Optimising the management of vaginal discharge syndrome in Bulgaria: cost effectiveness of four clinical algorithms with risk assessment

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► Supplementary material is published online only. To view these files please visit the journal online (http://sti.bmj.com).

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Accepted 22 January 2010

ABSTRACT

Objectives To evaluate the performance and cost effectiveness of the WHO recommendations of incorporating risk-assessment scores and population prevalence of *Neisseria gonorrhoeae* (NG) and *Chlamydia trachomatis* (CT) into vaginal discharge syndrome (VDS) algorithms.

Methods Non-pregnant women presenting with VDS were recruited at a non-governmental sexual health clinic in Sofia, Bulgaria. NG and CT were diagnosed by PCR and vaginal infections by microscopy. Risk factors for NG/CT were identified in multivariable analysis. Four algorithms based on different combinations of behavioural factors, clinical findings and vaginal microscopy were developed. Performance of each algorithm was evaluated for detecting vaginal and cervical infections separately. Cost effectiveness was based on cost per patient treated and cost per case correctly treated. Sensitivity analysis explored the influence of NG/CT prevalence on cost effectiveness.

Results 60% (252/420) of women had genital infections, with 9.5% (40/423) having NG/CT. Factors associated with NG/CT included new and multiple sexual partners in the past 3 months, symptomatic partner, childlessness and ≥10 polymorphonuclear cells per field on vaginal microscopy. For NG/CT detection, the algorithm that relied solely on behavioural risk factors was less sensitive but more specific than those that included speculum examination or microscopy but had higher correct-treatment rate and lower over-treatment rates. The cost per true case treated using a combination of risk factors, speculum examination and microscopy was €24.08. A halving and tripling of NG/CT prevalence would have approximately the inverse impact on the cost-effectiveness estimates.

Conclusions Management of NG/CT in Bulgaria was improved by the use of a syndromic approach that included risk scores. Approaches that did not rely on microscopy lost sensitivity but were more cost effective.

INTRODUCTION

The management of sexually transmitted infections (STIs) when resources are constrained relies on the syndromic approach promoted by WHO.[1] The performance of this approach has been extensively reviewed.[2] Concerns remain about the management of vaginal discharge syndrome (VDS), which aims to include treatment of cervicitis caused by *Neisseria gonorrhoeae* (NG) and *Chlamydia trachomatis* (CT) alongside treatment of vaginitis caused by *Trichomonas vaginalis* (TV), bacterial vaginosis (BV) and *Candida* spp. Critics have argued that the syndromic approach lacks both sensitivity and specificity, as most cervical infections are asymptomatic and only a minority of women presenting with VDS have cervical infections.[3]

Rapid point-of-care diagnostic tests for NG or CT would facilitate VDS management, but such tests do not currently exist.[4] To improve algorithm accuracy and to save costs WHO has suggested the use of individual risk-assessment scores (RAS). RAS are combinations of sociodemographic and behavioural risk factors and clinical signs found to be locally associated with cervical infections and/or the results of simple laboratory or bedside tests. Past evaluations of RAS have yielded mixed results, with higher positive predictive values and better cost-effectiveness profiles found in settings with higher NG/CT prevalence.[5–14] Such findings imply that effectiveness may not just vary between countries, but also between settings within a country. The most recent WHO STI guidelines[1] have recommended that RAS incorporate background cervical infection prevalence levels in the target population. Moreover, to reduce costs, the WHO guidelines have proposed modifications in the management of vaginal infections, in particular vulvo-vaginal candidiasis whose treatment is expensive, but these recommendations have not been validated in many settings.

After the demise of communism in the early 1990s, healthcare systems collapsed in many Central and Eastern European countries, accompanied by alarming rises of STIs and HIV.[15 16] Yet, many countries have been reluctant to embrace WHO policies perceived to be designed for developing countries.[17] In Bulgaria, there was a sevenfold increase in reported syphilis cases between 1990 and 1994.[18 19] STI treatment could officially only be offered at government-controlled dermatovenereological centres. With only one centre per region, many patients sought care in the unregulated private sector, or resorted to self-medication by obtaining over-the-counter antibiotics in pharmacies.[20] National STI guidelines have only existed for syphilis.[21] Introduction of syndromic management has been resisted both by the Ministry of Health and many dermatovenereological specialists on grounds of lack of scientific validity.

In 2000, the international non-governmental organisation Médecins Sans Frontières Switzerland (MSF) established a sexual health centre in Sofia, providing services to young, poor and marginalised populations, such as homeless people and the Roma population. The project involved Bulgarian clinicians and scientists and stimulated the development of evidence-based nationally relevant and acceptable STI guidelines. This study was conducted to evaluate the performance and costs of various approaches to managing vaginal and cervical infections for women presenting with VDS, including the use of RAS. Approaches were selected to represent varying levels of health-care capacity in the country. We modelled the cost effectiveness of each algorithm at different NG/CT prevalence levels. Results were used to advocate incorporation of the syndromic approach into the national guidelines. This process generated a number of lessons for getting research into practice, which might be relevant elsewhere.

PATIENTS AND METHODS

Between September 2001 and June 2002, consecutive non-pregnant women aged 15 years and above attending the MSF Sexual Health Centre with a clinically verified complaint of vaginal discharge were enrolled. Consenting patients completed a questionnaire about sexual and reproductive health and behaviours and underwent a clinical and speculum examination. Genital swabs were collected for vaginal pH reading (Spezialindikator 4-7, Merck, Darmstadt, Germany) and detection of amine odour for clinical diagnosis of BV,[22] microscopy for vaginal polymorphonuclear (PMN) cell count and detection of TV, BV and candidiasis (CA), and PCR assays for the detection of cervical NG and CT. Blood samples were collected for syphilis and HIV serologies, and rapid tests were performed on site. Laboratory methods are described in the online supplementary data. Women testing positive for HIV or syphilis serology were managed according to existing Bulgarian Ministry of Health guidelines. All patients received treatment according to the MSF algorithm with WHO RAS (R1) and microscopy (algorithm 1, figure 1) and followed WHO syndromic management guidelines. Patients also received STI health education and counselling and were offered condoms. Depending on PCR results, treatment for NG and CT was provided at a follow-up appointment.

Statistical methods

Risk factor analysis

We first determined risk factors for NG/CT using univariable analysis to obtain ORs and 95% CIs. Then, a stepwise backward logistic regression was conducted, starting with all variables with p values <0.25. Variables were removed from the model to obtain a parsimonious model containing only those variables with sufficiently strong associations (adjusted OR ≥2.0 or p<0.10). The strength of the associations was tested with Pearson's χ^2 (or Fisher's exact test) for comparison of proportions, analysis of variance for comparison of means and the Kruskal–Wallis non-parametric test for comparison of medians.

Risk scores

Risk scores were developed by incorporating variables that remained most significantly associated with NG/CT in the analysis above; each covariate was given a weighting proportionate to the strength of its association ($\log_n$ of the OR).[10 14]

Risk scores (R2 to R4) were designed to reflect the capacity of different levels of health provision in Bulgaria (online supplementary table 1). Thus, R2 was based on socio-behavioural data only—that is, when examination is not possible; R3 added outcomes of a speculum examination; and R4 incorporated clinical signs and results of microscopy, where this could be done. These scores were incorporated in the treatment algorithms 2, 3 and 4, respectively, which followed the format of the most recent WHO algorithms (figures 2 and 3).[1]

WHO guidelines recommend eliciting signs of pelvic inflammatory disease (PID), which have been shown to be associated with NG/CT. In our study, women complaining of lower abdominal pain were classified as having possible PID, and were given treatment for NG/CT and for TV/BV, but not for CA. The

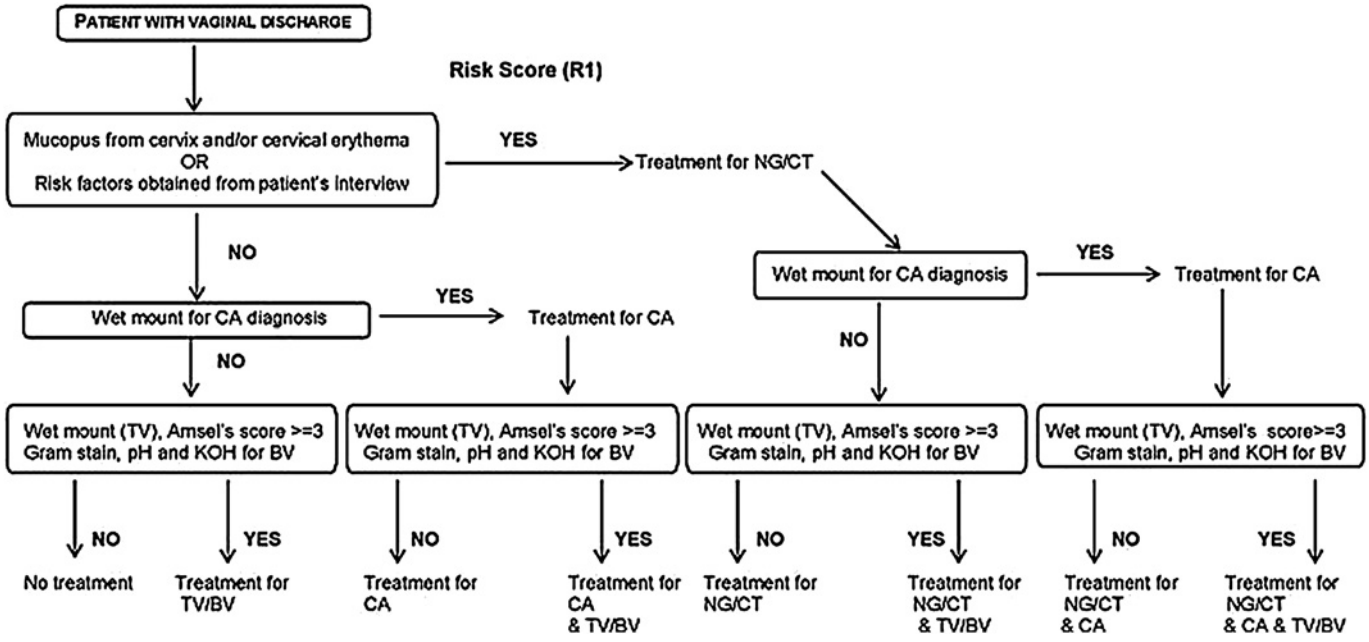

Figure 1 Algorithm 1 for Vaginal Discharge Syndrome management at the Médecins Sans Frontières (MSF) clinic in Sofia, Bulgaria, using the WHO risk-assessment score and microscopy (R1). BV, bacterial vaginosis; CA, candidiasis; CT, *Chlamydia trachomatis*; KOH, potassium hydroxide; NG, *Neisseria gonorrhoea*; TV, *Trichomonas vaginalis*.

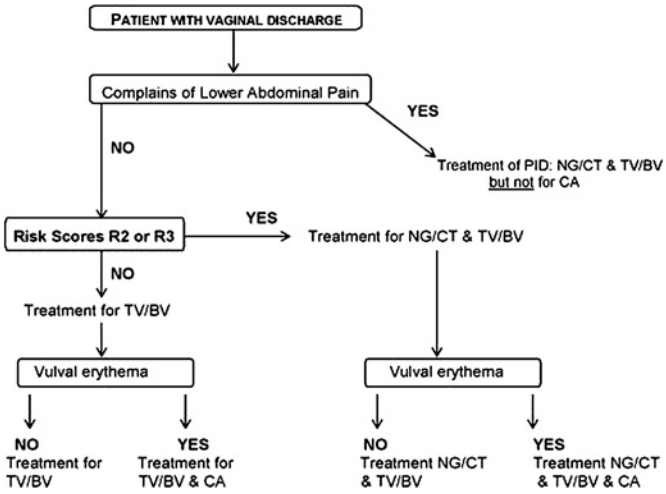

Figure 2 Algorithms 2 and 3 for Vaginal Discharge Syndrome management using the study-derived risk-assessment score without speculum (R2, algorithm 2) or with speculum (R3, algorithm 3). BV, bacterial vaginosis; CA, candidiasis; CT, *Chlamydia trachomatis*; NG, *Neisseria gonorrhoea*; PID, pelvic inflammatory disease; TV, *Trichomonas vaginalis*.

group without lower abdominal pain underwent the RAS. In this subgroup those with a positive score were considered at risk for cervical infection and received treatment for NG/CT.

Algorithms performance

The validity of the four treatment algorithms was assessed by comparing the treatment given against treatment that should have been given using the 'gold standard' for each infection or group of infections (ie, NG/CT, TV/BV and CA) (see online supplementary data). Standard performance indicators (sensitivity, specificity and positive predictive value (PPV)) were calculated from two-by-two tables. We also estimated correct-treatment rate (ie, the proportion of patients correctly identified as requiring treatment or not), and the over-treatment rate (ie, the proportion of non-infected patients who received treatment, which is equal to 1 − specificity).

Economic analysis

We compared the costs of managing VDS using the different algorithms. The costing analysis was conducted from the provider's perspective, considering MSF as the sole provider. Financial and economic costs were the same because no goods or services were donated. Costs were collected retrospectively from MSF financial accounts for the year 2002, and converted into euros (€) using the fixed exchange rate of 1.95 leva per euro. Only incremental recurrent costs were estimated, assuming all other costs remained equal. Infrastructure, training and supervision costs were therefore not included. Direct costs of labour, diagnostic supplies and drugs were estimated using an ingredients-based approach, in which the total quantity of goods and services used was estimated and then multiplied by the respective unit prices.[23] The cost of labour was determined through an observational time allocation study and time units were multiplied by the relevant salary units of staff performing various tasks (counsellor, clinician, laboratory technician). Costs of inputs can be found in online supplementary tables 2 and 3. All research-related costs were excluded. Total costs were divided by the number of people treated to obtain the cost per patient, and were divided by the number of laboratory-confirmed cases to obtain the cost per true case treated.

We performed a sensitivity analysis of the performance and cost effectiveness of the various management approaches using different assumptions about the prevalence of NG/CT infections.

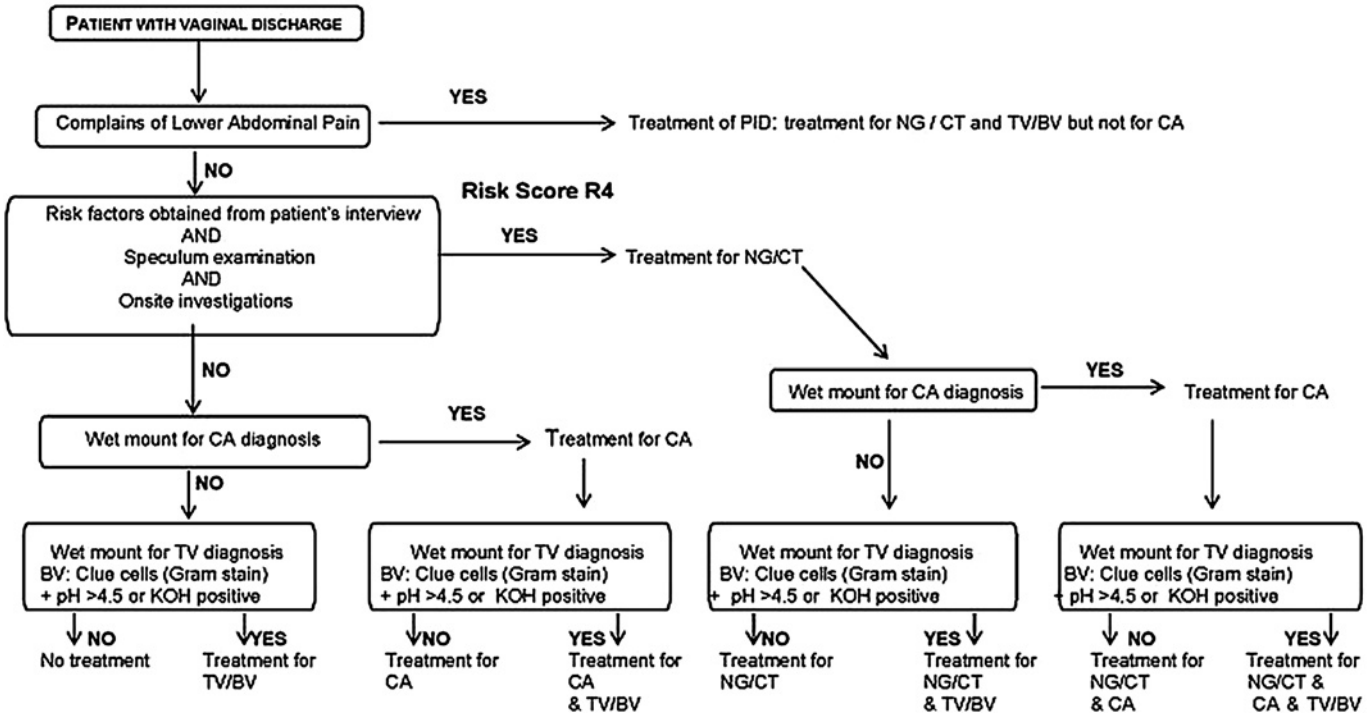

Figure 3 Algorithm 4 for Vaginal Discharge Syndrome management using the study-derived risk-assessment score with microscopy (R4). BV, bacterial vaginosis; CA, candidiasis; CT, *Chlamydia trachomatis*; KOH, potassium hydroxide; NG, *Neisseria gonorrhoea*; PID, pelvic inflammatory disease; TV, *Trichomonas vaginalis*.

Table 1 Prevalence of sexually transmitted and reproductive tract infections among 424 women with vaginal discharge syndrome in Sofia, Bulgaria

	Women	
Pathogens	**n/N**	**%**
Cervical infections		
Neisseria gonorrhoeae (NG)	3/423	0.7
Chlamydia trachomatis (CT)	39/423	9.2
Any NG and/or CT (NG/CT)	40/423	9.5
Vaginal infections		
Candidiasis (CA)	87/424	20.5
Bacterial vaginosis (BV)	149/424	35.1
Trichomonas vaginalis (TV)	12/421	2.9
TV and/or BV	150/420	35.7
Any vaginal pathogens or condition (TV/BV/CA)	235/420	56.0
Any vaginal or cervical infections	252/420	60.0
Serological infection		
Syphilis (VDRL+/TPHA+)	10/422	2.4
HIV	0/424	0.0

TPHA, *Treponema pallidum* haemagglutination assay; VDRL, Venereal Diseases Research Laboratory.

RESULTS

Overall, 495 women presented to the MSF clinic with a complaint of vaginal discharge over the 9-month study period; 439 women were eligible for the study, and the presence of abnormal discharge was ascertained in 424 (97%) women, all of whom consented to enrol in the study. Participants had a mean age of 23.9 years (range 16–54), 16% were cohabiting or married, most (79%) had completed secondary school, their mean age at sexual debut was 16.9 years (SD +/− 2.09), 13.4% reported multiple partners in the past month and 27% in the past year, and 26% had undergone a voluntary abortion in their life.

The prevalences of NG and CT were 0.7% and 9.2%, respectively, with a combined NG/CT prevalence of 9.5% (40/423). The prevalence of vaginal infections was 20.5% for CA, 2.9% for TV, 35.1% for BV and for TV/BV 35.7%. Overall, 60% (252/420) had a treatable vaginal or cervical infection (table 1).

Risk factors associated with NG/CT identified through multivariable analysis are shown in table 2. Four factors were elicited by interview, two clinical factors obtained during speculum examination and one laboratory-based factor (vaginal PMN count). These factors were combined to form risk scores R2 to R4.

Table 2 Factors associated with NG/CT infection in multivariable analysis used in constructing risk assessments scores R2 to R4

Risk factors	Adjusted OR (95% CI)	p Value
From interview		
Away from home in past 12 months	2.0 (0.9 to 4.1)	0.06
Not having children	4.0 (1.2 to 13.7)	0.03
New sexual partner *or* >1 sex partner in the past 3 months	2.7 (1.3 to 5.5)	<0.01
Symptomatic partner in the past month (presence of urethral discharge/dysuria)	2.9 (0.9 to 9.0)	0.05
From speculum examination		
Presence of cervical erythema *or* endocervical mucopus	1.9 (0.9 to 4.1)	0.08
Presence of malodorous vaginal discharge	2.0 (0.9 to 4.1)	0.06
From vaginal microscopy		
≥10 PMN/HPF on vaginal smear	3.0 (1.3 to 7.3)	0.02

CT, *Chlamydia trachomatis*; NG, *Neisseria gonorrhoeae*; PMN/HPF, polymorphonuclear cells per high power field (microscopy).

Algorithms performance

Table 3 summarises the performance of the four algorithms being tested against NG/CT and vaginal infections.

For NG/CT detection, the sensitivity of the WHO-derived MSF algorithm (algorithm 1) was 85% while specificity and PPV were quite low (39% and 13%, respectively). The inclusion of specific risk factors found in the modelling analysis increased sensitivity markedly up to 93–98% (where on-site microscopy for PMN could be performed for algorithms 3 and 4). This was accompanied by a large reduction in specificity (28% and 13% for algorithms 3 and 4, respectively).

For TV/BV, the highest sensitivity was achieved by using Amsel's score including microscopy for 'clue cells' (94%, algorithm 4). However, this strategy supposes that all women with suspected PID should receive treatment for BV without microscopic examination, which led to lower specificity and PPV (73% and 66%, respectively) than algorithm 1.

For CA, sensitivity was highest when microscopy was added (algorithm 1). Algorithm 4 had a low sensitivity (77%) because it did not include on-site investigations for women suspected of PID. Algorithms 2 and 3, which did not incorporate microscopy and relied on the presence of the clinical sign vulval erythema to provide treatment for CA,[1] had a low sensitivity (43%) and poor specificity (54%).

Economic evaluation

Total costs of diagnosis and treatment for all 424 women varied from €514 using algorithm 3 to €1504 using algorithm 4. Algorithm 4 had the highest personnel costs owing to the gynaecological examination and laboratory procedures, and the highest drug costs owing to high over-treatment rates. The cost per true NG/CT case treated relatively low (€24.08) using the MSF algorithm (algorithm 1) (table 4). This strategy would have treated 85% (34/40) of truly infected women, while treating 63% (269/424) of study participants. In contrast, algorithm 4 would have treated 86% (365/424) of all women, to correctly treat 98% (39/40) of truly infected women, at a 60% higher cost (€38.58) (table 4).

Impact of NG/CT prevalence on cost effectiveness

Cost effectiveness of the algorithms was modelled for different NG/CT prevalences (table 4). Changes in NG/CT prevalence are not expected to affect the actual performance of the tests, but to impact the PPV, and thus, the cost effectiveness of the approaches. PPV rose markedly with increasing prevalence (from 6–8% for low prevalence (5%) settings, up to 40% in the high prevalence (30%) settings). Consequently, the cost effectiveness of all strategies improved in the high prevalence settings. For strategies that did not incorporate microscopy (algorithms 2 and 3), the cost per true case treated ranged from around €7 in high prevalence settings to around €45 in low prevalence settings. For algorithms 1 and 4, which incorporate both speculum examination and microscopy, the cost per true case treated ranged from €8 to €73 in high and low prevalence settings, respectively. Overall, algorithm 2 appeared to be the most cost effective but it missed a larger proportion of true cases.

DISCUSSION

We report the first study conducted in an Eastern European country assessing the performance and cost effectiveness of various approaches to treating women presenting with vaginal discharge syndrome. This is also the first study to evaluate comprehensively the recommended WHO VDS algorithm, which includes a RAS,

Table 3 Performance of algorithms for the detection of cervical and vaginal infections at the Médecins Sans Frontières (MSF) clinic in Sofia, Bulgaria

Performance indicators, % (95% CI)					
Algorithm	**Sensitivity**	**Specificity**	**PPV**	**Correct treatment**	**Overtreatment**
NG/CT					
1 (MSF)	85 (69 to 94)	39 (34 to 43)	13 (9 to 17)	43 (38 to 48)	61 (56 to 66)
2 (no speculum)	63 (46 to 77)	60 (55 to 65)	14 (9 to 20)	60 (56 to 65)	40 (35 to 45)
3 (speculum)	93 (73 to 98)	28 (24 to 33)	12 (9 to 14)	34 (30 to 39)	72 (67 to 76)
4 (microscopy and spec.)	98 (85 to 100)	13 (10 to 17)	11 (7 to 14)	21 (17 to 25)	87 (83 to 90)
TV/BV					
1 (MSF)	88 (81 to 92)	94 (90 to 96)	89 (83 to 94)	92 (89 to 94)	6 (4 to 10)
2 and 3 (no speculum/speculum)	100 (97 to 100)	0 (0 to 2)	36 (32 to 41)	36 (32 to 41)	100 (98 to 100)
4 (microscopy and speculum)	94 (89 to 97)	73 (67 to 78)	66 (59 to 72)	80 (76 to 84)	27 (22 to 33)
CA					
1 (MSF)	100 (95 to 100)	100 (98 to 100)	100 (95 to 100)	100 (99 to 100)	0 (0 to 1)
2 and 3 (no speculum/speculum)	43 (34 to 54)	54 (46 to 60)	22 (16 to 29)	52 (47 to 57)	46 (40 to 51)
4 (microscopy and speculum)	77 (67 to 85)	24 (20 to 30)	23 (19 to 28)	37 (32 to 41)	76 (70 to 80)

Note: Algorithms 2 and 3 were not combined for NG/CT but were combined for TV/BV because the outcome of speculum examination is not used to distinguish TV from BV.
BV, bacterial vaginosis; CA, candidiasis; CT, *Chlamydia trachomatis*; MSF, NG, *Neisseria gonorrhoeae*; PPV, positive predictive value; TV, *Trichomonas vaginalis*.

the use of background population NG/CT prevalence and clinically based criteria for the management of candidiasis.

Performance and cost effectiveness of algorithms for NG/CT detection

The NG/CT prevalence found in this population was surprisingly high, similar to rates found in many developing nations,[11 24–27] although this was essentially due to high CT prevalence. Our stringent testing for NG and CT by double PCR strengthens the specificity of our results, perhaps at the expense of sensitivity. Moreover, the Amplicor PCR has been known to lack sensitivity for the detection of NG, although this has been observed with urine rather than cervical samples.[28] Consistent with previous studies, reports by women of recent change of partner or multiple sexual partnerships (considered high-risk behaviour indicators), report of a symptomatic partner, childlessness and presence of leucocytes in the vaginal smear were correlated with NG/CT infections.[11 24–27]

A NG/CT prevalence at around 10% falls within the 'grey zone' of algorithm performance, since such prevalence usually translates into low PPVs.[1] The algorithms using RAS had passable performances (>60% sensitivity and specificity for algorithm 2). Using the combination of speculum examination and RAS (algorithms 1 and 3) increased sensitivity to 90%, but reduced specificity. Similarly, the incorporation of simple microscopy (algorithm 4) maximised sensitivity (98%) at the expense of specificity and PPV. In public health, a balance has to be found between sensitivity and specificity. Low algorithm sensitivity results in many untreated infections, which place the infected person at continued risk of persistent symptoms, progression to more serious complications and further disease transmission. Low specificity leads to overdiagnosis, which in turn can increase the risk of adverse drug reactions, modify normal vaginal flora and increase treatment costs. Additionally, with low PPV, women who do not have an STI will receive a false-positive result and may suffer adverse psychosocial

Table 4 Performance and cost effectiveness (in €) of alternative management strategies according to prevalence of cervical (NG/CT) infections among 424 Bulgarian women with vaginal discharge syndrome

	Algorithm 1: MSF R1 with speculum and microscopy	**Algorithm 2: R2 without speculum**	**Algorithm 3: R3 with speculum**	**Algorithm 4: R4 with microscopy**
9.5% NG/CT prevalence (at MSF Sofia clinic)				
PPV, %	13	14	12	11
No of patients treated	269	178	291	365
Cost per patient, €	1.93	0.93	2.01	3.55
Cost per true case treated, €	24.08	20.57	23.94	38.58
5% NG/CT prevalence				
PPV, %	7	8	6	6
No of patients treated	264	174	309	363
Cost per patient, €	1.91	1.20	2.08	3.54
Cost per true case treated, €	45.05	38.33	44.87	72.61
20% NG/CT prevalence				
PPV, %	26	28	24	22
No of patients treated	280	188	322	371
Cost per patient, €	1.97	1.25	2.12	3.57
Cost per true case treated, €	11.58	10.00	11.47	18.30
30% NG/CT prevalence				
PPV, %	37	40	36	33
No of patients treated	290	198	331	376
Cost per patient, €	2.01	1.28	2.15	3.59
Cost per true case treated, €	7.86	6.85	7.76	12.27

CT, *Chlamydia trachomatis*; MSF, Médecins Sans Frontières; NG, *Neisseria gonorrhoeae*; PPV, positive predictive value; R, risk score.

consequences. Speculum examination may appear simple, but it is time consuming and is not always feasible in all primary healthcare settings. In Bulgaria, however, incorporation of speculum examination in primary care is desirable given the observed gain in sensitivity. The study also demonstrated that microscopy for vaginal PMN count, even using a low threshold, actually added very little to sensitivity for the detection of cervical infection, while greatly increasing the costs, and is thus not recommended for routine management. The MSF/WHO or RAS algorithms 1 and 2 appear to provide the best combination of treatment coverage and cost effectiveness suitable for the Bulgarian settings.

Performance of algorithms for vaginal infections

Unsurprisingly, the most common pathogens found among women complaining of vaginal discharge were bacterial vaginosis and *T vaginalis* (35.7% combined prevalence), while vulvovaginal candidiasis was found in 20.5% of women. Evidence suggests that BV is involved in the pathogenesis of PID, and both BV and TV predispose to preterm delivery and possibly to acquisition of HIV infection.[29 30] TV and BV are often much more prevalent than NG or CT infections, both are strongly correlated with symptoms and signs of abnormal vaginal discharge, and are more easily and inexpensively treated. The study demonstrated that diagnostic strategies that incorporated microscopy performed well with sensitivity, specificity and PPV all approaching 90%. However, where resources are constrained, a presumptive treatment strategy with metronidazole to cover both TV and BV for all women presenting with VDS might be preferred, and would be cost effective.

Influence of NG/CT prevalence on the cost effectiveness of algorithms

As expected, the PPVs of algorithms increased with higher NG/CT prevalence, with improvements in cost effectiveness, consistent with findings summarised in a recent review.[31] This has consequences for the choice of case management strategies. In situations or settings in which high sensitivity is to be achieved—for example, where prevalence of cervical infections is expected to be high, the use of a combination of speculum examination and risk assessment may be preferred. In situations in which raising the PPV is a priority—for example, when prevalence of cervical infection is low, the probability of further transmission is low, or when potential adverse effects of false positive results are high (eg, possible intimate partner violence in low-risk women), the use of algorithms that only include RAS may be preferred.

Implications for policy in Bulgaria

The relatively small sample size of the study, conducted at just one NGO-led clinic limits the generalisability of the findings. However, at the time, this was the first comprehensive study of vaginal discharge aetiologies in the country, particularly among poor and marginalised populations. This evidence obtained with local scientists, combined with the economic analysis, persuaded policy makers and practitioners of the poor performance of current management practices and of the need to introduce STI management guidelines. A similar approach was used for the adoption of STI syndromic management guidelines in Azerbaijan.[32] Moreover, syndromic management appeared well accepted by patients, as reported in separate patients' satisfaction surveys (data not shown). However, it took several months of training and practice for the MSF clinical team to accept syndromic management procedures, which highlights the deeply entrenched habits among some STI clinicians.[33]

In conclusion, this study showed that algorithms for VDS relying on a relatively simple questionnaire and physical examination have good sensitivity for NG/CT and acceptable specificity that can greatly simplify the care of patients with STI in Bulgaria. However, the intermediate prevalence of cervical infections in this population leads to low PPVs and relatively less favourable cost-effectiveness indicators. Accurate and cheap point-of-care diagnostics tests for gonorrhoea and Chlamydia would prove useful in this and similar settings. The process of collaborative research to generate local evidence can greatly facilitate the adoption and implementation of international treatment guidelines.

Key messages

- High prevalence of vaginal and cervical infections with *N gonorrhoeae* and *C trachomatis* (9.5%) among women presenting with abnormal vaginal discharge syndrome in Sofia, Bulgaria.
- Syndromic management including risk-assessment score and simple speculum examination proved to be the most cost-effective approach to vaginal discharge syndrome management.
- Approaches may, however, vary according to background prevalence of cervical infections.

Acknowledgements We thank the authorities from the Ministry of Health, Bulgaria, for granting permission to conduct the study. We acknowledge the contribution of the personnel and the patients of the MSF Centre for Sexual Health in Sofia. We are particularly indebted to Dr Krassimira Chudomirova (Department of Dermato-Venereology, Plovdiv) and Dr Stefana Sabtcheva (Laboratory of Microbiology, Oncology Centre, Sofia) for their enthusiastic participation in this study. Our sincere gratitude goes to Dr Lilani Kumaranayake, health economist at the London School of Hygiene and Tropical Medicine who advised on the economic analysis.

Funding This study was supported by a grant from the Swiss Agency for Development and Cooperation. PM and FT-P were supported by the UK Department for International Development (DFID) Knowledge Programme on HIV/AIDS and STI of the London School of Hygiene and Tropical Medicine. The views expressed in this article do not necessarily represent those of DFID.

Competing interests None.

Patient consent Obtained.

Ethics approval Permission to carry out the study was given by Ministry of Health of Bulgaria. Ethical clearance was obtained from the Geneva University Hospital Ethical Committee and from the Commission of Professional Ethics of the Bulgarian Medical Board. The economic study was later approved by the Ethics Committee of the London School of Hygiene and Tropical Medicine.

Contributors NC and PC designed the overall study; NC carried out the study and performed all analyses with PC; PM contributed to the overall design and analyses; AJ and AG contributed to protocol writing; JL-A, BN and PV contributed to the elaboration and the supervision of the laboratory procedures; laboratory work in Bulgaria was supervised by RD; EP and FT-P contributed to the economic analysis; NC, PC and PM jointly wrote the first draft of the manuscript, which was reviewed by all authors.

Provenance and peer review Not commissioned; not externally peer reviewed.

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