Published in final edited form as:

Sex Transm Dis. 2016 February ; 43(2 Suppl 1): S18–S27. doi:10.1097/OLQ.0000000000000283.

School-Based Sexually Transmitted Disease Screening: Review and Programmatic Guidance

Felicia M. T. Lewis, MD[*,†], **Patricia Dittus, PhD**[*], **Melinda E. Salmon, BA**[*,†], **M. Jacques Nsuami, MD, MPH**[‡]

[*]Division of STD Prevention, Centers for Disease Control and Prevention, Atlanta, GA;

[†]Philadelphia Department of Public Health, Philadelphia, PA;

[‡]Louisiana State University Health Sciences Center, New Orleans, LA

Abstract

School-based sexually transmitted disease (STD) screening (SBSS) was designed to provide chlamydia and gonorrhea testing, treatment, and counseling to adolescents in a school setting to overcome some of the difficulties of screening in this population. To inform STD control programs and other entities on decision making about potentially implementing this intervention, we reviewed existing published and gray literature on SBSS from 1998 to 2014. Although they are work-intensive to establish, school-based STD screening programs are a feasible and cost-effective way of testing large numbers of male and female adolescents for chlamydia and gonorrhea, and to provide counseling and treatment to almost all those who are found infected. School-based STD screening programs do not seem to reduce prevalence in either the school or the general adolescent population, although there are currently relatively few studies on large-scale SBSS. More research in this field is needed.

In 2012, 1,422,976 cases of infection with *Chlamydia trachomatis (CT)* and 334,826 cases of infection with *Neisseria gonorrhoeae (GC)* were reported to the Centers for Disease Control and Prevention (CDC), representing 456.7 and 107.5 cases per 100,000 persons, respectively.[1] As in previous years, adolescents and persons of color were disproportionately affected, with adolescent girls aged 15 to 19 years demonstrating a *CT* rate of 3291.5 per 100,000 persons and a *GC* rate of 521.2 per 100,000.[1] Strategies to interrupt transmission of *CT* and *GC* in these populations have long been sought; however, as a population, adolescents can be difficult to reach[2] and existing *CT* screening recommendations are not well followed.[3–5]

After the introduction of noninvasive urine-based nucleic acid amplification techniques (NAATs) in the early 1990s,[6] it became feasible to perform large-scale screenings for *CT*/*GC* in non-clinical venues such as health fairs and schools. Mass school-based screening for sexually transmitted diseases (STDs) was designed as a strategy to overcome some of the

Correspondence: Feelicia Maude Toby Lewis, MD, Philadelphia Department of Public Health/CDC Philadelphia, PA. felicia.lewis@phila.gov.

Conflict of Interest: None declared.

difficulties of reaching adolescents, normalize and increase uptake of testing, and curtail transmission, and it was hoped perhaps to even decrease prevalence of infection in adolescent cohorts.[7] This method of screening is usually performed by an outside entity, mostly the local health department[8–11] or, in some cases, a school-based health center (SBHC)[12] operating in close partnership with the schools or school district where it is performed. Currently in the United States, an estimated 5 jurisdictions are performing school-based STD screening (SBSS) on a large scale.

The basic SBSS model that is currently used, and that will be discussed below, was developed in 1995 in New Orleans[7] and has been described in detail by several jurisdictions.[8,9,11] This mass screening method is different from ongoing STD screening that may take place at SBHC, which are clinical entities present in only approximately 2% of US schools, and where the availability of services and the methods used to deliver them vary widely.[13,14] An excellent literature review on the topic of school-based screening, including some SBSS programs and routine STD screening in SBHC, both in the United States and abroad, is provided by Jamil et al.[15] However, the studies in the review by Jamil et al. were implemented in a variety of ways in countries with very different health systems than the United States; thus, we have chosen to focus our current review on US classroom-based high school programs to more closely examine and compare their programmatic components.

In the basic SBSS model, students are called down by classroom to hear a brief educational presentation on STDs and screening (the content of which varies by site), including that testing is voluntary and most appropriate for sexually active students. Subsequently, all students are given a testing kit in a brown paper bag, including a demographic form to be completed by the student and a urine collection cup. All students are then escorted to the rest rooms, where they are free to provide (or not to provide) a urine sample for testing. Urine samples are tested for *CT* and *GC* through NAAT. Students who test positive are offered in-school counseling and treatment and, depending on the jurisdiction, may be offered other services such as partner services, condoms, emergency contraception, expedited partner therapy (EPT), or HIV testing (A. Peterson, personal communication, 2014; J. Schillinger, personal communication, 2014).[7–11,16] Depending on capacity, SBSS programs either offer rescreening[17] or will instruct students to be rescreened appropriately.[18]

Public health planners initially hoped that this screening model might be able to forward several public health goals, among them increasing community screening and treatment of CT in girls and women 15 to 24 years old, as recommended by CDC.[19] Other goals could include increasing community and provider knowledge of STD-related prevention, treatment, and epidemiology; reducing reinfection; reducing incidence of *CT*/*GC*; treating asymptomatic *CT* to prevent progression to PID[20,21]; and increasing access to care. In addition, SBSS may have utility for those outside formal public health settings, including for schools themselves, community hospitals, or other organizations that may be interested in the large-scale, community-based provision of STD screening among adolescents.

PURPOSE

As informed by the principles of Program Science[22] and to inform STD control programs, state and local educational agencies, and other entities on decision making about implementing or not implementing SBSS, we present a literature review and guidance regarding programmatic decisions. Although many gaps in research exist, this article compiles metrics for decision making informed both by existing literature, gray literature, and the opinions of public health program officials who currently operate SBSS programs.

METHODS

The electronic databases EMBASE and PubMed were searched (January–March 2014) for any published English-language articles from all available years using search terms such as school-based screening, high school screening, chlamydia screening, gonorrhea screening, and mass screening. Ancestry searches using the references from selected articles were also performed. Studies that presented findings or original research from programs that conducted mass screening in American junior or senior high schools were selected. In addition, public health program areas without any published data that authors knew either had performed or were performing SBSS as described were approached for unpublished data, information on programmatic operations, history of the program, and lessons learned.

RESULTS

Literature Review

Twenty published articles were included in the literature review (Table 1). Of these, 11 (55.0%) were written using data from the New Orleans SBSS[7,23–32]; among these, several overlapped in terms of content over time.[7,23,29] Other jurisdictions that published findings included New York City (NYC), Philadelphia, rural Pennsylvania, Michigan, and San Francisco. Eleven articles (55.0%) presented cross-sectional percent positivity (point prevalence) and demographics of infection among those tested during a given time frame.[7–12,17,23–25,29] Rescreening or repeat screening was examined in 3.[17,23,32] Behavioral or knowledge associations were examined in 5.[12,27,28,30,33] All articles except one presented data from large cities.[34]

_CT/GC_ Positivity and Demographics—Overall *CT* positivity ranged from 2.2% to 13.1% in females and 0.6% to 7.0% in males; however, excluding the 2 studies from San Francisco, the lower end of the range was 8.1% in females and 2.5% in males (Table 1). Infection with *GC* was far less frequent in all studies. African Americans, females, and older students consistently had the highest reported positivity in all studies. Other demographic factors associated with *CT/GC* infection were enrollment in a disciplinary school[11,17] and residing in a high-morbidity area[11] or in a physically deteriorated neighborhood.[26]

Behavioral/Knowledge Associations—Several articles discussed either behavioral factors or student knowledge that was associated with infection or with participation in the screening process.[8,12,27,28,30,33] Philadelphia has demonstrated that the places where students met their sex partners were consistently correlated with infection on multivariable analysis: having met sex partners at their own school was protective for males and females, having met partners in the neighborhood was risky for females, and meeting partners in venues other than their own school, neighborhood, or through friends was very risky for both.[33] In addition, history of arrest was associated with infection in females, and young age at first sex was associated with infection in males.[33] In a Michigan high school, having ever had an STD was significantly more likely in students reporting at least 4 lifetime sex partners, not using a condom at last intercourse, and having had sex in the last 3 months; however, these factors were not significantly associated with testing positive at an SBSS event.[12] Interestingly, students in NYCand Philadelphia who did not respond to the initial sexual activity question at time of screening tested positive at least as often as those who reported being sexually active.[8,35]

In New Orleans, participating students' knowledge about STD was assessed using a survey tool. In this study, only 31% of 12th graders knew all of the most basic facts that *CT* and *GC* are transmitted sexually, that each can be cured, and that STDs can be asymptomatic and are preventable. Advanced grade level, female sex, and having had a previous *CT*/*GC* infection were each associated with a higher knowledge score on multivariate analysis, but having simply attended a school where screening was performed in the past and being currently infected were not.[27] Students' own perceptions of STD risk was also assessed in another New Orleans study[28]: although most students (64.5%) did not perceive themselves at high risk, those who thought themselves at high risk were no more likely to test positive for *CT* or *GC* than those who did not, and estimates of risk did not differ by age, sex, or black versus other races. Last, students in New Orleans were surveyed about their reasons for refusing SBSS testing.[30] This study revealed several misconceptions among students; for example, of those who stated they had had sex and did not test, the majority refused testing because they bathed every day and therefore did not consider themselves at risk of STD.

Cost Analyses—Two studies formally analyzed the cost-effectiveness of SBSS programs. Fisman et al.[36] constructed a dynamic *CT* transmission model using Philadelphia data and found that SBSS as practiced (assuming 35% of eligible students screened) was cost-effective, particularly if both males and females participated, resulting in a cost of $500 to $3500 per quality-adjusted life year gained. Wang et al.[31] used a decision-analysis model comparing school-based versus non–school-based *CT* screening in New Orleans SBSS and found that the SBSS program (52.3% of eligible students screened) prevented an estimated 38 cases of pelvic inflammatory disease (PID) and $119,866 in treatment costs, resulting in a net savings of $1524 per case of PID prevented. School-based STD screening costs were presented in 1997 US dollars, with screening, treatment, and program costs estimated at $128.49 per student tested[31]; a base-case analysis demonstrated that, at an intervention cost of $86,449, the SBSS program detected and treated 159.8 cases of *CT* ($541 per infected student treated).[31] Cost-effectiveness in both studies was due to the projected net reduction in incidence of PID and its sequelae; in both, untreated *CT* infection was assumed to result in PID approximately 30% of the time (now considered to be closer to 10%).[21]

Program Science (Published and Unpublished Data)

Although public health program improvement is not a primary focus of the published literature, several articles mentioned aspects of their programs that may be of use to practitioners considering school-based screening programs, including how programs were initiated, capacity of programs, and sustainability of programs. Individuals working in program areas conducting SBSS also offered insights; 3 program areas that have sustained SBSS for more than one consecutive year but have not formally published work on their programs were included in the review (Table 2). These included Washington, DC[16]; Chicago, IL (S. Tilmon, personal communication, 2014); and Detroit, MI (A. Peterson, personal communication, 2014).

Program Initiation—In all jurisdictions, setting up SBSS required lengthy planning and a great deal of community input, both from participating schools and parents. In addition, planners had to take into account the existing local public health laws to structure their programs. Areas of particular concern for the jurisdictions in which SBSS programs were initiated included the legal issues of adolescents' ability to consent for testing without parental consent, adolescents' ability to consent for sexual activity and statutory rape laws, and laws regarding confidentiality of medical information and reporting to the Health Departments. For example, in New Orleans and Michigan, planners had to take into account that written or verbal parental consent was necessary for students younger than 18 years to participate in the program (A. Peterson, personal communication, 2014).[7] An excellent overview of necessary steps to consider when deciding whether or not to initiate an SBSS program is informed by several of the reviewed programs and described in a 2005 manual by ETR Associates,[37] as well as in guidance for starting such a program in Indian country.[38]

Program Capacity—School-based STD screening program capacity varied by local legal restrictions, financial considerations, and program goals. All programs screened both males and females, ranging from 1201 to 112,228 persons from program initiation to June 2013 (Table 2). All programs except San Francisco were able to find substantial numbers of infected students, with total positivity ranging from5.4% to 11.2% compared with San Francisco's 1.9%. Health departments in New Orleans, NYC, Philadelphia, San Francisco, and Washington, DC, directly provided treatment teams for in-school treatment, whereas Chicago, Detroit, and New Orleans used SBHC or health department clinics for treatment. Jurisdictions that provided treatment teams for in-school treatment seemed to have slightly higher treatment rates (92.9%–100%) when compared with jurisdictions that used SBHC or a combination of treatment strategies (83.1%–99.0%). NYC, Philadelphia, and Washington, DC, were able to directly provide condoms to students. In NYC and San Francisco, planners took advantage of the explicit legality of EPT for *CT* in their state and were able to provide adolescents with treatment for their sex partners in this manner (J. Schillinger, personal communication, 2014).[10] Washington, DC, was able to offer in-school HIV testing for infected students,[16] whereas Philadelphia's agreement with their school district expressly forbade similar testing (M. E. Salmon, personal communication, 2014).

Program Sustainability—Although by definition, only programs able to sustain themselves for more than 1 school year were included in this review, none of the participating programs were able to completely pay for itself. Funding streams for staff salary, medication, and testing at all locations depended on local and national sources that varied from year to year (J. Schillinger, personal communication, 2014;S. Tilmon, personal communication, 2014; M. E. Salmon, personal communication, 2014).[10,16,29] This variability greatly affected the number of schools SBSS programs were able to access at a given time (New Orleans, NYC, Michigan, Chicago) and at times threatened the existence of the program (NYC, Chicago). Alone among programs, Philadelphia, through a data exchange agreement with local Medicaid providers, was able to pay for the cost of testing for most students it tested; however, staffing, medication, and program support were not included in the agreement (M. E. Salmon, personal communication, 2014). In Washington, DC, active and ongoing community involvement proved crucial for implementing and sustaining SBSS.[39]

DISCUSSION

What SBSS Programs Can Do: Increase Access to Screening, Cost-Effective Case Findingand Treatment

Although they are work-intensive to establish, SBSS programs are a feasible way to screen large numbers of adolescent girls for *CT* on an annual basis, as recommended by CDC.[19] Moreover, New Orleans SBSS data showed that, in a group of students for whom any programmatic barriers to participation were removed, a majority were shown to test annually.[32] School-based STD screening results in substantial case finding in both males and females in most jurisdictions where it has been attempted. In addition, in all SBSS programs that screened males and females, more males than females chose to test, which may be notable given the difficulty of accessing male adolescents for screening outside STD clinics. In the published literature, San Francisco was an exception, with overall *CT* positivity ranging from only 1.3% to 2.1%[9,10] as was rural Pennsylvania, where only 2 *CT* cases were detected among 51 adolescent girls tested.[34] The cause of this is not entirely clear; the authors of the San Francisco studies attribute the difficulty in case finding in their jurisdiction to multiple factors, including low prevalence of lifetime sexual intercourse in their youth.[10] In addition, most SBSS programs are able to treat or ensure treatment of most *CT*/*GC* cases that are found[8,10,11,15,26] and, consequently, may reduce PID and other sequelae of untreated *CT*/*GC* infection.[40] Due, in large part, to this reduction, available data indicate that SBSS programs are cost-effective.[31,36] However, only 2 cost-effectiveness studies specifically focusing on SBSS have been performed, and both assumed that approximately 30% of untreated *CT* infections will progress to PID. More recent work has demonstrated that a 10% progression to PID might be more appropriate.[21,41] Other cost-effectiveness studies of *CT* screening performed in family planning clinic settings (where screening costs are lower than in SBSS) have demonstrated that *CT* rates lower than 1.1% to 1.2% were no longer cost-effective,[6,42] but notably showed that when age was used to select women and NAATs were used on urine samples, screening was still cost-saving at a prevalence at or greater than 1.1%.[6,43] Furthermore, one of these studies suggests that *CT* screening programs using NAAT only require a treatment rate of more than 11% of infected females to remain cost-saving.[6] Given that the age group of those screened in SBSS has the highest *CT* prevalence and NAA-based testing is always used, it seems reasonable for areas with *CT* prevalence lower than the 3% threshold suggested by CDC,[44] but greater than approximately 1.5%, to consider SBSS as an effective strategy for case finding and treatment, whether or not they have the ability to treat students themselves (Table 3).

What SBSS Programs Cannot Do: Reduction in Prevalence, Increasing Knowledge About STDs

Very few studies examine other aspects of SBSS, but available data suggest that SBSS programs have been unable to reduce prevalence of infection in a sustained manner, either in individual schools or in the adolescents who test as a whole.[17,29,35] Longitudinal data from programs (A. Peterson, personal communication, 2014)[29,45] and a modeling study[36] all demonstrate a temporary decline in percent positivity (proxy measure of prevalence in this cohort) among students during the first 3 to 4 years, with a subsequent rebound to preprogram levels or higher. Interestingly, this pattern of initial decline and subsequent increase in *CT* cases has also been seen after the implementation of *CT* control programs on a larger scale in settings outside the United States, such as in Sweden and British Columbia,[41,46] and has been attributed to a true increase in prevalence.[41] In high schools, it is hypothesized that this rebound in positivity occurs at least in part because the school environment does not exist separately from the larger community—high school students do not only choose their sex partners from their own schools.[29,33] Indeed, Philadelphia data demonstrated that adolescents met their partners in their own school less than half of the time.[33] Until the proportion of susceptible persons who are screened in the larger community reaches an effective screening rate[32,41] and a sufficient number of partners of those who are infected are referred for treatment,[47], it seems unrealistic to expect SBSS programs alone to decrease community *CT*/*GC* prevalence. Recent unpublished data from the first 4 years of the Michigan SBSS are showing a consistent yearly decline in percent positivity among students in all 5 schools included; it remains to be seen whether or not numbers rebound in this jurisdiction (A. Peterson, personal communication, 2014). Further studies are needed. In addition, SBSS programs do not seem to appreciably increase student knowledge about STDs, at least in a way that results in fewer infections; rather, in the one study that examined it, student knowledge increased most with history of prior infection, indicating that a medical encounter or personal experience with STD was a more effective way of teaching about STD than didactics[27] (Table 3).

Other Potential Applications for SBSS Programs: Identification of Risk, Linkage to Care, Dissemination of Other Prevention Strategies

Because they are able to reach large numbers of students, SBSS programs can potentially be used as platforms for other public health interventions or for investigations into perceptions of risk and real risk factors. Two studies investigating student attitudes showed that students who perceived themselves to be at high risk for STD were not significantly more likely to test positive in the SBSS program,[28] but that some students harbored real misinformation about their susceptibility to and actual risk of infection.[30] Another study showed that a brief interview could be used to predict infection in a cohort of students testing in an SBSS program and, consequently, could be used to identify students who were at high risk for infection.[33] If SBSS programs were to be used in such a manner, high-risk students could then be targeted for text message reminders about rescreening (such as in Washington, DC),[18] condom use, or other effective risk-reduction interventions.

LIMITATIONS/GAPS

The small number of studies that have examined sustained SBSS programs across the United States substantially limited the conclusions that could be drawn in this review. In addition, the outcomes of SBSS may not be generalizable to all areas, as 11 of 20 studies were drawn from New Orleans and only 1 very small pilot study was done in a rural area.[34] Another limitation of the review is that any costs studied are societal costs, rather than direct costs to public health programs: programs do not treat PID and therefore will not see cost-savings from decreased case numbers. Additional cost studies accounting for *CT* screening that is paid for by individuals newly insured under the Affordable Care Act should be performed. Other gaps in research include the lack of case-control or prospective cohort studies of PID to see if its incidence (as opposed to the incidence of *CT*/*GC*) is indeed affected by SBSS, validation of risk behaviors associated with infection in a jurisdiction at other geographic sites, comparison of treatment rates using different models of treatment, and prospective evaluation of the efficacy of behavioral or other interventions on rates of infection in high-risk students. In addition, other metrics of measuring the success of SBSS, such as number of partners brought to treatment or percentage of infected youth treated via SBSS (as compared with those diagnosed elsewhere), should be evaluated.

SUMMARY

In summary, SBSSs are a feasible way of screening and treating large numbers of adolescent girls and males for *CT* and *GC*, and are probably effective at reducing PID and other sequelae of infection. Such programs are cost-effective to society as a whole, although they require substantial investment of time and resources from the jurisdictions that perform them. School-based STD screening programs do not seem to decrease prevalence or effectively increase student knowledge of STDs, but may serve as an effective platform for the identification of more high-risk adolescents and/or the dissemination of other public health prevention strategies.

REFERENCES

1. Centers for Disease Control and Prevention. 2012 STD Surveillance Report. 2012.
2. Newacheck P, Hung Y, Park M, et al. Disparities in adolescent health and health care: does socioeconomic status matter? Health Serv Res. 2003; 38:1235–1252. [PubMed: 14596388]
3. Fiscus LC, Ford CA, Miller WC. Infrequency of sexually transmitted disease screening among sexually experienced U.S. female adolescents. Perspect Sex Reprod Health. 2004; 36:233–238. [PubMed: 15687081]
4. Heijne JC, Tao G, Kent CK, et al. Uptake of regular Chlamydia testing by U.S. women: A longitudinal study. Am J Prev Med. 2010; 39: 243–250. [PubMed: 20709256]
5. Chow JM, de Bocanegra HT, Hulett D, et al. Comparison of adherence to chlamydia screening guidelines among Title X providers and non–Title X providers in the California Family Planning, Access, Care, and Treatment Program. J Womens Health. 2012; 21:837–842.

6. Howell MR, Quinn TC, Brathwaite B, et al. Screening women for *Chlamydia trachomatis* in family planning clinics: the cost-effectiveness of DNA amplification assays. Sex Transm Dis. 1998; 25:108–117. [PubMed: 9518379]
7. Cohen DA, Nsuami MJ, Etame RR, et al. A school-based chlamydia control program using DNA amplification technology. Pediatrics. 1998; 101:E1.
8. Han JS, Rogers ME, Nurani S, et al. Patterns of chlamydia/gonorrhea positivity among voluntarily screening New York City public high school students. J Adolesc Health. 2011; 49:252–257. [PubMed: 21856516]
9. Kent CK, Branzuela A, Fischer L, et al. Chlamydia and gonorrhea screening in San Francisco high schools. Sex Transm Dis. 2002; 29: 373–375. [PubMed: 12170123]
10. Barry PM, Scott KC, McCright J, et al. Stay in school? Results of a sexually transmitted diseases screening program in San Francisco high schools—2007. Sex Transm Dis. 2008; 35:550–552. [PubMed: 18356770]
11. Asbel LE, Newbern EC, Salmon ME, et al. School-based screening for *Chlamydia trachomatis* and *Neisseria gonorrhoeae* among Philadelphia public high school students. Sex Transm Dis. 2006; 33:614–620. [PubMed: 16614587]
12. Salerno J, Darling-Fisher C, Hawkins NM, et al. Identifying relationships between high-risk sexual behaviors and screening positive for chlamydia and gonorrhea in school-wide screening events. J Sch Health. 2013; 83:99–104. [PubMed: 23331269]
13. Lofink H, Kuebler J, Juszczak L, et al. 2010–2011 School-based Health Alliance Census Report. Washington, DC: School-Based Health Alliance, 2013.
14. Council on School Health. School based health centers and pediatric practice. Pediatrics. 2012; 129:387–393. [PubMed: 22291117]
15. Jamil MS, Bauer HM, Hocking JS, et al. Chlamydia screening strategies and outcomes in educational settings: A systematic review. Sex Transm Dis. 2014; 41:180–187. [PubMed: 24521724]
16. Furness B, Shah Y, Kharfen M, et al. Incorporating HIV testing into a city-wide school-based STD screening program. In: National STD Prevention Conference. Atlanta, GA: Centers for Disease Control and Prevention, 2014.
17. Anschuetz GL, Beck JN, Asbel L, et al. Determining risk markers for gonorrhea and chlamydial infection and reinfection among adolescents in public high schools. Sex Transm Dis. 2009; 36:4–8. [PubMed: 18813031]
18. Whycoff V, Shah Y, Kharfen M, et al. Lessons learned: incorporating text message reminders into a school-based STD screening program. In: YTH Live. Oakland, CA: Internet Sexuality Information Services, Inc., 2014.
19. CDC. Sexually transmitted diseases treatment guidelines. MMWR Recomm Rep. 2010; 59:100–110.
20. Scholes D, Stergachis A, Heidrich F, et al. Prevention of pelvic inflammatory disease by screening for cervical chlamydial infection. N Engl J Med. 1996; 334:1362–1366. [PubMed: 8614421]
21. Oakeshott P, Kerry S, Aghaizu A, et al. Randomised controlled trial of screening for *Chlamydia trachomatis* to prevent pelvic inflammatory disease: The POPI trial. BMJ. 2010; 340:903–909.
22. Aral SO, Blanchard J. The Program Science initiative: Improving the planning, implementation and evaluation of HIV/STI prevention programs. Sex Transm Infect. 2012; 88:157–159. [PubMed: 22363021]
23. Cohen DA, Nsuami MJ, Martin DH, et al. Repeated school-based screening for sexually transmitted diseases: A feasible strategy for reaching adolescents. Pediatrics. 1999; 104:1281–1285. [PubMed: 10585978]
24. Nsuami MJ, Cohen DA. Participation in a school-based sexually transmitted disease screening program. Sex Transm Dis. 2000; 27:473–479. [PubMed: 10987455]
25. Nsuami MJ, Cammarata CL, Brooks BN, et al. Chlamydia and gonor-rhea co-occurrence in a high school population. Sex Transm Dis. 2004; 31:424–427. [PubMed: 15215698]
26. Nsuami MJ, Taylor SN, Smith BS, et al. Increases in gonorrhea among high school students following Hurricane Katrina. Sex Transm Infect. 2009; 85:194–198. [PubMed: 18955385]

27. Nsuami MJ, Sanders L, Taylor SN. Knowledge of sexually transmitted infections among high school students. Am J Health Educ. 2010; 41: 206–2017.
28. Nsuami MJ, Taylor SN. Most adolescents who participate in school-based screenings for sexually transmitted infections do not perceive themselves at high risk of sexually transmitted infection. Int J STD AIDS. 2012; 23:822–824. [PubMed: 23155104]
29. Nsuami MJ, Nsa M, Brennan C, et al. Chlamydia positivity in New Orleans public high schools, 1996–2005: Implications for clinical and public health practices. Acad Pediatr. 2013; 13:308–315. [PubMed: 23685203]
30. Sanders L, Nsuami MJ, Cropley LD, et al. Reasons given by high school students for refusing sexually transmitted disease screening. Health Educ J. 2007; 66:44–57.
31. Wang LY, Burstein GR, Cohen DA. An economic evaluation of a school-based sexually transmitted disease screening program. Sex Transm Dis. 2002; 29:737–745. [PubMed: 12466713]
32. Low N, Forster M, Taylor SN, et al. Repeat chlamydia screening among adolescents: Cohort study in a school-based programme in New Orleans. Sex Transm Infect. 2013; 89:20–24. [PubMed: 22773326]
33. Lewis FM, Newman DR, Mettey A, et al. Partner meeting place is significantly associated with gonorrhea and chlamydia in adolescents participating in a large high school sexually transmitted disease screening program. Sex Transm Dis. 2014; 41:605–610. [PubMed: 25211256]
34. Alicea-Alvarez N, Hellier SD, Jack LW, et al. A pilot study of Chlamydia screening among high school girls. J Nurse Pract. 2011; 7:25–28.
35. Lewis FM, Mettey A, Anschuetz GL, et al. Risk assessment in a large cohort of urban public high school students infected with *CT* or *GC*—Philadelphia, 2009–2010 International Society for Sexually Transmitted Diseases Research; 2011; Quebec, Canada.
36. Fisman DN, Spain CV, Salmon ME, et al. The Philadelphia High School STD Screening Program: Key insights from dynamic transmission modeling. Sex Transm Dis. 2008; 35:S61–S68. [PubMed: 18607306]
37. ETR Associates, Lezin N, Taylor J. Chlamydia: Starting a school-based screening and treatment program. Scotts Valley, CA: ETR Associates, 2005.
38. Indian Health Service. Starting a School-Based Chlamydia Screening Program in Indian Country. In: Indian Health Service and Centers for Disease Control and Prevention, eds. Department of Health and Human Services, 2007.
39. Shah Y, Furness B, Seechuk K. School-based screening and beyond: Expanding collaborations to service DC’s youth In: National STD Prevention Conference. Atlanta, GA: Centers for Disease Control and Prevention, 2012.
40. Anschuetz GL, Asbel L, Spain CV, et al. Association between enhanced screening for *Chlamydia trachomatis* and *Neisseria gonorrhoeae* and reductions in sequelae among women. J Adolesc Health. 2012; 51:80–85. [PubMed: 22727081]
41. Low N Screening programmes for chlamydial infection: When will we ever learn? BMJ 2007; 334:726–728.
42. Howell MR, Quinn TC, Gaydos CA. Screening for *Chlamydia trachomatis* in asymptomatic women attending family planning clinics: A cost-effectiveness analysis of three strategies. Ann Intern Med. 1998; 128: 277–284. [PubMed: 9471930]
43. Honey E, Augood C, Templeton A, et al. Cost effectiveness of screening for *Chlamydia trachomatis*: A reviewof published studies.Sex Transm Infect. 2002; 78:406–412. [PubMed: 12473799]
44. Marazzo JM, Celum CL, Hillis SD, et al. Performance and cost-effectiveness of selective screening criteria for *Chlamydia trachomatis* infection in women. Implications for a national chlamydia control strategy. Sex Transm Dis. 1997; 24:131–141. [PubMed: 9132979]
45. Mettey A, Anschuetz GL, Lewis FM, et al. Seven years, 112,000 tests later: Trends from the Philadelphia high school STD screening program In: National STD Prevention Conference. Atlanta, GA: Centers for Disease Control and Prevention, 2010.
46. Brunham RC, Pourbohloul B, Mak S, et al. The unexpected impact of a *Chlamydia trachomatis* infection control program on susceptibility to reinfection. J Infect Dis. 2005; 192:1836–1844. [PubMed: 16235186]

47. Kretzschmar M, Welte R, van den Hoek A, et al. Comparative model-based analysis of screening programs for *Chlamydia trachomatis* infections. Am J Epidemiol. 2001; 153:90–101. [PubMed: 11159151]

TABLE 1.

Published Studies Involving Mass STD Screening Programs in High Schools, 1998–2014

Citation	Study Type	N, # Schools, Year(s)	*CT*/*GC* Positivity	Other Findings
Michigan				
Salerno et al.[12]	Cross-sectional study to determine prevalence of *CT*/*GC* and examine (bivariate analysis) relationships between self-reported behaviors and testing positive	N = 869 9th–12th grade students from 1 school, 2005–2009	*CT*/*GC*: 12.8% females, 4.4% males	Students aged 14–20 y attended biannual education and screening events and completed sexual health questionnaires. Students may have participated in program more than one time. 752 self-identified as sexually active and 521 (69%) of these screened for *CT*/*GC*. Female sex was associated with testing positive. Weak association between being African American and testing positive. No significant difference in testing positive during screening between students who reported any of 3 high-risk behaviors (≥4 lifetime partners, no condom at last sex, sex in past 3 mo) vs. those who did not; however, each of these 3 behaviors was associated with self-reported lifetime history of any STD.
New Orleans				
Cohen et al.[7]	A demonstration project to determine the feasibility, acceptability, and yield of an SBSS program	N = 1933 7th–12th grade students in 3 schools, 1995–1996	*CT*: 9.7% females, 4.0% males	Students from junior/senior high schools (grades 7–12) tested for *CT*. Parental consent required and was obtained for 86.9% of students. Among all students with consent, 67.8% were tested. Females were less likely to be tested than males. Average laboratory cost per infection identified was $272. 111/126 (88%) infections were treated.
Cohen et al.[23]	Cross-sectional comparison of *CT*/*GC* prevalence among students in 3 schools with 3 y of annual screening and students in 5 schools without prior screening	N = 4805 9th–12th grade students from 8 schools, 1995–1998	*CT*: 11.5% females, 6.2% males. *GC*: 2.5% females, 1.2% males	Students tested at least once for *CT*/*GC* in a 3-y period. Parental consent required. *CT* prevalence increased with increasing age. Repeated participation in program associated with a decrease in *CT* prevalence in males but not in females
Low et al.[32]	Cohort study using random-effects logistic regression to determine *CT* screening uptake and investigate determinants of repeated yearly student participation in screening	N = 35,041 9th–12th grade students registered in up to 13 schools, 1995–2005		Students were ≥14 y old. 19,826 were registered for ≥2 y. Parental consent required and standards for this changed over time. Overall uptake was >30% each year. Over time, screening uptake declined with more stringent parental consent procedures. Proportion of students tested each year decreased with increasing number of years registered in school. Among students with consent for 2, 3, and 4 y, respectively, 61.6%, 50.5%, and 49.3% of females and 65.8%, 59.8%, and 59.3% of males were tested each year. Females with a previous positive test were less likely to participate in screening the following year. Students with ≥1 partner in the previous 3 mo were more likely to participate in subsequent screening.
Nsuami et al.[24]	Cross-sectional analysis to determine patterns of participation in screening program and prevalence of infection	N = 1475 9th-12th grade students at 3 schools, 1995–1998	*CT*: 16.3% female, 5.4% male	Students remained in school during 3 school years. Students who never tested, tested once, or tested more than once were compared using bivariate analysis. 1156 (78.4%) of students obtained parental consent to test each year. Nearly 90% of students enrolled for 3 y participated in the program, and 81% participated more than once. Students who tested were more likely to be male and younger than those who never tested. Point prevalence did not change significantly over time. Students who tested positive were more likely to be older, to be female, and to have tested only one time. Reinfection occurred only among female students and was 7.3%.
Nsuami et al.[25]	Cross-sectional analysis to determine rates of coinfection with *CT* and *GC* in a high school cohort	N = 5877 9th–12th grade students in 12 schools, 1998–1999	*CT* prevalence: 297 (10.4%) females, 154 (5.1%) males. *GC* prevalence: 87 (3.0%) females, 30 (1.0%) males. Coinfection prevalence: 36	Students with parental consent were additionally asked whether or not they had STD symptoms at time of screening. STD symptoms were reported significantly more frequently by students who were coinfected than those who were not (16.0% vs. 7.7% with *GC* only and 5.0% with *CT* only).

Citation	Study Type	N, # Schools, Year(s)	*CT*/*GC* Positivity	Other Findings
			(1.3%) females, 14 (0.5%) males	
Nsuami et al.[26]	Multivariate logistic regression analysis comparing rates of *GC* before and after Hurricane Katrina in a school in affected neighborhood	N = 646 9th–12th grade students in 1 school, 2004–2007		Students tested before hurricane Katrina (2004–2005, n = 313), after hurricane Katrina (2006–2007, n = 300) or before and after the hurricane, n = 33). Parental consent required each year. Odds ratio for *GC* infection more than doubled (odds ratio, 2.2; 95% confidence interval, 0.9–5.4) among students whose physical environment still displayed the deterioration left by hurricane Katrina.
Nsuami et al.[27]	Multivariate analysis examining STD knowledge among high school students participating in screening program	N = 3563 9th–12th grade students in 9 schools, 2003–2005		Students given a paper-and-pencil, self-administered 6-question STD knowledge questionnaire while participating in SBSS. Among all students surveyed, 21.8% correctly answered all 6 knowledge questions: 10.5% among 9th graders, 19.7% among 10th graders, 26.4% among 11 th graders, and 31.1% among 12th graders. Sex, grade, and a previous *CT*/*GC* infection predicted knowledge. Lower knowledge of STDs was not associated with increased probability of infection.
Nsuami et al.[28]	Survey to determine perceptions of STD risk	N = 3336 9th-12th grade students in 9 schools, 2003–2005		Students testing in the SBSS asked to assess their STD risk as none, not very high, medium, pretty high, or very high. Those answering pretty high or very high were categorized as perceiving themselves at high risk. 1183 (35.5%) perceived themselves at high risk vs. 2153 (64.5%) who perceived themselves as not at high risk. Of those who perceived themselves at high risk, 13.7% tested positive for *CT* or *GC* compared with 12.1 % of those who did not perceive themselves at high risk; however, the difference was not statistically significant. Estimate of STD risk did not differ by grade, sex or race.
Nsuami et al.[29]	Multivariate logistic regression analysis to determine trends in *CT* positivity among students and factors associated with infection	N = 30,626 tests from 9th–12th grade students in up to 13 schools, 1995–2005	Mean *CT* positivity: 13.1% females, 7.0% males	Students may have tested in program in multiple years. Laboratory assay changed from LCx to BD in 2000–2001 school year. *CT* positivity in males associated with age, being African American, school year, and *GC* coinfection. *CT* positivity in females associated with age, being African American, testing with BD assay, and coinfection with *GC*. Retesting in the program was not significantly associated with *CT* positivity in males or females. Between 1996 and 2005, no evidence that *CT* positivity increased in the population but rather that laboratory capacity to detect infection improved with use of BD assay, and positivity was consistently high. Strongest predictor of *CT* infection was *GC* infection.
Sanders et al.[30]	Cross-sectional survey to determine reasons for refusing to participate in screening, using the health belief model as theoretical framework	N = 156 9th-12th grade students in 9 schools, 2004–2005		Students who had parental consent to participate in screening but who refused completed a 25 question checklist survey. Most frequent single reason given by males was that they simply did not want to take the test. Most frequent single reason given by females was either they had never had sex or they simply did not want to take the test. 85/156 refused testing because they did not perceive themselves to be susceptible to STD due to several factors, most of which were inaccurate (no recent sex; being healthy; taking a bath every day).
Wang et al.[31]	Retrospective economic evaluation using decision-analysis model to compare costs and cases of expected PID in school-based vs. non-school-based *CT* screening	9th-12th graders in 5 schools, 1997–1998	Assumed 30% of untreated *CT* would progress to PID	Base-case analysis: at intervention cost of $86,449, school screening detected/treated 159.8 *CT* cases and prevented 24 among female partners of male cases. Compared with non-school-based screening, the program prevented an estimated 38 PID cases and $119,866 in medical costs for treating PID and its sequelae. Replacing non-school-based screening with school screening resulted in net savings of $ 1524/case of PID prevented. Sensitivity analysis: results remained cost-saving over range of prevalence estimates (6.2%—18.6% among females, 3.05% to 9.15% among males); cost-effectiveness was sensitive only to the estimated cost of treating PID and ranged from $540 to $1869 to prevent a case of PID and sequelae. Higher *CT* prevalence resulted in greater cost-effectiveness.
NYC				
Han et al.[8]	Multivariate logistic regression analysis to determine relationships between demographics, sexual activity,	N = 27,353/57,418 (47.6%) 9th-12th grade students from 244 schools, 2006–2009	*CT* and/or *GC*: 8.9% females, 3.8% males	Positivity increased with age for both males and females. Males more likely to screen than females. African American students had highest prevalence (11.4% females, 5.1% males). Of all sexually active students (only available from 2008–2009 school year), 7326 (70.6%) screened, and 2241 (28.0%) students not sexually active screened. Students who did not

Citation	Study Type	N, # Schools, Year(s)	*CT*/*GC* Positivity	Other Findings
	test positivity and screening status			answer sexual activity question had positivity rate of 6.2%, as compared with 7.1% of those who answered "yes" and 1.4% of those who answered "no."
Pennsylvania				
Alicea-Alvarez et al.[34]	Pilot study to determine feasibility of a school-based *CT* screening and *CT* positivity amongst a sample of rural high school females	N = 56/165 (31.0%) of eligible 10th—12th females in 1 school returned consent and 51 submitted a urine sample, 2009	*CT*: 3.9%	90% participants were non-Hispanic white, 8% non-Hispanic black, 1% Asian. Mean age of testers was 15.2 y. Raffle for $50 incentive provided to students who tested.
Philadelphia				
Anschuetz et al.[17]	Multivariable analysis to determine risk markers for *CT*/*GC* infections; secondary analysis of *CT*/*GC* infection and reinfection rates	N = 19,307 paired samples from 14,862 9th-12th grade students in >65 schools, 2002–2006	*CT*/*GC* rate (per person-years): males, 2.4/100, females 6.0/100	677/2269 (29.8%) *CT* and/or *GC*-positive students were retested. Previous positive test, black race, and enrollment in disciplinary school were associated with infection; partner treatment status among females was associated with reinfection.
Asbel et al.[11]	Analysis of cross-sectional data from the first year of program	N = 19,701 samples from 19,394 9th-12th grade students in >65 schools, 2003	*CT*: 8.1% females, 2.5% males. *GC*: 0.8% females, 0.2% males	Prevalence higher in black race, older age, disciplinary school type, high morbidity zip codes. 1051/1052 (99.9%) *CT* and/or *GC* infections were treated.
Fisman et al.[36]	Evaluation of cost-effectiveness using dynamic transmission modeling (susceptible-infectious-recovered-susceptible model)	9th-12th graders in >65 schools, 2002–2006	Fixed *CT* prevalence of 7.9% in females was used in all simulations; 30% of untreated *CT* infections were assumed to progress to PID	Screening males only for *CT* would prevent approximately 4 times as many infections in females as would be prevented by screening females only. Effectiveness and cost-effectiveness of screening increased as prevalence in males decreased; cost-effectiveness in females increased as prevalence increased, up to a point. Screening of males and females more effective and cost-effective than female-only screening. Rebound prevalence seen in Philadelphia data and other jurisdictions is explainable by the model and does not decrease the cost-effectiveness of screening. All models projected a net reduction in PID over the first 5 y of screening at between $500 and $3500 per quality-adjusted life year gained.
Lewis et al.[33]	Multivariable logistic regression analysis to determine relationships between demographics, self-reported risk behaviors, and test positivity.	N = 1489 positive and 318 negative 9th-12th grade students in >65 schools, 2009–2012		Independent factors associated with infection among females included black race, history of arrest, higher partner number, meeting partners in the neighborhood, and meeting partners at a venue other than their own school, neighborhood, or through friends. Factors associated with infection among males included early sexual debut and meeting partners at a venue other than their own school, neighborhood, or through friends. For males, meeting partners through friends was protective, and meeting partners at their own school was protective for both males and females. However, less than half of all students (44.7%) met partners in their own school.
San Francisco				
Barry et al.[10]	Analysis of cross-sectional data from 2 schools in high-morbidity areas	N = 537 samples from 853 11 th–12th grade students in 2 schools, 2007	*CT*: 2.2% females, 0.6% males	7 students tested positive for *CT*. No *GC* found. Prevalence higher in blacks (5.4%) and Hispanics (2.0%). All infections identified were treated.
Kent et al.[9]	Pilot study determining the feasibility and acceptability of a *CT*/*GC* screening program	N = 664 9th—12th grade students at 4 selected high schools, 1999	*CT*: 3.9% females, 0.8% males. *GC*: 0.7% females, 0.0% males	Students screened for *CT*/*GC* in different screening settings (clinic, health fair, lunch room, small room). Education provided individually before screening. $10 incentives provided to students who screened. <1% of parents denied consent for participation in educational component of program. Positivity increased with age for both males and females. Efficiency (# screened/STD service staff hour) varied substantially depending on school setting. Most efficient but least complete screening was in large school health fair setting; most complete but least efficient was in small school where entire classes were released to test.

TABLE 2.

Summary of SBSS Program Capacity

Project Area	Years of Operation	Opt-out Consent	No. Screened by June 2013	No. (%) *CT/GC+*	Mode of Treatment (% *CT/GC* Treated)	Other Services	References
Chicago	2009–present	Yes	15,421	1429 (9.0)	SBHC*, HD referral† (95.0)		S. Tilmon (PC, 2014)
Detroit	2011–present	No	3449	327 (9.5)	SBHC (99.0)		A. Peterson (PC, 2014)
New Orleans	1995–2005	No	30,626	3422(11.2)	SBHC, HD‡ (83.1)		Nsuami 2010, Nsuami et al.[29]
NYC	2006–present	Yes	56,845	3069 (5.4)	HD (92.9)	EPT§, EC¶, PS, condoms	J. Schillinger (PC, 2014)
Philadelphia	2002–present	Yes	112,228	8251 (7.4)	HD (97.4)	PS, condoms	M. E. Salmon (PC, 2014)
San Francisco	1999, 2006–2007	Yes	1201	23(1.9)	HD (100)	EPT	Kent et al.[9]; Barry et al.[10]
Washington, DC	2007–present	Yes	10,262	600 (6.0)	HD, SBHC (87.0)	PS, HIV// text message reminders, condoms**	Furness et al.[16]

PC indicates personal communication.

*In-school treatment provided by SBHC or school nurse.

†Referral to treatment in STD clinic by HD; HIV testing, condoms and EPT available at time of treatment in clinic.

‡In-school treatment provided by health department teams.

§EPT provided at time of treatment.

¶Emergency contraception provided at the time of treatment.

//In-school HIV testing offered at time of treatment to students testing positive.

**Students offered text message reminders to call in for results, get partners treated, and for rescreening.

TABLE 3.

Potential Goals of SBSS Efforts and Any Supporting Evidence

Goal	Achievable?	Source
Increase appropriate screening	Yes	Han et al.[8], Kent et al.[9], Asbel et al.[11], Cohen et al.[23], Nsuami et al.[29], Low et al.[32], Furness et al.[16], A. Peterson (PC, 2014), S. Tilmon (PC, 2014)
Case finding	Yes	Han et al.[8], Asbel et al.[11], Furness et al.[16], Nsuami et al.[29], A. Peterson (PC, 2014), S. Tilmon (PC, 2014)
Rescreen infected persons	Yes, though logistically difficult due to time constraints of school year	Asbel et al.[11], Furness et al.[16], Nsuami et al.[29]
Treat infected people	Yes	Kent et al.[9], Han et al.[8], Asbel et al.[11], Furness et al.[16], Nsuami et al.[29], A. Peterson (PC, 2014), S. Tilmon (PC, 2014)
Provide partner services to infected people	Yes	Han et al.[8], Asbel et al.[11], Furness et al.[16]
Decrease prevalence of *CT*/*GC* in school	No	Nsuami et al.[29], Lewis et al.[33], Fisman et al.[36], Mettey et al.[45], S. Tilmon (PC, 2014)
Increase level of knowledge regarding STD treatment, prevention, and epidemiology	Equivocal; knowledge (weakly) associated with increasing age and attending school where presentation had been	Nsuami et al.[27]
Discriminate between low and high-risk persons who test in SBSS	Yes, though only one study	Lewis et al.[33]

PC indicates personal communication.