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Factors associated with the over-treatment and under-treatment of gonorrhea and chlamydia in adolescents presenting to a public hospital emergency department

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SUMMARY

Objectives: The purpose of this study was to measure the prevalence of *Chlamydia trachomatis* (CT) and *Neisseria gonorrhoeae* (GC) and the rates and factors associated with their over-treatment (OT) and under-treatment (UT).
Methods: A retrospective chart review was performed of patients aged 13–24 years who were screened for GC/CT in the emergency department (ED) of a public hospital. Descriptive statistics were obtained for all variables, and multivariate log binomial regression was performed to ascertain the factors associated with OT and UT.
Results: Seven hundred and ninety-seven adolescents and young adults were screened for GC/CT. The overall sexually transmitted infection (STI) positivity rate was 21.6%; 136 (21.6%) subjects were over-treated and 74 (43.4%) subjects were under-treated. Patients presenting with STI exposure or genito-urinary symptoms were more likely to be OT. Additionally, females aged 18–19 years or with a prior history of STIs were more likely to be OT. Females (83.6%) were more likely to be UT, while STI exposure, genito-urinary symptoms, and a prior history of STI were protective of UT .
Conclusion: Adolescents and young adults screened for STIs have a high prevalence of GC/CT. A significant proportion of these patients end up over-treated and an even higher proportion are under-treated.

1. Introduction

Adolescents and young adults have a disproportionately higher burden of sexually transmitted infections (STIs) compared to other age groups: 15–24-year-olds have the highest rates of both *Chlamydia trachomatis* (CT) and *Neisseria gonorrhoeae* (GC).[1] In 2014, this age group accounted for 65% of CT infections and 53% of GC infections in the USA .[1] Furthermore, the county in which the present study was conducted, Cook County, Illinois, is ranked second in the USA for the highest rates of both CT and GC infections after Los Angeles County.[2]

The Centers for Disease Control and Prevention (CDC) currently recommend annual chlamydia and gonorrhea screening for all sexually active women under the age of 25 years, annual chlamydia screening for young men in high prevalence clinical settings, and annual gonorrhea screening for men who have sex with men.[3] The emergency department (ED) has long been postulated as a potential avenue for sexually transmitted disease screening. The ED often serves as the point of care site for difficult to reach populations, which include adolescents.[4] Adolescents are known to under-utilize primary care services and over-depend on the ED for routine health care, especially when they lack health insurance.[5–7]

Screening for STIs may be accompanied by treatment, but often patients screened for STIs may end up being over-treated or under-treated. When compared to physician office visits, one study found that EDs diagnosed CT in 70% more visits and were more likely to

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provide the recommended treatment as well as the presumptive treatment.[8] It appears that the research performed to date has focused on under-treatment (UT) of CT/GC; over-treatment (OT) is rarely reported.[9] In addition, most studies have focused on adolescent and adult females but not males.[9] Jenkins et al. reported that UT rates ranged from 43% to 84%, with slightly lower rates in female-only studies and even lower rates for symptomatic males, while OT rates ranged from 6.7% to 31.9% with higher rates in symptomatic males.[9]

The purpose of this study was to measure the prevalence of CT/GC in an ED in a large public hospital, the rates of OT and UT, and factors associated with OT and UT for both female and male adolescent and young adult patients in a high-risk region.

2. Methods

2.1. Study design

A retrospective chart review of adolescents and young adults who presented to the Pediatric Emergency Department of John H. Stroger Hospital of Cook County and who were screened for GC/CT during a 12-month period (July 2014 to June 2015) was conducted. The hospital institutional review board approved the study protocol and data collection tool.

2.2. Study setting and population

John H. Stroger Hospital of Cook County is an urban public safety net hospital that provides care to all patients regardless of their ability to pay. The pediatric emergency department treats over 45 000 children, adolescents, and young adults annually, caring for patients until 24 years of age. Due to the high prevalence of STIs in this patient population, adolescents and young adults presenting to this ED are screened irrespective of the presenting complaint, but have the option to 'opt out' of the screening.

Adolescent and young adult patients aged 13–24 years who presented to the ED during the study period and who were screened for GC/CT were eligible to be included. Exclusion factors included adolescents who presented for a sexual assault examination or who had missing GC/CT test results.

2.3. Data collection

The practice of the pediatric ED is to keep a log of all patients screened for any STI to facilitate follow-up of the laboratory results. These logs were matched with patient medical records, and the medical records were reviewed for up to 6 months after the last ED visit to document follow-up and/or treatment. Study data were primarily collected using REDCap electronic data capture tools.[10]

A chart abstraction form was developed to record baseline demographics, patient history, clinical management, laboratory results, and follow-up. Baseline demographics included age, sex, ethnicity, race, and insurance status. Based on the frequency distribution, age was re-coded from a continuous variable to a three-level categorical variable. Patient history included documented presenting symptoms, recent STI exposure, and past history of STIs. Presenting symptoms were coded as either genitourinary (GU) or non-GU. GU symptoms included urinary symptoms, vaginal discharge, abnormal vaginal bleeding, and penile discharge. All other symptoms were classified as non-GU symptoms. Management included treatment given during the ED visit and the discharge diagnosis. Laboratory data provided results for nucleic acid amplification testing (NAAT) of chlamydia or gonorrhea. Adequate treatment was based on the prescription of medication according to the standard CDC guidelines during the initial ED encounter.[3] Over-treatment was defined as a patient who was treated empirically for GC/CT during the initial visit but had negative laboratory results. Under-treatment was defined as a patient who had a positive laboratory result for either GC or CT but was not initially treated. Follow-up was considered successful if it was documented in the medical records that the provider had informed the patient of their result and prescribed the appropriate therapy.

2.4. Outcome measures

The primary outcomes of the study were the rates of *Neisseria gonorrhoeae* (GC), *Chlamydia trachomatis* (CT), and co-infection with GC/CT, the rate and factors associated with OT, and the rate and factors associated with UT.

2.5. Statistical analysis

All analyses were performed using IBM SPSS Statistics version 23.0 software (IBM Corp., Armonk, NY, USA).[11] Data were initially collected for up to five ED visits to capture repeat presenters. For this study, the initial ED visit was taken into consideration and any subsequent visits were not analyzed. Data from subsequent visits are currently being analyzed for re-infection rates as part of another article.

Descriptive statistics were used to describe the demographic variables and clinical factors. To measure OT and UT, the dataset was divided into two groups, the GC/CT-positive group and the GC/CT-negative group. Comparisons of the two groups were explored using the Chi-square test of independence.

Sub-analyses of the GC/CT-negative and GC/CT-positive groups were conducted to determine factors that predicted OT or UT, respectively. Factors that were moderately associated with the treatment outcome using bivariate analysis ($p \leq 0.1$), as well as moderately significant interaction terms between demographic and clinical factor variables ($p \leq 0.2$), were entered into the multivariate log binomial regression analysis. Using manual backward conditional deletion, main effects ($p > 0.05$) and interaction terms ($p > 0.10$) were removed sequentially. The main effects that were not significant were removed and left out if found not to have a confounding effect (change in risk ratio (RR) by $> 10\%$). The Hosmer–Lemeshow test was used to assess the goodness of fit of the regression models.

3. Results

During the study period, 797 adolescents and young adults were screened for GC/CT during their initial visit and were recruited following the application of the inclusion and exclusion criteria. The subjects ranged in age from 13 to 24 years (mean age 18.9, standard deviation 1.44 years). The majority of the study population was black (59.7%) and female (66.1%) (Table 1). More than half of the subjects were insured (54.8%; Medicaid $n = 408$, private insurance, $n = 29$); 45.2% were uninsured ($n = 360$). Most of the subjects did not report known exposure to STIs (91.1%), had no prior history of STIs (81.3%), and had non-GU presenting symptoms (34.3%).

Demographic and clinical factor variables among those who tested positive versus those who tested negative for GC/CT are shown in Table 1. Race was the only demographic variable that was significantly different between the two groups. For clinical factors, the GC/CT-positive group was more likely to report recent STI exposure, have a prior history of STIs, and present with GU symptoms ($p < 0.01$).

Table 1
Study characteristics.

		STI-negative (n = 626) (%)	STI-positive (n = 171)(%)	p-Value
Demographics				
Age, years	13–17	92 (14.7)	30 (17.5)	0.65
	18–19	268 (42.8)	72 (42.1)	
	≥20	266 (42.5)	69 (40.4)	
Race	Black	353 (56.4)	123 (71.9)	<0.01
	Non-black	273 (43.6)	48 (28.1)	
Sex	Female	410 (65.5)	117 (68.4)	0.47
	Male	216 (34.5)	54 (31.6)	
Insurance	Private/Medicaid	349 (55.8)	88 (51.5)	0.32
	Uninsured	277 (44.2)	83 (48.5)	
Clinical factors				
STI exposure	Yes	41 (6.5)	30 (17.5)	<0.01
	No	585 (93.5)	141 (82.5)	
History of STI	Yes	103 (16.5)	46 (26.9)	<0.01
	No	523 (83.5)	125 (73.1)	
Presenting symptoms	GU	192 (30.7)	81 (47.4)	<0.01
	Non-GU	434 (69.3)	90 (52.6)	

STI, sexually transmitted infection; GU, genito-urinary.

3.1. Prevalence of infection, over-treatment, and under-treatment

Overall, 171 (21.6%) patients tested positive for an STI (GC, CT, or both): 152 (19.1%) patients were positive for CT, 44 (5.5%) for GC, and 25 (3.1%) were co-infected with GC/CT (Fig. 1). One hundred and thirty-six (21.6%) subjects were over-treated and 74 (43.4%) subjects were under-treated (Table 2).

3.2. Factors associated with over-treatment and under-treatment

3.2.1. Over-treatment (OT)

Fig. 2 shows the results of the bivariate analysis. Multivariable logistic regression was performed to ascertain the effects of age, sex, STI exposure, STI history, and presenting complaint on the likelihood that subjects were OT (Table 3). A significant interaction between sex and the presenting complaint was found, thus results were stratified by sex.

Female patients with OT were more likely to be aged 18–19 years (RR 2.13, 95% confidence interval (CI) 1.18–3.84), present with STI exposure (RR 97.83, 95% CI 12.50–763.4), have a prior history of STIs (RR 3.78, 95% CI 2.07–6.88), and present with GU symptoms (RR 2.34, 95% CI 1.36–4.02). The goodness of fit test was 0.89 for the female OT regression model.

Male patients with OT were more likely to present with STI exposure (RR 31.76, 95% CI 7.35–137.22) and have GU presenting symptoms (RR 8.07, 95% CI 3.26–19.95). Age and a prior history of STI were not statistically significant. The goodness of fit test was 0.80 for the male OT regression model.

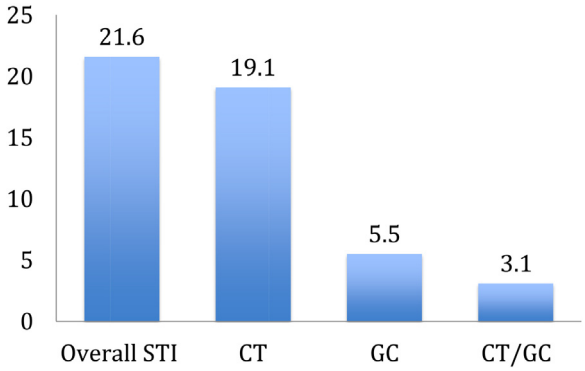

Fig. 1. Rates of chlamydia and gonorrhea infection in the study patients (n = 797).

Table 2
Sexually transmitted disease diagnosis and ED treatment

	Not treated in ED n (%)	Treated in ED n (%)	Total n (%)
Negative GC/CT	490 (78.3)	136 (21.6)	626 (100)
Positive GC/CT	74 (43.4)	97 (56.7)	171 (100)

ED, Emergency Department; GC, Neisseria gonorrhoeae; CT, Chlamydia trachomatis.

3.2.2. Under-treatment (UT)

Fig. 3 shows the results of the bivariate analysis. Multivariable logistic regression was performed to ascertain the effects of sex, STI exposure, STI history, and presenting complaint on the likelihood that subjects were UT (Table 4).

All predictor variables were statistically significant. A subject was more likely to be UT if they were female (RR 3.28, 95% CI 1.34–8.05) and was less likely to be UT if they presented with STI exposure (RR 0.03, 95% CI 0.003–0.21), had a prior history of STIs (RR 0.13, 95% CI 0.05–0.33), and had GU symptoms (RR 0.26, 95% CI 0.12–0.57) (Table 4). The goodness of fit test was 0.34 for the UT regression model.

Of the 74 individuals who were not initially treated, 49 (66.2%) were contacted and informed of their diagnosis. Of these, 33 (44.6%) sought treatment in the ED.

4. Discussion

This study demonstrated a considerable burden of infection with CT and GT among adolescents and young adult patients presenting to a pediatric ED in inner city Chicago. The overall prevalence of GC and CT was 21.6%. CT was the most prevalent STI. These rates are similar to those reported in two studies, but are substantially higher than other rates reported in the literature.[4,12–19] This study also revealed a disproportionate prevalence of STI infection in black subjects, which is similar to the racial disparities reported by the CDC.[20]

The presence or lack of insurance was the only factor that was not associated with OT or UT. This is to be expected, as many patients were uninsured and this is a safety net hospital that cares for individuals regardless of their ability to pay.

The OT rate was comparable to the rates found in other studies.[9] Given the high prevalence of STIs in the present study population, it is not striking that patients are over-treated. For females, being aged 18–19 years, STI exposure, history of STI, and GU symptoms predicted OT, while for males, STI exposure and GU symptoms predicted OT.

Currently, guidelines for the empiric treatment of STIs are vague and thus the use of empiric treatment is left to the physician's

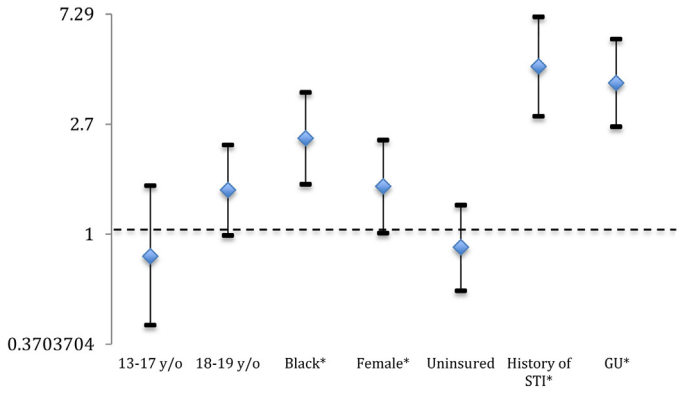

Fig. 2. Unadjusted risk ratio (RR) for factors associated with over-treatment.

Table 3
Adjusted risk ratio for factors associated with over-treatment stratified by sex.

		Female		Male	
		RR (95% CI)	*p*-Value	RR (95% CI)	*p*-Value
Age, years	13–17	1.23 (0.49, 3.04)	0.66	1.84 (0.54, 3.94)	0.33
	18–19	2.13 (1.18, 3.84)	0.01	1.46 (0.54, 3.94)	0.45
	≥20	Ref.		Ref.	
STI exposure	Yes	97.83 (12.5, 763.4)	<0.001	31.76 (7.35, 137.22)	<0.01
	No	Ref.		Ref.	
History of STI	Yes	3.78 (2.07, 6.88)	<0.001	0.92 (0.25, 3.37)	0.90
	No	Ref.		Ref.	
Presenting complaint	GU	2.34 (1.36, 4.02)	0.002	8.07 (3.26, 19.95)	<0.01
	Non-GU	Ref.		Ref.	

RR, risk ratio; CI, confidence interval; STI, sexually transmitted infection; GU, genito-urinary.

discretion.[14] The lack of clear guidelines coupled with the prolonged time interval between specimen submission and the availability of results, as well as poor follow-up, may prompt providers to presumptively treat adolescents presenting with STI exposure and GU symptoms. However, OT of an adolescent can create unnecessary emotional trauma secondary to being labeled as having an STI and can potentially harm a monogamous relationship.[15] OT is also associated with the risk of antibiotic resistance, especially for GC. Historically, GC has demonstrated the ability to develop resistance to multiple drugs: sulfonamides, penicillin, tetracycline, fluroquinolones.[21] Thus, OT leads to overuse, which could potentially lead to the emergence and spread of cephalosporin resistance.[21]

In comparison to other studies, the UT rate in the present study was lower.[9] Adolescents presenting with STI exposure and GU symptoms were more likely to be appropriately treated. However, adolescent females were more likely to be UT than males. One reason for this may be that females are more likely to have an indolent infection, whereas males present with more consistent symptoms.[1,3,22] Other factors can also complicate the diagnosis and empiric treatment of STIs in females, such as pregnancy, concurrent urinary infection, vaginal bleeding, and vulvovaginitis.[14] Untreated CT/GC infection in women can result in several adverse sequelae, the most serious of which include pelvic inflammatory disease, ectopic pregnancy, and infertility.[1,3] Furthermore, UT is a public health concern, as delayed treatment results in a potential pool of untreated adolescents and young adults in the community who are at risk of spreading the infection.

Of the 74 patients who were not treated empirically but were disease-positive, 49 were successfully contacted and less than half returned for treatment. The reasons for the lack of follow-up were unsuccessful contact attempts (e.g., phone number out of service), no documented contact attempt in the medical charts, or successful contact with a patient who subsequently did not return for treatment. It is also possible that some of these subjects received healthcare and treatment elsewhere.

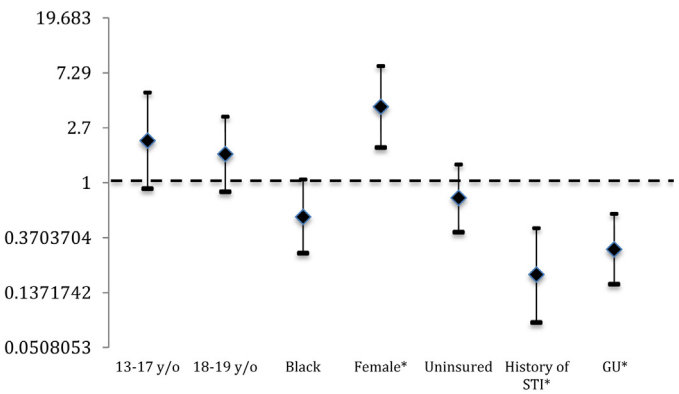

Fig. 3. Unadjusted risk ratio (RR) for factors associated with under-treatment.

The availability of a point-of-care testing for CT and GC would substantially decrease both OT and UT, the complications associated with them, and the number of adolescents who require follow-up treatment. To ensure follow-up and prompt treatment of STI-positive youths who are not presumptively treated, modern methods of communication should be employed. To address the lack of follow-up, perhaps other avenues of screening and treatment could be employed, such as school-based health centers and primary care ambulatory care settings. One of the reasons that adolescents and young adults under-utilize ambulatory services is the lack of adequate health insurance.[6,7] The Affordable Healthcare Act (ACA) may enable more adolescents to obtain their care from primary care sites where they can have continuity of care. Further, other modern methods of communication could be utilized to improve communication and follow-up, such as e-mail or patient portal notification. Phone notification at the study institution can be unreliable, as the patients tend to change phone numbers frequently, whereas e-mail addresses remain more consistent over time. EDs can also partner up with local health departments (LHDs) who frequently manage STI-positive individuals and can be a source of co-managing and tracking down patients lost to follow-up.[9]

This study has some limitations. The study was conducted at a single, urban, public hospital that caters for the underserved and uninsured patients residing in a county with a high prevalence of STIs. Thus, the management patterns and results may not be generalizable to other adolescent and young adult populations that have a low prevalence of STIs.

A retrospective review of the medical charts was conducted and variable documentation by different providers and incomplete medical records were encountered. Hence this study may have been prone to misclassification and selection biases and may have been subject to confounding, as some risk factors may have been present but not recorded.

Table 4
Adjusted risk ratio for factors associated with under-treatment.

		RR (95% CI)	*p*-Value
Sex	Female	3.28 (1.34, 8.05)	0.01
	Male	Ref.	
STI exposure	Yes	0.03 (0.003, 0.21)	0.001
	No	Ref.	
History of STI	Yes	0.13 (0.05, 0.33)	<0.01
	No	Ref.	
Presenting complaint	GU	0.26 (0.12, 0.57)	<0.01
	Non-GU	Ref.	

RR, risk ratio; CI, confidence interval; STI, sexually transmitted infection; GU, genito-urinary.

Treatment that may have been obtained at other facilities cannot be accounted for with regard to the subjects who did not follow-up for treatment. Therefore the actual treatment follow-up rate may be higher than reported.

In conclusion, this study showed that a significant proportion of adolescents end up over-treated and an even higher proportion are under-treated. Providers are faced with the difficult decision to empirically treat or not treat an adolescent presenting with possible sexually transmitted disease exposure and/or GU symptoms. Females who are more likely to suffer from the sequelae of STIs are more likely to be UT. Further investigation into the institution of modern methods of patient communication aimed at increasing follow-up is warranted. Efforts should also be made to enroll adolescents and young adults in health insurance plans that will enable them to seek care at primary care sites for continuity of care.

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Ethical approval: The study was approved by the Institutional Review Board of John H. Stroger Hospital of Cook County.

Conflict of interest: No conflict of interest exists for any of the authors.

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