Disparities in Chlamydia Testing Among Young Women With Sexually Transmitted Infection Symptoms

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Background: Diagnostic chlamydia testing is recommended for all young women demonstrating sexually transmitted infection (STI) symptoms. Differential testing among symptomatic women may contribute to disparities in chlamydia rates. Our objective was to determine whether providers test young women with STI symptoms for chlamydia differently by age, race/ethnicity, or insurance status, and whether testing patterns differ by documentation of previous STI.

Methods: Retrospective cohort analysis using electronic medical records and billing data of women 14 to 25 years old with one or more diagnostic or procedure codes indicative of STI symptoms (N = 61,498 women). Random effects logistic regression analysis was performed to assess the odds of chlamydia testing given a woman presented for a nonpregnancy-related visit with STI symptoms. All analyses controlled for history of STI, setting, and year, and adjusted for within-person correlation.

Results: A chlamydia test was performed in 38% of visits with codes indicating STI symptoms. Women aged <18 or >19 were less likely to be tested than women aged 18 to 19, with young women aged 14 to 15 having the lowest odds of being tested (Odd Ratio [OR]: 0.52). Providers were more likely to test minority (OR_{black}: 2.87; OR_{Latina}: 2.10) compared with white women. Women were also more likely to be tested if they had public insurance (OR: 2.41) or were self-pay (OR: 2.35) compared with if they had private insurance. Women aged 14 to 15 and 16 to 17 with prior history of STI had increased odds of chlamydia testing (OR: 1.79 and 1.43, respectively) compared with women aged 18 to 19, changing the overall direction of association compared with women with no history of STI. The odds of testing were dramatically reduced for minority and nonprivately insured young women with history of STI, although significant differences persisted.

Conclusions: Provider chlamydia testing differs by age, race/ethnicity, and insurance status when a woman presents with STI symptoms and no prior history of STI. This bias may contribute to higher reported rates of chlamydia among younger, minority, and poor women.

Chlamydia trachomatis is the most prevalent sexually transmitted infection (STI) in the United States, with more than 1 million incident cases reported in 2007.[1] Of these, more than half were reported in females aged 15 to 25.[2] Untreated chlamydia among young women constitutes a significant public health problem as infection may result in pelvic inflammatory disease, leading to chronic pelvic pain, infertility, and/or ectopic pregnancy.[2] The estimated cost per chlamydia case in women aged 15 to 24 in 2004 was $224, with 82% of this attributable to preventable sequelae.[3]

Diagnostic chlamydia testing is recommended for all young women demonstrating STI symptoms.[4] Because chlamydia infection is generally asymptomatic, the United States Preventive Services Task Force also recommends routine screening for all sexually active young women aged 14 to 25. This recommendation has resulted in increased annual screening, but disparities in screening and infection rates remain.[2] Recent Healthcare Effectiveness Data and Information Set data among women tested for chlamydia (regardless of symptom status) indicate significant differences by race/ethnicity and insurance status.[1,5] Although the chlamydia infection rate for white women was 249 per 100,000, the rates for black and Hispanic women were 1906 and 753, respectively.[1] Furthermore, in contrast to the 37% to 50% of female Medicaid enrollees aged 16 to 25 screened for chlamydia during the years 2000 through 2005, only 22% to 38% of female commercial insurance plan enrollees of the same age were screened.[5] A 2006 study by Geisler et al. also demonstrates that continuous insurance coverage is associated with lower chlamydia rates independent of race/ethnicity.[6] Whether these disparities occur only among asymptomatic women (eligible for screening chlamydia tests) or also among women with STI symptoms (requiring diagnostic chlamydia tests) is unclear.

Differential chlamydia testing may contribute to racial/ethnic and socioeconomic disparities in chlamydia rates. Hoover et al. found that at 78% of outpatient visits made by young women with STI symptoms, the young women were not tested for chlamydia.[7] This study did not, however, investigate

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differences in testing by race/ethnicity among these symptomatic women.[7] Differential diagnostic testing may contribute to chlamydia disparities because of underdiagnosis in certain groups.

To better understand the factors that contribute to age, racial/ethnic, and socioeconomic disparities in chlamydia diagnosis among young women, this study sought to determine whether providers differentially test symptomatic women for chlamydia.

MATERIALS AND METHODS

Study Design and Population

This study is a retrospective longitudinal cohort analysis using clinical data contained in the Regenstrief Medical Record System (RMRS, an electronic data repository for 3 major hospitals and more than 30 clinics in Indianapolis, IN) and affiliated hospital billing systems.[8] RMRS captures registration information, orders, medications, laboratory and radiography reports, and other clinical data.[8] For the purposes of this study, we used a probabilistic matching algorithm to link RMRS data with billing system data using unique identifiers and visit date. The billing data augmented the International Statistical Classification of Diseases and Related Health Problems (ICD-9) diagnosis codes in RMRS and added information such as ICD-9 procedure codes, Current Procedural Terminology codes, National Uniform Billing Committee Condition Codes, Logical Observation Identifiers Names and Codes, and Healthcare Common Procedure Coding System codes. Few RMRS visits (~4%) lacked matching billing data and were included using only ICD-9 diagnosis codes.

Using this linked dataset, we created a cohort of young women aged 14 to 25 between 1995 and 2007. To facilitate comparison with other published research, we included visits of young women with diagnosis or procedure codes for pelvic inflammatory disease; cervicitis, vaginitis, vulvitis, and/or endometriosis; vaginal discharge or other vaginal symptoms; dyspareunia, pelvic pain, and/or abdominal pain; postcoital bleeding and/or irregular vaginal bleeding; urinary symptoms; or sexually transmitted disease symptoms.[7]

We excluded visits that occurred during a pregnancy, as providers may have had a different approach to these women with regard to chlamydia testing and/or diagnosis. To identify a pregnancy period, we used the following data: gestational age, delivery date, delivery-related ICD-9 codes, pregnancy-related ICD-9 or RMRS diagnosis codes, positive pregnancy test, or estimated date of confinement, and the visit dates when measured. For data relating to a delivery, we defined the pregnancy period using the delivery date and gestation length. For those pregnancies with no gestational data, we calculated the pregnancy period as beginning 280 days before the specified delivery date. After these periods were defined and excluded, we sought outstanding pregnancy-related visit codes and established a 14-day window before and after each visit date to exclude (~1% of excluded visits). Next, if there were any positive pregnancy tests outside the aforementioned pregnancy windows, we added an additional 14-day pregnancy window (less than 0.1% of excluded visits).

Using the aforementioned criteria, we identified 218,532 unique clinical visits among 65,761 young women. Of these, 205,354 visits among 61,498 women had no missing data for race/ethnicity and insurance status variables. Visits with missing data were more likely to have a public insurance payer, less likely to have a private insurance payer, and less likely to occur among women with a pregnancy history, as compared with visits with no missing data. There were no differences by race/ethnicity for individuals with missing insurance data.

On average, each young woman had 3.5 clinical visits meeting the inclusion criteria (Standard Deviation: 4.5). Forty percent of the young women had only 1 visit that met the inclusion criteria.

Measures

Chlamydia Test Outcome Measure. All chlamydia tests from outpatient, inpatient, and emergency room settings were included. Approximately 95% of chlamydia tests during the study period were nucleic acid amplification tests.

Race/Ethnicity. Race/ethnicity was based on self-reported race/ethnicity identification from the most recent clinical visit. If race/ethnicity data were not available in the RMRS data, we used race/ethnicity as reported in the billing data. On the basis of the prevalent populations in our cohort, we categorized the race/ethnicity variable as black, Latina, white, or other. The other race category was primarily entered as "other" in the medical record system but also included Asian (~1%) and Native American/Alaskan (~0.1%) race/ethnicity.

Age. Age was categorized in 2-year increments between 14 and 25 years to allow for an unconstrained (i.e., nonlinear) model of associations with chlamydia testing. Age was included as a time-varying variable in regression analyses.

Insurance Status. Insurance status as an indication of socioeconomic status and access to care was coded in the following ways: public, public pending, private, self-pay, or other. Public pending indicates a situation in which an individual is preliminarily assessed as eligible for public insurance, but not yet enrolled because of either a lapse in coverage or new eligibility. Other indicates a diverse group of insurance types, each of which have few visits, and includes payment by workman's compensation, disability coverage, correctional facility care, and Medicare. Although insurance status data were available through both RMRS and relevant billing systems, we chose to use the billing data insurance status for 2 reasons: (1) insurance data were more often missing from the RMRS repository; and (2) the billing data were more likely to reflect insurance that provided actual reimbursement, as opposed to insurance with lapsed or inadequate coverage for the care sought. When insurance data were not available in the billing system, we used RMRS data. When insurance data were missing from both sources, we imputed it from the most recent visit with insurance data (within a 6-month period). Recognizing that insurance status might change over time, we used a time-varying variable.

History of STI. Prior STI (time-varying variable) was used as a stratifying variable in multivariable analyses. This measure was included because information available in the medical record could influence physicians' diagnostic testing decisions. Prior STI was defined as any positive laboratory result, including chlamydia, gonorrhea, trichomonas, syphilis, and HIV, before the visit date in which the woman presented with STI symptoms.

Analysis

Data were analyzed using Stata 10 (Stata Corp, College Station, TX). Descriptive analyses included bivariable tests of

the association between race/ethnicity, age and insurance status, and our primary outcome, chlamydia testing. These descriptive analyses were performed at the subject level, indicating age at first visit and multiple insurance types over time if applicable. We performed a random effects logistic regression (which accounts for correlated within-subject data) to determine the independent associations between individual factors and the odds of chlamydia testing among symptomatic women presenting for a nonpregnancy-related visit. All analyses controlled for setting (inpatient/outpatient/emergent) and visit year.

Our research protocol was approved by the Indiana University School of Medicine Institutional Review Board.

RESULTS

Cohort and Visit Characteristics

Approximately one-half of young women in the study cohort were white, with the remainder of minority or unknown race/ethnicity (Table 1, upper panel). Symptomatic white women were proportionately less likely to receive chlamydia diagnostic tests, black women and Latino women were proportionately more likely to receive chlamydia tests. One-third of women had private insurance coverage, and one-third had public insurance. A greater proportion of visits, however, had public insurance coverage, indicating more frequent visits among young women with this insurance type. Visits by women with private insurance were less likely to be associated with chlamydia tests.

About 15% of the women had a history of chlamydia and 22% had a history of any STI. Approximately one-third of the population was pregnant at some point during the study period. Having a prior chlamydia, STI, or pregnancy diagnosis was associated with increased chlamydia testing. Approximately one-half of the women had diagnoses indicating dyspareunia, pelvic pain, or abdominal pain. One-quarter of these women were tested for chlamydia. Nearly one-fifth of women with STI symptoms were diagnosed with cervicitis, vaginitis, vulvitis, or endometritis, and 70% of these women were tested for chlamydia. Visits specifying pelvic inflammatory disease (4%) and sexually transmitted disease symptoms (5%) were relatively uncommon, but about two-thirds of women with these diagnoses (66% and 61%, respectively) were tested for chlamydia (Table 1, lower panel).

Overall, among visits by symptomatic women, 62% had no associated chlamydia test.

Multivariate Analyses

Women younger than 18 or older than 19 years were less likely to be tested than women aged 18 to 19, with young women aged 14 to 15 having the lowest odds of being tested in adjusted analyses (Odd Ratio [OR]: 0.52) (Table 2). Providers were more likely to test minority women for chlamydia compared with white women (OR_{black}, 2.87; OR_{Latina}, 2.10). Women were also more likely to be tested if they had public, public-pending, or self-pay insurance compared with if they had private insurance (OR_{public}2.41; $OR_{public\text{-}pending}$3.38; $OR_{self\text{-}pay}$2.35).

Stratification by prior history of STI reduced but did not eliminate differences in chlamydia testing by race/ethnicity or insurance status (Table 2). Among symptomatic women with prior STI history, black were still more likely than white women to receive chlamydia testing (OR: 1.38), and those with public, public-pending, or self-pay insurance were more likely

TABLE 1. Individual and Visit Characteristics of the Study Cohort

Individual Characteristics	Total Individuals (N = 61,498) N	Ever Tested (N = 28,937) N	%
Race/ethnicity			
White	31,265	10,676	34%
Black	23,010	14,742	64%
Latino	4504	2469	55%
Other	2719	1050	39%
Insurance status			
Private	20,647	4866	24%
Public	20,587	10,972	53%
Public-pending	705	403	57%
Self-pay	7233	3052	42%
Other	1590	944	59%
More than 1 type over time	10,736	8700	81%
History of CT	9259	8143	88%
History of STI	13,358	11,428	86%
History of pregnancy	23,068	14,891	65%
Visit Characteristics	**Total Visits (N = 205,354) N**	**Tested at Visit (N = 78,463) N**	**%**
Age (yr)			
14–15	18,205	5256	29%
16–17	29,592	11,878	40%
18–19	38,804	16,251	42%
20–21	41,208	16,578	40%
22–23	39,724	15,122	38%
24–25	37,821	13,378	35%
Insurance status			
Private	59,113	13,630	23%
Public	110,979	48,934	44%
Public-pending	5219	2767	53%
Self-pay	24,469	10,005	41%
Other	5574	3127	56%
Setting			
Outpatient	158,398	63,638	40%
Inpatient	6296	2048	33%
Emergency department	40,660	12,777	31%
Visit year			
1995–1998	40,403	17,268	43%
1999–2001	49,898	18,050	36%
2002–2004	56,142	20,734	37%
2005–2007	58,911	22,411	38%
STI symptom			
Pelvic inflammatory disease	7426	4897	66%
Cervicitis, vaginitis, vulvitis, endometritis	39,174	27,333	70%
Vaginal discharge other vaginal symptoms	19,377	8631	45%
Dyspareunia, pelvic pain, abdominal pain	105,680	28,378	27%
Post-coital bleeding, irregular vaginal bleeding	27,810	7091	25%
Urinary symptoms	8614	2200	26%
STD symptoms	10,842	6601	61%

History of CT indicates history of chlamydia; STI, sexually transmitted infection; STD, sexually transmitted disease.

TABLE 2. Adjusted Odds of CT Testing Among Young Women by Age, Race/Ethnicity, and Insurance Type for All Visits With STI Symptoms and Visits Prior to First STI and Following First STI*

		Visits Stratified by Prior STI	
	All Visits N = 205,354 Visits; 61,498 Individuals	No Prior STI N = 139,811 Visits; 54,303 Individuals	Prior STI N = 65,543 Visits; 13,349 Individuals
Age			
14–15	0.52 (0.49, 0.55)	0.45 (0.42, 0.48)	1.79 (1.59, 2.02)
16–17	0.95 (0.91, 0.99)	0.85 (0.80, 0.90)	1.43 (1.33, 1.53)
18–19	Reference group	Reference group	
20–21	0.94 (0.91, 0.98)	0.91 (0.86, 0.96)	0.90 (0.85, 0.95)
22–23	0.88 (0.84, 0.92)	0.86 (0.81, 0.91)	0.78 (0.73, 0.83)
24–25	0.81 (0.77, 0.84)	0.77 (0.72, 0.81)	0.71 (0.67, 0.76)
Race/ethnicity			
White	Reference group	Reference group	
Black	2.87 (2.76, 2.99)	2.66 (2.52, 2.79)	1.38 (1.29, 1.48)
Latino	2.10 (1.95, 2.26)	2.36 (2.16, 2.57)	1.11 (0.94, 1.32)
Other	1.49 (1.36, 1.64)	1.44 (1.29, 1.62)	1.21 (1.02, 1.44)
Insurance			
Private	Reference group	Reference group	
Public	2.41 (2.33, 2.50)	2.66 (2.53, 2.78)	1.34 (1.26, 1.43)
Public-pending	3.38 (3.12, 3.66)	4.07 (3.64, 4.54)	1.66 (1.47, 1.88)
Self-pay	2.35 (2.24, 2.47)	2.51 (2.36, 2.67)	1.44 (1.33, 1.57)
Other	4.72 (4.35, 5.12)	5.33 (4.78, 5.95)	2.79 (2.45, 3.18)

*Models adjusted for visit year and setting (inpatient/outpatient/ER).
STI indicates sexually transmitted infection.

than those with private insurance to receive chlamydia testing (OR_{public}, 1.34; $OR_{public\text{-}pending}$, 1.66; $OR_{self\text{-}pay}$, 1.44). Among women with no prior history of STI, Latinas were more likely than white women to receive chlamydia testing (OR: 2.36), and women with public, public-pending, or self-pay insurance status (OR_{public}, 2.66; $OR_{public\text{-}pending}$, 4.07; $OR_{self\text{-}pay}$, 2.51) were much more likely to receive chlamydia tests than women with private insurance. Prior STI history changed the direction of association between age category and odds of chlamydia testing among women aged 14 to 15 (OR: 1.79) and 16 to 17 (OR: 1.43) compared with women aged 18 to 19, whereas prior STI history made little difference in odds of chlamydia testing among women aged 20 to 25.

DISCUSSION

Among young women evaluated for symptoms consistent with an STI, providers differentially tested women for chlamydia based on age, race/ethnicity, and insurance status. Specifically, minority women and women with self-pay or public insurance at the time of the visit were more likely to receive chlamydia tests, whereas adolescents aged 14 to 15 were less likely to be tested. Differences by race/ethnicity and insurance status were less prominent but still evident among women presenting with STI symptoms with a prior history of STI. Young women aged 14 to 17 with a prior history of STI, however, were more likely to be tested for chlamydia, compared with young women aged 18 to 19.

Our study adds to the existing literature of STI disparities by specifically studying testing patterns among symptomatic young women by age, race/ethnicity, and insurance status. Our findings complement those of the Hoover et al. study, which found similar disparities by race/ethnicity and insurance status in screening among asymptomatic women.[7] Although the Hoover et al. study also presented rates of chlamydia testing among symptomatic women, these rates were not stratified by race/ethnicity or insurance status as in their analysis of asymptomatic women. There are several additional studies demonstrating testing differences by demographic factors among asymptomatic women.[6,9,10] Although many women with chlamydia infections are asymptomatic, diagnostic testing is recommended for women with abnormal vaginal discharge of unknown etiology, bleeding with vaginal intercourse, or dysuria without evidence of urinary tract infection.[4] In sum, our data suggest that providers differentially obtain chlamydia tests for women with similar risk profiles. These testing decisions could be based on providers' conscious, a priori risk evaluations, based, for example, on knowledge of locally available chlamydia prevalence rates that are matched to a given patient's demographic characteristics. The nature of our data does not allow us to assess this type of provider behavior; therefore, such hypotheses cannot be proven or disproven. This type of rational decision-making explanation seems unlikely, however, given recent national studies showing relatively low levels of physicians' knowledge and comfort related to STI screening and diagnosis.[11] Even if this were an explanation for our findings, such use by clinicians of public health morbidity data would be inappropriate because local prevalence statistics do not typically address disease distributions among symptomatic women, and because public health morbidity data could be subject to the same biases in differential testing described in this study.

Disparate chlamydia testing could also reflect the influence of providers' racial/ethnic, social class, or age-related stereotypes. Van Ryn presents a conceptual model of provider contribution to race/ethnicity disparities in medical care.[12] In this model, provider beliefs based on a patient's race/ethnicity

may contribute to clinical decision-making directly or through differential interpretation of the patient's symptoms. These beliefs also influence the interpersonal interaction with the patient, thereby affecting the patient's likelihood of disclosing sensitive information. Thus, in the case of highly stigmatizing conditions such as chlamydia, these stereotypes may be sufficiently strong as to inhibit chlamydia testing despite its relevance to a differential diagnosis for STI-related symptoms. The operation of such stereotypes in decision-making means that different threshold criteria–beyond symptoms–are used to identify women for chlamydia testing. Under conditions of decisional uncertainty, stereotypes provide cognitive tools for rapid classification and assignment to decisional categories.[13,14]

One unexpected finding was that a prior history of STI affects providers' differential testing practices. Among women with a prior history of STI, testing did not vary as dramatically by race/ethnicity or insurance status, compared with among women with no prior history of STI. This finding implies that a history of STI may trump the stigma associated with race/ethnicity and socioeconomic status.

There are several notable strengths of our study. First, this study uses a rich clinical data repository to assess whether there are differences in chlamydia testing by sociodemographic factors among women presenting with STI symptoms. Second, these data represent a diverse population of young women within a mid-sized metropolitan area, including patients of different racial and ethnic groups and socioeconomic levels. This is in contrast to other retrospective analyses which have been limited to Medicaid patients or patients with managed care. Third, the data rest squarely on recorded billing and diagnostic codes, rather than patient recall, to determine presenting signs and symptoms. For a relatively rare condition such as symptomatic chlamydia, this is critical to having a large enough cohort to conduct the analyses performed. Fourth, given the duration of this study and the patient-level indicators available, we were able to account for within-person correlation. In fact, many women presented multiple times with STI symptoms, and without this statistical approach, findings may have been spurious because of falsely tight confidence intervals.

We would also like to acknowledge potential limitations of our study. First, we had no access to sexual behavior data such as sexual activity, condom use, or number of sexual partners and other high-risk behavior data such as substance use. Such data may have refined the risk profile of a young woman presenting with nonspecific findings consistent with chlamydia, although should not be necessary for a clinician's decision to test a symptomatic individual. Second, our reliance on billing codes for defining STI symptoms may have resulted in incomplete identification of all symptomatic women, and thus our estimate may be conservative. Although this method of identifying STI symptoms has been used in other studies, many of the codes (e.g., abdominal pain) are nonspecific and not necessarily indicative of STI risk given other presenting signs or symptoms. Individuals with known medical conditions that manifest these symptoms (e.g., abdominal pain and appendicitis) should not have both the symptom and definitive disease process coded.[15] An individual undergoing a stepwise work-up over multiple visits, however, may not require testing (or repeat testing) for chlamydia. Of note, as a sensitivity analysis, multivariable regressions were repeated using only "STI symptoms" codes, and findings were similar, so this issue is likely not contributing substantially to our findings. Third, for women who presented with symptoms but were not tested, we have no mechanism for knowing whether the decision not to test was an appropriate judgment by the provider or a missed chlamydia diagnosis.

In conclusion, chlamydia is a public health problem, particularly among young women, that is plagued by racial/ethnic and socioeconomic disparities largely of unknown etiology. In this study, we found that providers test symptomatic minority and poor women more, and women younger than 17 years old less. Despite multiple studies suggesting disparities in chlamydia disease rates and a few suggesting disparities in chlamydia screening, this is the first study to show differences in chlamydia testing among symptomatic women. These differences are largely eliminated among women with a prior history of STI. These findings have significant public health implications relating to conscious or unconscious biases influencing provider behaviors. In addition, they may represent one mechanism by which differences in disease rates have been improperly propagated.

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