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Trends in sexually transmitted infection screening during COVID-19 and missed cases among adolescents

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ABSTRACT

Objective: The COVID-19 pandemic disrupted sexual health services for young people, with potential consequences of decreasing preventive screening and increasing undiagnosed sexually transmitted infections (STIs). This study aimed to assess trends in asymptomatic screening among patients receiving STI testing and to estimate the number of STI cases that were missed during the early months of the pandemic.
Study design: A cross-sectional study of electronic health records for chlamydia, gonorrhea, and trichomonas testing encounters from six pediatric primary care clinics in Philadelphia, July 2014 to November 2020.
Methods: A total of 35,548 testing encounters were analyzed, including 2958 during the pandemic. We assessed whether testing at each encounter was performed as asymptomatic screening, risk-based testing, or symptomatic testing. We evaluated screening trends over time and estimated the number of missed STI cases during the pandemic.
Results: The mean monthly testing encounters decreased from 479 per month prepandemic to 329 per month during the pandemic. The percent of tests performed as asymptomatic screening dropped from 72.5% prepandemic to a nadir of 54.5% in April 2020. We estimate that this decrease in asymptomatic screening would represent 159 missed cases (23.8% of expected cases) based on patient volume from the previous year.
Conclusions: During the pandemic, the total volume of STI testing encounters and the proportion of tests performed as asymptomatic screening decreased, potentially resulting in missed diagnoses. Undiagnosed STIs can result in severe sequelae and contribute to community transmission of STIs. Efforts are needed to re-establish and sustain access to STI services for adolescents in response to disruptions caused by the pandemic.

Introduction

Chlamydia trachomatis (CT) and *Neisseria gonorrhea* (GC) are the most common bacterial sexually transmitted infections (STIs) in the United States, and adolescents and young adults are the age groups with the highest incidence of infection.[1] The rates of STIs have been on the rise for six consecutive years and have now reached an all-time high.[1] Chlamydia and gonorrhea can be detected using nucleic acid amplification tests and treated with readily available antibiotics.[2] However, untreated STIs can lead to serious sequelae, including pelvic inflammatory disease,[3] adverse outcomes during pregnancy,[4] and increased susceptibility to HIV.[5] In addition, untreated STIs contribute to increased community transmission of these pathogens. Routine screening for bacterial STIs among adolescents is an evidence-based Centers for Disease Control and Prevention guideline strategy for mitigating the public health impact of these communicable diseases.[6]

The COVID-19 pandemic has the potential to severely disrupt access to sexual health services for young people. Emerging evidence suggests that rates of STI testing, both as symptomatic

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testing and asymptomatic screening, decreased during the initial months of the pandemic.[7–10] Several studies also found that among the tests that were conducted, greater test positivity was observed.[7–9,11] This pattern could be attributed to a shift toward treating symptomatic patients and deferring asymptomatic screening[12] and/or increasing population prevalence and community transmission of STIs during the pandemic.[13] Systematic decreases in STI screening during the pandemic may have resulted in missed STI cases, with significant consequences for individual health, healthcare costs,[14] and the epidemiology of these STIs.

Research to date has not yet determined how the pandemic has affected patterns of asymptomatic STI screening for adolescents. This study aimed to assess trends in asymptomatic screening among patients receiving STI testing in pediatric primary care settings in Philadelphia. In addition, this study estimates the number of STI cases that were missed during the pandemic based on changes in asymptomatic screening.

Methods

We analyzed electronic health record (EHR) data from six pediatric primary care clinics located within the city of Philadelphia, including two clinics funded through the Title X Federal Family Planning program to provide confidential sexual health services and comprehensive family planning for low-income and uninsured people. Our study sample consisted of all patient encounters with a patient address in Philadelphia or the surrounding counties (Bucks County PA, Chester County PA, Delaware County PA, Montgomery County PA, New Castle County DE, Burlington County NJ, Camden County NJ, Gloucester County NJ, and Salem County NJ) that included CT, GC, or *Trichomonas vaginalis* testing at any anatomic site (i.e. urine, vaginal swab, urethral swab, throat swab, or rectal swab) from July 1, 2014, to November 30, 2020. Trichomonas testing was included; recently, guidelines have suggested that screening should be considered in settings with high prevalence of STIs, such as the Philadelphia area.[2] Testing for syphilis was not included because, based on the 2015 Centers for Disease Control and Prevention guidelines,[15] routine screening among adolescents was only recommended for men who have sex with men, and we could not ascertain sexual orientation via EHR data. To compare outcomes from the period before the COVID-19 pandemic in the United States to the period after pandemic onset, we defined July 1, 2014, to February 29, 2020, as the prepandemic period and March 1, 2020, to November 30, 2020, as the pandemic period.

Measures

Testing type category

We used the *International Statistical Classification of Diseases, Tenth Revision,* order diagnosis associated with each STI testing encounter to classify encounters as asymptomatic screening, risk-based testing, or symptomatic testing. Order diagnoses that would not indicate clinical suspicion for an STI were classified as asymptomatic. In addition, diagnoses that indicate sexual activity (without identifying a specific risk), diagnoses that refer to counseling or education, and diagnoses that indicate that non-standard guidelines should be used for STI screening (e.g. pregnancy, men who have sex with men), but which do not necessarily indicate higher risk, were classified as asymptomatic. Order diagnoses that might lead a primary care provider to consider an STI as part of differential diagnosis were classified as symptomatic. These include symptoms of genitourinary infection (including abnormal urine findings), rectal infection, pharyngeal infection, as well as systemic symptoms consistent with acute HIV (e.g. weight loss, fever). Laboratory results and other signs that are often associated with symptoms of an STI, such as pyuria, were classified as symptomatic. Non-specific gastrointestinal complaints (e.g. abdominal pain) were classified as symptomatic, as they could be related to pelvic inflammatory disease. Diagnoses related to irregular bleeding or other menstrual symptoms were classified as symptomatic. Order diagnoses that indicated that the patient was at increased risk for an STI based on specific events, behaviors, and circumstances were classified as risk based. This includes those who were the victim of sexual assault, experienced a needlestick injury, reported injection drug use, had a sexual partner with a recent STI, or reported condomless intercourse. To minimize misclassification bias, two physician members of the research team (S.W. and D.T.S.) independently reviewed the 1547 distinct order diagnoses and encounter reasons associated with encounters in the data set and classified each diagnosis or reason as indicative of one of the three testing type categories. When there was disagreement on classification, discrepancies were solved by consensus. Consensus on classification was reached for 1468 diagnoses. A third member of the research team (N.L., nurse practitioner) was consulted to determine the final classification for the remaining 79 diagnoses.

When no order diagnosis was recorded for an encounter, the encounter reason (i.e. visit indication as noted by the staff member scheduled the visit) was used. For encounters with missing data for both order diagnosis and encounter reason, the testing type category was classified as “missing.”

Encounter-level characteristics

Age at encounter was measured in years as reported in the EHR. Sex was measured as sex assigned at birth, as reported in the EHR. Gender identity data were not routinely collected by the health system during the study period. Race (i.e. Black, White, Asian, or multiracial/other) and ethnicity (i.e. Latinx or non-Latinx) were extracted from the EHR and thus likely represent staff perceptions of the race/ethnicity of patients or parents at registration rather than self-identification by the patient. Race is a sociopolitical construct and included in the analysis as a measure of potential exposure to racism and discrimination. Insurance status at each encounter was categorized as private insurance, Medicaid, or uninsured. Laboratory results for all STI testing performed at each encounter were extracted and classified as either positive or not positive.

Statistical analysis

Descriptive statistics were calculated for all measures, and comparisons were made between the prepandemic and pandemic periods using Chi-squared tests for categorical variables, *t*-tests for normally distributed continuous variables, and Mann–Whitney U tests for non-normal continuous variables. Monthly trends in asymptomatic screening were investigated by calculating the proportion of encounters each month that were classified as asymptomatic screening. Locally estimated scatterplot smoothing was used to visualize trends over time, with a 95% confidence interval displayed for the fitted curve.[16]

To estimate the number of potential missed STI cases during the nine-month pandemic period, we first identified the *expected screening estimate*—the number of asymptomatic screening encounters using the observed number of asymptomatic screening encounters from the analogous 9-month period the previous year. To account for decreased overall patient volume (i.e. all patient encounters for any visit reason) during the pandemic, we also calculated a *patient-volume-adjusted expected screening estimate* by multiplying the *expected screening estimate* by the ratio of patient volume during the pandemic period over the patient volume during the analogous 9-month period the previous year (57,103 encounters/68,001 encounters = 0.84). The number of *estimated* *missed cases* and the *patient-volume-adjusted estimated missed cases* were calculated by multiplying the *expected screening estimate* and the *patient-volume-adjusted expected screening estimate*, respectively, by the observed STI test positivity rate for asymptomatic screening encounters during the pandemic (14.2%). Finally, the total number of *expected cases* and the *patient-volume-adjusted expected cases* were calculated by adding the number of observed cases during the pandemic (n = 510) to the *expected missed cases* and *patient-volume-adjusted missed cases*, respectively. This research was reviewed and deemed exempt by the institutional review boards at the Children's Hospital of Philadelphia and Access Matters.

Results

A total of 35,548 STI testing encounters (14,158 unique patients) were analyzed, including 2958 (2289 unique patients) during the pandemic period. The median patient age at encounter was 17.5 (interquartile range: 16.3–18.6), and 57.4% of patients were assigned female sex at birth. Most patients' race was recorded as Black/African American (84.2%), and most patients' ethnicity was recorded as non-Hispanic/Latinx (95.1%). At their first encounter in the data set, more than half of the participants were enrolled in a Medicaid insurance plan (55.3%), 34.3% had private insurance, and 10.0% were uninsured. Most encounters included testing for chlamydia (99.1%) or gonorrhea (98.3%); only 25.6% of encounters included testing for trichomonas. During the pandemic, a smaller proportion of the STI testing encounters were among uninsured patients compared with the prepandemic period (3.9% vs 13.0%). A summary of the characteristics of the STI testing encounters by the pandemic period is presented in Table 1.

During the prepandemic period, an average of 479 STI testing encounters occurred each month, dropping to an average of 329 encounters per month during the pandemic period. Asymptomatic screening was relatively stable during the prepandemic period, with 72.5% of STI tests being performed as asymptomatic screening. The percentage of tests performed as asymptomatic screening declined during the pandemic, reaching a low of 54.5% in April 2020 (Fig. 1). STI test positivity for any STI from all asymptomatic screening encounters was 11.3% over the entire study period, 11.1% during the prepandemic period, and 14.2% during the pandemic period. CT test positivity for asymptomatic screening encounters that included CT screening was 9.9% over the entire study period, 9.7% during the prepandemic period, and 11.9% during the pandemic period. GC test positivity for asymptomatic screening encounters that included GC screening was 1.8% over the entire study period, 1.6% during the prepandemic period, and 3.3% during the pandemic period. Trichomonas test positivity for asymptomatic screening encounters that included trichomonas screening was 3.6% over the entire study period, 3.7% during the prepandemic period, and 3.3% during the pandemic period.

From March to November of 2019, 3112 asymptomatic screening encounters occurred. Thus, the *expected screening estimate* during the pandemic period is 3112, and the *patient-volume-adjusted expected screening estimate* during the pandemic is 2613. We observed 1994 asymptomatic screening encounters during the pandemic period, corresponding to 1118 fewer screening encounters than expected based on patient volume from the previous year and 619 fewer screening encounters than the patient-volume-adjusted estimate. Given that 14.2% of asymptomatic screening encounters resulted in a positive STI test during the 9-month pandemic period, this translates to 159 *estimated missed cases* (23.8% decline from *expected cases*) based on patient volume from the previous year and 88 *patient-volume-adjusted missed cases* (14.7% decline from *patient-volume-adjusted expected cases*).

Discussion

This study assessed changes in asymptomatic screening for STIs among adolescents and young adults who were associated with the COVID-19 pandemic. We found that during the pandemic, the total volume of STI testing encounters decreased, corroborating previous research.[7–9] Furthermore, the proportion of tests performed as asymptomatic screening also decreased during this time. This finding is consistent with a previous study among patients of all ages at an STI clinic in Rhode Island, where researchers found that testing volume declined during the pandemic overall, and the largest declines were among screening visits for patients without symptoms.[10]

Our study suggests that this pattern of decreased screening also affected adolescents and young adults. It is likely that during the

Table 1
Description of STI testing encounters at six pediatric outpatient clinics, July 1, 2014, to November 30, 2020.

Variable	Overall	Prepandemic (July 1, 2014– February 29, 2020)	Pandemic (March 1, 2020– November 30, 2020)	*P*
n	35,548	32,590	2958	
Age (years), median (IQR)	17.47 (16.28, 18.61)	17.48 (16.27, 18.62)	17.44 (16.41, 18.46)	0.82
Insurance status (%)				<0.01
Medicaid	20,421 (57.4)	18,611 (57.1)	1810 (61.2)	
Private	10,652 (30.0)	9635 (29.6)	1017 (34.4)	
Uninsured	4336 (12.2)	4222 (13.0)	114 (3.9)	
Missing	139 (0.4)	122 (0.4)	17 (0.6)	
Race (%)				<0.01
Asian	419 (1.2)	357 (1.1)	62 (2.1)	
Black/African American	31,754 (89.3)	29,212 (89.6)	2542 (85.9)	
Other/multiracial	1545 (4.3)	1364 (4.2)	181 (6.1)	
White	1830 (5.1)	1657 (5.1)	173 (5.8)	
Ethnicity (%)				<0.01
Hispanic/Latinx	1303 (3.7)	1157 (3.6)	146 (4.9)	
Not Hispanic/Latinx	34,183 (96.2)	31,378 (96.3)	2805 (94.8)	
Refused/unknown	62 (0.2)	55 (0.2)	7 (0.2)	
Male sex (%)	9927 (27.9)	9069 (27.8)	858 (29.0)	0.18
Testing type (%)				<0.01
Asymptomatic	25,636 (72.1)	23,642 (72.5)	1994 (67.4)	
Missing	1265 (3.6)	1147 (3.5)	118 (4.0)	
Risk	1596 (4.5)	1454 (4.5)	142 (4.8)	
Symptomatic	7051 (19.8)	6347 (19.5)	704 (23.8)	

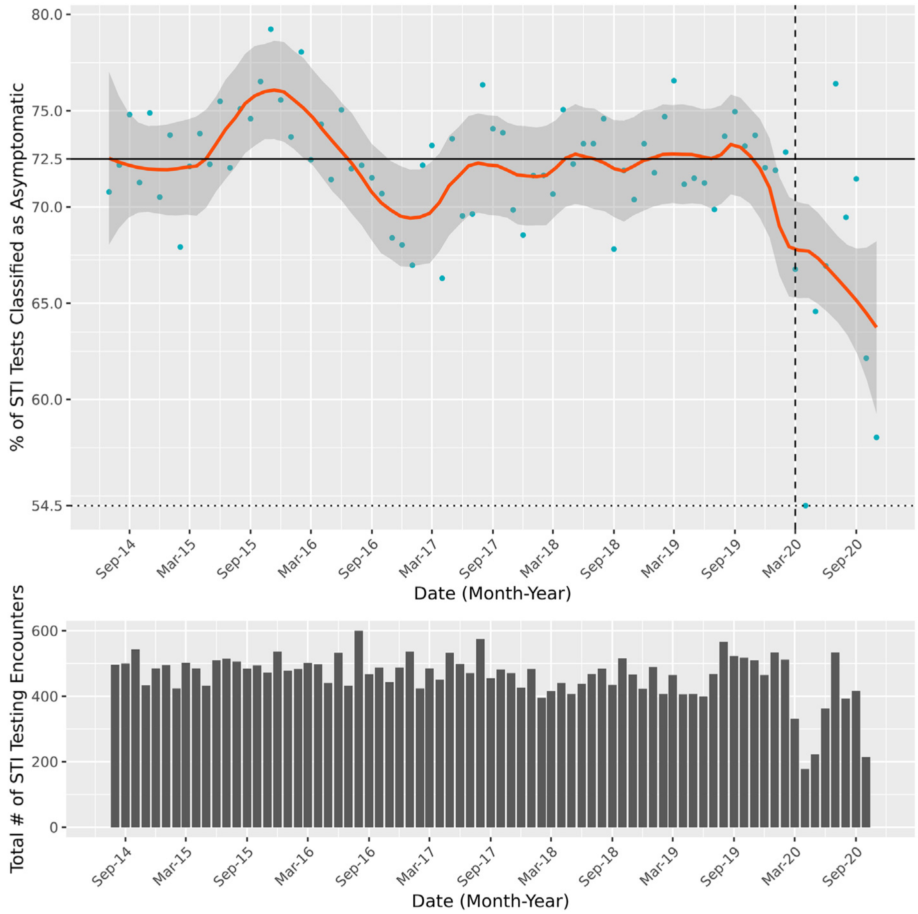

Fig. 1. Top panel: percent of STI tests classified as asymptomatic screening over time. Horizontal solid line denotes prepandemic average, horizontal dotted line denotes nadir of screening rate, and vertical dashed line denotes the start of the pandemic. Bottom panel: number of STI testing encounters by month over time.

pandemic, providers and health systems prioritized testing symptomatic patients and may have opted to defer routine preventive health appointments that would have included asymptomatic screening for STIs. Many clinical guidelines for STI management during the pandemic recommend that providers defer asymptomatic screening due to the risk of exposure to COVID-19 during a clinical visit.[17,18] These pressures to limit routine screening were exacerbated in the fall of 2020 when a national shortage of testing supplies and competition for laboratory resources severely constrained clinical capacity to provide STI testing.[19] Our study shows that these strategic responses to the evolving pandemic had a demonstrable effect on how STI services were delivered to young people. Innovative and flexible strategies for providing sexual health services to young people will be needed as we confront these shocks to the healthcare systems. Protocols to continue STI screening with limited contact between patients and providers, such as the “express visits,” recommended by DiMarco et al. in their guidelines for STI screening during disruptions to in-person care.[20] The use of home-based STI testing with self-collection of specimens is another promising strategy for expanding the reach of testing in contexts where in-person care is not feasible.[21]

This pattern of decreased screening raises concerns about undetected STI cases, as deferred routine screening for STIs can be expected to result in undiagnosed STIs. Routine screening is a foundational strategy for the management of bacterial STIs.[6] This is especially important for managing chlamydia and gonorrhea, as most cases of these infections present asymptomatically.[22] One modeling study estimated that 16% of untreated CT infections would result in pelvic inflammatory disease.[23] Untreated STIs also increase susceptibility to HIV[5] and enhance forward transmission of HIV,[24] leading to increased community transmission of both infections. The diagnosis of STIs is also a key opportunity to link young people to pre-exposure prophylaxis (PrEP) against HIV. Youth with a recent STI are eligible for PrEP,[25] and recent estimates suggest that only 11% of eligible adolescents and young adults were prescribed PrEP;[26] missed diagnoses of STIs also represent missed opportunities for PrEP counseling and linkage. In addition, the cost of untreated STIs is substantial. Kumar et al. found that 64% of the cost of lifetime medical costs of chlamydia infections could be attributed to untreated asymptomatic infections.[14] Considering that the total medical costs for chlamydia and gonorrhea combined are estimated at nearly $1 billion per year nationwide,[27] strategies to optimize the diagnosis and treatment of asymptomatic infections could significantly lessen the economic burden of these infections.

In our study, we estimated that between 14.4% and 23.8% of expected STI cases were missed during the pandemic due to decreases in asymptomatic screening. Patterns observed in our study are consistent with another study of STI testing in the United States,[8] suggesting a substantial number of undiagnosed STI cases nationwide. In 2019, 2.4 million cases of chlamydia and gonorrhea were reported, including more than 1.3 million among adolescents and young adults.[1] Our results have significant local implications for adolescent health, community health, and healthcare costs; additional research is warranted to determine if these patterns of decreased screening may have similar implications nationwide.

A decrease in asymptomatic screening may also be masking increases in STI incidence during the pandemic. Several studies have found lower rates of STI incidence in the early months of the pandemic.[8,10,12] However, these studies also note lower testing volume, which suggests the possibility that decreased screening could account for much of the decline in incidence.[12] One modeling study showed that disruptions to STI screening could have offset the impact of changes in sexual behavior during the pandemic, resulting in an overall increase in incidence of chlamydia among men who have sex with men in the Netherlands.[28] Our findings suggest that stable or even decreased levels of STI incidence within clinic-based study samples during that pandemic could still be indicative of increasing STI population prevalence due to decreases in screening.

This study is subject to several notable limitations. First, we were unable to assess the prevalence of STI screening among patients eligible for testing. Data on patient's sexual activity are not well captured in the EHR, limiting our ability to identify the total population of patients eligible for testing. Instead, we used the proportion of STI tests performed as asymptomatic screening to assess the degree to which routine screening was taking place relative to symptomatic and risk-based testing. Although this measure is a proxy for the STI screening rate, it does not account for potential changes in the number of patients indicated for screening based on age, gender, and sexual activity. Second, our method for estimating missed STI cases assumes that prevalence and forward transmission of bacterial STIs was similar during the 9-month pandemic period explored in this study and the corresponding 9-month period in the previous year. It is possible that COVID-related public health ordinances (i.e. school closures, limits on public gatherings, social distancing recommendations) may have resulted in reduced risk for STIs among adolescents, which would result in an overestimation of missed STI cases. However, recent data suggest that by the end of 2020, STI prevalence nationwide had rebounded to equal or greater levels than the previous year.[29] Third, despite using a system for classifying encounter testing type that drew on the expertise of adolescent health providers and multiple fields of EHR data, there remains potential for misclassification due to inaccuracies and missing data in the EHR. Finally, this study is limited to a single pediatric health system in a large US city, and the results may not be generalizable to other settings.

Conclusion

The COVID-19 pandemic has introduced new challenges for young people in getting connected to STI-related services. In addition, adolescent health providers were forced to make hard decisions about how to allocate and prioritize in-person care and testing supplies in the face of widespread community transmission of COVID-19 and disruptions to the medical supply chain. In this context, routine preventive sexual health screenings for adolescents may have been delayed or missed. As healthcare systems become better equipped to serve patients in the setting of the ongoing pandemic, we may observe an increase in the incidence of STIs and their sequelae related to the undiagnosed cases during the pandemic. Health systems that serve adolescents should use this opportunity to enhance routine STI screening to diagnose and treat these infections. A systematic review and meta-analysis of strategies to improve STI screening rates found that universal collection of urine specimens, patient reminders for screening, and additional staffing resources dedicated to STI screening programs all proved to be effective strategies.[30] A multicomponent quality improvement intervention implemented in pediatric primary care clinics, which including universal urine specimen collection and EHR-based prompts to remind clinicians to order STI screening, was associated with a significant increase in chlamydia screening rates of adolescent and young adult women in Philadelphia.[31] As we adapt and strengthen our public health systems to respond to COVID and prepare for future public health emergencies, efforts are needed to minimize delays and mitigate disruptions to preventive sexual health care for adolescents.

Author statements

Ethical approval

This research was reviewed and deemed exempt by the institutional review boards at [blinded].

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Competing interests

The authors have no conflicts of interest or financial disclosures relevant to this article to report.

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