Screening pregnant women for chlamydia: what are the predictors of infection?

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ABSTRACT

Objectives: To determine the risk factors associated with chlamydial infection in pregnancy and the sensitivity and specificity of these when used for selective screening.

Methods: A prospective, cross-sectional study of pregnant women aged 16–25 years attending four major public antenatal services across Melbourne, Australia. Between October 2006 and July 2007, women were approached consecutively and asked to complete a questionnaire and to provide a first-pass urine specimen for *Chlamydia trachomatis* testing using PCR.

Results: Of 1180 eligible women, 1087 were approached and 1044 (88%) consented to participate. Among the 987 women for whom a questionnaire and a definitive diagnostic assay were available, the prevalence of chlamydia was 3.2% (95% CI 1.8 to 5.9). In a multiple logistic regression model, more than one sexual partner in the past year (AOR 11.5; 95% CI 7.1 to 18.5) was associated with chlamydia infection. The use of any antibiotic within 3 months (AOR 0.2; 95% CI 0.1 to 0.6) was associated with a decreased risk of infection. Screening restricted to women who reported more than one sexual partner in the past year would have detected 44% of infections in women aged 16–25 years and would have required only 7% of women to be screened. The addition of those women aged 20 years and under would have required 27% of women to be screened and detection of 72% of infections.

Conclusions: Selective chlamydia screening of pregnant women based on risk factors can improve the yield from screening. However, the potential harm of missed infections among excluded women would need to be considered.

Targeted screening of younger women for genital *Chlamydia trachomatis* infection has been shown to reduce the incidence of pelvic inflammatory disease and has been advocated as a means of preventing chlamydia-associated reproductive sequelae such as infertility, ectopic pregnancy and chronic pelvic pain.[1–5] Although such screening and treatment has been focussed on preventing reproductive pathology and improving future fertility, chlamydial infection in pregnancy is also associated with adverse pregnancy outcomes and significant neonatal morbidity. For example, untreated chlamydia infection in pregnancy increases a woman's risk of miscarriage, preterm prelabour rupture of membranes, preterm labour and postpartum endometritis, while babies born to mothers with chlamydia are more likely to be of low birth weight and are at risk of vertical transmission of chlamydia leading to neonatal conjunctivitis and pneumonitis.[6–12]

The US Preventive Services Task Force has found evidence from observational studies that pregnant women who are treated for chlamydia have improved pregnancy and birth outcomes. Accordingly, the Task Force recommends chlamydia screening of all pregnant women aged 24 years and younger, as well as older pregnant women who are at increased risk for infection.[4]

However, there are limited published data from larger, prospective studies from developed countries on the risk factors for chlamydia in pregnancy. Such data would help to inform the development of guidelines for the selective screening of pregnant women for chlamydia. The aims of this study were to determine the risk factors for chlamydia among a broad cross-section of pregnant women in Australia and to determine the sensitivity and specificity of these risk factors when used as criteria for selective chlamydia screening.

METHODS

Recruitment for this study was undertaken at four major antenatal services across Melbourne, Australia, between October 2006 and July 2007: the Royal Women's Hospital (Inner Northern Melbourne), Mercy Hospital for Women (North East Melbourne), Sunshine Hospital (Western Melbourne) and Southern Health (South Eastern Melbourne). The last service comprised clinics at three separate sites: the Monash Medical Centre, Dandenong Hospital and Casey Hospital. Multiple sites were selected to include women from across a wide geographic area as well as diverse socioeconomic and cultural backgrounds.

Eligible women were pregnant of any gestation, aged 16–25 years, attending any of the four antenatal services. Recruitment was restricted to this age group to minimise the likelihood of false-positive chlamydia results, which would be higher among older women where the prevalence of infection would be expected to be lower. This was also in line with national and international guidelines.[4 5 13] At the time of the study, screening for chlamydia across this age group was not routinely offered at the participating services.

Women aged 16–25 years were approached consecutively as they arrived at the clinic. They were provided with a participant information sheet explaining the study and a consent form. The total number of women aged 16–25 years attending the clinics while recruitment was being undertaken was noted.

Women who consented to the study were asked to complete an anonymous questionnaire and to provide a first-pass urine sample. The questionnaire

included questions about demographics, genitourinary symptoms, recent sexual history and the self-reported use of any antibiotics within the preceding 3 months. Women were also asked to report how likely they thought it was that they or any sexual partner in the past year could be infected with chlamydia.

Translations of the questionnaire were printed in Chinese, Arabic and Vietnamese. Interpreters were available for a number of other languages and were used if a woman felt comfortable with and consented to completing the English version of the questionnaire with the interpreter. All other women completed the questionnaire unassisted in a private room and returned the questionnaire in a sealed envelope. People accompanying the women to the clinic were asked to wait outside whilst the participant completed the questionnaire. Women were excluded if they were not able to complete the questionnaire because an interpreter was not available for their preferred language.

First-pass urine specimens were tested for *C trachomatis* by PCR using the COBAS Amplicor Assay (Roche Diagnostics, Pleasanton, California, USA) as described by the manufacturer. Specimens showing inhibition were retested using another specimen collected at a subsequent visit.

Infected women were treated with single-dose oral azithromycin (1.0 g) and were asked to provide a repeat urine sample at a subsequent visit at least 3 weeks after treatment. Women were advised to contact their sexual partner(s) so that they could seek testing and treatment for chlamydia. We did not aim to determine pregnancy or neonatal outcomes so data on these were not collected.

The prevalence of genital chlamydia was calculated, with the standard errors and associated 95% CIs adjusted for the possibility of residual correlation in the outcome measure due to clustering of participants at the hospital level. Associations between questionnaire variables and chlamydia infection were investigated using multiple logistic regression with odds ratios (ORs) and 95% CIs. A stepwise technique was used for model selection, with variables selected for inclusion in the model if the likelihood ratio test for model comparison generated $p<0.1$

The sensitivity of a risk factor for detecting chlamydia was defined as the probability of the risk factor being present among infected women, and represents the proportion of infected women who would be detected by screening using that risk factor. The specificity of a risk factor for detecting chlamydia was defined as the probability of the risk factor being absent among uninfected women, and represents the proportion of uninfected women who would avoid screening if it was based on that risk factor. All analyses were conducted in Stata V.9 (StataCorporation 2005, Stata Statistical Software, Release 9.0, College Station, Texas, USA).

RESULTS

During the recruitment period, 1180 eligible women attended the antenatal clinics while recruitment was taking place. Of these women, 1087 (92%) were invited to participate and 1044 (88% of those eligible) consented to participate in the study. Altogether, 1009 women provided both a completed questionnaire and a urine sample for chlamydia testing.

In 22 women (2.2% of those tested), the result of chlamydia testing remained indeterminate despite repeat specimen collection and testing. All further analyses were undertaken on the 987 women for whom definitive results were available.

Among these 987 women, 32 women tested positive for chlamydia giving a prevalence rate of 3.2% (95% CI 1.8 to 5.9). The prevalence was similar among three of the hospital services (Royal Women's: 2.0%; 95% CI 0.6 to 4.5; Mercy Hospital for Women: 2.0%; 95% CI 0.6 to 6; and Sunshine Hospital: 2.9%; 95% CI 1.2 to 5.9), but was significantly higher at one of the services (Southern Health: 6.3%; 95% CI 3.6 to 10.1; $p<0.01$). Women attending Southern Health were on average 6 months younger than those attending the other hospitals ($p<0.01$) and had a higher number of recent sexual partners ($p<0.01$). These two factors contributed to the higher chlamydia prevalence observed at this hospital.

Women in the study were culturally and linguistically diverse (table 1) and were drawn from 171 different postal areas across Victoria. Only 6.6% (65/987) of women reported having more than one sexual partner during the past year. There was no relationship between self-reporting of risk perception and infection status (table 2). Self-reported symptoms (vaginal discharge, dysuria) were not informative of infection status (table 2).

Thirty-one of the infected women received treatment, with one unable to be contacted. Twenty-five women provided a repeat chlamydia test following treatment, all of which were negative for *C trachomatis*. Data were not collected on the testing or treatment of partners, or on when repeat tests in infected women were performed. The characteristics of women with and without chlamydia are compared in table 2.

Univariate analysis found that chlamydia infection was associated with being born outside Australia, not speaking a

Table 1 Characteristics of pregnant women screened for chlamydia

Variables	Median (range) or n (%)*
Age in years (range)	23 (16–25)
Country of birth	
Australia	568 (57.5)
Other†	419 (42.5)
Preferred language other than English	
No	800 (81.1)
Yes‡	187 (18.9)
Socio-economic indexes for areas¶	
1	241 (24.4)
2	147 (14.9)
2,3	108 (10.9)
3	175 (17.7)
4	95 (9.6)
Number of prior births	
0	660 (66.9)
1	252 (25.5)
>1	73 (7.4)
Self-report of prior chlamydia testing	
Yes	131 (13.3)
No	708 (71.7)
Unsure	141 (14.4)
Months since last chlamydia test (range)§	18 (1–96)
Gestation in weeks (range)	27 (5–42)
No. of male sexual partners in past year (range)	1 (0–50)

*The total numbers may not equal 987 because of missing data; †19% were born in Asia, 6.7% in Africa, 5.2% in Europe, 5.1% in the Middle East, 3.7% in New Zealand and 1.4% in the Pacific; 2% were identified as Aboriginal or Torres Strait Islander; ‡preferred languages other than English included Arabic (3%), languages from Sudan and the horn of Africa (3%), Vietnamese (2.5%), Indian languages (2.2%), Chinese languages (1.7%), Urdu (1.3%), Dari (0.6%), Khmer (0.6%), Macedonian (0.5%) and Turkish (0.5%); ¶Socio-Economic Indexes for Areas (SEIFA) indicate a continuum of advantage (high values) to disadvantage (low values) and have been allocated based on postal area of residence. The index takes into account variables such as income, education and employment. Some postal areas cross-multiple SEIFA areas: only the most frequent combinations have been listed; §self-reported estimate from the 131 women who reported prior chlamydia testing.

Table 2 Characteristics associated with chlamydia infection among pregnant women

Characteristic	No. women*	No. infected	% infected	Unadjusted OR (95% CI)	Adjusted OR† (95% CI)	p Value
Age group (years)						
16–20	234	15	6.4	3.0 (0.8 to 0.7)	2.1 (0.6 to 7.9)	0.25
21–25	753	17	2.3	1.0	1.0	
Country of birth						
Australia	568	22	2.4	0.6 (0.4 to 0.9)	–	
Other	419	10	3.9	1.0	–	
Preferred language other than English						
No	800	29	3.6	2.3 (1.2 to 4.4)	1.4 (0.9 to 2.3)	0.15
Yes	187	3	1.6	1.0	1.0	
Educational level						
Year 9 or less	102	5	4.9	1.0	–	
Year 10–12	617	22	3.6	0.7 (0.4 to 1.2)	–	
Tertiary qualification	268	5	1.9	0.4 (0.1 to 1.5)	–	
Planned pregnancy						
No	498	25	5.0	1.0	–	
Yes	487	7	1.4	0.3 (0.1 to 0.5)	–	
History of chlamydia						
No	738	21	2.8	NA	NA	
Yes	51	0	0			
Unsure	198	11	5.6			
Antibiotics in past 3 months						
No	809	30	3.7	1.0	1.0	
Yes	175	2	1.1	0.3 (0.1 to 0.7)	0.2 (0.1 to 0.6)	<0.01
Vaginal discharge						
No or unsure	820	27	3.3	1.0	–	
Yes	162	5	3.1	0.9 (0.1 to 2.2)	–	
Dysuria						
No or unsure	878	30	3.4	1.0	–	
Yes	104	2	1.9	0.6 (0.1 to 2.4)	–	
Relationship status						
Married or in a relationship and living with partner	801	21	2.6	1.0	–	
In a relationship but not living with partner	132	7	5.3	2.1 (0.9 to 4.5)	–	
Not in a relationship	54	4	7.4	3.0 (1.1 to 7.8)	–	
New sexual partner in past year						
No	921	24	2.6	1.0	–	
Yes	65	8	12.3	5.2 (2.7 to 10.3)	–	
No. of male sexual partners in past year						
⩽1	921	18	2.0	1.0	1.0	
>1	66	14	21.2	13.5 (9.6 to 19.1)	11.5 (7.1 to 18.5)	<0.01
Self-perceived risk for chlamydia						
Unlikely	888	27	3.0	1.0	–	
Possible or likely	94	5	5.3	1.8 (0.7 to 4.3)	–	
Perceived risk of chlamydia in sexual partner(s)						
Unlikely	883	28	3.3	1.0	–	
Possible or likely	104	4	3.8	1.2 (0.8 to 1.9)	–	

*The total numbers may not equal 987 because of missing data; †adjusted for age, language spoken at home, antibiotic use in last 3 months and number of male sexual partners in past year. NA, not applicable.

language other than English, unplanned pregnancy, a new sexual partner in the past year, reporting more than one sexual partner in the past year and not being in a current relationship. Multiple logistic regression found that having more than one sexual partner in the past year and not having preferred language other than English remained associated with increased risk for chlamydia, while antibiotic use in the past 3 months was associated with decreased risk of infection (table 2) after adjusting for other factors.

Country of birth and educational level were each strongly correlated with language spoken at home ($p<0.01$); language

spoken at home was a stronger predictor of chlamydia infection and retained in the model. Reporting a new sexual partner, unplanned pregnancy and relationship status were each strongly associated with the number of reported sexual partners ($p<0.01$), but the number of sexual partners was a stronger predictor of chlamydia infection and remained in the logistic regression model. The prevalence of infection among women reporting more than one sexual partner in the previous year was 21.2% (95% CI 12.1 to 33.0%)

The sensitivity and specificity of selected variables for the detection of chlamydia in this population are shown in table 3. Screening women solely on the basis of reporting more than one sexual partner in the past year would have required only 7% of women aged 16–25 years to be screened to detect 44% of infections. By comparison, screening all women aged 20 years and under would have required 24% of women aged 16–25 years to be screened with little increase in the detection rate (47%). Using a combination of both these risk factors would have required 27% of women to be screened leading to the detection of 72% of infections.

For age—the only continuously valued covariate—we generated a receiver operating characteristic curve to examine how the sensitivity and specificity changed with the cut-off age for screening. The estimated area under the curve (AUC) was 0.64 (95% CI 0.54 to 0.75)—an improvement on the null value of AUC = 0.50 associated with random screening ($p = 0.009$).

DISCUSSION

In this study, a higher number of recent sexual partners was predictive of chlamydia infection in pregnancy after adjusting for other risk factors. If screening had been limited to women who reported more than one partner in the past year, only 7% of women would have required screening with 44% of infections detected. The addition of women aged 20 years and younger would have increased the detection rate to 72% with 27% of women screened. Even with the latter approach, however, a proportion of infections would have escaped detection.

This is one of the largest and most representative studies to be published on the risk factors for chlamydia in pregnancy from a developed country. Sampling of women for this study was undertaken at multiple antenatal sites, capturing a diverse group of women from across a wide geographical area. The study was prospective, with consecutive women approached and a very high participation rate.

Table 3 Sensitivity and specificity of risk factors for predicting chlamydia infection among pregnant women

	Sensitivity (95% CI)	Specificity (95% CI)	Proportion screened (%)
Age ⩽20 years	47% (29 to 65%)	77% (74 to 80%)	24
Unplanned pregnancy	78% (60 to 91%)	50% (47 to 54%)	49
>1 sexual partner	44% (26 to 62%)	94% (93 to 96%)	7
New sexual partner in past year	25% (11 to 43%)	94% (92 to 95%)	7
No antibiotic use in past 3 months	94% (79 to 99%)	18% (16 to 21%)	82
Age ⩽20 years and/or >1 partner in past year	72% (53 to 86%)	74% (71 to 77%)	27
>1 partner and/or new sexual partner in past year	47% (29 to 65%)	93% (90 to 94%)	9
Age ⩽20 years and/or unplanned pregnancy	59% (41 to 76%)	35% (32 to 38%)	65

It is uncertain to what extent the findings of this study would apply to populations of pregnant women with differing demographic and sexual risk profiles. Overall, the sexual risk profile of women in this study was relatively low compared with other cross-sectional studies of chlamydia in selected female populations and comparable to that of the local, broader, population of non-pregnant women of similar age. Altogether, 95% of women in this study reported only one sexual partner in the past year the study. By comparison, in a national representative survey, 33% of Australian women aged 16–19 and 15% of women aged 20–29 years had more than one male partner in the past year.[14] The factors associated with chlamydia in this population and the performance of the criteria used for selective screening may not be applicable in other populations. Further validation of these criteria in other populations is required. This was a cross-sectional study that did not examine for possible re-infection during pregnancy or collect data on whether sexual partners were treated. Furthermore, information was not sought on maternal or neonatal outcomes associated with chlamydia infection.

A number of previous studies have examined the prevalence of and risk factors for chlamydia in various populations of pregnant women in developed settings. However, the generalisability of some of these studies is limited by small sample sizes and samples potentially biased towards women at higher risk for infection, such as women seeking termination of pregnancy or women from selected ethnic groups. Others have involved retrospective review of medical records, where selection bias may be a problem.[15–18]

Separate, larger studies of pregnant women from Hungary (n = 6161), London (n = 1216) and Dublin (n = 783) each found younger age to be a predictor of chlamydia infection after adjusting for other factors. However, none of these other studies assessed the women's recent sexual risk nor did any provide the participation rates for their study.[19–21] In our study, having more than one sexual partner in the past year was, in fact, the strongest predictor of chlamydia infection and remained so after adjustment for other factors, including age.

We are not aware of any other published studies that have reported on the sensitivity and specificity of risk factor criteria in the selective screening of pregnant women for chlamydia. The sensitivity and specificity of risk factors for screening pregnant women for gonorrhoea and chlamydia combined was examined in a US study, but not for chlamydia alone. Furthermore, data were not collected on recent sexual risk.[22]

In our study, screening was not restricted to any particular gestational period. The US Centers for Disease Control and Prevention (CDC) recommends chlamydia screening of pregnant women at the first antenatal visit, with retesting during the third trimester in women aged less than 25 years and those who have had either a new or more than one sexual partner.[5] If screening is restricted to early pregnancy, women can be re-infected later on, prior to delivery. If screening only occurs late in pregnancy, any obstetric infection associated sequelae, such as preterm labour, may, hypothetically, not be averted, although there is no empirical evidence to support this.[5]

Despite the likely benefits of screening younger pregnant women for chlamydia,[4] and recommendations for screening pregnant women under the age of 25 years in some countries, in practice the extent of screening within this group varies considerably within and between countries.[5 13 23 24] The findings from this study indicate that selective chlamydia screening based on risk factors for infection can substantially improve the yield from screening. However, if screening based on risk factors

Key messages

- The number of recent male sexual partners is associated with chlamydia infection in pregnant women.
- Risk criteria could be used to selectively screen pregnant women for chlamydia to increase the yield of infection.
- Selective screening would, however, miss a proportion of infections.

of selected women under the age of 25 years is considered, rather than universal screening of all women in this age group, the potential harm of missed infections needs to be considered. Ideally, decisions on whether screening should be conducted, and what criteria should be used, should take into account local data on prevalence and risk factors together with the cost-effectiveness of different approaches.

If an assessment of a woman's sexual risk is used for selective chlamydia screening, obstetricians, midwives and other providers of antenatal care will need to be comfortable asking about recent sexual history. Given that most pregnant women infected with chlamydia do not suspect that either they or their sexual partners could be infected—as shown in this and another study[25]—screening should not rely on a woman's self-perceived risk.

Future studies looking at the risk factors for chlamydia in other populations of pregnant women should assess sexual risk and ensure this is accounted for as a possible confounding factor. So far, there have been no randomised trials comparing the outcomes of chlamydia screening versus no screening in pregnant women: one that compares routine, universal screening of young pregnant women with the existing standard of care, which in many settings consists of either sporadic or highly selective screening. Such a study would be ethical if women in the control arm received the accepted standard of care for that population. It is likely that a large, cluster randomised study would be required to demonstrate any effect given that chlamydia-associated maternal and neonatal outcomes are relatively uncommon. Such a study, however, is needed to help inform whether screening of pregnant women should be widely implemented. If so, our study shows that high screening rates within antenatal clinics are achievable.

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REFERENCES

1. **Østergaard L,** Andersen B, Møller JK, *et al*. Home sampling versus conventional swab sampling for screening of *Chlamydia trachomatis* in women: a cluster-randomized 1-year follow-up study. *Clin Infect Dis* 2000;**31**:951–7.
2. **Scholes D,** Stergachis A, Heidrich FE, *et al*. Prevention of pelvic inflammatory disease by screening for cervical chlamydia infection. *N Eng J Med* 1996;**334**:1362–6.
3. **LaMontagne DS,** Fenton KA, Randall S, *et al*. Establishing the National Chlamydia Screening Programme in England: results from the first full year of screening. *Sex Transm Infect* 2004;**80**:335–41.
4. **USPSTF**. Screening for chlamydial infection: US Preventive Services Task Force recommendation statement. *Ann Intern Med* 2007;**147**:128–34.
5. **Centers for Disease Control and Prevention**. Sexually Transmitted Diseases Treatment Guidelines 2006. *MMWR* 2006;**55**(No.RR–11).
6. **Wager GP,** Martin DH, Koutsky L, *et al*. Puerperal infectious morbidity: relationship to route of delivery and to antepartum *Chlamydia trachomatis* infection. *Am J Obstet Gynecol* 1980;**138**:1028–33.
7. **Martin DH,** Koutsky L, Eschenbach DA, *et al*. Prematurity and perinatal mortality in pregnancies complicated by maternal *Chlamydia trachomatis* infections. *JAMA* 1982;**247**:1585–8.
8. **Cohen I,** Veille JC, Calkins BM. Improved pregnancy outcome following successful treatment of chlamydial infection. *JAMA* 1990;**263**:3160–3.
9. **Ryan GM,** Abdella TN, McNeeley SG, *et al*. *Chlamydia trachomatis* infection in pregnancy and effect of treatment on outcome. *Am J Obstet Gynecol* 1990;**162**:34–9.
10. **Schachter J,** Grossman M, Sweet RL, *et al*. Prospective study of perinatal transmission of *Chlamydia trachomatis*. *JAMA* 1986;**255**:3374–7.
11. **Mårdh PA.** Influence of infection with *Chlamydia trachomatis* on pregnancy outcome, infant health and life-long sequelae in infected offspring. *Best Pract Res Clin Obstet Gynaecol* 2002;**16**:847–64.
12. **Blas MM,** Canchihuaman FA, Alva IE, *et al*. Pregnancy outcomes in women infected with *Chlamydia trachomatis*: a population-based cohort study in Washington State. *Sex Transm Infect* 2007;**83**:314–8.
13. **RANZCOG**. College statement: Antenatal screening tests, November 2006. Royal Australian and New Zealand College of Obstetricians and Gynaecologists. http://www.ranzcog.edu.au/publications/statements/C-obs3.pdf (accessed 27 November 2007).
14. **de Visser RO,** Smith AMA, Rissel CE, *et al*. Sex in Australia: heterosexual experience and recent heterosexual encounters among a representative sample of adults. *Aust N Z J Public Health* 2003;**27**:146–54.
15. **Chokephaibulkit K,** Patamasucon P, List M, *et al*. Genital *Chlamydia trachomatis* infection in pregnant adolescents in east Tennessee: a 7-year case-control study. *J Pediatr Adolesc Gynecol* 1997;**10**:95–100.
16. **Allaire AD,** Huddleston JF, Graves WL, *et al*. Initial and repeat screening for *Chlamydia trachomatis* during pregnancy. *Infect Dis Obstet Gynecol* 1998;**6**:116–22.
17. **Garland SM,** Tabrizi S, Hallo J, *et al*. Assessment of *Chlamydia trachomatis* prevalence by PCR and LCR in women presenting for termination of pregnancy. *Sex Transm Infect* 2000;**76**:173–6.
18. **Garland SM,** Johnson B. *Chlamydia trachomatis* infections - The Royal Women's Hospital experience. *Med J Aust* 1989;**150**:174–7.
19. **Nyari T,** Deak J, Nagy E, *et al*. Epidemiological study of *Chlamydia trachomatis* infection in pregnant women in Hungary. *Sex Transm Infect* 1998;**74**:213–5.
20. **McMillan HM,** O'Carroll H, Lambert JS, *et al*. Screening for *Chlamydia trachomatis* in asymptomatic women attending outpatient clinics in a large maternity hospital in Dublin, Ireland. *Sex Transm Infect* 2006;**82**:503–5.
21. **Oakeshott P,** Hay P, Hay S, *et al*. Detection of *Chlamydia trachomatis* infection in early pregnancy using self-administered vaginal swabs and first pass urines: a cross-sectional community based survey. *Br J Gen Pract* 2002;**52**:830–2.
22. **Magriples U,** Copel JA. Can risk factor assessment replace universal screening for gonorrhoea and chlamydia in the third trimester? *Am J Perinatol* 2001;**18**:465–8.
23. **NCCWCH**. Antenatal care: routine care for the healthy pregnant woman, 2003. National Collaborating Centre for Women and Children's Health. http://www.rcog.org.uk/resources/Public/pdf/Antenatal_Care.pdf (accessed 27 November 2007).
24. **Bernloehr A,** Smith P, Vydelingun V. Antenatal care in the European Union: a survey on guidelines in all 25 member states of the Community. *Eur J Obstet Gynecol Reprod Biol* 2005;**122**:22–32.
25. **Cheney K,** Chen M, Donovan B. *Chlamydia trachomatis* infection among antenatal women in Sydney. *Aust N Z J Public Health* 2006;**30**:85–6.