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Developing sentinel surveillance for chlamydia and gonorrhea using test results from routine screening during pregnancy

Gweneth B. Lazenby, MD MSCR[1], **Jeffrey E. Korte, PhD**[2], **Ekaterina Pekar, MA**[3], **Thomas A. Peterman, MD MSc**[4], **Anna B. Cope, PhD**[4]

[1.]Departments of Obstetrics and Gynecology and Medicine Division of Infectious Diseases

[2.]Department of Public Health Sciences

[3.]Biomedical Informatics Center, Medical University of South Carolina, Charleston, SC

[4.]Division of Sexually Transmitted Disease Prevention, Centers for Disease Control and Prevention, Atlanta, GA

Abstract

Background.—Interpretation of case-based surveillance of chlamydia and gonorrhea is limited by the lack of negative tests for comparison. We sought to develop a sustainable electronic health record (EHR)-based approach to disease surveillance in a sentinel population of pregnant persons.

Methods.—We conducted a one-year assessment of sexually transmitted infections (STIs) in persons receiving at least one pregnancy-related visit within our university medical center. Data were obtained using EHR analytic structured query language code (SQL). Patients were categorized by whether they had an STI test during pregnancy and if screened, by the STI test results (positive or negative). We assessed screening and positivity by demographic using bivariate analyses. Predictors of a positive STI test were determined using logistic regression.

Results.—We identified 4,553 persons who received pregnancy care from January 1 to December 31, 2021. Seventy-six percent (n, 3483) of persons were screened for an STI during pregnancy. Those who identified as white or had private insurance were less likely to have a chlamydia test. Among persons screened, *Trichomonas* was the most commonly detected STI (5%, 141/2,698) followed by chlamydia (4%, 135/3,456), and gonorrhea (0.7% 24/3,468). Predictors of a positive STI test during pregnancy were Black race [adjusted odds ratio (aOR) 6.0 (95% Confidence Interval 4.2–8.7)], age ≤ 25 [aOR 2.5 (1.9–3.3)], and public insurance [aOR 1.6 (1.2–2.1)].

Conclusions.—We demonstrated that EHRs can be utilized to assess gonorrhea and chlamydia positivity. These methods could potentially be applied in other jurisdictions to improve the understanding of national STI surveillance.

Short Summary

Corresponding author: Gweneth B. Lazenby, 96 Jonathan Lucas Street, MSC 619, Dept. of Ob/Gyn, Charleston, SC 29425, 843-792-6212, 843-792-0533 (fax), lazenbgb@musc.edu.

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Electronic health records of a sentinel population of pregnant persons were queried to perform STI surveillance. This approach may improve the accuracy of national case estimates of STIs.

Keywords

chlamydia; gonorrhea; pregnancy; sentinel population; surveillance

Introduction

Chlamydia and gonorrhea are the most commonly reported bacterial sexually transmitted infections (STIs) in the United States.(1) For the decade ending in 2019, case reports of both chlamydia and gonorrhea consistently increased in national surveillance data. (2) However, during the COVID-19 pandemic, yearly case reports for chlamydia decreased, while gonorrhea case reports increased.(3) An analysis of cases reported by week demonstrated the number of reported chlamydia decreased by 24% and gonorrhea cases decreased by 28% during the pandemic shutdown in March and April of 2020. The cumulative number of weekly chlamydia cases in 2020 remained 14% lower than 2019 numbers, but the cumulative number of weekly reported gonorrhea cases in 2020 increased 50% above 2019 numbers by mid-May 2020.(4) Case-report surveillance data are limited by the lack of complete denominators which would include negative tests as well as positive tests. Differences between reported case rates and true rates of infection in a population may also be caused by changes in who is tested, i.e. fewer high risk women are being tested, or changes in test sensitivity and specificity, i.e. using culture instead of molecular tests. (5) Temporal changes in populations and diagnostic methods may limit the reliability of surveillance based on reported cases.

Despite increasing trends in the number of nationally reported persons testing positive for chlamydia and gonorrhea, evidence among sentinel populations suggests prevalence of these infections may not be following the same trajectory. An analysis of the National Health and Nutritional Examination Survey (NHANES) between 1999 and 2008 demonstrated a decline and/or stabilization of chlamydia cases in a stable representative sample.(6) A more recent publication of the NHANES data reports that the percentage of women ages 14 to 39 years with positive chlamydia tests was relatively stable: 2007–2008: 1.6% (95% CI, 1.1%–2.2%); 2009–2010: 1.7% (95% CI, 1.2%–2.1%); and 2011–2012: 1.9% (95% CI, 1.5%–2.2%). The authors noted that the prevalence of chlamydia infection was impacted by age (< 25 years) and race/ethnicity. Non-Latina Black women < 25 years of age were seven times more likely to be diagnosed with chlamydia than young, non-Latina white women.(7) Another analysis of approximately 390,000 females between the ages of 16 and 24 who were enrolled in the National Job Training Program demonstrated a decline in the percentage of persons testing positive for chlamydia from 1990 to 2002 and a stabilization of chlamydia cases from 2002 to 2012.(8) It is difficult to determine why reported number of persons testing positive may be decreasing in some groups and not others.(9) Ronn et al. hypothesized that increased screening and partner notification practices in 2000–2015 may account for the observed downward trend in chlamydia prevalence in NHANES.(10) A 2021 comparison of reported cases and prevalence in the National Job Training Program suggested that changes in the number of persons testing positive could be due to changes in screening practices rather than changes in the prevalence of infection.(5)

Reviewing trends in sentinel populations can assist in the interpretation of national case-report data. Good sentinel populations for disease surveillance are those where infection is likely to be found, testing is not based on symptoms, testing practices remain consistent over time, and a large and consistent fraction of the population is tested.(11) Pregnant persons are an excellent population for sentinel surveillance of STIs given routine screening for chlamydia is recommended regardless of the presence of symptoms or risk factors.(1) The Centers for Disease Control and Prevention (CDC) recommends routine screening for chlamydia and gonorrhea in pregnant persons < 25 years of age and older persons who are at increased risk of either infection.(12–14) Using data extracted from the Perinatal Information System (PINS) database (15) of all mother-baby pairs delivering at the Medical University of South Carolina (MUSC), we observed a decrease in chlamydia and gonorrhea diagnoses over an eleven-year period in a stable delivery population of pregnant persons.(16) The PINS database is not linked to the electronic health record (EHR), so we could not confirm positive chlamydia and gonorrhea laboratory test results or the exact number of persons tested in our previous analysis. Furthermore, we could only assess STI outcomes for pregnant persons who delivered a baby.

Rather than rely on a retrospective clinical database that may be impacted by input errors, we sought to use our healthcare systems EHR EPIC© (Verona, WI, USA) Clarity database to develop a prospective surveillance system for evaluation of STI diagnoses among pregnant persons. Using EHR system data analytics, we aimed to accurately determine the number of persons tested for STIs and the percentage of positive chlamydia, gonorrhea, and *Trichomonas* tests during pregnancy. From our previous retrospective evaluation of trends in chlamydia and gonorrhea diagnoses among pregnant persons, we determined age, race/ethnicity, and insurer were associated with infection in our hospital.(16) In this pilot study, we sought to build an analytic code to extract data from the EHR to determine the prevalence of STIs among persons seeking pregnancy care during 2021 and to evaluate characteristics that may influence testing positive for an STI during pregnancy. Our goal was to develop a sustainable EHR-based approach to ongoing disease surveillance that could be adopted outside of our healthcare system.

Materials and Methods

This one-year prospective surveillance pilot study was approved by the Medical University of South Carolina (MUSC) Institutional Review Board (Pro00106414). Using Structured Query Language (SQL) script, we collected data from the EPIC© Clarity, a relational database within the EHR that can be used for quality improvement and research purposes.(17–20) We identified persons in the MUSC healthcare system's EHR with a pregnancy episode initiated during our study period of January 1, 2021 to December 31, 2021, regardless of pregnancy outcome (i.e. fetal loss or delivery). We analyzed visit and test result data in EPIC© as of Dec 31, 2021.

The EPIC© Stork Obstetrics Information System is an obstetric software application designed to manage pregnancies through automated functions and workflows during prenatal, perinatal, and postnatal care. The Stork application allows providers to organize and view the complete course of pregnancy care as a "pregnancy episode." A pregnancy episode is created when an individual presents to the health care system for any care related to a pregnancy, and the application integrates all documentation, laboratory tests, ultrasounds, and EHR tools specific to pregnancy.(21) In our healthcare system, when an individual initially presents for pregnancy care (outpatient or inpatient) for the first time, a single pregnancy episode is created in the EHR. All pregnancy-related care for this unique pregnancy will be bundled under this single episode until the pregnancy ends with delivery or fetal loss.

The start date of each pregnancy episode was the foundation for the date range to identify variables for our analysis. The start date of each episode was the foundation of population inclusion rule. Any person with an episode start date between 01-01-2021 and 12-31-2021 was included. Both the last menstrual period (LMP) and estimated date of delivery (EDD) are discrete fields within the EHR. If LMP was not documented, we estimated the beginning of pregnancy as being approximately 40 weeks prior to delivery date. If a delivery date was not documented, we calculated the beginning of pregnancy to be approximately 40 weeks prior to EDD. If the LMP and EDD were not documented, then we used the date the pregnancy episode was created in the EHR as the probable beginning of pregnancy.

A unique identification number was assigned to each person with a unique pregnancy episode. All pregnancy episodes captured within the study period were eligible for inclusion. If individuals sought care for more than one pregnancy (became pregnant more than once) during the study period, each unique pregnancy was assigned an identification number and data were abstracted from the unique pregnancy episodes. For a unique pregnancy, duplicate episodes can be created in the EHR. If more than one pregnancy episode was created in the EHR for a unique pregnancy, the episode created last was used for the purpose of this study. The following variables were abstracted from each patient's medical record: LMP, EDD, age, primary insurer billed for pregnancy-related care (i.e. Medicaid, Medicare, commercial insurer, etc.), self-reported ethnicity and race, results of a single first chlamydia, gonorrhea, and *Trichomonas* nucleic acid tests submitted during a pregnancy episode, date of the first chlamydia, gonorrhea, and *Trichomonas* test during a pregnancy episode, number of outpatient antenatal visits, delivery date (if applicable), zip code, county of residence, and clinical site (university hospital or regional medical centers). Because some pregnant persons are tested for STIs more than once during pregnancy, we elected to use a single, first test result collected during pregnancy to avoid the effect of multiple counts on our denominator. (Appendix)

Our primary outcome of interest was the number of individuals testing positive for chlamydia, gonorrhea, and/or *Trichomonas*. From our retrospective analysis, we determined age, race/ethnicity, and insurer were predictor variables for testing positive for chlamydia or gonorrhea during pregnancy and we sought to confirm these variables were predictive of STI positivity in a prospective analysis.(16) We have previously reported that *Trichomonas* is a prevalent STI among non-Hispanic, Black pregnant and non-pregnant women receiving care in our university hospital clinic.(22, 23) We sought to evaluate predictors of *Trichomonas* positivity among pregnant persons as well. Our hospital system covers several regions within our state. We collected data on the site of care, county of residence, and zip code to determine if individuals delivering at our university hospital lived near and received pregnancy care at our university hospital or within the regional medical centers. Not all individuals receiving pregnancy care delivered within the hospital system. If an individual delivered > 20 weeks gestation during the study period, a delivery date was noted and delivery during the study period was included as an outcome variable.

The first STI test collection dates were considered eligible for inclusion if they occurred within the 40 weeks prior to the EDD. The recorded age for subjects was estimated from their age in years at the beginning of pregnancy. The MUSC healthcare system provides care throughout South Carolina. In order to focus on a stable obstetric patient population, we limited the analysis to persons receiving care from the university hospital.

Analysis

We calculated the overall number and proportion of pregnant persons who were screened for chlamydia, gonorrhea, and/or *Trichomonas* and among those screened, the number and proportion who tested positive. We also assessed the monthly proportion of positive tests for each STI in the calendar month the test was collected to determine if positive tests were clustered during a specific month(s) of the study period. The number of tests missing for persons seeking pregnancy care were noted.

We used bivariate χ^2 analyses to assess differences in age, race, ethnicity, and insurer between: 1) pregnant persons who were and were not screened for STIs during their pregnancy episode and 2) screened pregnant persons who tested positive for each STI. Persons were categorized by age (≤ 25 and > 25 years), race (Black, white, and other race), ethnicity (Latina or non-Latina), and insurer (commercial, public, or uninsured). Public insurers were Medicaid or Medicare. The racial groups defined as “other” included Asian, American Indian, Native Alaskan, Native Hawaiian, and Pacific Islander. Univariate and multivariate logistic regression models were used to determine predictors of positive STI tests. In univariate analysis, predictor variables with p-values < 0.05 were considered significantly associated with the outcome. Potential predictor variables with $p < 0.2$ in univariate analyses were included in the multivariate model to estimate adjusted odds ratios (aOR). Predictor variables were considered significantly associated with the outcome in the adjusted analysis if $p < 0.05$ and 95% confidence interval (CI) did not cross 1.0. Data were analyzed using SAS 9.4® software (Cary, NC).

Results

We successfully developed a SQL query that can be run against EPIC© EHR at any moment and any date range. (Appendix) We encountered several challenges in data extraction and interpretation. First, documentation of LMP and EDD within a pregnancy episode was inconsistent. For example, if a person had pregnancies in short succession, the LMP may not be documented or was considered unreliable. When it was difficult to reliably determine the beginning of pregnancy, we could not verify that STI test dates and results were collected within a pregnancy. If persons were transferred and/or admitted to the university labor and delivery unit for antepartum or intrapartum care, a pregnancy episode was created. These persons may have received antenatal testing outside of our hospital system and STI test dates and results were not available. Lastly, some STI test results were entered as free text in the EHR rather than interfacing with the laboratory. We suspect that these were results of point-of-care STI screening tests performed at individual clinical sites within the regional medical centers. Manually entered lab results appeared differently in the EHR compared to laboratory results. For example, free text chlamydia test results were reported as: "pos; trich-neg" and "pos; trich-pos." Similarly, there were free text entries for gonorrhea test results such as "neg trich: pos" and "neg trich: neg." These batched entries suggest that screening was done for chlamydia and *Trichomonas* and gonorrhea and *Trichomonas*, but the result entries were batched rather than entered in the EHR individually. Free text entries were captured using our SQL code to find STI test results. The statistical software code in SAS® was created to convert free text results into dichotomous outcomes (positive or negative) for individual STIs. These data were then available for analysis. Ultimately, all free text results were performed at regional medical centers and were not included in the analysis described below.

During the study period, within our healthcare system 6,483 persons were assigned a unique pregnancy episode and received at least one antenatal care visit and 886 persons were assigned a pregnancy episode but did not have outpatient antenatal visits associated with the episode. Most persons (4,553, 71%) presented to the university hospital and 1,889 were seen at regional medical centers, which are located throughout South Carolina. The site of care was not specified for 41 persons. Most (3,619, 80%) of the persons seeking pregnancy care from the university hospital reside in three surrounding counties. Our analysis included 4,553 persons receiving at least one outpatient antenatal care visit from a university hospital clinic. (Figure 1)

Test results for the sexually transmitted infections chlamydia, gonorrhea, and *Trichomonas* were not recorded in the EPIC© EHR for all persons assigned a unique pregnancy episode within the university hospital. Seventy-six percent of pregnant persons had at least one STI test (3,483/4,553). Most persons had a test result for chlamydia [3,456 (78%)] and gonorrhea [3,468 (76%)] and fewer persons had a test result for *Trichomonas* [2,698 (59%)]. Of the persons who were tested, most first STI tests were collected during the first trimester of pregnancy; chlamydia [2,573 (76%)], gonorrhea [2,585 (76%)], and *Trichomonas* [1,919 (73%)].

We categorized persons by whether they were screened for any STI in pregnancy. Persons who were screened for an STI during pregnancy were more likely to be ≤ 25 years old (79.3%; $p = 0.006$) and self-report Black race (80.7%; $p < 0.0001$). Persons without insurance (54.7%) and persons who did not deliver at MUSC during the study period (70.5%) were less likely to be screened for an STI ($p<0.0001$ for both). Latina ethnicity did not impact screening during pregnancy. (Table 1)

Among pregnant persons who had at least one STI test (3,483), 7.7% were positive (n=267). Two persons had a positive test for all three infections (0.04%) and 31 persons had positive tests for at least two STIs (0.7%). *Trichomonas* tests were more frequently positive than chlamydia or gonorrhea tests (5% compared to 4% and 0.7%, respectively). (Table 2) During the study period, the percentage of STI test results that were positive for individual infections were steady across each calendar month (*Trichomonas* range 3.2–7.1%; chlamydia range 2.4–5.4%; gonorrhea range 0–2.4%). (Figure 2)

A positive test for chlamydia, gonorrhea, and/or *Trichomonas* was significantly associated with young age (≤ 25 years), public insurer, and Black and other race in the univariate analyses. In an adjusted analysis, those that had a positive test for chlamydia, gonorrhea, and/or *Trichomonas* were more likely to be ≤ 25 years of age [aOR 2.5 (95% CI 1.9–3.3)], self-report as Black race [aOR 6.0 (4.2–8.7)], and receive public insurance [aOR 1.6 (1.2–2.1)] when compared to pregnant persons testing negative. Latina ethnicity and delivery during the study period were not significantly associated with a positive test for any STI. (Table 3)

In univariate analyses, significant predictors of a positive chlamydia test were age, public insurance, Black and other race, and a positive gonorrhea or *Trichomonas* test. Delivery within the healthcare system during the study period was not predictive of chlamydia infection. In the adjusted analysis, young age [aOR 3.8 (2.6–5.7)], Black race [aOR 3.3 (2.0–5.6)], other race [aOR 2.2 (1.1–4.4)], and *Trichomonas* positivity [aOR 1.8 (1.03–3.2)] were associated with a positive chlamydia test.

Predictor variables significantly associated with gonorrhea positivity in the univariate analyses were young age, public insurer, Black race, and chlamydia and *Trichomonas* positivity. Due to zero observations for Latina persons, ethnicity was not included in the multivariable model for gonorrhea. In multivariate analysis, persons who had a positive chlamydia or *Trichomonas* test were more likely to have a positive gonorrhea test [aOR 3.0 (1.1–8.3)), and aOR 5.6 (2.3–13.7)), respectively]. Persons with public insurance were also more likely to have a positive gonorrhea test [aOR 3.3 (1.2–9.4)].

In univariate analyses, predictor variables significantly associated with a positive *Trichomonas* test were young age, public insurer, Black race, and chlamydia and gonorrhea positivity. In the adjusted analysis, predictors of a positive *Trichomonas* test were self-reported Black race [aOR 6.6 (3.9–11.3)], a positive chlamydia test [aOR 1.8 (1.03–3.2)], and a positive gonorrhea test [aOR 5.5 (2.2–13.6)].

Discussion

Electronic health records can be used to monitor disease trends in sentinel populations. We demonstrated common sexually transmitted infection tests collected during pregnancy can be successfully extracted from the EPIC© EHR. The observed percentage of positive test results for chlamydia and gonorrhea was similar to our prior retrospective cohort study.(16) This is our first prospective evaluation of *Trichomonas* infections among pregnant persons, and we observed these infections were twice as common as chlamydia infection. As such, the observed frequency of positive tests for these common STIs during pregnancy are consistent with our expectations based on our prior studies(16, 22–24) providing validity for the use of EHRs for monitoring of STIs within this sentinel population.

We believe pregnant women are an excellent sentinel population for the surveillance of chlamydia due to the prevalence of infection (4% among our subjects) and the frequency of screening regardless of symptoms (78%).(10) We recognize that national recommendations for asymptomatic chlamydia screening during pregnancy is limited to persons "< 25 year and those at increased risk for chlamydia (i.e., those who have a new sex partner, more than one sex partner, a sex partner with concurrent partners, or a sex partner who has an STI)."(1) More than 75% of persons receiving pregnancy care at our urban, academic hospital system are ≤ 25 years of age, suggesting our population and other centers with similar populations are suitable for performing chlamydia surveillance. We believe that the interpretation of U.S. national public health case-based surveillance and estimates of disease prevalence could be complemented by using a nationally integrated EHR to monitor sexually transmitted infection positivity (number of positive tests/number of tests collected). EHRs have largely replaced paper medical records in the American healthcare system(19) and can be utilized to monitor disease within a population as we have demonstrated in this analysis. EPIC© is a widely used EHR in the U.S., and the Clarity database has been employed to collect data and improve patient care across multiple medical institutions.(25) Due to universality of the code, the SQL procedure we used for this analysis could be applied to other EHR databases to link data from multiple institutions.(20) (Appendix) We expect our query code can be utilized by other organizations using EPIC© EHR Stork module with few modifications. The variables that may be system specific to EHR configuration are STI test identification and antenatal visit definition.

Assuring accurate data collection from EHRs is important. In our eleven-year retrospective study of chlamydia and gonorrhea infections among pregnant persons, we determined that approximately 2,250 deliveries occurred annually within our university hospital clinics.(16) In this analysis of EHR data, we identified 4,553 persons who received at least one pregnancy care visit. However, only 2,169/4,553 (48%) delivered an infant at the university hospital by the end of the study period. The number of deliveries we observed aligns with counts from our previous analysis.(16) We anticipate that persons who did not deliver an infant > 20 weeks gestation could have experienced early pregnancy loss (i.e. miscarriage, abortion, or ectopic pregnancy) or chose to deliver at another facility. Among persons delivering at our center in 2018, 3.4% of persons screened had a positive chlamydia test and 1.1% had a positive gonorrhea test during pregnancy.(16) In our analysis of EHR data from 2021, 4% of tested pregnant persons had a positive chlamydia result and 0.7% had positive gonorrhea result. From previous studies of persons seeking care within our university hospital clinic, we anticipated that 3–10% of persons would have a positive *Trichomonas* test.(22, 23) *Trichomonas* positivity in this analysis was also within the range of what we expected (5%). The consistency of results between our previous analysis using data manually extracted from the PINS database and our analysis of EHR data provides additional support for the validity of this method.(16, 23)

Our model of EHR surveillance has some key limitations. Creation of a pregnancy episode within the EHR is dependent on the provider documentation and utilization of the episode function within the Stork application within EPIC©. We cannot confirm that all pregnancy-related visits in our healthcare system triggered the creation of a pregnancy episode within the EHR. We also noted that there were very few variables that were consistently present for a pregnancy-related visit. For example, persons may have had pregnancy care appointments that included STI tests outside the healthcare system. Unless manually recorded, test results from outside of the healthcare system would not be captured using data from the EHR. Additionally, STI screening practices at an initial pregnancy care assessment may differ between a university hospital and regional medical centers. Our analysis was limited to persons receiving care within the university hospital clinics. This limited our sample size of persons who had positive STI tests, especially with gonorrhea, which may affect the precision of our statistical models to determine predictors of positivity. Because a substantial percentage of pregnancies end in fetal loss i.e. miscarriage, ectopic, or elective termination, we did not limit our data to only persons delivering an infant within our system but we recognize that some fetal losses may not be captured in the EHR as a pregnancy episode. Regardless of pregnancy outcome (live birth or fetal loss), we felt it was important and more inclusive to evaluate STI test positivity in all persons receiving any pregnancy-related care in order to avoid underestimating the prevalence of common STIs. Lastly, this analysis only considered the results from a person's first gonorrhea, chlamydia, and/or *Trichomonas* test to understand screening, but the extract can be built to pull all STD test results during pregnancy for other analyses of prevalence.

Although we recognize the limitations of using an EHR, we believe that our model may improve surveillance of STIs. Although the number of nationally reported cases of chlamydia and gonorrhea have risen in recent years, we have demonstrated through manual data abstraction that the prevalence of positive tests among pregnant persons at our institution has declined and stabilized over time.(16) Our findings of declining chlamydia infections in the last two decades are similar to those of other stable sample populations.(6, 8) We believe that the ability to automate the extraction of screening and positivity data from EHRs has the potential to improve the accuracy of estimates of STI incidence in our patient population. This approach could be adopted by other healthcare settings to establish a larger network of sentinel surveillance of STIs in pregnant persons. This improvement in disease surveillance could improve the understanding of disease trends and assure effective allocation of national funds to identify and potentially prevent further spread of STIs.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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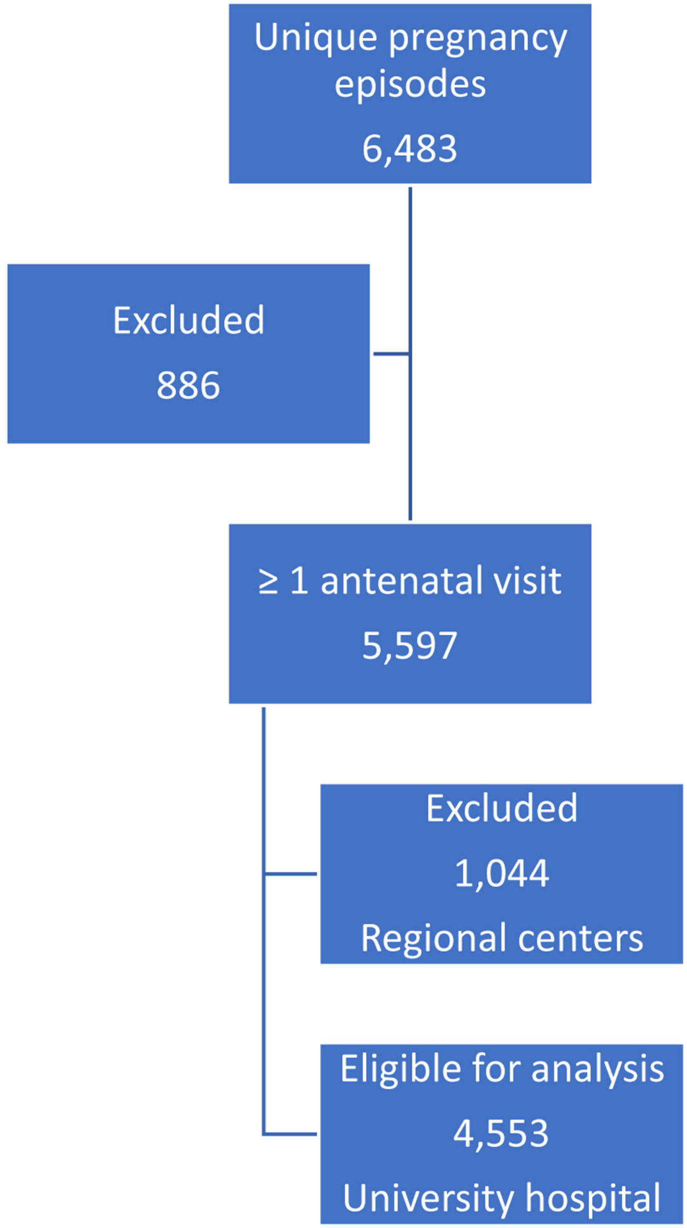

Figure 1.
Study cohort

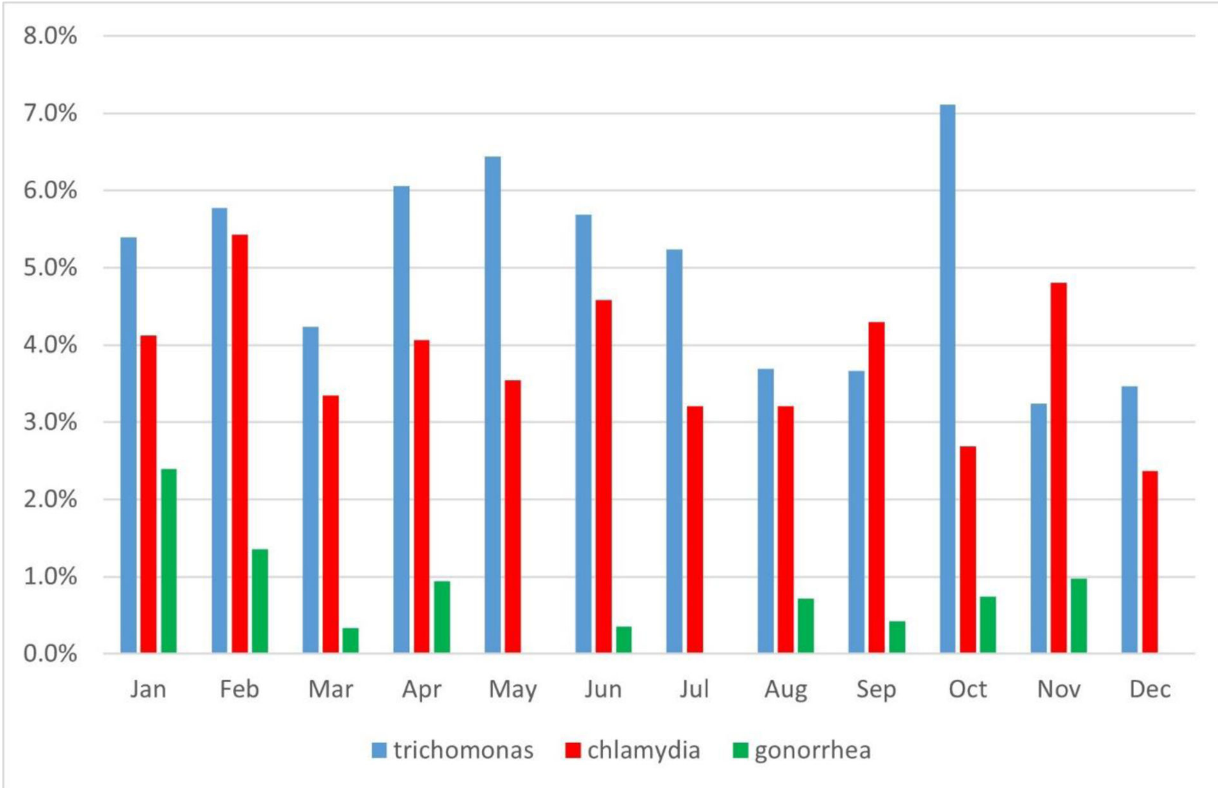

Figure 2.

Percent of pregnant persons screened during pregnancy care for *Trichomonas*, chlamydia, and/or gonorrhea who tested positive by month of test result at a university hospital, 2021*

*Test results that occurred prior to 2021 are not included in this figure.

Table 1.

Characteristics of persons who were screened for Chlamydia, Gonorrhea, or *Trichomonas* during pregnancy in a university hospital, 2021

	N	Screened (%)
Age*		
≤ 25 years	1220	968 (79.3%)
> 25 years	3333	2515 (75.5%)
Race*		
Black	1458	1177 (80.7%)
White	2440	1823 (74.7%)
Other	596	458 (76.8%)
Ethnicity		
Latina	445	357 (80.2%)
Non Latina	3985	3067 (77.0%)
Insurer*		
Public	1553	1224 (78.8%)
Private/Military	2819	2160 (76.6%)
None	181	99 (54.7%)
Delivery*		
Yes	2169	1803 (83.1%)
No	2384	1680 (70.5%)

* p-value < 0.05

Table 2.

Characteristics of persons seeking antenatal care in a university hospital who tested positive for Chlamydia, Gonorrhea, or *Trichomonas*, 2021

	Chlamydia		Gonorrhea		*Trichomonas*	
	Tested N	Positive N (%)	Tested N	Positive N (%)	Tested N	Positive N (%)
Total	3456	135 (3.9%)	3468	24 (0.7%)	2698	141 (5.2%)
Age						
</= 25	963	90 (9.4%)	965	15 (1.6%)	798	67 (8.4%)
> 25	2493	45 (1.8%)	2503	9 (0.4%)	1900	74 (3.9%)
Race						
Black	1169	90 (7.7%)	1172	19 (1.6%)	1014	112 (11.0%)
White	1809	23 (1.3%)	1815	4 (0.2%)	1295	19 (1.5%)
Other	454	21 (4.6%)	456	1 (0.2%)	370	10 (2.7%)
Ethnicity						
Latina	350	18 (5.1%)	355	0 (0.0%)	292	10 (3.4%)
Non-Latina	3048	114 (3.7%)	3054	24 (0.8%)	2363	129 (5.5%)
Insurer						
Public	1219	78 (6.4%)	1221	18 (1.5%)	1022	84 (8.2%)
Private/military	2140	53 (2.5%)	2149	5 (0.2%)	1597	54 (3.4%)
None	97	4 (4.1%)	98	1 (1.0%)	79	3 (3.8%)
Delivery						
Yes	1794	69 (3.8%)	1793	15 (0.8%)	1318	78 (5.9%)
No	1662	66 (4.0%)	1675	9 (0.5%)	1380	63 (4.6%)

Table 3.

Predictors of Chlamydia, Gonorrhea, or *Trichomonas* positivity among pregnant persons tested for an STI in a university hospital, 2021

Positive test for chlamydia, gonorrhea, and/or *Trichomonas*		
	Unadjusted Odds Ratio (95% Confidence Interval)	**Adjusted Odds Ratio (95% Confidence Interval)**[1]
Age		
> 25 years	1.0 (ref)	1.0 (ref)
</= 25 years	3.8 (2.9, 4.8)	2.5 (1.9, 3.3)
Insurance		
Private/military	1.0 (ref)	1.0 (ref)
Public (Medicaid/Medicare)	3.0 (2.3, 3.9)	1.6 (1.2, 2.1)
Uninsured	1.6 (0.70, 3.4)	1.5 (0.66, 3.6)
Race		
White	1.0 (ref)	1.0 (ref)
Black	8.4 (5.9, 11.8)	6.0 (4.2, 8.7)
Other	3.0 (1.8, 4.8)	1.8 (0.86, 3.7)
Ethnicity		
Non-Latina	1.0 (ref)	1.0 (ref)
Latina	0.94 (0.62, 1.4)	1.3 (0.61, 2.6)
Delivered at university hospital		
No	1.0 (ref)	1.0 (ref)
Yes	1.1 (0.86, 1.4)	0.94 (0.72, 1.2)
Chlamydia positive		
	Unadjusted OR (95% CI)	**Adjusted OR (95% CI)**[2]
Age		
> 25 years	1.0 (ref)	1.0 (ref)
</= 25 years	5.6 (3.9, 8.1)	3.8 (2.6, 5.7)
Insurance		
Private/military	1.0 (ref)	1.0 (ref)
Public (Medicaid/Medicare)	2.7 (1.9, 3.8)	1.4 (1.0, 2.2)
Uninsured	1.7 (0.6, 4.8)	1.5 (0.5, 4.6)
Race		
White	1.0 (ref)	1.0 (ref)
Black	6.5 (4.1, 10.3)	3.3 (2.0, 5.6)
Other	3.8 (2.1, 6.9)	2.2 (1.1, 4.4)
Ethnicity		
Non-Latina	1.0 (ref)	1.0 (ref)
Latina	1.4 (0.8, 2.3)	1.7 (0.6, 4.6)
gonorrhea positive		

No	1.0 (ref)	1.0 (ref)
Yes	8.5 (3.3, 21.8)	2.7 (0.9, 7.4)
Trichomonas positive		
No	1.0 (ref)	1.0 (ref)
Yes	3.8 (2.3, 6.3)	1.8 (1.0, 3.2)
Delivered at university hospital		
No	1.0 (ref)	1.0 (ref)
Yes	1.0 (0.7, 1.4)	0.87 (0.6, 1.3)
Gonorrhea positive		
	Unadjusted OR (95% CI)	**Adjusted OR (95% CI)**[3]
Age		
> 25 years	1.0 (ref)	1.0 (ref)
</= 25 years	4.4 (1.9, 10.0)	2.2 (0.9, 5.2)
Insurance		
Private/military	1.0 (ref)	1.0 (ref)
Public (Medicaid/Medicare)	6.4 (2.4, 17.3)	3.3 (1.2, 9.4)
Uninsured	4.4 (0.5, 38.2)	5.6 (0.6, 52.9)
Race		
White	1.0 (ref)	1.0 (ref)
Black	7.5 (2.5, 22.0)	2.0 (0.6, 6.6)
Other	1.0 (0.11, 8.9)	0.4 (0.04, 4.0)
Ethnicity	(not calculated)	(not calculated)
chlamydia positive		
No	1.0 (ref)	1.0 (ref)
Yes	8.5 (3.3, 21.8)	3.0 (1.1, 8.3)
Trichomonas positive		
No	1.0 (ref)	1.0 (ref)
Yes	11.5 (4.9, 26.8)	5.6 (2.3, 13.7)
Delivery at university hospital		
No	1.0 (ref)	1.0 (ref)
Yes	1.6 (0.7, 3.6)	0.7 (0.3, 1.6)
***Trichomonas* positive**		
	Unadjusted OR (95% CI)	**Adjusted OR (95% CI)**[4]
Age		
> 25 years	1.0 (ref)	1.0 (ref)
</= 25 years	2.3 (1.6, 3.2)	1.3 (0.9, 1.9)
Insurance		
Private/military	1.0 (ref)	1.0 (ref)
Public (Medicaid/Medicare)	2.6 (1.8, 3.6)	1.4 (1.0, 2.1)
Uninsured	1.1 (0.3, 3.7)	1.2 (0.3, 4.1)

Race		
White	1.0 (ref)	1.0 (ref)
Black	8.3 (5.1, 13.7)	6.6 (3.9, 11.3)
Other	1.9 (0.86, 4.0)	0.9 (0.28, 3.0)
Ethnicity		
Non-Latina	1.0 (ref)	1.0 (ref)
Latina	0.6 (0.3, 1.2)	1.8 (0.6, 5.4)
gonorrhea positive		
No	1.0 (ref)	1.0 (ref)
Yes	11.5 (4.9, 26.8)	5.5 (2.2, 13.6)
chlamydia positive		
No	1.0 (ref)	1.0 (ref)
Yes	3.8 (2.3, 6.3)	1.8 (1.0, 3.2)
Delivery at university hospital		
No	1.0 (ref)	1.0 (ref)
Yes	1.3 (0.9, 1.8)	1.1 (0.8, 1.6)

[1] Adjusted for age, insurance, race, Ethnicity, and delivery at university hospital.

[2] Adjusted for age, insurance, race, Ethnicity, delivery at university hospital, gonorrhea positivity, and *Trichomonas* positivity.

[3] Adjusted for age, insurance, race, Ethnicity, delivery at university hospital, chlamydia positivity, and *Trichomonas* positivity.

[4] Adjusted for age, insurance, race, Ethnicity, delivery at university hospital, gonorrhea positivity, and chlamydia positivity.