Reliability of IgG serum antibodies, the electronic health record, and self-report in estimating urogenital and extragenital *Chlamydia trachomatis* infections in men who have sex with men

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Abstract

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Background – Few studies have examined the systemic antibody response in extragenital *Chlamydia trachomatis* (CT) infections. We estimate seroprevalence of IgG serum antibodies to CT among a cohort of men who have sex with men (MSM) with and without current infections stratified by anatomic site. We also examine the reliability of IgG serum antibodies, the electronic health record, and self-report as markers of past CT infections.

Methods – This is a cross-sectional study that uses data from the ExGen Cohort Study, a group of 140 MSM in King County, Washington, United States. Serum were tested for IgG using the mixed peptide enzyme-linked immunosorbent assay (ELISA). Participant data was manually abstracted from electronic health record systems that participate in the Epic CareEverywhere network. Seroprevalence stratified by infection status and site of infection was calculated along with 95% Wilson confidence intervals. Positive and negative percent agreements were

calculated using serum IgG antibodies and electronic health record diagnoses as the reference measure when comparing each other and self-report of past infections.

Results – Among participants with a current extragenital CT infection (n=17), 88.2% (n=15, 95% CI: 62.2, 97.9) had IgG serum antibodies. One hundred percent (95% CI: 19.8, 100) of participants with either urogenital (n=2) or pharyngeal infections (n=2) were seropositive for IgG. Only 46.2% (n=49, 95% CI: 36.6, 56.1) of participants who were seropositive for IgG had a past diagnosis in their electronic health record. Self-report captured 73.6% (n=78) of the participants who were IgG seropositive while the electronic health record only documents 46.2% (n=49).

Conclusion – IgG serum antibodies are generated in response to extragenital CT infections. The mixed peptide ELISA can be used to better estimate the prevalence of prior infections. Self-report may be more reliable in settings without comprehensive electronic health records.

INTRODUCTION

Chlamydial infection, caused by the bacterium *Chlamydia trachomatis* (CT), was previously the most common nationally notifiable condition in the United States before the onset of the SARS-CoV-2 pandemic,[1] with an estimated 4 million cases of CT in 2018.[2] CT infections are typically asymptomatic but can lead to pelvic inflammatory disease, ectopic pregnancy, and infertility.[3] While CT has historically been considered primarily a urogenital sexually transmitted infection, infections at extragenital sites (e.g., rectum and pharynx), have been shown to have epidemiologic significance. The estimated prevalence of rectal CT is 10-15% among male sexual health clinic patients and 8-9% among women attending sexual health clinics.[4–7] Pharyngeal CT has a prevalence of approximately 1-3%.[4,8,9] Despite the fact that extragenital infections make up a substantial number of sexually-transmitted CT infections, we know very little about the human host response to extragenital infections. Only a handful of studies have measured the systemic antibody response to CT in rectal infections,[10,11] and to our knowledge, none have examined the presence of serum antibodies in pharyngeal infections. This information is critical to approximating the validity of serum antibodies to CT and by extension, serological assays, as a marker of past infection.

The diagnostic gold standard for CT testing is nucleic acid amplification testing (NAAT), which utilizes samples from cervical, rectal, or pharyngeal swabs. Though useful for clinical care, NAATs have limited utility in helping to fully understand the epidemiology of CT, since NAAT testing only detects *current* CT infections (as NAATs measure the presence of CT DNA or RNA[12]). Serological assays, which allow us to detect the presence of serum antibodies to CT and thus are an indicator of *past* CT infection, are promising tools to help improve our understanding of CT epidemiology. However, the performance of these assays has long been plagued by low sensitivity and specificity.[13] Validating new assays as an indicator of past infection is incredibly challenging as there is no agreed upon gold standard for past CT infections. Other sources of data to measure CT prevalence (e.g., self-report or electronic health

record [EHR] data) are also problematic, as other studies have consistently demonstrated that these data sources are not reliable indicators of past infection.[14–19] Further, previous studies have found only moderate agreement between self-reported CT and presence of serum antibodies, but it is unclear whether the assays were not sensitive enough to detect serum antibodies or self-report was invalid.[20,21] Finally, a major limitation of previous studies is our lack of understanding of whether or not extragenital infections even generate a systemic immune response robust enough to be detected by serologic assays. Without these data, it is difficult to fully understand why there has been poor agreement between serum antibodies and other markers of past infection.

The mixed peptide enzyme-linked immunosorbent assay (ELISA) is a newer serological assay that has a relatively high sensitivity and specificity to detect current CT infection (using NAAT and composite reference standard of four commercial anti-CT IgG ELISAs a gold standard).[22] The promising performance characteristics of this assay present an opportunity to examine the systemic immune response to CT at all anatomic sites (i.e. urogenital, rectal, and pharyngeal CT), which have not previously been studied with this assay. Identifying the assay's ability to detect the immune response to CT infections at different anatomic sites then allows for CT antibodies to be compared to other markers of past infection, such as the electronic health record (EHR) data and self-report. A better understanding of the relationship between serum antibodies to CT, documentation in the EHR, and self-report of past infection will move us closer to quantifying the population burden of CT infections.

In this study, we leveraged data from a cohort study of extragenital CT infection to address these knowledge gaps using the mixed peptide ELISA. First, we aimed to identify whether *current* extragenital CT infections generate a systemic (serum) antibody response to CT. Next, we estimated the percent agreement between three different measures of prior CT infection (serum antibodies, history of chlamydia in the EHR, and self-report).

METHODS

Study Design & Population

We conducted a cross-sectional study nested within the ExGen Study, a 12-month, longitudinal cohort study of 140 men who have sex with men (MSM) in King County, Washington. Participants were recruited from the Seattle & King County Sexual Health Clinic and the Center for AIDS Research patient registry at the University of Washington between March 2016 and December 2018.[23] Inclusion criteria were age ≥18 years of age, ability to speak and read English, access to the internet, and reported both performing oral sex in the last two months and receptive anal sex in the last 12 months.[23] Participants also must have experienced at least one of the following in the past year: been diagnosed with chlamydia, gonorrhea, or syphilis, used methamphetamine or amyl nitrate ("poppers"), or had more than two sex partners in the last two months or more than five sex partners in the last year. At enrollment, participants completed an enrollment survey in REDCap[24,25] which queried them on demographics, sexual behaviors, and history of STIs. Participants also received STI testing, and serum was collected. All procedures of the ExGen Study were reviewed and approved by the University of Washington Institutional Review Board (UW IRB). This analysis received a "Not Human Research Determination" from the UW IRB as the data are now all de-identified.

Data Sources & Definitions

CT enrollment testing included NAAT (Aptima Combo-2, Hologic, Inc, San Diego, CA) from urine (urogenital CT) and from self-collected rectal and pharyngeal swabs (to detect rectal and pharyngeal CT, respectively).[23] As part of the main ExGen study, participants consented to have their medical records reviewed for STI-related information. We manually abstracted information on past diagnosis of CT from patients' Sexual Health Clinic EHRs and all other EHRs that participate in the Epic CareEverywhere network, including Everett Clinic, Polyclinic, Evergreen Health, Kaiser Permanente Washington, MultiCare Health System, Overlake Hospital

Medical Center, PeaceHealth, Providence Health, all UW Medicine clinics, and Valley Medical Center. There was no time limitation on the EHR data that we abstracted (i.e. all clinic records were available to us from the time the patient and/or clinic moved into the Epic system).

Self-report of history of CT was obtained from the ExGen enrollment REDCap survey. Participants were asked: “Have you ever been diagnosed with a sexually transmitted infection? Syphilis, gonorrhea, chlamydia, herpes, HPV/warts, nongonococcal urethritis (NGU) are all types of sexually transmitted infections.” If a “yes” response was received for the first question, participants were asked, “Which sexually transmitted infection(s) have you been diagnosed with?”. The response options listed all the STIs, and participants could select more than one type of infection. Participants were then asked for the date of their most recent diagnosis.

The presence of serum IgG antibodies to CT was measured from participants’ enrollment serum samples using the mixed peptide ELISA, which utilizes 24 CT peptides as antigens. For this study, the assay was performed as previously described.[22] A serum sample was considered positive for IgG antibodies to CT if the optical density (OD) of the sample was greater than the mean OD plus 1 standard deviation of the background, which was a mix of amino acids. We defined “current chlamydia infection” as a positive NAAT for urogenital, rectal, or pharyngeal CT at enrollment.

Analyses

For our first aim to identify the presence of serum antibodies to CT in current CT infections, we reported the number and percent of individuals who tested positive for CT by NAAT at enrollment and who had IgG serum antibodies present. This was calculated as a percentage with a continuity-corrected 95% Wilson confidence interval (CI) overall and by anatomic site of infection. We repeated this analysis among individuals who have never had CT as recorded in their EHR.

For our second aim to compare three measures of prior CT infection, we estimated reliability by calculating positive and negative percent agreement between (1) presence of serum IgG antibodies to CT and history of chlamydia in the EHR; and (2) presence of serum IgG antibodies to CT and self-report, using serum antibodies as the reference measure. We also stratified those with a history of chlamydia infection according to the EHR into two groups based on the amount of time that has elapsed since diagnosis: those who had a chlamydia diagnosis within the past two years and those who had a chlamydia diagnosis more than two years ago. Positive and negative percent agreement between (a) serum antibodies and history of chlamydia in the EHR and (b) self-report and EHR chlamydia diagnosis were calculated using the EHR as the reference measure. We also calculated percent agreements for these measures among participants without current CT infections and present this in a Venn diagram. All data management and calculations were performed using R version 4.2.2,[26] RStudio,[27] and the tidyverse,[28] lubridate,[29] and rlang R packages.[30]

RESULTS

There were 139 participants in the ExGen cohort study (out of 140) with serum specimens drawn at enrollment. The mean age was 37 years, the majority identified as White race, slightly less than 20% identified as Hispanic or Latino, and just over half had been previously diagnosed with HIV (Table 1). Just over 12% of participants (n=17) tested positive (via NAAT) for CT at enrollment. Most of these enrollment infections (n=14) were at the rectum. Nearly 70% of participants reported that they had ever been diagnosed with CT, and 33.1% were diagnosed with chlamydia in the past 24 months, according to their EHR.

Identifying Serum Antibodies to Current Infection

Among participants with a CT infection at enrollment (n=17), 88.2% (95% CI: 62.2, 97.9) had IgG serum antibodies to CT (Table 2). Eight of these participants who were diagnosed with

CT at enrollment did not have a history of CT in their EHR, and among these 8 participants with their first diagnosed infection, 75.0% (95% CI: 35.6, 95.5) had IgG serum antibodies. In the subset of participants with a current rectal infection (n=14), 85.7% were seropositive for IgG, and among those experiencing their first documented infection within this group (n=6), 66.7% had IgG antibodies. The sample sizes for pharyngeal (n=2) and urogenital (n=2) infections were small, but all participants with current pharyngeal or urogenital infections were seropositive. Among the 122 participants who did not have a current CT infection, 74.6% (95% CI: 65.8, 81.8) had IgG serum antibodies to CT, indicating a past infection. Notably, among those without a current CT infection and without a history of CT in their EHR, 64.6% (95% CI: 52.9, 74.8) had IgG serum antibodies.

Reliability of IgG Serum Antibodies, EHR, and Self-Report as Markers of Past CT Infection

Table 3 displays positive and negative percent agreements using IgG serum antibodies as the reference measure. For a past EHR diagnosis, the positive percent agreement was 46.2% (95% CI: 36.6, 56.1), indicating that 46.2% of individuals who had IgG serum antibodies also had a diagnosis of CT in their EHR. The negative percent agreement for a past EHR diagnosis was 90.9% (95% CI: 74.5, 97.6), indicating that 90.9% of individuals without IgG serum antibodies did not have a diagnosis of CT in their EHR. For self-report of past CT infection, the positive percent agreement was 73.6% (95% CI: 64.0, 81.4) and the negative percent agreement was 48.5% (95% CI: 31.2, 66.1).

Table 4 shows positive and negative percent agreements using history of CT in the EHR as the reference measure. The positive percent agreement between a history of CT in the EHR and the presence of IgG serum antibodies to CT was 94.2% (95% CI: 83.1, 98.5), indicating that 94.2% of those with a diagnosis of CT in their EHR also had IgG serum antibodies detected. The negative percent agreement for IgG serum antibodies was 34.1% (95% CI: 24.5, 45.1), indicating that 34.1% of those who did not have a diagnosis of CT in the EHR also did not have

IgG serum antibodies detected. For self-report of past CT, the positive percent agreement was 92.3% (95% CI: 80.6, 97.5) and the negative percent agreement was 46.6% (95% CI: 36.0, 57.5). These values did not differ substantially when examining recent (<2 years ago) vs. past (2+ years ago) infections (data not shown).

The overlap of each of the measures of past CT infection amongst participants who did not have a current CT infection is demonstrated in Figure 1. Thirty percent (37 of the 122) of participants without a current CT infection were seropositive for IgG serum antibodies, had a CT diagnosis in the EHR, and self-reported a past CT infection. Of the 91 participants who had IgG serum antibodies, 21 (23%) did not have a past CT diagnosis in their EHR nor did they self-report a past infection, meaning that they likely had an infection that was undiagnosed. Additionally, 30 of these 91 (33%) reported having a CT infection in the past but there was no evidence of CT diagnosis in their EHR. It is also notable that 15% of participants (12 of 82) who self-reported a CT infection did not have IgG antibodies or a CT diagnosis in their EHR. All individuals who had a CT diagnosis in the EHR either self-reported CT and/or were seropositive for IgG. Finally, 7% of participants with a history of CT in their EHR did not have antibodies to CT, and these participants all experienced infection between 3 months and 1 year prior to enrollment.

DISCUSSION

Generally, we found that both extragenital and urogenital CT infections generate systemic IgG antibody responses. Many participants in this cohort likely had past undiagnosed asymptomatic CT infections based on the overlap of IgG seroprevalence, self-report, and past diagnoses in the EHR. We found that nearly all (93%) of past CT diagnoses documented in the EHR were also identified using self-report. These results indicate that measuring the presence of IgG serum antibodies and self-report of past infections can be used to estimate past urogenital and extragenital CT infections.

Our first aim (Table 2) sought to measure the systemic antibody response to extragenital and urogenital CT. We found that 88.2% of participants with a current CT infection as detected by NAAT (rectal, urogenital, or pharyngeal) had IgG serum antibodies. Among those with a current rectal infection, 85.7% had IgG serum antibodies and all participants with current pharyngeal (n=2) or urogenital (n=2) infections had IgG serum antibodies. Notably, those participants who were experiencing their first diagnosed CT infection had a slightly lower prevalence of CT serum antibodies (75.0%) compared to all participants with a positive CT NAAT (88.2%). The fact that not all participants with current NAAT-positive tests have detectable IgG reflects previous research on the timing of seroconversion in populations that were mostly female with urogenital infections: most people experience seroconversion of IgG within 3 months of a positive NAAT result, but others may take up to 2 years to develop IgG after a positive NAAT.[31–33] Because we only examined a cross-sectional sample of this cohort, we are not sure of the timing of infection. It is possible some individuals were exposed to CT just days prior to the NAAT test and blood draw (not giving enough time for an antibody response to generate) whereas others may have been exposed months prior. The duration of untreated rectal CT as defined by positive weekly NAATs in this cohort was approximately 13 weeks,[23] highlighting the fact that participants with a positive NAAT at enrollment may be at different points within this clinical detection window. We do not know if participants with current infections who did not have IgG antibodies later developed them. Importantly, however, our findings indicate that extragenital CT infections generate systemic IgG antibody responses.[34]

Additionally, we found that the seroprevalence of IgG among participants without a current CT infection and without a CT diagnosis in their EHR was 64.6% (Table 2). This group represents participants who had a past asymptomatic infection, an infection that was diagnosed outside of the Epic CareEverywhere network, or an infection that was diagnosed prior to the implementation of an EHR. This high prevalence of IgG serum antibodies to CT contributes to the body of evidence that many CT infections are not diagnosed and are likely

asymptomatic.[35,36] Systemic antibody responses in extragenital infections and the high seroprevalence among people without CT diagnoses support the utility of serological assays for estimating CT population prevalence for all types of CT infections, including those at extragenital sites.

After demonstrating the presence of IgG as a marker of past CT extragenital infection, we also explored the reliability of this measure, specifically comparing IgG seroprevalence to CT diagnosis in the EHR and self-report of CT. We found that less than half of participants with IgG serum antibodies (46.2%) had a diagnosis of CT in their EHR (Table 3). This indicates that many CT infections were not captured by the EHR in this population, but it does not necessarily mean that these infections went undiagnosed. CT data in the EHR are greatly influenced by screening patterns and fragmentation of health care services and data sharing. In this setting (King County, Washington, United States), participants may have received testing and care outside of the CareEverywhere network, and thus their past infections would not be captured.

Additionally, we found that the vast majority (90.9%) of participants without IgG serum antibodies did not have diagnosis of CT in their EHR (Table 3). The remaining 9.1% of individuals without IgG serum antibodies who had a diagnosis of CT in the EHR represent a group who tested positive for CT in a clinical setting. We would expect that all would have IgG serum antibodies (i.e., the percent without IgG serum antibodies would be 0% instead of 9.1%). However, the timing of CT antibody seroconversion and seroreversion is not fully understood, and it is possible that this group of individuals either experienced seroreversion, never developed antibodies, or had levels of antibodies that were below detectable levels by the mixed peptide ELISA. There is limited data on the percentage of people who never seroconvert and the timing of seroreversion. Approximations of never experiencing seroconversion based on studies of people with current NAAT-diagnosed CT infections range widely from 10% to 42.9%.[31–33] In studies of urogenital CT, Ohman and colleagues found that the percent of individuals with IgG antibodies from a recent chlamydia infection declined from 65.5% to 34.5%

3-10 years post infection.[31] It is also possible that some individuals had a positive NAAT test – and thus a diagnosis of CT in their EHR – but did not have a "true" infection. NAATs detect nucleic acid and not viable, replicating CT; thus, a positive NAAT does not necessarily indicate the presence of an infection that would generate a measurable systemic antibody response.

We found that the majority (92.3%) of participants who had a diagnosis of CT in their EHR reported a past CT infection (Table 4). This positive percent agreement is higher than previous studies that compared self-report to clinical charts which found agreements between 60% and 84%.[15,16,18,19,21] Further, among participants without a current CT infection who reported past CT infection, 81% were IgG seropositive (Figure 1). These findings indicate that self-report is a relatively reliable marker of past infection in this study population. Given that self-report captured 73.6% of the participants who were IgG seropositive while the EHR only captured 46.2% of participants who were IgG seropositive (Table 3), we conclude that self-report of past CT infection may actually be a more informative measure of past infection compared to the EHR in situations when the EHR is not comprehensive, such as the EHR we evaluated here.

However, it is important to note that the somewhat high reliability of self-report in this study population may be because this group of study participants, by design, were at high risk of STIs and were likely well-versed in understanding STI healthcare services and diagnoses. This high reliability likely does not extend to other populations who may not interact with STI services as frequently; indeed, past studies on the validity of self-report of STIs as a marker of past infection have yielded mixed results. Some studies that compared self-report of STIs to data in the medical record or EHR found that self-report was not a reliable indicator of past infection among adolescents,[15–17] MSM,[18] and female sex workers using injection drugs.[19] Conversely, Niccolai and coauthors report high-reliability of self-report for STIs using latent class analysis and composite reference standards to compare self-report to medical records and state health department reports among female adolescents.[37] In terms of CT specifically, Frisse and

coauthors report moderate agreement (kappa = 0.42) between self-report of CT and the presence of serum antibodies measured using the microimmunofluorescence assay (MIF),[20] O'Campo and coauthors also report moderate agreement (kappa = 0.35) between self-report of chlamydia and the medical record in pregnant females,[21] and Hornberger and coauthors report substantial agreement (kappa = 0.64) between self-report and CT in the medical chart.[14]

The use of IgG seroprevalence, self-report, and EHR diagnoses as markers of past CT infection have several limitations. Estimating past sexually transmitted CT infections may be complicated in populations where ocular CT is endemic as IgG serum antibodies are generated in response to these infections as well.[38] As previously mentioned, not all EHR data, including the source we used in this study, is comprehensive in capturing past CT diagnoses. We also performed these analyses in a unique study population of MSM with a high risk of STIs who may be more well-informed on STI diagnoses than other populations, meaning that self-report may not always have such high agreement with IgG seroprevalence. The major strength of our study is that IgG seroprevalence was measured using the mixed peptide ELISA which allowed us to capture asymptomatic infections, including those that are extragenital. This assay is specific and does not have cross-reactivity with other *Chlamydia* species, including *Chlamydia pneumoniae* and zoonotic *Chlamydia* species.[34] Additionally, ocular CT is rare in King County, Washington, so our results were probably not impacted by this type of CT infection.

In conclusion, we found that extragenital CT infections generate a measurable immune response to infection and that self-report was a reliable indicator of past infection in this population. Although IgG seroprevalence, EHR data, and self-report are not perfect markers of past CT infections, we believe that a combination of serum IgG and self-report CT may be the most accurate method to estimate past CT infections in epidemiologic studies conducted in similar populations. In future studies, researchers may consider using a combination of IgG seropositivity and either self-report or EHR history to estimate the prevalence of CT infections. Using these methods in diverse populations will allow us to better understand the impact of

current screening practices, access to services for screening, and the burden of both symptomatic and asymptomatic CT infections.

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Table 1. Demographic characteristics of men who have sex with men in the ExGen cohort study, 2016-2018 (N = 139)

	All participants n (%)
Age in years	37 (20-75)[a]
Race	
Asian/Pacific Islander	8 (5.8)
Black	17 (12.2)
Native American/Alaskan Native	1 (0.7)
White	104 (74.8)
Another race not listed	9 (6.5)
Ethnicity[b]	
Not Hispanic/Latino	113 (81.3)
Hispanic/Latino	25 (18.0)
Previously diagnosed with human immunodeficiency virus[c]	71 (51.1)
Enrollment criteria	
Bacterially sexually transmitted infection diagnosis, past 12 months	103 (74.1)
Methamphetamine or popper use, past 12 months	35 (25.6)
Number of sex partners (>2 partners in past 2 months or >5 partners in past year)	116 (83.5)
Chlamydial diagnosis at enrollment	17 (12.2)
Rectal	14 (10.1)[d]
Pharyngeal	2 (1.4)[d]
Urogenital	2 (1.4)
Self-report of ever diagnosed with chlamydia	95 (68.3)
Diagnosed with chlamydia in EHR, past 24 months	46 (33.1)

[a] Mean and range
[b] One individual did not report ethnicity, so percents do not sum to 100%
[c] HIV diagnoses were extracted from electronic health record
[d] One individual had both a pharyngeal and rectal infection at enrollment

Table 2. Seroprevalence of total IgG antibodies to *Chlamydia trachomatis* (CT) and Wilson 95% confidence intervals among ExGen study participants with and without a positive nucleic acid amplification test (NAAT) for CT stratified by anatomic site of infection

	Seroprevalence for all participants based on CT status at enrollment		Seroprevalence for participants without a history of CT in the EHR	
	n/N	*Percent (95% CI)*	*n/N*	*Percent (95% CI)*
CT at any anatomic site	15/17	88.2 (62.2-97.9)	6/8	75.0 (35.6-95.5)
Rectal	12/14	85.7 (56.2-97.5)[a]	4/6	66.7 (24.1-94)
Pharyngeal	2/2	100 (19.8-100)[a]	1/1	100 (5.5-100)
Urogenital	2/2	100 (19.8-100)	1/1	100 (5.5-100)
No CT	91/122	74.6 (65.8-81.8)	51/79	64.6 (52.9-74.8)

[a] One participant had both a pharyngeal and rectal infection at enrollment.
The rows indicate the denominators in this table. For example, among 14 participants diagnosed with rectal CT at enrollment, 12 participants were seropositive for IgG serum antibodies. And among 6 participants diagnosed with rectal CT at enrollment who did not have a history of CT in their EHR, 4 were seropositive for IgG.

Table 3. Positive percent agreement (PPA) and negative percent agreement (NPA) of history of CT in the EHR and self-report of CT, using total IgG serum antibodies to CT as a reference measure

	PPA N = 106 Seropositive for total IgG			NPA N = 33 Seronegative for total IgG	
	n/N	*Percent (95% CI)*		*n/N*	*Percent (95% CI)*
EHR CT diagnosis[a]	49/106	46.2 (36.6-56.1)	No EHR CT diagnosis[a]	30/33	90.9 (74.5-97.6)
Self-report of CT[b]	78/106	73.6 (64.0-81.4)	No self-report of CT[b]	16/33	48.5 (31.2-66.1)

[a] The numerators for this row are people who had an EHR CT diagnosis amongst those who were seropositive for total IgG (PPA column) and people who did not have a CT EHR diagnosis amongst those who were seronegative for total IgG (NPA column).
[b] The numerators for this row are people who indicated that they had ever been diagnosed with chlamydia amongst those who were seropositive for total IgG (PPA column) and those who responded “no” to ever being diagnosed with an STI or indicated that they were diagnosed with an STI other than chlamydia amongst those were seronegative for total IgG (NPA column).

Table 4. Positive percent agreement (PPA) and negative percent agreement (NPA) of total IgG serum antibodies to CT and self-report of CT, using history of CT in the EHR as a reference measure

	PPA N = 52 with EHR CT diagnosis ever		NPA N = 88 without past CT diagnosis in EHR	
	n/N	*Percent (95% CI)*	*n/N*	*Percent (95% CI)*
Total IgG serum antibodies to CT[a]	49/52	94.2 (83.1-98.5)	30/88	34.1 (24.5-45.1)
Self-report of CT[b]	48/52	92.3 (80.6-97.5)	41/88	46.6 (36-57.5)

[a] The numerators for this row are people who were seropositive for total IgG antibodies to CT (PPA columns) amongst those who ever had a CT diagnosis in their EHR, had a CT diagnosis in their EHR ≤2 years ago, or had a CT diagnosis >2 years ago, respectively, and people who were seronegative for total IgG antibodies to CT (NPA columns) amongst those who ever had a CT diagnosis in their EHR.

[b] The numerators for this row are people who responded “chlamydia” to the question “Which sexually transmitted infections have you been diagnosed with?” (PPA columns) amongst those who ever had a CT diagnosis in their EHR, had a CT diagnosis in their EHR ≤2 years ago, or had a CT diagnosis >2 years ago, respectively, and those who responded “no” to ever being diagnosed with an STI or indicated that they were diagnosed with an STI other than chlamydia (NPA columns) amongst those who ever had a CT diagnosis in their EHR.

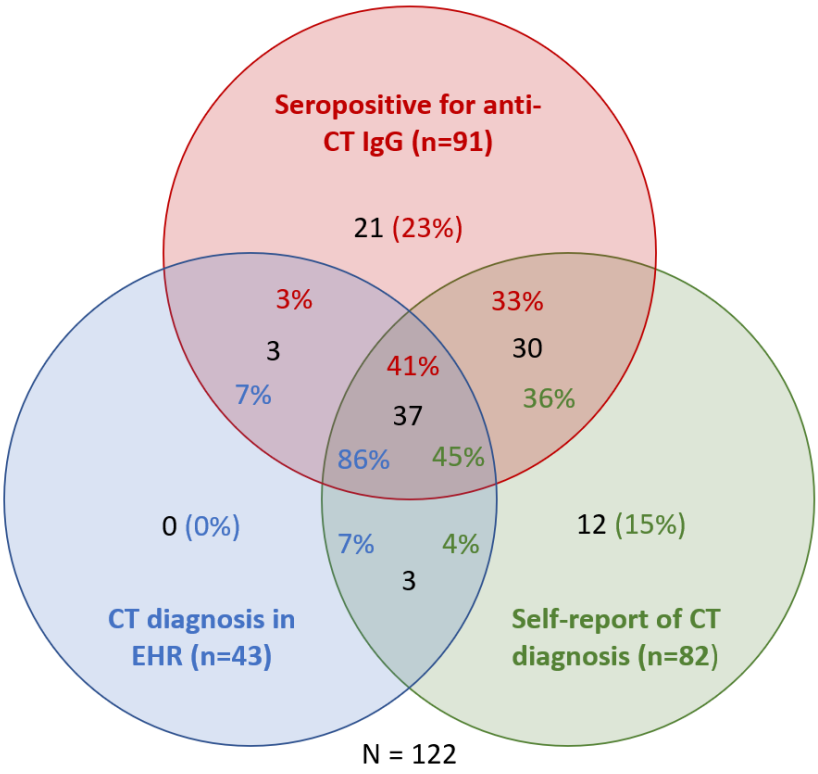

Figure 1. Venn diagram displaying the overlap of anti-*Chlamydia trachomatis* (CT) total IgG seropositivity, diagnosis of CT in the electronic health record, and self-report of past CT diagnoses amongst participants without CT infection at enrollment.