Chlamydia Screening Strategies and Outcomes in Educational Settings: A Systematic Review

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Abstract: *Chlamydia trachomatis* (*CT*) screening programs have been established in educational settings in many countries during the past 2 decades. However, recent evidence suggests that high uptake of screening and management (treatment, partner notification, and retesting for reinfection) improves program effectiveness. We conducted a systematic review to understand the screening strategies, the extent of screening conducted, and uptake of management strategies in educational settings. Screening studies in educational settings were identified through a systematic search of published literature from 2005 to 2011. We identified 27 studies describing 30 screening programs in the United States/Canada (n = 10), Europe (n = 8), Australia/New Zealand (n = 5), and Asia (n = 4). Most studies targeted both male and female students (74%). Classroom-based strategies resulted in 21,117 testes overall (4 programs), followed by opportunistic screening during routine health examination (n = 13,470; 5 programs) and opportunistic screening at school-based health centers (n = 13,006; 5 programs). The overall median *CT* positivity was 4.7% (range, 1.3%–18.1%). Only 5 programs reported treatment rates (median, 100%; range, 86%–100%), 1 partner notification rate (71%), 1 retesting rate within a year of an initial *CT* diagnosis (47%), and 2 reported repeat positivity rates (21.1% and 26.3%). In conclusion, this systematic review shows that a variety of strategies have been used to screen large numbers of students in educational settings; however, only a few studies have reported *CT* management outcomes.

Adolescents and young adults are major risk groups for *Chlamydia trachomatis* (*CT*) and *Neisseria gonorrhoea* (*NG*) infections.[1–3] Clinical guidelines in many countries recommend annual *CT* screening for all sexually active young women[4–6] and extend to young men in some countries.[7] Also, it is recommended that any person diagnosed as having *CT* infection should be retested within 3 months of treatment.[5,6,8] The conventional approach to opportunistically screen people attending primary care clinics for nonsexual health reasons has often failed to achieve high coverage,[9–11] and retesting rates are also low in many clinical settings.[12–15]

The advent of nucleic acid amplification tests, which detect *CT*/*NG* infection with self-collected vaginal swab and urine specimens, has encouraged screening programs outside conventional clinical settings, including educational settings, with numerous programs established in various countries.[16–19] However, in recent years, mathematical modeling studies have suggested that to achieve population level impact on *CT* transmission, screening programs need to achieve high testing coverage and also high rates of partner notification and retesting for reinfection after treatment.[20–22]

Mathematical modeling in Australia has predicted that screening 40% of men and women younger than 25 years annually would decrease *CT* prevalence rapidly for 10 years in all age groups.[20] Other mathematical modeling also suggests that treating symptomatic men and women and screening 38% of women aged 15 to 24 years annually would significantly reduce the average number of secondary infections and that screening men and women aged up to 29 years may affect *CT* transmission.[21] Modeling by Althaus et al.[22] also estimated that in a population-wide screening program, the treatment for current partners is the most effective strategy for reducing *CT* transmission at the population level.

Despite screening programs being implemented in educational institutions (school, college, universities) for many years, the screening strategies used and other program components that improve effectiveness have not been studied in a systematic manner. In this context, we systematically reviewed the published literature on *CT*/*NG* screening programs in educational settings to explore the screening strategies used, the extent of screening conducted, and the uptake of treatment, partner notification, and retesting after treatment.

METHODS

The review was conducted according to the PRISMA guidelines.[23] The electronic bibliographic databases, PubMed and EMBASE, were searched for English-language studies published between January 1, 2005, and January 28, 2011, with the following search terms: Chlamydia, or Chlamydia infections, or *Chlamydia trachomatis*, OR Gonorrhea, AND Screening, or Mass Screening, or testing. The reference lists of selected studies were also screened to identify other eligible studies. A study was included if it reported on a *CT* or *CT* and *NG* screening program in an educational setting (school, college, university, technical institution) using self-collected specimens and reported the number of tests.

The articles were reviewed by 2 authors (M.S.J. and R.J.G.) independently, and disagreements were resolved by discussion and consensus. One author (M.J.) extracted the data from each article, and a second author (R.G.) double checked the data. The following information was extracted: demographics; screening strategy (location, recruitment, advertisement, incentive, etc); number screened; *CT*/*NG* positivity; notification of results; treatment, retesting, and reinfection rate;

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and partner notification. The authors were contacted to collect additional information, if required.

Programs were classified into 7 groups (hereafter called *program type*) based on screening strategy and location. All analyses were conducted in STATA 12 (StataCorp, College Station, TX).

RESULTS

Of 3219 articles identified through the literature search, 27 articles were included in the review (Fig. 1).[24–50] Of these, 3 articles described programs using 2 different screening strategies[29,31,46] and were thus classified into different program types, giving a total of 30 programs that formed the basis of analysis.

Overview of Programs

Programs involved classroom-based screening (n = 4), opportunistic screening at school-based health centers (SBHCs; n = 5), opportunistic screening during routine health/sports physical examinations (n = 6), voluntary screening at SBHC (n = 3), screening at other on-campus locations (n = 4), event-based screening (n = 4), and other strategies (n = 5; Table 1). Programs were conducted in the United States/Canada (37.0%), Europe (29.6%), Australia/New Zealand (18.5%), and Asia (14.8%). Most targeted both male and female students (74.1%). The specimens consisted of urine only (77.8%), vaginal swab only (7.4%), and urine for men and vaginal swab for women (14.8%).

Across all programs, 53,935 tests were conducted (median, 515). The overall median *CT* positivity was 4.7% (n = 28), and *NG* positivity was 0.2% (n = 12). Five programs reported the treatment rate with a median of 100% (range, 86%–100%).

Findings by Program Type

Classroom-Based Screening. In these 4 programs, students were approached in the classrooms for screening.[25,27,38,44] In 2 programs, every grade 9 to 12 student was scheduled to attend an education/screening session[25] or students viewed a brief presentation in classrooms.[27] Every student received a test kit and returned it with or without a specimen at stalls near bathrooms.[25,27] The entire class was escorted to the testing area, and students were individually counseled for an opportunity to screen in the third program.[44] In the fourth program, female students were provided with screening information and test kits during lectures or lecture breaks, and specimens were returned on the next day.[38] In 2 of these programs, screening was part of ongoing annual programs in New Orleans[44] and Philadelphia[25] high schools.

Across these programs, 21,117 tests were conducted (median, 535), but most of these tests (93.3%) were done in one program.[25] The median *CT* positivity was 5.4% (n = 4). Test results were accessible through a Web site in one program.[38] Two programs reported treatment rates of 99.9%[25] and 100%.[27]

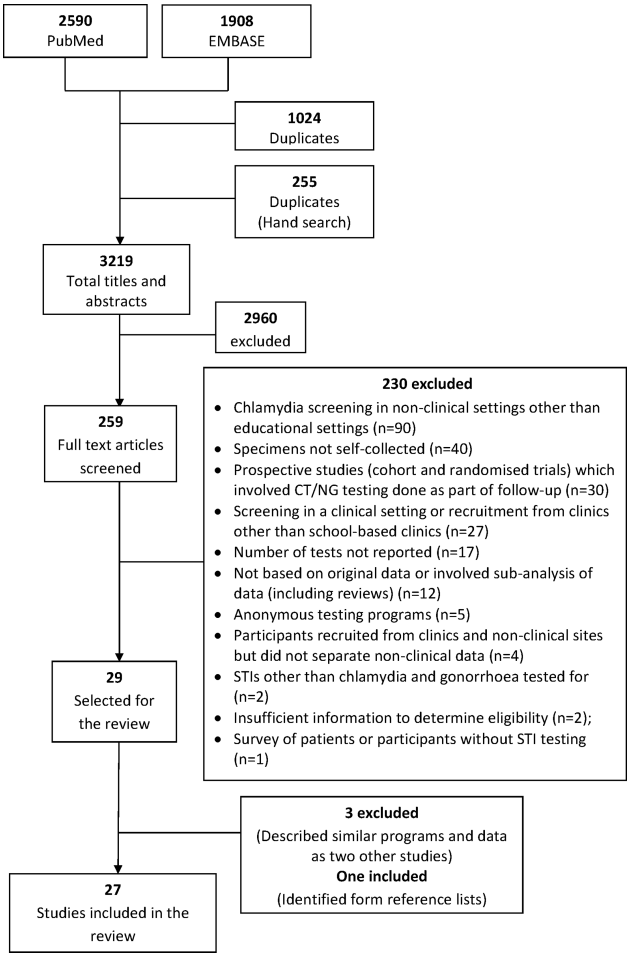

Figure 1. Flow diagram of systematic search strategy.

TABLE 1. Strategies and Outcomes of *CT* and *NG* Screening Programs in Educational Settings Published Between January 2005 and January 2011 Classified by Program Type

Author Year	Country; Setting	Sex; Age, y	Screening Strategy	Tests	*CT* Positive, % (95% CI)	*NG* Positive, % (95% CI)	Treatment and Partner Notification (PN)
Classroom-based screening (n = 4)							
Asbel et al. 2006[25]	US; HS	M/F; 12–20	Students scheduled for education session and received kits. Specimens collected at stalls near restrooms	19701	5.2* (4.8–5.5)	0.5 (0.4–0.6)	TR: 99.9%*. Positive students encouraged to ensure partners get treatment
Barry et al. 2008[27]	US; HS	M/F	Presentation in classrooms, students received test kits. Specimens collected at stalls near bathrooms	537	1.3 (0.5–2.7)	0.0 (0.0–0.7)	TR: 100%. Field delivered therapy and PDPT
Kucinskiene et al. 2008[38]	Lithuania; HS, MC	F	Personal contact established and information provided during lectures/breaks. Home-collected specimens	533	5.6 (3.8–7.9)	0.2 (0.0–1.0)	Positive students invited to attend a venereologist (57% attended)
Nsuami et al. 2009[44]	US; HS	M/F	Entire class escorted to testing area and individually counseled regarding screening opportunity	346	12.4 (9.1–16.4)	2.3 (1.0–4.5)	Index case and same-school partner treated at school. Encouraged to refer other partners to clinic
Opportunistic screening at SBHC (n = 5)							
Aldeen et al. 2010[24]	England; U	M/F; >18	Posters throughout campus and SBHC. Receptionists offered flyers to consecutive students	88	3.4 (0.7–9.6)		Positive students offered treatment and PN
Baker et al. 2005[26]	NZ; U	F; 18–25	Receptionist offered screening to a fixed proportion of attendees (every 2nd to 3rd appointment)	715	2.7 (1.6–4.1)		Positive students advised to return for treatment and contact tracing
O'Connell et al. 2009[45]	Republic of Ireland; U, IE	F	Nurse/Doctor informed students about screening after consult; receptionist informed students; nurses referred students to doctor†	496	4.9‡ (3.1–7.3)		Positive students referred to health unit for management and contact tracing
Gaydos et al. 2008[33]	US; MS, HS	F	SBHC attendees asked to voluntarily screen if sexually active	9256	18.1 (17.4–18.9)		
Schillinger et al. 2005[46]	US; S, C	M	Screening at well adolescent visits, acute care visits or visits for other reasons	2451	7.1 (6.1–8.2)	1.1 (0.7–1.7)	Treatment according to CDC guidelines. Staff sought to notify all sex partners
Voluntary screening at SBHC (n = 3)							
Gaydos et al. 2008[32]	US	M/F; 14–16	Students enrolled in an intervention study encouraged to voluntarily screen at SBHC	875	10.1 (8.1–12.2)	4.1 (0.3–5.7)	Positive students treated at SBHC, asked to name same-school partners and refer others to STD clinics
	HS						
James et al. 2008[37]	US	M/F	Students informed about voluntary screening through e-mails, flyers, and radio	789	9.7 (7.8–12.0)	1.4 (0.7–2.5)	Positive students treated at SBHC and encouraged to notify their partners
	C/U						
Langille et al. 2008[39]	Canada	F	Students informed in school assembly, via newsletter, Web site, and class visits. Kits picked up from SBHC	27	7.4 (0.9–24.3)		Positive students treated at SBHC and followed up for contact tracing
	HS						
Opportunistic screening during health/sports examination (n = 5)							
Hennrikus et al. 2010[34]	US	M/F; 18–23	Educations session to inform and specimen collected during sports physical examination	439	2.7 (1.4–4.7)		Positive students treated and encouraged to bring partners for treatment
	U						
Hsieh et al. 2010[35]	Taiwan	M/F; 14–20	Research/school staff recruited students during annual health examination	993§	2.3¶ (1.5–3.5)	0.2 (0.0–0.7)	
	HS						
Imai et al. 2010[36]	Japan	M/F; ≥18	Oral/written invitation and information sessions on screening days. Specimens dropped in boxes on-campus	10,687	8.4‖ (7.7–9.1)		Students advised to visit a clinic if found positive
	C/U/PS						

TABLE 1. *(Continued)*

Author Year	Country; Setting	Sex; Age, y	Screening Strategy	Tests	*CT* Positive, % (95% CI)	*NG* Positive, % (95% CI)	Treatment and Partner Notification (PN)
Mossong et al. 2009[43]	Luxembourg	M/F; ≥16	Students were provided with information leaflets and screening during compulsory medical examination	1327**	1.9** (1.2–2.8)		Positive students advised to seek treatment at FPC or visit GP
	SS						
Vogler et al. 2009[49]	Australia	M/F; 14–19	Screening during adolescent health check delivered by indigenous health workers	24			Indigenous health worker performed treatment and contact tracing
	HS						
Event-based screening (n = 4)							
Buhrer-Skinner et al. 2009[29]	Australia	M/F	Screening during market day of Orientation week. Promoted through posters	95	5.3 (1.7–11.9)		TR: 100%. Positive students were offered contact tracing
	U						
Currie et al. 2010[31]	Australia	M/F; 14–35	Various student events. Promoted by Student reps, posters, student media, SMS, Web advertising	638††	1.7 (0.9–3.1)		Positive students offered treatment at SHC. Nurses conducted contact tracing
	U/TS						
Schillinger et al. 2005[46]	US		School health fair	545	1.5 (0.6–2.9)	0.0 (0.0–3.5)	Treatment according to CDC guidelines. Staff sought to notify all sex partners
	School						
Vaughan et al. 2010[48]	Republic of Ireland	M/F; 18–29	Annual sexual health awareness and guidance week. Promoted through posters, leaflets, media, radio, e-mail, and newspaper. Kits available in toilets and distributed by volunteers	583	3.9‡‡ (2.4–5.9)		TR: 86%. Positive students referred to project nurse/research advisor for PN which was conducted with 15/21 positive cases
	U/TS						
Other on-campus locations (n = 4)							
Bowden et al. 2005[28]	Australia	M/F	Study office—recruitment done by clinicians and peer recruiters. Specimen collected in toilets. Advertisement and nonmonetary incentive	452	15.6 (0.4–2.6)	0.0 (0.0–0.8)	Positive students offered treatment and follow-up at school, SHC, or with GP
	HS						
Colliers et al. 2009[30]	Belgium	M/F; 18–39	University restaurant—test kits supplied in lavatories. Promoted via presentations, flyers, posters, and e-mail	243	2.9 (1.2–5.8)		Positive students and their partners were counseled and treated
	U						
Currie et al. 2010[31]	Australia	M/F; 17–56	Stall near lecture theatres—183 students were sent SMS about screening ($10 incentive) and asked to send to other students	472§§	1.8 (0.7–3.6)		Positive students offered treatment at SHC. Nurses conducted contact tracing
	U						
Lorimer et al. 2009[41]	Scotland	M/F; 16–24	College canteen—students invited to complete a survey and provide urine specimen	22			Positive results referred to a GUM clinic for management as per standard protocol
	C						
Other strategies (n = 5)							
Buhrer-Skinner et al. 2009[29]	Australia	M/F	Screening during clinical sessions	20	15.0 (3.2–37.9)		TR: 100%. Positive students were offered contact tracing
	SHS						
Lee et al. 2005[40]	South Korea	M/F; 18–25	Details not provided	622	3.7 (2.4–5.5)	0.2 (0.0–0.9)	Positive students offered treatment at STI clinic and asked to refer their partners
	U						

(Continued on next page)

TABLE 1. *(Continued)*

Author Year	Country; Setting	Sex; Age, y	Screening Strategy	Tests	*CT* Positive, % (95% CI)	*NG* Positive, % (95% CI)	Treatment and Partner Notification (PN)
Morris et al. 2010[42]	US	M/F; <30	Screening at various nonclinical settings. Specific screening strategy at schools not detailed	454	4.6 (2.9–7.0)		Positive students contacted to provide standard treatment and partner management
Takahashi et al. 2005[47]	HS/AS Japan	M	Students recruited through advertisements	204	3.4 (1.4–6.9)		
Williamson et al. 2007[50]	U Scotland	M/F; 13–25	Onsite testing with specimen collection by nurses	301	6.3 (3.8–9.7)		
	U/TS						

Treatment rate, number of individuals treated divided by number of positive tests.
*Calculated among 19,394 tests after excluding 307 out of age range.
†A different method was used in each institution.
‡Positivity among 450 sexually active.
§From 670 individual students in 2 successive years.
¶Positivity based on number of tests.
||Positivity among 10,440 sexually active students.
**Among sexually active only, 684 specimens from nonsexually active excluded.
††Submitted by 627 individual students.
‡‡Positivity from 538 tests after excluding 45 specimens out of age range and 9 with labeling error.
§§Submitted by 392 individual students.
AS indicates alternative school; C, college; CDC, Centers for Disease Control and Prevention; CI, confidence interval; F, female; FPC, family planning center; GP, general practice; GUM, genitourinary medicine; HS, high school; IE, institute of education; M, male; MC, medical college; MS, middle school; NZ, New Zealand; PDPT, patient-delivered partner therapy; PN, partner notification; PS, professional school; S, school; SHC, sexual health center; SHS, secondary high school; TR, treatment rate; TS, technical school; U, university; US, United States.

Opportunistic Screening at SBHC. In these programs, students attending SBHCs were screened opportunistically.[24,26,33,45,46] Detailed screening method was not available from all programs but included the following: receptionist approaching every second or third clinic attendee,[26] advertisement at SBHC and on-campus with receptionist offering flyers to consecutive students attending for nonsexual health reasons,[24] nurse/doctor offering screening after consultation, nurse referring students to doctors, or receptionists offering information leaflets to students.[45]

Across these programs, 13,006 tests were conducted (median, 715). The median *CT* positivity was 4.9% (n = 5). In one program where screening was routinely offered to sexually active female students attending SBHCs, 47% of those with *CT* diagnosis were retested within 1 to 12 months (mean, 4.3 months), and the repeat positivity rate was 26.3%.[33]

Voluntary Screening at SBHC. In these programs, students were encouraged to get voluntarily screened at SBHC by promoting screening through: e-mails, flyers, and student radio[37]; newsletter, school Web site, nurse visits to classes, and information session in school assembly[39]; and education sessions for students enrolled in an intervention study.[32] In one program, test packs could be picked up and dropped off in the SBHC waiting room.[39] Across these programs, 1691 tests were conducted (median, 789), and the median *CT* positivity was 9.7% (n = 3).

Opportunistic Screening During Health/Sports Physical Examination. In 5 programs, students were opportunistically screened during routine/annual health examination,[35,36,43] sports physical examination,[34] and adolescent health check.[49] None of the programs mentioned whether these examinations were carried out at SBHCs. Screening strategies varied across programs and included the following: information leaflet distribution,[43] recruitment by research/school staff,[35] information sessions for student athletes with a station added to usual sports examination rotation for specimen collection,[34] sexually transmitted infection (STI) testing within sexual health component of adolescent health checkup,[49] and posting notices with oral and written invitations by staff before screening and lectures at health checkup site, in lecture hall, or in classrooms on screening days with specimens dropped off in boxes.[36]

Across these programs, 13,470 tests were conducted (median, 993), and one program disproportionately contributed to the number of tests (79.3%).[36] The median *CT* positivity was 2.5% (n = 4). In a program that conducted screening in 2 consecutive school years, 53% of participants in the first year were retested in the next year, and the repeat *CT* positivity was 21.1%.[35] In one program, tests results were available through a Web site.[36]

Event-Based Screening. These 4 programs used various student events for screening such as orientation week[29]; sexual health awareness and guidance week[48]; school health fair[46]; orientation week; market stalls; band and bar nights; sporting events; scavenger hunts; and Halls of Residence.[31] Screening was promoted through advertisements including posters[29]; posters, student media, SMS, Web sites, and education sessions[31]; and posters, leaflets, media, radio, e-mail, and newspapers.[48] In one program, test packs were available in bathrooms as well as distributed by volunteers with specimen collection boxes placed inside toilet areas.[48]

Across these programs, 1861 tests were conducted (median, 564). The median *CT* positivity was 2.8% (n = 4). Treatment rate was 86% in one program[48] and 100% in another.[29] In one program, of the students diagnosed as having *CT*, partner notification was conducted with 71% (15/21), with patient referral being the most preferred method (n = 13).[48]

Screening at Other On-Campus Locations. These programs offered screening at on-campus locations other than

SBHC and classrooms.[28,30,31,41] Screening was offered in canteens in one program,[41] whereas in another program, test packs were available in the lavatories of university restaurant and students were informed through presentations, flyers, posters, and e-mails.[30] In the third program, clinicians recruited students in offices after being informed through advertisements, presentation in school assemblies, and peer recruiters.[28] In one school, students were given appointments, whereas screening was conducted on a "drop-in" basis in the second school with specimen collection in nearby toilets.[28] In the fourth study, a station was set up and 183 students were sent an SMS inviting them to screen and receive $10 cash incentive.[31] Students were encouraged to forward SMS to other students.

Across these programs, 1189 tests were conducted (median, 348), and the median *CT* positivity was 2.9% (n = 3).

Other Strategies. In 5 studies, sufficient screening details were not provided to allow classification.[29,40,42,47,50] Program details are contained in Table 1.

DISCUSSION

This systematic review shows that *CT*/*NG* screening in educational settings is a feasible approach to screen large numbers of young people and to identify and treat new infections. Screening programs have been conducted in many countries and in a range of educational facilities including schools, colleges, and universities. A variety of screening strategies were used, but the number of students screened seemed to be higher in classroom-based programs and programs offering opportunistic screening at SBHC and during routine health examinations. The *CT* management outcomes such as treatment, partner notification, and retesting at 3 months after treatment were only reported in a few studies.

The review has a few limitations. First, we did not search the gray literature and thus may not have included other relevant unpublished studies. Second, we purposely selected a literature search period of January 2005 to January 2011 to provide a current perspective on *CT* screening in educational settings; however, we acknowledge that we may have excluded programs published before this time, which may have had different outcomes to those included in our review. Other eligible articles may also have been published after the cutoff date for literature search. Third, the duration of programs varied, most were of a short duration but some were more than a year, which would influence the number of students screened. Finally, any comparison of *CT*/*NG* positivity across the programs is limited by different age groups, ethnic composition, and proportion of sexually active students in the target population as well as prevalence in the underlying populations.

One of the main objectives of this review is to understand the strategies that result in more people being screened. The programs that targeted entire classes of students[25] and conducted opportunistic screening at SBHC[33,46] and opportunistic screening during routine/annual health examination[36,43] appeared to screen the most number of students. However, the decision of what strategy to use may be dependent on resources available, availability of SBHCs, and whether the schools conduct annual health and/or sports physical examinations. School-based health centers are present only in 6.4% of US public schools.[51] A survey of 736 US colleges/universities found that STI services were available in 66% of institutions with a SBHC, and only 48% and 67% of these screened sexually active men and women, respectively.[52]

Education facilities are ideal to reach adolescents and young adults for screening because it is mandatory for students to remain in school in many countries. However, in addition to screening coverage, the success of screening programs depends on treatment, partner management, and retesting after treatment. Overall, there was a lack of quantitative data on these outcomes. A number of programs noted the presence of partner notification strategies, but the outcomes were only reported in one program in the review.[48] The presence of SBHCs seems to facilitate the treatment for students and their same-school partners[32,37,39,45]; however, partner treatment can be challenging when they are not students at the same school. One of the programs in the review reported retesting rates at 1 year after a positive *CT* diagnosis with higher rates achieved (47%; median time to retest, 4.3 months[33]) compared with clinical settings.[12–14]

A key aim of STI screening is to reduce population prevalence. However, it may not be realistic for school-based screening programs alone to achieve this because of sexual mixing of students with outside partners who are not participating in screening.[53] It may also take some time for screening programs to achieve prevalence reductions, even if coverage is high, as suggested by mathematical modeling.[20] Two school-based screening programs included in our review[25,44] were part of annual programs that achieved high testing coverage over many years, but only demonstrated a transient decline in prevalence for boys in one program[53,54] and girls in the other.[55,56] School-based screening programs can, nevertheless, represent an important component of an overall population-based screening program, by improving access for a subgroup of the population with high *CT* prevalence,[1,3] yet lower access to testing, especially in young men.[57–59]

This is the first systematic review, to our knowledge, to synthesize the findings of *CT* screening programs in educational settings based on strategies, coverage, and outcomes. The review demonstrated that screening programs have been conducted in a range of educational facilities in a number of countries and screened a large number of both male and female students, although some strategies seemed to reach a greater number of students than others. However, only a few programs reported on important screening outcomes such as treatment, partner notification, and retesting after treatment. Future evaluations of school-based program should also focus on collection and reporting of these important program outcomes.

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