

State of Alaska  
Epidemiology



# Bulletin

Recommendations  
and  
Reports

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## Risk Factors for Repeat *Chlamydia trachomatis* Infection and Alaska-Specific Rescreening Recommendations

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## Executive Summary

*Chlamydia trachomatis* (CT) is the most common reportable condition in the United States, and is associated with complications including ectopic pregnancy and infertility. Since 2000, Alaska has had one of the highest CT infection rates in the nation. Because a high prevalence of repeat CT infection is observed nationwide in women who were treated for CT infection in the preceding several months, the Centers for Disease Control and Prevention recommends that all women with CT infection to be retested approximately 3 months after treatment. Little is known about the contribution of repeat CT infection to Alaska's high rate of disease. In order to determine the rate of repeat CT infection in Alaska and to provide Alaska-specific retesting recommendations for CT patients, we evaluated the frequency and predictors of repeat infection among persons with CT infection who were reported to the Section of Epidemiology (SOE) during 2002–2006.

During the study period, 20,391 CT cases, representing 16,438 persons, were reported to SOE. Of the 16,438 persons reported with at least one CT infection, 65% were female, 69% were aged <25 years, 43% were Alaska Native, 38% were white, 52% resided in the Anchorage/Mat-Su region, and 22% (3,688) had one or more repeat CT infections during the study period.

During the study period, 5,254 *repeat* CT cases, representing 3,688 persons, were reported to SOE; the incidence of repeat infection was 76 per 1,000 person-years. Of the 3,688 persons reported with at least one repeat CT infection, 76% were female, 80% were aged <25 years, 60% were Alaska Native, 24% were white, and 49% resided in the Anchorage/Mat-Su region. In multiple regression analysis, the strongest predictors for first repeat CT infection included age <25 years, Alaska Native race, and a reported gonorrhea infection <1 year prior to the initial CT report. There were no significant differences in rates of repeat CT infection among geographic regions.

In Alaska, repeat CT infections are common, particularly among specific risk groups. In this report, we provide rescreening recommendations to decrease the burden of CT infection.

## **Introduction**

*Chlamydia trachomatis* (CT) infection is the most common reportable disease in the United States. In 2008, over 1.2 million cases were reported to the U.S. Centers for Disease Control and Prevention (CDC).<sup>1</sup> *Chlamydia trachomatis* infection has been legally reportable to the Alaska Section of Epidemiology (SOE) by health care providers and laboratories since 1996. In 2008, 4,860 cases of CT infection were reported to SOE. Alaska has had the first or second highest reported CT infection rates in the nation since 2000.

Although often asymptomatic, CT infections can lead to serious sequelae, especially in females, including pelvic inflammatory disease, ectopic pregnancy, and infertility.<sup>2</sup> Furthermore, CT infection increases a person's risk for transmitting and acquiring human immunodeficiency virus.<sup>3</sup> Delayed treatment increases the risk of disease transmission to sexual partners.

In the 2006 treatment guidelines, CDC documented a high prevalence of repeat CT infection among women who were treated for CT in the preceding several months.<sup>4</sup> Research has documented an increased risk for adverse sequelae, such as pelvic inflammatory disease, to be more closely associated with repeat CT infections compared with the initial infection.<sup>5-7</sup> Therefore, according to the CDC, recently infected women are a major priority for repeat testing for CT. The 2006 report recommends that clinicians and health-care agencies consider advising all women with CT infection to be rescreened approximately 3 months after treatment. Providers also are strongly encouraged to rescreen all women treated for CT infection whenever they next seek medical care within the following 3–12 months, regardless of whether the patient believes that her sex partners were treated.<sup>4</sup> Although there is less evidence to support retesting for CT in previously infected males, some specialists recommend rescreening males for CT approximately 3 months following treatment.<sup>8</sup>

The purpose of this study was to describe the frequency and predictors of repeat CT infection in Alaska and to develop Alaska-specific rescreening recommendations for CT patients.

## **Methods**

We performed a retrospective study involving the cohort of persons identified in the SOE Morbidity Database with an initial CT infection that was reported between January 1, 2002 and December 31, 2006. The Morbidity Database includes full name and date of birth (making it possible to assign individuals with unique identifiers for the purposes of linking multiple reports over time), basic demographic information, and date and source of the report.

A case was defined as a CT infection that was reported to SOE during the study period, excluding those reports that occurred <30 days after a previous report in the same person or those reports determined by a SOE staff member to have likely been due to an unresolved CT infection for some other reason (e.g., because the patient never received treatment). The <30 day exclusion was used because there is evidence that the nucleic acid amplification tests used to diagnose CT cases can detect residual chlamydial DNA or RNA up to 3 weeks after CT treatment is provided.<sup>4,9</sup> Repeat infections were defined as cases that occurred in the same person throughout the study period.

We used multivariate logistic regression to model the predictors of repeat infection. Separate models were created for males and females. Covariates in the models were measured categorically and included age, race, geographic region, and having had a report of gonorrhea to

SOE within one year prior to the primary CT case report. To account for unequal follow-up time among individuals in the cohort, we also included the year of primary infection as a linear variable.

## Results

During the study period, 20,391 cases of CT infection, representing 16,438 persons, were reported to SOE. The annual CT infection rate increased from 590 cases per 100,000 population in 2002 to 674 cases per 100,000 population in 2006. Of the 16,438 persons reported with at least one CT infection, 65% were female, 69% were aged <25 years, 43% were Alaska Native, 38% were white, 52% resided in the Anchorage/Mat-Su region (Table 1).

During the study period, 5,254 *repeat* CT cases, representing 3,688 persons, were reported to SOE. Overall, 22% (3,688/16,438) of patients with a primary CT infection had  $\geq 1$  repeat CT infection. The overall incidence of repeat CT infection was 76 per 1,000 person-years. Of the 3,688 persons with at least one repeat CT infection, 76% were female, 80% were aged <25 years, 60% were Alaska Native, 24% were white, and 49% resided in the Anchorage/Mat-Su region (Table 1). Persons with repeat infection had a mean of 2.4 reported CT infections (range: 2–10). The mean time between the date of primary infection and the defined study end-point was longer for persons with a repeat infection compared to those without a repeat infection (3.7 and 2.8 years, respectively;  $P < 0.0001$ ). Univariate risk factors for repeat infection are detailed in Table 1.

Of the 2,817 females with repeat CT infection, 53% were aged <20 years and 31% were aged 20–24 years at the time of initial infection (Table 2). Within 3 months of their primary infection, 7% of females aged  $\leq 14$  years, 5% of females aged 15–19 years, and 3% of females aged 20–24 years had a repeat CT infection (Figure 1). Within 12 months of their primary infection, 19% of females aged  $\leq 14$  years, 18% of females aged 15–19 years, and 12% of females aged 20–24 years had a repeat CT infection (Figure 1). Among the 704 females aged <25 years who had a repeat infection within 6 months of their primary infection, 129 (18.3%) had a third reported infection within 1 year of the primary case report, and 285 (40.5%) had a third reported infection by the end of the study period. Repeat infections occurred in a greater proportion of Alaska Native females than in females of other races (Figure 2).

As was observed among females, the risk of repeat infection among males decreased with increasing age; however, the proportions of reported repeat infection were lower among males (Figure 1). Males aged 15–19 years were consistently at greater risk for repeat infection compared to males of other age groups. By 6 and 12 months, the proportion of repeat infection was highest among black and Alaska Native males (Figure 2).

In multivariate regression analysis, the strongest predictors for first repeat CT infection among females and males were age <25 years, Alaska Native race, and a reported history of gonorrhea infection <1 year prior to the primary CT report (Table 3). There were no statistically significant differences in rates of repeat CT infection between geographic regions. Predictors of repeat infection were not appreciably different at 6 and 12 months from the date of initial infection, and therefore are not presented here.

## Discussion

This report highlights the fact that repeat CT infections are an important contributor to Alaska's high annual prevalence of CT infection. In the current evaluation, young age, female sex,

minority race, and report of gonorrhea infection were all significant predictors for recidivism. Consistent with other studies, we documented that younger age was the strongest predictor of repeat CT infection.<sup>2,6</sup> Within 3 months of their initial CT infection,  $\geq 3\%$  of all males and females aged  $<25$  years had at least one reported repeat CT infection. While few population-based studies have examined the rate of repeat CT infection using public health surveillance data, the 22% overall recidivism rate in Alaska was nearly 50% higher than the 15% recidivism rate in a cohort of 32,698 females aged 10–44 years who were appropriately treated for CT infection from 1993–1998 (mean follow-up time, 3.4 years) in Washington State.<sup>2</sup>

The majority of research regarding repeat CT infection has been conducted among populations of patients using sexually transmitted disease clinics, family planning services, or among high school populations.<sup>10-13</sup> Many patients change health care providers between CT infections; therefore, studies performed using data from one or two clinics will likely underestimate the frequency of recidivism.<sup>2</sup> The population-based data in this study provide a comprehensive picture of repeat CT infection in Alaska because the investigators were able to link patient case reports from multiple sources through the SOE Morbidity Database.

In a review of economic evaluations, Honey and colleagues concluded that targeted screening for CT is cost effective following a variety of scenarios (e.g., method used to detect CT, population in question, and cost estimates used).<sup>14</sup> The review documented screening to be cost effective at a threshold CT prevalence ranging from 3%–10%.<sup>15,16</sup> A 2006 ranking of clinical preventive services found CT screening of sexually active women  $<25$  years of age to be cost-effective, but under-utilized.<sup>17</sup> Furthermore, a study by Hu and colleagues found that, in addition to annual screening recommendations, adding CT rescreening for females aged 15–29 years was the most cost effective strategy to decrease CT infection incidence rates.<sup>18</sup> In populations where the recidivism rates are lower (e.g.,  $<3\%$ ), the cost-effectiveness could be enhanced by integrating rescreening with other health care visits because only the costs due directly to specimen collection and testing would be applicable.<sup>19</sup> A study by Tao and colleagues found that adding rescreening of women at six months to a screening program added little cost and was consistently cost-effective compared to initial screening only.<sup>20</sup>

This study has several limitations that should be considered. Additional information that is not available for review (sexual behaviors, substance use, history of sexual assault and having other sexually transmitted diseases not currently reported to SOE) would have allowed us to better describe the important risk factors that contribute to repeat CT infection. It is possible that characteristics of repeat CT infection represent greater rescreening efforts and testing practices, better access to rescreening, the use of more sensitive testing technology, or more complete reporting among some populations and reporting agencies in comparison to others. Because Alaska Native people have universal access to care within the Alaska Native Health Corporations, it is possible that the higher proportion of repeat infection among Alaska Native people represents a higher rate of rescreening compared to non-Native people who may not have access to an integrated system of care. It is also possible that the population-based surveillance data may underestimate the true incidence of repeat CT infections, particularly among military or seasonal workers who may have less opportunity for a subsequent CT report due to migration in and out of the state. The mean follow-up time was significantly greater among individuals with a repeat infection, which thus allowed for a greater opportunity for the report of a repeat infection.

In conclusion, due to the high rates of repeat CT infection in Alaska, and the potential cost savings associated with preventing repeat CT infections, we recommend the following:

### Recommendations

1. For females with CT infections:
  - Rescreen for CT in all females aged <25 years, three months after they have received appropriate treatment.
  - Rescreen for CT in all females aged  $\geq 25$  years when they next seek medical care within the following 3–12 months after treatment.
2. For males with CT infections:
  - Rescreen for CT in all males aged <20 years, three months after they have received appropriate treatment.
  - Rescreen for CT in all males aged 20–29 years when they next seek medical care within the following 3–12 months after treatment.
3. For pregnant individuals with CT infections:
  - Conduct a test of cure (preferably by NAAT) for CT 3-4 weeks after completing therapy for all pregnant women.
  - Rescreen for CT in all pregnant women aged  $\leq 25$  years and those pregnant women who are at increased risk for CT infection (e.g., those who have a new sex partner or multiple sex partners) during their third trimester of pregnancy.
4. Screen all pregnant women for CT and *Neisseria gonorrhoeae* infection at their first prenatal visit.<sup>4</sup>
5. Annually screen all sexually active females aged  $\leq 25$  years and women aged >25 years with risk factors (i.e., those who have a new sex partner or multiple sexual partners) for CT and *Neisseria gonorrhoeae* infection as per the CDC guidelines.<sup>7</sup>
6. Strongly encourage patients with CT infection to participate in partner services activities, including the confidential and timely notification of all partners at risk.
7. Test and appropriately treat all sex partners to confirmed CT-infected patients.
8. Offer HIV screening for all persons who seek evaluation and treatment for a sexually transmitted disease.
9. Discuss STD risk reduction strategies with patients at risk for chlamydial infection. Reference guide available online at:  
<http://www.mpaetc.org/downloads/Risk%20Assessment%20Risk%20Reduction.pdf>  
or call 800-269-8065 to request a copy.
10. Follow CDC's Updated Sexually Transmitted Diseases Treatment Guidelines, 2006 Recommendations and Reports in treating CT infection.<sup>21</sup>
11. Report confirmed or suspected cases of CT infection to the Alaska Section of Epidemiology within 5 working days via telephone (907-561-4234 or 800-478-1700) or fax (907-561-4239). *Conditions Reportable to Public Health in Alaska* is available at:  
<http://www.epi.hss.state.ak.us/pubs/conditions/default.stm>

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**Table 1. Characteristics of Persons with *Chlamydia trachomatis* (CT) Infection and Risk Factors for Repeat Infection, Alaska 2002–2006**

Characteristics†	Persons with a Primary CT Case (N=16,438)		Persons with ≥1 Repeat Infection (n=3,688)		Rate Ratio	(95% Confidence Interval)
	N	%	n	Incidence Rate*		
<b>Sex</b>						
Female	10,693	65.1	2,817	90.8	1.8	(1.7–2.0)
Male	5,745	35.0	871	49.3		Reference
<b>Age (years)</b>						
≤14	215	1.3	87	147.9	3.2	(3.2–5.5)
15-19	5,201	31.6	1,680	118.0	3.3	(2.8–4.0)
20-24	6,007	36.5	1,198	65.8	1.9	(1.6–2.2)
25-29	2,517	15.3	430	55.9	1.6	(1.3–1.9)
30-34	1,099	6.7	135	38.9	1.1	(0.9–1.4)
≥35	1,399	8.5	158	35.4		Reference
<b>Race</b>						
White	6,250	38.0	883	45.0		Reference
Alaska Native	7,111	43.3	2,215	113.1	2.5	(2.3–2.7)
Asian	1,033	6.3	202	66.5	1.5	(1.3–1.7)
Black	1,686	10.3	358	69.8	1.6	(1.4–1.8)
<b>Region</b>						
Anchorage Mat-Su	8,611	52.4	1,821	72.2		Reference
Gulf Coast	833	5.1	123	46.5	0.6	(0.5–0.8)
Interior	2,537	15.4	508	63.5	0.9	(0.8–1.0)
Northern	1,516	9.2	476	107.8	1.5	(1.3–1.7)
Southeast	1,055	6.4	192	60.0	0.8	(0.7–1.0)
Southwest	1,886	11.5	568	109.7	1.5	(1.4–1.7)
<b>Gonorrhea Report</b>						
Yes	1,333	8.1	619	173.1		Reference
No	15,105	91.9	3,069	68.0	2.5	(2.3–2.8)
<b>Reporting Agency</b>						
Private	3,888	23.7	732	61.6		Reference
Health Corporation	5,202	31.7	1,550	110.6	1.8	(1.6–2.0)
Health Department	2,391	14.6	491	67.4	1.1	(1.0–1.2)
State	3,489	21.2	773	71.5	1.2	(1.1–1.3)
Military	1,360	8.3	119	26.8	0.4	(0.4–0.5)
Other	107	0.6	23	85.0	1.4	(0.9–2.1)
<b>Year of Primary Infection</b>						
2002	3,563	21.7	984	61.9	0.6	(0.5–0.7)
2003	3,259	19.8	873	71.9	0.7	(0.6–0.8)
2004	3,106	18.9	735	80.4	0.8	(0.7–0.9)
2005	3,252	19.8	637	90.0	0.9	(0.8–1.0)
2006	3,258	19.8	459	103.8		Reference

\* Incidence rate = per 1,000 person-years

† Characteristics reported at the time of the primary case report



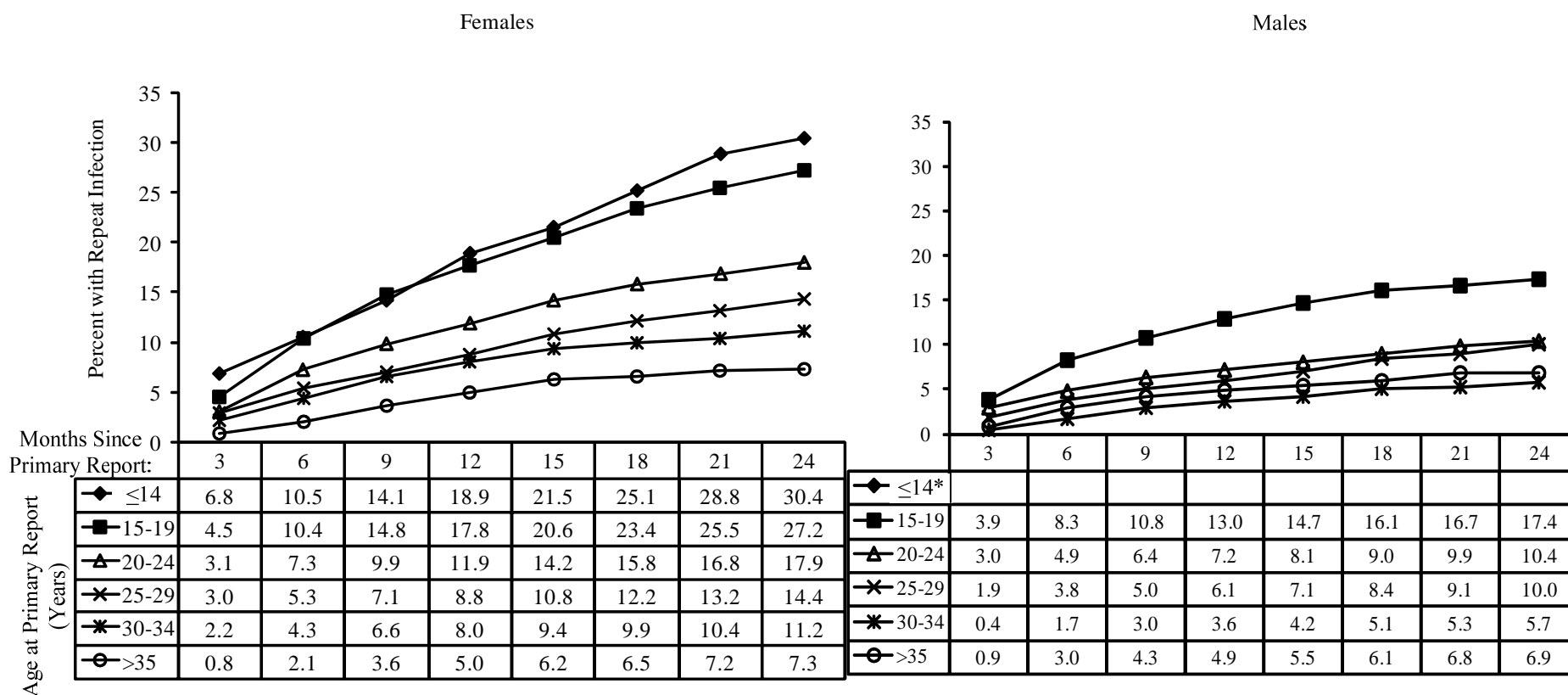
**Table 2. Risk Factors for Repeat *Chlamydia trachomatis* (CT) Infection by Sex, Alaska 2002–2006**

Characteristics†	Females with $\geq 1$ Repeat CT Report (N=2,817)				Males with $\geq 1$ Repeat CT Report (N=871)			
	N	Incidence Rate*	Rate Ratio	(95% Confidence Interval)	N	Incidence Rate*	Rate Ratio	(95% Confidence Interval)
<b>Age (years)</b>								
$\leq 14$	83	166.0	4.6	(3.3–6.3)	4	45.3	1.3	(0.3–3.5)
15-19	1,410	131.0	3.6	(2.9–4.6)	270	77.8	2.3	(1.7–3.0)
20-24	863	78.0	2.2	(1.7–2.7)	335	46.8	1.4	(1.1–1.8)
25-29	281	63.7	1.8	(1.4–2.3)	149	45.4	1.3	(1.0–1.8)
30-34	96	49.2	1.4	(1.0–1.8)	39	25.7	0.7	(0.5–1.1)
>35	84	36.2		Reference	74	34.5		Reference
<b>Race</b>								
White	648	53.7		Reference	235	31.1		Reference
Alaska Native	1,813	129.5	2.4	(2.2–2.6)	402	71.9	2.3	(2.0–2.7)
Asian	160	79.2	1.5	(1.2–1.8)	42	41.3	1.3	(0.9–1.9)
Black	175	77.1	1.4	(1.2–1.7)	183	64.0	2.1	(1.7–2.5)
<b>Region</b>								
Anchorage Mat-Su	1,310	85.3		Reference	511	51.6		Reference
Gulf Coast	100	55.9	0.7	(0.5–0.8)	23	26.9	0.5	(0.3–0.8)
Interior	407	76.5	0.9	(0.8–1.0)	101	37.6	0.7	(0.6–0.9)
Northern	400	133.2	1.6	(1.4–1.7)	76	53.9	1.0	(0.8–1.3)
Southeast	158	74.5	0.9	(0.7–1.0)	34	31.5	0.6	(0.4–0.9)
Southwest	442	128.6	1.5	(1.3–1.7)	126	72.3	1.4	(1.1–1.7)
<b>Gonorrhea Report</b>								
Yes	477	212.5	2.6	(2.4–2.9)	142	106.7	2.4	(2.0–2.8)
No	2,340	81.3		Reference	729	44.6		Reference
<b>Reporting Agency</b>								
Private	623	67.9		Reference	109	40.3		Reference
Health Corporation	1,310	125.8	1.9	(1.7–2.0)	240	66.7	1.7	(1.3–2.1)
Health Department	284	88.8	1.3	(1.1–1.5)	207	50.7	1.3	(1.0–1.6)
State	515	91.3	1.3	(1.2–1.5)	258	50.0	1.2	(1.0–1.6)
Military	69	28.3	0.4	(0.3–0.5)	50	25.1	0.6	(0.4–0.9)
Other	16	103.3	1.5	(0.9–2.5)	7	60.6	1.5	(0.6–3.2)
<b>Year of Primary Infection</b>								
2002	753	72.5	0.6	(0.5–0.6)	231	41.9	0.7	(0.5–0.8)
2003	654	83.0	0.6	(0.6–0.7)	219	51.4	0.8	(0.6–1.0)
2004	568	100.1	0.8	(0.7–0.9)	167	48.1	0.8	(0.6–1.0)
2005	490	113.2	0.9	(0.8–1.0)	147	53.3	0.8	(0.6–1.1)
2006	352	128.1		Reference	107	64.0		Reference

\* Incidence Rate = per 1,000 person-years

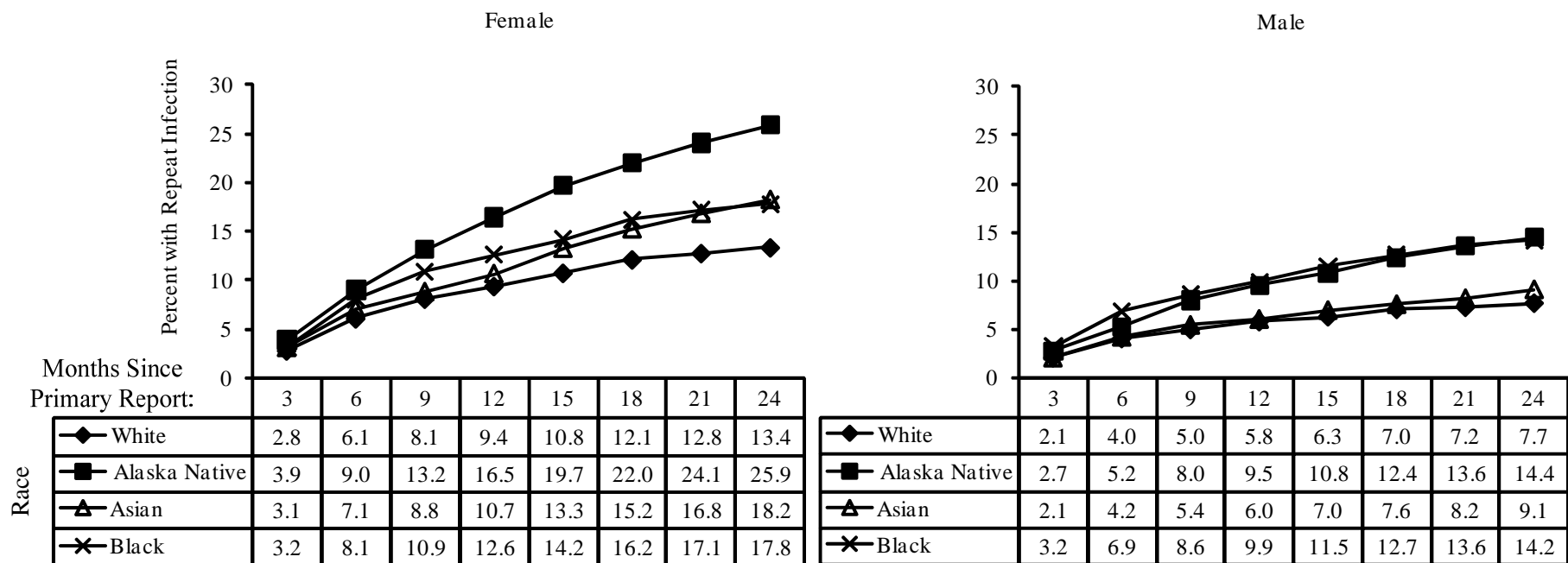
† Characteristics reported at the time of the primary case report

**Figure 1. Percentage of Patients with Repeat *Chlamydia trachomatis* Infection by Sex, Age Group and Time since the Primary Report, Alaska 2002–2006**



\*Fewer than 10 cases of repeat infection

**Figure 2. Percentage of Patients with Repeat *Chlamydia trachomatis* Infection by Sex, Race and Time since the Primary Report, Alaska 2002–2006**



**Table 3. Multivariate Regression Results for Predictors of Repeat *Chlamydia trachomatis* Infection by Sex, Alaska 2002–2006**

Characteristics*†	Females		Males	
	Odds Ratio	(95% Confidence Interval)	Odds Ratio	(95% Confidence Interval)
<b>Age (years)</b>				
≤14	6.4	(4.4–9.3)	1.3	(0.4–4.0)
15-19	5.4	(4.2–6.8)	2.7	(2.1–3.6)
20-24	3.2	(2.5–4.1)	1.8	(1.4–2.3)
25-29	2.3	(1.8–3.0)	1.6	(1.2–2.2)
30-34	1.7	(1.3–2.3)	0.8	(0.5–1.1)
>35	Reference		Reference	
<b>Race</b>				
White	Reference		Reference	
Alaska Native	2.6	(2.4–3.0)	2.4	(2.0–2.9)
Asian	1.7	(1.4–2.0)	1.2	(0.8–1.7)
Black	1.3	(1.1–1.6)	1.8	(1.5–2.3)
<b>Region</b>				
Anchorage Mat-Su	Reference		Reference	
Gulf Coast	0.6	(0.5–0.8)	0.5	(0.3–0.8)
Interior	0.8	(0.7–0.9)	0.7	(0.5–0.8)
Northern	1.1	(0.9–1.2)	0.7	(0.6–1.0)
Southeast	0.7	(0.6–0.9)	0.6	(0.4–0.9)
Southwest	1.0	(0.9–1.1)	1.0	(0.8–1.2)
<b>Gonorrhea Report</b>				
Yes	2.8	(2.5–3.3)	2.4	(1.9–3.0)
No	Reference		Reference	

\*Adjusted for year of primary case report to account for unequal follow-up time between patients

†Characteristics reported at the time of the primary case report