BMJ

RESEARCH

Randomised controlled trial of screening for *Chlamydia trachomatis* to prevent pelvic inflammatory disease: the POPI (prevention of pelvic infection) trial

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Cite this as: *BMJ* 2010;340:c1642
doi:10.1136/bmj.c1642

ABSTRACT

Objective To determine whether screening and treating women for chlamydial infection reduces the incidence of pelvic inflammatory disease over the subsequent 12 months.

Design Randomised controlled trial.

Setting Common rooms, lecture theatres, and student bars at universities and further education colleges in London.

Participants 2529 sexually active female students, mean age 21 years (range 16-27).

Intervention Participants completed a questionnaire and provided self taken vaginal swabs, with follow-up after one year. Samples were randomly allocated to immediate testing and treatment for chlamydial infection, or storage and analysis after a year (deferred screening controls).

Main outcome measure Incidence of clinical pelvic inflammatory disease over 12 months.

Results Baseline prevalence of chlamydia was 5.4% (68/1254) in screened women and 5.9% (75/1265) in controls. 94% (2377/2529) of women were followed up after 12 months. The incidence of pelvic inflammatory disease was 1.3% (15/1191) in screened women compared with 1.9% (23/1186) in controls (relative risk 0.65, 95% confidence interval 0.34 to 1.22). Seven of 74 control women (9.5%, 95% confidence interval 4.7% to 18.3%) who tested positive for chlamydial infection at baseline developed pelvic inflammatory disease over 12 months compared with one of 63 (1.6%) screened women (relative risk 0.17, 0.03 to 1.01). However, most episodes of pelvic inflammatory disease occurred in women who tested negative for chlamydia at baseline (79%, 30/38). 22% (527/2377) of women reported being tested independently for chlamydia during the trial.

Conclusion Although some evidence suggests that screening for chlamydia reduces rates of pelvic inflammatory disease, especially in women with chlamydial infection at baseline, the effectiveness of a single chlamydia test in preventing pelvic inflammatory disease over 12 months may have been overestimated.

Trial registration ClinicalTrials.gov NCT00115388.

INTRODUCTION

Genital infection with *Chlamydia trachomatis* is the most common bacterial sexually transmitted infection in the United States and Europe, with over three million new infections diagnosed each year.[1 2] But most chlamydial infections remain asymptomatic and undiagnosed.[3] Untreated chlamydial infection in women can lead to pelvic inflammatory disease, causing scarring of the fallopian tubes, which can result in tubal infertility, chronic pelvic pain, and ectopic pregnancy. The annual cost of chlamydial infection and its sequelae in the United States has been estimated to exceed $2bn.[2]

In many developed countries, screening programmes for chlamydia have been set up to reduce transmission and reproductive tract morbidity.[2] The US Centers for Disease Control and Prevention recommend annual screening of all sexually active women aged 25 or less.[1] In England the recommendation applies to women aged 24 or less.[2] But controversy remains about the evidence base. The results of the landmark trial by Scholes et al[4] have been questioned,[5-7] and the continuing search for supporting evidence from other randomised controlled trials and epidemiological studies has not been always fruitful.[8-11] The UK National Institute for Health and Clinical Excellence recommended improvements in the quality of randomisation, allocation concealment, and blinding of assessment of outcome in any future trials of chlamydia screening.[3] A more accurate estimate of the rate of progression of genital chlamydial infection to pelvic inflammatory disease is also urgently needed to evaluate the cost effectiveness of screening programmes.[12] However, neither of the two previous trials[4 9] tested all the control women. No trials of chlamydia screening have taken place in a British population.

The national chlamydia screening programme was progressively rolled out across England from 2003 to 2008. This left a window of opportunity from 2004 to 2007 to carry out a community based trial in a non-healthcare setting using self taken samples. In the

POPI (prevention of pelvic infection) trial we investigated whether screening young sexually active female students for chlamydial infection and treating those found to be infected reduced the incidence of pelvic inflammatory disease in the subsequent 12 months. We also carried out an exploratory study to investigate the incidence of pelvic inflammatory disease in women with untreated chlamydial infection.[13]

METHODS

The design and recruitment methods have been published elsewhere.[13-15] Briefly, women were eligible for inclusion if they were aged 27 or less and were sexually active. We excluded women who had never had sexual intercourse, had been tested for chlamydial infection in the past three months, or were pregnant. Female nurses, research assistants, the principal investigator (PO), and peers recruited women in bars, common rooms, and lecture theatres at 20 London universities and further education colleges. (Further education colleges take students from age 16 and teach both academic subjects and vocational subjects, such as hairdressing.)

Participants provided written informed consent.[13] They were warned of the risks of chlamydial infection and that their samples might not be tested for a year and were advised to get checked independently if they thought they had been at risk.

Procedures

Participants were asked to complete a brief confidential questionnaire on sexual health; to provide self taken vaginal samples in the nearest lavatory; and to allow access to their medical records, with follow-up after a year.[13] Within two weeks of recruitment we randomly allocated sealed sample packs, which contained the completed, unopened questionnaires and consent forms, into two groups using random number tables. Vaginal swabs from packs allocated to the intervention group were tested for *C trachomatis* using transcription mediated amplification (TMA; Gen-Probe, San Diego, CA). Vaginal swabs from packs allocated to deferred screening were stored at −80°C and analysed one year later. PO contacted infected women within two weeks of diagnosis and asked them to attend their local genitourinary medicine clinic or general practitioner for treatment and partner notification. Vaginal smears made at baseline were Gram stained and examined for bacterial vaginosis using Nugent's criteria.[16 17]

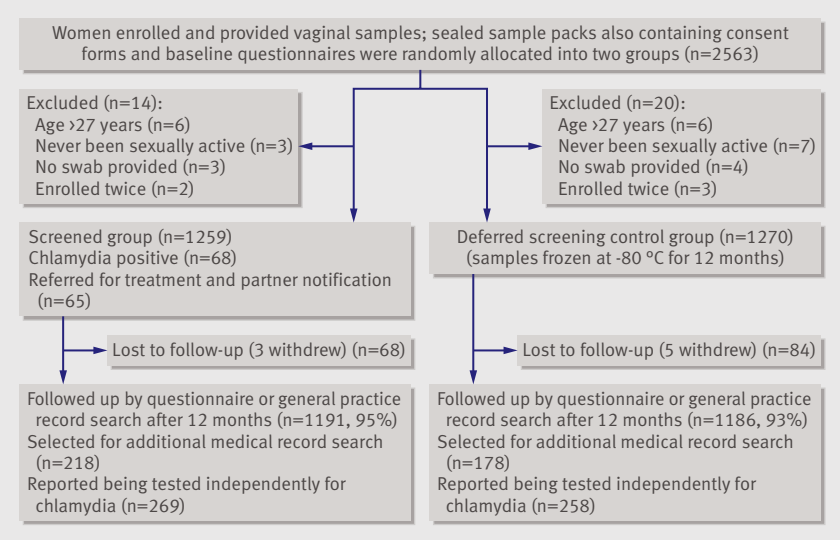
A year after recruitment, we asked the participants to complete a secure online questionnaire about possible symptoms of pelvic inflammatory disease (pelvic pain, dyspareunia, bleeding between menstrual periods, or abnormal vaginal discharge) and sexual behaviour during the past year. Those who did not respond or provide an email address were sent the questionnaire by post, backed up by telephone reminders. We followed up non-responders through their general practice records. For all women (or their general practitioner) who reported that during the past 12 months they had had treatment for pelvic inflammatory disease, had a laparoscopy, seen a health professional for abdominal or pelvic pain, been treated for a urinary tract infection, or reported three of four possible symptoms of pelvic inflammatory disease, we endeavoured to obtain copies of the clinical findings from medical records of general practitioners, hospitals, family planning clinics, and genitourinary medicine clinics. After anonymisation of data, three genitourinary doctors blinded to group allocation and baseline chlamydia status used modified Hager's criteria[18] and Centers for Disease Control guidelines[1] to classify cases into probable, possible, or not pelvic inflammatory disease.[13] Cases were categorised independently by two doctors, with review by a third for disagreements.

Masking

Participants were blind to group allocation except for those in the intervention group with baseline samples that tested positive for chlamydia and who were referred for treatment, and 38 women with indeterminate test results who were asked to post a repeat sample. Investigators were blind during recruitment and follow-up except PO when she referred women with chlamydial infection for treatment. Categorisation of pelvic inflammatory disease status was also blind.[13]

Statistical analysis

Assuming a 2% incidence of pelvic inflammatory disease in the control group, we needed a sample of 4122 women to detect a relative risk of 0.48 with 80% power and 5% significance. We had difficulty with recruitment,[14 15] however, as we were asking women who were not attending college for health reasons to provide vaginal samples that might not be tested for a year. Two studies[9 19] suggested a higher rate of pelvic inflammatory disease, enabling us to revise down our sample size calculations. Assuming a 3% incidence of pelvic inflammatory disease in the control group,[9 19] we



Trial profile

Table 1 | Baseline characteristics of 2529 women allocated to immediate or deferred screening for *Chlamydia trachomatis*. Values are percentages (numbers) unless stated otherwise

Characteristics	Screened women (n=1259)	Deferred screening controls (n=1270)
Age (years):		
<20	44.2 (557)	44.6 (567)
20-24	46.5 (585)	43.3 (550)
≥25	9.3 (117)	12.0 (153)
Ethnicity:	n=1250	n=1262
White	63.0 (787)	60.1 (758)
Black Caribbean	8.5 (106)	9.5 (120)
Black African	15.3 (191)	17.4 (220)
Black other	2.3 (29)	1.7 (22)
South Asian	3.0 (35)	2.8 (35)
Chinese	1.0 (11)	0.7 (9)
Other	7.3 (91)	7.8 (98)
Recruited at university*	69.5 (875)	66.7 (847)
Cigarettes smoked per day:	n=1253	n=1265
None	66.9 (838)	69.9 (884)
1-10	26.6 (333)	24.0 (304)
>10	6.5 (82)	6.1 (77)
Mean (SD) age at sexual debut	16.4 (1.8); n=1233	16.5 (1.8); n=1247
No of sexual partners in past year:	n=1251	n=1262
None	3.4 (42)	4.2 (53)
1	52.0 (650)	54.6 (689)
2	23.1 (289)	21.2 (268)
>2	21.6 (270)	20.0 (252)
Contraception:	n=1243	n=1260
None	7.6 (95)	8.0 (101)
Condoms	53.4 (664)	55.2 (695)
Contraceptive pill	49.1 (610)	46.4 (585)
Implant, injection, or patch	5.1 (63)	5.3 (67)
Coil	1.7 (21)	1.7 (22)
Douching	0.2 (2)	0 (2)
Symptoms in past 6 months:	n=1242	n=1254
Pelvic pain	13.7 (170)	11.8 (148)
Dyspareunia	13.1 (163)	10.0 (125)
Bleeding between menstrual periods	14.1 (175)	11.3 (142)
Abnormal vaginal discharge	12.6 (157)	10.7 (134)
Any symptoms	36.6 (455)	31.3 (393)
Reported history of sexually transmitted infection ever:	n=1190	n=1219
Chlamydia	5.9 (70)	6.6 (80)
Genital warts	1.2 (14)	1.2 (15)
Genital herpes	0.6 (7)	0.9 (11)
Bacterial vaginosis	0.9 (11)	0.5 (6)
Gonorrhoea	0.3 (4)	0.2 (2)
Reported history of pelvic inflammatory disease:	n=1252	n=1265
	2.1 (26)	0.9 (12)
Baseline infections:		
Chlamydia†	5.4 (68); n=1254	5.9 (75); n=1265
Bacterial vaginosis	20 (241); n=1191	21 (248); n=1193

*Not further education colleges.
†No results were available for 10 baseline samples (five intervention, five control). Three intervention samples were indeterminate or inhibitory and participants failed to return a repeat baseline postal sample, four samples leaked, and three control samples were either lost or the labels were illegible after defrosting.

needed a sample of 2274 women to detect a relative risk of 0.44[4 13] with 80% power and 5% significance. Recruiting 2500 women allowed for 10% loss to follow-up.

For the primary analysis we estimated the relative risk of developing pelvic inflammatory disease in the 12 months after recruitment to the screened group compared with the deferred screening control group. In secondary analyses we examined the proportion of control women with untreated chlamydial infection who developed pelvic inflammatory disease within 12 months. We used exact methods to compute confidence intervals for unadjusted relative risks.[20] To adjust the relative risk of pelvic inflammatory disease for symptoms at baseline we also carried out an exploratory binomial regression using Stata version 10. Thirty five samples randomly allocated to the screening group were unintentionally put in the freezer and not tested for *C trachomatis* for 12 months. All participants were, however, analysed according to their original group allocation.

RESULTS

Between September 2004 and October 2006, 2563 eligible women were recruited and randomised (figure). We were unable to obtain information on all non-participants, but recruitment forms completed early in the study suggested 41% of 956 ineligible women had never had sexual intercourse, 24% were outside the age range, and 13% had been tested for chlamydial infection in the previous three months.[13] A survey during three recruitment sessions suggested that eligible women refusing to participate were more likely than responders to be from ethnic minority groups.[15] After 34 exclusions (figure), 2529 women (mean age 20.9 years) were included in the study. Baseline characteristics of participants were similar between the screened and deferred screening groups except that more women in the screened group reported symptoms in the six months before recruitment (table 1).

Chlamydial infection and treatment at baseline

Sixty eight (5.4%) women in the screened group tested positive for chlamydia at baseline. PO contacted 65 of the women to ask them to attend their local genitourinary medicine clinic or general practitioner for treatment and partner notification. Two women could not be contacted directly as their mobile telephone number was not working, they did not provide an email address, and they had requested no post to the home address. The college nurses contacted them for us. A further chlamydia positive sample from the 35 intervention samples unintentionally put in the freezer was not tested for 12 months. When telephoned after 1-2 months, 59 women confirmed they had been treated: 36 at a genitourinary medicine clinic, 12 by their general practitioner, and three at a community sexual health clinic. Eight women did not provide details. When control samples were tested 12 months after recruitment, 75 (5.9%) were positive for chlamydia.

Table 2 | Details of follow-up for potential pelvic inflammatory disease (PID) over 12 months. Values are numbers unless stated otherwise

Variables	Screened women (n=1259)	Deferred screening controls (n=1270)
% (No) followed up by questionnaire to participant or general practitioner	94.6 (1191)	93.4 (1186)
% (No) selected for additional record search for clinical details of potential PID:	17.3 (218)	14.0 (178)
Participant or general practitioner reported PID*	12	9
Laparoscopy	16	24
Visited doctor for abdominal or pelvic pain	108	95
Treated for urinary tract infection	50	22
Reported 3 of 4 symptoms† but did not report seeing doctor	32	28

*Some participants were in more than one category, but each is included only once, in hierarchical order.
†Pelvic pain, dyspareunia, bleeding between menstrual periods, or abnormal vaginal discharge.

Follow-up

Overall, 94% (2377/2529) of the women were followed up after 12 months. Nearly half (47%, 1108) replied by email, 32% (n=760) by postal questionnaire, 8% (n=199) by telephone, and 13% (n=310) were followed up by questionnaire to their general practitioner. The 152 women lost to follow-up were younger (mean age 20.0 years (SD 2.5) *v* 21.0 (SD 2.8); P<0.01) and more likely to be of black ethnicity (46% (68/149) *v* 26% (620/2363); P<0.01) than the remainder. Table 2 gives details of the 396 women who were selected, on the basis of questionnaire responses, for more detailed assessment and search of medical records.

Incidence of pelvic inflammatory disease

The incidence of pelvic inflammatory disease was 1.3% (15/1191) in screened women compared with 1.9% (23/1186) in controls (relative risk 0.65, 95% confidence interval 0.34 to 1.22, table 3). After adjustment for symptoms at baseline the relative risk was 0.57 (0.29 to 1.11). The overall incidence of pelvic inflammatory disease over 12 months was 1.6% (38/2377, 95% confidence interval 1.1% to 2.1%).

Rates of pelvic inflammatory disease were examined in the 137 women with chlamydial infection at baseline who were followed up for 12 months. Seven of 74 women in the deferred screening group developed clinical pelvic inflammatory disease (incidence 9.5%, 4.7% to 18.3%). All seven women were tested for *C trachomatis* at the time pelvic inflammatory disease was diagnosed and five tested positive. By comparison, only one of 63 (1.6%) screened and treated women positive for chlamydia developed clinical pelvic inflammatory disease (relative risk 0.17, 0.03 to 1.01). Initial treatment for chlamydial infection in this woman was confirmed by telephone but she developed symptoms of pelvic inflammatory disease and tested positive for chlamydia 26 weeks after recruitment. On the 12 month questionnaire she reported three sexual partners in the previous year and no use of condoms.

Most cases of pelvic inflammatory disease (79%, 30/38) occurred in women who tested negative for chlamydia at baseline. Chlamydia test results at the time pelvic inflammatory disease was diagnosed were available for 26 (of 38) women, of whom 16 tested positive for chlamydial infection. Ten of these 16 women were negative for chlamydia at baseline. Seventy per cent (21/30) of women with pelvic inflammatory disease who completed the 12 months' questionnaire reported having had two or more sexual partners during the year. The groups showed a slight imbalance for reported symptoms but similar sexual behaviour during the follow-up period (table 4).

Independent testing during follow-up

Overall, 527 (22%) participants reported having been tested independently for chlamydia (figure); 15% (n=38) of the control women and 10% (n=27) of the screened women said they tested positive. Those women in the deferred screening group (blind to group allocation and baseline chlamydia status) who

Table 3 | Incidence of pelvic inflammatory disease (PID) in 2377 women followed up for 12 months. Values are percentages (numbers) unless stated otherwise

Variables	Screened women	Deferred screening controls	Relative risk (95% CI)	P value
All PID: probable* and possible†	1.3 (15/1191)	1.9 (23/1186)	0.65 (0.34 to 1.22)	0.19
Probable PID	0.8 (10/1191)	1.3 (16/1186)	0.62 (0.29 to 1.34)	0.24
Rate of PID in women who were positive for chlamydia at baseline	1.6 (1/63)	9.5 (7/74)	0.17 (0.03 to 1.01)	0.07

*Doctor assessed as probable—that is, clinical diagnosis of PID and treated[1]; modified Hager's criteria—pelvic pain, cervical motion tenderness, uterine or adnexal tenderness.[18]
†Abdominal pelvic pain with features of PID, which may have responded to antimicrobial therapy, but no record of cervical excitation or uterine or adnexal tenderness; or long standing abdominal pain consistent with endometriosis, but some features of PID—for example, uterine tenderness, and unable to confirm if antimicrobial therapy had a benefit.[1]

were positive for chlamydia at baseline were more likely than those who were negative to report having been tested independently (43%, 29/67 *v* 24%, 229/968; P<0.001).

DISCUSSION

The risk of clinical pelvic inflammatory disease over 12 months in women screened for *C trachomatis* was non-significantly reduced by 35%. The overall incidence of pelvic inflammatory disease was, however, low (1.6%). In 137 women with chlamydial infection at baseline, 9.5% in the deferred screening control group developed pelvic inflammatory disease compared with only 1.6% in the screened group. Over 90% (67/74) of control women with chlamydial infection at baseline did not develop clinical pelvic inflammatory disease; and most cases (79%, 30/38) of pelvic inflammatory disease, including 10 cases of chlamydia positive pelvic inflammatory disease, occurred in women who were negative for chlamydia at baseline, suggesting these were incident infections.

Strengths and limitations of the study

This is the first trial of chlamydia screening to obtain samples for delayed chlamydia testing from the control women. Analysis of these samples enabled us to provide novel data on the risk of pelvic inflammatory disease in untreated women positive for chlamydia in the community, which can now be used for modelling and cost effectiveness studies.[12] Secondly, this is the first UK study to provide prospective data on the overall risk of clinical pelvic inflammatory disease in a large cohort of sexually active young women in the community. Thirdly, this is the most robust trial to date.[3 8] Randomisation was done blind and after recruitment[6] and the main outcome was assessed blind. The 94% follow-up was a major achievement in this young, mobile, mainly inner city population, requiring repeated telephone calls and emails. We also obtained data on independent chlamydia testing and treatment in both groups. Participants came from a wide range of backgrounds and included 1124 sexually active teenagers of whom 46% came from ethnic minorities. As in the English national chlamydia screening programme, we used self taken samples and routine management of infected women. Vaginal swabs are more sensitive than urine samples for the detection of chlamydia.[21]

The main weakness is that despite a similar sample size (2529 *v* 2607) and incidence of pelvic inflammatory disease (1.6% *v* 1.7%) to the Scholes trial, screening twice as many women (1259 *v* 645) and treating more women with chlamydial infection (67 *v* 44), the trial was underpowered. The annual incidence of pelvic inflammatory disease was less than the 3%[9 13 19] used in the sample size calculations, and screening did not reduce the risk by at least 50%.[4] Secondly, participants were advised to be screened independently, and the one in five who acted on this advice had a high prevalence of chlamydial infection. The rate of independent testing reported by women in the deferred screening group who were positive for chlamydia at baseline was even higher (43%). It is likely that this reduced the effect of the intervention. Thirdly, the clinical diagnosis of pelvic inflammatory disease lacks sensitivity[22] and specificity, which is also likely to attenuate the effect size.[8] The diagnosis of pelvic inflammatory disease depended on the women seeing a health professional,[7] and the women's reports of possible symptoms or consultations for pelvic inflammatory disease may be unreliable, particularly for those who could be followed up only by telephone questionnaire (10% of controls, 7% of screened women), and who might tend to respond negatively to questions. We were able to obtain detailed medical records only of the 17% of women with potential pelvic inflammatory disease. In addition, the medical records were sometimes incomplete and many women changed address and general practitioner during the study period or attended different hospitals and clinics. Finally, as with all randomised clinical trials, the study has limited generalisability and may not apply to different populations such as women attending healthcare facilities, those from different ethnic groups, higher risk women such as sex workers, or non-UK populations.

Comparison with other studies

Only two trials have been carried out on chlamydia screening to prevent pelvic inflammatory disease in non-pregnant women.[8] These were done in the United States and Denmark and started in 1990 and 1997.[4 9] The trial by Scholes et al involved 2607 women from a health maintenance organisation.[8] However, over a third of the women (n=364) in the intervention group were not screened, and these women had a low rate of pelvic inflammatory disease (0.5%, 2/364) leading to a relative risk of pelvic inflammatory disease in those allocated to screening compared with usual care of 0.44 (95% confidence interval 0.20 to 0.90). Pelvic inflammatory disease is polymicrobial, but in many cases no pathogens are isolated. If chlamydial infection is implicated in only about 30% of cases of pelvic inflammatory disease, even if screening and treatment prevented all cases of pelvic inflammatory disease due to chlamydia, it would be unlikely to halve the overall risk of pelvic inflammatory disease.[8] Recently, the

Table 4 | Reported symptoms of potential pelvic inflammatory disease and sexual behaviour over 12 months in 2057 women who completed follow-up questionnaires

Reported symptoms and behaviour	% (No) of women	
	Screened women (n=1029)	Deferred screening controls (n=1028)
Pelvic pain	11.0 (113)	10.2 (105)
Dyspareunia	10.9 (112)	9.3 (96)
Bleeding between menstrual periods	13.5 (139)	12.8 (132)
Abnormal vaginal discharge	15.2 (156)	13.0 (134)
Any symptom	34.0 (350)	31.3 (322)
≥2 sexual partners in past 12 months	36.7 (367); n=1001	37.6 (377); n=1003
Condom use	54.5 (538); n=987	56.5 (557); n=985
Sexually transmitted infection in past 12 months	4.8 (48); n=1007	5.2 (52); n=1000

WHAT IS ALREADY KNOWN ON THIS TOPIC

Chlamydia trachomatis can cause pelvic inflammatory disease (PID) leading to tubal infertility and ectopic pregnancy

Annual testing of all sexually active women aged 24 or less is widely recommended and many developed countries have set up chlamydia screening programmes

The evidence base has been questioned

WHAT THIS STUDY ADDS

While screening and treatment of chlamydial infection might reduce the risk of clinical PID over 12 months, especially in women with chlamydial infection at baseline, most cases of PID occurred in women who tested negative for chlamydia at baseline, suggesting incident infection

The effectiveness of a single chlamydia test in preventing PID over 12 months might have been overestimated

Policy makers might consider focusing on more frequent testing of women at higher risk, such as those with a recent change of sexual partner or history of chlamydial infection in the past three months

findings by Scholes et al have been suggested as fortuitous.[8]

In a later trial in 1700 female high school students, Ostergaard et al found that 2.1% of those in the home sampling group and 4.2% in the usual care group reported treatment for pelvic inflammatory disease when interviewed after a year.[9] Ascertainment of pelvic inflammatory disease was, however, unblinded and nearly 50% of the women were lost to follow-up.[8] In addition, reports by the women might be unreliable, as masked analysis of clinical data in our trial confirmed pelvic inflammatory disease in only 11 of the 21 women whose questionnaires reported that they had had pelvic inflammatory disease. Finally, the incidence of pelvic inflammatory disease in our trial was slightly lower than the 2.3% found in similar aged women attending English and Welsh general practices.[23] The women in our study with pelvic inflammatory disease were assessed by doctors in genitourinary medicine, and both coding and diagnosis may be more reliable. It is, however, likely that the incidence of pelvic inflammatory disease would be higher in those lost to follow-up, sexually active teenagers aged <16, or those not in education.

Implications

This is the only chlamydia screening trial with this design ever likely to be done in a developed country. This is because of ethical issues with delayed chlamydia testing and the widespread introduction of chlamydia screening programmes. Although some evidence shows that screening reduced rates of pelvic inflammatory disease, especially in women with chlamydial infection at baseline, the absolute number of cases prevented was small. Our findings suggest that to prevent one case of clinical pelvic inflammatory disease over 12 months, it may be necessary to screen 147 women for chlamydial infection or to treat 13 women who are positive for chlamydia. These numbers are greater than previously suggested.[8 11] If the incidence of pelvic inflammatory disease in women with chlamydial infection has been overestimated, and particularly if it is less than 10%,[24] then the cost effectiveness of screening might be exaggerated.[8 10]

Most cases of pelvic inflammatory disease over 12 months were not prevented by a single chlamydia screen and occurred in women who were negative for chlamydia at baseline. This suggests the importance of incident infection. Policy makers might consider focusing on more frequent testing of those at higher risk, such as women with a new sexual partner or a recent history of chlamydial infection.[11 25 26]

We thank the students and staff at London Southbank University; Kingston University; City University; St George's, University of London; Roehampton University; London College of Fashion; London College of Communication; University of East London; Greenwich University; University of Westminster; Wimbledon School of Art; Kingston College; Lambeth College; Southwark College; South Thames College; Lewisham College; Bromley College; North East Surrey College of Technology; Carshalton College; Merton College; Coulsdon College; and Croydon College. We also thank research assistants Deborah Banks, Ruth Harbit, and Stella Ivaz; research nurses Sally Dean and Cathy McKay; peer recruiters Linzie Long, Michelle Lamb, Laura Proctor, Sarah Simms, Sarah Kerry, and Sheila Kerry, and grant administrator Frances Kazakos. We also thank Drs Harry Mallinson and Jorgen Jensen for doing the chlamydia tests; Drs Elizabeth Williams, Katia Prime, and Paddy Horner for analysing the data on pelvic inflammatory disease; and the staff at the general practices, genitourinary medicine clinics, sexual health clinics, and hospitals who provided copies of medical records.
Contributors. PEH, PO, and SK conceived and designed the study. All authors helped draft and revise the article and approved the final version to be published. PO and SK are guarantors.
Funding: This study was supported by the BUPA Foundation (grant No 684/GB14B). TMA sample collecting kits were provided by Gen-Probe (San Diego, CA).
Competing interests: All authors have completed the unified competing interest form at www.icmje.org/coi_disclosure.pdf (available on request from the corresponding author) and declare (1) no financial support for the submitted work from anyone other than their employer; (2) no financial relationships with commercial entities that might have an interest in the submitted work; (3) no spouses, partners, or children with relationships with commercial entities that might have an interest in the submitted work; and (4) no non-financial interests that may be relevant to the submitted work.
Ethical approval: This study was approved by Wandsworth research ethics committee (reference 03.0012).
Data sharing: No additional data available.

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Accepted: 16 February 2010