0%)
50+	37 (1.3%)	277 (0.8%)	2 (2.6%)	1 (0.9%)	317 (0.9%)
Gender					
Female	2891 (99.9%)	33724 (99.9%)	77 (100%)	109 (100%)	36801 (99.9%)
Transgender FTM	4 (0.1%)	25 (0.1%)	0 (0%)	0 (0%)	29 (0.1%)
Race					
White	1204 (41.6%)	13072 (38.7%)	35 (45.5%)	43 (39.4%)	14354 (39.0%)
Black	432 (14.9%)	5649 (16.7%)	12 (15.6%)	12 (11.0%)	6105 (16.6%)
American Indian/Alaska Native	39 (1.3%)	545 (1.6%)	1 (1.3%)	6 (5.5%)	591 (1.6%)
Asian	292 (10.1%)	3313 (9.8%)	8 (10.4%)	9 (8.3%)	3622 (9.8%)
Native Hawaiian/Other Pacific Islander	48 (1.7%)	955 (2.8%)	0 (0%)	3 (2.8%)	1006 (2.7%)
Other	110 (3.8%)	1643 (4.9%)	4 (5.2%)	5 (4.6%)	1762 (4.8%)
Multiracial	87 (3.0%)	1140 (3.4%)	3 (3.9%)	2 (1.8%)	1232 (3.3%)
Missing	*683 (23.6%)*	*7432 (22.0%)*	*14 (18.2%)*	*29 (26.6%)*	*8158 (22.2%)*
Ethnicity					
Hispanic/Latinx	297 (10.3%)	4953 (14.7%)	9 (11.7%)	12 (11.0%)	5271 (14.3%)
Not Hispanic/Latinx	1667 (57.6%)	20266 (60.0%)	45 (58.4%)	63 (57.8%)	22041 (59.8%)
Missing	*931 (32.2%)*	*8530 (25.3%)*	*23 (29.9%)*	*34 (31.2%)*	*9518 (25.8%)*
Gender of sex partners					
Male	2060 (71.2%)	27515 (81.5%)	53 (68.8%)	83 (76.1%)	29711 (80.7%)
Female	19 (0.7%)	441 (1.3%)	0 (0%)	1 (0.9%)	461 (1.3%)
Both	52 (1.8%)	695 (2.1%)	2 (2.6%)	0 (0%)	749 (2.0%)
Missing	*764 (26.4%)*	*5098 (15.1%)*	*22 (28.6%)*	*25 (22.9%)*	*5909 (16.0%)*
Reason for testing					
Symptomatic	1530 (52.8%)	11227 (33.3%)	49 (63.6%)	52 (47.7%)	12858 (34.9%)
Asymptomatic screening	1009 (34.9%)	17858 (52.9%)	17 (22.1%)	43 (39.4%)	18927 (51.4%)
Exposed	227 (7.8%)	3487 (10.3%)	8 (10.4%)	7 (6.4%)	3729 (10.1%)
Missing	*129 (4.5%)*	*1177 (3.5%)*	*3 (3.9%)*	*7 (6.4%)*	*1316 (3.6%)*
Pregnancy status[a]					
Not pregnant	868 (30.0%)	11427 (33.9%)	29 (37.7%)	23 (21.1%)	12347 (33.5%)
Pregnant	61 (2.1%)	1971 (5.8%)	1 (1.3%)	10 (9.2%)	2043 (5.5%)
Missing	*1966 (67.9%)*	*20351 (60.3%)*	*47 (61.0%)*	*76 (69.7%)*	*22440 (60.9%)*
HIV status					

HIV negative	367 (12.7%)	4600 (13.6%)	18 (23.4%)	16 (14.7%)	5001 (13.6%)
HIV positive	10 (0.3%)	83 (0.2%)	0 (0%)	1 (0.9%)	94 (0.3%)
Missing	*2518 (87.0%)*	*29066 (86.1%)*	*59 (76.6%)*	*92 (84.4%)*	*31735 (86.2%)*
CT diagnosis					
Uncomplicated	2319 (80.1%)	31463 (93.2%)	60 (77.9%)	84 (77.1%)	33926 (92.1%)
PID	406 (14.0%)	158 (0.5%)	13 (16.9%)	7 (6.4%)	584 (1.6%)
Ophthalmia	0 (0%)	2 (0.0%)	0 (0%)	0 (0%)	2 (0.0%)
Other	51 (1.8%)	892 (2.6%)	1 (1.3%)	14 (12.8%)	958 (2.6%)
Missing	*119 (4.1%)*	*1234 (3.7%)*	*3 (3.9%)*	*4 (3.7%)*	*1360 (3.7%)*
Urogenital infection					
Urogenital infection	2895 (100%)	33749 (100%)	77 (100%)	109 (100%)	36830 (100%)
Rectal infection[b]					
Rectal infection	8 (0.3%)	29 (0.1%)	1 (1.3%)	0 (0%)	38 (0.1%)
Missing	*2887 (99.7%)*	*33720 (99.9%)*	*76 (98.7%)*	*109 (100%)*	*36792 (99.9%)*
Pharyngeal infection[b]					
Pharyngeal infection	4 (0.1%)	26 (0.1%)	1 (1.3%)	0 (0%)	31 (0.1%)
Missing	*2891 (99.9%)*	*33723 (99.9%)*	*76 (98.7%)*	*109 (100%)*	*36799 (99.9%)*
CT infection in previous year					
No infection in previous year	2422 (83.7%)	29040 (86.0%)	62 (80.5%)	90 (82.6%)	31614 (85.8%)
Infection in previous year	473 (16.3%)	4709 (14.0%)	15 (19.5%)	19 (17.4%)	5216 (14.2%)
Facility type[c]					
Family Planning	440 (15.2%)	8408 (24.9%)	0 (0%)	5 (4.6%)	8853 (24.0%)
Private Physician/HMO	1037 (35.8%)	10420 (30.9%)	24 (31.2%)	40 (36.7%)	11521 (31.3%)
Hospital ER/Urgent Care Facility	541 (18.7%)	2571 (7.6%)	22 (28.6%)	11 (10.1%)	3145 (8.5%)
Prenatal care	91 (3.1%)	1855 (5.5%)	5 (6.5%)	11 (10.1%)	1962 (5.3%)
Women's Health Clinic	239 (8.3%)	2341 (6.9%)	3 (3.9%)	1 (0.9%)	2584 (7.0%)
FQHC/CHC	164 (5.7%)	3700 (11.0%)	4 (5.2%)	11 (10.1%)	3879 (10.5%)
HIV, STD and Other Health Dept.	46 (1.6%)	1371 (4.1%)	7 (9.1%)	2 (1.8%)	1426 (3.9%)
Other	301 (10.4%)	2704 (8.0%)	11 (14.3%)	22 (20.2%)	3038 (8.2%)
Missing	*36 (1.2%)*	*379 (1.1%)*	*1 (1.3%)*	*6 (5.5%)*	*422 (1.1%)*
Year					
2010	467 (16.1%)	3208 (9.5%)	16 (20.8%)	22 (20.2%)	3713 (10.1%)
2011	479 (16.5%)	3373 (10.0%)	16 (20.8%)	23 (21.1%)	3891 (10.6%)
2012	430 (14.9%)	3488 (10.3%)	6 (7.8%)	10 (9.2%)	3934 (10.7%)
2013	274 (9.5%)	3651 (10.8%)	6 (7.8%)	5 (4.6%)	3936 (10.7%)
2014	250 (8.6%)	3708 (11.0%)	7 (9.1%)	10 (9.2%)	3975 (10.8%)
2015	233 (8.0%)	3928 (11.6%)	10 (13.0%)	8 (7.3%)	4179 (11.3%)
2016	290 (10.0%)	4421 (13.1%)	8 (10.4%)	6 (5.5%)	4725 (12.8%)
2017	272 (9.4%)	4431 (13.1%)	5 (6.5%)	13 (11.9%)	4721 (12.8%)
2018	200 (6.9%)	3541 (10.5%)	3 (3.9%)	12 (11.0%)	3756 (10.2%)

[a] Pregnancy status was only collected from October 2014 onwards.

[b] Missing data represents both negative test results and individuals not tested.

[c] Initial dataset contained 20 facility types: HIV C&T Site*, STD Clinic*, Drug Tx, **Family Planning**, Other Health Dept. Clinic*, **Private Physician/HMO**, **Hospital ER/Urgent Care Facility**, Correctional Facility, Lab, Labor & Delivery, **Prenatal care**, School-based Clinic, Mental Health Facility, HIV Care Clinic*, **Women's Health Clinic**, Hospital - other than ER, **FQHC/CHC**, Indian Health Services, Military, Other.
Facilities that accounted for more than 5% of cases were directly included in collapsed dataset (bold above); four facilities (asterisk above) were combined into a new collapsed facility category of 'HIV, STD and Other Health Dept.' in the collapsed dataset; all other facilities were moved into 'Other' category in the collapsed dataset.

Figure 1. Proportion of CT Cases Receiving Treatment, by Drug Type, 2010-2018

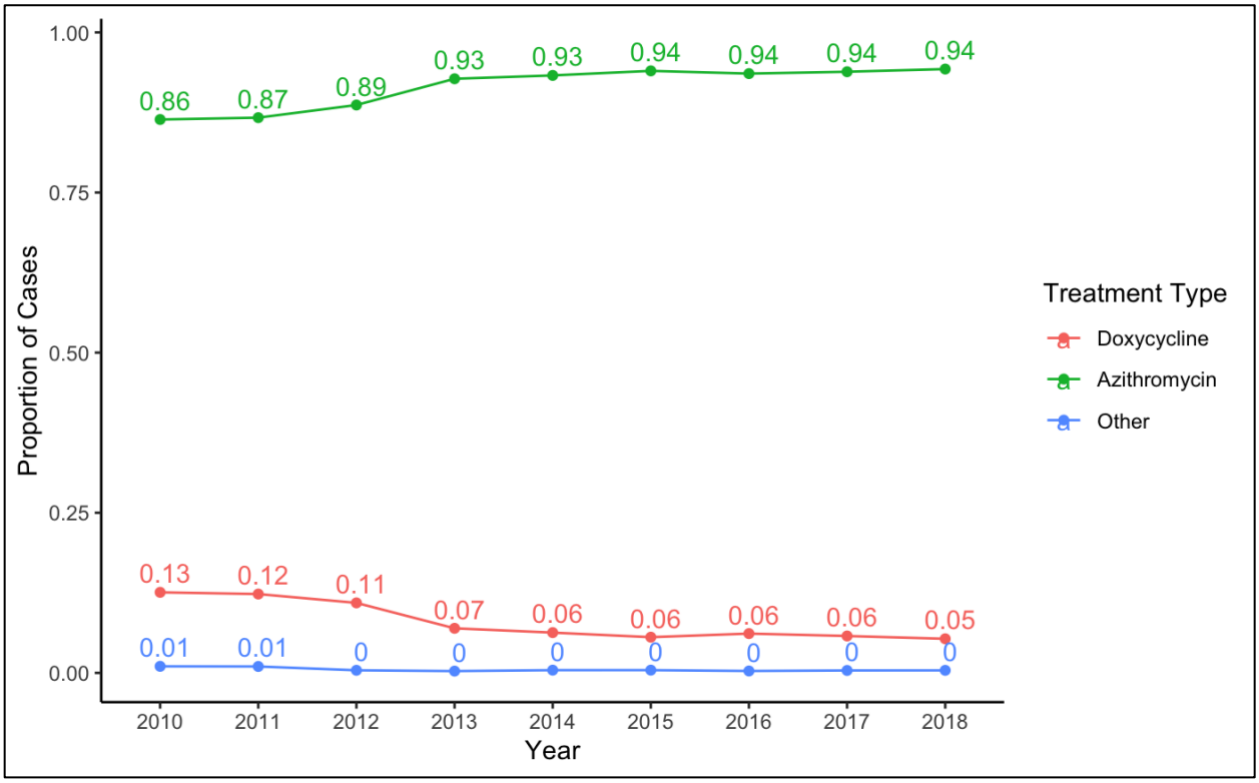

Figure 2. Percent of CT Cases Within Each Facility Type Who Received Azithromycin, 2010-2018

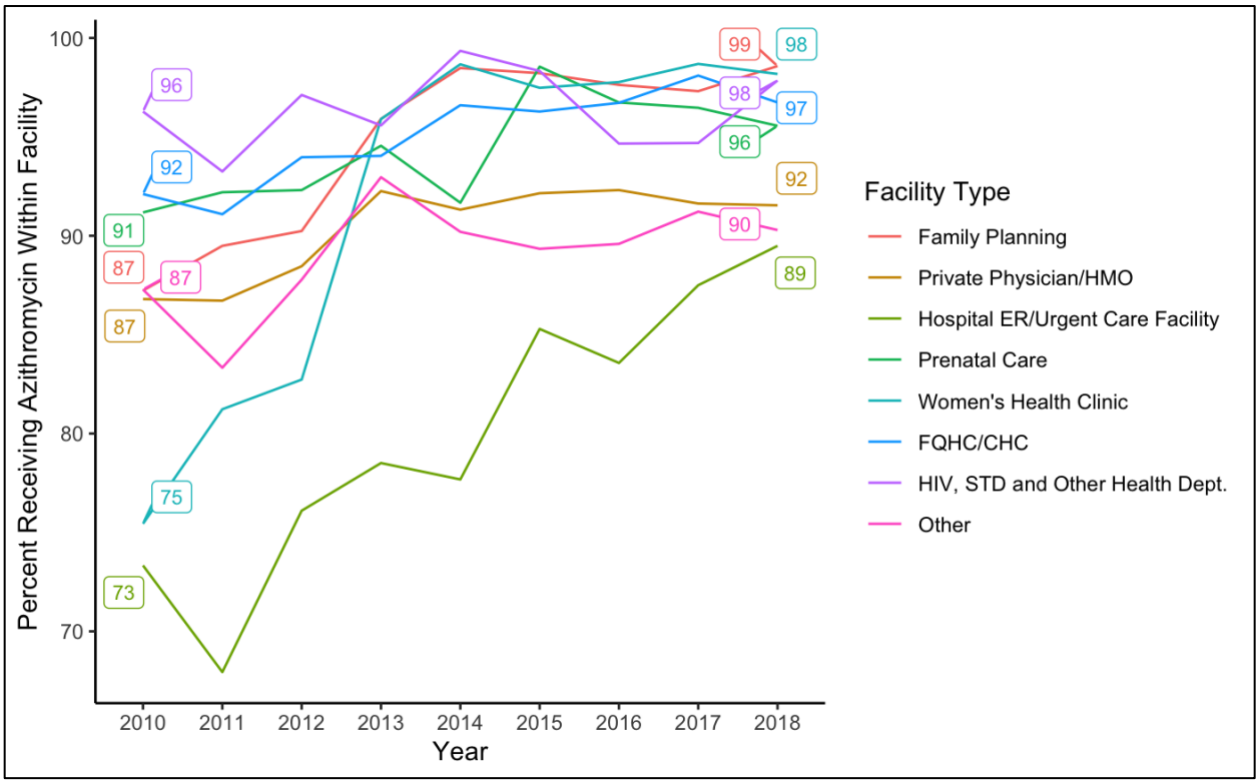

Table 2. Characteristics associated with azithromycin treatment compared to doxycycline, 2010-2018 (N = 36644)

Characteristics	Azithromycin Recipient n/N (Row %)	PR (95% CI)	aPR (95% CI)
Age			
15-19	9295/10008 (93)	ref	ref
20-24	12886/13981 (92)	0.99 (0.99, 1.00) ^	0.99 (0.98, 1.00) ^
25-29	6255/6776 (92)	0.99 (0.99, 1.00)	0.99 (0.98, 1.00) ^
30-34	2760/3020 (91)	0.98 (0.97, 1.00) ^	0.98 (0.97, 1.00) ^
35-39	1314/1454 (90)	0.97 (0.96, 0.99) ^	0.97 (0.95, 0.98) ^
40-44	648/727 (89)	0.96 (0.94, 0.98) ^	0.96 (0.94, 0.99) ^
45-49	314/364 (86)	0.93 (0.89, 0.97) ^	0.93 (0.89, 0.97) ^
50+	277/314 (88)	0.95 (0.91, 0.99) ^	0.95 (0.91, 0.99) ^
Gender			
Female	33724/36615 (92)	ref	ref
Transgender FTM	25/29 (86)	0.94 (0.81, 1.08)	0.94 (0.85, 1.05)
Race			
White	13072/14276 (92)	ref	ref
Black	5649/6081 (93)	1.01 (1.01, 1.02) ^	1.03 (1.02, 1.03) ^
American Indian/Alaska Native	545/584 (93)	1.02 (1.00, 1.04)	1.03 (1.01, 1.05) ^
Asian	3313/3605 (92)	1.00 (0.99, 1.01)	1.00 (0.99, 1.01)
Native Hawaiian/Other Pacific Islander	955/1003 (95)	1.04 (1.02, 1.06) ^	1.03 (1.02, 1.05) ^
Other	1643/1753 (94)	1.02 (1.01, 1.04) ^	1.01 (1.00, 1.02)
Multiracial	1140/1227 (93)	1.01 (1.00, 1.03)	1.01 (1.00, 1.03)
Missing	*7432/8115 (92)*	*1.00 (0.99, 1.01)*	*1.01 (1.01, 1.02)* ^
Ethnicity			
Not Hispanic/Latinx	20266/21933 (92)	ref	ref
Hispanic/Latinx	4953/5250 (94)	1.02 (1.01, 1.03) ^	1.01 (1.00, 1.02)
Missing	*8530/9461 (90)*	*0.98 (0.97, 0.98)* ^	*0.99 (0.98, 1.00)*
Gender of sex partners			
Male	27515/29575 (93)	ref	ref
Female	441/460 (96)	1.03 (1.01, 1.05) ^	1.03 (1.01, 1.05) ^
Both	695/747 (93)	1.00 (0.98, 1.02)	1.01 (0.99, 1.02)
Missing	*5098/5862 (87)*	*0.93 (0.93, 0.94)* ^	*0.97 (0.96, 0.98)* ^
Reason for testing			
Asymptomatic screening	17858/18867 (95)	ref	ref
Symptomatic	11227/12757 (88)	0.93 (0.92, 0.94) ^	0.97 (0.96, 0.98) ^
Exposed	3487/3714 (94)	0.99 (0.98, 1.00)	1.00 (0.99, 1.01)
Missing	*1177/1306 (90)*	*0.95 (0.93, 0.97)* ^	*0.99 (0.97, 1.00)*
Pregnancy status[a]			
Not pregnant	11427/12295 (93)	ref	ref
Pregnant	1971/2032 (97)	1.04 (1.03, 1.05) ^	1.03 (1.02, 1.04) ^

Missing	*20351/22317 (91)*	*0.98 (0.97, 0.99) ^*	*1.01 (1.00, 1.01)*
HIV status			
HIV negative	4600/4967 (93)	ref	ref
HIV positive	83/93 (89)	0.96 (0.90, 1.03)	0.98 (0.92, 1.05)
Missing	*29066/31584 (92)*	*0.99 (0.99, 1.00)*	*1.01 (1.00, 1.01)*
CT diagnosis[b]			
Uncomplicated	31463/33782 (93)	ref	ref
PID	158/564 (28)	0.30 (0.26, 0.34) ^	0.31 (0.28, 0.36) ^
Other complication	894/945 (95)	1.02 (1.00, 1.03) ^	1.00 (0.98, 1.02)
Missing	*1234/1353 (91)*	*0.98 (0.96, 1.00) ^*	*0.99 (0.97, 1.01)*
Infection site[c]			
Urogenital	33749/36644 (92)	-	-
Rectum	29/37 (78)	0.85 (0.72, 1.01)	0.84 (0.71, 0.99) ^
Pharynx	26/30 (87)	0.94 (0.82, 1.08)	0.93 (0.81, 1.06)
CT diagnosis in previous year			
No infection in previous year	29040/31462 (92)	Ref	ref
Infection in previous year	4709/5182 (91)	0.98 (0.98, 0.99) ^	0.98 (0.97, 0.99) ^
Facility type[d]			
Private Physician/HMO	10420/11457 (91)	Ref	ref
Family Planning	8408/8848 (95)	1.04 (1.04, 1.05) ^	1.03 (1.02, 1.03) ^
Hospital ER/Urgent Care Facility	2571/3112 (83)	0.91 (0.89, 0.92) ^	0.93 (0.92, 0.95) ^
Prenatal care	1855/1946 (95)	1.05 (1.04, 1.06) ^	1.04 (1.02, 1.05) ^
Women's Health Clinic	2341/2580 (91)	1.00 (0.98, 1.01)	0.98 (0.97, 1.00) ^
FQHC/CHC	3700/3864 (96)	1.05 (1.04, 1.06) ^	1.04 (1.03, 1.05) ^
HIV, STD and Other Health Dept.	1371/1417 (97)	1.06 (1.05, 1.08) ^	1.05 (1.04, 1.06) ^
Other	2704/3005 (90)	0.99 (0.98, 1.00)	0.99 (0.98, 1.01)
Missing	*379/415 (91)*	*1.00 (0.97, 1.03)*	*1.01 (0.98, 1.04)*
Year			
2010 - 2012	10069/11445 (88)	Ref	ref
2013 - 2015	11287/12044 (94)	1.07 (1.06, 1.07) ^	1.07 (1.06, 1.08) ^
2016 - 2018	12393/13155 (94)	1.07 (1.06, 1.08) ^	1.08 (1.07, 1.09) ^

^ Statistically significant at the $\alpha = 0.05$ level

[a] Pregnancy status was only collected from October 2014 onwards.

[b] Ophthalmia is included in 'Other complications' category.

[c] All individuals had at least a urogenital infection so this variable was excluded from regression analyses. Not all individuals were tested for rectal and pharyngeal infections. PRs for rectal and pharyngeal are comparing those with an infection in that specific site compared to those without an infection (not tested and tested negative) in that site respectively.

[d] Initial dataset contained 20 facility types: HIV C&T Site*, STD Clinic*, Drug Tx, **Family Planning**, Other Health Dept. Clinic*, **Private Physician/HMO**, **Hospital ER/Urgent Care Facility**, Correctional Facility, Lab, Labor & Delivery, **Prenatal care**, School-based Clinic, Mental Health Facility, HIV Care Clinic*, **Women's Health Clinic**, Hospital - other than ER, **FQHC/CHC**, Indian Health Services, Military, Other.
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