Sexually Transmitted Diseases, December 2008, Vol. 35, No. 12, p.000–000
DOI: 10.1097/OLQ.0b013e31815ed7c8

Is Jail Screening Associated With a Decrease in Chlamydia Positivity Among Females Seeking Health Services at Community Clinics?—San Francisco, 1997–2004

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Background: **Young adults entering jail are at increased risk for sexually transmitted diseases (STD) such as chlamydia, are released quickly, and are unlikely to be tested for STDs elsewhere. San Francisco jails performed targeted chlamydia screening and treatment since 1996.**

Goal: **To determine this program's impact on chlamydia positivity among females attending neighborhood medical clinics.**

Study Design: **During 1997–2004, jail testing density, a measure of the proportion of persons from year 2000 census blocks that were tested in jail, was compared by neighborhood. Chlamydia positivity among females aged 15 to 25 years were compared at 2 clinics serving areas with different jail testing densities.**

Results: **Of persons offered screening at intake, 89% accepted. A total of 42,952 tests were performed among 23,561 persons in jail (45% black, 73% male). A total of 2765 (6.4%) tests were positive for chlamydia; 81% of chlamydial infections were treated. Jail testing density significantly correlated with neighborhood female chlamydia rates. Mean jail testing density at Clinic S, calculated by using the residence of persons tested for chlamydia, was 7 times greater than that at Clinic O. Chlamydia positivity declined at Clinic S from 16.1% to 7.8% (P_{trend} <0.001). No significant change occurred at Clinic O in chlamydia (4.7% in 1997 and 2004, P_{trend} = 0.81).**

Conclusions: **In San Francisco, screening young adults in jail focused testing on persons from neighborhoods with high chlamydia rates. Jail screening started immediately before chlamydia declines among young females at a clinic serving neighborhoods with high jail testing density. These programs might help reduce community prevalence and racial/ethnic disparities in STDs.**

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In the United States, high rates of bacterial sexually transmitted diseases (STDs), including chlamydia, continue despite control strategies.[1] In fact, the United States has the highest rates of STDs among developed countries.[2] Chlamydia remains the most commonly reported nationally notifiable disease,[1] and can result in serious health sequelae among females (e.g., infertility and pelvic inflammatory disease).[3] Chlamydia is often asymptomatic, increases the chances of transmitting and acquiring human immunodeficiency virus (HIV) infection,[4] and is probably among the leading causes of preventable infertility among females.[5] In addition, racial/ethnic minority groups have disproportionately higher rates of STDs, including chlamydia. Compared with whites, chlamydia rates are more than 7 times greater among blacks and 3 times greater among Hispanics.[1] Eliminating these disparities is a goal of the US government,[6,7] and should be a goal of local STD control programs. To avoid the complications of chlamydia, new prevention, screening, and treatment strategies are needed. To reduce health disparities these strategies should focus on young persons and racial/ethnic minority groups who are at increased risk of acquiring STDs.[1]

A high rate of incarceration also continues in the United States. The United States has the highest prison population rate in the world (714/100,000).[8] At midyear 2005, America's jails and prisons held approximately 2.2 million persons.[9] This cross-sectional census showed that more than 800,000 were held in jails; many more passed through jails during a year. Since 1995, the number of persons in jails increased 31%. Racial/ethnic disparities in incarceration rates also exist. Nationwide, in 2005, the jail incarceration rate for black males was 800/100,000 population, more than 4.8 times the rate of white males.[9]

Because of demographic and behavioral factors, adults entering jail are at increased risk for acquiring STDs compared with nonincarcerated adults.[10–13] These adults entering jail are more likely to have had multiple sex partners,[14] to have a history of substance abuse, and to have been the victim of sexual assault.[15] In addition, the majority are younger than 35 years and more than 60% are racial/ethnic minorities.[15] The majority of adults entering jail return to their home communities within days or weeks.[16,17] Adults released from prisons are likely to have multiple sexual encounters,[18] and to have high-

The authors thank Anindya De, PhD, Office of Workforce and Career Development, Centers for Disease Control and Prevention; Owen Devine, PhD, National Center on Birth Defects and Developmental Disabilities, Centers for Disease Control and Prevention; Ameera Snell, San Francisco STD Prevention and Control Services; Michael Hennessey, JD, San Francisco Sheriff, and the San Francisco Department of Public Health Jail Health Services staff for their support of this screening program.

Presented in part at the 2006 National STD Prevention Conference, Jacksonville, FL, May 2006.

The findings and conclusions in this report are those of the author(s) and do not necessarily represent the views of the Centers for Disease Control and Prevention.

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Received for publication April 23, 2007, and accepted October 12, 2007.

risk sex with multiple partners soon after release.[19] Despite being at high risk for STDs, these adults might not be screened for STDs because they often do not have a primary-care provider or health insurance coverage,[20] and no chlamydia or gonorrhea screening guidelines exist for men.

Because of these characteristics—-substantial numbers of persons at high risk for STDs who are quickly released from jail and who lack screening in other places—screening and treating young adults entering jail for STDs might prevent subsequent transmission of STDs and might reduce community rates of STDs among nonincarcerated persons. In addition, because the majority of persons in jail are racial/ethnic minorities, these screening and treatment methods might also address racial/ethnic disparities in STD rates. Nationwide, although several STD screening programs in jails exist,[1,16,21] the impact of these programs on true STD rates outside of jails has not been investigated.

Chlamydia is primarily an asymptomatic infection that will not be detected without appropriate screening. As a result, more screening increases reported prevalence rates because more cases are detected, not necessarily because there are true increases in community prevalence. Thus, unless there have been consistent, widespread screenings of all populations at risk, measuring the impact of chlamydia screening and treatment programs cannot be based on reported chlamydia prevalence rates. Other methods must be used to evaluate screening programs.

In 1996, enabled by the introduction of nucleic acid amplification tests, which can be performed in clinical and nonclinical settings, the San Francisco Department of Public Health (SFDPH) began expanding chlamydia screening to a limited number of publicly funded clinics including 2 neighborhood community health clinics that provided family planning services. These clinics became sentinel clinics for chlamydia surveillance. Also, during this same year a program to screen adults entering jail for chlamydia was introduced.

To determine whether the jail screening program in San Francisco might have had an impact on community chlamydia rates, we compared jail screening rates by neighborhood during 1997–2004 and described trends in chlamydia test positivity among young females at 2 neighborhood health clinics that, because of different incarceration rates, served neighborhood populations with different frequencies of being tested for STDs in jail. Chlamydia test positivity in these neighborhood clinics were used to more closely approximate true changes in neighborhood prevalence than measures based on reported neighborhood chlamydia prevalence.

Methods

Definitions

This analysis focuses on jails, facilities that in San Francisco are correctional institutions that hold persons immediately after arrest and before sentencing as well as for short sentences of <1-year duration. Duration of stay in jails is generally short, often <1 day. Neighborhood was defined according to standard San Francisco Department of Public Health planning office definitions.[22]

Jail Screening

In late 1996, STD Prevention and Control Services, SFDPH, in cooperation with San Francisco Jail Health Services (JHS), SFDPH, began screening adults in jail for chlamydia. STD screening was offered to males aged 18 to 30 years and females aged 18 to 35 years at jail intake when an SFDPH staff person was present (approximately 40–80 hours per week). Screening was subsequently offered to persons not screened at intake in housing units. No criteria other than age and availability of staff were used to select persons for screening. Data on test acceptance was available as part of another evaluation during 2000–2003 at intake only. If persons declined testing, we recorded whether the reason for declining was that they did not perceive themselves to be at risk for an STD (i.e., they had only had 1 sex partner or they had not been sexually active). Urine specimens were collected from persons accepting STD screening. The SFDPH laboratory tested urine for chlamydial DNA by using ligase chain reaction (Abbott LCx,® Abbott Laboratories, Abbott Park, IL) during 1997–2000 and strand displacement

TABLE 1. Characteristics of Chlamydia Tests Performed in Adult Jail—San Francisco, 1997–2004

	Men		Women		Total	
Characteristics	n	Percent	n	Percent	n	Percent
Tests performed	31,235		11,717		42,952	
Chlamydia positive	1911	6.1	854	7.3	2765	6.4
Year						
1997–1998	7689	24.6	2536	21.6	10,225	23.8
1999–2000	8958	28.7	3585	30.6	12,543	29.2
2001–2002	7485	24.0	3083	26.3	10,568	24.6
2003–2004	7103	22.7	2513	21.4	9616	22.4
Race/ethnicity						
Black	12,706	40.7	6457	55.1	19,163	44.6
Hispanic	9109	29.2	1341	11.4	10,450	24.3
White	5438	17.4	2543	21.7	7981	18.6
Asian	1723	5.5	490	4.2	2213	5.2
Other	78	0.2	12	0.1	90	0.2
Unknown	2181	7.0	874	7.5	3055	7.1
Age (yr)						
18–25	20,740	66.4	6676	57.0	27,416	63.8
26–30	10,495	33.6	2748	23.5	13,243	30.8
31–35	*		2293	19.6	2293	5.3

*Not eligible for screening.

amplification (BD ProbetecET®, Becton Dickinson, Franklin Lakes, NJ) during 2000–2004.

Treatment

When possible, JHS staff treated persons with positive tests before release. A standing (automatic) treatment order ensured prompt treatment. STD Services staff attempted to locate and treat persons who were released before positive results became available. If persons could not be located, alerts were placed in the jail and the STD clinic medical record to ensure treatment if they returned. Because treatment information was not consistently recorded in the STD Services electronic surveillance system until 2001, we analyzed treatment information during 2001–2004. Patient-delivered partner therapy was available for persons treated after release by STD Services staff beginning in 1999. Patient-delivered partner therapy was available upon release for persons treated in jail starting in January 2004.

Jail Testing Density

To compare screening in jail by neighborhood, we calculated jail testing density. We defined jail testing density as the number of persons in the age and sex groups targeted for jail screening (males aged 18–30 years and females aged 18–35 years) who were tested during 1997–2004, divided by the year 2000 census population[23] for these same sex and age groups. Test data for calculating jail testing density counted a person once per year regardless of the number of times that person was tested during a year. To obtain an annual average jail testing density, we divided this aggregate jail testing density by the 8-year evaluation period.

Clinic Population

To determine whether the jail screening program might have had an effect on chlamydia positivity among young women seeking health services at neighborhood clinics, we selected 2 publicly-funded general medical clinics that offered family planning services, Clinic S and Clinic O. These clinics were located in neighborhoods with different jail testing density. Starting in 1997, both clinics had a stable policy of routinely screening sexually active women 25 years and younger for chlamydia using nucleic acid amplification tests at the SFDPH laboratory. We determined chlamydia positivity among females aged 15 to 25 years at these 2 clinics during 1997–2004. We chose this age group because screening criteria existed for this group,[24] and females in this age group are likely to be sex partners of males who are aged 18 to 30 (the age group screened in adult jails). To ensure that changes in positivity at the clinics were not due to changing demographics at the 2 clinics, we also analyzed positivity separately by race/ethnicity.

To determine whether females tested at the 2 clinics lived in neighborhoods with different jail testing density, we calculated mean jail testing density for each clinic by assigning the jail testing density of the neighborhood of residence to each clinic test for which an address was known. To display this information visually, we mapped the residence of females who were tested at these clinics. Clinic test data for mapping counted a female once regard-

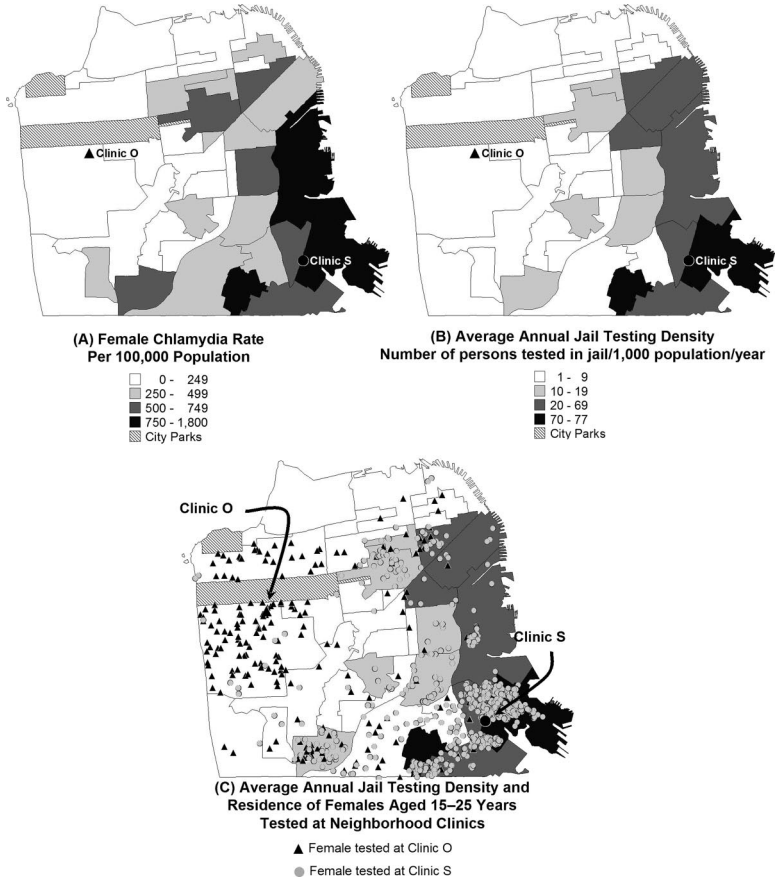

Fig. 1. (A) Female chlamydia rate, 2004 (from San Francisco STD Prevention and Control Services. Sexually Transmitted Disease Annual Summary, 2004. San Francisco Department of Public Health; October 2005); (B) average annual jail testing density, 1997–2004; and (C) average annual jail testing density (background; same as [B]) and residence of females tested at neighborhood clinics (plotted points; each point represents 1 female), 1997–2004; by neighborhood—San Francisco.

less of the number of times she had been tested at a neighborhood clinic during the evaluation period.

Statistics

Data were analyzed by using SAS® 9.1 (SAS Institute, Inc., Cary, NC) and MapInfo Professional® 6.0 (MapInfo Corp., Troy, NY). To meet program evaluation needs, all analyses, except where noted otherwise, were performed at the level of test, not person. To compare jail testing density with female chlamydia rates by neighborhood, Spearman correlation coefficients were calculated. To compare mean jail testing density by clinic, a 2-sample *t*-test with unequal variance was used. To evaluate chlamydia positivity over time we used the χ^2 test for trend (P_{trend}).

This evaluation was determined to be a nonresearch public health program evaluation by Centers for Disease Control and Prevention.

Results

Jail Screening

During the 8-year evaluation period, 11,717 chlamydia screening tests were performed among females, and 31,235 tests were performed among males (Table 1). A total of 23,561 persons were tested at least once. Each person was tested an average of 1.8 times (median, 1; range, 1–23 times), and 72.7% of tests were performed among males. Race/ethnicity was known for 93% of persons accepting screening and varied by gender. The number of screening tests varied by year due to the availability of staffing. We estimated that we screened approximately 45% of eligible males and 38% of eligible females entering jail over the evaluation period. During 2000–2003, 16,546 persons were offered screening at jail intake. Of these, 14,782 (89.3%) accepted screening (1933 persons were unable to produce a specimen). Of the 1764 persons (11%) who declined screening, 651 (37.0%) did not perceive themselves to be at risk for chlamydia.

Over the 8-year evaluation period, screening in jail identified 1911 chlamydial infections (6.1% positivity) among males and 854 chlamydial infections (7.3% positivity) among females. Of all chlamydial infections identified, 69% were among males. Positivity remained approximately stable during the evaluation period.

During 2001–2004, a total of 1048 (81%) of the 1295 chlamydial infections identified were known to have been treated. Of those treated, 789 (75%) were treated within 14 days of the test. JHS staff treated 782 (75%), whereas STD Services staff treated 177 (17%) after release from jail. Other public or private providers treated the remaining 89 infections (8%).

A valid address was known for 15,392 (65%) of the 23,561 persons tested in jail. Persons for whom a valid address was unknown were more likely to be male and white, Hispanic, or unknown race/ethnicity than persons for whom address information was known.

We mapped reported female chlamydia rate and average annual jail testing density by neighborhood (Fig. 1A, B). In neighborhoods with the highest jail testing density, more than 7% of persons eligible for screening in jail (males aged 18–30 years and females aged 18–35 years) were tested per year in jail. Jail testing density was significantly correlated with reported chlamydia rates (Spearman correlation coefficient [r] = 0.83, $P < 0.0001$) among females.

Clinic Screening

During the evaluation period, Clinic S performed 1841 chlamydia screening tests among females aged 15 to 25 years (Table 2). Clinic O performed 625 tests among this same group. Within this group, the mean age of testers was similar at the 2 clinics. At Clinic S, 82% of screening tests were among black females compared with 6% at Clinic O. Addresses were known for 85% of tests at Clinic S compared with 46% at Clinic O.

TABLE 2. Chlamydia Testing Among Females Aged 15 to 25 Years at Neighborhood Clinics—San Francisco, 1997–2004

	Clinic O		Clinic S	
Characteristics	n	Percent	n	Percent
Tests performed	625		1841	
Chlamydia positive	25	4.0	179	9.7
Year				
1997–1998	173		414	
1999–2000	201		460	
2001–2002	154		512	
2003–2004	97		455	
Race/ethnicity				
Black	40	6.4	1505	81.8
Hispanic	32	5.1	124	6.7
White	207	33.1	67	1.8
Asian	314	50.2	74	4.0
Other	1	0.2	1	0.1
Unknown	31	5.0	101	5.5
Age (mean yr)	21.6		20.6	
Address				
Known	290	46.4	1565	85.0
Unknown	335	53.6	276	15.0
JTD				
1–9	229	79.0	94	6.0
10–19	31	10.7	172	11.0
20–69	25	8.6	310	19.8
70–77	5	1.7	989	63.2
Mean JTD (median)	7.9	3.0	54.5	75.0

JTD indicates jail testing density of neighborhood of residence (tests in jail/1000 eligible population/yr).

In contrast to females screened at Clinic O, females who were screened at Clinic S tended to reside in neighborhoods with high jail testing density (Table 2). The mean jail testing density for tests at Clinic S was 54.5 tests/1000 population/yr, compared with 7.9 at Clinic O ($P < 0.001$). Figure 1C illustrates this difference.

In 1997, chlamydia positivity was 3.4 times higher at Clinic S compared with Clinic O (16.1% vs. 4.7%, Fig. 2A). Positivity declined at Clinic S from 16.1% in 1997 to 7.8% in 2004 ($P_{trend} < 0.001$), whereas it did not change significantly at Clinic O; 4.7% in 1997 and 2004 ($P_{trend} = 0.81$). These findings remained consistent when analyzed separately by race. Significant declines in chlamydia positivity were observed at Clinic S among black females ($P_{trend} < 0.001$) and white females ($P_{trend} = 0.03$), but no other significant declines were observed among any race at Clinic O or Clinic S.

Discussion

This analysis demonstrated that a program that screened and treated a substantial proportion of young adults entering jails for chlamydia focused efforts on persons from neighborhoods with high reported rates of chlamydia. We also demonstrated that screening was acceptable to inmates and that most infections identified among inmates could be treated despite short stays in jail for many persons. In addition, after the start of this screening and treatment program among jail inmates, we identified a significant

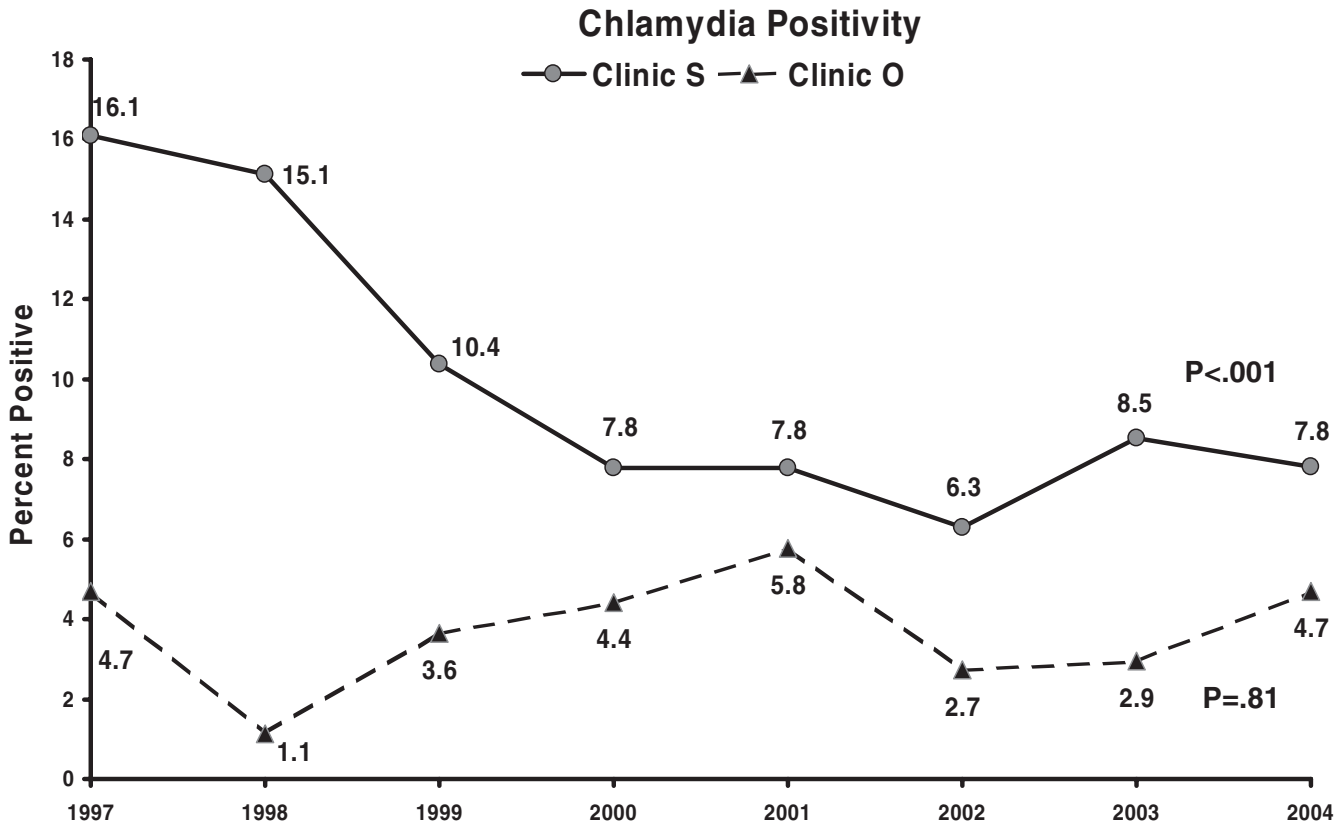

Fig. 2. Chlamydia positivity among females aged 15 to 25 years tested at neighborhood clinics by clinic, 1997–2004—San Francisco. *P*-values are for chi square test for trend.

decline in chlamydia among young females at a neighborhood clinic with high chlamydia positivity that served a population with high incarceration rates.

We have attempted to document the possible impact of a jail screening program on community chlamydia positivity by using the proxy of chlamydia positivity among young females seeking health services at neighborhood clinics that routinely offered chlamydia screening. More research is needed to confirm these findings. If this relationship is causal, the presumed mechanism by which jail screening might affect chlamydia positivity among this group of females is that males who are screened and treated in jail or shortly after release can no longer pass this infection to nonincarcerated female partners after release. Additionally, a smaller number of females are screened and treated in jail. The decline we observed in chlamydia positivity at Clinic S occurred predominately among blacks. During the period of the study, reported chlamydia rates in San Francisco were stable or increased among all racial/ethnic and age groups.[22,25]

Although certain studies have reported a higher chlamydia positivity in jails than we observed[1,10,13] (likely reflecting the higher rates of chlamydia observed among heterosexuals in their communities compared with San Francisco), we identified chlamydia positivity similar to many other studies in jails[1,12,26,27] and community clinics.[28] In addition, similar to other researchers,[29] we observed a significant and striking correlation between jail testing density (a proxy for incarceration rate) and chlamydia rates.

We saw no substantial decline in chlamydia positivity among those tested in the jails. We attribute this to the theory that persons in jail are at high risk for STDs and might represent core transmitters among whom each infection is likely to result in more than one subsequent infection (reproductive rate $[R_0] > 1$).[30,31] The impact of this screening program is most easily observed among the lower risk partners of these incarcerated persons among whom each infection is likely to result in less than one subsequent infection (reproductive rate $[R_0] < 1$). This type of effect has been demonstrated before. Mertz et al. found that an extensive communitywide chlamydia screening program had the smallest impact on the group with the highest prevalence (and thus likely the highest risk) of disease.[32]

Although we do not report the results of gonorrhea testing, the positivity of chlamydia in jails and in the clinics was 3 to 4 times higher than gonorrhea. Analysis of gonorrhea results did not demonstrate a significant decline in gonorrhea positivity at Clinic S, possibly because relatively few gonorrhea cases were detected and treated in jail compared with chlamydia cases. This might indicate that the absolute number of infections identified and treated (and thus removed from the pool of infections) affects STD rates among partners of core transmitters, rather than the number of persons screened.

This evaluation highlights possible advantages to STD screening among young adults in jails. First, because of the demographic characteristics of young persons in jails, targeted screening in jails allowed our program to focus testing efforts on persons from neighborhoods with high STD rates. In fact, in certain neighborhoods with the highest chlamydia rates, the jail-screening program was able to test approximately 7% of the target populations per year. This rate of screening was despite only having staff available to screen less than half of eligible

persons passing through jail. Second, jail demographics also meant that screening in jail focused testing on persons from racial/ethnic minority groups and persons otherwise at high risk for acquiring an STD. Third, because persons at high risk are able to be served by a limited number of testing sites, STD screening in jail is likely to be an efficient method for identifying and treating new STDs unlikely to be diagnosed elsewhere. Finally, jail screening might also decrease STD rates in the home communities of incarcerated persons.

Because similar disparities exist in STD and incarceration rates, screening in jail is likely to be useful in reducing racial/ethnic disparities in STD rates. This correlation likely exists because the same societal forces that increase overall risk for acquiring an STD are also forces that make a person more likely to be incarcerated (e.g., poverty, racism, and substance abuse).[15,33,34] If these forces can be mitigated or eliminated, incarceration rates, as well as STD rates, might decrease. Until these changes occur, focused and widely implemented jail screening programs might be an important part of a larger strategy to help reduce these disturbing racial disparities in STD rates. Additionally, some researchers have attributed the increase in HIV infection among blacks to the rising rate of incarceration among blacks.[35] If true, finding and treating STDs among incarcerated adults and their partners will also be increasingly critical as a prevention measure for HIV.

This evaluation had certain limitations. First, no direct link exists between persons screened in jail and females screened in the neighborhood clinics; therefore, no direct causal inferences can be made. This analysis was limited to 2 clinics because data were not available for the entire evaluation period at other neighborhood medical clinics. This limits the generalizability of the findings. Additionally, consistently recorded data and data from nucleic acid amplification tests were not available before 1997, precluding an analysis of chlamydia positivity before and after the start of the jail screening program.

Changes other than the jail screening program might have accounted for the observed decline in chlamydia positivity at Clinic S. During the evaluation period, SFDPH made program improvements for STD control including patient-delivered partner therapy and increased availability of screening tests in other clinics and settings throughout the city. However, those improvements were not targeted to specific neighborhoods or populations and would not be expected to impact Clinic S more than Clinic O. SFDPH also started a peer education and screening program in the neighborhood surrounding Clinic S.[36] Although this program has demonstrated increased knowledge of STDs among the target population, its impact on STD rates is unknown.[37] However, this program operated for a relatively short period and was less sustained compared with the jail screening program. Another change that could have accounted for the differential decline we observed was a change in the proportion of eligible females who were screened at the 2 clinics. Additionally, address information was missing for 25% of clinic patients (15% at Clinic S, 54% at Clinic O) and 35% of those screened in jail. This would not affect the observed differences in chlamydia positivity at the 2 clinics, but could have affected the difference in measured jail testing density for the 2 clinics if address data were differentially missing by jail testing density.

In conclusion, we document a significant decline in chlamydia positivity among young females at a clinic that serves persons from neighborhoods with high rates of incarceration. This decline occurred after the start of an extensive jail screening program that tested as many as 7% of persons in the target age and sex groups per year in the neighborhoods with the highest chlamydia rates. Because this was an ecologic analysis, no causal link can be inferred; therefore, more research is needed to conclusively demonstrate the impact that jail screening programs might have on community STD rates. Finally, because similar racial disparities exist in incarceration and STD rates, comprehensive jail screening programs focusing on young adults might help to reduce racial disparities in STDs.

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