Chlamydia and gonorrhoea in pregnant Batswana women: time to discard the syndromic approach?

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Abstract

Background: Chlamydia and gonorrhoea are major causes of morbidity among women in developing countries. Both infections have been associated with pregnancy-related complications, and case detection and treatment in pregnancy is essential. In countries without laboratory support, the diagnosis and treatment of cervical infections is based on the syndromic approach. In this study we measured the prevalence of chlamydia and gonorrhoea among antenatal care attendees in Botswana. We evaluated the syndromic approach for the detection of cervical infections in pregnancy, and determined if risk scores could improve the diagnostic accuracy.

Methods: In a cross-sectional study, 703 antenatal care attendees in Botswana were interviewed and examined, and specimens were collected for the identification of C trachomatis, N gonorrhoeae and other reproductive tract infections. Risk scores to identify attendees with cervical infections were computed based on identified risk factors, and their sensitivities, specificities, likelihood ratios and predictive values were calculated.

Results: The prevalence of chlamydia was 8%, and gonorrhoea was found in 3% of the attendees. Symptoms and signs of vaginal discharge did not predict cervical infection, and a syndromic approach failed to identify infected women. Age (youth) risk factor most strongly associated with cervical infection. A risk score with only sociodemographic factors had likelihood ratios equivalent to risk scores which incorporated clinical signs and microscopy results. However, all the evaluated risk scores were of limited value in the diagnosis of chlamydia and gonorrhoea. A cut-off set at an acceptable sensitivity to avoid infected antenatal care attendees who remained untreated would inevitably lead to considerable over-treatment.

Conclusion: Although in extensive use, the syndromic approach is unsuitable for diagnosing cervical infections in antenatal care attendees in Botswana. None of the evaluated risk scores can replace this management. Without diagnostic tests, there are no adequate management strategies for C trachomatis and N gonorrhoeae in pregnant women in Botswana, a situation which is likely to apply to other countries in sub-Saharan Africa. Screening for cervical infections in pregnant women is an essential public health measure, and rapid tests will hopefully be available in developing countries within a few years.
Background

Sub-Saharan Africa has the highest prevalence of gonorrhoea and chlamydia worldwide. These two sexually transmitted infections (STIs) have a major impact on health, particularly in women and neonates [1]. A cervical infection with Neisseria gonorrhoeae or Chlamydia trachomatis can cause serious complications, such as ascending infections, infertility, cervical cancer, spontaneous abortion, premature delivery and low birth weight [2]. Epidemiological and biological studies have shown that ulcerative and non-ulcerative STIs can enhance HIV transmission [3,4].

It should be part of the mandate of the antenatal care programmes to diagnose and treat C. trachomatis and N. gonorrhoeae, due to their association with maternal, foetal and infant morbidity. In developing countries, diagnosis of cervical infections is limited to the syndromic approach, using the 'vaginal discharge syndrome' (VDS) algorithm. In the early 1990s, the World Health Organization developed syndromic management guidelines as a case management of symptomatic STI patients in countries without laboratory support [5]. Easily recognized symptoms and signs are combined using flowcharts, and patients are treated with two or more antibiotic regimens to cover the majority of, or the most serious, organisms responsible for producing a syndrome. The VDS algorithm for the management of vaginal and cervical infections is far from ideal, and for chlamydia or gonorrhoea, this simplified approach is neither sensitive nor specific [2,5-8]. Simple, rapid tests for these infections have been requested for more than a decade [9,10], and the continued use of the syndromic approach in the management of cervicitis has been viewed as a temporary solution while awaiting the development of such tests [11].

The majority of women with a cervical infection are asymptomatic [12] and their infection will not be detected by the syndromic approach. As screening with specific diagnostic tests have been out of reach, risk scores based on sociodemographic risk factors, symptoms or signs of infection, urine sticks and microscopy have been explored as screening tools to identify asymptomatic infections among pregnant women. Studies from sub-Saharan countries have shown variable and unconvincing results [9,10,13-16].

It has become clear that vaginal discharge is poorly predictive of cervicitis, and in order to reduce over-treatment, the WHO recommends the incorporation of risk assessments in the syndromic management of cervical infections [5]. In Botswana, the syndromic approach has recently been revised, and lower abdominal pain was included as a second entry symptom in the VDS algorithm [17]. Treatment for C. trachomatis and N. gonorrhoeae is reserved for women who present with vaginal discharge or lower abdominal pain and have either a positive risk assessment (age less than 21 years or complaints of yellow discharge) or yellow discharge or cervical mucopus on examination. These new recommendations are based on a non-validated study of female STI patients [18]. Risk factors’ association with infection is specific to the population group from which they are extracted [5,13], and a validation of the algorithm in the antenatal care is lacking.

There are two parallel strategies to manage reproductive tract infections (RTIs) in pregnancy in Botswana. In addition to the syndromic management of women with symptoms, all antenatal care attendees are clinically screened for RTIs. The antenatal care guidelines recommend a routine speculum examination at the first antenatal visit, to "exclude genital infections, abnormalities and pelvic tumours" [19]. It is not uncommon for abnormal vaginal discharge to be found in women who are not eliciting symptoms. Asymptomatic pregnant women with signs of vaginal discharge will also be provided with syndromic treatment. Clinical screening bypasses the original entry point of the syndromic algorithms: symptoms which lead to health-care seeking, and it is not within the WHO recommendations.

The aim of this study was to determine the prevalence of C. trachomatis and N. gonorrhoeae among antenatal care attendees in Botswana, and to assess the validity of the 'vaginal discharge syndrome and lower abdominal pain' algorithm in the diagnosis of cervicitis in pregnancy. We also evaluated the diagnostic accuracy of risk scores based on sociodemographic factors, specific symptoms or signs, or microscopy. The results from Botswana are used to discuss the management of cervicitis in pregnancy in sub-Saharan Africa.

Methods

Participating in this study were 703 pregnant women who visited the 13 main facilities providing antenatal care in Gaborone, Botswana: 12 primary health clinics and one outpatient department. A proportionate sample of attendees was recruited from each location. This proportion corresponded to the percentage of all antenatal care attendees in Gaborone who visited that facility during the previous year. Facilities were visited one-by-one by a medical doctor between October 2000 and February 2001. In the majority of clinics, all attendees were included in the study. In the busiest clinics, only a sample of the attendees was included; the selection of attendees in these clinics was incidental. Approximately one out of every four antenatal care attendees in Gaborone was included in the study during the period of data collection. All participants gave written, informed consent. The only exclusion crite-
The LCx® Assays (Abbott Laboratories, IL) were performed same day, and stored at -20°C prior to batch processing. A case of C trachomatis according to the manufacturer’s instructions. A case of C trachomatis was defined as infection. 

The dependent variable “cervicitis” was defined as infections in the antenatal care. The first risk score level consists of only sociodemographic factors. At the second risk score level we added findings from the gynaecological examination. At the third level, we also allowed the results from microscopy of vaginal and cervical smears. Microscopy can be done on site, and thus all three risk score levels – the sociodemographic, the clinical and the microscopy score – can theoretically be performed during an antenatal care visit. The weights for each factor used in the risk scores were based on correspondent multiple logistic regression analysis models. The log of the OR for the variables in the model multiplied by 10 and rounded to the nearest whole number were used as weights for the respective factors in the risk scores [9]. The factors included and their respective weights are shown for each risk score in Table 1.

Statistical analyses and risk scores

Data were analysed with the statistical package SPSS Version 11. We performed univariate analyses on all independent variables in our dataset which could be associated with cervical infection. The factors were within four categories: sociodemographic and behavioural factors, symptoms, clinical signs, and microscopy results. The dependent variable “cervicitis” was defined as infection with C trachomatis or N gonorrhoeae, or both. Factors which in the univariate analysis were associated with infection at a 0.2 level (p-value of odds ratio (OR)) were included in multiple logistic regression analyses. We performed multiple logistic regression analyses on sociodemographic factors, symptoms, clinical signs and laboratory results, separately and combined. Due to the high number of variables, the full analysis of different factors’ independent association with cervicitis had to be performed in two steps. First, multiple logistic regression analyses for the four variable categories were performed separately. The analysis was then extended to combining the factors from the different categories which were significantly independently associated with cervical infection in the first step.

Three levels of risk scores were computed and retrospectively applied, and each of them were assessed for their usefulness as a diagnostic tool to manage N gonorrhoeae and C trachomatis infections in the antenatal care. The first risk score level consists of only sociodemographic factors. At the second risk score level we added findings from the gynaecological examination. At the third level, we also allowed the results from microscopy of vaginal and cervical smears. Microscopy can be done on site, and thus all three risk score levels – the sociodemographic, the clinical and the microscopy score – can theoretically be performed during an antenatal care visit. The weights for each factor used in the risk scores were based on correspondent multiple logistic regression analysis models. The log of the OR for the variables in the model multiplied by 10 and rounded to the nearest whole number were used as weights for the respective factors in the risk scores [9]. The factors included and their respective weights are shown for each risk score in Table 1.

Receiver Operating Characteristic (ROC) curves were used to compare the different risk scores. The ROC curve shows the sensitivity and specificity that correspond to each possible cut-off for the risk score. The validity of different diagnostic strategies (the existing STI management guidelines, diagnosis based on symptoms or signs alone, and diagnosis based on a risk score) was assessed by measuring sensitivity, specificity, positive and negative likelihood ratios (LR+ and LR-) and positive and negative predictive values (PPV and NPV). The LCR-based laboratory diagnosis of cervical infection was used as the reference standard. In the evaluation and comparison of diagnostic strategies, we present two cut-offs for the risk scores, taken at a sensitivity of 0.40 and 0.70.

The study was approved by ethical committees in Botswana and in Norway.

Results

Of the 703 women, 67 (10%) had laboratory-confirmed cervical infection: 51 (8%) were infected with C trachoma-
tis, and 21 (3%) with N. gonorrhoeae. T. vaginalis was identified in 131 (19%) women and bacterial vaginosis in 268 (38%) women. Candida species were identified by microscopy and/or culture in 416 (59%) of the women. A total of 561 (80%) of the antenatal care attendees had one or more of these five reproductive tract infections.

Subjective symptoms and clinical signs
In spite of the high prevalence of cervical and vaginal infections in this study, few women confirmed symptoms when probed. Complaints of vaginal discharge were elicited from 119 (17%) of the women and lower abdominal pain from 58 (8%). Vaginal discharge was the most common clinical sign; candidalike discharge was found in 81 (12%) and other abnormal discharge was found in 227 (32%) of the women.

Factors associated with C trachomatis and/or N gonorrhoeae
Demographic, behavioural, and obstetric factors; symptoms, signs, and simple laboratory tests; and their association with C. trachomatis and/or N. gonorrhoeae infection are shown in Table 2. Age was the strongest predictor of cervical infection. The prevalence of infection was highest among teenagers (22%, 95% confidence interval (CI): 13 to 32), whereas two-thirds of the infections were within the largest age group: women 20–29 years. None of the evaluated symptoms predicted cervical infection. Symptoms of vaginal discharge or lower abdominal pain were therefore not included in any of the risk scores. There were 65 (9%) women who reported believing that they had a genital illness, but the prevalence of cervicitis was not significantly higher in this group (OR = 1.6, 95% CI: 0.8 to 3.4). Of clinical findings, vaginal (excluding candida-like) discharge was significantly associated with increased prevalence of cervicitis (OR = 1.8, 95% CI: 1.1 to 3.0). Several discharge characteristics (thin, smelly, foamy and increased amounts) were also significantly associated with cervical infection. Two laboratory results were associated with cervicitis: white blood cells in the cervical smear, and infection with T. vaginalis.

The factors which were independently associated with cervical infection are shown in Table 3.
Table 2: Univariate analyses on risk factors for cervicitis (C trachomatis and/or N gonorrhoeae) among 703 antenatal care attendees in Gaborone, Botswana

| Factor                          | No. Women with cervicitis | Odds ratio | Confidence interval | p-value |
|---------------------------------|---------------------------|------------|---------------------|---------|
|                                 | No. (%)                   | (95%)      |                     |         |
| **Sociodemographic factors**    |                           |            |                     |         |
| Age groups                      |                           |            |                     |         |
| < 20                            | 76                        | 17 (22)    | 9.1                 | 3.4–24.1| 0.000   |
| 20–29                           | 432                       | 44 (10)    | 3.6                 | 1.5–8.5 | 0.004   |
| 30+                             | 195                       | 6 (3)      | 1                   |         |         |
| Education                       |                           |            |                     |         |
| Primary school or less          | 168                       | 17 (10)    | 1                   |         |         |
| Junior secondary school         | 310                       | 36 (12)    | 1.2                 | 0.6–2.2 | 0.620   |
| Senior secondary or higher      | 225                       | 14 (6)     | 0.6                 | 0.3–1.2 | 0.160   |
| Marital status                  |                           |            |                     |         |
| Married                         | 114                       | 2 (2)      | 1                   |         |         |
| Unmarried                       | 589                       | 65 (11)    | 6.9                 | 1.7–28.7| 0.008   |
| Partners last 12 months         |                           |            |                     |         |
| One partner                     | 671                       | 64 (10)    | 1                   |         |         |
| Two or more                     | 32                        | 3 (9)      | 1.0                 | 0.3–3.3 | 0.976   |
| Time in relationship            |                           |            |                     |         |
| One year or less                | 118                       | 19 (16)    | 2.5                 | 1.4–4.6 | 0.003   |
| 1 to 2 years                    | 137                       | 16 (12)    | 1.7                 | 0.9–3.2 | 0.094   |
| >2 years                        | 448                       | 32 (7)     | 1                   |         |         |
| **Subjective symptoms**         |                           |            |                     |         |
| Vaginal discharge               |                           |            |                     |         |
| No                              | 584                       | 55 (9)     | 1                   |         |         |
| Yes                             | 119                       | 12 (10)    | 1.1                 | 0.6–2.1 | 0.822   |
| Lower abdominal pain            |                           |            |                     |         |
| No                              | 650                       | 63 (10)    | 1                   |         |         |
| Yes                             | 53                        | 4 (8)      | 0.8                 | 0.3–2.2 | 0.610   |
| Thinks she has an infection     |                           |            |                     |         |
| No                              | 638                       | 58 (9)     | 1                   |         |         |
| Yes                             | 65                        | 9 (14)     | 1.6                 | 0.8–3.4 | 0.217   |
| **Clinical signs**              |                           |            |                     |         |
| Vaginal discharge               |                           |            |                     |         |
| Negative                        | 476                       | 37 (8)     | 1                   |         |         |
| Positive                        | 227                       | 30 (11)    | 1.8                 | 1.1–3.0 | 0.023   |
| Candida-like discharge          |                           |            |                     |         |
| Negative                        | 622                       | 61 (10)    | 1                   |         |         |
Table 2: Univariate analyses on risk factors for cervicitis (C trachomatis and/or N gonorrhoeae) among 703 antenatal care attendees in Gaborone, Botswana (Continued)

| Risk Factor                        | Positive | None    | Signs | Odds Ratio | 95% CI    |
|------------------------------------|----------|---------|-------|------------|-----------|
| Moderate or profuse discharge      |          |         |       |            |           |
| Negative                           | 447      | 34      | 8     | 1          |           |
| Positive                           | 256      | 33      | 13    | 1.8        | 1.1–3.0   |
| Yellow discharge                   |          |         |       |            |           |
| Negative                           | 438      | 38      | 9     | 1          |           |
| Positive                           | 265      | 29      | 11    | 1.3        | 0.8–2.2   |
| Thin/runny discharge               |          |         |       |            |           |
| Negative                           | 615      | 48      | 8     | 1          |           |
| Positive                           | 88       | 19      | 22    | 3.3        | 1.8–5.9   |
| Foamy discharge                    |          |         |       |            |           |
| Negative                           | 590      |         | 1     |            |           |
| Positive                           | 113      | 19      | 17    | 2.3        | 1.3–4.1   |
| Smelly discharge                   |          |         |       |            |           |
| Negative                           | 659      | 58      | 9     | 1          |           |
| Positive                           | 44       | 9       | 21    | 2.7        | 1.2–5.8   |
| Cervical bleeding/erythroplaquia    |          |         |       |            |           |
| Negative                           | 520      | 45      | 9     | 1          |           |
| Positive                           | 183      | 22      | 12    | 1.4        | 0.8–2.5   |
| Laboratory analyses                |          |         |       |            |           |
| Urine stix (nitritis/leucocytes)   |          |         |       |            |           |
| Negative                           | 609      | 59      | 10    | 1          |           |
| Positive                           | 94       | 8       | 9     | 0.9        | 0.4–1.9   |
| WBC in cervical smear              |          |         |       |            |           |
| None/few                           | 124      | 5       | 4     | 1          |           |
| 1+                                 | 267      | 22      | 8     | 2.1        | 0.8–5.8   |
| 2+                                 | 171      | 18      | 11    | 2.8        | 1.0–7.8   |
| 3–4+                               | 140      | 22      | 16    | 4.4        | 1.6–12.1  |
| Candida (microscopy or culture)    |          |         |       |            |           |
| Negative                           | 287      | 26      | 9     | 1          |           |
| Positive                           | 416      | 41      | 10    | 1.1        | 0.7–1.8   |
| Trichomoniasis                     |          |         |       |            |           |
| Negative                           | 571      | 41      | 7     | 1          |           |
| Positive                           | 132      | 26      | 20    | 3.2        | 1.9–5.4   |
| Bacterial vaginosis (BV)           |          |         |       |            |           |
| Negative                           | 435      | 40      | 9     | 1          |           |
| Positive                           | 268      | 27      | 10    | 1.1        | 0.7–1.9   |
Syndromic management and screening for cervical infections

The sociodemographic, clinical, and microscopy-based risk scores performed similar in the management of N gonorrhoeae and C trachomatis infection, as illustrated with their ROC-curves (Figure 1). The diagnostic accuracy of the risk scores did not increase significantly when detailed information from the clinical examination and subsequently the microscopy results were added to the sociodemographic risk factors.

Table 4 presents the evaluated options for the diagnosis of C trachomatis and N gonorrhoeae in antenatal care in the absence of specific diagnostic tests: the syndromic algorithm, symptoms, signs, and the three risk scores. The VDS algorithm did not identify women with C trachomatis and N gonorrhoeae in our study population (positive likelihood ratio (LR+) 1.1, 95% CI: 0.6 to 1.9). Symptoms of vaginal discharge or lower abdominal pain in pregnancy proved inappropriate as an entry point to the VDS algorithm, with a LR+ of 0.94 (95% CI: 0.6–1.5). The current practice of clinical screening for signs of vaginal discharge (excluding candida-like discharge) also had low discriminative ability (LR+ 1.5, 95% CI 1.1–1.9).

All risk scores suffered from the choice between low sensitivity and low specificity. With a cut-off taken at an acceptable sensitivity of minimum 0.7, the risk score based on sociodemographic factors identifies 50 (75%) and misses 17 (25%) of the 67 cervical infections. Per true case treated, six pregnant women would be prescribed multiple antibiotic regimens unnecessarily. With a cut-off at a sensitivity of 0.4, the sociodemographic risk score identifies only 29 (43%) of the cervical infections. The majority of the cervical infections would remain untreated, and although over-treatment is reduced, four pregnant women would still be unnecessarily treated with multiple antibiotics per infected women. The more comprehensive clinical and microscopy risk scores show similar results.

Discussion

Pregnant women are usually considered to be a low-risk population, but among antenatal care attendees in Botswana, the burden of reproductive tract infections is very high. The prevalence of cervical infections is 10%, and most of the infected women go undetected through normal antenatal care services. Published studies of STIs among pregnant women in other countries in sub-Saharan Africa show similar trends in the prevalence of cervical infections. In our study, 8% have a C trachomatis infection, compared to rates between 6% in Tanzania and 13% in Cape Verde [13,22]. Gonorrhea is found in 3% of the women, compared to rates that range from 2% in Gabon to 8% in South Africa [16,21]. Although difficult to measure, it is likely that complications and sequelae due to these infections among pregnant women and their infants in sub-Saharan Africa are substantial.

Syndromic approach

Elicited symptoms of increased discharge or lower abdominal pain are not predictive of cervical infection in antenatal attendees in Botswana. These symptoms are non-specific; they are common in pregnancy, and their association with cervical infections is even lower among pregnant than among non-pregnant women [23]. The
Receiver Operating Characteristics (ROC) curves for three levels of risk scores (sociodemographic, clinical and microscopy risk scores). The risk scores are based on multiple logistic regression analyses and used as a screening tool to identify *N. gonorrhoeae* and *C. trachomatis*. The risk scores are applied retrospectively on 703 antenatal care attendees in Gaborone, Botswana.

**Sociodemographic risk score.** Area under the curve 0.71 (0.65 to 0.78)

*Risk factors included:* Age, education, marital status, length of time in current relationship

**Clinical risk score.** Area under the curve 0.73 (0.67 to 0.79)

*Risk factors included:* Age, education, specific clinical signs

**Microscopy risk score.** Area under the curve 0.74 (0.68 to 0.80)

*Risk factors included:* Age, education, specific clinical signs and microscopy results of cervical smear
VDS algorithm is used extensively to diagnose cervical infections in antenatal care in Botswana [24], but our results show that this management is no better than random treatment.

To use the genital examination at the first antenatal care visit as a clinical screening tool for cervical infections is also unadvisable. According to the newly revised VDS algorithm in Botswana, symptoms or signs of yellow discharge are risk factors which should lead to treatment for cervical infections. In our study among antenatal care attendees, neither symptoms nor signs of yellow discharge are associated with cervical infection. In pregnancy, symptoms or signs of vaginal discharge in general, yellow discharge, or other specific discharge characteristics should not be used as criteria for treating *C. trachomatis* and *N. gonorrhoeae*.

Other studies from sub-Saharan Africa conclude that case management with the vaginal discharge syndrome has poor discriminatory ability in the diagnosis of cervicitis [25-27]. Several reviewers [28-30] emphasise that the syndromic approach should not be used as a screening tool for *N. gonorrhoeae* and *C. trachomatis*. Our study concurs with a substantial body of knowledge indicating that the syndromic approach should be used neither as a case management of symptomatic women nor as a clinical screening tool to identify *C. trachomatis* and *N. gonorrhoeae* in antenatal care attendees in sub-Saharan Africa.

### Screening strategies

Despite extensive analyses, all computed risk scores were of limited value as screening tools in antenatal care attendees. They had poor discriminative ability, even in the study population in which they were computed and adapted to under optimal conditions. As the syndromic approach, the risk scores also resulted in a large number of undetected cervical infections and substantial overtreatment. Additionally, notification and treatment of sexual partners, an essential element of STI management, is difficult to justify when the majority of the identified women do not have an STI [8]. A substantial improvement of the management of cervical infections in antenatal care in developing countries seems impossible without specific diagnostic tests.

The development of simple, rapid tests for *C. trachomatis* and *N. gonorrhoeae* has been a high priority since the 1990s [9-11]. Major progress has recently been made, and several tests for *C. trachomatis* and *N. gonorrhoeae* are now on the market [7,32]. The Sexually Transmitted Diseases Diagnostics Initiative at the WHO has begun a programme to field test and systematically evaluate these simple, affordable rapid tests [32,33]. So far, available tests are found to be specific (>90%), but with a variable sensitivity (25–85%) [34-36]. In Botswana, the health system is relatively well functioning, and this country could well serve as an exploratory site for the use of rapid tests for *C. trachomatis* and *N. gonorrhoeae*. Through the prevention of mother-to-child transmission of HIV programme, all health posts and clinics have lay workers who perform rapid tests for HIV. Simple tests for cervical infections performed by clinicians or lay workers may prove a feasible contribution to the improvement of diagnosis and the reduction of the disease burden of these conditions in this and similar settings.

Consistent with established knowledge on STI epidemiology [6,31], youth is the single factor most strongly associated with *C. trachomatis* and/or *N. gonorrhoeae* in our study.

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**Table 4: Diagnostic strategies to identify infection with *Chlamydia trachomatis* and/or *Neisseria gonorrhoeae* in 703 antenatal care attendees in Botswana.**

| Positive on assessment | Cervical infection |  |  |  |  |  |  |  |
|------------------------|-------------------|---|---|---|---|---|---|
| n (%) | N (%) | Sensitivity | Specificity | LR+* | LR- | PPV | NPV |
| **Symptoms and signs** | | | | | | | |
| VDS algorithm | 104 (15) | 11 (11) | 0.16 | 0.85 | 1.12 (0.63–1.92) | 0.98 | 0.11 | 0.91 |
| Symptoms alone: VD and/or LAP | 155 (22) | 14 (9) | 0.21 | 0.78 | 0.94 (0.57–1.49) | 1.02 | 0.09 | 0.90 |
| Signs alone: VD (excl. candidiasis) | 227 (32) | 30 (13) | 0.45 | 0.69 | 1.45 (1.06–1.89) | 0.78 | 0.13 | 0.92 |
| **Risk scores**, sensitivity minimum 0.7 | | | | | | | |
| Sociodemographic risk score | 327 (47) | 50 (15) | 0.75 | 0.56 | 1.71 (1.42–1.99) | 0.45 | 0.15 | 0.96 |
| Clinical risk score | 372 (53) | 54 (15) | 0.81 | 0.50 | 1.61 (1.37–1.83) | 0.39 | 0.15 | 0.96 |
| Microscopy risk score | 273 (39) | 51 (19) | 0.76 | 0.65 | 2.18 (1.80–2.55) | 0.37 | 0.19 | 0.96 |
| **Risk scores**, sensitivity minimum 0.4 | | | | | | | |
| Sociodemographic risk score | 156 (22) | 29 (19) | 0.43 | 0.80 | 2.17 (1.55–2.91) | 0.71 | 0.19 | 0.93 |
| Clinical risk score | 117 (17) | 29 (25) | 0.43 | 0.86 | 3.13 (2.20–4.30) | 0.66 | 0.25 | 0.94 |
| Microscopy risk score | 116 (17) | 29 (25) | 0.43 | 0.86 | 3.16 (2.22–4.34) | 0.66 | 0.25 | 0.94 |

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LR+ = positive likelihood ratio; LR- = negative likelihood ratio; PPV = positive predictive value; NPV = negative predictive value; VDS = vaginal discharge syndrome; LAP = lower abdominal pain; VD = vaginal discharge.

* The positive likelihood ratios are calculated with 95% confidence interval.

†Risk factors included in each risk score are described in Table 1.

[25-27]. Several reviewers [28-30] emphasise that the syndromic approach should not be used as a screening tool to identify *C. trachomatis* and/or *N. gonorrhoeae* in antenatal care attendees. They had poor discriminative ability, even in the study population in which they were computed and adapted to under optimal conditions. As the syndromic approach, the risk scores also resulted in a large number of undetected cervical infections and substantial overtreatment. Additionally, notification and treatment of sexual partners, an essential element of STI management, is difficult to justify when the majority of the identified women do not have an STI [8]. A substantial improvement of the management of cervical infections in antenatal care in developing countries seems impossible without specific diagnostic tests.

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Consistent with established knowledge on STI epidemiology [6,31], youth is the single factor most strongly associated with *C. trachomatis* and/or *N. gonorrhoeae* in our study.
population. Thus age can be useful as a screening tool in
the traditional sense, to minimise the number of standard
diagnostic tests by identifying people with a higher-than-
average prevalence of infection [29]. If it were decided in
Botswana to introduce screening for cervical infections
with rapid tests in the antenatal care, selective screening of
younger women should be considered.

Conclusion
Although the vaginal discharge syndrome does not dis-
trict between infected and uninfected women, the
algorithm is in extensive use to diagnose and treat C. tra-
chomatis and N. gonorrhoeae among antenatal care attend-
ees in Botswana. Unfortunately, risk scores do not appear
to improve the management of cervical infections in preg-
nancy substantially. To diagnose and treat asymptomatic
cervical infections, and to reduce the massive overtreat-
ment in the syndromic management, specific diagnostic
tests are necessary. Screening for cervical infections in
pregnant women is an essential public health measure,
and rapid tests will hopefully be available in developing
countries within a few years. In the temporary absence of
such tests, health authorities in sub-Saharan Africa should
consider realocating their resources to other STI measures
rather than diagnosing and treating gonorrhoea and
chlamydia inadequately in antenatal care.

Abbreviations
STI, sexually transmitted infection; VDS, vaginal discharge
syndrome; PMN/HPF, polymorphonuclear leukocytes per
high power field; OR, odds ratio; ROC, receiver operating
characteristics; LR+ and LR-, positive and negative likeli-
hood ratios; PPV and NPV, positive and negative predic-
tive value; CI, confidence interval.

Competing interests
The author(s) declare that they have no competing inter-
ests.

Authors’ contributions
MR contributed to the study design, was responsible for
data collection and data analysis, and drafted the manu-
script. MRa contributed to the study design and to formal
and organisational aspects of the study. MV contributed to
the study design, and led and performed the majority of
the laboratory work. JS and PH supervised the study. All
authors read and approved the final manuscript.

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