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RESEARCH ARTICLE

Reduced Risk of Syphilis Reinfection in Men Interviewed by Disease Intervention Specialists: A Pilot Study

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Introduction: Syphilis is a highly transmissible sexually transmitted infection. Rising rates of infection and reinfection are of great concern to public health officials. In local health departments across the U.S., disease intervention specialists attempt to interview all people diagnosed with early syphilis, to elicit sexual partner information, and to trace and treat the partners. This method of interviewing and contact tracing is an evidence-based practice that reduces the spread of the disease in the community, but few studies address the relationship between the disease intervention specialists' interviews and index patient reinfections. We hypothesized that patients who were interviewed, patients who provided partner information, and patients with more treated partners would have a reduced risk of reinfection.

Methods: Our sample consisted of 82 men listed in the Suffolk County Department of Health Services syphilis log who were diagnosed with primary, secondary, or early latent syphilis. We determined whether and when the patients were reinfected during a set time period, from 2016 to 2020. Kaplan−Meier analyses with log-rank statistics and Cox hazard proportional models were used to calculate time to reinfection and hazard ratios.

Results: Although none of the models produced $p<0.05$, notable trends were observed. In subset analyses of interviewed patients, 23.8% of patients who named partners were reinfected during the study period, whereas 50% of those who did not name partners were reinfected during that time. In addition, the hazard ratio for index patients who named partners was 0.51 (95% CI=0.225, 1.170, $p=0.113$). When some or all the patients' partners were treated, 20% were reinfected by the end of the study, whereas 33.3% of cases with no partners treated were reinfected by the end of the study. The hazard ratio for patients with some or all partners treated was 0.48 (95% CI=0.136, 1.711, $p=0.258$).

Conclusions: Although none of the results was statistically significant, trends suggest that partner elicitation and partner treatment status could be associated with reduced risk of syphilis reinfection. Because this pilot study utilized a small convenience sample that was not tested for statistical power, we could not adequately address these trends. Future studies, with larger sample sizes, should address these relationships.

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INTRODUCTION

Syphilis is a highly transmissible sexually transmitted infection, and rising rates of infection are of great concern to public health officials.[1] From 2018 to 2019, cases of primary and secondary syphilis, the stages at which syphilis is most transmissible, increased by 11.2%.[2] Reinfection is also common.[1,3−6] Because patients and providers often do not observe or recognize the signs and symptoms of syphilis, it is easy for patients to unknowingly pass the infection on to their sexual partners. Fortunately, syphilis is treatable with 1−3 doses of long-acting injectable benzathine penicillin G. The Center for Disease Control and Prevention (CDC) includes syphilis in its list of mandatory reportable infections, and local departments across the U.S. attempt to interview all people who test positive and are diagnosed with early syphilis: primary, secondary or early latent syphilis.[1,7] The interview serves 3 purposes: linkage to affordable treatment, education, and sexual partner elicitation. A health department disease intervention specialist (DIS) conducts the interview with the positive person, that is, the index patient. The DIS attempts to elicit the names and contact information of all sexual partners during the infectious period and the period in which the index patient became infected to link the partners to testing and prophylactic treatment.[6−9]

This method of interviewing patients and tracing their sexual contacts is an evidence-based practice that reduces the spread of the disease in the community,[7,10] but whether these tactics also reduce the index patient's likelihood of becoming reinfected is unknown. CDC publications and DIS training materials, along with previous studies and meta-analyses, have focused on the value of partner services in terms of treatment of partners and infection rates in the community.[7,8,10−13] Few studies have analyzed reinfection rates,[3−6,14] and fewer still have addressed a possible relationship between the disease intervention interview and syphilis reinfection. Analysis of this relationship will provide information that can enable health departments to better assess and improve the interview process as a method of disease intervention and prevention.

Because syphilis rates are higher in men than in women,[1,4,13] it is important to address reinfection interventions in the male population. Infection rates are especially high in men who have sex with men.[1,4,13] However, because not all men who have sex with men agree to participate in interviews or are willing to provide honest information about male partners, the sex of the partners may remain unknown. Therefore, studies about the effectiveness of DIS interviews should include all men.

We hypothesized that patients who were interviewed and patients who provided information about their sexual partners would have a lower risk of reinfection and a longer time until reinfection than those who do not participate in the interview or provide information about their partners. We hypothesized that a greater number of elicited partners would be associated with an increase in time to reinfection and a decrease in risk of reinfection. Finally, we hypothesized that patients who have a greater percentage of treated partners would also have increased in time to reinfection and a reduced risk of reinfection.

METHODS

This study was an observational retrospective record review study. We reviewed the Suffolk County Department of Health Services (SCDHS) syphilis log and serology records. We first selected patients who were diagnosed with primary, secondary, or early latent syphilis in 2016. We then examined the historical serology records of each patient to determine whether and when the patient was reinfected, from initial infection in 2016 through December 31, 2020. Reinfection date was determined by selecting the midpoint between the reinfection-positive test and the most recent negative test. For patients who were not reinfected, we gathered the last negative test date. Finally, we used interview records to determine whether or not the index patient was interviewed, whether or not the patient provided the DIS worker with partner information, the number of partners elicited from the index patient, and whether or not those partners were prophylactically treated for syphilis. Treatment outcomes for partners were verified by DIS with health care providers. We also gathered data on 2 potentially confounding variables from the interview record: having anonymous partners and the use of hook-up smartphone apps to meet partners.

Study Sample

The sample consisted of all Suffolk County men diagnosed with early syphilis (primary, secondary, or early latent syphilis) in 2016 who had 2 or more subsequent syphilis tests after the 2016 diagnosis listed in Suffolk County's syphilis serology records. Inclusion criteria also included male gender, age ≥18 years, and a Suffolk County address. Participants were excluded from the study if their gender identity was female or nonbinary, if they were aged <18 years at the time of the initial syphilis diagnosis, or if they had no subsequent syphilis

testing or only 1 subsequent syphilis test on record at the SCDHS. Participants were also excluded if there was no record indicating whether or not they were interviewed by an SCDHS DIS worker. We included all races and ethnicities. Non-English speakers were also included because DIS workers are required to use interpreters to communicate with patients in their own languages. Anyone identified as incarcerated was excluded.

Because this was an observational study, the sample size was based on the available data in SCDHS's syphilis logs, serology records, and interview records for syphilis testing between January 1, 2016 and December 31, 2020. This was a small pilot study, and the sample size was not tested for statistical power.

Measures

The *initial infection* was defined as the first positive test in 2016. A *positive test* was defined according to CDC protocols, by either a change in syphilis antibody test, from negative to positive, or by a fourfold increase in rapid plasma regain (RPR) titer. *Reinfection* was defined as a fourfold increase in RPR titer from the most recent RPR test.[15]

Statistical Analysis

This study used Kaplan–Meier analyses with a log-rank test to estimate and compare the survival curves and the mean time to event in a number of months from the initial positive test in 2016 to reinfection or censure. Index patients were categorized as interviewed/not interviewed and categorized as partners elicited/not elicited. The number of partners elicited was categorized as none, low (1–2), medium (3–4), and high (≥5). Time zero was the date of the first positive syphilis test in 2016, for each individual subject. As previously mentioned, the date of reinfection was estimated to be the midpoint between the last negative test and the reinfection-positive test. Subjects who remained negative were censored at the date of the last negative test in the 2016–2020 time period.

The Cox proportional hazard model was used to assess the risk for reinfection over 60 months from January 1, 2016 to December 31, 2020. Unadjusted and adjusted hazard ratios (HRs) of syphilis reinfection with 95% CIs were calculated on the basis of the Cox models. Independent variables and covariates included in the models were interviewed (Yes/No), named partner (Yes/No), and the number of partners named (none, low, medium, high).

Furthermore, Kaplan–Meier and Cox proportional hazard analyses were conducted, with the sample limited to interviewed patients. We assessed the relationship between the following characteristics of the interviews and the number of months until reinfection: whether or not partners were elicited; the number of partners elicited; whether or not any partners were prophylactically treated; and if some, none, or all partners were treated. We also assessed additional characteristics of the interviewed subjects, that is, engaging in anonymous sex and the use of hook-up apps, to determine whether these characteristics were related to the outcome and were possible confounding variables. Researchers used IBM SPSS Statistical software, Version 28.0.1, for all analyses.

Because this study was a record review observational study, subjects were at minimal risk of harm. Patient-identifying information was removed from all data, and patients were protected from breaches of confidentiality. The Stony Brook University IRB board and the SCDHS Research and Publications Review Committee reviewed and approved the study.

RESULTS

The Suffolk County syphilis log listed 162 men as diagnosed with early syphilis in 2016, 82 of whom met the inclusion criteria for this study. Of the 82, 28 (34.1%) were reinfected at some point by December 31, 2020, and 54 (65.9%) did not have any test results indicating reinfection as of December 31, 2020. DIS interviewed 68 (82.9%) of the men in the sample. Of those who were

Table 1. DIS Interview Characteristics Associated With Syphilis Reinfection in Men in Suffolk County, Including Those Who Were Interviewed and Not Interviewed

Characteristics	Number of cases	Percentage of cases	Number of cases reinfected	Percentage reinfected	Mean time to Reinfection	Log-rank *p*-value
n	82	100.0	28	34.1	44.73 months (95% CI=40.64, 48.83)	
Interviewed	68	82.9	23	33.8	44.09 months (95% CI=39.74, 48.41)	*p*=0.899
Not interviewed	14	17.1	5	35.7	44.31 months (95% CI=34.18, 54.44)	

DIS, disease intervention specialist.

Table 2. DIS Interview Characteristics Associated With Syphilis Reinfection in Men in Suffolk County Among Those Who Were Interviewed

Characteristic	Number of cases	Percentage of interviewed cases	Number of cases reinfected	Percentage reinfected	Mean time to reinfection	Log-rank *p*-value
n	68	100.0	23	33.8	44.08 months (95% CI=39.74, 48.41)	
Partner information elicited	42	61.6	10	23.8	47.07 months (95% CI=41.72, 52.42)	*p*=0.106
No partner information elicited	26	38.2	13	50.0	39.09 months (95% CI=32.67, 45.51)	
Some or all partners treated	30	45.6	6	20.0	49.19 months (95% CI=42.67, 45.5)	*p*=0.248
Partners elicited but none treated	12	17.6	4	33.3	40.64 months (95% CI=28.23, 53.06)	
All partners treated	17	25.0	3	17.6	51.34 months (95% CI=45.50, 57.20)	*p*=0.469
Some partners treated	13	19.1	3	23.1	45.78 months (95% CI=36.16, 55.40)	
Partners elicited but none treated	12	17.6	4	33.3	40.64 months (95% CI=28.23, 53.06)	
Has anonymous partners	46	67.60	16	34.8	43.11 months (95% CI=37.78, 48.44)	*p*=0.781
No anonymous Partners	21	30.9	7	33.3	45.04 months (95% CI=37.55, 52.53)	
Anonymous partner data missing	1	1.5	—	—	—	
Uses hook-up apps	22	32.4	4	18.2	49.06 months (95% CI=42.05, 56.07)	*p*=0.071
Does not use hook-up apps	43	63.2	19	44.2	40.62 months (95% CI=35.14, 46.10)	
Hook-up app data missing	3	1.0	—	—	—	

DIS, disease intervention specialist.

interviewed, 23 patients (33.8%) were reinfected by December 31, 2020. In the not-interviewed group, 5 patients (35.7%) were reinfected by the end of the study period (Table 1).

The interview group was analyzed separately as a subset of the sample. Of those interviewed, 42 (61.6%) provided partner information, and 26 (38.2%) did not. Of those who provided partner information, 10 (23.8%) were reinfected by the end of the study. Of those who did not provide partner information, 13 (50%) were reinfected by the end of the study. Of those interviewed, 30 (45.6%) of index patients had some or all of their elicited partners treated for syphilis. Seventeen (25%) of the interviewed patients had all of their named partners treated, 13 (19.1%) had some but not all partners treated, and 12 (17.6%) had no partners treated. A total of 33.3% of those with no treated partners were reinfected by the end of the study period, whereas only 20% of those with some or all partners treated became reinfected. The same trend is seen in the categorical variable, breaking the groups down into no partners treated, some but not all treated, and all named partners treated. A total of 23.1% of those with some partners treated were reinfected, and 17.6% of cases with all partners treated were reinfected by the end of the study period. Of those interviewed, 67.6% of interviewed cases claimed to have anonymous partners, and 32.4% stated that they met partners through hook-up apps such as Grindr and Tinder (Table 2).

Kaplan–Meier analyses showed the mean time to reinfection for the entire sample to be 44.73 (95% CI=40.64, 48.83) months. Mean time until reinfection for interviewed patients was 44.01 months (95% CI=39.74, 48.41) compared with 44.31 months (95% CI=34.18, 54.44) for patients who were not interviewed. There was not a statistically significant difference in time to reinfection (log-rank p=0.899) (Table 1 and Figure 1).

When the sample was limited to interviewed patients, the mean number of months until reinfection in those who provided partner information was 47.07 (95% CI=41.72, 52.42) compared with 39.09 months (95 % CI=32.67, 45.50) in those who did not provide partner information. Although the log-rank value was 0.106, the difference in months until reinfection does suggest a

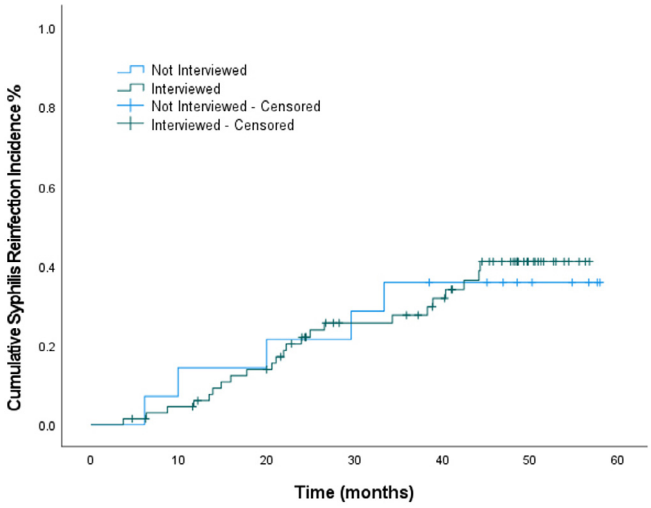

Figure 1. Cumulative syphilis reinfection incidence by interview status.

possible trend (Table 2 and Figure 2). In looking at partner treatment variables, neither the binary measure nor the categorical measure of partner treatment status was statistically significant, with log-rank values of p=0.248 and p=0.469, respectively. However, the mean number of months until reinfection for those who had some or all partners treated was 49.19 (95% CI=42.67, 45.50), compared with 40.64 months (95% CI=28.23, 53.06) for those who provided partner information but had no partners treated. This difference also suggests a possible trend (Table 2 and Figure 3). Having anonymous partners was not significantly associated with mean time to reinfection (p=0.781), nor was using hook-up apps to meet sexual partners (p=0.071).

When looking at the entire sample of men who were diagnosed with early syphilis in 2016, none of the Cox proportional hazard models was statistically significant, and no models were statistically significant when the sample was limited to interviewed patients. Of the models, the best fit was the model from the interviewed patient subset that included only the named partners yes/no variable, with a p=0.111. The HR for those who named their partners in the DIS interview was 0.51 (95% CI=0.225, 1.170, p=0.113), indicating a 49% reduction in risk. The p-value for the model that contained the binary partner treatment variable was also not statistically significant (p=0.258), but the HR of 0.48 (95% CI=0.136, 1.711) is notable.

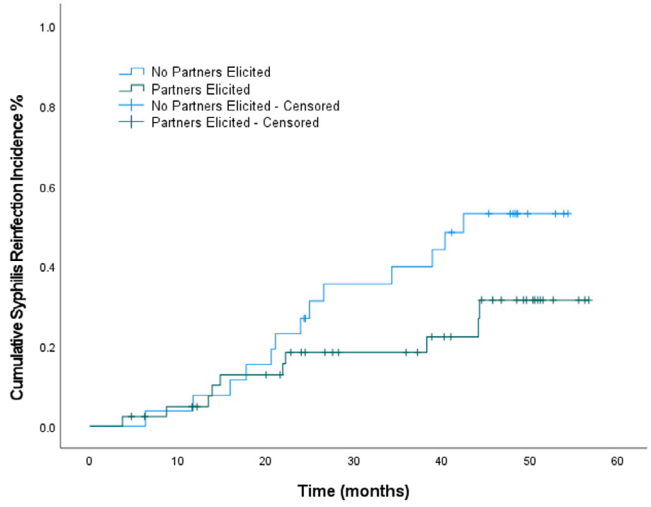

Figure 2. Cumulative syphilis reinfection incidence by partner elicitation status in patients interviewed by DIS.
DIS, disease intervention specialist.

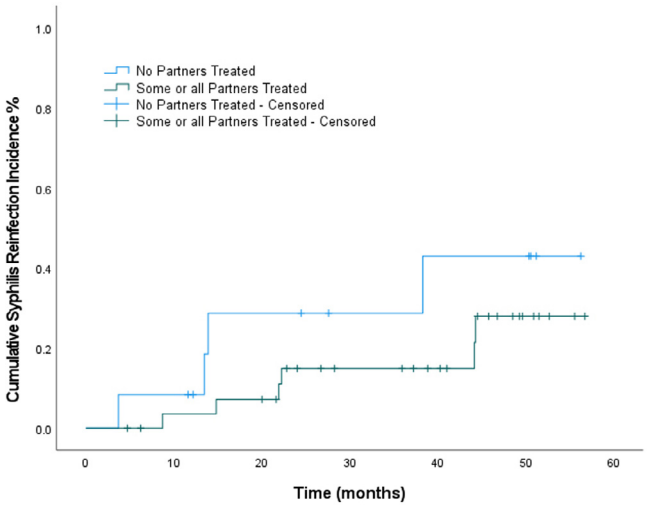

Figure 3. Cumulative syphilis reinfection incidence by partner treatment status in patients who provided partner information to DIS workers.
DIS, disease intervention specialist.

DISCUSSION

None of the Kaplan–Meier analyses or Cox hazard proportional models produced $p<0.05$. However, this was a small pilot study that utilized a convenience sample that was not tested for statistical power. Although elicitation of partners (yes/no) was not significantly associated with time until reinfection ($p=0.106$), the results suggest possible trends in the data. Most notably, in the interviewed subset group, 23.8% of patients who named partners were reinfected during the study period, whereas 50% of those who did not name partners were reinfected at that time. In addition, the HR for index patients who named partners was 0.51 (96% CI=0.225, 1.170, $p=0.113$), indicating a 49% reduction in risk. Similarly, partner treatment status was not significantly associated with time to reinfection ($p=0.258$), but the HR of 0.48 (95% CI=0.136, 1.711) indicated a substantial reduction in risk. In addition, 33.3% of cases with no partners treated were reinfected by the end of the study, and only 20% of cases with some or all partners treated were reinfected. Future studies should be conducted to assess these trends further.

Public health officials might assume that having anonymous partners or partners met on hook-up apps would increase the likelihood of reinfection. These partners are likely to be difficult to locate, to inform of possible exposure, and to link to treatment. However, neither of these factors was significantly associated with time to reinfection, nor did they show any statistical trends. They do not appear to have influenced the outcome or have acted as confounding variables.

Limitations

This exploratory study suffered from several important limitations that future studies should address. Owing to its small sample size, this study cannot adequately address the trends mentioned earlier seen in HRs and time to reinfection in patients from whom partners were elicited and in patients with treated partners. Future studies, with larger sample sizes, should address these relationships.

Another weakness is the limited number of variables included in the study. We did not include demographic variables such as race, income, educational status, or ZIP code, which might relate to the willingness to participate in the interview or the willingness to reveal information about partners. Future studies should include these variables, especially because they are often the only available data on the patients who refuse the interview, and the data might provide insight into some of the differences between the interviewed and not-interviewed groups. We also did not include other potential risk variables such as sex of partners, gender of partners, method of partner acquisition, drug use, intravenous drug use, partner intravenous drug use, or participation in transactional sex. Future studies should include these variables because they are possibly related to the reinfection risk as well as the willingness or ability to participate in the interview or to provide partner contact information.

Our study focused on the number of partners named and on how many of those were treated. Future studies should also consider the relationship between the total number of uncontacted partners (named and unnamed) and reinfection risk. In our sample, this number was

difficult to assess. In the DIS interview, some patients provided an exact number of partners from the interview time period, but others provide only a vague estimate, and others refused to answer or said they did not know. Because many of the unnamed partners are anonymous, we chose to assess the relationship between having anonymous partners and reinfection. As previously noted, we hypothesized that having anonymous partners would make contact tracing difficult, would increase community spread, and would increase the likelihood of reinfection. However, we found no relationship. Addressing the number of uncontactable partners would offer a more nuanced understanding of how the DIS process intervenes or fails to intervene in community spread, which then poses an increased risk of reinfection to the patient.

Our study did not address the characteristics of the sexual partners or characteristics of the partner notification process; DIS workers collect little information about or from contacts, aside from limited demographic information. However, some information is available, such as whether the contacts tested negative and were prophylactically treated, whether they tested positive and were treated, whether they had already been treated before notification, or whether they refused testing and treatment. Future studies might include these factors in analyses and might also consider whether the partner notification was performed solely by the DIS or was a cooperative effort between the DIS and the index patient.

We also did not include variables in the DIS interview and partner elicitation process that might lead to behavior change and adoption of risk reduction strategies. One such variable is patient engagement in the interview. Patients who provide partners might be more engaged in the interview and thus with the health education messages the DIS provides. Engagement in the interview might also suggest a readiness to change health-related behaviors. In addition, the very act of naming one's partners might help the patient to reassess their own attitudes about hazards, risks to self, risks to others, and health behavior change. Further quantitative and qualitative studies should address how the DIS interview process is related to changes in a patient's health literacy, changes in attitudes about sexual health and health risks, readiness to change, and actual behavior change. These studies should then address how these factors are associated with reinfection risk and time to reinfection.

Furthermore, our study did not assess whether behavior change occurred. Assessment of the data gathered at patient interviews at the point of reinfection might provide some insight into whether or not reinfected patients had made changes in sexual behavior, changes in sexual partners or networks, changes in partner typology, or changes in methods of acquiring partners. Any of these changes might increase or decrease reinfection risk. However, these data were not available for much of 2020 because Suffolk County DIS workers were reallocated to coronavirus disease 2019 (COVID-19) investigations and were not conducting syphilis investigations.

Another limitation is the unknown amount of variation in DIS workers and in the individual DIS interviews. Although CDC standardizes training for all DIS workers and although supervisory staff in Suffolk County in 2016 was consistent, individual DIS capability and style vary. In addition, although the DIS seeks out the same information for each interview and provides the same education, individual interviews can also vary. The DIS tailors the interview on the basis of the index patient's knowledge, health literacy, personality, mood, and affect as well as the patient's self-identified sexual orientation and reported sexual networks. Furthermore, by 2016, DIS workers across the country were experiencing multiple increased workplace demands and burdens, most notably, increases in syphilis cases and caseload.[16] These stressors might have influenced the amount of time DIS could devote to locating patients and their partners, and it might have affected how much time and attention DIS workers could devote to establishing trust, conducting interviews, or following up with patients for additional partner information. Future studies should address how individual DIS characteristics, such as years of experience, education level, caseload, and level of workplace satisfaction, are related to the likelihood of patients being interviewed, the number of partners elicited, and patient reinfection. Qualitative or mixed methods studies could assess the variation between interviews and observe how these variations are related to reinfection risk.

Finally, this study might not be generalizable to other counties in the U.S. Individual health departments and DIS workers vary from year to year and from county to county, as do demographic, socioeconomic, and cultural characteristics of the counties. A greater number of health departments should be included across geographic areas and SESs and across a longer time period. Although this study is small and suffers limitations, it is a pilot study that points to the need for further evaluation of the role of the DIS interview and partner elicitation in the reduction of the risk of syphilis reinfection.

CONCLUSIONS

Although CDC and local health departments rely heavily on the DIS interview to prevent the spread of syphilis and to reduce incidence rates, infection rates continue to rise.[1,7] Therefore, it is essential to understand what aspects and elements of the DIS interview and partner

services are most effective and produce the best public health outcomes. One important outcome is a reduction in index patient reinfections. Reduced risk of reinfection and reduced time to reinfection benefit not only the index patient but also their sexual partners, sexual networks, and communities.

In addition, previous studies show that DIS workers are overwhelmed and are struggling to elicit partner information.[16,17] If there is a statistically significant association between partner elicitation or percentage of partners treated and reinfection risk, this information can help to motivate index patients to name more partners and to provide more detailed information, which may in turn reduce syphilis infection rates in the community.

Previous studies have addressed or analyzed DIS efforts and the DIS interview as an intervention,[8–12,16] and some previous studies have looked at reinfection rates in relation to factors such as index patient demographics,[3–6] but few have even considered the relationship between the DIS interview and reinfection of index patients. Our study addressed this subject and observed a trend in the data that suggests that partner elicitation and partner treatment outcomes could be associated with a reduction in the risk of syphilis reinfection. Future studies should address this relationship to better understand how the DIS interview functions as a public health intervention.

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CREDIT AUTHOR STATEMENT

Laura McKellar: Conceptualization, Data curation, Formal analyses, Investigation, Methodology, Project administration, Resources, Software, Validation, Visualization, Writing — original draft, Writing — review & editing. Wei Hou: Conceptualization, Formal analyses, Methodology, Software, Supervision, Visualization, Writing — review & editing.

REFERENCES

1. Syphilis - STD information from CDC. Centers for Disease Control and Prevention. https://www.cdc.gov/std/syphilis/default.htm. Updated April 12, 2022. Accessed June 14, 2022.
2. Centers for Disease Control and Prevention. *Sexually Transmitted Disease Surveillance 2019*. U.S. Department of Health and Human Services; 2021. https://www.cdc.gov/std/statistics/2019/std-surveillance-2019.pdf. Accessed April 2, 2023
3. Almeida VC, Donalisio MR, Cordeiro R. Factors associated with reinfection of syphilis in reference centers for sexually transmitted infections. *Rev Saude Publica*. 2017;51:64. https://doi.org/10.1590/S1518-8787.2017051006432.
4. Jain J, Santos GM, Scheer S, et al. Rates and correlates of syphilis reinfection in men who have sex with men. *LGBT Health*. 2017;4(3):232–236. https://doi.org/10.1089/lgbt.2016.0095.
5. Phipps W, Kent CK, Kohn R, Klausner JD. Risk factors for repeat syphilis in men who have sex with men, San Francisco. *Sex Transm Dis*. 2009;36(6):331–335. https://doi.org/10.1097/OLQ.0b013e3181990c85.
6. Cohen SE, Chew Ng RA, Katz KA, et al. Repeat syphilis among men who have sex with men in California, 2002—2006: implications for syphilis elimination efforts. *Am J Public Health*. 2012;102(1):e1–e8. https://doi.org/10.2105/AJPH.2011.300383.
7. Centers for Disease Control and Prevention (CDC). Recommendations for partner services programs for HIV infection, syphilis, gonorrhea, and chlamydial infection. *MMWR Recomm Rep*. 2008;57(RR-9):1–83. quiz CE1-4 https://www.cdc.gov/mmwr/preview/mmwrhtml/rr57e1030a1.htm#:~:text=On%20the%20basis%20of%20evidence%20of%20the%20effectiveness%20and%20cost,with%20active%20health%20department%20involvement.
8. Cuffe KM, Gift TL, Kelley K, Leichliter JS. Assessing partner services provided by state and local health departments, 2018. *Sex Transm Dis*. 2021;48(6):429–435. https://doi.org/10.1097/OLQ.0000000000001328.
9. van Aar F, van Weert Y, Spijker R, Götz H, Op de Coul E, Partner Notification Group. Partner notification among men who have sex with men and heterosexuals with STI/HIV: different outcomes and challenges. *Int J STD AIDS*. 2015;26(8):565–573. https://doi.org/10.1177/0956462414547398.
10. Down I, Wilson DP, McCann PD, et al. Increasing gay men's testing rates and enhancing partner notification can reduce the incidence of syphilis. *Sex Health*. 2012;9(5):472–480. https://doi.org/10.1071/SH12023.
11. Brookmeyer KA, Hogben M, Kinsey J. The role of behavioral counseling in sexually transmitted disease prevention program settings. *Sex Transm Dis*. 2016;43(2):S102–S112 (suppl 1). https://doi.org/10.1097/OLQ.0000000000000327.
12. Ferreira A, Young T, Mathews C, Zunza M, Low N. Strategies for partner notification for sexually transmitted infections, including HIV. *Cochrane Database Syst Rev*. 2013;2013(10):CD002843. https://doi.org/10.1002/14651858.CD002843.pub2.
13. Marcus JL, Katz KA, Bernstein KT, Nieri G, Philip SS. Syphilis testing behavior following diagnosis with early syphilis among men who have sex with men—San Francisco, 2005—2008. *Sex Transm Dis*. 2011;38(1):24–29. https://doi.org/10.1097/OLQ.0b013e3181ea170b.
14. Luo Z, Zhu L, Ding Y, et al. Factors associated with syphilis treatment failure and reinfection: a longitudinal cohort study in Shenzhen, China. *BMC Infect Dis*. 2017;17(1):620. https://doi.org/10.1186/s12879-017-2715-z.
15. Workowski KA, Bachmann LH, Chan PA, et al. Sexually transmitted infections treatment guidelines, 2021. *MMWR Morb Mortal Wkly Rep*. 2021;70(4):1–187. https://doi.org/10.15585/mmwr.rr7004a1.
16. Cope AB, Mobley VL, Samoff E, O'Connor K, Peterman TA. The changing role of disease intervention specialists in modern public health programs. *Public Health Rep*. 2019;134(1):11–16. https://doi.org/10.1177/0033354918813549.
17. Cope AB, Bernstein K, Matthias J, et al. Unnamed partners from syphilis partner services interviews, 7 jurisdictions. *Sex Transm Dis*. 2020;47(12):811–818. https://doi.org/10.1097/OLQ.0000000000001269.